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Offshore Oil and Gas Industry Research Funding Models

An opportunity for coordinated, collaborative, industry based research

White Paper

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Offshore Oil and Gas Industry Research Funding Models - An opportunity for coordinated, collaborative, industry based research

Introduction

Oil and gas research has traditionally been funded via uncoordinated, individual and collective research funding mechanisms. This situation may have led to duplication of research, a potential reduction in financial leveraging opportunities for research projects and inadvertent siloing of knowledge within individual organisations. A negative result of such uncoordinated research activity, may be slow research progress and unfilled knowledge gaps for the oil and gas industry.

This paper proposes that a more efficient industry research process and funding model is required. One that is built upon best practice principles drawn from other successful and sustainable industry research funding models. It also proposes that there is an opportunity for all Australian offshore oil and gas operators, government funding entities, small to medium enterprise and research organisations to collaborate to perform co-ordinated industry research within Australia. Via, increased industry collaboration and strategically targeting high impact industry research topics, there is an opportunity to achieve more complex research outcomes. The result should be an improvement in knowledge of industry issues that must be managed long term.

The safe and efficient extraction and recovery of offshore oil and gas resources in Australia can be maximised for all stakeholders. This can be achieved by sharing research project risk, past domestic and international experience, industry knowledge, geological, seismic and environmental data and distribution of research outcomes to promote future applied and pure research activity.

Ultimately, the benefits of an increased Australian industry research capability, via leveraging of industry and government funding, requires the inclusion of Australia's world class research organisations and Universities as part of any industry research funding model initiative.

To begin to address these issues, this paper investigates existing Industry Research Funding Models (IRFM) that may be provide an industry wide sustainable offshore oil and gas industry research mechanism. Such a mechanism, will in turn, provide a level of coordination and accelerated research that updates community knowledge, provides information to support informed regulation, develops a social licence to operate, and accelerates research and development commercialisation.

As part of the methodology, the paper poses a research question, reviews domestic and international funding models, identifies of possible funding mechanisms, considers of regulations and legal frameworks in Australia, and importantly, assesses the need for a centralised industry research body to assist with the delivery of oil and gas industry based research, as has occurred elsewhere around the globe. An initial business case and implementation plan is also developed.

Australian Offshore Oil and Gas

Offshore oil and gas recovery is a complex pursuit and presents many environmental, technical and operational challenges to operators, that can be addressed via innovative, coordinated and collaborative research. In Australia, as elsewhere, the scale of the industry as it passes through its

cycle from exploration, discovery, feasibility, production and onto decommissioning, is enormous. The oil and gas industry's potential to impact positively on the Australian economy is immense, as is its potentially to impact upon it negatively if the industry does not perform high quality collaborative research to improve understanding and reduce long term operational risk. A strategic government and industry approach to industry based collaborative research is required, to ensure that resource oil and gas recovery is maximised and the benefits derived from developing Australia's oil and gas resources benefit all stakeholders in the community, government and industry.

According to Geoscience Australia[1], primary petroleum production in Australia currently occurs in offshore Victoria, along the North West Shelf in the Northern Carnarvon and Bonaparte basins of Western Australia and Northern Territory and the Cooper Basin in South Australia. The production of condensate and natural gas was planned to commence in the Browse Basin of Western Australia in 2016. Queensland is the main onshore oil and gas producing province. Figure 1 shows the oil and gas fields and basins. Geoscience Australia demonstrate the scale of Australian offshore and onshore oil and gas resources and the offshore oil and gas provinces and sedimentary basins around Australia. Figure 1 shows the extent of Australia's oil and gas fields and basins[2].

As of April 2016, capital expenditure on petroleum projects was estimated at $200 billion with some 13 committed projects underway[1]. In the period 2014-15 liquified natural gas (LNG) made a $16.9 billion contribution to Australian international trade of goods and services. The forecasted contribution for LNG for 2016-17 is $17.2 billion. Crude oil was lower in value at $8.7 and $5.7 billion respectively[3-5].

The oil and gas industry is presently a major sector of the Australian economy with respect to its physical scale and financial contribution. It also has a major part to play in the future Australian economy. Hence, there is a need to maximise the sector's ability to recover oil and gas effectively.

If recovery is maximised, the prize for the Australian economy is many billions of dollars.

Maximising Economic Recovery

The offshore oil and gas industry in Australia, when compared to other locations internationally, is a relatively new industry and the production of offshore oil and gas is still its initial stages. According to National Energy Resources Australia (NERA), there has been a rapid expansion phase underway in the past 10 years and Australia is now poised to become the world's largest liquid natural gas exporter by the end of the decade[5].

Given this rapid expansion and its potential impact upon the economy, Australia has an opportunity to learn from earlier projects and experiences and develop best practice capabilities to deliver a sustainable industry based on the principles as described by Brundtland [6], where sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. There is an opportunity for Australia to plan the maximisation and economic recovery of its offshore oil and gas assets under these principles by ensuring that industry research is coordinated, collaborative, unique and provides a maximum return on investment to all stakeholders with respect to research outcomes and the improvement in knowledge and capability.

A case study highlighting the importance of focussing industry efforts via increased government regulator involvement and industry collaboration in strategic areas is described by Sir Ian Wood[7]. Sir Wood [7] describes the experiences of the United Kingdom's Continental Shelf (UKCS) region and identifies key issues relating to development of oil and gas resources in the UKCS, particularly, as new

resources are becoming more difficult to find and as much oil and gas infrastructure is ageing and heading towards decommissioning.

Six key issues are identified: a lack of focus on maximising economic recovery, fiscal policy, government stewardship, industry stewardship, lack of collaboration and overzealous legal and commercial behaviour between operators. The report[7] also identified that high quality strategic research planned and promoted by industry bodies, but poor implementation and outcomes were frequent.

The report[7] goes into much detail and presents a relevant case study for Australia to compare against its own industry. It presents a series of strategies, the concepts of which may apply directly to Australia as part of a strategic offshore oil and gas IRFM. The report[7], includes strategies and actions relating to exploration, licences, data, asset stewardship, regional development, infrastructure, technology, and decommissioning. All of which relate to sustainable development[6] and have direct implications for the Australian oil and gas industry. The report, also describes the need for a more involved government regulator to ensure strategies are integrated into the industry. In the past, the regulator has been at 'arm's length' and this may need to change to encourage research activity.

Project Structure

The oil and gas industry may affect much of the offshore region around Australia with respect to exploration, construction, production and decommissioning activities. Hence, there is an opportunity to learn from previous IRFM case studies and models from other industries and assess whether they fit the Australian context. This white paper was an initiative of NERA, an industry-led government funded initiative who's vision is to maximise value to the Australian economy by having an energy resources sector which is globally competitive, growing, sustainable, innovative and diverse[5].

To perform a balanced assessment of the concept of an IRFM and to determine the models and mechanisms that may fit within the Australian offshore oil and gas industry with its unique challenges and opportunities, a project methodology was developed that would provide as much information and input as was practicable within the project scope and timeframe. The project methodology consisted of the following activities: posing research question(s) that apply to this project, follow a methodical approach to determine key issues and evaluate any data if available, draw conclusions, and present possible models and options on how an IRFM for the Australian industry may be achieved.

Part of the process of developing this paper was to investigate the current state of IRFMs used in the oil and gas industry and where possible, analogous industries worldwide. It was anticipated that there would be many models for review. Some models would be more applicable than others, but would likely have similar structures. A selection of models was chosen as examples and priority was given to models operating in an oil and gas context and the Australian mining context. Particularly, well established models with a track record of successful and prolonged industry engagement were considered a priority.

To provide a starting point for the investigation, a series of research questions was posed to direct the research into IFRMs globally. The overriding research questions that generated several subordinate questions (Table 1) was,

"*The Oil and Gas Industry in Australia is a high value, high profile industry, that benefits the Australian economy in many ways. It is proposed that to realise the full benefits of the industry and to maximise resource recovery, requires a systematic, coordinated, and sustainable industry approach. This may be*

achieved via industry led research collaboration, to efficiently deliver more complex research projects and outcomes.

There is a need to develop a clear understanding of what industry research funding models exist, how they are formed, funded, administered, managed and governed, and how the industry views them. From this, it should be possible to determine whether an Offshore Oil and Gas Industry Research Funding Model (IRFM) fits the needs of the Australian oil and gas industry and determine what actions and processes are required to make this happen.

The key questions are,

- *Does the industry understand, and government realise, the need for such a centralised industry research funding model?*
- W*ould such a model be permit based, production based, membership based or realised via some other mechanism to provide a research funding pool?*
- *Who would provide the industry catalyst and capability to make an industry research funding model happen and more importantly make it sustainable?"*
- *How would the concept of an industry research funding model be socialised to industry?"*

The above broad statement and research questions posed several others (Table 1) that guided the investigation and which set some project objectives. The questions provide information on existing IRFMs, the location of the fund, its longevity, business structure, governance structure, funding pool, whether the IRFM is industry, charity, government, private, or a co-government industry initiative etc. The questions were sufficiently broad to capture the essence of the IRFM and their derivatives, in the form of industry centres, clusters and collaborative groups.

Key project objectives provided scope and a range of activities that should be undertaken by the research. Eight objectives were identified. A summary is presented in Table 2 and full description in Appendix A. The activities required to realise the investigation are shown in Table 3.

Funding Models & Mechanisms

A project objective was to perform a desk based study to identify IRFMs, key stakeholders, governance structures, regulations and a business case. To achieve this, a detailed investigation was performed via interrogation of general publications, government websites, industry forums, industry organisations, industry websites, news feeds, and research organisations. The search included both domestic and international sources to provide a broad range of examples and model options. Countries covered included Australia, Canada, European Union countries, Ireland, Norway, United Kingdom and United States.

The information found relating to IRFM and mechanisms was broad. Information ranged from high-level industry information from numerous (and variable) websites through to detailed anecdotal organisational information on IRFM processes and procedures with example projects gained from experienced industry personnel interview. An attempt was made to investigate other industry funding models in areas such as aviation, medical, pharmaceutical, fisheries, ports and harbours etc., but this was found to be more difficult with models appearing to be less well developed than those of other industries such as mining and defence for example. Mining and defence appeared to be an exception.

After an initial review of identified models, it became clear that there were several common formats both nationally and internationally. It also became apparent that there has been a shift towards industry growth centres in Europe and the United Kingdom where much of the industry research commercialisation is focussed[8-14].

The funding formats that apply to these models and entities are shown in Table 4 and it is clear, that different funding principles exist globally. IRFM management entities and growth centres appear to use a combination of funding principles depending on the project and industry. An observation from the study was that over the past decade or so, the funding models had been incorporated with an industry centre concept focussing upon collaborative research commercialisation. Examples of these centres are entities such as Catapult Centres in the UK[12] , Defence Innovation Centre[15], Innovation Technology Facilitator[13], and Oil and Gas Technology Centre[16]. A list is shown in Table 5 along with others. Internationally there seems to many centres offering industry research capability. However, they are all very similar, so general examples were chosen.

For completeness, a desk study review was also made of other industries to assess their industry research funding models. The industries reviewed were, Aviation, Defence, Engineering, Forestry, Medical, Nuclear Energy, Pharmaceuticals, Railways, and Ports and Harbours. The review yielded many weblinks to various websites as shown in Appendix B. However, the information and data on these industry sites, while interesting, was found to be less well developed and focussed on the needs of specific industries and projects.

Operation of IRFMs

Collection Mechanisms

Table 5 shows common examples of the various IRFMS that may be applicable to the Australian oil and gas industry. Their successful implementation and operation obviously requires a formal structure to be established by the entity that would ultimately manage the IRFM. Essentially, each IRFM has a pool of funds generated via taxation revenue, application of a levy, collection of licence fees, charitable donations, government tax offset, industry membership fees, project sponsorship or fines and penalties (in extreme cases).

Under models that include government as a funding source and stakeholder, there are several collection mechanisms. For example, the pool of funds may be collected by federal or state government taxes, or permit and licence fees, which are placed in the government coffers and are subsequently distributed via government departments to industry research fund entities such as the Australian Research Council, for example[17]. In the case of oil and gas, funds are also raised via the Petroleum Resources Rent Tax (PRRT)[18].

Where governments charge a licence or permit fee for access to an oil and gas lease for example, funds are collected via a government body, as is the case with Petroleum Infrastructure Programme (PIP) in Ireland [19]. Funds are then distributed to projects via the relevant government departments and procurement schemes.

Where the production model is used, government charges a levy on production via tonnage sold. Funds may be collected via the research body directly following the establishment of an act of parliament that enables the IRFM entity to collect a levy directly on behalf of the government, as with the ACARP mining research model[20].

Where the model is funded via the issuing of memberships and project sponsorship contracts as with the AMIRA model[21], funds are collected via voluntary contributions, standard industry contracts and invoicing.

In the case of Foundation models, funds are may be generated from a percentage from company investments. Examples are the Lloyds Foundation[22], CSPL[23] and the Schlumberger Foundation[24]. A generic research funding model format is shown in Figure 2 where the finding pool can be generated by any of the above mechanisms or a combination.

Governance

The review of IRFMs revealed that many are established as not for profit entities, such as private companies, limited companies, foundations and trusts, government funded programs, government departments, internal company research departments, compensation funds and collaborative research centres. In most instances, the structure of the fund was developed via collaborration between industry, government and research organisations at some stage. In some cases, government maintains a direct involvement[25]. In others, industry runs the fund independently[20]. The remainder generally have government, research organisations and or industry as the main proponents.

The governance structure of most industry research funding organisations, generally involves the use of a board of directors, who as a management committee, steer the research priorities associated with the IRFM. They are either independent, or industry representatives, depending on the model. Day to day management is performed by an administration arm or entity and in some cases this entity is a separate company[20]. Project management and advice is generally provided by experienced managers and technical committees at a level subordinate to the management committee.

In an Australian IRFM, the effective and transparent governance of any funding model and the entity that manages it is essential. This is because it would potentially collect government funds, perform day to day project administration in the form of government procurement, provide operational activities and develop long-term strategy. The governance structure must also provide for the establishment of sustained industry credibility, relevance and IRFM sustainability.

The general principles of good corporate governance that would apply to an offshore oil and gas IRFM are described by the ASX Corporate Governance Council[26]. Where eight general principles are applied. Table 6 summarises these and detailed information is available from ASX Corporate Governance Council[26].

Under any new IRFM that is developed and regardless of the funding mechanism, the entity will require a board of directors in the form of a management committee. The structure of the board will need to be such that it adds long term vision and value to the IRFM and more importantly, steers the research priorities via industry engagement.

According to the ASX Corporate Governance Council[26], an effective board is one facilitates effective discharge of the duties imposed by law on the directors and adds value in a way that is appropriate to the particular company's circumstances. The structure of the board should be that it:

- *Has a proper understanding of, and competence to deal with, the current and emerging issues of the business.* In this case, it will be oil and gas industry research and the personnel involved will need to be drawn from experienced industry managers, consultants and government people.

- *Exercises independent judgement.* In this case, board members will need to be highly experienced individuals and recruited from the pool of people who have sufficient oil and gas industry

experience and knowledge to add value to industry research and guide it in a direction that is beneficial to all stakeholders. Directors should be from industry, government and research organisations where possible.

- *Encourages enhanced performance of the company.* In the case of oil and gas, it is essential for the board to develop a long-term strategy that will see the IRFM develop over time. For example, the board will need to focus upon different priorities as the fund evolves. In the initial stages, the governance of the model may be such that the immediate role of the IRFM is to identify immediate research priorities such as Decommissioning, Noise, Marine Life and so-on, where collaborative efforts of oil and gas operators in areas of common interest should be the focus. Subsequent research plans should include more fundamental ('blue sky') research where research organisations can be more involved in developing new research topics and methods that leverage inter-company collaboration and industry forum. As projects gain credibility via the best practice governance system and advanced and routine industry engagement, more strategic partnerships with research organisations should be planned. This will build future capability, leverage larger projects and develop research funds.

- *Can effectively review and challenge the performance of management.* In the case of the oil and gas Industry, metrics should be established that can define the benefits of industry research collaboration. In the initial stages this may simply be the provision of a forum and standard research agreement for companies to perform collaborative research within the framework of relevant government legislation. Over a longer timeframe, the benefits of collaborative research must somehow be demonstrated. For example, clearer decommissioning plans and outcomes could be developed, a reduction in research duplication can be achieved or an improvement in public awareness and positive engagement with community is progressed. Enhanced and sustainable industry activities may also be a metric.

Within any best practice governance system board members are elected by the stakeholders. Under any new IRFM, the oil and gas Industry operators, government bodies, and research organisations would require balanced representation on the management committee and any technical committees that are formed. This presents a complex process that must be managed by an organisation such as NERA and any new IRFM would require an entity, such as NERA, to manage governance and day to day administration. An example framework for the IRFM management entity is shown in the Figure 3. An example governance mechanism is shown in Figure 4.

Governance mechanisms and methods were discussed with the administrators of several existing industry research funds in Australia. Their general comments are covered under industry engagement section of this paper and within Appendix C.

Existing IRFM Assessment

The project methodology called for an investigation to identify IRFMs that may be applicable to the offshore oil and gas industry in Australia. To achieve this, a broad desktop study combined with strategic engagement with existing IRFM managers was performed. The review revealed domestic and international industry research models. It became apparent that the funding mechanism for an IRFM can be either a single type or potentially a combination as in the AMIRA model where membership and subscription are used or in the MRIWA and other models where a ratio of industry to government funds was used. Table 5 lists some of the common model types used by industry.

An objective was to assess and rank each model for implementation across the Australian offshore oil and gas industry if possible and to provide an assessment of the various funding models to identify pros and cons of each model, as applied to the oil and gas industry in Australia. This was

quite difficult to achieve due to the disparity between IRFMs globally. However, it was possible to identify some basic parameters for comparison.

Assessment and Ranking

Given the nature of the models and their disparity with respect to funding sources, priorities, governance and so-on, it was decided that quantitative comparison of the models would be very difficult. However, most funding models did appear to have some similar characteristics that could be compared and used as a broad guide. These characteristics are summarised in Table 7.

The key criteria that immerged were, collaboration, financial, governance, industry credibility, management and sustainability. In an 'ideal' sustainable IRFM, it would be reasonable to expect such a model and the entity that manages it to have access to or the ability to apply all or most of these criteria.

To provide a qualitative estimate for the relevance of IRFMs to the Australian context a simple ranking method was utilised. For example, in an 'ideal' model (and associated management entity), if a criterion present in the model can be confirmed, a value of one can be added to that criterion's 'score'. If a criterion is present in other models but not the model under assessment, a value of minus one can be added to that criterion's 'score'. If it was unclear whether the funding model entity being assessed, featured the criterion at all, then a value of '0' was applied.

While this approach is subjective, it does allow the different models to be viewed together and ranked, albeit over simplistically. Remembering, that it is the structure of the IRFMs that is important in this process and all the reviewed IRFMs have their merits and the aim is not to say one is better over another, but simply that one may fit this purpose better than another. The criteria and their 'scores' are presented in Table 7 and Appendix D.

From the analysis, five industry research entities and models appear favourable for an oil and gas IRFM. They are,

- The Petroleum Infrastructure Programme (PIP)[19] this is a successful joint industry government research model run by the Petroleum Affairs Division in Ireland. It is a direct example of an Oil and Gas IRFM. It is a benchmark example of an Oil and Gas Industry Research Funding Model.
- The Mining Research Institute Western Australia (MRIWA) is an industry research funding model run by the Government of Western Australia to promote Mining Industry Research via industry and government collaboration. This model concept, structure and framework has direct application to oil and gas research in Australia. The framework for Australia already exists and this model ranked well.
- The Australian Coal Association Research Programme (ACARP), is a world class black coal research programme based on the production levy model. This model structure and framework has direct application and relevance to oil and gas research in Australia. The framework for Australia already exists and this model ranked well.
- The Cooperative Research Centres (CRC) Programme is a competitive, merit based grant programme that supports industry-led and outcome-focused collaborative research partnerships between industry, researchers and the community[27]. The programme has direct relevance to the oil and gas Industry.
- AMIRA International is an industry led membership based model that has been operating for several decades. AMIRA focusses on mining however, the model may be suitable for oil and gas industry collaborative research in a modified form. The framework for Australia already exists and this model ranked relatively well.

Some common model attributes that provided the data for Figure 5 are shown in Table 7 and a more detailed list of model attributes is dealt with in the supplementary document, "Research Funding Model Classification Slides" that accompanies this paper (Appendix E).

Interestingly, the top five IRFMs all have different funding mechanisms, suggesting that factors other than simply funding mechanisms have an impact on their life cycle. From Table 7, it appears that governance and industry credibility have 9 separate criteria, and may have the most weight with respect to industry acceptance. This is followed by collaboration, financial, management and sustainability. All having 5 factors each.

An unusual case occurs with the Gulf Research Programme (GRP) that returns a negative score. The GRP obtained a negative score because it was the result of industry penalties and fines imposed by government and does not include direct industry involvement in research decisions. This is a less than ideal choice for an IRFM for the Australian oil and gas industry. However, to obtain best practice and learn from past experiences, this IRFM should not be ignored.

Most of the other industry models ranked lower simply because they had not been applied in Australian oil and gas context. However, the models all had credibility and some are very successful such as ARC Linkage and CRCs. The Lloyds foundation model is also a valuable one.

IRFM Pros and Cons

Australia has a Commonwealth Government system that interacts with the various State and Territory Governments. Each level of legislation aims to provide democratic governance of issues via laws, compliance and penalties for noncompliance. As a result, legislation is inevitably comprehensive and complex. Unfortunately, complexity is added when State and Territory legislation and Commonwealth Legislation overlap. For simplicity, in this early investigation into industry research funding models, only leases within Australian Commonwealth waters are considered relevant to the model. That may however change as the model evolves.

The research presented so far shows that there are many funding entities worldwide and most larger industries have some type of mechanism for industry led research. Under this project, five models have emerged as favourable and the pros and cons of the top five models are considered against the Australian context.

Petroleum Infrastructure Programme (PIP) Ireland

The Petroleum Infrastructure Programme (PIP)[19] is an exemplary model developed by the Republic of Ireland government. The aim of the model was to develop an IRFM mechanism that is based on a permit fee paid by oil and gas companies wanting to perform oil and gas activities in the waters around Ireland's continental shelf. The programme was established in 1997. The objective was to bring together oil and gas companies to perform collaborative research, improve data sets and encourage data sharing on larger projects. Early focus was on seismic data, drill core acquisition and interpretation and understanding geological formation source rocks. PIP is a long running model with industry credibility that has evolved over time from purely industry based projects, through industry-university applied research collaboration and onto industry-university pure research programmes that are able to leverage even larger projects and international funds.

The Pros of this model are,

- Permit based model – everyone who has a permit contributes annually to the fund via a government department that collects revenue.
- The resulting funding pool is several million Euros per year.

- It is an established model with straightforward vision and goals determined from regular reviews.
- It has a balanced governance system with experienced industry representatives and government representative participating in board decisions and strategy.
- PIP has established a successful working model that allows oil and gas companies to collaborate via a standard contracting arrangement that covers IP, work flow, results knowledge sharing, inclusion of Irish Universities and international linkages.
- The research project contracting structure is simplified via a government tender process using government procurement practices where projects are clearly defined and put out to tender.
- One company wins the project and then sub contracts to the other companies in the collaboration. Where IP is an issue, special clauses in contracts can be included to allow for University procedures etc.
- Clear research objectives and scope are provided via the industry experienced board enabling measurable performance to be made on projects.

The Cons of this model are,

- It is an overseas model and some of the drivers and mechanisms used for contracting and procurement would have to be modified to comply with Australian law particularly Australian Competition and Consumer Commission (ACCC).
- It is a permit model based on companies paying for permits to explore for, or produce oil and gas in Irish waters. The model has been running for over twenty years successfully, however, should companies relinquish their permits and licences, the fund will be reduced.
- For very large long term projects such as decommissioning, this model may not produce sufficient funds and may have to be subsidised via further funding mechanisms.

Mining Research Institute Western Australia (MRIWA)

The Mining Research Institute Western Australia (MRIWA) research model was developed by the Government of Western Australia to promote Mining Industry Research via industry-government collaboration. It is an Australian model focussed upon mining activities. Projects are funded by the State Government and industry as a partner at a three to one ratio. The aim is to improve processes, activities and understanding of the resources industry with the aim of maximising resource recovery for the benefit of Western Australia.

The Pros of this model are,

- It is a government funded initiative with a substantial pool of funds that can leverage industry project funds at a ratio of three to one.
- The model promotes industry, research organisation and government collaboration on projects.
- Projects fit the priority areas identified by the model governance system.
- Governance is well structured with industry experts contributing as well as government and academic representatives.
- The model ultimately reports to the minister.
- It is an ongoing fund with state government funding.
- It is a model already developed and operating in Australia.
- The model may be transferable to the Australian offshore oil and gas industry.

- It is a forward-looking model and provides capacity for PhD projects and industry sustainability.

The Cons of this model are,

- It is a model that is applied to mining and would require some modification to fit the needs of the Australian oil and gas industry if adopted.
- It is a state based model and would need to consider commonwealth laws, legislation and governance if adopted.
- The model relies on state funding and industry funding at a ratio or three to one. This would need to be changed to commonwealth funding.
- Not all companies that work within the mining industry are directly included in the funding mechanism.
- In this type of model, projects may be prioritised depending on the state of the industry.
- There may not be capacity for pure research when the industry cycle is down.
- The contracting mechanism isn't clear and may be complex if different for each project.
- Model may not entirely promote risk sharing and results sharing.
- Results and capabilities may become siloed in individual organisations.

Australian Coal Association Research Programme (ACARP)

The Australian Coal Association Research Programme (ACARP), is a world class black coal research programme based on a production levy model. The fund has been running since the mid nineteen seventies, and was converted to the ACARP in 1992. This model works on a levy of approximately five cents per tonne of black coal sold. The model has direct relevance to the oil and gas industry. The power of the model is that it is industry led, administered and managed. Project focus is derived from industry knowledge and needs. The model generates many millions of dollars for the pool (approximately $15m in 2016). The structure is shown in Figure 6.

The Pros of this model are,

- It is a world class model.
- It was originally a government funded initiative run by a tripartite agreement that included government, industry and research organisations.
- It includes all black coal producers via the levy, so all have an interest and all benefit.
- The model promotes industry funded research priorities, via industry and research organisation collaboration.
- Projects fit the priority areas identified by the model governance system.
- Governance is very well structured with industry experts contributing to projects, and steering and mentoring projects.
- The model uses standard contracting arrangements where ACARP facilitates research collaboration, organises funding from the pool and set's up standard research agreements with research organisations.
- It is an ongoing fund with commonwealth government approval and act of parliament.
- It is a world class model, already developed and operating in Australia.
- The structure of the model is well established and respected in the black coal industry.
- Collaboration with this model may provide a vehicle for establishment of an oil and gas equivalent.
- It is already a commonwealth legislated model and the model may be readily transferable to the Australian offshore oil and gas industry.

- It is a forward-looking model and provides capacity for PhD projects.
- The people involved in this model are enthusiastic and make it a success.

The Cons of this model are,

- It is a model that is applied to mining and would require modification to fit the needs of the oil and gas industry if adopted.
- It is a coal production model and would need to consider commonwealth laws, legislation and governance if adopted by oil and gas.
- Like the black coal industry in the early days of the model, the oil and gas industry may not appreciate the benefits and sustainability of this model.
- The model relies on production activity to generate funding. If production falls, the funding pool will fall.
- There is capacity within the legislation to reduce the levy to zero and hence funding could ultimately be halted in a worse case.
- In this type of model, projects are prioritised depending on the state of the industry.
- There may not be capacity for pure research when the industry cycle is down or in fact at any time.

Cooperative Research Centres

The Cooperative Research Centres (CRC) Programme is a competitive, merit based grant programme that supports industry-led and outcome-focused collaborative research partnerships between industry, researchers and the community[27]. The model has direct relevance to the oil and gas industry and its application to industry research should be utilised on long term projects such as decommissioning.

The CRC programme is funded by the Australian government and is long standing and very well respected internationally. CRC grants provide successful CRC applicants with access to grant funds for up to 10 years for collaboration with industry, research and community sectors to develop important innovative technologies, products and services. A CRC must have at least one Australian industry organisation and one Australian research organisation[28].

The Pros of this model are,

- It is a government funded initiative.
- It promotes industry collaboration and industry growth centres.
- Short term (3 years) and long term (10 years) initiatives are available.
- The government will fund up to 50% of the CRC. Industry must fund the remainder.
- It is a forward-looking model and provides capacity for PhD projects and hence sustainability.
- Operates weighted selection criteria so is peer reviewed. Projects are likely to be very high value with respect to innovation and pure research.
- Has access to extensive University level research facilities and collaborations.
- Can perform industry research that is pure research or development of concepts that may be too risky for commercial companies to take on alone or as a collaboration.
- Can perform research in highly specialised areas.
- The model has been already been applied activities similar to those performed in oil and gas[29].
- Application process is complex and competitive. Only the best research centres get funded.

The Cons of this model are,

- It is research organisation focussed.
- Application process is complex and competitive. This may focus research centres into narrower research areas.
- It only requires a minimum of one Australian research organisation and one Australian industry organisation, so does not necessarily capture all of industry under the one IRFM.
- It is not necessarily industry led and governed as in the context of this paper, so the priorities of the CRC may be focussed in one area or a closely associated topic at any one time. These topics may not always be aligned with industry priorities identified by industry forum.
- The projects are run within an academic environment and may not have the necessary industry governance mechanisms to include broader industry opinion and steer the research direction.
- Because the centre is funded by a small number of industry collaborators, there is a possibility that research could be duplicated elsewhere within Australia and globally, if uncoordinated.
- Research commercialisation may not be on a commercial entity timeframe.

AMIRA International

AMIRA International is an industry led membership based model that has been operating for several decades. The model focusses upon mining industry projects and has evolved over many decades. AMIRA aims to share the risks in projects via collaboration. The fund has been running since the late fifties and was an industry led initiative. The model format has relevance to the oil and gas industry. The power of the model is that it is industry led, administered and managed. Project priorities are derived from industry knowledge and needs. The model generates millions of dollars for the pool via membership and sponsorship. Project priorities and hence sponsorship depend on industry interest.

The Pros of this model are,

- It was originally an industry led initiative run by an agreement that included industry champions.
- The model promotes industry funded research priorities, via industry and research organisation collaboration.
- Projects fit the priority areas identified by the board.
- Governance is very well structured with industry experts contributing, steering projects.
- The model uses standard contracting arrangements where AMIRA facilitates research collaboration, organises funding and sponsorship and set's up standard research agreements.
- It is an ongoing fund with industry support.
- It is a world class international model, already developed and operating in Australia.
- The structure of the model is well established and respected in the mining industry.
- Collaboration with this model may provide a vehicle for establishment of an oil and gas equivalent.
- It is a forward-looking model and provides capacity for PhD projects and sustainability.

The Cons of this model are,

- The model was set up in the days when high-level industry champions were easily accessible in Australia. With globalisation, these people may not be so easy to access to develop such a model for oil and gas.
- It is a model that is applied to mining and would require modification to fit the needs of the oil and gas industry, if adopted.
- It is a membership and sponsorship model and would need to consider commonwealth laws and legislation and governance if adopted.
- The model relies on industry activity to generate funding. If production falls, the funding pool may fall as membership and sponsorship falls away.
- In this type of model, projects are prioritised depending on the state of the industry.
- There may not be capacity for pure blue sky research when the industry cycle is down.

The five models above all have their pros and cons. However, the main factors that must be considered are whether the model is acceptable to both government and industry in Australia. Government-industry acceptance and industry credibility are essential. Also, whether the model is sustainable and whether it will improve industry research collaboration and reduce duplication is also essential. With respect to engagement from an industry perspective, the model must have industry credibility, as with the PIP model and the industry driven models such as ACARP and AMIRA.

Governance of the model is also extremely important. Each of the models above has an effective and transparent governance model. However, regardless of the mechanisms for formal governance the IRFM must include capacity for industry technical input and project steering via the board and industry monitors. The use of industry monitors was a powerful contributor to the success of the mining based IRFMs, particularly ACARP and AMIRA.

Regulatory Framework

Regulatory Implications

The Offshore Oil and Gas Industry in Australia is highly regulated. Companies must operate within the relevant legislations and guidelines. Information relating to specific legislation, regulation and guidelines is presented by the Department of Industry Innovation and Science [30]. Referring to the Department of Industry Innovation and Science website[30] it is clear that there are many regulations and acts that companies must comply with during their activities in Australian waters. Research activities performed under the industry research fund would be subject to these regulations. Table 8 summarises the various regulations. Concordance tables are available to assist people to navigate between current and repealed acts [30].

The information within the various legislation, regulations and guidelines will no doubt impact any proposed industry research fund. For example, should a permit based IRFM, or a production based IRFM be developed, the collection of funds would need to be performed in the context of these regulations. This may be either directly, via the revenue raising mechanisms discussed in the regulations or via an entity developed specifically for fee collection as with the mining production levy model[20] that was developed via an act of parliament.

The regulation's impact will also occur via compliance issues when the industry research funding commences project activities at the various locations within the licence areas. The Government Acts and Guidelines are comprehensive, and to assist with understanding, administration and compliance, the site [30] provides administrative guidelines via several entities who provide governance, advice and forum for industry related issues. These include entities such as, Australian Petroleum Production & Exploration Association APPEA[31] who are the peak national body

representing Australia's oil and gas exploration and production industry. APPEA's members account for an estimated 98 per cent of the nation's petroleum production. There are also two government bodies, the National Offshore Petroleum Titles Administrator (NOPTA)[32] and the Environmental Management Authority (NOPSEMA)[33]. Each of these three entities would become stakeholders within any new industry research funding model as they would have a direct interest with respect to governance, regulation and forum.

Administrative Guidelines

The Department of Industry Innovation and Science [30] has two entities that assist with the review revision and administrative guidelines relating to offshore petroleum activities.

- The National Offshore Petroleum Titles Administrator (NOPTA)[32] and the National Offshore Petroleum Safety and,
- The Environmental Management Authority (NOPSEMA)[33].

According to NOPTA [32], their key functions in Commonwealth waters are to,

- Provide information, assessments, analysis, reports, advice and recommendations to members of the Joint Authorities and the 'responsible Commonwealth Minister' in relation to the performance of those ministers' functions and the exercise of their powers
- Facilitate life of title administration, including but not limited to Joint Authority consideration of changes to permit conditions, and approval and registration of transfers and dealings associated with offshore petroleum titles
- Manage the collection, management and release of data
- Oversee the keeping of the registers of petroleum and greenhouse gas storage titles.
- States and the Northern Territory (NT) maintain a titles administrator role in state/NT waters.

Similarly, according to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), NOPSEMA[33], is Australia's independent expert regulator for health and safety, environmental management, structural and well integrity for offshore petroleum facilities and activities in Commonwealth waters.

Any entity that develops and administers any new IRFM, such as NERA, must develop relationships with NOPTA and NOPSEMA as contributors to the governance and administration on the new IRFM, as they will have a direct interest in the IRFM activities. NOPTA and NOPSEMA would be primary inputs to the IRFM as shown in Figures 3 and 4.

An aspect of administration of collaborative research under any new IRFM that must be considered, is whether joint industry research projects that are run under the scheme, or the scheme itself breaches the Competition and Consumer Act[34]. The Competition and Consumer Act requires businesses to compete fairly. Most Australian businesses increase their customer base and their profits honestly through: continual innovation to improve products or services, sales and marketing showing the genuine benefits of their products or services, keeping costs down so they can offer competitive prices. However, businesses struggling to compete fairly and maintain profits may be tempted to deliberately and secretly set up or join a cartel with their competitors[34].

While any IRFM is genuinely intended to improve industry research outcomes via collaboration, any fund or entity would have to be set up to be totally transparent and not seen to be excluding any individual, group or entity from the fund process. It must be inclusive, otherwise, in a worst case, there may be a possibility that the IRFM entity is regarded as cartel activity by the Australian

Competition and Consumer Commission (ACCC). If governance structures and their management etc. are not set up correctly there could be an issue with compliance in this area. According to the Australian Competition and Consumer Commission (ACCC), a cartel exists when businesses agree to act together instead of competing with each other. This agreement is designed to drive up the profits of cartel members while maintaining the illusion of competition. While this is a literal definition and would never be the intention of the IRFM, it is essential that any entity and associated joint venture projects are set up to ensure that they comply with the ACCC's requirements.

Financial Implications

Five Industry Funding Models were found to be favourable for the collaborative IRFM concept and were discussed earlier. From these five, the two most favourable models appear to be the permit based IRFM and a production based IRFM. Each of these models has the potential to generate revenue for the IRFM. To demonstrate the potential funding pool for these two models, some financial projections for the size of the pool were made. Figure 7 and 8 shows the permit and production models respectively.

Option 1 Permit Model

The permit model objective would be that a portion of the revenue generated via fees and levies within the offshore oil and gas legislation and regulations[30], could become the collection mechanism for the industry research fund. For example, a percentage of the Registration Fees or Permits could be utilised, or a percentage of the Petroleum Resources Rent Tax, or a combination of both. Alternatively, part of the cost recovery implementation scheme used by NOPTA[32] could be modified to include the collection of revenue from participating companies and subsequent distribution into the industry research fund. However, that would mean a reduction in revenue to these organisations for their activities.

Ultimately, the aim would be to have a sharing arrangement between industry and government, where some quantum of the revenue from exploration permits, retention leases, production permits and all the associated licences is channelled into the IRFM. Table 9 shows an example scenario and the potential benefit to the fund. Example pool values are shown in Figure 7 for different increments.

The funding pool of Figure 7 is based on approximately 880 instances of records of titles that are currently listed in the National Electronic Approvals Tracking System (NEATS) data[35]. Each record would generate a quantum of research funding. However, during the development of any IRFM, a consideration must be made relating to the sharing of permits via joint ventures and that not all exploration permits, production licences or retention leases are the same. For example, the number of blocks within each is quite variable. Some Titles may never be developed to production. Some have a few hundred blocks, some have thousands. Also, the work programmes planned for these blocks varies significantly. The model projections at this stage of the whitepaper are only intended as an estimate to investigate feasibility of an IRFM, so the simplest Titles and licences case is considered. However, to realise an IRFM that can fund much larger projects, it may be that it is the number of blocks on a title that should be considered along with some percentage of indicative expenditure implemented on the title. This is an important consideration for the size of the funding pool because, for example, if the National Electronic Approvals Tracking System (NEATS) data[35] is analysed further it appears that the number of title holders is only approximately 197 and some operators and / or title holders would be required to contribute many times to the fund. The funding mechanism must be fair with all interested parties having equal weight in the governance of the fund.

Figure 7 shows that a co-investment by approximately 880 industry operators and government via a portion of the funds collected using the permit model, can establish an IRFM of several million dollars. If this is administered in a similar manner to the Petroleum Infrastructure Programme (PIP)[19] from the Republic of Ireland, it may become a successful and sustainable model. One that can evolve from pure industry based research performed by collaborating companies, through to University based research looking at specific site based problems, and onto pure research that leverages larger industry research funding mechanisms and projects. International collaboration may also be possible.

Option 2 Production Model

A second option available to the Industry Research Funding Model, that has been applied successfully to the black coal industry in Australia[20], would be to apply a small levy on every barrel of petroleum produced. That is, crude oil, condensate and liquid natural gas (LNG). In the case of the black coal production model, 5 cents per tonne sold is charged and placed into a research fund[20]. The model has been in operation successfully since 1992 and is internationally renowned.

Working with the total combined oil and gas production figures from 2014 and 2015 [31], scenarios based on production at five cents per barrel can produce a substantial IRFM pool of funds for industry based research. However, the financial impacts of such a collection mechanism would be focussed upon companies that are producing oil and gas and not all of those involved in the industry. In the case of offshore oil and gas in Australia as of 2017, this may be only a few operators.

Ideally, any industry research fund would aim to provide benefits of coordinated research to all operators within the industry and hence all companies involved in the industry should have an opportunity to contribute to the pool. Hence, this model may not be as favourable as the permit model.

From both an industry, government and fund perspective, obviously, the financial implications will be dependent on the chosen industry funding model. For example, if the model is dependent on the production model, where a levy on the sale price of a barrel of oil is used, the financial impact will be larger on individual operators producing a lot of oil and gas than say a sharing of fees generated by the permit system used by PIP[19]. However, the industry fund would be large enough to support larger projects. From a sustainability perspective, this may be more favourable.

In the case of the permit model utilised by PIP, the fund may generate several million dollars if the fund is based on the number of permits issued. However, some permits may be shared via joint venture projects and the actual number of permits available across the various industry stages may be less would first appear.

In summary, the IRFM could be funded by either the permit model or the production model, by a combination of these two, or indeed any of the models introduced by this paper. However, any model must have industry credibility and be attractive to the industry, government, and other stakeholders for it to be willingly adopted.

Industry research priorities and the scale of projects also needs to be considered when determining the required fund size. If the pool is too small, the research capability, albeit collaborative, may be too small and spread too thinly to achieve the necessary outcomes and capability. The fund should look at funding smaller scale projects that are manageable and provide a return on the invested effort. Such smaller projects could be manageable components of a much larger project. This is the approach taken by the black coal industry.

Key Stakeholders

A priority for the development of a new IRFM and for any entity that may ultimately manage it, is to identify all the stakeholders that would have an interest in the process. In this paper, stakeholder refers to those that would have a direct interest in developing an IRFM, would benefit from it, or would be affected by some aspect of it. Figure 9 shows the key stakeholders that could potentially add value to any IRFM via governance, community engagement, contributions and technical committee members.

However, during early stage development, the key stakeholders would be those that can provide a range of inputs relating to the formulation, implementation and long term management of any oil and gas industry research fund. The key stakeholders would fall into three broad groups, those involved in the formulation, those involved in the implementation and those involved in the long-term management.

During the formulation stage, it will be necessary to engage with key oil and gas industry stakeholders to socialise and promote the concept of an IRFM and emphasise its benefits. It is essential to engage with industry at appropriate levels to identify where the industry sees most benefit arising from such an IRFM. Various levels within the industry will view the concept differently and have differing opinions that must be managed. Experiences from other long term models can be applied to this process.

In Australia, there are over 95 oil and gas operators actively involved in offshore activities[35]. A list of companies is presented in Appendix 5. However, it is more likely that companies having a large interest invested Titles[35] in the offshore oil and gas industry in Australia would immerge as major stakeholders for the IRFM. For example, from the NEATS data[35], there are approximately 195 Title Holders [35-37], holding approximately 880 permits, licences and leases distributed over approximately 96 operators. As of 27 June 2017[35], the upper 20 title holders are shown in Table 10a and upper 20 operators shown in Table 10b. These companies appear to have interests spread across permits, leases and licences. However, during the initial formulation it may be pertinent to keep the early stakeholder engagement to a smaller number than this, or stage the engagement to make the process more manageable. Interestingly, Figure 10a and b shows that the top twenty oil and gas company stakeholders by number of Titles and Operator are quite different.

The aim of developing an IRFM is to improve collaboration between companies, reduce duplication and provide a mechanism for communication of research outcomes. To achieve this, during the formulation stage, there is a need to engage other stakeholders that would benefit from the outcomes of an IRFM. Hence, other key stake holders would include Commonwealth Government and non-profit organisations such as APPEA, NERA, NOPTA, NOPSEMA etc., who may have an interest in the administration and governance aspects of the initiative. Also, at the research level, there would be research organisations and Universities that would be contracted to perform aspects of the industry research projects. These institutions would be essential stakeholders as they provide access to leading edge research capability.

During the implementation stage, the stakeholder group would increase in number to include all the offshore oil and gas companies. One of the objectives of an IRFM is to provide an opportunity for companies to engage in collaborative research to address some of the larger and more complex research projects that are common to many or all locations. Including all the operators of all sizes in the implementation stage will ensure that information and data sharing to maximise recovery is accessible to all scale of companies under the principles of sustainable development[6]. It will also

ensure that the opinions and issues of all operators are heard in a manner similar to the industry forum provided by the black coal industry[20].

Other stakeholders will include the Commonwealth Government, who would provide assistance via modification of regulations and legislation to enable the research fund to operate. There would also need to be negotiations with industry professional bodies and regulators such as APPEA, NERA, NOPTA and NOPSEMA to enable funds collection, administration and management. Depending on the model, some organisations may find that their funding pool is reduced. An early interaction with research organisations and Universities is also essential, so that the processes and procedures to bring these organisations into projects is established and leads to efficient contracting arrangements with them.

The long-term management of the IRFM fund would need to be via just one organisation as referred to in Figure 9. This organisation would be responsible for the governance, management and administration of projects under the IRFM. The objective of having such a key stakeholder entity for management and governance is that the organisation can actively engage with all the other stakeholders to ensure that the research programme becomes efficient, sustainable, inclusive and available to all. Some example stakeholder management activities that the long-term management of the IRFM fund may be involved in is shown in Figure 11.

The long-term management of the IRFM will require active engagement with industry, government and community stakeholders via conduits such as: developing industry partnerships to enable efficient joint venture research projects, development of an industry forum for technical committees and interested parties to formulate and share ideas, engagement with industry pioneers to provide anecdote and case studies, provision of an industry awards system to help promote, add value and prominence to excellence and achievement in industry research, development of active links with industry associations to promote the industry research funding model to their members, development of links for community engagement to assist in educating the community on the advanced research efforts being undertaken by the industry to promote knowledge about oil and gas activities and their social licence to operate, actively promoting research activities to a wider audience via the use of social media platforms, promotion of research activities at conferences and events and within peer reviewed media, development and maintenance of a database of current research activities and projects and integration of this with industry case studies as a tool for education of the community and industry.

Figure 11 shows that there are many activities that will require the long-term management of the many stakeholders shown in Figure 9 to make the IRFM sustainable and acceptable to all the stakeholders. To ensure that all the stakeholders are identified and engaged correctly, a business case and a long term strategic plan must be developed with clear objectives and milestones for implementation.

In summary, the key stakeholders are derived from many sources and backgrounds. However, the key to the IRFM is the ability to generate a sustainable and realistic fund. This this will require industry and government agreeing upon the mechanism, in principle, as a first stage. In the initial stages of development of industry engagement with the top 10 industry Title holders, the Commonwealth Government and the government body that currently administers the titles and collects the revenue should be considered the priority stakeholders or key stakeholders. Active engagement and promotion should commence with those entities as soon as possible.

Business Case

The previous paragraphs and sections have introduced the concept of an IRFM and discusses the many models available to the oil and gas industry. Estimates of the potential pool that can be generated from various sources have also been presented. However, for any new IRFM to be attractive to the industry and government alike, there is a need to develop a business case for pursuing the development of the model. So, what is the value proposition of the new IRFM, why is it needed and why would the IRFM be better over traditional research funding methods already in place in Australia?

The short answer is to ensure continuing investment in and the economic wellbeing of the offshore oil and gas Industry via co-ordinated industry led and research activity that leads to a sustainable industry research funding model. Research activity that reduces duplication in the form of the research itself, project administration, project management and contract development costs by centralising research activity within one centralised industry research centre, that is actively engaged with the oil and gas industry. Such a centre could be analogous to the Oil and Gas Innovation Centre (OGIC) [10], Innovation Technology Facilitator (ITF)[13], the Oil & Gas Technology Centre[16] or Catapult Centres [12], for example.

From an industry perspective, placing research that applies across the industry into one centralised body means that the risk in research can be shared as can the administration and management costs. Higher risk or larger more complex projects can be undertaken and the benefits shared across the industry. This will allow internal company budgets to be steered towards more specialised research and can focus on more site-specific issues. Such projects can be channelled into the ARC Linkage and CRC research systems. Therefore, freeing up people and resources that need to be applied to them, that would otherwise potentially be involved in duplicated research.

Another factor that is beneficial to the business case is that a centralised IRFM can incorporate all current best practice research activity into its database and coordinate research across industry to minimise duplication, increase financial leveraging opportunities, centralise knowledge and speed up the delivery of project outcomes. It will also be possible to achieve greater cost reduction and value creation by ensuring there is increased project certainty as projects are run by experienced industry monitors with clearly defined research goals and milestones as is the case in black coal research[20].

The IRFM can be established as a tri-partite industry-government-research-organisation entity with greater accountability to industry via the best practice IRFM governance mechanisms and technical committee feedback. Centralising administration with one entity will allow more research funding to be applied to the research and provide the opportunity for a mechanism to collaborate domestically and internationally with an entity that has industry credibility.

Using a centralised IRFM funding entity, it will be possible to achieve a more holistic research focus that can visualise the complete oil and gas cycle and industry research can become less production centric and insular. If necessary an ERFM would be able to deliver more short term (transient) projects that are of immediate benefit to the industry at a lower cost.

The IRFM can place a greater focus on strategic research development that is of benefit to all the stakeholders that can identify long term risks and potential liabilities. Research can be more diversified as knowledge gaps are identified easier via collaboration and forum, and industry experience and knowledge can be used to focus pure research activities within Universities via government and academic input

To place the business drivers in context, the cycle of the oil and gas industry is shown in Figure 12. The life cycle of an oil and gas industry project is shown along the horizontal bar in the centre of the ellipse. The project progresses along this bar. However, to place controls and reduce risks, stage gates are used at each key stage. Exploration and discovery, scoping studies, feasibility, pre-development, construction and commissioning, operations and production, closure and legacy and finally sell or relinquish leases. The location of funding models are shown on the industry life cycle in Figure 13.

Key business drivers apply to all the stages in the form of: the need for cost savings and value creation, risk minimisation, increased project certainty and tripartite management in the form of industry, government and community. The motion in the model runs in a continuous cycle of improvement. The IRFM provides improved business opportunities at each stage gate resulting from increased understanding by all stake holders of the industry cycle shown as the outer parts of the ellipse. Improved knowledge from research projects result at each stage. Ongoing research funding that is strategic and forever evolving via the centralised research body, improves research co-ordination and prevents of duplication.

Government policy can be better informed because of improved understanding of the state of research within each stage. For example, if an essential research priority has not been completed within a stage, then the project cannot progress to the next stage unless that project is completed to the satisfaction of all stakeholders. Business can make more informed decisions and can ensure that legacies from previous stages are not left behind.

In summary, the business case for an IRFM are that from an industry perspective, establishing an IRFM via some research funding mechanism will provide a dedicated pool of research funds on which to build an industry led research capability. Industry led research will be guided by industry monitors and value for money and industry relevance will be maintained. Depending on the model adopted, the industry can be assured that the fees or levies paid to government is directed into research that benefits the Australia economy and the industry's social licence to operate.

From a government business case perspective, government funds raised from oil and gas activities will be channelled into leading edge industry research, that in turn leverages advanced research outcomes, that will improve knowledge of the industry and any issues that require the development of more robust industry procedures and regulations. Government will have a knowledge base on which to build constructive dialogue with community groups so that the benefits of offshore oil and gas exploration, production and decommissioning may be shared with all stakeholders.

From a research organisation perspective, the benefits will be more co-ordinated research activities leading to the increase in capability and inclusion of Australia research organisations in advanced oil and gas research projects.

An example business case for an IRFM is shown in Figure 14, where a simplified example of the benefits derived from leveraging a collaborative project to improve the business case is shown. For example, if there is a research project that is required, that is long-term and it requires a significant amount of industry funding to realise, say a decommissioning research project costing $10m. If each company contributes to the IRFM to the tune of $2m per year with funds derived from across the industry via the permit model, the project can be realised and the benefits returned to all stakeholders. However, if each company sponsors individual projects as a percentage of their turnover, then the scale of the project cannot be realised and the impact of the research will be

diminished. Also, each company may duplicate the same research and less risk is mitigated due to less knowledge being developed, or outcomes remaining within one or two companies.

From the simple example shown in Figure 14. The business case for a centralised research body using an IRFM is clear. The centralised body coordinates research and disseminates it to the wider industry. Companies can leverage larger more complex long-term projects and the benefits are increased knowledge and improved risk mitigation. The result is a sustainable industry.

IRFM Socialisation Plan

The concept of developing an IRFM based on the combination of experiences and best practice governance demonstrated in other models within Australia and globally is proactive and forward looking. The idea of combining industry research into one centralised entity that co-ordinates calls for research tenders, reviews proposals, deals with tenders and contracting, and manages the research process in general will no doubt improve industry research outcomes. Simply because it provides a co-ordinated approach to research and a forum to ensure that companies are aware of the research being undertaken. In its complete form, as an entity such as a NERA IRFM, it can address many of the more complex industry research topics via industry collaboration and sharing of risk.

However, to realise a new IRFM requires a great deal of ground work and the socialising of the concept must be approached strategically. To achieve this, it is recommended that a plan to socialise the model is developed. An example socialisation plan is shown in Figure 15. The timeframe for effective socialisation is approximately 12 to 18 months. The socialisation process has three key periods: engage with industry, develop organisational and individual relationships and nurture and maintain relationships. The effort and strategy involved in this process and its value should not be under estimated. It takes time to build credible industry relationships and requires experienced industry people such as those at NERA to undertake this initiative.

To engage successfully with industry, four key stages are required; introduce and socialise the IRFM activities, agree industry research project activity, secure in-principal support for the IRFM, secure funding commitment to realise IRFM. Under each stage there are various activities that must be completed.

Stage 1, introduce and socialise, requires; the definition of the planned IRFM capabilities and service offering, visits to industry where proponents listen and understand the industry the challenges, develop the focus on topical and emerging research 1 – 5 years out, discuss & promote the benefits of the IRFM, and attend relevant industry events.

Stage2, agree industry research project activity, requires; identification and discussion of specific research opportunities and undertaking of a gap analysis, define the research question(s), develop hypotheses, and formulate idea(s), and identify scale of project(s) with respect to timeframe and cost estimate.

Stage 3, secure in-principal support for the IRFM, requires; discussion of the IRFM and industry resources and capabilities, discussion of industry expectations and agreement of deliverables, discussion of IP, memorandum of understanding (MOU) and other confidentiality matters, development a draft IRFM research proposal and realistic budget to realise.

Stage 4, requires; the alignment of the IRFM research proposals with specific organisation requirements and capabilities, agreement for meeting location, date, attendees and objectives, prepare of a succinct but targeted presentation – detail benefits, time frame, costs, deliverables etc.

anticipate questions and answers, present and provide notes - follow up – clarify any concerns, manage the project(s) - deliver in full, on time and as specified (DIFOTAS) using the IRFM management operating system (MOS).

The above activities are a guideline for the realisation of any new IRFM and should be implemented as soon as possible. To at least establish interest in the concept of an IRFM.

Discussion

The Australia offshore oil and gas industry is a major industry sector with the capacity to bring significant benefits to the Australian economy. The size of the prize is many billions of dollars. However, the pursuit of oil and gas in a sustainable manner, requires that significant technical, environmental and community acceptance challenges are overcome.

It is essential to develop and educate the community and government on the activities of the industry and how those activities may affect the community, environment, and returns to government in the form of revenue. To achieve this, it is necessary for an advanced, coordinated and industry led research initiative be developed that promotes industry collaboration on research projects within the limits of Government regulation and laws.

At present, research is performed on a case by case basis within companies, research organisations and consultants. Some limited collaboration occurs. While each research project may appear unique, there is a danger that repetition or duplication of research occurs because of unintentional siloing of research project results in research organisations or companies, or publication of research results in media that are not generally accessed by community or industry.

What may be required, is a centralised IRFM that is industry led and analogous to some of the more successful industry led research funding bodies present in other industries. Such a model will be directly aligned with the needs of the industry and would become the centralised research fund for priority research areas identified via industry forum and strategic planning.

This paper has reviewed many of the existing IRFMs and identified their characteristics, their potential to raise a suitable finding pool and their governance systems. When the IRFMs were investigated and via conversations with their general management, it is clear there is an opportunity to develop a similar IRFM model for the oil and gas industry. In the case of the mining industry in Australia and the petroleum industry in the Republic of Ireland, there are some excellent IRFMs that may transfer directly into the Australian oil and gas industry. The structures of these IRFM are based on initial government involvement to establish the IRFM and the entity that manages it. As the IRFM becomes established, the government regulator steps back and remains at arm’s length to the process and only becoming directly involved when necessary. Industry then takes over the governance, management and delivery of industry led research projects via the application of experienced technical committees and management committees who are involved in the industry and have the knowledge and experience to steer collaborative industry projects to completion.

The simplification of contracting arrangements is also a common feature of successful and long-term IRFMs. Industry works on commercial timeframes and as a result, often requires that research projects are completed quickly. However, when working with research organisation or other companies, the time required to develop research agreements can be long as can the establishment of joint venture projects. The streamlining of collaborative research agreements within an IRFM entity, allows standard procurement and tendering processes to be used and projects to be initiated relatively quickly.

The paper has reviewed many IRFM funding mechanisms. Two mechanisms stand out. The first is the permit model based on revenue generated from the issuing of offshore oil and gas, exploration permits, production licences and retention leases. An advantage of this type of model is that the collection mechanism already exists within Australia and the model has been applied for some years successfully in the Republic of Ireland. However, there would need to be some negotiation with industry and government to channel a portion of the revenue into the IRFM. This model has the benefit that it allows the entire industry to contribute to the IRFM funding pool.

The second stand out model is the that used by the black coal industry in the eastern states of Australia. The IRFM funding pool is generated by a 5 cents levy on every tonne of coal sold. This generates a large pool of research funds each year and the whole industry benefits from advances in industry research under this model. This model works well in black coal where there are over one hundred companies producing black coal. However, in the Australian offshore oil and gas industry as of 2017, only a small proportion of companies are producing oil and gas. While the volume produced can produce a significant funding pool at say 5c per barrel, the funding pool would be generated by only those producing oil & gas and not all those involved in the industry. Potentially, this may make sharing and collaboration more difficult. Also, funds for any IRFM are not generated until production starts, effectively reducing access to critical research at the initial stages of the oil and gas cycle (Figure 13).

The paper has also investigated governance structures and the structure of any entity that may be developed to manage and administer the IRFM. In Canada, European Countries, Norway and the United Kingdom for example, a lot of emphasis has been placed on the development of industry growth centres. Their aim is to develop clusters of expertise and research excellence with a view to bringing together industry, government and research organisations, to perform industry research and promote research commercialisation. These centres are generally government funded with a requirement that industry provides equivalent funds at some acceptable ratio and that the centre must be self-sustaining within a set timeframe – usually 5 to 10 years.

To establish an industry centre requires a significant amount of effort and the oil and gas industry is fortunate in that it already has several established entities that could help realise the goal of a sustainable IRFM. Organisations such as NERA, APPEA, NOPSEMA and NOTPA are well placed to liaise with industry and government to realise this initiative and develop the necessary industry engagement to bring it to fruition. However, it will need a strategic approach developed as a staged process with clearly defined milestones, activities and deliverables at each stage (Figure 15).

The IRFM development process is estimated to require at least 12 to 18 months to develop and will need to include a strategic industry engagement that focusses upon the key industry stakeholders identified in Figure 10. The socialisation of the concept is essential so that the benefits of an IRFM can be seen by all.

Via consultation and positive interaction with industry, government and community, the concept of an IRFM, tailored to meet the needs of the Australia oil and gas industry can be taken from a concept through to an established centralised research body. The body must be industry led, based on best practice and deliver valuable industry based research, that allows Australia oil and gas resource recovery to be maximised.

Conclusions

The Australian offshore oil and gas industry is a complex and highly technical pursuit. To achieve a sustainable industry and to ensure that the Australian offshore oil and gas resource recovery is

maximised, there is a need for a coordinated, industry led research initiative, that allows companies to come together under one centralised research entity. This initiative would be an IRFM.

For companies, as a member of the IRFM, it will be possible to develop more complex projects via collaboration and spread the project risk via multiple stakeholders being involved in the industry research activities. Improving research coordination will assist government to make informed decisions on oil and gas research projects and assist with the mitigation of any risks involved.

Such an approach requires a sophisticated IRFM and an entity to manage it, that has a strong governance structure, an established and sustainable funding pool, and which considers the full life cycle of the oil and gas industry with respect to research improving the business case for advanced and continued industry led research.

This paper has investigated industry research funding models that are already in operation in Australia and globally. There are numerous models available, however, some are more advanced than others. Most have benefited from government funding to get them started and subsequent and ongoing industry funding to maintain them long-term. In the case of oil and gas, there is an exemplary example in the form of the permit model exercised in the Republic of Ireland. The Petroleum Industry Programme (PIP) has been in operation since 1997 and has proven very successful with respect to providing capability to take on more advanced industry research projects and the sharing of data. Over its life, the Petroleum Industry Programme has evolved several times to maintain industry focus and research priorities, and develop capability which includes the involvement of Irish research Universities and international collaboration. This model should be seriously considered as an option for the Australian oil and gas IRFM.

Similarly, there are several existing mining-industry led research funding models that have direct relevance and should be considered. However, they rely on a different mechanism for funding in the form of a levy, membership fees or government co-contribution at some ratio to industry funding. In the case of the levy model, it was originally applied by government to the black coal industry to encourage research. As a result, an industry research body, ACARP, was formed in 1992. This body was originally a government initiative and its structure evolved over time to become purely industry led. This model raises many millions of dollars per year and focusses upon key industry research priorities identified via industry forum. The power of this model is in the people that run the research programme, its continued relevance to the industry and its international industry credibility. This model should also be seriously considered as an option for the Australian oil and gas industry research funding model however, the oil and gas industry is slightly different with respect to the number of producers compared to black coal mining activity.

In Australia, the offshore oil and gas industry is heavily regulated and there are numerous regulations and laws that must be considered when performing oil and gas activities. Any industry research funding model will have to negotiate these regulations effectively for compliance of research projects with respect to operations, governance, sustainability and so-on. When developing collaborative joint venture projects, issues such as compliance with Australian Competition and Consumer Commission rules will also have to be considered.

The business case for a centralised industry research funding model operated by an industry growth centre such as NERA is compelling. Such a model and centre would allow companies and research organisations to pool their research capability into one centralised repository where past knowledge and experience can be brought together and leveraged to improve present and future research outcomes. The industry research funding model could focus on priority areas identified by the

industry, government and community. Because of this forum, silos of information can be prevented and project risk and results can be shared amongst many stakeholders. The benefit will be increased leveraging of research funding and capability from shared projects. Specific research within individual companies that applies to their specific operations or region can also be performed within the model, or internally within each company as required.

The initial research question, "*Does the industry understand, and government realise, the need for such a centralised industry research funding model?", remains unanswered.* A key factor to success in developing an industry research funding model is to engage the key stakeholders in industry via a staged industry research model socialisation plan. Such a plan requires clear objectives and milestones to commence positive engagement with key industry stakeholders. This should be approached systematically, via stages, with sufficient flexibility in the process to include all stakeholders who will be affected by any new industry research funding model. The process of developing a new industry research funding model and engagement of stakeholders should continue as a matter of urgency.

Acknowledgement

The project team would like to acknowledge the input provided by existing IRFM entities that provided open and extremely valuable background on the establishment and management of industry research funding models.

Next Steps

It is recommended that the industry and government develop a centralised industry research funding model as soon as possible.

Industry engagement should be undertaken strategically.

NERA should build upon this white paper and lead this initiative under a dedicated Industry Research Funding Model development project during the remainder of 2017 and 2018.

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References

1. Pigram, C., *Minerals and petroleum, a guide for investors.* 2015, Canberra: Commonwealth of Australia (Geoscience Australia) 2015.
2. Anon. *Oil*. 2017 [cited 2017 08/05/2017]; Available from: http://www.ga.gov.au/scientific-topics/energy/resources/petroleum-resources/oil.
3. Gibbons, M., et al., *Resource and Energy Quarterly*. 2016, Australia: Department of Industry, Innovation and Science.
4. Hatt, M., et al., *Resources and energy quarterly March 2017*. 2017, Office of the Chief Economist.
5. NERA, *National Energy Resources Australia - Sector Competitiveness Plan 2017*. 2017, Australian Resources Research Centre: Australia.
6. Brundtland, G.H., *Report of the World Commission on Environment and Development: Our Common Future*. 1987: Oslo, Norway.
7. Wood, S.I., *UKCS Maximising Recovery Review: Final Report*. 2014.
8. Anon. *NERC - Centre for Doctroral Training in Oil and Gas*. 2017 [cited 2017 24/04/2017]; Available from: http://www.nerc.ac.uk/funding/available/postgrad/focused/cdt/oilgas/.
9. Anon. *Research Council of Norway*. 2017 [cited 2017 27/04/2017]; Available from: http://www.forskningsradet.no/en/Nordic_research_funding/1253987573972.
10. Anon. *OGIC - Oil and gas Innovation Centre*. 2017 [cited 2017 27/04/2017]; Available from: http://www.ogic.co.uk/who-what-is-ogic/.
11. Anon. *OGRC - Oil and gas Research Fund*. 2017 [cited 2017 27/04/2017]; Available from: http://www.nd.gov/ndic/ogrp-infopage.htm.
12. Catapult, *Technology and innovation centres. Closing the gap between concept and commercialisation*. 2011: United Kingdom.
13. ITF. *Innovation Technology Facilitator*. 2017 [cited 2017 04/07/2017]; Available from: http://www.itfenergy.com/.
14. NDIC. *North Dakota Industrial Commission Oil and Gas Research Program*. 2017 [cited 2017 04/07/2017]; Available from: https://www.dmr.nd.gov/ogr/.
15. Anon. *Defence Innovation Hub*. 2017 [cited 2017 18/04/2017]; Available from: https://www.business.gov.au/Centre-for-Defence-Industry-Capability/Defence-Innovation-Portal/Frequently-Asked-Questions#hub.
16. Anon, *The Oil & Gas Technology Centre.* 2017.
17. ARC. *ARC Linkage Program*. 2017; Available from: http://www.arc.gov.au/linkage-program.
18. Murray, C.K., *Review of the Petroleum Resource Rent Tax (PRRT)* 2017, The Treasury: Australia.
19. PIP. *Petroleum Infrastructure Programme*. 2017 [cited 2017 04/07/2017]; Available from: http://www.pip.ie/page/1.
20. ACARP. *Australian Coal Association Research Program*. 2017 [cited 2017 07/04/2017]; Website of ACARP]. Available from: http://www.acarp.com.au/index.aspx.
21. AMIRA. *AMIRA International*. 2017 [cited 2017 07/04/2017]; Available from: http://www.amira.com.au/.
22. Anon. *Lloyds Register Foundation*. 2017 [cited 2017 28/04/2017]; Available from: http://www.lrfoundation.org.uk/.
23. CSPL. *Health and Safety Trust*. 2017 [cited 2017 07/04/2017]; Available from: http://www.hstrust.com.au/.
24. Anon. *Schlumberger Foundation*. 2017; Available from: http://www.slb.com/about/foundation/about_foundation.aspx.
25. Anon. *MRIWA – Mining Research Institute of Western Australia*. 2017 [cited 2017 27/04/2017]; Available from: http://www.mriwa.wa.gov.au/.

26. ASX, *Principles of Good Corporate Governance*. 2010: ASX Corporate Governance Council.
27. Anon. *Cooperative Research Centres*. 2017 [cited 2017 01/05/2017]; Available from: https://www.business.gov.au/assistance/cooperative-research-centres-programme.
28. Anon. *CRC Coperative reseaerch Centres*. 2017 [cited 2017 02/05/2017]; Available from: https://www.business.gov.au/assistance/cooperative-research-centres-programme.
29. Anon. *Deep Exploration Technologies CRC* 2017 [cited 2017 02/05/2017]; Available from: http://detcrc.com.au/.
30. Anon. *Australian Government Department of Industry and Innovation and Science*. 2017 [cited 2017 10/04/2017]; Offshore Petroleum Legislation]. Available from: https://industry.gov.au/resource/UpstreamPetroleum/OffshorePetroleumRegulatoryRegime/Pages/OffshorePetroleumLegislationRegulationandGuidelines.aspx.
31. Anon. *Australian Petroleum Production & Exploration Association (APPEA)*. 2017 [cited 2017 04/05/2017]; Available from: https://www.appea.com.au/about-appea/.
32. NOPTA. *National Offshore Petroleum Ttitles Administrator*. 2017 [cited 2017 10/04/2017]; Available from: http://www.nopta.gov.au/forms/forms.html.
33. NOPSEMA. *National Offshore Petroleum Safety and Environmental Management Authority*. 2017 [cited 2017 10/04/2017]; Available from: https://www.nopsema.gov.au/.
34. Anon. *Australian Competitiion & Consumer Commission*. 2017 [cited 2017 04/05/2017]; Available from: https://www.accc.gov.au/business/anti-competitive-behaviour/cartels.
35. NEATS. *National Electronic Approvals Tracking System (NEATS)*. 2017 01/03/2017 [cited 2017 27/06/2017]; Data relating to holders of Offshore Petroleum Titles.]. Available from: http://www.nopta.gov.au/neats.html.
36. Anon. *Invest in the West - Oil and Gas Titles in Western Australia*. 2017 [cited 2017 05/05/2017]; Available from: http://www.dsd.wa.gov.au/docs/default-source/default-document-library/invest-in-the-west---oil-and-gas-titles-in-western-australia-0315?sfvrsn=11.
37. Anon. *National Electronic Approvals Tracking System*. 2017 [cited 2017 05/05/2017]; Available from: http://www.nopta.gov.au/neats.html.
38. GRP. *Gulf Research Program*. 2017 07/04/2017]; Available from: http://www.nationalacademies.org/gulf/about/index.html.

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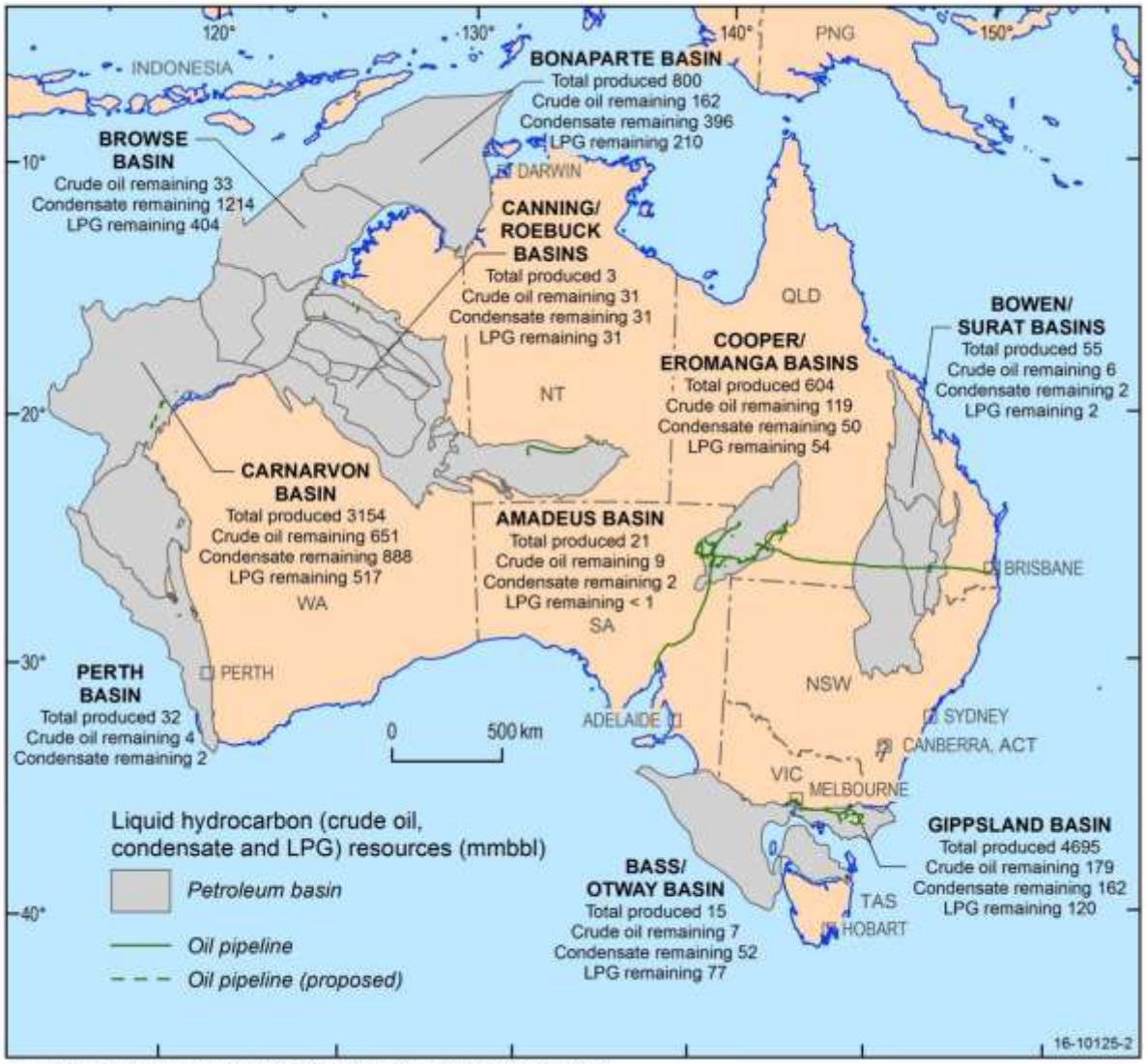


Source: Geoscience Australia, Encom GPinfo, a Pitney Bowes Software (PBS) Pty Ltd.
Whilst all care is taken in the compilation of the petroleum pipelines by PBS, no warranty is provided re the accuracy or completeness of the information, and it is the responsibility of the Customer to ensure, by independent means, that those parts of the information used by it are correct before any reliance is placed on them.

Figure 1. Shows the extent of Australia's oil and gas fields and basins (After Geoscience Australia[2]).

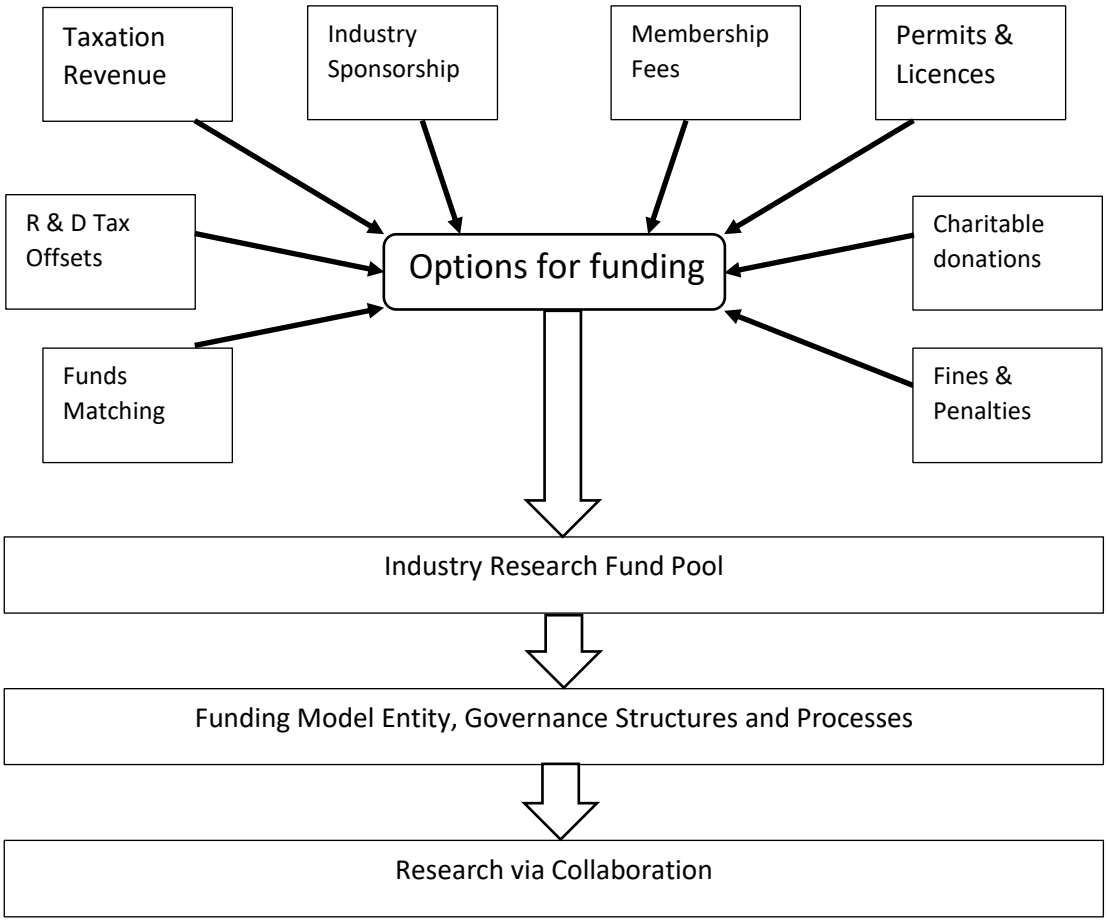


Figure 2. Generic industry research funding model showing alternative funding sources.

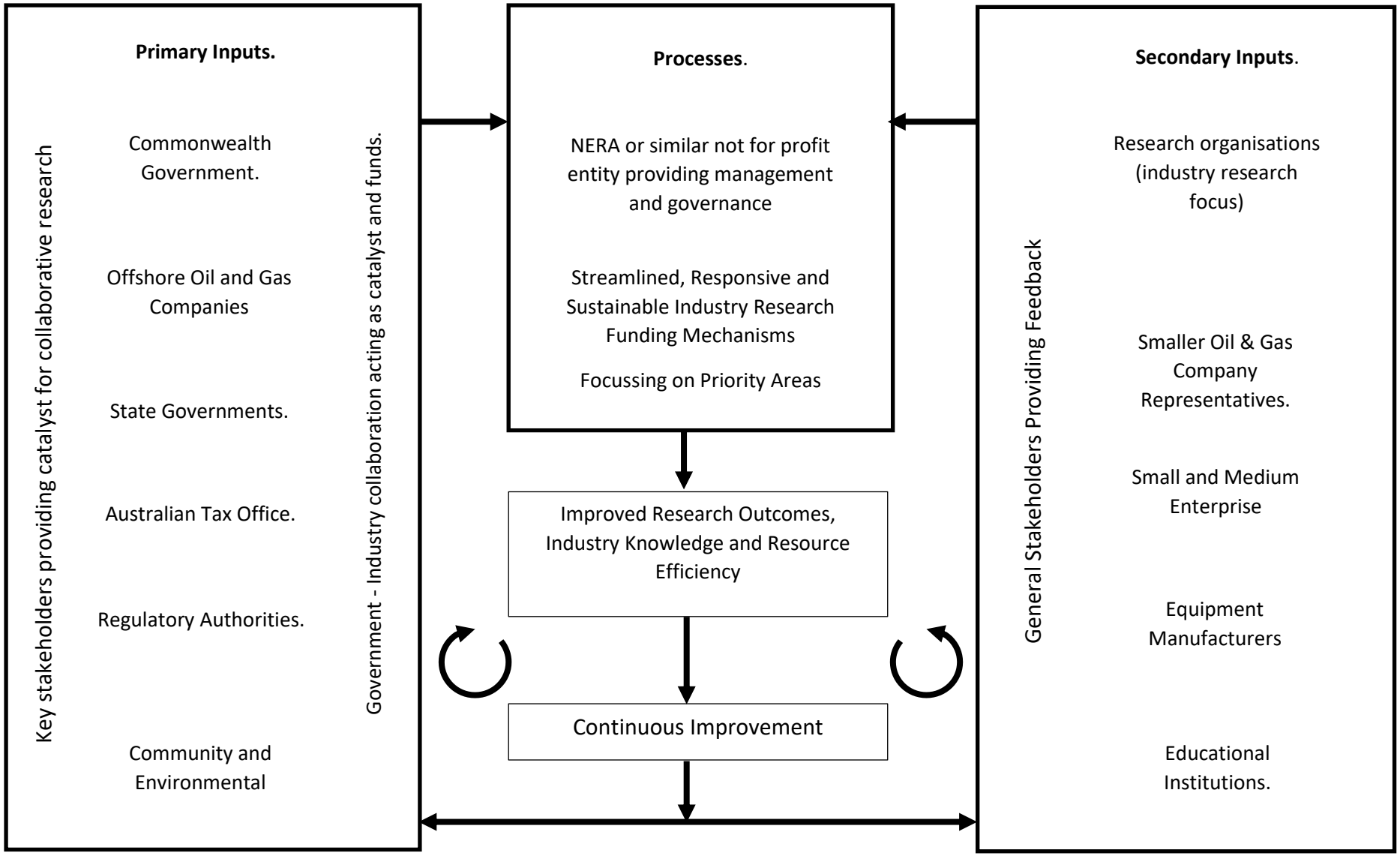


Figure 3. Example framework and governance process for an Industry Research Funding Model.

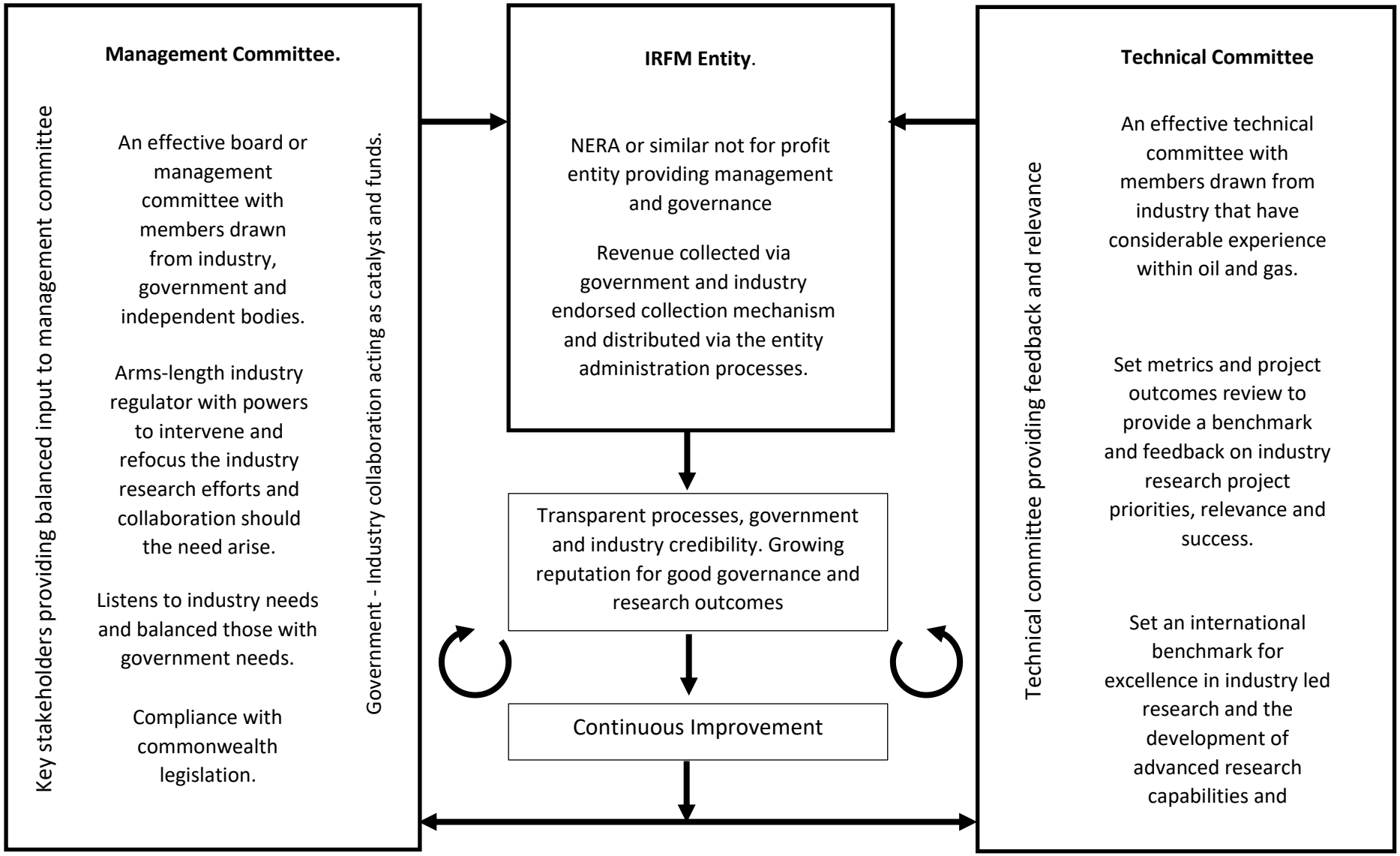


Figure 4. Example Governance Structure.

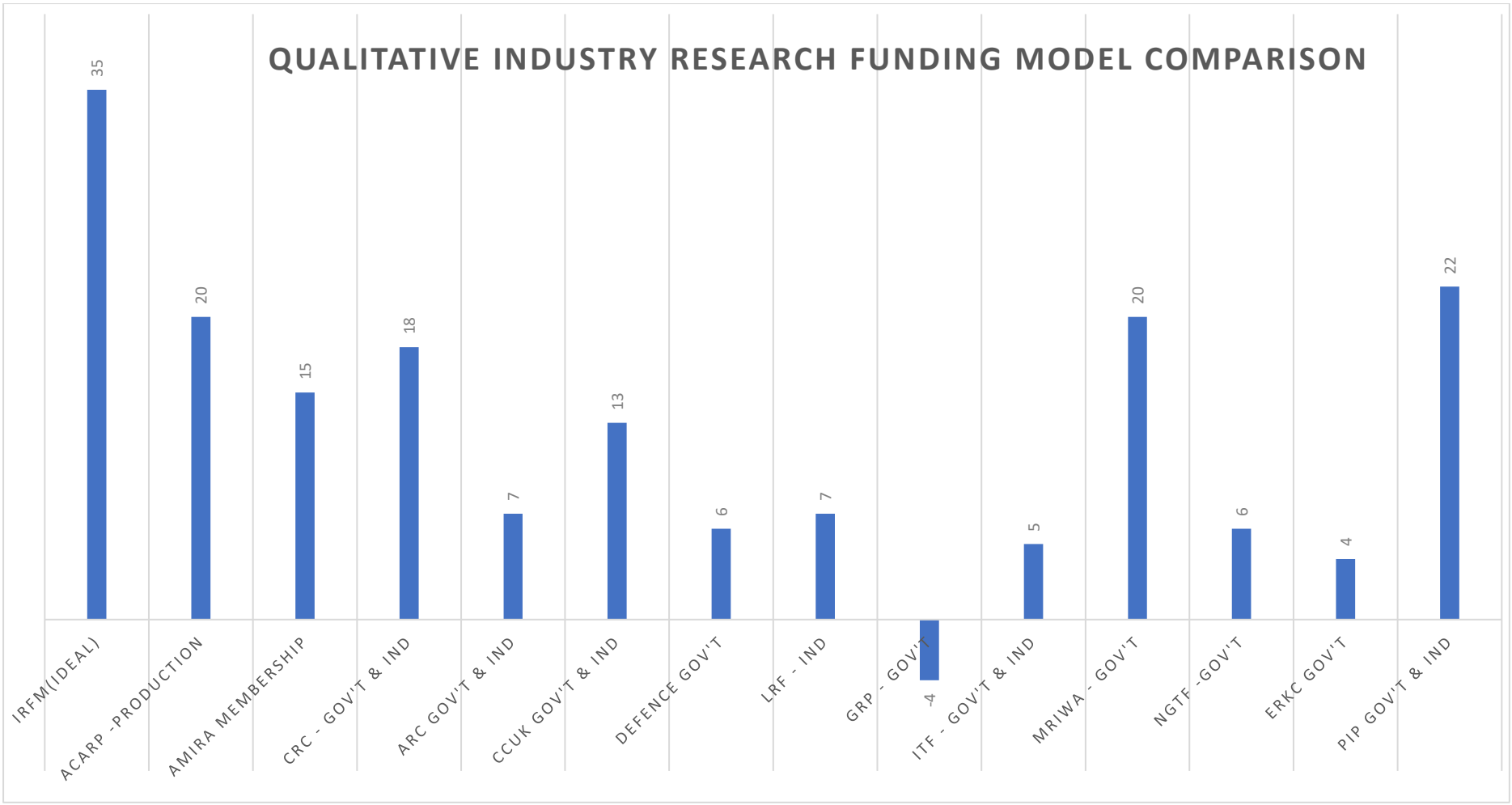
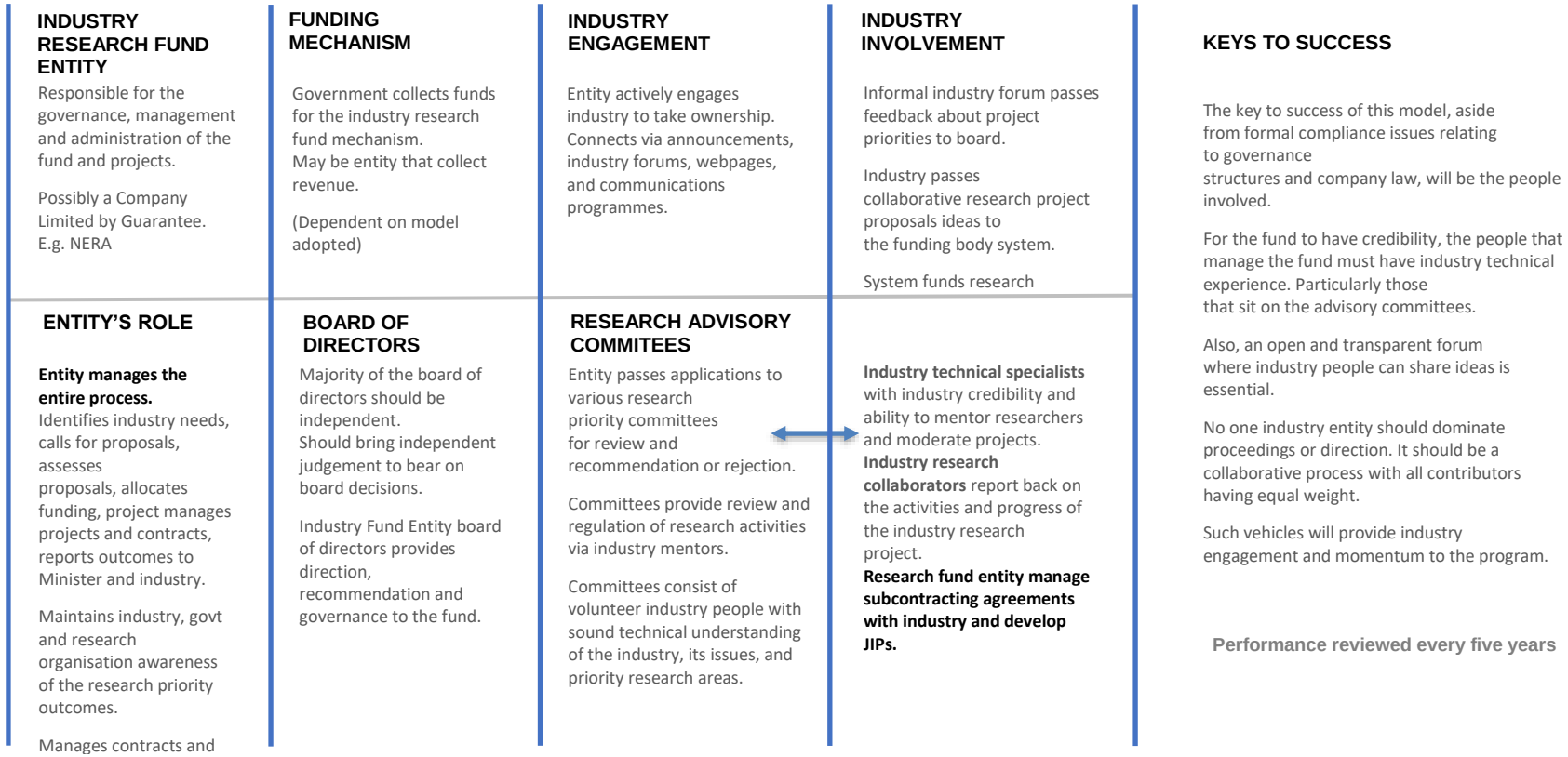


Figure 5. Qualitative comparison of industry research funding models and entities.



Note: Please refer to separate summary document "Research Funding Model Classification" for more information (Appendix E).

Figure 6. Common Industry Research Funding Model attributes.

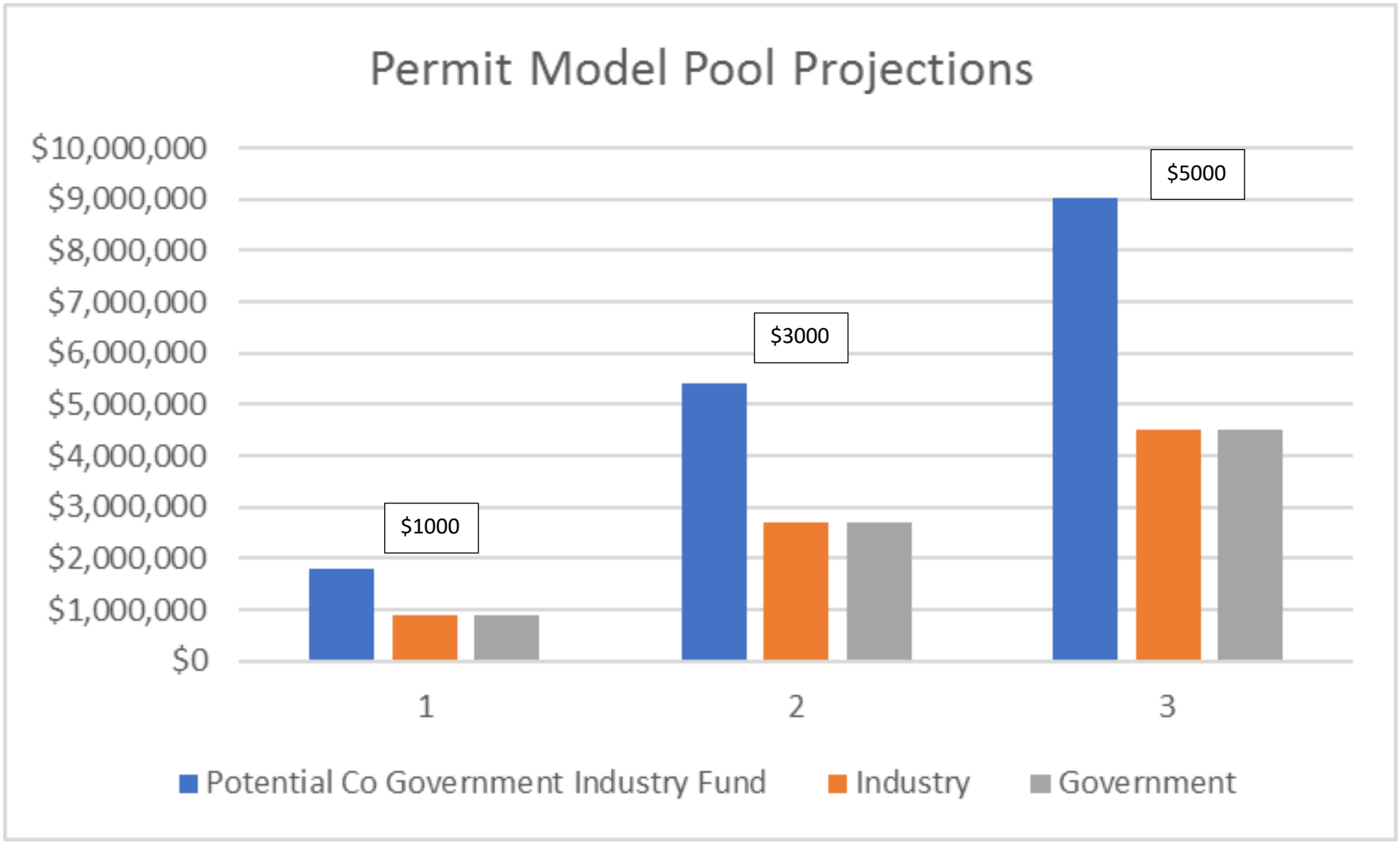
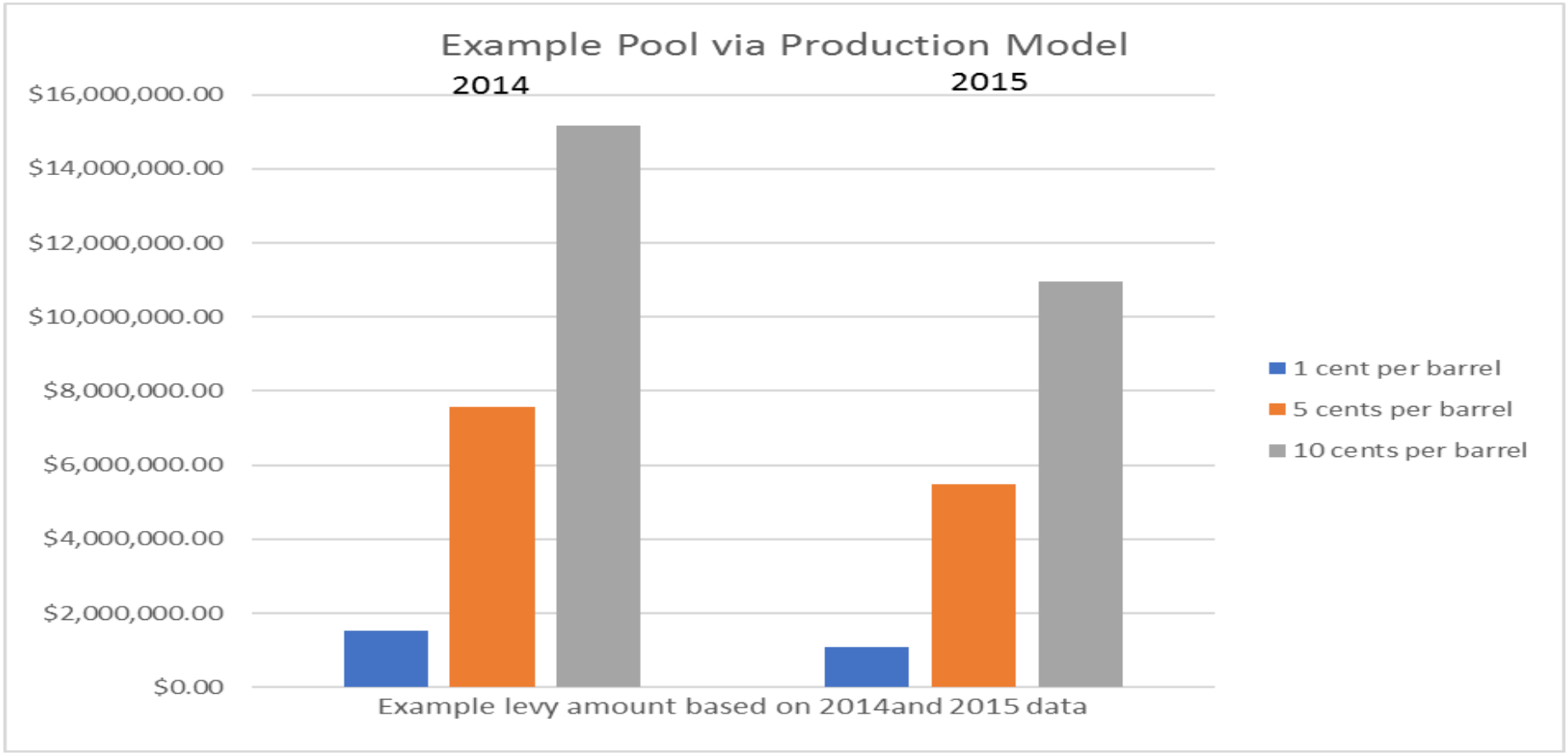


Figure 7. Demonstration of the potential funding pool via the permit model $1k, $3k and $5k based on approximately 880 contributors.



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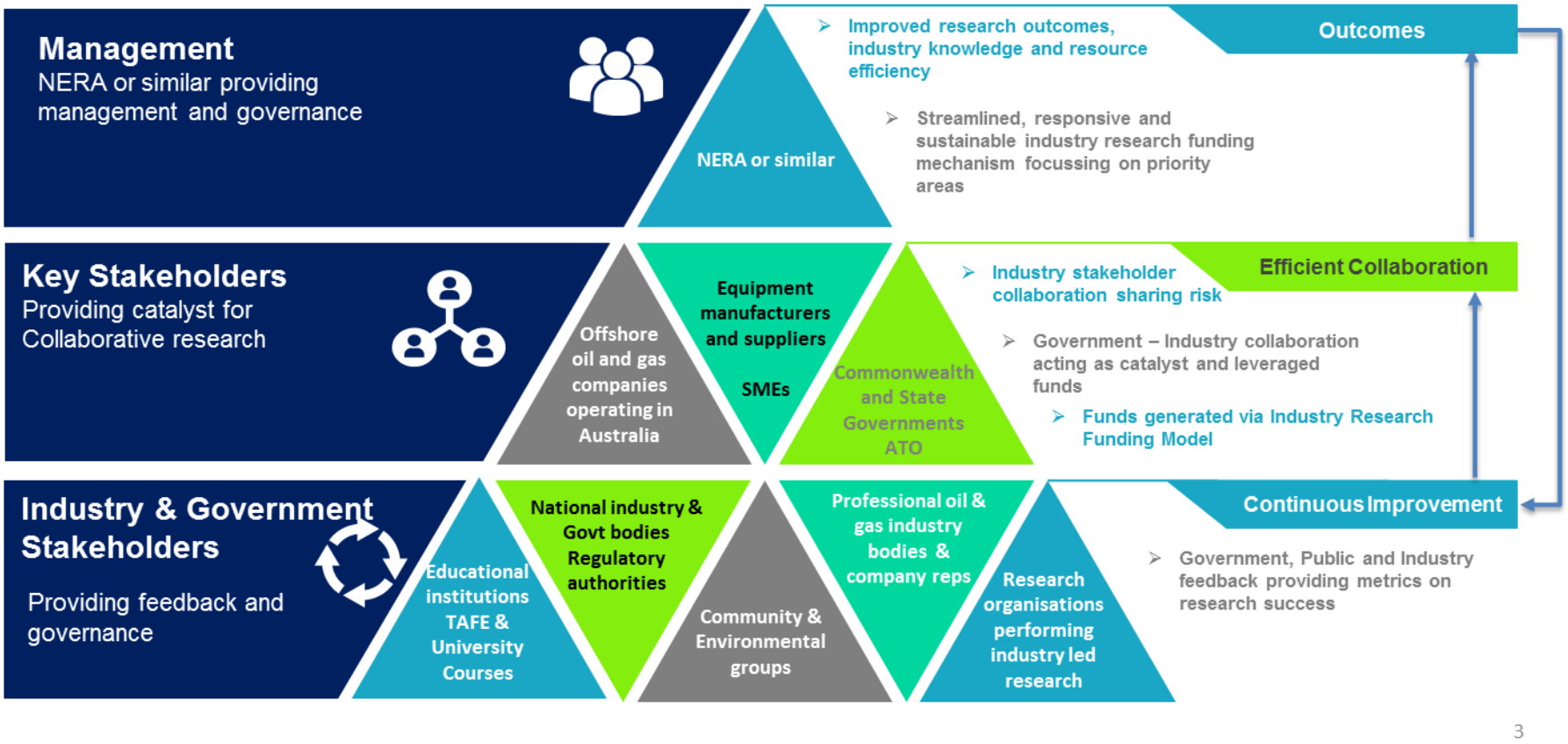

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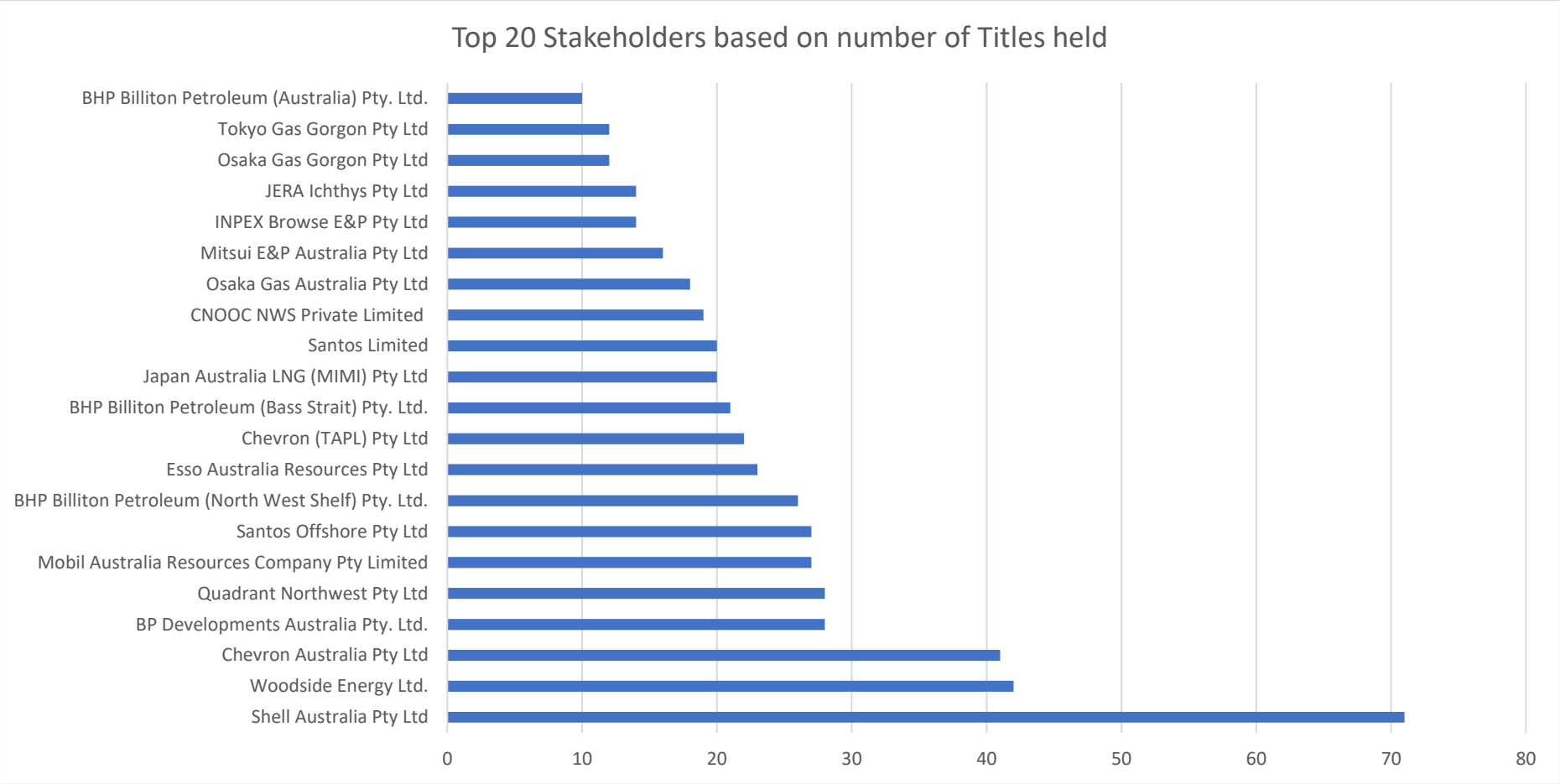


Figure 10. Top twenty oil and gas company stakeholders by number of Titles held (Data after NEATS [35]).

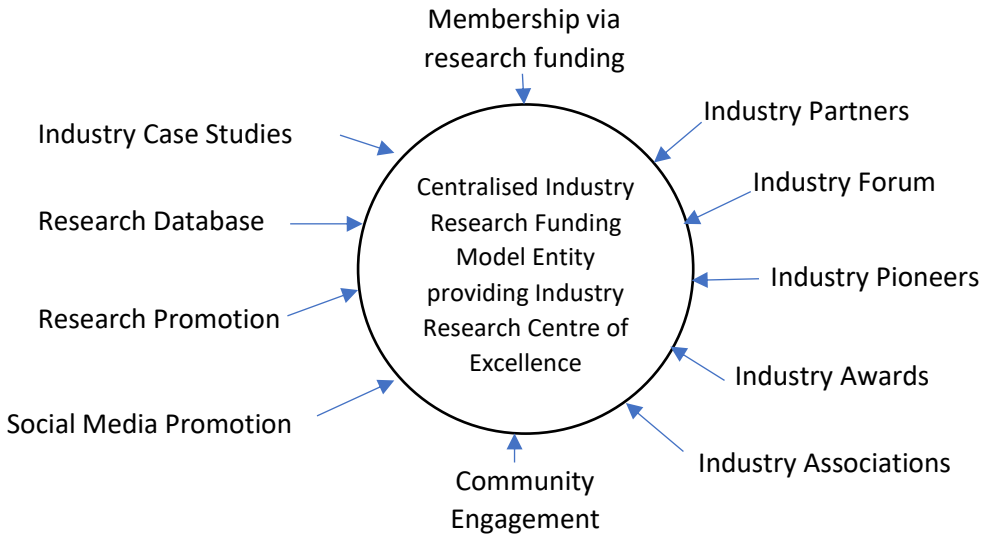
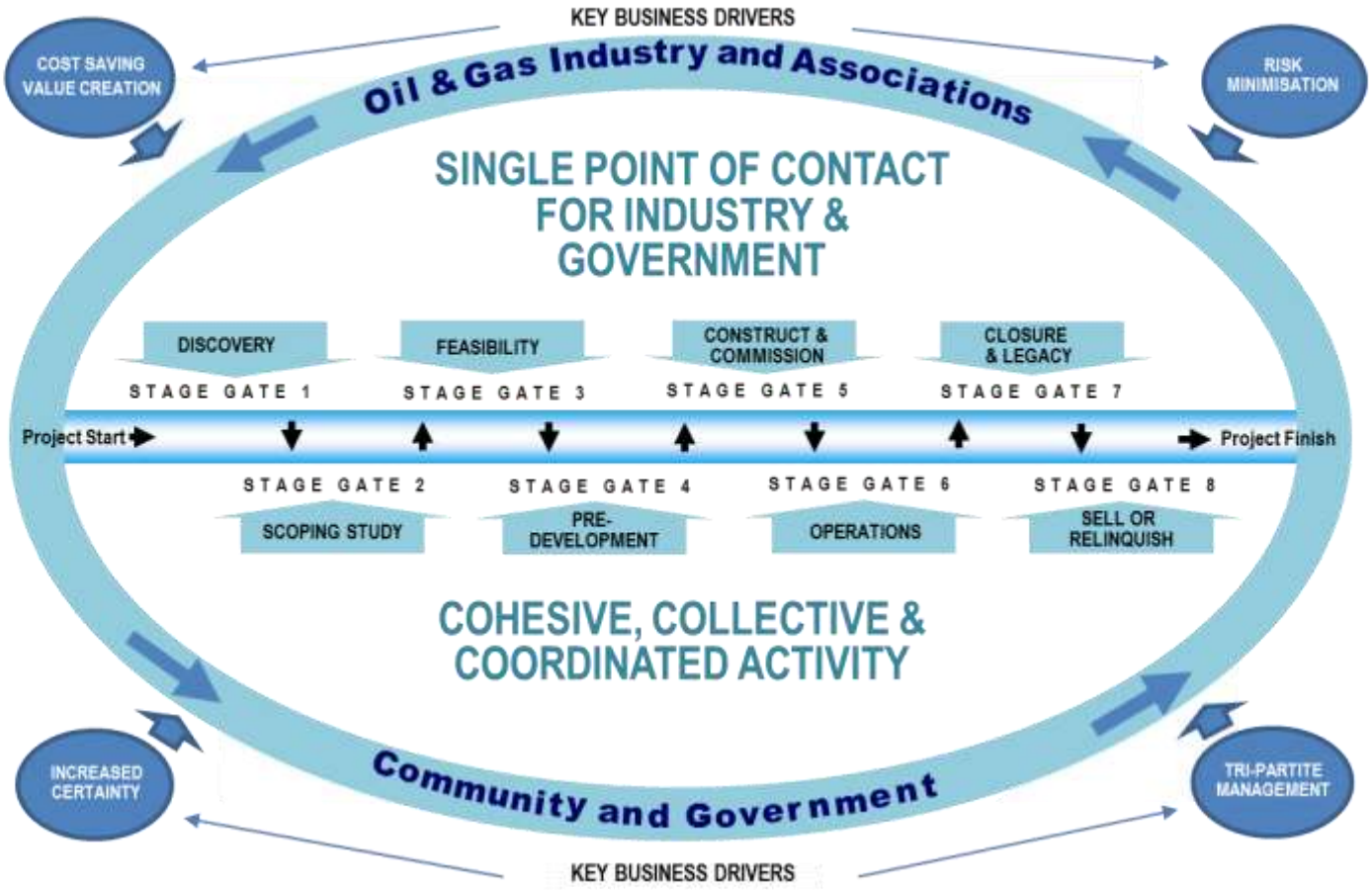


Figure 11. Long term stakeholder management activities of a centralised industry research body.



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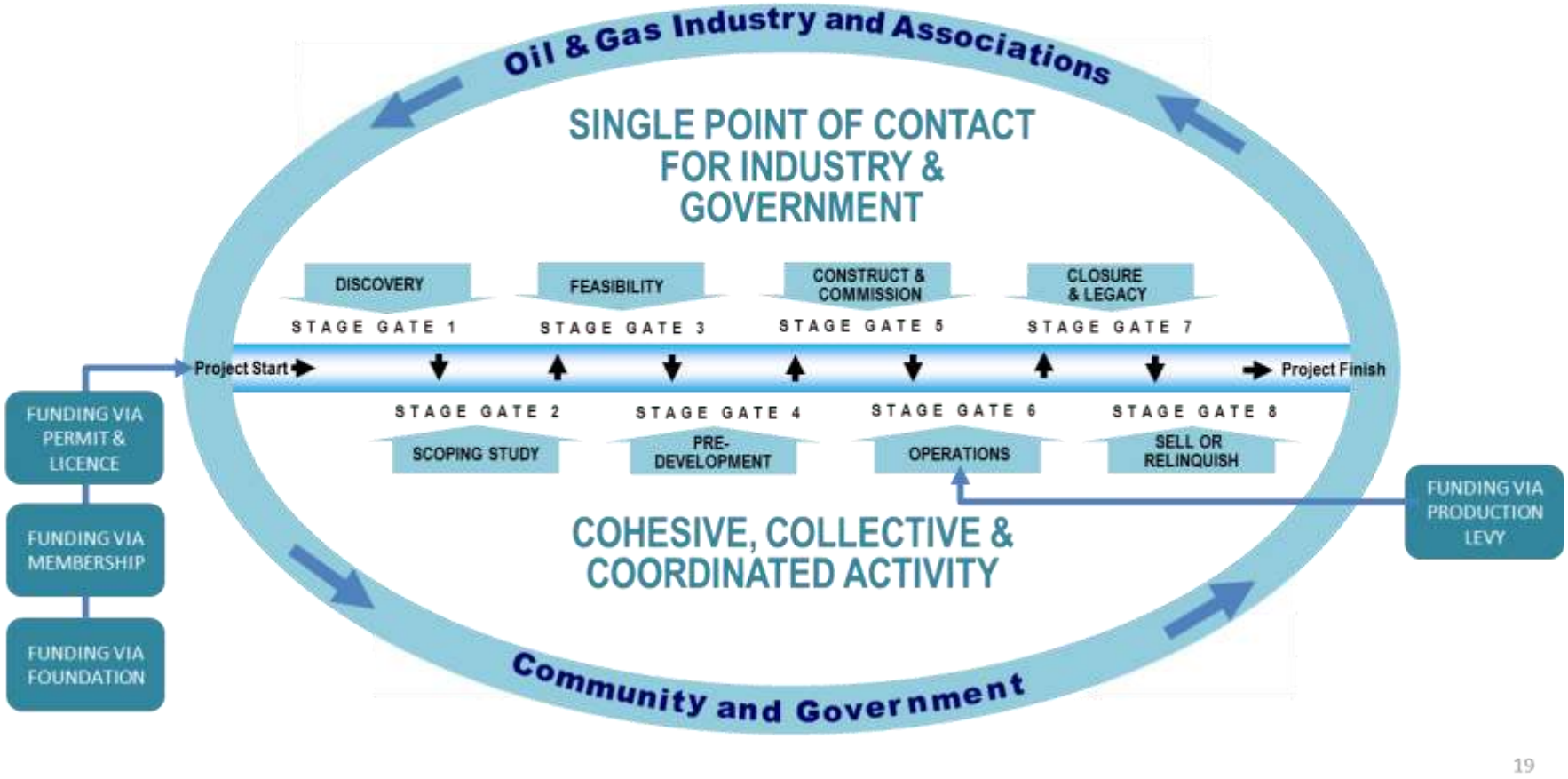


Figure 13. Location off Industry Research Funding Model opportunities on the oil and gas life cycle.

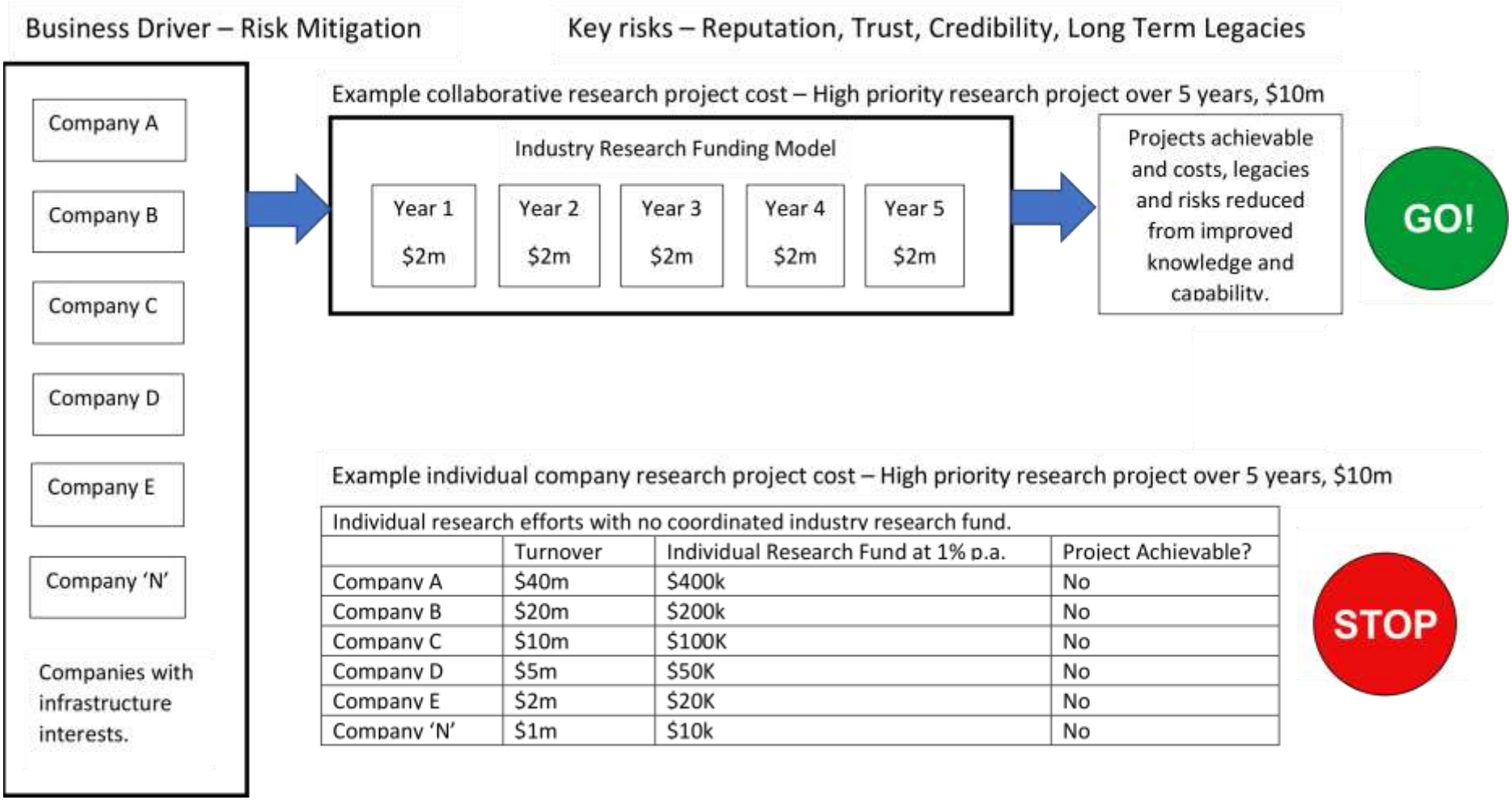


Figure 14. A simplified demonstration of the business case for an IRFM. Coordinated collaborative projects have more leverage.

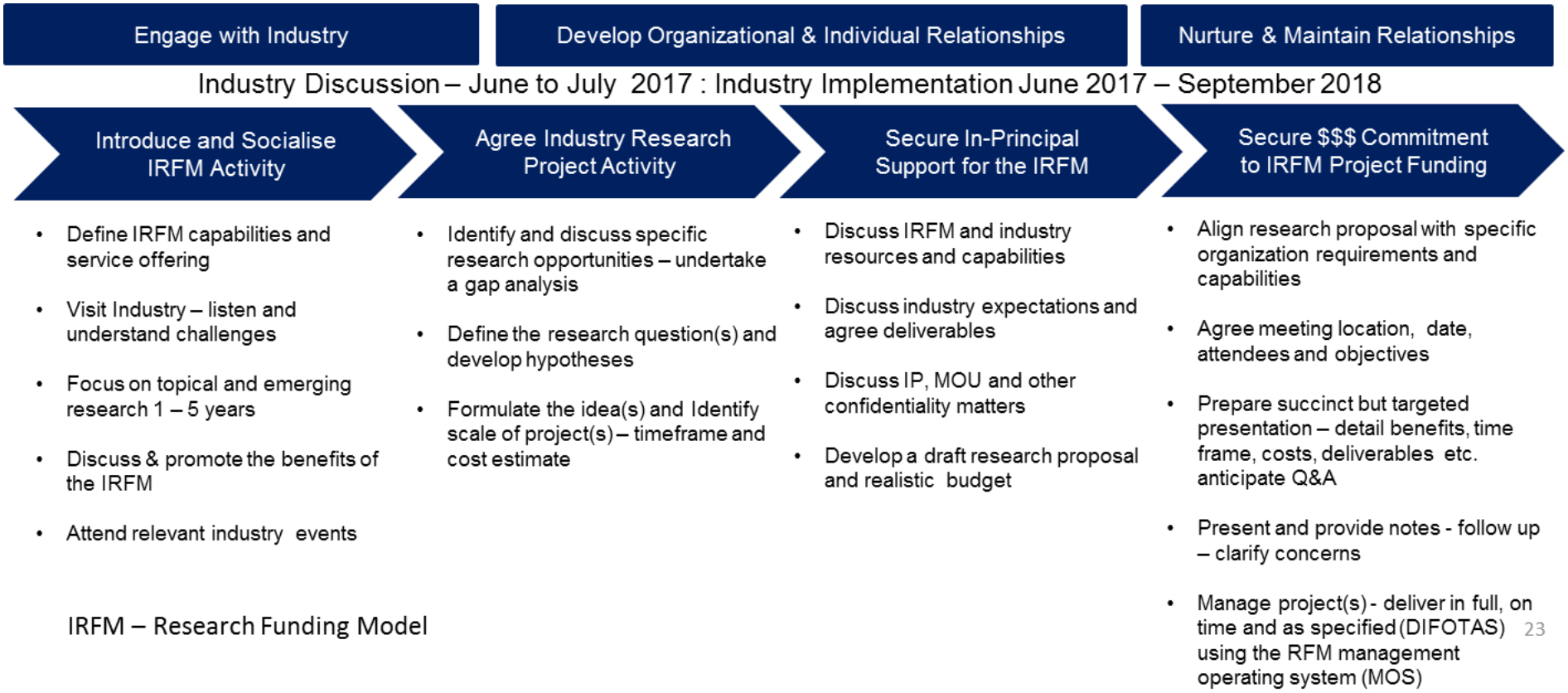


Figure 15. Socialising the Industry Research Funding Model.

List of Tables.

Table 1. Research questions posed to identify IRFM location, catalyst and criteria.

Table 2. Project objectives.

Perform desk based study to identify funding models, stakeholders, governance structures, law and business case studies.
Develop set of stake holder questions for ongoing interview processes. Local interviews with industry stakeholders. Phone interviews with remote stakeholders and experienced industry research fund managers.
Identify common and unique criteria that are applied to each funding model.
Identify current international and domestic research funding models for oil and gas.
Identify current international and domestic funding models for similar industries.
Identify the common and unique criteria that are applied to each funding model
Identify common and unique criteria that are applied to each governance model.
Consider the implications of State and Federal laws with respect to application of existing and proposed funding models.
Develop the business case for adopting the chosen oil and gas industry funding models or the preferred alternative resulting from the research.
Develop the administration models for oil and gas industry funding models.
Bring together the data into a formal structured report.
Produce and deliver the White paper as a structured report and an executive summary outlining the key points of the project and its findings.

Table 3. Project activities.

Funding model type	General principle to generate a research funding pool
Foundation - Charity	Industry funds research from some percentage of its annual revenue as a charity.
Foundation – Revenue	Industry funds research from some percentage of its annual revenue from investments.
Government - Co-funding	Government and industry fund research via funds matching.
Government - Production	Government applies a levy to industry.
Government - Taxation	Government funds research entirely from general taxation and royalties.
Government – Fines and Penalties	Government funds research entirely from penalties and fines.
Government – Permits and Licences	Government funds research entirely from permits and licences.
Government - Tax Offset	Industry funds research via some tax offset mechanism from government.
Industry - Internal	Industry funds research entirely from own budget.
Industry – External Collaborative	Industry funds research from membership fees and project sponsorship.
Industry – External	Industry funds research from membership fees.

Table 4. Common Industry Research Funding Models.

Entity	Funding model type used	Location
ACARP [20] (Australian Coal Association Research Program)	Government - Production.	Australia
AMIRA International [21]	Membership and Project Sponsorship.	Australia
ARC Linkage [17] (Australia Research Council)	Government – Industry Co-funding.	Australia
Catapult Centres [12]	Government – Industry – Public Sector Co-funding.	United Kingdom
Defence Innovation Hub [15]	Government - Taxation	Australia
Lloyds Register [22]	Foundation – Investments	United Kingdom
Gulf Research Program [38]	Government – Fines and Penalties	United States
Industry Technology Facilitator [13]	Industry - Membership	Brazil, United Kingdom, Australia
MRIWA – (Mining Research Institute of Western Australia)[25]	Government – Industry Co-funding	Australia
NERC – Centre for Doctoral Training in Oil and Gas[8]	Government – Industry Co-funding	United Kingdom
NGTF (Next Generation Technologies Fund)	Government - Taxation	United Kingdom
OGRP (Oil and Gas Research Council)[11]	Government - Production	United States
Oil and Gas Innovation Centre[10]	Government – Industry Co-funding	United Kingdom
PIP – (Petroleum Infrastructure Programme) [19]	Government – Permits and Licencing	Ireland
Research Council of Norway[9]	Government	Norway
Schlumberger Foundation	Foundation – Investments	Global

Table 5. Example Industry Research Fund Entities.

Principle 1: Lay solid foundations for management oversight.
Principle 2: Structure the board to add value.
Principle 3: Promote ethical and responsible decision making.
Principle 4: Safeguard integrity in financial reporting.
Principle 5: Make timely and balanced disclosure.
Principle 6: Respect the rights of shareholders.
Principle 7: Recognise and manage risk.
Principle 8: Remunerate fairly and responsibly.

Table 6. Good corporate governance principles (After ASX Corporate Governance Council [26].

Criteria	Criteria Description
Collaboration	Continued Research Organisation Involvement
	Centralised Research Database Providing a Single Coordinated Point of Contact
	Accessible to many simultaneous stakeholders
	Joint venture oriented
	Able to bring together complimentary skill sets
Financial	Model funding type defined
	Funds Matching Ratio %, Industry, %Government, %Research Organisation (Excluding R&D Tax Offset)
	Fully Funded
	Sustainable Funding independent of production
	Funds Collection from Companies
Governance	Project Outcomes Governance
	Identifies Industry Priorities
	Measurable improved industry research outcomes
	Established via Act of Parliament/ Government
	Australian Government Endorsed
	Provides open industry forum
	Active Research Commercialisation
	Organisation Governance via Industry Board
	Provision of Project Deliverables Oversight Over other
Industry Credibility	Management via 'Hands On' Technical Advisory Committee
	Industry Project Focus
	Clear Oil and Gas Industry Research Priorities
	Project Moderation / Mentoring
	Close Industry Liaison
	High-level of technical ability within advisory committee and board
	Used by Oil and Gas Industry
	Successfully applied to another Industry

	Coordinated Industry Led Researchers
Management	Project Administration
	Provides Call for Research Proposals
	Standard Contract Management
	Project Cycle and Delivery always 12 months or less
	Research Marketing & Promotion
Sustainability	Year of Operation
	Addresses Industry Sustainability via PhD Sponsorship
	Continued Government Involvement via direct funding
	Potential Pool Value ($ millions) p.a.
	Sustainable example in existence in Australia

Table 7. Common criteria found in the various Industry Research Funding Models.

Offshore Petroleum Legislation	
Offshore Petroleum and Greenhouse Gas Storage Act 2006	Petroleum Resource Rent Tax Act 1987
Offshore Petroleum (Royalty) Act 2006	Petroleum Resource Rent Tax Assessment Act 1987
Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Act 2003	Petroleum Resource Rent Tax Assessment Act 1987
Offshore Petroleum and Greenhouse Gas Storage (Registration Fees) Act 2006	Petroleum Resource Rent Tax (Interest on Underpayments) Act 1987
Offshore Petroleum (Repeals and Consequential Amendments) Act 2006	Petroleum Revenue Act 1985
Petroleum (Timor Sea Treaty) Act 2003	Petroleum Excise (Prices) Act 1987
Petroleum (Timor Sea Treaty) (Consequential Amendments) Act 2003	Petroleum (Submerged Lands) Amendment Act 2003
Offshore Petroleum Amendment (Greater Sunrise) Act 2007	Petroleum (Submerged Lands) Legislation Amendment Act 2001
Greater Sunrise Unitisation Agreement Implementation Act 2004	
Offshore Petroleum Regulations	
Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009	Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Regulations 2004
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011	Offshore Petroleum and Greenhouse Gas Storage (Registration Fees) Regulations 1990
Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009	
State and Territory Coastal Waters Legislation	
Petroleum (Offshore) Act 1982—New South Wales	Petroleum (Submerged Lands) Act 1982—Tasmania
Petroleum (Submerged Lands) Act 1981—Northern Territory	Offshore Petroleum and Greenhouse Gas Storage Act 2010—Victoria
Petroleum (Submerged Lands) Act 1982—Queensland	Petroleum (Submerged Lands) Act 1982—Western Australia
Petroleum (Submerged Lands) Act 1982—South Australia	Petroleum (Submerged Lands) Regulations 1990—Western Australia

Table 8: Summary list of legislation and regulations that apply in Australian offshore waters.

Example Titles Fee Amount		7500				
Contribution to the Research Fund Pool		5000				
Contribution Mechanism	Extra contribution	Industry pays government	Government receives	Government pays pool	Remaining government fee	
Business as usual	0	7500	7500	0	7500	No fund
Additional contribution by industry only	5000	12500	12500	5000	7500	Industry only
Contribution by government only from existing fee	5000	7500	7500	5000	2500	Government only
Additional combined industry government contribution	10000	12500	12500	10000	2500	Co Industry Government

Table 9. Options for revenue generation via the permit model $5K example.

Title Holder	Number of Titles
Shell Australia Pty Ltd	71
Woodside Energy Ltd.	42
Chevron Australia Pty Ltd	41
BP Developments Australia Pty. Ltd.	28
Quadrant Northwest Pty Ltd	28
Mobil Australia Resources Company Pty Limited	27
Santos Offshore Pty Ltd	27
BHP Billiton Petroleum (North West Shelf) Pty. Ltd.	26
Esso Australia Resources Pty Ltd	23
Chevron (TAPL) Pty Ltd	22
BHP Billiton Petroleum (Bass Strait) Pty. Ltd.	21
Japan Australia LNG (MIMI) Pty Ltd	20
Santos Limited	20
CNOOC NWS Private Limited	19
Osaka Gas Australia Pty Ltd	18
Mitsui E&P Australia Pty Ltd	16
INPEX Browse E&P Pty Ltd	14
JERA Ichthys Pty Ltd	14
Osaka Gas Gorgon Pty Ltd	12
Tokyo Gas Gorgon Pty Ltd	12
BHP Billiton Petroleum (Australia) Pty. Ltd.	10

Table 10a. Top twenty industry stakeholders as Title Holders (Data after NEATS 2017[35]).

Operator	Number of Titles where involved as an Operator
Woodside Energy Ltd.	173
Chevron Australia Pty Ltd	121
Quadrant Northwest Pty Ltd	54
Esso Australia Resources Pty Ltd	48
Origin Energy Resources Ltd	45
Santos Offshore Pty Ltd	31
Santos Limited	30
Woodside Browse Pty. Ltd.	27
Shell Australia Pty Ltd	23
Eni Australia Limited	18
INPEX Ichthys Pty Ltd	16
INPEX Browse E&P Pty Ltd	15
Engie Bonaparte Pty Ltd	14
Santos Browse Pty Ltd	13
Chevron Australia (WA-374-P) Pty Ltd	12
Quadrant Oil Australia Pty Limited	12
Cornea Resources Pty Ltd	9
Basin Oil Pty Ltd	8
Chevron Australia (WA-365-P) Pty Ltd	8
PTTEP Australasia (Ashmore Cartier) Pty Ltd	8
Chevron Australia (WA-364-P) Pty Ltd	6

Table 10b. Top twenty industry stakeholders as Operators (Data after NEATS 2017[35]).

Title Holder	Number of Titles	Titles held as percentage of Titleholders. (%)
Shell Australia Pty Ltd	71	36.04
Woodside Energy Ltd.	42	21.31
Chevron Australia Pty Ltd	41	20.81
BP Developments Australia Pty. Ltd.	28	14.21
Quadrant Northwest Pty Ltd	28	14.21
Mobil Australia Resources Company Pty Limited	27	13.70
Santos Offshore Pty Ltd	27	13.70
BHP Billiton Petroleum (North West Shelf) Pty. Ltd.	26	13.19
Esso Australia Resources Pty Ltd	23	11.67
Chevron (TAPL) Pty Ltd	22	11.16
BHP Billiton Petroleum (Bass Strait) Pty. Ltd.	21	10.65
Japan Australia LNG (MIMI) Pty Ltd	20	10.15
Santos Limited	20	10.15
CNOOC NWS Private Limited	19	9.64
Osaka Gas Australia Pty Ltd	18	9.13
Mitsui E&P Australia Pty Ltd	16	8.12
INPEX Browse E&P Pty Ltd	14	7.10
JERA Ichthys Pty Ltd	14	7.10
Osaka Gas Gorgon Pty Ltd	12	6.09
Tokyo Gas Gorgon Pty Ltd	12	6.09
BHP Billiton Petroleum (Australia) Pty. Ltd.	10	5.07

Table 10c. Number of Titles held as a percentage of Titleholders (Data after NEATS 2017[35]).

Appendix A: Project Objectives

Objective 1. Identify the various national and international industry research funding models which could be adopted (e.g. production model, permit model, per company model, emissions model, government co-investment, fisheries model, coal industry model, etc.) for the offshore oil and gas industry; including legal and regulatory requirements. For each model, identify how each funding model works (collection of funds, governance, government co-investment, regulatory framework).
Identify Industry Funding Models.
National.
International.
Regulatory requirements.
Legal requirements.
Impact of intellectual property.
Objective 2. Provide an assessment of these funding models; identifying pros and cons of each model (as applied to the offshore oil and gas industry).
Place the models in a matrix where possible to evaluate and determine a rank.
Pros.
Cons.
Hybrid model needed?
Sensitivity of the model?
Objective 3. Assess and rank each model, for implementation across the Australian offshore oil and gas industry.
Objective 4. Identify the needs of the Australian offshore oil and gas industry and assess those needs against the ranked models to see whether an Australian version can be applied and relevance.
Objective 5. Identify the governance structure which could be adopted for the funding model.
What is the governance structure of existing industry research funding models and how is it applied?
Governance by whom and how?
What is the application process, the assessment process the funding model and the monitoring systems in place to ensure outcomes benefit Australia and the funding bodies?
Assessment processes.
Application processes.
Monitoring for duplication.
Project monitoring and mentoring.
Collaboration between organisations to share research
Objective 6. Identify all potential key stakeholders who would be involved in the formulation, implementation and ongoing management of any oil and gas research fund.
Would the stakeholders change from project to project?
Who would be the stakeholders?
Indigenous groups and peoples.
Australian Government.
Oil & gas companies.
Research organisations.
Equipment suppliers.
Universities.
Countries adjacent to oils and gas resources?

Objective 7. Identify and document the key business drivers for the offshore oil and gas industry in developing a collaborative research fund. This should include examples (or issues) of where research funds could be used.
Improved knowledge and skills.
Improved technologies, process and outcomes from exploration, production methods and distribution activities.
Tax incentives.
Sustainability.
Via collaboration, business may improve their capabilities and credibility via collaboration.
Resource extraction efficiency and revenues
Improved safety
Percentage of taxes and royalties used for research and development outcomes.
Industry research funding model in more accessible place and research priorities clear to researchers and industry.
Provide a matrix of the key business drivers and show how they map to research outcomes.
Objective 8. Identify how the funding model could be administered.
How are other funding models administered?
What is the best method to evaluate these?
Develop a model funding model.
Administration via state government?
Administration via Federal government?
Administration via an independent organisation or entity?
What is the method for acquiring funds? e.g. Government provides some percentage, company provides some percentage, tax relief provides some other percentage?
Tabulation and analysis of data acquired from the literature review, interviews with industry personnel and industry researchers

Table 11. Project Objectives.

Appendix B. Other Industries Research Funding Models

The following links discuss various government and other body funding initiatives, discussion papers and PowerPoint presentations relating either to research funding, or of the need to involve and partner with key stakeholders and to be forward thinking in its outlook so that Australian (and other research institutions) may remain at the forefront of global research.

Gross Expenditure on Research and Development (GERD) is a core statistic of the national innovation system and the primary measure of financial input to the R&D system, aggregating business, government, higher education, and other expenditure in a national total.

Government allocates R&D funds into four broad categories. In 2011-12, the higher education sector will receive close to a third (29%) of the funding, the business sector 24%, the major Australian government research organisations, e.g. CSIRO, DSTO, ANSTO, AIMS, Geosciences Australia and AAD, receive 19%, and the remaining 28% is to activities that are accessed by more than one sector, i.e. multi-sector. About a third of the multisector category is NHMRC grants which predominantly go to universities and private non-profit MRIs.

Australia is ranked 15th of all countries. By comparison to the top 10 average, Australia has higher research intensity but is lower than the average across the (mostly rich, developed) OECD member nations. Australia also has higher GERD per capita population, higher percentage of GERD for basic research and higher percentage of GERD financed by industry.

In the 2009-10 Budget, the government announced that it would replace the existing R&D Tax Concession with a simplified tax incentive program. The intent of introducing the new R&D Tax Incentive is to:

- encourage more companies to undertake R&D activities; increase financial support to companies who conduct eligible R&D activities;
- provide support to companies who are in tax loss through cash refunds;
- redistribute support in favour of SMEs, which are more responsive to fiscal incentives;
- support all eligible R&D undertaken in Australia, regardless of where the intellectual property is owned;
- decouple the incentive from the company tax rate; and
- increase certainty through simpler and improved administrative processes.

Only links that add in some way to the body of research funding model knowledge are discussed below.

Research Funding – General weblinks:

1. http://www.collaborationforimpact.com/wp-content/uploads/2014/03/How-to-develop-a-funding-model.pdf
2. http://www.oecd.org/science/sci-tech/45710868.pdf
3. http://www.sirisacademic.com/wb/blog/the-project-based-funding-model-in-research-what-impact-on-contemporary-research-22/
4. http://www.ncoa.gov.au/report/appendix-vol-2/10-2-research-and-development.html
5. http://www.rand.org/content/dam/rand/pubs/research_reports/RR800/RR840/RAND_RR840.pdf
6. http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=6&ved=0ahUKEwjYio3OwcHTAhUHNJQKHdD9AlwQFghFMAU&url=http%3A%2F%2Fwww.aston.ac.uk%2FEasyS

iteWeb%2FGatewayLink.aspx%3FalId%3D223040&usg=AFQjCNHxYygFGmS1u5_Z-EGrLSvhGhj6zw

7. http://www.adelaide.edu.au/research-services/funding/international/docs/us-defence-research-agencies-informal-guide.pdf
8. https://www.cbr.cam.ac.uk/fileadmin/user_upload/centre-for-business-research/downloads/working-papers/wp396.pdf
9. http://www.bu.edu/research/articles/funding-for-scientific-research/
10. http://theconversation.com/is-it-time-for-a-new-model-to-fund-science-research-in-higher-education-63691
11. https://theconversation.com/only-by-keeping-close-ties-with-europe-can-uk-research-remain-globally-competitive-63358
12. http://ifris.org/wp-content/blogs.dir/1/files/2014/10/9.-SPP-July-2007-Theves.pdf
13. http://embor.embopress.org/content/early/2014/01/07/embr.201338068
14. http://www.smh.com.au/technology/sci-tech/how-australian-scientists-are-bending-the-rules-to-get-research-funding-20150409-1mhrbw.html
15. https://www.industry.gov.au/research/Documents/ReviewAdvicePaper.pdf

Aviation:

1. https://www.casa.gov.au/education/standard-page/research-grants-program
2. https://researchfunding.duke.edu/search-results?search_api_views_fulltext=aviation&opportunity_external_date=&opportunity_external_date_1=&opportunity_external_date_2=1&changed=&changed_1=&=Search
3. http://abaa.com.au/downloads/TAAAF-Aviation-Policy-Summary-2016.pdf

CAA (Civil Aviation Authority) Australian Government relating to Aviation Safety Research. Discussion regarding the need for a new Aviation Policy Partnership between Industry and Government. Also, the creation of an Aviation Future Fund that invests in capability and provides training, research support and coordination and the need for a new funding model for CASA that will drive greater efficiency, transparency and accountability and reduce appropriation spend.

Defence:

1. https://www.dst.defence.gov.au/sites/default/files/speeches_presentations/documents/AusBusDefIndustry.pdf
2. http://www.defence.gov.au/whitepaper/Docs/2016-Defence-Industry-Policy-Statement.pdf
3. https://www.business.gov.au/
4. https://www.aspi.org.au/publications/defence-science-and-innovation-an-affordable-strategic-advantage/SR79_Defence_Science_Innovation.pdf

Funding provided by the Australian Government Department of Defence, is directed towards various Defence driven priorities (e.g..) capability and enterprise needs; technology foresight and force design.

Funds are allocated and distributed to various academic, public research and industry recipients via the “Next Generation Technology Fund” and the “Defence Innovation Hub”.

The Defence Innovation Portal serves as an intermediary for the Australian Government and the various funding recipients

Engineering:

1. https://www.engineering.unsw.edu.au/electrical-engineering/research/our-research/grants-and-fundings

Funding is derived primarily from ARC (Australian Research Council) grants with additional funding made available from various state and federal government bodies, industry and major private organisations.

Forestry:

http://forestresearch.net.au/wp-content/uploads/RD-co-ord-and-funding-models-final-Burvill.pdf

Major funding sources in 2007–08 were: Australian Government (44% of total funding); State agencies (28.5%); Private sector (20%); and Universities (7.5%).

In 2009 the Minister for Agriculture, Fisheries and Forestry established the Rural Research and Development Council as the Australian Government's key advisory body on rural R&D. The Australian Government matches eligible R&D expenditure by FWPA (Forest and Wood Products Australia) subject to conditions specified in a statutory funding agreement.

Total R & D expenditure by FWPA is less than 10% of the sector total, indicating that it is a less dominant player in funding compared to other jurisdictions.

Best practice aspects of Canada, Finland and the EU Forest Based Sector Technology Platform R&D funding models are discussed. Performance in R&D management in the sector was improved by a strong commitment and drive by industry. Long-term development and sustainability, relied on ongoing industry support, rather than with authorities or academia. All jurisdictions were aligned in that strong academic institutions and support are a critical enabler but not a driver.

Strong Government support, both political and financial, is required. Financial support was shared amongst various sources. This share could move in percentage terms between industry and public based on national and industry economic performance at the time.

Lobbying and business development management was required to keep funding streams open. Successful models have dedicated business development managers from industry to drive funding availability and take full advantage of public money and tax incentives but also market the organisations to attract industry and private financial support.

There was also a common pattern in the better models of alignment between all stakeholders. There was a form of "co-opetition" in which industry players network and cooperate to help the industry become strong and sustainable, yet they still compete for business.

There is a common approach in many jurisdictions to include Pulp and Paper plus the new Bio Industries in the Forest and Wood (Forest) Products sector. This definition of the industry allowed better alignment and co-ordination of R&D Centres of Excellence. This concentration of technical force allowed better co-operation, knowledge exchange, better spending power, lower overheads and more tangible outcomes.

Click on Link 1 for more detail relating to these models.

Medical:

1. https://canceraustralia.gov.au/sites/default/files/publications/cancer-research-australia-overview-funding-cancer-research-projects-and-research-programs-australia/pdf/cancer-research-in-australia-full-report.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3727685/
3. http://researchaustralia.org/health-medical-research/medical-research-future-fund/
4. http://www.phcris.org.au/publications/researchroundup/issues/33.php
5. https://www.cdhowe.org/sites/default/files/attachments/research_papers/mixed/Commentary_463.pdf
6. https://theconversation.com/new-funding-models-are-a-long-term-alternative-to-medicare-co-payments-35382
7. https://www.ncbi.nlm.nih.gov/books/NBK50972/
8. http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1617/Quick_Guides/NDIS
9. https://www.ndis.gov.au/html/sites/default/files/documents/Provider/201617-vic-nsw-qld-tas-price-guide.pdf

Link 1 – In Australia, funding for various medical research initiatives (cancer etc.) largely (66%) comes from the Australian Government NHMRC (National Health and Medical Research Council) and other Government sources with the remainder coming from various other sources (Cancer Councils and Foundations, State and Territory Governments etc.) The Pharmaceutical industry is also a provider of funds ($82m from 6 companies between 2006 – 2011)

Link 2 - In the U.S., public funding for medical research has traditionally been delivered by the government's annual or biannual appropriations process; states also follow this model. The reliance on this process has historically led to major swings in research funding.

It is argued that the old model of funding research through appropriations is broken and that a new model is needed and that research investment should be funded through long-term capital, financial structures such as state, national, or international bonds that amortize the cost over the benefiting generations

California's Proposition 71 (2004) is cited as an example (i.e.,) a $6 billion initiative ($3 billion for research funding and $3 billion to pay interest on the bonds over 35 years), demonstrates the power of this concept, even at a state level, to lift an entirely new field of medical intellectual capital—in this case, stem cell research— from an exploratory phase into an intense medical revolution.

Although 90% of the bond funds are reserved for stem cell research, the 10% ($300 million) that the California Institute for Regenerative Medicine (CIRM) invested in stem cell facilities has already been leveraged out to more than $1 billion in linked donations, including funds from several international collaborators. California's agency now also has bilateral funding agreements with 13 foreign governments and the National Institutes of Health, further leveraging the reach of its research funding.

Link 3 - The MRFF (Medical Research Future Fund) created in 2015, is anticipated to have a balance of $50b by 2020, providing funds of around $1b per annum from 2021.

Links 4 and 5 – In Canada, healthcare delivery silos are impeding the country's ability to adapt to changing demands. Experience elsewhere in the world shows integrated payment models that

distribute single payments or funding envelopes across providers add financial incentives to reduce costs and increase efficiency and effectiveness across a patient's entire journey through the system.

A series of emerging policy reforms in the United States, the Netherlands, England, and Germany has attracted attention from international policymakers for going beyond the silos of traditional payment reforms in healthcare to introduce new financial flows that bridge sectors and settings.

New models such as bundled payments and accountable-care organizations disburse single payments across groups of provider entities, offering shared financial incentives to improve coordination, efficiency, and effectiveness across a patient's entire journey.

Although still in their infancy, early evaluations have found compelling evidence of the potential for some of these models to reduce healthcare costs while maintaining or improving the quality of care

Link 6 – In Australia, the article" New funding models are a long-term alternative to Medicare co-payments" proposes the introduction of a system based on "capitation with some pay-for-performance and residual fee-for-service elements" (i.e.,) a system which pays doctors an annual fee for each patient they have enrolled in their practice. The payment is in return for the GP "looking after" that patient for the entire year.

Capitation has been the primary funding method for general practice in the United Kingdom for more than 100 years. More recent examples of capitation implementation come from North America: from the growth of managed care in the United States, where capitation has been widely used, to the province of Ontario in Canada, where a voluntary capitation system was introduced in 2007.

A recent study shows the mixed capitation payment method reduced the number of services (consultations) GPs provided by around 6% per day, while increasing their likelihood of meeting preventive care quality targets by 7%.

Pay-for-performance arrangements now play a significant role in the funding of primary care in the United Kingdom and United States. Australia is lagging.

Links 8 and 9 – In Australia the *NDIS* (National Disability Insurance Scheme) *Act* established the National Disability Insurance Agency (NDIA), the independent statutory agency responsible for administering the NDIS. The NDIS will largely replace the existing system of disability care and support provided under the National Disability Agreement (NDA).

According to the Productivity Commission's *Report on Government Services 2017,* 28.9 per cent of the $8.4 billion spent on specialist disability services in 2014–15 came from the Australian Government, and 71.1 per cent came from the states and territories

The Productivity Commission noted that 'current funding for disability is subject to the vagaries of governments' budget cycles' and proposed that the Australian Government should finance the entire costs of the scheme from general revenue, or a levy 'hypothecated to the full revenue needs of the NDIS'

The Australian Government's share of NDIS expenditure in 2019 is expected to be around $11.2 billion. The Government estimates that around $6.8 billion of this expenditure will come from the redirection of existing disability funding and the Australian Government's share of the Disability Care Australia Fund, leaving $4.4 billion to be sourced elsewhere

The Government has proposed that this additional amount should come from budget savings directed to a special account—the NDIS Savings Fund—which will 'hold NDIS underspends, and selected saves

from across the Government'. While savings may come from any portfolio, all savings proposed so far have been from the Social Services portfolio.

To the extent that it cannot be funded from these sources, the Australian Government's contribution will be a cost to the Budget

Nuclear Energy:

1. http://www.world-nuclear-news.org/V-Innovative-ways-of-funding-nuclear-power-projects-18021601.html
2. https://news.engr.ncsu.edu/2016/07/college-leads-in-funding-for-nuclear-energy-research/
3. https://www.scientificamerican.com/article/obama-energy-research-nuclear-power/
4. http://www.climatecentral.org/news/nuclear-research-targets-emissions-19113
5. https://research.usc.edu/files/2011/05/Guide-to-FY2016-DOE-Research-Funding.pdf
6. http://enformable.com/2017/01/us-government-proposes-further-funding-for-nuclear-research/
7. http://www.ansto.gov.au/cs/groups/corporate/documents/document/mdaw/mdu5/~edisp/acs109534.pdf
8. http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx
9. https://cna.ca/wp-content/uploads/2014/05/Strategic-Value-of-the-NRU-May-2014-v-4.pdf

Link 1 – Traditionally, nuclear power plants were financed, developed, and operated by governments. in recent years, government financing has taken on a new cross-border perspective, with Russia and China offering complete solutions for developing nuclear projects in other countries. Under these schemes, the country offering the solution puts together a consortium to deliver the project together with financing from its government, its government export credit agencies (ECAs) and/or national banks.

Aside from 'traditional' government funding, there are now six alternative methods: corporate balance sheet financing; the French Exception model; the Finnish Mankala model; vendor equity; ECA and debt financing; and private financing with government support mechanisms. In practice, projects tend to progress using a mix of these funding mechanisms – click on Link 1 for further details relating to each of these models.

Link 5 - The Department of Energy (DOE) is the single largest federal government supporter of basic research in the physical sciences in the United States, providing more than 40% of the total federal funding. DOE oversees and is the principal federal funding agency of the nation's research programs in high-energy physics, nuclear physics, and fusion energy sciences.

Link 3 - In the USA (2011) funding covers a $36 billion boost in loan guarantee authority for nuclear power facilities for a total of $54 billion, $300 million for an innovative energy research program, and a $226 million increase in funding for the Office of Science for research and development of "breakthrough" technologies for a total of $5.1 billion.

Link 2 - In the USA the DOE (Department of Energy) in 2016 announced $82 million in awards, funding 93 projects in 28 states. NC State received the most overall funding and the most funding for fellowships of any university in the United States

Link 3 - The USA (2010) continues its push to advance clean energy research and development by pouring $300 million into the Advanced Research Projects Agency-Energy, or ARPA-E, an innovative program designed to develop transformational energy technologies.

Link 7 – ANSTO (Australian Nuclear Science and Technology Organisation) is an Australian Government Corporate Commonwealth entity with its own Board that is established and constituted under the provisions of the Australian Nuclear Science and Technology Organisation (ANSTO) Act 1987. ANSTO forms part of the portfolio responsibilities of the Minister for Industry, Innovation, and Science.

Link 8 - The Atomic Energy Commission (Commissariat a l'Energie Atomique – CEA) was set up in 1945 and is the public R&D corporation responsible for all aspects of nuclear policy, including R&D. In 2009, it was re-named Commission of Atomic Energy and Alternative Energy (CEA).

In mid-2006 the CEA signed a four-year €3.8 billion R&D contract with the government, including development of two types of fast neutron reactors which are essentially Generation IV designs: an improved version of the sodium-cooled type (SFR) and an innovative gas-cooled type.

In March 2007, the CEA started construction of a 100 MWt materials test reactor at Cadarache. The €500 million cost is being financed by a consortium including CEA (50%), EdF (20%), Areva (10%) and EU research institutes (20%).

The National Scientific Evaluation Committee (CNE) in mid-2009 said that the sodium-cooled model, **Astrid** (Advanced Sodium Technological Reactor for Industrial Demonstration), should be a high priority in R&D because its actinide-burning potential.

In December 2009, as part of a €35 billion program to improve France's competitiveness, the government awarded €1 billion to the CEA for Generation IV nuclear reactor and fuel cycle development

In September 2010, the government confirmed its support, and €651.6 million funding to 2017, for a 600 MWe Astrid prototype. (A further €350 million was later approved to 2020.)

Pharmaceutical:

1. https://translational-medicine.biomedcentral.com/articles/10.1186/s12967-016-0838-4
2. http://www.outsourcing-pharma.com/Preclinical-Research/GSK-opens-Centre-of-Excellence
3. http://www.who.int/bulletin/volumes/90/11/12-113712/en/
4. https://www.pwc.com/gx/en/pharma-life-sciences/pdf/challenge.pdf
5. http://mitsloan.mit.edu/100years/pdfs/Andrew_Lo.pdf
6. http://www.atsjournals.org/doi/full/10.1513/AnnalsATS.201209-075PS

Link 1 - The total worldwide R&D spend of pharmaceutical and biotechnology companies increased from USD 108 billion (2006) to USD 141 billion (2015). Amongst the world top 50 companies by total R&D investment in the fiscal year 2014/2015 were 16 pharmaceutical companies. Accordingly, the pharmaceutical industry is a worldwide top investor in R&D today and it is predicted that it will keep its role as a leading R&D stakeholder in the future with an industry-wide forecasted total R&D spend of USD 160 billion by 2020.

The challenge related to the high R&D spend is the rising expectations of investors for a reasonable return of investment (ROI) provided by a high number of new molecular entities (NMEs) launched to the major pharmaceutical markets. The challenge for industry comes from putting the costs of pharmaceutical R&D in context to the output, namely the number of NMEs launched to the market

Concepts that companies follow to increase their R&D efficiencies include; activities to reduce portfolio and project risk; activities to reduce R&D costs; and activities to increase the innovation potential.

It was found that 73 % of the investigated companies were making process changes in R&D via one or more of the following activities: creating growth options with M&As; improving R&D efficiency by restructuring R&D into more manageable smaller, biotechnology-like units; reducing R&D costs from virtual R&D and outsourcing, widening the competence field by progressively expanding collaborations and research partnerships; increasing the technology base by accessing more drug candidates in all phases from external sources; strengthening the innovation potential by venture capital investments; and broadening the knowledge base via crowdsourcing.

Link 2 – In 2005 GlaxoSmithKline (GSK) created a Centre of Excellence for External Drug Discovery (CEEDD) that aims to provide GSK with alternative scientific and drug discovery approaches. The CEEDD also aims to exploit the full potential of GSK's R&D assets to generate more targets and compounds

Link 3 - In 2012, the World Health Assembly adopted a resolution to start multilateral negotiations for the possible adoption of a binding convention on health R&D. The concept of a new convention rests on four main premises:

The current R&D model, based on patents and market-oriented research, fails to generate new health technologies to face the global challenges arising from existing health needs, particularly in developing countries.

It is crucial not only to enhance the innovation of relevant products, but also to secure product access and affordability by *delinking* R&D costs from the prices of the products.

The efficiency of health research can be improved through better monitoring, priority-setting and international coordination of R&D; and

Voluntary financing cannot be the main or unique source of funding; a better, more sustainable and predictable financing model is needed.

The basic objective of the convention proposal is to put in place a new model of R&D that would lead to a reduction of R&D costs and increase innovation through a more focused, health-driven research agenda and through improved monitoring, cooperation and sharing of research results. This would lead, in turn, to much more affordable, accessible treatments.

Link 4 – A PWC (PricewaterhouseCoopers) report identifies the need for a collaborative business model to fund the development of pharmaceutical drugs. Two models are discussed:

Collaborative: Federated Model (which is made up of a virtual variant and a venture variant model and comprises: a network of separate entities; based on shared goals & infrastructure; which draws on in-house and/or external assets; and combines size with flexibility and an

Owned: Fully Diversified Model which comprises: a network of entities owned by one parent company; based on provision of internally integrated product-service mix; which spreads risk across business units. Refer to Link 4 for additional details

Link 5 – A PowerPoint presentation (2014) that discusses risk and return and how research and development funding has dropped away in real terms over the last decade. Also, how, as business gets smarter, the level of risk increases (e.g.,) payer pushback, litigation etc. Argues that if risk is

managed effectively that significant financial returns are still possible, but that government funding is essential when: there is no quantifiable economic return; the horizon is too long; the costs are too large; the probability of success is too low (or completely unknown); and the social impact is large.

Link 6 – Discusses the importance of research collaboration between the pharmaceutical industry and academia? Also, how the ROI on pharmaceutical funding since the early 1980s has declined significantly (e.g.,) $1 invested in capitalized research returned about $3 (in sales). Roughly 30 years later, capitalized R&D returned only $0.83 per $1 invested.

In the USA (2012) a $33 billion National Institutes of Health (NIH) budget funds mostly basic research, along with translational and clinical research. In contrast, research supported by industry is mostly clinical and translational, with less spent on basic research.

Over the last 2 decades, the relative amount of research supported by the NIH compared with that supported by the pharmaceutical industry has changed dramatically. In the early 1990s, the NIH and industry contributed approximately equally to supporting biomedical research; now the pharmaceutical industry spends 25 to 30% more on research than the NIH.

Rail:

1. http://www.rtbu.org.au/innovative_funding_models
2. http://www.thefifthestate.com.au/columns/spinifex/how-the-entrepreneur-rail-model-can-spark-public-transport-investment/80244
3. https://www.rssb.co.uk/innovation-programme/funding-opportunities

Link 1 – Discusses how innovative funding models can contribute to funding the capital cost of new public transport infrastructure in Australian cities where there is value capture. Value capture is based on the premise that government has a right to capture a reasonable portion of the additional economic and property value generated from new public transport infrastructure to fund these enhancements. The concept of value capture is not new, with countries such as the United Kingdom and Canada having used various value capture mechanisms to finance public transport infrastructure for more than a century.

Link 2 - Discusses how rail and land development add value to a city. Rail projects raise the value of land around stations substantially. The value of an entrepreneur rail project is outlined in some detail in the paper

Link 3 – examples of funding opportunities/competitions made available by the UK Government in 2016

Ports and Harbours:

1. http://www.namra.net.au/about

Link 1 - Based in Darwin, NAMRA brings together the Australian Institute of Marine Science (AIMS), Charles Darwin University (CDU), the Australian National University (ANU) and the Northern Territory Government (NTG) to build marine research capacity and capability in northern Australia

Appendix C: Evidence

Conversation with ACARP.

Contacts: Can be advised via NERA.
Respondents were long term personnel with an in-depth knowledge and understanding of the ACARP research program.
During the conversation with the ACARP people, the history and development of ACARP was discussed in detail.
They explained the catalyst for the project which started with Prime Minister Frazier contacting the coal industry and explaining that a 5 cent per tonne levy was to be applied to coal production to fund research which at the time was very limited in output and performed only by Universities and research organisation.
The levy went into a federal fund and initially there was a tripartite process consisting of Researchers, Government and Coal Companies.
Early days, Powercoal, which was a state owned coal mine provided powerful support.

Setup

In 1992 ACARP was formed. 80% of industry thought it was useful, 20% were unconvinced. An initial 3-year process was started. Then 2 further years. After which the scheme was reviewed every five years.
The fund was driven via an impost mostly from industry, hence, industry took overall control. A clause was introduced to the legislation that had the potential to bring the levy back to zero cents.
Whole of the industry said yes to the program. Took several strongly committed individuals to get the program up and running and get the program really going.
Large companies that had their own research and development facilities saw ACARP as an impost and a threat to their own R&D.
The program was confrontational at first. Government was happy to hand over the baton.
NERDIC was no longer viable.
Coal Industry Signed an MOU with Parliament to commit to the process.
ACARP has an agreement with the Black Coal Companies. Government wanted an arm's length approach.
ACARP manages approximately $17m a year that is derived from sold tonnes of coal. Works well in the coal industry and is 5c cents per tonne regardless of the coal price. In real money, after taxes, it is 2.4c per tonne. It is difficult to get commitment via any other levy method.
Argument from industry was, is 5c per tonne affordable, and this question is often raised. However, the levy remains.
Within the ACARP program, there are more than 140 members.
Importantly, there is a practical limit to the number of projects that can be run at any one time. This is due to the limited number of competent technical people that can advise and steer projects.
ACARP manages a researcher database, but reality is that there a is a limited number of available researchers too.
Renewal process is every five years with the next review in 2020. Call is for themes and checks management model and ensures it remains relevant.
The governance structure has five committees that define research priorities and technical direction of the program. Driven via industry direction and technical experts.
Strength in the program is that below board level is the technical level and they understand the processes. The process for determining priorities is open and easy with anyone able to raise an issue and discuss it.
The board provide mostly fiduciary responsibilities and only become involved when asked to step in to assist.
Board has a formal structure and constitution with proportional representation via 14 members.

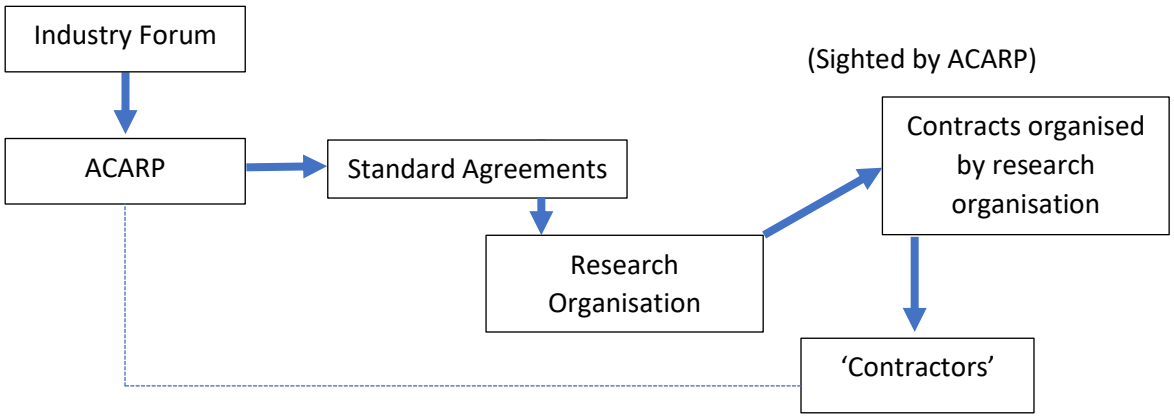
Forum

The program has credibility because of the technical strengths of the person sitting at the forum table. The approach is open and "come in and talk to us." This promotes a genuinely collaborative programme and makes collaboration easy.
Forum has no charter.
Very strong technical and open discussions.
People in the forum can relax because they all have the same problems to manage and solve.
Helps develop a network outside ACARP for problem solving.
No one big player dominates proceedings.
High quality engagement is achieved.
Usually 15 to 18 people per meeting.

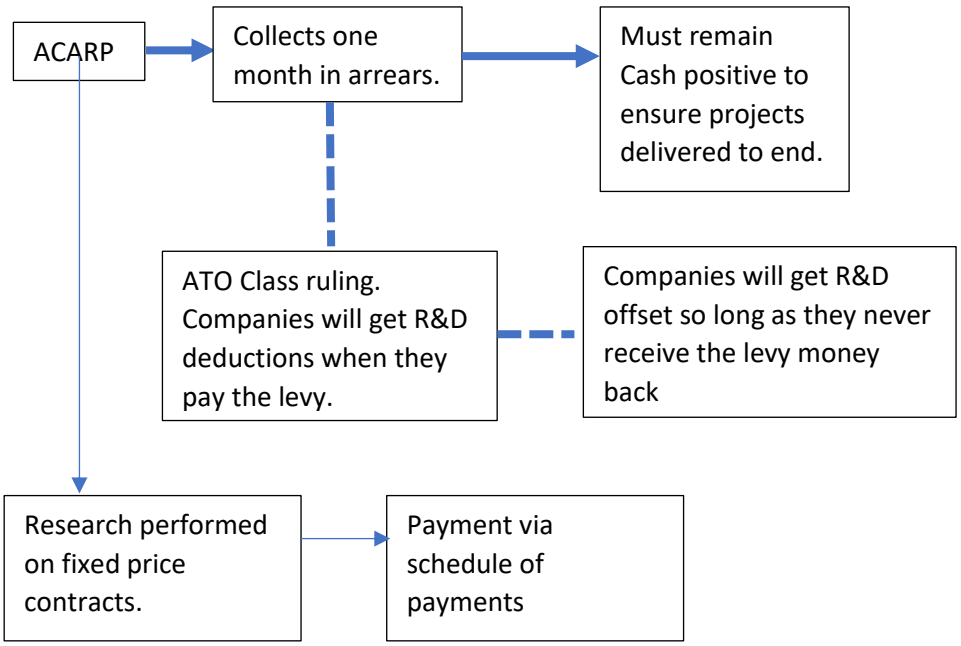
Project Size

Most common project size is $220k with one researcher and two mines. Most are ongoing extensions of past work. Building on capability. These projects are bite sized chunks of larger projects.
Largest flagship project was Automation of Longwall, CSIRO over 4 years at a $1m per year.
LASC – Gyroscopic drive.
Partnership was with Industry, CSIRO, OEAMS with Top down support. (Peter Coates).
This type of collaboration was a step change for industry. They had to take a risk.
In general, projects are smaller, and usually 330 submitted to 60 funded.
Projects that are funded are so because people on the board and committee see the benefits.

Research Management Process



Levy Collection



Proposals

May, short proposals, then October long proposals, Technical committees review and sign off. Decision December.
Administration takes a few months to complete and start projects.
Industry monitors appointed. Generally, committee members or their representatives. 2 or 3 on each project.
Encourage engagement with researchers. May refine the proposal if opportunity arises.
Timeframe for projects is generally 12 to 18 months. $200K mark. Longer projects can be 3 years.
Proposal development may take over a year to complete. 8 months is the average.
Consideration of proposals is all at once. Advantage is that gaps in research areas are identified by the technical committee. Enabling gaps to be filled.
Priorities are reviewed once per year.
Challenging question: Over $100m spent, "Tell us how effective ACARP has been?"

- Only anecdotal evidence. Industry quantifies the benefits.
- People on committee have experience to say whether good or bad.
- Coal exports could be a metric.
- Industry knowledge base has been created over time.

People are Key

People are key. On the administration and technical sides, all have good industry knowledge, and trust. Until we have this, the program won't work as effectively. The people produce a good and workable model. ACARP uses a forum. Th forum needs people to input to it via an open-door policy.

Conversation with AMIRA.

Contacts: Available via NERA.

Summary

AMIRA started in 1959.
High-level executives founded AMIRA due to there being little research and almost no government funding.
Looked at other models. U.K. Agriculture and so-on. Used these models as a starting point.
Convened by AusIMM, BHP, Colonial, Western Mining for example.
View was to develop collaborative research projects.
A few examples performing research at the time were, CSIRO, Uni's Laboratories.
Idea was to facilitate industry research. Promote and Facilitate Research Services.
30 companies were persuaded to join as members.
Required a united, high-level representation. The key proviso was that it should be completely independent, no government involvement, no research organisation involvement. However, can leverage government funds.
Importantly, the initial high-level involvement has been eroded or lost due to globalisation.
AMIRA no longer has this advantage.
AMIRA runs a membership model. Membership covers costs with industry sponsoring projects. Must be a member to sponsor a project.
Membership does not provide a high-level of funding. Sponsorship adds funds to projects.
AMIRA has a regular constitutional review. Need to change model via board review. Current system has resulted in unwieldy board that is hard to manage. The board generally contracts in hard times.
Board is very technical, but does not have much governance experience.
May evolve the membership model via review every so often, however, many organisations worldwide have used the AMIRA model. "Imitation is the greatest form of flattery."
Due to its structure, AMIRA does not report to government other than via Tax and the ASIC requirements for not for profit organisations.
Governance is via AGM and board meetings.

Projects

Has had many successful projects.

P.9 up to P9Q has lasted over 50 years and provided incremental benefits. Originally a three to four-year project.

Project is a simulation platform that had 20 sponsors originally. Provides information models for mineral processing.

Also generates the next level of people and students become trained via this project.

Another project example is WAXI. Public, private relationship for exploration. Idea is capacity building in west Africa. Valued by companies for networking opportunities.

Added value for outcomes.

10-year project

Planned to expand into South America East Africa and elsewhere.

Is a successful project model and provides credibility.

Most projects develop technologies. Early stage adoption is via collaboration.

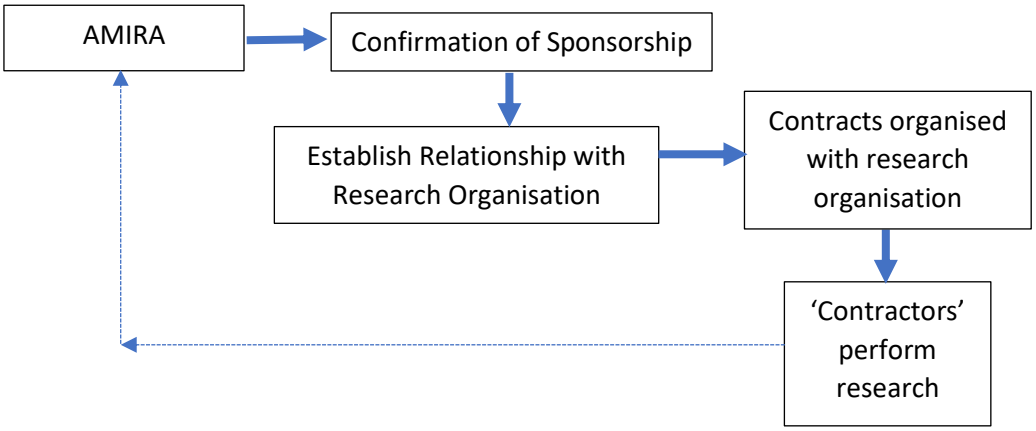
Collaborative projects provide more benefits than individual projects. For example, in the case of applying research and technologies to different deposit types.

Many different deposit types. Can determine is the technology is applicable to all locations or is environment or site specific.

R&D is performed via expression of interest. The aim is to spread the risk over several sponsors. If the project fails, still learn something, but impact is less on each company. must take risks to advance.

AMIRA

AMIRA Manages the Research Process



Financial Calendar

Have found no ideal method.

Due to global nature and different financial calendars, not possible to easily synchronise or streamline.

Best approach is to time proposals and develop awareness of intent to allow companies to plan.

Takes at least one year.

Very basic and simple projects can be quicker, but of limited scope.

Commercial organisations are much more savvy and quicker than research organisations.

Commercial or Research Organisation involvement depends where emphasis of project is.

Early stage research should be via research organisation.

Technology implementation should be via commercialisation. At this point, IP and commercialisation starts to dominate.

Project Management.

AMIRA has tried and tested methods, Expectation of how projects are managed is part of this.

AMIRA focusses researchers to keep within scope. Ensures that deliverables are delivered within expectations.

Not all projects have steering committees, but project advisory committee ensures that research remains on track. Advisory committees include people with necessary experience.

Conversation with PIP

Name: Available upon request.

Project Secretariat, formal questions to be posed to Petroleum Affairs Division

Question 1

Initiative came from both government and industry.

One main driver who saw an opportunity to set up the program.

Many companies saw an opportunity to address the problem of sea bed sampling and set up a source rocks project.

They were prepared to bring I a vessel via a collaborative project.

One person saw the opportunity and prepared a structure for collaboration. The structure was created around the idea and became a future method.

Vision was with P.A.D. to see this as an opportunity to collaborate.

Question 2

Formal questions may have to be passed on to P.A.D., for official answers.

Originally, the projects were run via voluntary contributions from companies. It was implied that if they had a licence, their company would participate and contribute to collaborative projects.

As PIP progressed they moved from 'voluntary' to compulsory.

It was 'implied compulsory' in the early days.

Accepted - Ireland, because the initiative / idea had originated from industry.

Particularly useful for new projects such as common data sharing.

Collaborative approach was seen in a positive way.

No real issues.

Question 3

Periodic reviews

Independent review by tender in 2009

Recommendations made on overall structure.

Periodic review of members.

Rounds – open to licences.

Irish Studies Group

Also, have own independent audits every 3 years.

Memo on articles.

Workshop every few years.

Member companies spend a day discussing the program and direction.

Establish what impact does the system have on their operations.

Gaps in research in industry identified from their point of view.

Funds to be spent over next 3 years identified.

Rules and procedures not changed so much. Have been updated three times in twenty years approximately.

Question 4

Management committee.

P.A.D – Provides one member of the study group.

Holders of licences provide member of the study group.

Voluntary members can be on the study group for a reduced fee.
Technical committee.
Representative of the management committee.
Geology
Environmental
Engineering
Data management and sharing.
Member companies propose members for this committee/
Committee provides scope of work for research projects.
Send them out to tender,
Must be approved by the management committee and be within budget.
PIP is set up via a company via limited guarantee.
Holds the funds.
Issues contracts.
Members are invited to propose directors, plus one independent director.
Representatives are usually at the exploration manager level.
Independent director would have been working in the sector and would be known to government.
Senior management – from companies.
Only operates upon instruction from the management committee.
Requires at least two or three people to sign off any actions.
Transparent process. P.A.D. gets a regular report.

Question 5

Tried various models over the years. Several phases gone through.
Initially the most successful was ones where the oil and gas companies identify an issue via technology.
Projects were
Geology
Environmental
Shallow drilling project 1999. Groups struggling with seismic acquisition. Source rocks needed better identification.
Lots of member companies contributed.
Sharing of seismic data was the result.
Then,
Needed blue sky research to build capacity within Ireland
Government – Rockal Studies – Universities submit proposals to work on the core.
Site survey data also.
Came up with idea of open proposals under different themes.
Different themes came from technical committees.
Then,
Mixed projects, some very good, some less so.
Major costly projects spun out into more blue-sky research. Result was significant capacity.
3rd phase,
Leveraging of funds from other research initiatives.
Applied geoscience Research Centre set up.
Open call for research again.
ICRAIC
Less control over research direction but had a purpose.
25% of fund provided a time seven uplift of funds and allows focus on big projects.
Transatlantic collaboration Newfoundland and Labrador.
50% each Partner, Projects of over €1m each.

Looked at the stratigraphic framework.
Applied Geoscience Members, ICRAIC
Without PIP this probably wouldn't have happened.
A lot more research infrastructure has resulted.
Best geoscientists from around the world attracted.
PhD
Post Graduates
Aim is to attract the best.
Licence rounds

Question 6

Service contract used.
Lead company for a consortium.
One company awarded normal service contract.
Goes out to tender via the technical committee.
Works the best. = Standard contract with one lead company. Four sun contractors to that company with separate contracts.
Easy to manage and get collaborative projects.
One or other holds the contract.
Navcore / PIP
University - slightly different.
Recommendation is that companies involve Irish Universities to perform the research.

Question 7.

PIP cycle doesn't always fit the company's cycles, depend on the renewal cycles of the licences.
Payments are made on deliverables.

Question 8

Example Timeframe
2015 recommendation to do work.
Takes time to scope.
Oil companies take time to develop.
March 2016
Scope of work.
Public procurement – 52 days to allow people to tender. – must follow government procurement procedures.
Takes at least two months.
May 2016
Project awarded 20th June 2016
Seem very quick! But considered slow.
Project turn around speed depends on interest.

Question Nine

Need to have the scope of works tied down quite precisely.
Big projects are reasonably well defined.
Scope of works may need to be tightened in some instances.
Payment schedules and trigger payments must be agreed.
Clear milestones essential.
Good contract and clear and regular reporting is essential. This picks up IP issues in some projects.
Only have a few clauses.
Standard industry developed contracts. Can be varied a little by entities. Particularly Universities or Services Companies.

Innovate UK (IUK)

IUK functions as a peak UK (government funded) body to promote and financially support innovation in key strategic industry and technologies across the UK. It reports to the Department for Business Innovation and Skills.

In operation since 2007 IUK is the operating entity for the UK Technology Strategy Board and is a UK government agency with an independent industry led Board. It has an annual operating budget of UK sterling 550m and delivers its programs (funding) either directly to successful projects or through the 11 Catapult "centres" across the UK.

Headed by Dr Ruth McKernan its primary objective is to provide funding support for innovation (projects) in key strategic industry sectors (Emerging technologies; Health and Life sciences; Infrastructure and Manufacturing). Funding is provided through two programs –either for strategic projects identified by IUK as areas of national importance or open funding where companies and research organisations can apply direct. Funding is provided for both research based projects and to commercialise technologies. Funding for projects is provided as in the form of grants rather than as loans.

UK Catapults

The Catapults network (11 Centres) has been established by Innovate UK and provides access to expert technical capabilities, equipment, and other resources required to take innovative ideas from concept to reality. Catapults are not-for-profit, independent physical centres which connect businesses with the UK's research and academic communities.

Each Catapult centre specialises in a different area of technology for businesses undertaking late stage research and development and commercialise traditional academic research. The centres will gain their funds from a mix of competitively earned commercial funding and core Innovate UK investment using a one-third funding model from three sources:

- business-funded R&D contracts.
- collaborative applied R&D projects, funded jointly by the public and private sectors,
- public funding for long-term investment in infrastructure, expertise and skills development

Each Catapult centre is a company ltd by guarantee (CLG), and a separate legal entity from Innovate UK controlled by an independent Board.

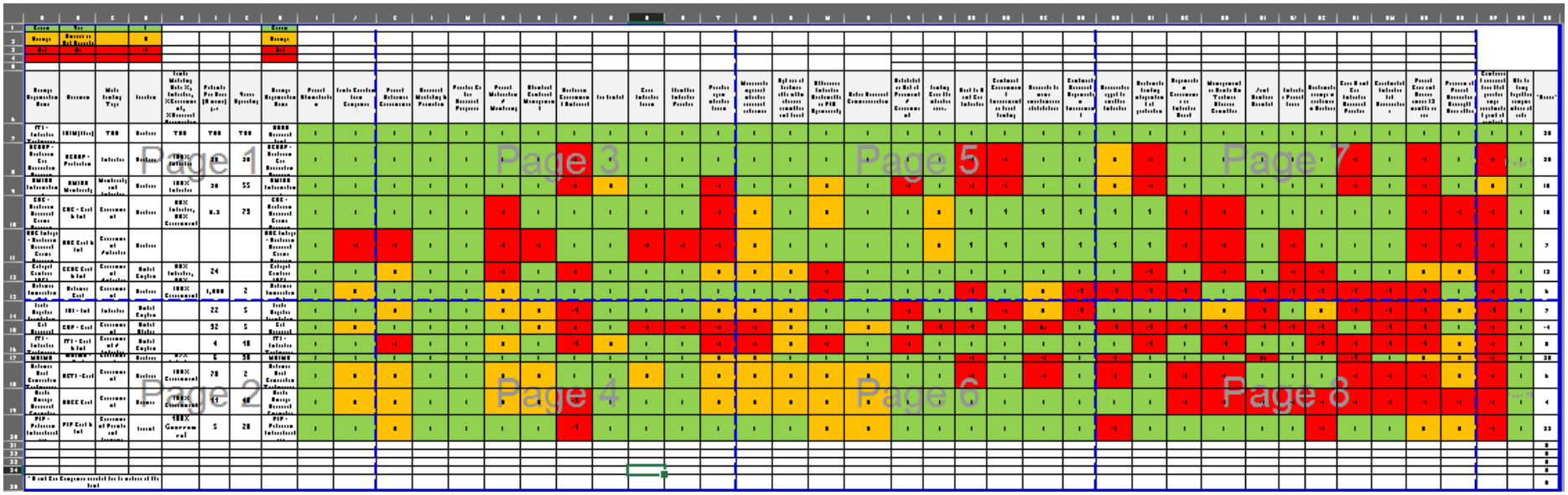
Scottish Enterprise

In operation since 1991 SE is the peak Scottish government economic development agency responsible for promoting and funding innovation and research (in industry and universities) to grow and develop key strategic industry sectors.

It has an independent industry led Board and an annual budget of UK sterling 250 million. Its CEO is Dr Lena Wilson. It has an investment arm –The Scottish Investment Bank which operates 2 investment funds – The Scottish Investment Fund for start-up and early stage businesses providing funds of up to UK 1.5 million and the Scottish Venture Fund which provides funds of up UK sterling 10 million.

SE acts as the umbrella organisations for promoting the commercialisation of research and innovation for Scottish companies through several affiliated agencies such as OGIC, OGTC, Highlands and Islands Enterprise, Skills Development Scotland and DIT UK.

Appendix D: Model Comparison



Funding model criteria comparison chart. The ideal model has all the criteria. Other models do not display all criteria hence they receive a lower score in this instance.

Appendix E: Supplementary Material

Please refer to included DVD

PowerPoint Presentation – Project Overview and Concept Socialisation.

PowerPoint Presentation – Research Funding Model Classification Slides.

Appendix F: Offshore Oil and Gas Operators Australia

3D Oil T49P Pty. Ltd.

Asset Energy Pty Ltd

AWE (Carnarvon) Pty Limited

AWE (Houtman) Pty Limited

Basin Oil Pty Ltd

Bass Strait Oil Company Ltd

BHP Billiton Petroleum (Victoria) Pty. Ltd.

BHP Billiton Petroleum (Australia) Pty. Ltd.

BHP Billiton Petroleum (North West Shelf) Pty. Ltd.

Bight Petroleum Pty Ltd

Bounty Oil & Gas NL

BP Developments Australia Pty. Ltd.

Carnarvon Hibiscus Pty Ltd

Carnarvon Petroleum Limited

Chevron Australia (EPP44) Pty Ltd

Chevron Australia (EPP45) Pty Ltd

Chevron Australia (WA-364-P) Pty Ltd

Chevron Australia (WA-365-P) Pty Ltd

Chevron Australia (WA-367-P) Pty Ltd

Chevron Australia (WA-374-P) Pty Ltd

Chevron Australia (WA-383-P) Pty Ltd

Chevron Australia (WA-392-P) Pty Ltd

Chevron Australia (WA-439-P) Pty Ltd

Chevron Australia (WA-444-P) Pty Ltd

Chevron Australia (WA-444-P) Pty Ltd

Chevron Australia New Ventures Pty Ltd

Chevron Australia Pty Ltd

ConocoPhillips (Browse Basin) Pty Ltd

ConocoPhillips Australia Exploration Pty Ltd

Cooper Energy Limited

Cornea Resources Pty Ltd

Cue Exploration Pty Ltd

Engie Bonaparte Pty Ltd

Eni Australia B.V.

Eni Australia Limited

Esso Australia Resources Pty Ltd

Exmouth Exploration Pty Ltd

Finder No 1 Pty Limited

Finder No 10 Pty Limited

Finder No 11 Pty Ltd

Finder No 12 Pty Ltd

Finder No 13 Pty Ltd

Finder No 14 Pty Ltd

Finder No 7 Pty Limited

Finder No 9 Pty Limited

Finniss Offshore Exploration Pty Ltd

Flow Energy Pty Ltd

Goldsborough Energy Pty Ltd

Gulf Energy Ltd

Hess Australia (Karratha) Pty Ltd

Hess Australia (Offshore) Pty Limited

Hess Australia (Pilbara) Pty Ltd

Hess Exploration Australia Pty Limited

Hydra Energy (WA) Pty. Ltd.

INPEX Browse E&P Pty Ltd

INPEX Ichthys Pty Ltd

IPB Browse Pty Ltd

IPB WA 424P Pty Ltd

IPB West Pty Ltd

Karoon Gas Browse Basin Pty Ltd

Liberty Petroleum Corporation

Lightmark Enterprises Pty Ltd

Llanberis Energy Pty Ltd

Loyz Oil Australia Pty Ltd

Magellan Petroleum (Offshore) Pty Ltd

Mobil Australia Resources Company Pty Limited

Murphy Australia AC/P57 Oil Pty Ltd

Murphy Australia AC/P58 Oil Pty Ltd

Murphy Australia AC/P59 Oil Pty Ltd

Murphy Australia EPP43 Oil Pty Ltd

Murphy Australia WA-476-P Oil Pty Limited

Oil Basins Limited

Origin Energy Resources Ltd

Pathfinder Energy Pty Ltd

Pilot Energy Limited

PTTEP Australasia (Ashmore Cartier) Pty Ltd

PTTEP Australia Timor Sea Pty Ltd

Quadrant Northwest Pty Ltd

Quadrant Oil Australia Pty Limited

Quadrant Permits Pty Ltd

Quadrant PVG Pty Ltd

Quadrant PVG Pty Ltd

Roc Oil (WA) Pty Limited

Santos Browse Pty Ltd

Santos Limited

Santos Offshore Pty Ltd

Santos Offshore Pty Ltd

SGH Energy VICP54 Pty Ltd

SGH Energy WA377P Pty Ltd

Shell Australia Pty Ltd

Sinopec O&G Australia (Puffin) Pty Ltd

Statoil Australia Theta B.V.

Tap Oil Limited

Timor Sea Oil & Gas Australia Pty Limited

Total E&P Australia

Total E&P Australia Exploration Pty Ltd

Vermilion Oil & Gas Australia Pty Ltd

Vulcan Exploration Pty Ltd

WHL Energy Limited

Woodside Browse Pty. Ltd.

Woodside Energy Julimar Pty Ltd

Woodside Energy Ltd.