



Australian Government



COAG  
Energy Council

# NATIONAL HYDROGEN STRATEGY

## Issues paper series

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This issues paper discusses the investment environment, long-term market structure and financial support needed to commercialise and build up a large-scale self-sustaining Australian hydrogen industry.

Discussion includes possible sources of public and private financing, the broader investment environment and the ongoing support and market settings needed to enable industry growth while ensuring benefits to the Australian public.

A list of questions is presented at the end seeking further input from interested stakeholders.

## Attracting Hydrogen Investment

This paper has been informed by submissions to the *Request for Information* released in March this year, as well as:

- targeted visits to countries that have already started to develop hydrogen technologies and markets
- the stakeholder roundtables that were held throughout May and June

The COAG Energy Council Hydrogen Working Group would like to thank industry and community members for their engagement in the strategy development process.

In this paper, 'hydrogen' refers to 'clean hydrogen,' defined as being produced using renewable energy or using fossil fuels with carbon capture and storage (CCS). This definition reflects the principle of technology neutrality set by COAG Energy and Resources Ministers when they commissioned a comprehensive and ambitious strategy for the development of an Australian hydrogen industry.

### Background

Significant levels of new investment will be needed to successfully commercialise and scale a global hydrogen industry. For example, to meet the Hydrogen Council's estimates of providing up to 18% of the world's final energy demand by 2050, global annual investments of between US\$20 to \$25 billion are needed for a total investment of about \$280 billion by 2030.<sup>1</sup> While the investment required in Australia will only be a fraction of this, it represents significant new volumes of capital.

Given the scale of investment needed, Australia can expect a large proportion of the capital required to come from overseas, and will need to provide an attractive investment environment in order to compete. Besides the factors that make us attractive as a producer, investors will consider:

- Australia's openness to foreign investment
- Perceived and actual sovereign risk
- Private sector appetite for risk and expectations of return on investment
- Private sector capability and capacity
- Sectoral regulatory and market settings
- Potential non-market barriers and risks (like community acceptance of hydrogen)
- Availability and cost of capital incentives and allowed revenue for natural monopolies (like electricity and gas distribution networks)
- Government policies and incentives supporting industry development.

Australia has a good reputation as an attractive destination for foreign investment. We already attract a significant amount of foreign investment, partly because foreign investors have confidence that their investments are safe and will grow. Foreign investors regard Australia as an excellent place to invest because of its population growth, highly skilled workforce, strategic location, strong record of economic growth and a stable governance and

regulatory environment.<sup>2</sup> We have low sovereign risk and well-developed financial systems. Private credit, equity markets and foreign capital play a strong role in the economy.<sup>3</sup>

Australian governments each have an important role to play in establishing the policy and regulatory settings to facilitate development of Australia’s emerging hydrogen industry. Ensuring a facilitative trade environment will lower transaction costs, build industry confidence, drive economic opportunity and creates jobs. To build investment certainty there is an opportunity for all Australian governments to work together to:

- promote the role of industry and government partnerships to support innovation, improve capability and develop skills
- reduce costs to business through delivery of integrated regulatory frameworks and government-to-business interactions.

Ideally, these strong foundations coupled with various sector-specific initiatives will support a thriving hydrogen industry in its early stages of development while ensuring all Australians benefit over the longer term.

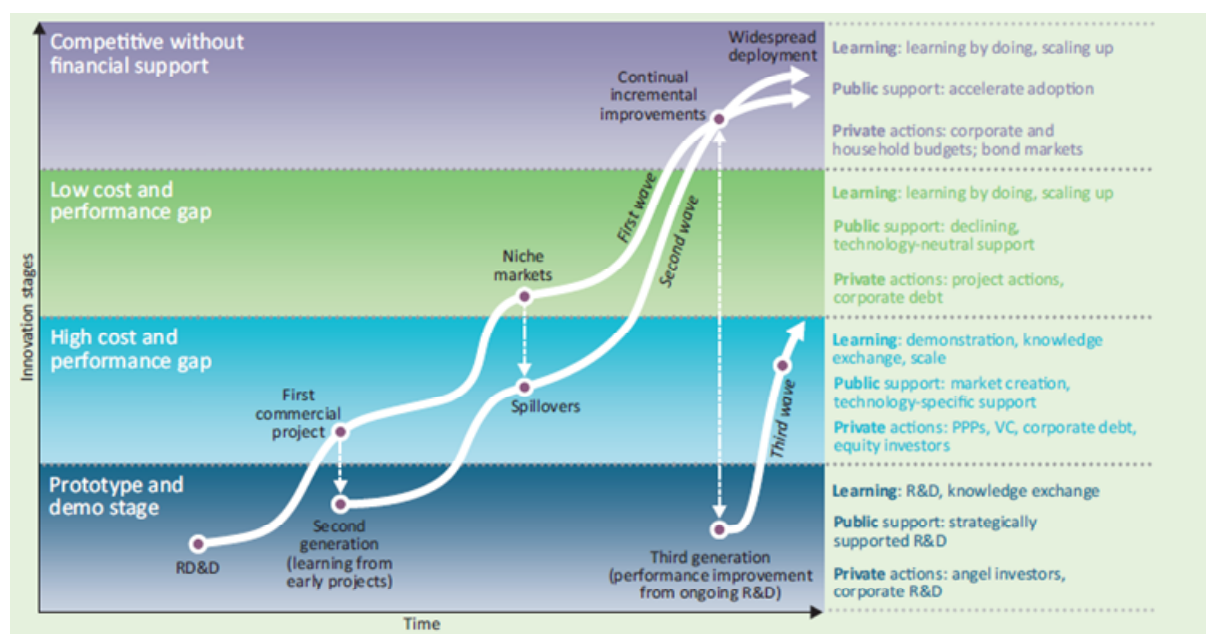
## Industry development and market activation

Now that sufficient basic research and development (R&D) is complete, the support needed to build the hydrogen industry will go through three phases:

- Hydrogen commercialisation
- Hydrogen supply chain development and scale-up
- Hydrogen market establishment and maturation.

This is reflected in Figure 1, which shows the various activities and types of support needed at different stages of technology development and market activation.

Figure 1: Stages of technology development and sources of innovation<sup>4</sup>



This paper discusses the barriers faced by industry during each of these phases and the investment settings needed at each phase to support projects and to help the industry grow.

**Note:** The *Hydrogen at scale* paper explores the broader industry development challenges of building up a large-scale hydrogen industry. It explores hydrogen production pathways in order to make the vision for Australia's hydrogen industry a reality.

## Hydrogen commercialisation

The production, transport and storage technologies for hydrogen are relatively mature but are yet to be tested as part of a viable large-scale supply chain. Hydrogen technologies are also falling in cost but have further to go to be cost-competitive against incumbent energy providers.

A key risk is that Australia's hydrogen innovation and scale-up could stall in the 'valley of death' stage of technology commercialisation. The 'valley of death' refers to the point where technologies have been successfully proved as a concept but still require large capital investments to demonstrate the technology and to test various business models for full-scale roll-out. At this stage, new technology is typically more costly to build and operate than its mature technology equivalents and capital requirements to fund the technology to become profitable can often be beyond the risk tolerance and timelines of most debt and equity market participants.

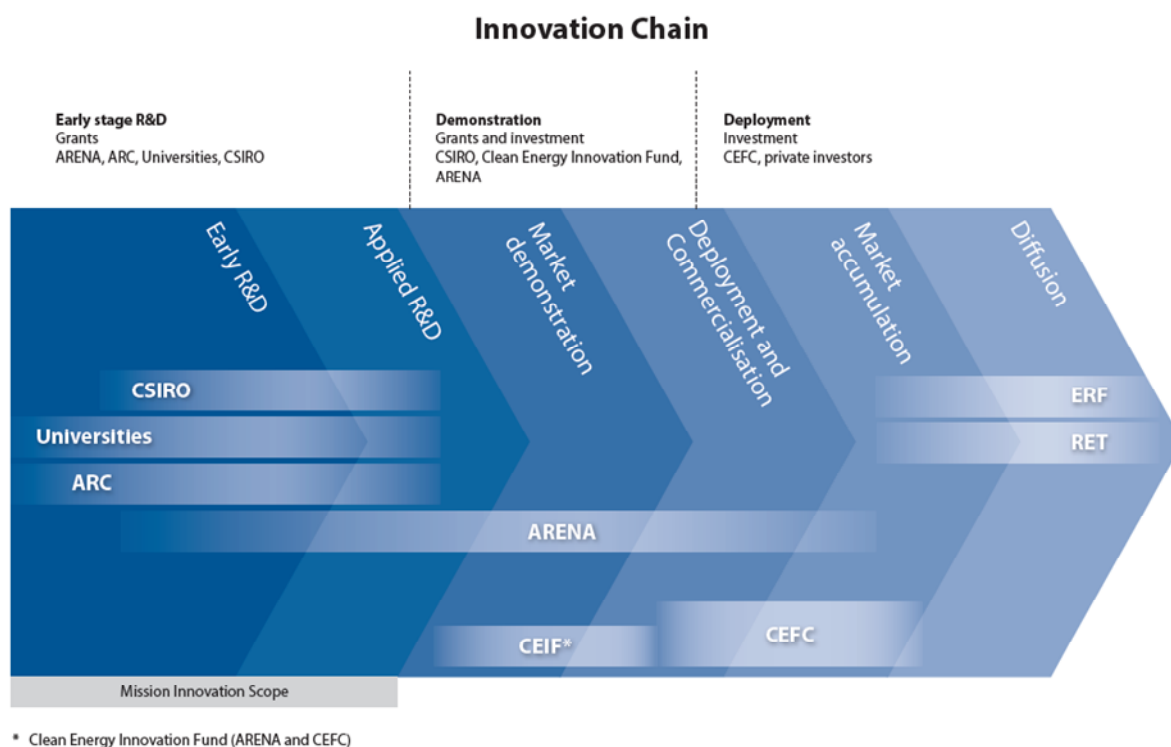
While businesses are responsible for charting their own commercial readiness, governments recognise that transitioning nascent technologies from research into early stage commercialisation is challenging. Government support, through commercialisation advice, grants and concessional debt and equity, is useful at this stage to help technologies to become commercially viable.

The Australian Government has an extensive suite of measures to support clean technologies to market including:

- The **Australian Renewable Energy Agency (ARENA)** – an agency originally funded with \$2 billion to accelerate investment in renewable energy projects until 2022 when its funding is due to cease.<sup>5</sup> ARENA funding is already largely committed.
- The **Clean Energy Finance Corporation (CEFC)** – established to invest \$10 billion of debt and equity in the clean energy sector to help lower Australia's emissions and to deliver a positive return.
- The **Clean Energy Innovation Fund (CEIF)** – a fund jointly managed by ARENA and CEFC to provide \$200 million to support emerging technologies make the leap from demonstration to commercial deployment.
- The **Emissions Reduction Fund (ERF)** and the **Climate Solutions Fund (CSF)** – provide \$4.5 billion to purchase emissions abatement from eligible activities through the ERF. While use of clean hydrogen is not specified as an eligible activity in its own right, use of clean hydrogen may be an eligible activity under abatement methods for the Transport and Facilities sectors or under future developed methods. As at May 2019, \$2.176 billion remains available to purchase emissions abatement.

How these initiatives interact across the innovation chain is displayed in Figure 2.

Figure 2: Australian government clean energy funding measures across the innovation chain<sup>6</sup>



Through some of the above initiatives and other measures, the Australian Government has invested over \$100 million in hydrogen projects since 2017. While these initiatives can provide support to commercialise hydrogen production and use they have mostly been designed to support clean energy development, and so may not fully support all aspects of hydrogen industry commercialisation. The rates of return required on CEFC projects mean that projects need a stable income stream. Market accumulation measures such as the Renewable Energy Target (RET) scheme, and the Emissions Reduction Fund were not designed with hydrogen in mind.

More targeted initiatives have been developed by state and territory governments to support hydrogen projects. These include Victoria's Hydrogen Investment Program and Queensland's upcoming Hydrogen Industry Development Fund. In 2017, South Australia released a call for hydrogen infrastructure proposals through its \$50 million Renewable Technology Fund that has been used to contribute funding towards four hydrogen projects.

These initiatives will help the industry to progress in the near term. Nonetheless, additional changes to existing initiatives and support may be needed to overcome longer term commercialisation barriers. The optimal approach could be to adapt and build on this existing framework rather than developing entirely new mechanisms to support hydrogen commercialisation. This approach has the advantages of drawing on the existing expertise and capability of the agencies involved with administering these initiatives and ensures that support for hydrogen commercialisation is integrated with other clean energy technology commercialisation activities.

## Hydrogen supply chain development and scale-up

Demand for hydrogen is expected to gradually grow as costs come down. Once competitive, industry will need to rapidly scale up supply chains. Creating an attractive environment for industry scale-up and supply chain development will be a shared responsibility between governments and industry.

Supply chain development and scale up will need a range of different financing options to support development of both hydrogen technology and supporting infrastructure. This will involve a mixture of public and private infrastructure, some of which may operate in regulated markets, and some of which may include foreign investment. Ideally, scaling up leverages existing infrastructure and efficiently builds new infrastructure to overcome 'chicken and egg' issues of needing to create demand and supply sides of the market at the same time.

Financing emerging hydrogen technologies and companies will be higher risk and will suit investors seeking higher rates of return. Conversely financing for relatively mature supporting infrastructure such as roads and rail will be lower risk and may attract investors seeking safer and more stable rates of return.

Many submissions received expressed a need for governments to create a supportive investment environment. Stakeholders cited government support for development of the Australian liquefied natural gas (LNG) industry as an equivalent historical example for the role of governments in providing support to enable large-scale industry development and international supply chains.

Submissions asserted that government intervention, including the provision of finance to develop hydrogen industries, can be justified through:

- advancing national interests with economic, environmental and social benefits
- establishing export industries, energy security, decarbonisation, and employment
- overcoming market failures of public and quasi-public goods (such as infrastructure)
- overcoming the 'chicken and egg' problem
- leveraging private sources of financing.

In making interventions to build and scale up nascent industries and supply chains, a long-term vision is required. Governments have an important early role to play in supporting the Australian industry to be globally competitive through creating an enabling environment to support industry development. This is recognised by the International Energy Agency which recommends that to develop hydrogen value chains, government policy efforts should aim to:

- Establish targets and/or long-term policy signals
- Support demand creation
- Mitigate investment risks
- Promote R&D, strategic demonstration projects and knowledge sharing
- Harmonise standards and removing barriers.<sup>7</sup>

Government investment can come in a variety of forms. Ultimately, measures will either provide supply or demand side stimulus and can either provide direct financial support to overcome cost barriers, or indirect support to enable projects and to reduce project risks (along with the costs associated with managing those risks). Demand policies set by governments in other countries will also stimulate hydrogen supply in Australia as we become an exporter. Table 1 describes some of the various supply and demand side measures governments can use to stimulate private and public investment.

Table 1: Examples of government supply and demand side mechanisms

	Direct government measures and incentives	Indirect government measures	Examples
Supply side	<ul style="list-style-type: none"> <li>Grant funding</li> <li>Public Private Partnerships (PPPs)</li> <li>Equity co-investments</li> <li>Loans</li> <li>Tax incentives</li> </ul>	<ul style="list-style-type: none"> <li>Mandated supply side targets</li> <li>Underwriting risk</li> <li>Foreign Direct Investment attraction facilitation</li> </ul>	<ul style="list-style-type: none"> <li>PPPs in accordance with National PPP Policy Framework<sup>8</sup></li> <li>Northern Australia Infrastructure Facility</li> <li>CEFC</li> <li>R&amp;D Tax Incentive</li> <li>Export Finance and Insurance Corporation (EFIC)</li> </ul>
Demand side	<ul style="list-style-type: none"> <li>Grants, rebates and subsidies</li> <li>Off-take agreements and guarantees</li> <li>Government purchases</li> <li>Contracts for difference</li> <li>Tax Incentives</li> </ul>	<ul style="list-style-type: none"> <li>Mandated demand side targets</li> <li>Legislated performance standards</li> </ul>	<ul style="list-style-type: none"> <li>WA Government LNG offtake agreement</li> <li>Emissions Reduction Fund</li> <li>ACT Government purchase of hydrogen fuel cell car fleet<sup>9</sup></li> <li>Renewable Energy Target</li> <li>SA Home Battery Scheme</li> <li>Victoria Solar PV Rebates</li> <li>ACT Vehicle Emission Reduction Scheme<sup>10</sup></li> <li>City of Leeds (UK) hydrogen conversion project<sup>11</sup></li> <li>Japanese government investment in hydrogen refuelling stations</li> <li>Korean government investment in large-scale fuel cells</li> </ul>



Stakeholder submissions to the *Request for Information* recommended a wide range of both direct and indirect supply and demand side initiatives to support industry growth.

On the supply side, stakeholders suggested initiatives including:

- Grant funding to defray capital or operating costs of projects or trials
- Access to lower cost or more competitive financing to assist projects that have difficulties in obtaining low cost debt or equity
- Establishing or accessing existing Australian sovereign wealth funds to make strategic investments
- Making clean hydrogen an eligible technology under the Renewable Energy Target (RET) or creating specific and new targets for clean hydrogen
- Entering into private public partnerships and other various project risk sharing arrangements
- Designating large-scale hydrogen projects with Major Project Status<sup>12</sup>
- Underwriting project development risk.

On the demand side, stakeholders have suggested initiatives including:

- Market demand activation through government purchasing, for example supporting fleet purchases
- Providing offtake agreement guarantees, including being a customer of last resort
- Direct establishment of hydrogen demand, such as purchases of hydrogen fuel cell vehicle (FCEV) fleets
- Underwriting shipments of hydrogen exports
- Providing tax incentives and 'holiday' royalty-free periods to encourage hydrogen exports
- Selecting regional towns where the current cost of electricity supply is high, and repurposing existing subsidies to offset cost of conversion to hydrogen (akin to the City of Leeds pilot hydrogen city conversion project in the United Kingdom).

The wide range of funding initiatives proposed to support industry development suggests that there is a role for both supply and demand side policies to stimulate market activation. This view is reflected by Hydrogen Mobility Australia in its submission, which states:

*“To enable the growth of a domestic sector, requires two immediate actions by the governments: (1) co-investment support for industry to scale up hydrogen infrastructure to stimulate supply and (2) support for the creation of an initial market pull for hydrogen and fuel cell applications to stimulate demand.”*

The appropriate combination of policy options will be dictated by governments' levels of ambition and the private sector's willingness to take risks. Fulfilling COAG Energy and Resources Ministers' stated ambition of making Australia a world leader by 2030 will require policies that can scale up and attract large amounts of capital to fast-developing markets. Not all instruments will work well together, and the mixture will change over time as markets develop. While recognising that each jurisdiction has its unique advantages and ambitions, it will be important to ensure that policies across jurisdictions are complementary and do not skew investment in inefficient ways.



An early consideration is the extent to which government funding strategies should target domestic and exports-focused measures. Stakeholder submissions indicate that both domestic and export focused measures are needed to support industry growth. Stakeholders advise that to have a thriving export industry we will need to develop our domestic supply chains, potentially ahead of these being economically competitive. For example, in its submission the Australian Gas Infrastructure Group states that we need to develop:

*“... a framework that helps secure both the domestic and export opportunities. The two are not mutually exclusive; early progress in deploying hydrogen in our domestic networks and homes will build scale and demonstrate to export markets Australia’s hydrogen capabilities; meanwhile progress in hydrogen exports will help scale up production and reduce costs for domestic energy consumers”.*<sup>13</sup>

Actions by governments to stimulate domestic markets for hydrogen ahead of it being cost-competitive with other mature technologies will come at a cost to consumers or to taxpayers and will need to be carefully considered in policy design. An important consideration for governments will be to determine the scale and types of domestic markets that will best support Australia to meet its international ambitions. Factors influencing decisions will include how to best provide necessary domestic skills and capabilities and how to ensure domestic markets are available in the event that international markets do not emerge as quickly or as extensively as expected.

### Hydrogen market establishment and maturation

As the hydrogen industry becomes cost competitive and matures, governments’ support for hydrogen will shift focus from a combination of direct and indirect measures and incentives to mostly indirect ongoing market support. This support includes ensuring robust market and trading frameworks, international engagement and outreach, effective regulation, continued support for R&D, and education and skills development.

The role of industry at this time will be to ensure continued growth of the sector through a number of ways, including:

- maintaining and improving community sector trust, such as through community outreach and meeting or exceeding community expectations around environmental performance, safety and jobs creation.
- remaining competitive and improving market share, through actively seeking market opportunities, maintaining strong and enduring business partnerships, ongoing performance improvements and continued technology and business model innovation.

As the sector grows and the level of direct government support winds down, the private sector needs to take the lead on other measures to encourage investment. CSIRO’s *Australian National Outlook 2019* points out the need for a shift towards a healthier risk-taking culture within Australia’s private sector, as indicated by relatively low levels of technology adoption in many sectors of the economy, and a low ranking relative to other major economies for venture capital investments as a percentage of GDP.<sup>14</sup>

As identified earlier in this paper, at this time it will be important that investment and market settings emerge that allow for sustainable growth of the industry, ensure Australia remains competitive, and provide an appropriate level of benefits flowing back to the Australian public.

Experience from establishing the LNG sector suggests that early consideration is needed of the market settings to support future hydrogen trading. As raised in the case study included in the *Hydrogen at scale* issues paper, a key lesson learned from establishing Australia's LNG sector was that LNG trading functions, such as spot and derivative markets, should have been developed from the outset. The case study also identifies that linking LNG contracts to international oil prices has led to volatile and at times depressed gas prices.<sup>15</sup> These are considerations for the first movers in the hydrogen market. The trading arrangements they set will influence how future hydrogen transactions are conducted. Governments may not have a direct role in these early market settings, unless taking on a role in the market, for instance, setting certain transparency conditions for a transaction where a government has a role as an off-taker or to underwrite risk.

As raised in other issues papers, markets will need to cater for a broad and diverse range of consumer needs. Consumers are expected to have varying needs with regards to the purity, form, carbon intensity and production method of the hydrogen they would like to purchase depending on its end use. For example, hydrogen used in fuel cell electric vehicles needs to be of a very high purity, while hydrogen of a lower purity or stored in an alternate form, for example ammonia, may be sufficient to support power generation needs. Similarly, some consumers may wish to purchase hydrogen produced from renewable, rather than fossil based sources. Markets will need to appropriately cater for and value these different needs. This is discussed further in the *Guarantees of origin* issues paper.

Markets will also need to be carefully designed to account for hydrogen's sector coupling effects. As discussed in other issues papers, there is the potential for considerable value from effective linking of electricity, gas and transport markets. However, this potential will only be realised if market signals and frameworks effectively draw out these benefits and avoid perverse or unintended outcomes.

### **Community acceptance and benefits for all Australians**

As raised in other issues papers, gaining and maintaining community acceptance of the hydrogen industry will be more challenging if the Australian community perceives that they are not appropriately benefiting from the establishment of an Australian hydrogen industry. Consideration is needed for how to best share benefits from the hydrogen industry over the longer term. There are advantages to considering from the outset how benefits will be provided to the Australian public, as this will improve transparency and investment certainty for project financiers.

While it is important to recognise that there are general benefits for all Australians from the economic growth and employment that come from growth of new industries, these benefits are likely to be concentrated in the regions in which this economic activity occurs.

One way to ensure benefits are spread across all Australians is to consider the tax, excise and royalty treatment of hydrogen. Currently, hydrogen is not specifically taxed, as it is not considered a fuel or a mineral resource. This reflects its current use in the Australian economy, as a product that is manufactured for input to industrial processes. Resource-related royalty, excise and taxation arrangements currently apply to the fossil fuels currently used to make most of Australia's hydrogen. Similarly, the Goods and Services Tax may apply at various stages of producing, storing and transporting hydrogen to end consumers. Various levels of payroll tax, company tax and state based land taxes may also apply at various points of the value chain.

As hydrogen becomes an export commodity and in the longer term gains domestic market share, consideration may need to be given to adjusting current revenue arrangements to incorporate hydrogen. Examples of revenue arrangements that apply to other Australian goods that could extend to hydrogen include (but are not limited to):

- Export tariffs on hydrogen exported from Australia
- Classification as an excisable fuel type under the *Excise Tariff Act 1921* (which in turn could link to relevant tax credits under the *Fuel Tax Act 2006*)
- Road usage charges incorporated into state and territory-based registration fees.

Alternately, benefits could be provided in forms other than revenue, such as an ensured supply of low cost hydrogen in Australia. In response to the *Request for Information*, several stakeholders expressed a view that developing a domestic reservation strategy for hydrogen could help to address other needs, such as addressing high energy costs and easing cost of living pressures.

Any government revenue settings will need to ensure reasonable level of benefits are provided to the Australian public, while ensuring that benefits do not significantly impede industry growth. Ideally the level of revenue provided by hydrogen should be comparable with other incumbent energy carriers, so as to maintain effective domestic competition.

## Questions

The National Hydrogen Taskforce is seeking responses to the questions below. You can submit your comments via the Department of Industry, Innovation and Science's consultation Hub: <https://consult.industry.gov.au/national-hydrogen-strategy-taskforce/national-hydrogen-strategy-issues-papers>

1. *What changes to existing government support and additional measures are needed to:*
  - *commercialise and scale up the hydrogen industry?*
  - *ensure an appropriate balance between export and domestic demand?*
2. *How do we ensure an attractive investment environment for private sector finance? Which methods would be most effective in leveraging maximum private sector finance and which activities should governments prioritise with limited funds? How should these methods change over the short, medium and long term?*
3. *What level of domestic market support is needed to achieve COAG Energy Council's ambition of being a major global player in hydrogen? In particular, what types of support will best provide the necessary domestic skills and capabilities and ensure domestic markets are available in the event that international markets do not emerge as quickly or as extensively as expected?*
4. *What market and revenue designs and settings will best allow for sustainable growth of the hydrogen industry and an appropriate level of benefits flowing back to the Australian public?*
5. *What market signals and settings are needed to capture hydrogen's sector coupling benefits? When should these market signals and settings be applied?*

## References

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