Submission
2016 National Research Infrastructure Roadmap
Capability Issues Paper

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This submission only relates to the first question asked in the Issues paper. Letters of support for this submission to the NCRIS roadmap from key industry organisations, including National Energy Resources Australia (NERA), Chevron, Woodside, GE Oil & Gas and Clough are attached.

Question 1: Are there other capability areas that should be considered?

Yes – *Engineering Science and Technology Validation*.

There is a significant gap between the development and demonstration of an innovative technology within a laboratory environment, and the translation and deployment of that technology on industrial scales, where the risk of failure constitutes the primary barrier to the adoption of innovation. This is particularly the case for Australia's resource-oriented engineering industries, where the scale of capital investment required for plant infrastructure makes extensive validation of the process technology prior to deployment non-negotiable. Some of the seven current capability areas within the National Research Infrastructure Roadmap contain select elements important to the development of innovative technologies with potential industrial applications; however these are mostly targeted at stimulating advances of a fundamental nature, with a significant gap then remaining before adoption by industry can occur. None of the existing capability areas are sufficiently focussed on the engineering aspects of science and technology translation and development. The difference between proof-of-principle and reliable operation in a real-world environment is vast, as demonstrated by the existence of standardised definitions for technology readiness levels (TRL) by the American Petroleum Institute (API 17N) and other organisations (US Departments of Defence and Energy, FAA). If industry adoption is to occur then validation of new engineering technologies on scales both relevant to, and recognised by, the adopting industry are as important as the fundamental scientific breakthrough. For example, achieving the TRL-6 defined in API 17N is crucial for a technology's adoption by the oil and gas industry.

A key aim of the 2016 National Research Infrastructure Roadmap process is to increase collaboration between Australia's research system and end-users such as industry and business. A dedicated capability area that specifically facilitates technology transfer via appropriate validation of deployable instruments and processes is essential to that aim. Engineering firms from small-and-medium enterprises to major, multi-national corporations are at the heart of Australia's resources and manufacturing industries. While innovation is essential to Australian companies achieving a competitive edge across international markets, the combined forces of abundant resources and natural risk-aversion often act to stifle research adoption in this sector. This risk-aversion is not only due to financial considerations but is also driven by Australia's prioritisation of safety and environmental standards to ensure we achieve world-best practice. Open-access major research facilities dedicated to the development and validation of deployable technologies would have a

major impact in breaking the status quo. Such facilities might be dedicated to particular industry sectors of national strategic importance, such as minerals, or oil & gas processing. However, the ubiquity with which many engineering technologies are used across all sectors of the economy means that major research infrastructure within a new capability area of *Engineering Science and Technology Validation* could have a very wide-ranging impact.

By way of example, the oil and gas industry both internationally and particularly in Australia has a reputation of extremely slow technology adoption with average deployment times for new innovations around 25 years. This is especially problematic for the liquefied natural gas (LNG) sector, which inherently requires advanced technologies to produce a tradeable commodity, and is of national strategic importance given Australia is poised to become the world's largest LNG exporter. Moreover, the LNG industry is clearly evolving towards smaller-scale production plants, which have several inherent advantages. For example, they can be used to monetise stranded natural gas reserves, especially in remote locations, with greatly reduced environmental impact. Additionally, combined with wider adoption of LNG storage and bunkering facilities, small scale plants will accelerate the shift from diesel and heavy-fuel oils to LNG, which is cheaper and significantly more environmentally friendly (less CO_2, and substantially reduced particulate emissions) particularly in the shipping, heavy transport and mining sectors.

Risk aversion and market dominance by long-established proprietary technologies are key reasons for the current situation afflicting technology development within the Australian LNG industry. This could be overcome by establishing an open-access national research facility for industrial-scale innovation and demonstration based around a micro-scale (10 tonnes per day) LNG plant. Such plants are commercially available and readily adapted to enable modular integration, testing and validation of new LNG process technologies; these might be developed by small engineering service companies who are well aware of the deficiencies of existing solutions, and/or by researchers based in Universities, CSIRO or other research institutions who are abreast of fundamental developments in materials science for example. By designing the plant to be far more highly instrumented than normal, key data sets corresponding to crucial plant events (e.g. start-up and shut down) could be acquired and made discoverable to users of the facility based around Australia and internationally. Currently similar data sets are limited and generally of far lower quality than would be produced by a micro-scale plant facility dedicated to research but are nonetheless considered invaluable and closely guarded by operating companies. An open-access LNG plant facility would be unique globally, and foster innovation and growth in technology deployment across the LNG industry; it could emulate the important role now being played by industrial-scale subsea equipment testing facilities recently established in Norway. Additionally the micro-scale plant facility could play a crucial role delivering unrivalled training and educational opportunities for operators, maintenance contractors, engineers and data analysts who will be central to the next 50 years of Australian LNG production. Such major research infrastructure could thus stimulate a transition in the types of exports Australia's resource industries deliver, moving beyond raw materials and into knowledge, expertise and innovation.