ATSE

CONFERENCE AND WORKSHOP COMMUNIQUÉ

UNCONVENTIONAL GAS: OPPORTUNITIES & CHALLENGES

PREAMBLE

The discovery and development of unconventional gas has been one of the most significant technology–driven energy developments of the past decade. The exploitation of shale gas has allowed the USA to become self-sufficient in natural gas, and far less dependent on imports of liquid hydrocarbons. Coal seam gas (CSG) has enabled eastern Australia to become one of the world's great exporters of LNG. But whilst these developments have produced major economic benefits, they have also resulted in concerns regarding their environmental and social impacts.

Recognising the global nature of the discussion currently underway regarding the benefits and the challenges of unconventional gas, the Australian Academy of Technological Sciences and Engineering (ATSE) decided to hold an International Conference and Workshop on Unconventional Gas that would bring together Academicians, Academy representatives and Experts from countries actively considering unconventional gas issues. The meetings, convened by Professor Peter J Cook CBE FTSE and Dr Vaughan Beck, FTSE, on behalf of ATSE, were held in September 2015 in Sydney Australia and included Academicians and other participants from nine countries: Argentina, Canada, China, Germany, South Africa, Switzerland, United Kingdom, United States and Australia.

The Conference brought together 150 participants (researchers, NGOs, Governments, regulators, industry, as well as Academicians) from Australia and around the world for a series of keynote presentations and panel discussions that served not only to summarise the current state of knowledge regarding unconventional gas, but also to highlight the areas of dispute and uncertainty.

The subsequent Workshop involved Academicians, invited experts and government observers. The participating Academicians considered the conclusions and observations arising from the Conference, as well as recent national unconventional gas (and oil) reviews, in reaching a number of conclusions, which were then circulated for comment before being finalised.

Together, these meetings provided an outstanding opportunity to critically analyse the evidence relating to the opportunities and the challenges of unconventional gas developments including both CSG and shale gas. Whilst there are a number features common to both, there are also some significant differences. These relate not to the composition of their gas (both are predominantly methane), but to their geological setting. For example, shale gas is commonly found at depths of 3km or more in impermeable shales which have to be hydraulically fractured in order to extract the gas. This process may require significant volumes of water initially but once fractured and initially produced (the flow-back stage), there is then very little water produced subsequently from the shale formation. Conversely CSG is produced from coal seams at much shallower depths (typically 300-1000m). These formations may or may not require hydraulic fracturing: the gas within the formation is held under pressure by groundwater and it is commonly necessary to withdraw large quantities of water from the coal seam on an ongoing basis in order to produce the gas locked in the coals.

Bearing these differences in mind, the Academicians and experts sought not to make recommendations, but to identify Key Findings that others could use to develop recommendations and policy responses.

The Findings are summarised below under eight main Themes:

Theme 1: Unconventional Gas Resources

Unconventional gas can be produced in a manner that is environmentally responsible and that provides significant societal benefits, provided leading practice is followed.

Theme 2: Addressing Community Concerns

Gaining community support for unconventional gas developments requires sustained engagement, recognition of prevailing community values, communication of scientific, technical and socio-economic information by trusted sources, certainty in the regulatory regime and confidence that long term socio-economic benefits will accrue.

Theme 3: New Knowledge

Research in sedimentary basins will improve our knowledge of unconventional gas and other resources, decrease project costs and impacts, improve regulations and contribute to the development of a risk-based approach to regulation and to the management of environmental and community impacts.

Theme 4: Hydraulic Fracturing

Provided leading practice is followed and there is comprehensive knowledge of the sub surface, hydraulic fracturing is most unlikely to cause damaging induced seismic events or result in widespread, systemic impacts on drinking water resources.

Theme 5: Groundwater

Poor well construction and improperly decommissioned wells are risks to groundwater and it is important to be able to demonstrate life-time well integrity and remediation responsibility for unconventional gas wells and adopt leading practice for waste water disposal and management of materials and chemicals.

Theme 6: Protecting Landscape and the Environment

Cumulative environmental and biodiversity impacts can be minimised, using a risk-assessment framework along with better planning of infrastructure and integrated land management.

Theme 7: Emissions

Fugitive methane emissions, which can be material over the lifetime of an unconventional gas project, need to be monitored and a baseline established, in order to remove uncertainties regarding the magnitude of these emissions and provide a basis for remedial action.

Theme 8: Regulation

If regulations are to meet community expectations, protect the environment and reduce costs to industry, they must have clarity of purpose, transparency and engender trust.

The 2015 ATSE International Unconventional Gas Conference and Workshop provided an outstanding example of how Academies can work together to bring a credible and informed perspective to an important and, for many, a controversial topic. In so doing, Academies can assist government, industry and the community at large by communicating the technical issues and challenges, thereby contributing to developing a way forward that addresses community concerns and confers societal benefit.

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KEY FINDINGS

Theme 1: Unconventional Gas Resources

a. Scientific evidence based on, for example, extensive shale gas developments in North America and coal seam gas (CSG) developments in Australia over the past decade, indicates that provided leading practice is followed, including in regulation and monitoring, unconventional gas can be produced in a manner that is environmentally responsible and provides significant societal benefits.

b. Globally, unconventional gas resources are very large, however all shale gas or CSG resources differ in their geological, economic, environmental, legal, regulatory and cultural settings. This will impact on the extent to which it will be economically and environmentally feasible to develop those resources.

c. There is an ongoing need to better understand the properties of the rocks hosting unconventional gas resources, including their geology and structure, fracture mechanics, anisotropy adsorption characteristics and hydrogeology. This knowledge will not only potentially improve the economics of gas recovery but also help to minimise environmental impacts.

d. Future technological innovations have the potential to increase the unconventional gas resources base in a number of ways. This includes more targeted exploration, improved efficiency and cost effectiveness of production, better monitoring of impacts and by decreasing the potential for adverse hydrological and other environmental and social impacts.

Theme 2: Addressing Community Concerns

a. As part of unconventional gas leading practice it is essential to gain community support. This requires scientists, engineers and other stakeholders to actively and effectively engage with communities in an open and transparent manner that recognises communities differ and attitudes and concerns can change over time. In some cases opposition to unconventional gas developments may reflect not a lack of knowledge but underlying community values, therefore it is important to understand those values at the start of engaging with the community

b. Unconventional gas developments can and do bring significant socio-economic community benefits at local, regional and national levels.

c. The health and safety impacts associated with conventional gas production, which have been monitored over many years, are now considered to be well understood and can be minimised through the implementation of leading practice. In contrast, unconventional gas production has been underway for little more than a decade and consequently health impacts are not fully documented in publicly accessible databases, or through longitudinal studies or via independent research and health impact assessments. There is a need to collect more community health data (both baseline and operational) including for remote, vulnerable and disadvantaged communities where unconventional gas developments are planned or underway.

d. It is important that credible, impartial and trusted sources of knowledge and expertise communicate scientific, technical and socio-economic facts, models, anticipated outcomes and uncertainties in a clear, transparent and readily accessible way to communities likely to be impacted by unconventional gas developments, and to do so within the context of community values.

e. The extent of change in communities affected by unconventional gas developments needs to be documented, based on agreed indicators rather than perceptions, with cumulative socio-economic impacts requiring particular attention; inadequate attention has been paid to the impact of the “boom-bust” phenomenon experienced by some unconventional gas communities.

Theme 3: New Knowledge

a. Much has been learned from unconventional gas exploration and production to date, but at the local level, there are always unique geological features and challenges to understand natural contaminants, prevailing baseline conditions, natural variability, cumulative effects (social, environmental, economic), groundwater hydrology, community values and expectations, and emissions. Such knowledge is important when taking a risk-based approach to the management of impacts of the industry on the environment or the community.

b. There will be an ongoing need to generate new knowledge, new understanding, improved technologies, appropriate regulations, favourable economics and community acceptance, if unconventional gas resources are to be developed. Many countries will also require development of the requisite skill and infrastructure base.

c. Modelling the potential consequences of unconventional gas production is widely and appropriately used for forecasting likely impacts, but its effectiveness is often limited by uncertain parameterization and limited knowledge of rock heterogeneity and connectivity. Ongoing research is required to reduce these uncertainties and gaps in knowledge.

d. Sedimentary basins around the world are important for agriculture, natural resources and ecosystems, groundwater, and fossil fuel resources such as unconventional gas, but they are under pressure from competing resource and urban developments and are often poorly understood. There is a need for more comprehensive research into and documentation of sedimentary basin resources and processes and the cumulative impacts of basin developments on the natural and human environment.

Theme 4: Hydraulic Fracturing

a. Induced seismic events associated with hydraulic fracturing are almost always minor (generally less than 1 on the Richter Scale) and the likelihood of structural damage occurring from them is very low. Disposal of produced water by re-injection is more likely to trigger seismic events in the 1-3 range but this can be minimised by avoiding injection of fluids into areas with potentially active faults.

b. Unconventional gas projects need adequate background information on their geological/structural setting. This requires conducting seismic surveys, as well as effective seismic monitoring, in order to minimise the possibility of induced seismicity associated with existing faults being reactivated by hydraulic fracturing or more likely, by disposal of produced water.

c. There is scope for ongoing improvement in fracturing technologies, including through decreased use of water and chemicals, along with full public disclosure of the composition of hydraulic fracturing fluids.

d. There is no evidence of widespread, systemic impacts on drinking water resources from hydraulic fracturing of shales in the United States.

Theme 5: Groundwater

a. Poor well construction and improperly decommissioned wells are regarded as key risks to groundwater. It is important to ensure the adoption of leading construction practice and to demonstrate well integrity over the lifetime of a well. This requires the clear identification of responsibilities for any remediation over the lifetime of a well. The use of established procedures developed for conventional oil and gas operations is relevant to the protection of groundwater in unconventional gas areas.

b. Inappropriate waste water disposal, poor management of materials and spills of chemicals at the surface do occur at low rates during unconventional gas operations and can lead to ground water contamination. The adoption of leading practice and regulation are effective mechanisms to reduce both the occurrence and impact of these events.

c. The impact on fresh water resources arising from their use for hydraulic fracturing of shale gas developments can be small regionally but significant locally; in areas where there is a scarcity of water, other hydraulic options should be used, such as salt water or gases such as carbon dioxide.

d. The impact of CSG developments on groundwater arises not from the use of water but from the large quantities of produced formation water associated with gas production and from related impacts, such as the lowering of the water table.

e. To minimise the impact on water resources, unconventional gas developments need to adopt leading practice for monitoring, water treatment and reuse and for minimising spillage or leakage of used or produced water. Appropriately treated produced water can be used as a source of water for agriculture, or re-injected into aquifers.

Theme 6: Protecting Landscape and the Environment

f. Multiple well-head drilling, horizontal drilling and multi-stage hydraulic fracturing are large scale industrial processes that result in disruption, albeit temporary, at the well head and the surrounds.

g. Better planning of infrastructure, such as positioning of well pads, access roads and gathering and transmission pipelines is important if integrated land management is to be followed and environmental and biodiversity impacts minimised.

h. The environmental review process must be capable of assessing and adapting to new technological advances in production, new codes of behaviour, liability rules, outcomes of benchmarking and cumulative assessment practices

i. Local and cumulative environmental impacts of unconventional gas developments, such as habitat fragmentation and potential loss of threatened species, must be evaluated using a cumulative risk-assessment framework and this should inform planning and decision-making, such as siting and the location of associated infrastructure.

Theme 7: Emissions

a. Fugitive emissions must be considered in the context of a life-cycle assessment of greenhouse gas emissions, with uncertain estimates of the amount of fugitive methane emitted to atmosphere from well to final consumer.

b. The majority of fugitive methane is emitted from just a few points in the production –transport chain (‘super emitters’). These can be remediated through measures such as green completions and application of leading practice.

c. Baseline studies and monitoring of methane emissions during production and post well closure phases, is important in order to remove uncertainties regarding the magnitude of these emissions.

d. More consideration could be given to opportunities for using carbon dioxide in enhanced gas recovery and hydraulic fracturing and for applying carbon capture and storage to gas separation, gas-based power generation and gas-using industrial processes.

Theme 8: Regulation

a. Some regulatory regimes can be so complex (with hundreds of conditions placed on a single project), that the effective regulation of the industry and the meeting of community expectations regarding the reduction of risk can be jeopardised.

b. If regulations are to meet community expectations, protect the environment and reduce costs to industry, they must have clarity of purpose, transparency and engender trust.

c. An effective, efficient and enforced risk-based regulatory framework for unconventional gas developments is essential to safeguard the environment, ensure public safety, protect community interests and landowner rights, and ensure orderly developments.

d. Regulations should be outcome-focussed, adaptive to new data and conditions, and be informed by the best available science, technology and practice. This ‘adaptive management’ approach allows new data to inform the decision makers.

e. Regulatory leading practice can be achieved when operators are required to identify and manage agreed risks consistent with the ‘as low as reasonably practicable’ (ALARP) principle. It is broadly accepted that a goal-based approach, where it is the operator’s responsibility to identify all possible risks and how they are to be mitigated and demonstrably managed, is the most effective way to avoid damaging impacts on the environment and safety, and protect community interests and land-owner rights, and help facilitate the achievement of a social license to operate.