ADVANCE QUEENSLAND

Queensland Mining Equipment, Technology and Services

10-Year Roadmap and Action Plan

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Edition 2

Queensland Government

The Department of State Development, Manufacturing, Infrastructure and Planning

Copies of this publication are available on our website at www.statedevelopment.qld.gov.au and further copies are available upon request to:

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Foreword

The Queensland Government has a vision for Queensland's economy to be Australia's strongest and most diverse. Our strategy to achieve this vision is to strengthen our traditional industries and diversify our economy by nurturing new industries.

Queensland's world-class energy and resources industry faces new challenges in a highly competitive global environment.

Global population growth and increasing standards of living are contributing to demand for natural resources. While Queensland is well placed to meet this demand with its significant reserves of coking and thermal coal, base metals, bauxite, oil and gas, demand is increasing for efficiency and productivity of operations. Maintaining the long-term viability of the industry also requires securing the technology to cost-effectively develop resources that are increasingly difficult to access.

Increasing the scale of operations or incremental innovation will not be sufficient to meet these challenges. Step changes in technologies and processes used across the supply chain are now essential and this is creating a renewed drive to accelerate the energy and resources industry's rate of innovation. Bold leadership and investment will be required to maintain Queensland's place in the global industry.

Queensland's mining equipment, technology and services (METS) sector is a world leader in safety, mine site rehabilitation and remediation processes, knowledge and technology, contract mine servicing and project management. The sector is well positioned to assist the energy and resources industry find site-specific solutions to reduce production costs, make it easier to extract difficult-to-access resources and improve environmental outcomes. Partnerships between METS companies, the energy and resources industry and research institutions have the opportunity to create the innovative, profitable and environmentally sustainable mines and gas fields of the future.

Access to Queensland's global energy and resources companies, as well as the mid-tier and junior operators, is critical for local METS companies to develop and grow, and to test the innovative products, processes and services that have the potential to be incorporated into global supply chains.

In 2015, METS Ignited – an industry-led, government-funded growth centre for Australia's METS sector – was established at QUT's Gardens Point campus. The Queensland Government has committed $6 million over four years to METS Ignited to ensure Queensland METS firms fully realise benefits from METS Ignited initiatives. This Queensland-focused Roadmap complements the national METS Sector Competitiveness Plan developed by METS Ignited.

The Queensland Government is supporting the growth of METS and other priority sectors over four years through the Advance Queensland initiative – a $420 million comprehensive suite of programs to drive innovation, build on our natural advantages, diversify our economy and create the knowledge-based jobs of the future.

Part of the Advance Queensland initiative is the development of the Queensland METS 10-Year Roadmap and Action Plan. This Roadmap outlines our vision for the sector to become a global leader in the development of commercially valuable solutions for the energy and resources industry worldwide.

The Hon. Cameron Dick MP

Minister for State Development, Manufacturing, Infrastructure and Planning

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Vision

By 2027, through innovation and collaborative partnerships, Queensland's globally competitive METS sector will lead the development of commercially valuable solutions for the energy and resources industry worldwide.

The Queensland Government is committed to expanding the economic contribution of the state's METS sector and increasing employment in this knowledge-intensive industry sector.

Queensland's METS sector will build on its current competitive advantages, including the state's abundant natural resources, highly skilled workforce and the quality and diversity of METS companies by focusing on innovation and the collaborative partnerships required to increase commercialisation rates and drive business growth.

Through sustainable growth of the METS sector, Queensland will improve its international competitiveness, support regional growth and create the jobs to diversify its economy.

Queensland's METS Sector

More than 800 METS companies in Queensland

Generates $7b in revenue to Queensland

Global GDP to double driving growing commodity demand

Industry snapshot

Queensland's METS sector supplies equipment, technical, safety and other services to both the mining and oil and gas industries. This includes education, mine rehabilitation and remediation, mining technologies and contract service provision (e.g. scientific, technical and professional services).

The Queensland METS sector is well established, comprising more than 800 METS companies.[1] The sector is highly diverse, ranging from large contract mining companies capable of designing and building whole mine sites, to small firms that design and produce specialised equipment tailored to specific operations.[2]

While Queensland's METS sector is highly diverse in both size and scope, it is linked by core competencies in coal, oil, gas and minerals. According to Deloitte research, the Queensland METS sector employs 19,500 people across the state, especially in the resource regions of Mackay, Fitzroy, North West and Darling Downs-Maranoa, as well as a significant number of people in South East Queensland. The same research estimates that the METS sector generated $7 billion in revenue and $2.5 billion in value-add to Queensland in 2015-16.

Queensland's world-class resources, diverse environment and history of mining and gas extraction have contributed to our METS sector becoming a world leader in a number of areas, including research and development, project construction and operations, minerals processing, health, safety and environmental management systems, education, and various other fields of innovation.

Queensland has many METS companies leading their respective fields internationally in the development and commercialisation of new processes, technologies and products for the energy and resources industry. Growth in this sector has the potential to create new job opportunities for Queenslanders.

Industry drivers

The energy and resources industry has many of the biggest and most complex industrial operations in the world, which is a driver of demand for the services of METS companies. By the nature and scale of its activities, the energy and resources industry draws upon significant financial, human and natural resources. With this broad reach comes an equally broad set of stakeholders, ranging from financiers and shareholders to regulators and local communities.

Meeting the expectations of these stakeholders, while also remaining competitive in a highly dynamic industry, will continue to encourage energy and resource companies to look to METS companies to develop the innovative solutions they need. Queensland's METS sector is well placed to meet this demand. Its reputation for meeting and exceeding the needs of energy and resource companies is a key element in the value proposition offered by Queensland's METS companies internationally, and also makes it well placed to capitalise on domestic opportunities.

Demand for commodities is expected to continue with global gross domestic product predicted to more than double over the next thirty years. Much of this growth is expected to occur in Asia, led by China and India.[3] This growth in demand provides long-term opportunities for Queensland's METS sector.

Economic and technology drivers

The Queensland energy and resources industry is facing many of the same challenges that confront this industry globally. Finding and accessing quality ore grades or gas deposits is increasingly challenging. Productivity has fallen over the past decade and the industry faces significant cost pressures.

Prices for key commodity groups continue to fluctuate and Australian resource producers compete with countries across the world to get commodities to export markets at the lowest possible cost.[4]

While demand is expected to continue in the longer term, Queensland's METS sector is positioned to develop commercially viable products and processes to improve the economic viability of accessing and processing difficult-to-reach and lower-quality resources. Queensland's unique geography tends to limit the application of many techniques used in Europe and North America,[5] therefore locally developed improvements in technology and innovative solutions will continue to be required. Addressing these challenges will ensure the sustainability of energy and resource companies and, in turn, assist METS companies to maintain and grow their share of the current and future markets both in Australia and internationally.

Information technology forms the basis for innovation in data acquisition, modelling of resource deposits, mine site planning, and operational systems and processes. New sensing and communication technologies will drive improved safety and productivity and enable greater automation and remote control.[6] The volume of data generation and the ability to collect, store and analyse data will become central to business decision making.[7]

Australia is already a world leader in the development and export of integrated systems technology. Breakthroughs in automation, data analysis, modelling and resource processing have changed the nature of mining work. The rise in connectivity and remote sensing technologies is enabling the development of new remote monitoring and analytics solutions. This has allowed some METS companies to alter their business model from providing products, processes and services to working with producers to provide end-to-end services internationally, such as remotely monitoring mining operations.[8]

Environmental and social drivers

Globally, the environmental and social obligations of energy and resource companies and the level of accountability for their impacts are increasing, resulting in greater levels of sustainability reporting and increased regulation. Earning and maintaining a social licence for operations will continue to be an important factor for managing risk and optimising productivity in the future, particularly in the world's developing countries.[9] Companies will remain under pressure to ensure their activities have minimal impact on the natural environment, inform and support local communities and ensure worker health and safety.[10]

A growing number of energy and resource companies throughout the world recognise the economic and productivity benefits of adopting more environmentally sustainable planning, construction and operational processes and procedures. Reducing energy and water costs is a major focus for remote energy and resource projects worldwide.

To stay competitive, Queensland needs to remain at the forefront of research and development into socially and environmentally sustainable resource extraction processes throughout a project life cycle, from planning approvals and construction to operation, remediation and rehabilitation.

There is enormous potential for Queensland METS companies to succeed in international markets, specifically in developing countries where governments are looking to mitigate environmental impacts and improve relationships between energy and resource projects and the communities in which they operate.

Queensland's strengths

A stable government, strong and resilient economy and a mature METS sector make Queensland a leading destination to invest in energy and resources projects.

Queensland's abundant natural resources have underpinned the growth of a world-class energy and resources industry. The ongoing contribution of resource extraction to the Queensland economy provides the impetus for growth in the METS sector, while providing the opportunity to commercialise products, processes and services locally before entering international markets.

Queensland's METS sector has a number of competitive advantages that place the state in an excellent position to increase economic activity and employment. They include world-class education standards and workforce capabilities, universities focused on energy and resources, clusters of METS expertise, readily transferable skills and product offerings, and export opportunities driven by Australia's reputation for high standards and proximity to domestic and Asian supply chains.

World-class education and training facilities and a highly skilled workforce

Queensland has a highly skilled and productive workforce and strong, sector-specific education infrastructure. Our world-class education and training facilities include highly regarded universities and technical and vocational education institutes that offer mining and energy-focused study and skills development.

METS companies are evolving and changing their skills profile as energy and resource operations increase their focus on low-impact, sustainable practices through big data, robotics, automation and systems integration. Queensland's education system is well positioned to respond to these changes in future workforce skill requirements and will be further supported through the Queensland Government's Advancing Education Action Plan. This plan includes a focus on science, technology, engineering and mathematics (STEM) education in Queensland schools.

World-class research institutions focused on energy and resources

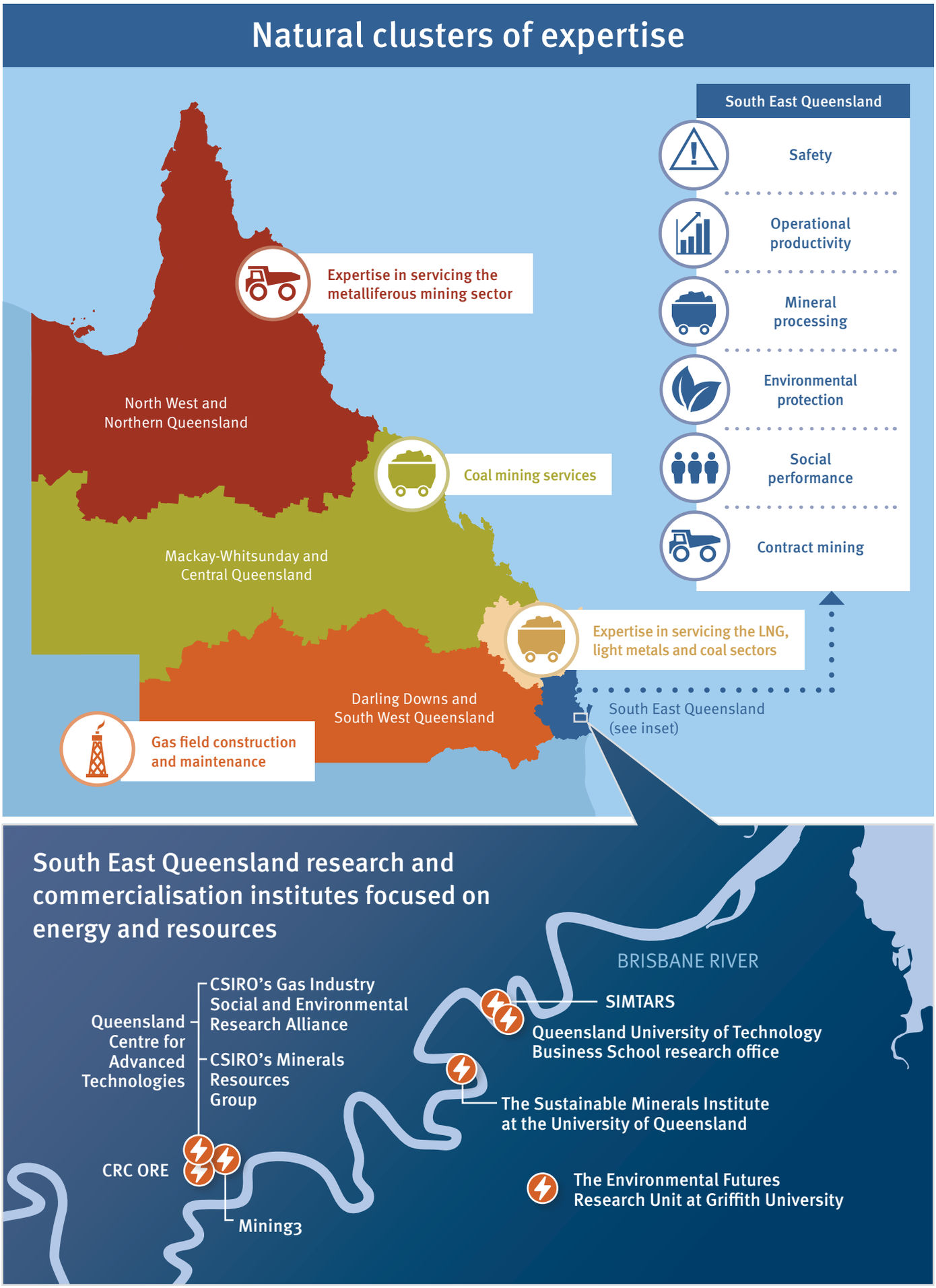
A number of Queensland's education institutions are major centres of energy and resources-related research across the entire supply chain, from exploration to extraction to processing and finally rehabilitation. Areas of research include social licence and socioeconomic development, environmental excellence, geological mapping and analysis, mineral processing, technical and operations system safety, extraction and processing optimisation, and autonomous environment.

Research and commercialisation institutes include:

- the Sustainable Minerals Institute at the University of Queensland, including the Centre for Coal Seam Gas
- Queensland University of Technology Business School research office
- the Environmental Futures Research Unit at Griffith University
- Mining3 (CRC Mining and a division of CSIRO's Minerals Resources Group)
- CRC ORE
- CSIRO's Minerals Resources Group
- CSIRO's Gas Industry Social and Environmental Research Alliance
- Queensland Centre for Advanced Technologies
- SIMTARS, a division of Queensland's Department of Natural Resources, Mines and Energy.

The reputation of these organisations is well established internationally. This is a key strength for the sector. It also presents a great opportunity for the Queensland METS sector to collaborate and develop practical, commercial solutions to industry challenges, based on the latest research from these organisations.

Natural clusters of expertise



Natural clusters of expertise

Queensland is home to more than 800 METS companies operating in diverse areas of the sector. The connections between the companies, suppliers and institutions have resulted in the development of natural clusters of expertise in various locations across Queensland.

For example:

- South East Queensland has a cluster of METS companies with a particular focus on safety, operational productivity, mineral processing, environmental protection, social performance and contract mining.
- Darling Downs and South West is the base for a number of METS companies specialising in gas field construction and maintenance for the Surat Basin and beyond.
- Mackay-Whitsunday and Central Queensland are recognised hubs for coal mining services.
- North West and Northern Queensland have a reputation for METS companies that have developed specialised areas of expertise in servicing the metalliferous mining sector.

These clusters form the basis for building collaborative partnerships and developing innovative products and services, leading to increased growth and employment.

Readily transferable products, services and skills

Queensland is already recognised by the World Bank as a global innovation hot spot.[11] Our METS sector is known for its cutting-edge, innovative solutions, products, processes and services. Its global success has resulted from its penetration into supply chains worldwide and reputation for problem solving and best practice. The sector has the potential to continue to work with industry and researchers to enhance the productivity and efficiency of existing and new operations – and not just for the energy and resources industry.

METS sector products, services and skills are highly transferable to other industry sectors and markets in other locations. Similarly, technology generated within other industries can be applied to Queensland's METS sector.

Reputation for high standards

Australia currently has some of the highest levels of environmental protection requirements and workplace safety regulations in the world. As a result, Queensland's METS companies are world leaders in the development of products, processes and services to reduce the environmental impacts of operations and improve workplace safety systems. Australia's leadership in these fields has created significant export opportunities for Queensland's METS sector to expand into new markets that are seeking to integrate improved safety and environmental processes.

Proximity to domestic and Asian supply chains

Queensland has a number of global energy and resources companies operating in the state, supported by a large number of small and medium enterprises. Access to these energy and resources companies provides the opportunity to develop and grow local METS companies, as well as to test the local market with innovative products, processes and services that may be incorporated into global supply chains.

Queensland's ideal position at the gateway to the Asia-Pacific offers ready access to national and international markets. Being positioned on the north-eastern perimeter of Australia also means we are in a business-friendly time-zone with Asian markets.

Industry challenges

The opportunity for growth of the METS sector is significant. However, industry consultation exposed some challenges to be addressed to reach the vision of a thriving hub of innovation, commercialisation and growth.

Some of these challenges will be addressed directly by the Queensland METS 10-Year Roadmap and Action Plan, while others will be addressed through other government initiatives, such as Advance Queensland and the Australian Industry Growth Centre, METS Ignited. Other challenges relate to the cyclical nature of resource development, which is driven by international commodity prices, and beyond government control.

The five key challenges identified by industry to further business growth are outlined below.

Access to investment capital

It is recognised that Australia has a small venture capital industry.[12] In the absence of access to venture and growth capital in Australia to support new ideas from concept to commercialisation and growth, METS firms have traditionally self-funded or relied on investment from their customers, such as large mining firms.

The recent decline in commodity prices and subsequent market pressures on operational costs and productivity means that large mining companies have reduced their internal research and development budgets and increasingly outsourced these activities to their key suppliers. This shift means that many smaller METS companies are now solely carrying the risk of commercialising new products, processes and services.

Industry indicates that improving the support of research, development and commercialisation of new ideas will help de-risk investment and attract capital to the sector.

Levels of collaboration

To improve the competitiveness of the energy and resources industry in Queensland, innovations in products, processes and services need to be identified across the entire supply chain. Currently there is a fragmentation of research and development effort because of a lack of collaboration between industry and researchers. Improving links between research institutes, the energy and resources corporations, and METS companies will help identify opportunities to find solutions for existing resource industry challenges.

There is a strong argument for improving the level of collaboration between these three key players. Bringing energy and resources companies, METS companies and researchers together is key to

understanding changing industry demand, developing new or improved products, processes and services quickly and bringing them to market.

Links to technology drivers

Innovation is central to the responsible growth of the energy and resources industry. To remain globally competitive, the industry will need to apply solutions driven by data analytics, automation and robotics. Innovative solutions are also required to reduce energy costs. METS sector companies are focusing on these technology drivers as a critical first step to ensure ongoing growth.

Business capability improvements

The application of modern business techniques such as cost-to-profitability analysis, design-led innovation, lean production technologies and supply-chain market development are necessary to METS companies' success, particularly when seeking to expand their business. Investment in modern business systems, particularly data management and data analytics, would improve the competitive advantage of Queensland METS companies.

Accurate market intelligence is also crucial for METS companies looking to export. Industry indicates that marketing effectiveness is increased and time and money can be saved if companies establish the right connections from the start. During industry consultation, there were many stories shared of lost time and money from investing in unproductive relationships in foreign markets.

Companies seeking to innovate and/or enter new markets may need

Case study: Exploration Drill Rigs (XDR)

The mining sector is notoriously cyclical, but Exploration Drill Rigs (XDR) is pursuing equilibrium – and growth – by adapting and growing its products for new resources and reducing its manufacturing costs.

Redbank-based XDR designs, engineers and produces a range of innovative drilling rigs and ancillary products for the international mining industry, including the petroleum and gas industries.

Under XDR's current business model, project management, research and development and innovation are undertaken at its facility in Queensland, and all major manufacturing is performed at the plant it built in Gujarat, India.

Gujarat was developed to enable XDR to minimise costs while maintaining strict control over the quality of the parts used in its rigs and associated products. It also enables XDR to help other Queensland companies gain a competitive advantage by manufacturing products under contract.

The model proved invaluable when elements of Australia's mineral industry began shrinking in 2012 and XDR looked to the emerging coal seam gas industry for an additional revenue stream.

'We spent a lot of effort developing and refining our product to ensure it met safety and quality standards,' explains Andrew Heseltine, XDR's head of Group Business Development. 'We faced a lot of resistance from companies to try something new over tried-and-tested traditional techniques and rigs.'

Michael Ilett, CFO of XDR, says there are lots of benefits to XDR rigs and technology. 'XDR's rigs operate safely with four people on a shift and can be set up in 30 minutes; the innovative design eliminates the need for guy ropes, certain permits and pilots; plus it has everything on-board required to workover and maintain a well.

'Put simply, we have less people on site, less operating costs and our machines are very low maintenance due to unique design and construction.'

appropriate business models and skills. Companies have indicated they may require assistance to develop appropriate business models, sales skills, marketing materials, undertake export readiness training and have access to timely, accurate market intelligence. Support for companies will assist promotion of new products and skills in potential new markets.

Cost of doing business

In the world market, Australia is a leader in a number of 'ease of business' criteria for companies looking to establish new operations.[13] Australia is also well known for its mature and stable financial and legal systems. However, some costs of running a business in Australia (e.g. labour, transport, regulatory and energy costs) are higher than some of our competitors.[14]

METS companies have identified red tape and regulation as a significant cost. Historically, Australia's political stability has been an advantage which narrowed the cost difference, however the gap between Australia and its competitors in this area is closing.

While the recent depreciation of the Australian dollar has improved the attractiveness of Australian products to world markets, Queensland METS companies need to be innovative and add value to their products, processes and services to ensure they are not competing on price alone. The challenge is to maintain our position as a favourable place in which to establish new businesses in an increasingly competitive environment.


ASC

Actions to date

Supporting Queensland's advanced manufacturers

Queensland's METS sector has developed a significant amount of advanced manufacturing equipment and technical skills across Queensland.

Advanced manufacturers also contribute significantly to the state's economic growth and prosperity. The Queensland Government is committed to supporting these businesses, a number of which are METS. The Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan identifies a number of initiatives to assist these businesses grow and innovate.

The Advanced Manufacturing Benchmarking Program assists businesses to measure their performance and practices and subsequently informs their choice of a suite of business improvement measures, offered by the Department of State Development, Manufacturing, Infrastructure and Planning or other agencies, to help them grow and innovate.

The Boosting Business Productivity Program comprises a series of workshops, forums and specific programs delivered across the state to strengthen business model development and management skills, increase participation in global supply chains and address rising energy and other input costs.

The Advanced Manufacturing Transition Package, supported by a network of 'best practice' advanced manufacturing businesses, includes a series of workshops and forums delivered across the state to develop digital business capability and assist in new technology identification and absorption.

Jobs Queensland is developing the Skills, Training and Workforce Development Strategy to prepare businesses for the new technical and workplace requirements of the future. The Strategy will include analysis of issues across the manufacturing components of the METS sector with a focus on the skills required to transition (METS) manufacturers from broad-based manufacturing to advanced manufacturing models.

Business mentoring for innovation

The Engineering, Construction and Resources Innovation (ECRi) Hub is a Queensland Government initiative to support the development and uptake of innovation in the engineering, construction and resources industries.

The broad goals of the ECRi Hub are to:

- create opportunities for collaboration
- help innovators get to market
- match solutions to challenges
- drive economic benefit.

This program will connect selected startups or small-to-medium enterprises with professional skills, services and knowledge that can improve their ability to commercialise new ideas/technology.

Supporting METS to access supply chain opportunities

The Accessing Supply Chain Opportunities (ASCO) program (developed in cooperation with major resource project proponents) is a suite of business development activities to support both suppliers and project proponents, particularly those within the energy and resources industry. A core focus of ASCO is to encourage local supply of goods and services.

The ASCO program aims to increase supply chain participation for suppliers and potential suppliers through a series of workshops focused on:

- addressing issues in the supply chain
- developing a better customer focus
- understanding and responding to major project supply chain requirements
- becoming more aware of major project opportunities
- being better placed to submit competitive tenders.

Case study: NLT Australia

Caboolture-based NLT Australia has set the standard for operating wi-fi in underground coal mines by developing the world's first intrinsically safe wireless access point (where energy levels are low enough to avoid causing ignition of methane gas).

NLT Australia is a subsidiary of Northern Light Technologies, a Toronto, Canada-based global leader in mining cap lamps and tracking and communications systems, with a particular niche in underground coal mines. NLT Australia has a further focus on wi-fi communication systems for deployment in remote and difficult locations.

NLT Australia has developed from a sales and support operation for its parent company into a world-class research and development, engineering, manufacturing and service operation with 23 employees and growing.

It was NLT's founder, Tim Haight who pushed the Australian subsidiary toward developing wi-fi communications for underground coal mines. 'People told me I was crazy... [but] we ended up designing the product to enable us to successfully deploy it in this hazardous environment.'

'In an intrinsically safe environment you have to design the product so that even if there's a catastrophic failure it won't create a spark to ignite methane gas, yet you still need a good output of power to enable the power to reach long distances.'

As well as being a source of innovation and know-how, NLT Australia's Caboolture facility manufactures most of the communications technology for NLT distributors worldwide.

NLT's products provide personnel and asset tracking; voice over wi-fi; real-time vehicle monitoring and traffic management; two-way text messaging; environmental monitoring; operational video conferencing for consultation with remote experts; and on-demand, remote control of machinery.

NLT plans to expand its technology to tunnels, refineries, process plants, factories and other industrial environments. 'Our software and hardware products are awesome,' says Haight, 'so we're poised to do some really amazing things.'

Developing and promoting the METS sector

The promotion of METS sector capabilities and investment opportunities in Queensland is an important early stage element for long-term growth and sustainability. The Queensland Government is already promoting the Queensland METS sector to encourage sectoral growth.

Trade & Investment Queensland (TIQ) is the government's global business agency, assisting exporters to break into emerging and established markets and promoting Queensland as the ideal place for investment. It has an overseas network of Trade and Investment Commissioners and a network of Regional Advisers within Queensland.

TIQ offers services to potential investors in Queensland, potential buyers of Queensland products, processes and services and potential Queensland exporters. TIQ's export services include consultation and planning around a firm's export readiness, export development assistance such as identification of markets and trade barriers, managing outbound virtual and face-to-face trade missions to assist firms with establishing market contacts, hosting inbound trade missions and virtual trade missions, and participating in international trade exhibitions.

Resources Investment Commissioner

The role of Queensland's inaugural Resources Investment Commissioner is to encourage new investment capital from across the globe into Queensland for new exploration activity and energy and resources technology. By promoting Queensland's energy and resources investment opportunities to the world, the Commissioner is playing a crucial role in enabling new projects to provide jobs through delivery of demonstrable growth in resource industry investment and the state's METS sector.

Supporting innovation and growth

Many promising startup companies have limited access to investment capital to support them through the research and pre-commercial stages of sustainable enterprises. To address this market failure, governments provide financial and other incentives to assist companies to commercialise their products, services and processes. Globally, successful METS sectors tend to be supported by strong government programs and subsidies prior to becoming self-sustaining.

The Queensland Government's Advance Queensland initiative has a number of programs and funding opportunities that can help Queensland METS companies innovate and grow including:

- **Industry Attraction Fund** to attract businesses to Queensland, by either relocating or establishing new projects in the state. The fund will support job creation, regional growth, increased innovation and the building of local supply chains
- **Knowledge Transfer Partnerships** program to help businesses with two-thirds of the cost of hiring a graduate to work on an innovative project
- **Ignite Ideas Fund** to support the development of new or improved products, processes or services to secure investment, launch into global markets and grow business
- **Business Development Fund** to help turn ideas into reality with co-investment in Queensland businesses at the forefront of commercialising ground-breaking research or innovations
- **Industry Accelerator Program**, including an early-stage METS industry accelerator, to develop and market-test new products and services, positioning participants to seek investment and customers
- **Innovate Queensland,** a series of capacity-building workshops, webinars and collaboration activities aimed at innovators, entrepreneurs and organisations. These workshops are designed to help small-to-medium-sized enterprises implement practical innovation and technology commercialisation solutions, grow their business through innovation activities and create jobs for the future
- the Office of the Queensland Chief Entrepreneur, led by the **Queensland Chief Entrepreneur**, plays a vital role in building and promoting the importance and contribution of entrepreneurship and investment in Queensland.

METS Ignited established in Queensland

Queensland is home to METS Ignited, an industry-led initiative with a vision of an aligned, collaborative, agile Australian METS ecosystem enjoying a growing share of the global market through leadership and innovation. METS Ignited is part of the Australian Government's Industry Growth Centres initiative, with a committed $14 million in funding over four years.

The Queensland Government is supporting METS Ignited by committing a further $6 million to drive the early development and piloting of national METS sector initiatives in Queensland and supporting activities directly of benefit to Queensland. No other government has made a financial contribution to this growth centre.

In November 2016, METS Ignited released its Sector Competiveness Plan for Australia's METS sector. This plan was developed following an extensive program of consultation across Australia with METS and mining companies. It was further informed by an analysis of existing publications and new research.

The Queensland Government is working with METS Ignited to deliver six initiatives under this plan and thereby gain access to the knowledge, resources and efficiencies offered by this partnership.

Being located in Brisbane, the growth centre provides the highly innovative small and medium enterprises in both South East and regional Queensland with direct access to the programs being developed in partnership with the Department of State Development, Manufacturing, Infrastructure and Planning. This will assist them to develop and commercialise ideas arising from partnerships between the METS sector, the energy and resources industry, universities and research institutions.

The Queensland METS 10-Year Roadmap and Action Plan has been designed to leverage METS Ignited's Sector Competitiveness Plan.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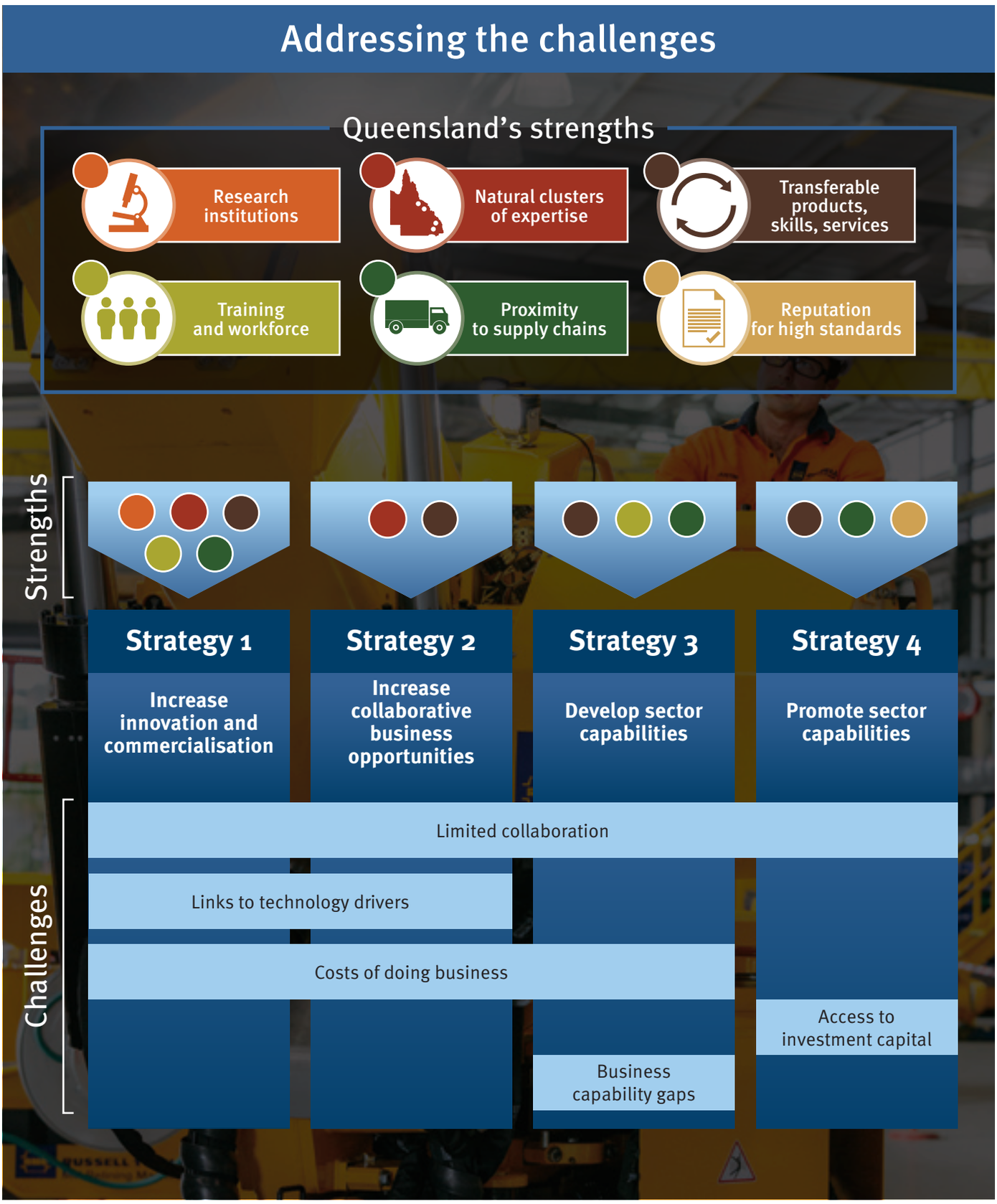

Addressing the challenges
Queensland's strengths
Research institutions
Natural clusters of expertise
Transferable products, skills, services
Training and workforce
Proximity to supply chains
Reputation for high standards
Strengths
Strategy 1
Increase innovation and commercialisation
Strategy 2
Increase collaborative business opportunities
Strategy 3
Develop sector capabilities
Strategy 4
Promote sector capabilities
Challenges
Limited collaboration
Links to technology drivers
Costs of doing business
Access to investment capital
Business capability gaps

Future strategies and actions

Although a number of actions have been undertaken to support and grow Queensland's METS sector, more must be done to ensure Queensland's METS sector will lead the development of commercially valuable solutions for the energy and resources industry worldwide.

The following strategies detail the actions identified to assist the Queensland METS sector achieve this vision.

Strategy one: increase innovation and commercialisation

As market and operating conditions change, the METS sector must continue to innovate to create value and ensure the growth and long-term sustainability of the energy and resources industry in Queensland.

If the Queensland resources sector is to remain globally competitive, it must have a strong innovation focus. This is not just a matter of adopting off-the-shelf initiatives developed elsewhere, but of sustaining a culture of innovation and building the skills, capabilities and resources required to develop and implement effective solutions locally.[15] Ultimately, companies that innovate grow faster[16] and are more profitable than those that don't.[17]

Although Queensland's METS sector has proven itself in the development of new products and services to support the energy and resources industry, a key challenge for research institutions and companies is translating ideas into commercial opportunities.

The following actions are designed to assist with increasing innovation and commercialisation.

Establish an accelerator pathway for Queensland METS companies seeking to commercialise new products or processes

Innovation accelerators can help to both improve commercialisation timeframes and hasten the decision to abandon a particular proposal due to its lack of commercial viability.

Accelerators support new and established companies through the innovation process by leveraging corporate assets such as industry know-how and financial resources. Innovation accelerators form an important and growing part of innovation ecosystems. They are fixed-term, cohort-based programs that include mentorship and educational components and, depending on the design, provide access to funds, investors or potential customers.

The Queensland Government, through the Advance Queensland initiative, is supporting an industry accelerator for METS companies at the early stage of the commercialisation process. It will offer programs to develop and market-test new products and services, positioning participants to seek investment and customers.

The Queensland Government, through the Department of State Development, Manufacturing, Infrastructure and Planning, and METS Ignited will complement the early-stage accelerator by establishing a late-stage accelerator program for companies seeking to commercialise products that have already been developed and market-tested.

This accelerator program is intended to prove the commercial viability of new technologies to attract investment into Queensland and grow METS sector jobs. It will facilitate Queensland METS companies to commercialise innovative products and services that are ready for market.

This late-stage accelerator will also complement the Engineering, Construction and Resources Innovation Hub's activities, which will support innovation being driven by the internal research and development departments within energy and resources companies. This strategy will demonstrate the Queensland Government's commitment to supporting the entire innovation value chain for the energy and resources industry. Implementation of these accelerators will assist locally based providers to reduce their innovation timeframes

and increase their likelihood of successful commercialisation by being able to identify and respond quickly to opportunities and move rapidly from the generation of ideas, through testing and development to commercialisation.

Investigate the development of a suite of facilities for METS companies to test new products, processes or services in Queensland

Industry feedback has identified a need for facilities to test new products, processes and services during the development and commercialisation processes. Access to test facilities will assist Queensland companies to prove up their prototypes in order to encourage potential customers to allow testing in real operational environments.

A comprehensive suite of test facilities has the potential to attract additional income to existing facilities and encourage investment in Queensland's METS sector. It will also provide facilities for live testing of ideas generated through Queensland's accelerator programs. The Queensland Government will work with METS Ignited, industry and research bodies to investigate the potential for developing a suite of facilities for METS companies to test new products, processes or services in Queensland. This will include identification of existing and potential facilities.

Pilot an open innovation community in Mackay

The government is supporting Mackay to pilot an open innovation community of METS companies, Bowen Basin mining companies and researchers focused on addressing the specific challenges of Bowen Basin miners. Promotion and

Case study: 3D Data Guidance

A 20 per cent increase in efficiency is a win in any industry, but when it involves mining and agriculture, the benefits can have a significant effect on the environment, jobs and safety.

Toowoomba-based 3D Data Guidance has designed a high-production bulldozer blade, called a Spade Blade™, which significantly increases bulldozer capacity, productivity and efficiency in comparison to conventional blades.

3D also offers software solutions for large bulk earthwork strategies in mining, civil works, agriculture and rehabilitation operations, and when the Spade Blade™ and software are used together, productivity gains can be doubled.

The Spade Blade™ reduces load time, fuel consumption and wear-and-tear on drive components. It also penetrates very hard material without 'ripping', which can reduce or eliminate the need for blasting in mines. Ripping is a method of loosening hard soil in order to be able to move it.

Independent testing demonstrated production gains of up to 30 per cent, and trials by an independent engineering company showed the Spade Blade™ performed up to 30 per cent better than the conventional U-shaped bulldozer blade.

The Spade Blade™ has potential applications for earthmoving companies, mining companies, dry bulk material handling terminals and earthmoving equipment rental companies. Its ability to reduce the need for ripping makes it particularly useful in wet weather when trucks cannot run. Other benefits include increased fuel efficiency, reduced cycle times, shorter use of equipment on fixed-contract projects, less load carry-back down the hill, and ground penetration beyond the capabilities of standard blades.

Meanwhile, 3D's unique software system simulates the movement of material for bulk earthmoving projects and works out the most efficient path to push material. 'The blade and software are two separate products,' explains company founder David Hall, 'but when combined you get significant production gain.' Published articles report that, irrespective of the shape of the blade, the software demonstrates savings of up to 40 per cent. These products have the ability to improve implementation and timeline for completion of large-scale mine rehabilitation plans.

facilitation of this community's goals will be supported by the Queensland Government, METS Ignited and regional partners. As a pilot, this model will be reviewed for application to other regional METS centres in Queensland.

It is intended that the community will work collaboratively to develop and commercialise solutions to challenges identified by representatives of Bowen Basin mining companies.

The development of business ecosystems that are based upon collaboration and mutual advantage brings sustainable benefits and growth to the wider economy[18].

Strategy two: increase collaborative business opportunities

The Queensland Government recognises that collaboration is a critical element of successful innovation. Successive ABARE-BRS surveys have found that collaboration is an important mechanism of capability development for METS firms. Customers were consistently identified as the most important collaboration partner.[19]

However, Australia is near the bottom of OECD rankings on collaboration, whether 'business-to-business' or 'business-to-research'. Innovative Australian businesses that effectively collaborate with research organisations are 242 per cent more likely to report increases in productivity compared with those that don't innovate.[20] The following actions are designed to increase collaboration across the METS sector.

Create an energy and resources technology networking series

An energy and resources technology networking series will be introduced and held in different regions across Queensland, focusing on sharing information about new technology for the energy and resources sector. It is intended that each event will encourage mutually beneficial interaction between local

METS companies, miners and gas producers, as well as researchers focused on addressing the energy and resources sector challenges. Topics will be as diverse as reducing energy costs, the application of data analytics and software, automation and robotics.

It is envisaged that these events will link with METS Ignited's strategies to align miners, METS companies and researchers and will encourage greater interaction within the clusters of expertise that have developed in a number of Queensland's regions. It will also enable METS companies to become more resilient by identifying opportunities to diversify service provision to other industries.

Develop and promote clusters of expertise

The Department of State Development, Manufacturing, Infrastructure and Planning will partner with local agencies and industry bodies to grow regional clusters of expertise, focusing on developing business opportunities for those METS companies with specialist expertise.

Six separate clusters of METS expertise are ready for development. While the safety, operational productivity, mineral processing, environmental protection, social performance and contract mining clusters have been identified, they have no formal structure or recognition. Functioning clusters foster innovation, strengthen entrepreneurship, enhance productivity, profit levels and employment growth in industries, and also boost regional economic performance.[21] However, government support is often critical for effective cluster creation and sustainability.[22]

The Queensland Government will work with METS Ignited, Brisbane Marketing and industry to bring South East Queensland cluster members together. Increasing collaboration between these clusters and relevant industry partners will enable members to identify common goals and challenges, enabling increased productivity and enhanced potential for innovation.

Case study: Berg Engineering

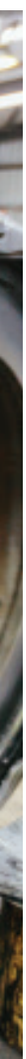
Berg Engineering is almost unrecognisable from its humble beginning in 1972 as a machine shop in a suburban Bulimba garage. Roger Berg founded and developed the business offering 'high quality manufacturing for a reasonable price, delivery always on time'.

These days the company has evolved into a $30 million business employing 170 people across four countries and specialising in maintenance and refurbishment of critical assets like pumps, valves and gear boxes for multinational companies. However, founder Roger Berg's philosophy remains true in the hands of his son, Derek Berg, who is the current CEO and MD of Berg Engineering.

'Today, we work closely with our clients to provide customised solutions and asset optimisation,' explains Berg. 'We offer considerable savings, performance excellence and efficiencies by taking control of their entire pump or valve fleet and help them to make decisions about fleet management and the asset's design, procurement and maintenance.'

Berg offers six stages of service: financing, engineering, manufacturing, commissioning, maintenance and retirement. Its Asset Optimisation Program provides end-to-end management of assets, and Berg says clients have reduced operating costs by up to 19 per cent, with a range of 10-15 per cent on consumable and simple items and 20-30 per cent on complex and difficult items.

Berg Engineering has an impressive roster of customers, including Queensland Alumina, BP, Caltex, CS Energy, NRG United Group, Xstrata, PT Freeport, Glencore, BHP, Rio Tinto and Vale. As the company looks to the future, Derek Berg is determined to 'take what Australia does well – innovation in the mining industry and our ability to remain relevant in a relatively high-cost country – and to export it throughout South East Asia'. To date, the company has offices in Brisbane, Gladstone, New Caledonia (Noumea) and Indonesia (Jakarta), with plans to open soon in Singapore.



Create opportunities for METS companies to supply energy-efficient solutions to the resource industry

According to the Energy Efficient Exchange, a joint initiative of the Australian, state and territory governments, the comminution process—the grinding and crushing of ore—is the most energy-intensive step in mining and accounts for around 40 per cent of the total energy used on metalliferous sites.[23] Up to 3 per cent of the world's total electrical energy consumption is attributed to the comminution process.[24]

The Coalition for Energy Efficient Comminution (CEEC) is an industry-funded, not-for-profit organisation which has supported the development of an analytical tool to allow mining operators to benchmark their current comminution energy efficiency in processing ores.

From the CEEC energy curve, mining operators can establish a baseline of their current processing efficiency. Potential processing improvements can also be assessed against this baseline. The introduction of alternative processing strategies can lead to significant savings in mine site energy consumption.

The Department of State Development, Manufacturing, Infrastructure and Planning and METS Ignited will fund CEEC to commission research to extend the capability of this analytical tool to include the collection of more detailed information about energy costs. Queensland METS companies can then apply this tool to the development of mine-specific solutions.

Workshops to facilitate this process will be funded by the Queensland Government and METS Ignited and delivered by CEEC.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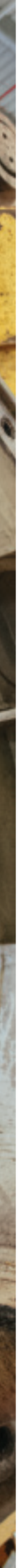

Strategy three: develop sector capabilities

Industry forums undertaken by the Department of State Development, Manufacturing, Infrastructure and Planning identified a number of capability improvements needed for business growth. Similarly, Austmine identified areas where METS companies need to improve business capabilities prior to commencing exporting or expanding export business, with one of the most commonly identified being international marketing capabilities (identified by 27 per cent of members).[25]

Develop entrepreneurial management capabilities, innovative business models and industry development frameworks

The Queensland Government will partner with METS Ignited to support a centre focused on developing entrepreneurial management capabilities, innovative business models and industry development frameworks in the METS sector.

QUT proposes to establish a centre, where the research will focus on developing the managerial skills, business models and industry support frameworks for METS companies to create and capture value from new technology.

While METS companies have significant technical capabilities, entrepreneurial skills in relation to change management and international business development are essential for future growth. Transformative business models focused on collaboration and commercialisation of new technologies are also essential.

The findings of the centre's research will be applied by Queensland's METS companies keen to develop the capabilities and business models that will best set them up for success. Findings of the centre's research will also inform design and implementation of future industry development programs for Queensland's METS sector.

Deliver business capability training

The Queensland Government will deliver training to build the business skills required for export and investment readiness.

This training will build the capability of participating METS companies to take advantage of the opportunities in international markets and to engage in international trade.

This training will be provided through the Queensland Trade and Investment Strategy 2017-2022.

Establish a concierge service to connect Queensland METS businesses with programs to support the METS sector

The Queensland Government will establish a concierge service to assist Queensland METS businesses to navigate the range of programs currently on offer to support the METS sector.

Advance Queensland, TIQ, Austrade, peak bodies, the Federal Department of Industry, Innovation and Science and the Federal Government's METS and Oil and Gas Growth Centres all deliver programs designed to drive growth within the METS sector.

By connecting Queensland's METS businesses with these programs, the concierge service will ensure that the benefits of these programs are shared among a wider audience and minimise costs to METS companies, particularly small and medium enterprises, in identifying assistance programs.

Develop baseline information on industry size, capability and collaboration

The potential value of effective collaboration between METS companies, researchers and energy and resource industry representatives is well recognised.

Quantifying the current size, capabilities and interactions within the sector is important to develop a baseline against which to measure the impact of strategies identified in this Roadmap and future actions.

For this reason, the Queensland Government and METS Ignited will commission research to develop baseline information on the size of Queensland's METS sector, the capabilities of individual METS companies and the extent to which METS firms collaborate with each other, energy and resources companies and researchers.

This will allow analysis of:

- the extent to which METS firms collaborate and with whom
- outcomes generated by different collaboration strategies of METS firms and whether they lead to more innovation, new business ventures, etc.
- the effectiveness of capabilities, culture and management systems in enhancing the value of collaboration for delivering positive outcomes for METS businesses.

The outcomes of this analysis will enable government to gauge the effectiveness of current strategies and assist the development of future policies to improve the health of the sector, the capabilities of its participants and the extent and value of collaboration.

Strategy four: promote sector capabilities

METS Ignited's Sector Competiveness Plan acknowledges the perception that while Australia is generally well recognised for the innovation of its small and medium enterprises and for the quality of its METS sector, it does not yet have a clear brand positioning in the global market.

The proposal to develop an Australian METS Brand and Value Proposition is strongly supported by the Queensland Government, which recognises Queensland's METS companies will benefit from the application of this branding. The programs outlined below will promote the quality and capabilities of Queensland's METS sector and publicise its specific contribution to the Australian brand.

Implement a program to promote Queensland's METS sector in domestic and international markets

The Queensland Government will drive growth in Queensland's METS sector by:

- promoting the sector at national and international trade shows
- providing information about Queensland's METS sector's capabilities and raise awareness in the international market
- utilising social media channels to encourage peer-to-peer learning within the sector
- creating marketing material, case studies and videos to highlight the capabilities of Queensland's high-performing METS companies.

Facilitate international trade opportunities

The benefits of exporting can be substantial with access to new customers generating business growth and increased revenues. During an economic downturn, exporting increases the sustainability of a business through geographic and market diversification. The 2016 Global Innovation Index Report shows that being a successful innovator requires joining the global marketplace to find new users for products, services and technologies and gaining knowledge to further innovate[26].

The Queensland Government, through TIQ, is focused on assisting Queensland companies to participate in global supply chains.

The Queensland Government will facilitate international trade opportunities by continuing to work with TIQ and Austrade to promote Queensland's METS sector in overseas markets, and create business opportunities by promoting the expertise of particular METS companies to potential foreign customers.

TIQ will continue to provide METS companies with opportunities to engage with potential partners and buyers through a range of activities including participation in business matching activities and arranging meetings with visiting delegations. Access will also be provided to the Queensland Government's network of in-market offices, export advisors and market specialists.

Develop an online portal to promote industry capability

The Queensland Government will develop an online portal to promote Queensland's METS sector. The portal will host an industry directory of Queensland METS companies and will provide information on Queensland METS companies' capabilities to a national and international audience.

Case study: Mine Energy Solutions (MES)

With the world moving away from liquid fuels like diesel, Crestmead-based Mine Energy Solutions (MES) has created HDCNG™, an 'end-to-end' fuel solution that compresses, transports and delivers natural gas to mine sites and converts vehicles to dual fuel operation.

For the mining industry, HDCNG™ can deliver fuel cost savings of up to 30 per cent, reduce carbon dioxide emissions by up to 20 per cent and reduce diesel particulate levels by more than 80 per cent. HDCNG™ could also significantly reduce heavy transport of diesel on Queensland roads which could improve road safety and potentially reduce future road maintenance and upgrade costs.

MES is a joint venture between IntelliGas, a Queensland-based gas technology company, and Sime Darby, a large Malaysia-based multinational corporation with employees across 23 countries. Sime Darby is also one of the largest Caterpillar dealers in the world and employs 3500 Queenslanders at its wholly owned subsidiary, Hastings Deering.

The company worked closely with the mining industry to develop its dual fuel system to meet the needs of mine trucks. A HDCNG™ prototype was launched in May 2015 at a mine site training facility in Morayfield. After further research and development, in late 2016 a truck at the New Acland coal mine on the Darling Downs was fitted with a dual fuel mix of 85 per cent gas and operated under real mine conditions with a load of more than 200 tonnes of coal.

Graham Box, Business Development Manager at MES, reports that this truck exceeded all expectations with no reported loss in power, speed or performance. Having proved itself as a viable fuel alternative for heavy-duty trucks and other high-horsepower applications in mining operations, HDCNG™ is now in the early stages of commercialisation.

Queensland Mining Equipment, Technology and Ser

Vision	By 2027, through innovation and collaborative partners development of commercially valuable solutions for th
Strengths	World-class education and training facilities, and a highly skilled workforce Internationally recognised research institutions focused on energy and resources Natural clusters of expertise
Challenges	Business capability gaps, particularly in data management, business systems, export skills and knowledge of international markets Cost of doing business in Australia compared to overseas competitors

Strategy 1
Increase innovation and commercialisation

- Establish an accelerator pathway for Queensland METS companies seeking to commercialise new products or processes (with METS Ignited and other partners).
- Investigate development of a suite of facilities in Queensland for METS companies to test new products, processes or services through a stocktake of existing and potential test facilities (with METS Ignited).
- Pilot a Mackay Open Innovation Community of METS companies, Bowen Basin mining companies and researchers focused on addressing the specific challenges of Bowen Basin miners (with METS Ignited and local partners).

Strategy 2
Increase collaborative business opportunities

- Create an energy and resources technology networking series. These facilitated events will be held in different regions across Queensland and focus on sharing information about new technology for the energy and resources sector.
- Develop and promote clusters of expertise in safety, operational productivity, mineral processing, environmental protection, social performance and contract mining.
- Create opportunities for METS companies to identify and supply energy efficient solutions to the resource industry by working with the Coalition for Energy Efficient Comminution (with METS Ignited).

ervices - 10 Year Roadmap and Action Plan summary

erships, Queensland's globally competitive METS sector will lead the
the energy and resources industry worldwide.

Highly regarded METS companies with readily transferable products, skills and service offerings

Proximity to domestic and Asian supply chains

Export opportunities for METS companies driven by Australia's reputation for high standards for environmental protection and operational safety

Limited collaboration between the METS sector, energy and resources industry and researchers

Access to investment capital

Links to technology drivers such as data analytics and software, automation and robotics

Strategy 3
Develop sector capabilities

- Support the establishment of a centre focused on developing management capabilities and business models (with METS Ignited).
- Deliver a pilot export and investment readiness training program to address identified business capability gaps (through TIQ) and review opportunities for further training with TIQ.
- Create a Concierge Service to assist Queensland METS companies identify the most appropriate local, state and federal government programs to support their business.
- Develop baseline information on the size of Queensland's METS sector, the capabilities of individual METS companies and the extent to which METS firms collaborate (with METS Ignited).

Strategy 4
Promote sector capabilities

- Promote Queensland's METS sector in domestic and international markets by:
  - promoting the sector at national and international trade shows
  - sharing information about Queensland's METS sector
  - utilising social media channels to encourage peer to peer learning within the sector
  - creating marketing material, case studies and videos to highlight the successes of Queensland's high performing METS companies.
- Facilitate international trade opportunities for Queensland's METS sector (with TIQ and Austrade).
- Develop an online portal to promote the specific capabilities of individual Queensland METS companies to potential customers.

Notes

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