HYDROGEN QUEENSLAND

POLICY MECHANISMS FOR THE EMERGING HYDROGEN INDUSTRY

A review of demand and funding mechanisms

10 May 2023

H2Q Policy Working Group

Contents

Foreword

This paper was prepared by H2Q Policy Working Group over Feb-April 2023 to stimulate debate on policy measures required by the emerging Hydrogen industry in Queensland. The paper provides a snapshot of industry issues prior to the Australian Government announcement of the Hydrogen Headstart Program in May 2023 and sets out a review of known policy mechanisms for supporting emerging clean technology industries. With the Headstart Program providing the long-awaited policy signal for investors in Australia, it is critical that Queensland Government continues engaging with the local industry and uses the toolkit of all competitive measures to attract businesses to Queensland and support the local hydrogen industry.

A faster energy transition will result in mitigating the worst impacts of climate change. With the hydrogen industry in its infancy, investors and other market participants are hesitant. Policy and market intervention to address uncertainty and provide coordination, may alleviate concern. For the hydrogen industry investment uncertainties comprise:

- technology readiness of the hydrogen use in various user sectors and applications
- the development of standards and safety regulations, availability (technical readiness and physical supply) of required inputs on both supply and demand side – renewable energy and water infrastructure for production of green hydrogen, production and user equipment, transport, and distribution infrastructure.
- a significant cost difference between the manufactured hydrogen and its established market alternatives for fuel and industrial feedstock. as well as the lack of structured policy to provide a signal for future businesses and industrial users to invest in hydrogen vs its available alternatives.

The key driver for the emergence of the hydrogen industry is, we trust, its potential to support decarbonisation efforts across a range of industrial sectors. Where time is of the essence, as in the case of the decarbonisation effort, policy mechanisms are required to assist the market participants to resolve key investment uncertainties and risks, to enable investment decisions to progress.

H2Q Policy Working Group has prepared this paper to outline key known policy mechanisms that could support Queensland decarbonisation policy goals by developing a favourable investment environment for emerging industries focused on decarbonisation outcomes. Naturally, our focus is on the specific needs of the emerging hydrogen industry in Queensland.

The paper is based on a desk-top survey of key policy mechanisms for diffusion of clean technologies; as well as mechanisms deployed specifically for the hydrogen industry in various locations globally to-date to address common risks.

As a 'relevance test' for the paper, we sought input from a small section of Queensland market participants. The industry insight offered was a consideration of policy mixes specific to Queensland, with a great focus on

- a strong policy signal, backed by significant financial support
- coordination, planning, 'working out the detail' and developing a common Line of Sight for investment decisions, with a key role to be played by the decarbonisation policy driver in place of economic driver for creating the market demand; and
- policy development via direct industry engagement on policy details.

It is hoped that the paper will inform the local market participants to enable discussion, debate and development of policy mechanisms useful to the Queensland hydrogen industry.

Executive summary

- A range of measures and policy mechanisms have been developed to support emerging markets to-date in various institutional contexts. Some of these existing mechanisms maybe suitable for supporting the emerging Queensland hydrogen industry. Table 1 provides a summary of policy mechanisms and their suitability for certain stages of the technology and industry development cycles.
- Given the price differential between the high and low carbon emissions technologies, tax or regulation or incentives like Feed in Tariff or Contracts for Difference (CfD) are required to stimulate both innovation and diffusion of low emission technologies.
- A tax on carbon emissions or regulation requirements for specific sectors (where emissions are high, this includes all sectors where hydrogen technology could provide a viable contribution) are required to provide a financial dis-incentive and/or obligation to act.
- Market-based schemes that create obligated parties to reduce emissions and provide a range of incentives for low emission technologies is an alternative way to stimulate demand for low-emission technologies in particular sectors. Market-based schemes should be used to achieve the primary policy goal (i.e. emissions reduction), not a derived policy goal (i.e. increase in hydrogen technology)
- Sectors with existing use of grey hydrogen (and existing processes and infrastructures) are the natural sectors for early adoption/ transition/technology and market development.
- A range of measures are required to bring all actors of the value chain in action simultaneously, for an emerging market that is lacking production-side and demand-side infrastructures, and faces supply-chain shortages.
- Different measures should be deployed at different times to respond to the situation, and we indicate which measures are suitable for what in Table 1. The situation and therefore the response is different for each sector, and sometimes subsectors
- Government (state and federal) is well suited to coordinate this time structured package of measures, setting out clear expectations of industry.
- Creation of new institutions may be required, such as
    - Financing/ Loan body targeted at financing low-emission technologies (these would also require policy clarity with respect to low-emission technologies)
    - Parties required to administer the CfD
- Scaling-up application of hydrogen technologies to particular industrial applications will require knowledge sharing between users and technology providers. Knowledge sharing between the different players is required towards creating a common market and a positive business case for the hydrogen technology.
- Caution is required not to dis-advantage Australian broader energy and industrial goals through policy commitments to large-scale export industry of hydrogen or its derivates.

Table 1 Innovation and diffusion stage policy mechanisms

	Policy mechanism	What it does?	Advantages	Disadvantages	Relevance to Hydrogen market
Innovation stage	**Patents**	Legal framework to protect market share for the patent holder	The monopoly rents reward the innovator	The efficiency loss due to monopolistic supply vs welfare gain from accelerated innovation	
	R&D funds and tax credits	Government provides R&D subsidies and tax breaks for specific technologies/ activities	Direct funds to businesses Encourage knowledge spill-overs	Rewards effort; rather than outcome Governments are bad at picking winners; the public sector does not bet its own money and thus lacks a key device to discipline risk taking	
	Procurement – minimum standards	Government specifies the outcome (min standards for emissions or efficiency); but not technology	Rewards success Creates incentive to innovate: the ability to force out the competition		Require defining specific outcomes to be rewarded. Reward could be guaranteed via procurement
Diffusion stage	**Tax**	Tax on emissions	Corrects the negative externality		Would apply to all activities; does not directly relate to the hydrogen technology
	Tax credits and subsidies to achieve specific outcomes				Additional credit amounts for domestic content, energy

	Policy mechanism	What it does?	Advantages	Disadvantages	Relevance to Hydrogen market
					communities, and low-income communities.
	Contracts for Difference – fixed price		Certainty for QLD producers Simple Single price throughout contract and no price discovery required	Significant cost Significant market intervention over long time horizon Price setting difficult, risking insufficient investment if too low and over-subsidy if too high	
	Contracts for Difference – fixed price premium		High certainty for QLD producers with an additional value above input costs High value for QLD producers Single premium, maintained throughout life of contract	Significant cost Significant market intervention over long time horizon Premium setting difficult High risk of over-subsidy as differential fixed through life of contract and risk of insufficient support	
	Contracts for Difference – variable premium		Adjusts in line with the market value, ensuring value for money	Level of support may be less than alternatives, leading to investor uncertainty Complexity Premium setting difficult	

	Policy mechanism	What it does?	Advantages	Disadvantages	Relevance to Hydrogen market
	Direct regulation – minimum standards/ mandates	Minimum standard requirement for the outcome sought (environmental quality; energy efficiency; local content?)/ not the technology		No incentive to innovate beyond the target Bureaucracy cost	Safeguard mechanism US IRA provisions introduced local content requirement for steel in all renewable energy projects to stimulate the local production of green steel; and as a consequences assist with green steel via hydrogen.
	Market Schemes Targets/Quota obligations and Tradable Green Certificates	The government specifies a certain share of total electricity production or consumption that must come from renewable energy. Producers of green energy receive green certificates	Provide some certainty about potential income	Needs to be well designed and allocated	Green certificates – Renewable gases

Context

Governments can implement a range of incentive mechanisms to achieve the policy goal of greenhouse gas emissions reduction. By extension, this would create an incentive for all low carbon emission technologies (including hydrogen) to compete and develop in the market place.

With respect to hydrogen, over the last 18 months, potential **viable domestic opportunities**[1] for the hydrogen technology have been prioritised in the following sectors:

- Industrial heat
- On-site energy storage
- Long-haul transport
- Ammonia production
- Fuel refining process
- Synthetic fuel production.

Key issues and uncertainties raised at the recent H2Q forum (April 2023, Brisbane), which are also echoed across the emerging hydrogen industry more broadly, relate to:

- the lack of structured policy to provide an investment signal.
- technology readiness of the hydrogen use in various user sectors and applications.
- the development of standards and safety regulations, availability (technical readiness and physical supply) of required inputs on both supply and demand side – renewable energy and water infrastructure for production of green hydrogen, production and user equipment, transport, and distribution infrastructure.
- a significant cost difference between the manufactured hydrogen and its established market alternatives for fuel and industrial feedstock, as well as the lack of structured policy to provide a signal for future businesses and industrial users to invest in hydrogen vs its available alternatives
- lack of coordination and detailed planning.

This paper offers a review of the policy mechanisms available to reduce investment risk, typical for emerging markets, and provide investment incentive to enable projects that achieve the goal of emission reduction in these sectors.

Policy mechanisms for creating markets for clean technology - overview

Key policy mechanisms to enable clean energy projects and achieve emissions reduction goals are:

- **Demand stimulating mechanisms**
    - **Tax and Regulation** - provides for financial dis-incentives not to invest, or an obligation to invest in low carbon technologies. **These mechanisms provide certainty of the**

[1] Industry research indicates that co-location of production and use of green hydrogen is preferred due to uncertainty of the long-distance transportation technologies for hydrogen (e.g. environmental and cost implications). Further, the stakeholder engagement for the Australian NEM 2022 report cast a doubt over the Australian potential as a hydrogen export superpower due to domestic energy system demand for renewable energy generation (prioritised over the production of green hydrogen) and transportation challenges mentioned above. Further, caution against export-only focus is provided in the Australian hydrogen market study (cefc.com.au) (p.86).

taxing mechanisms at play during investment and operations, therefore de-risking the investment decisions from a tax perspective.

- **Tax credits/Subsidies** – these provide an effective monetary contribution to the EBITDA margin of the investment in low-emissions technologies, but do not provide an obligation or a dis-incentive to deviate from the business as usual. This means that subsidies and tax credits must be substantially high to address the price differential and to impart action. **By signalling a direction of policy, these mechanisms provide a degree of certainty to business strategy allowing for greater confidence when it comes to implementation of decarbonisation plans.**

- **Market-based schemes** – these are equivalent to a combination of tax and subsidies. To be successful, they **must have an obligated party**, target and a market-based reward mechanism. **Establishing a clear and consistent source of demand provides confidence to all parts of the value chain. Importantly,** market-based schemes are used to achieve outcomes, not just for creating a market for a particular technology. For example, to increase a share of renewable energy (Green energy certificates) or to increase energy efficiency (Green certificates).

- **Funding and financing mechanisms - Grants/ Loans /Contracts for Price Difference / Subsidies**– these are enabling and support mechanisms dedicated to reducing the risk involved in progressing from pilot projects to commercial scale; and from project conception to operation. Access to financing is critical during the initial stages of project development, as this is point where risk and uncertainty are greatest. **Grants, loans and bonds provide access to external capital and serve as 'bridging' function, enabling projects to become bankable or operationally sustainable. Government policy could influence the development of the Sustainable Finance – a set of financial regulations, standards, norms and products that pursue an environmental objective.**

- **Policy mixes – often a mix of responses is required to support an emerging market, including setting standards, regulation, skills development, infrastructure planning and coordination of catalyst projects.**

These mechanisms are considered in more detail in the following sections.

Demand stimulating mechanisms

Tax and regulation

Tax and regulation are key tools for the government to address externalities, such as carbon emissions.

Tax is an effective tool as it changes the economic incentive and, therefore, the behaviour of tax payers. The best intervention is considered to be a tax that:

- Puts tax on the activity that generates externality
- Uses the tax revenue to compensate the victims of the externality
- The compensation is such that it offsets the loss of welfare at the margin.

Direct regulation is another tool that is used widely to address specific externalities. There are different forms of direct regulation:

- The regulator may proscribe or forbid certain inputs into the production process; or put standards on the amount of input
- The regulator may proscribe or forbid certain technologies under in the process or put standards on the performance
- The regulator may put limits on selected outputs of the production process, or put requirements on the product
- The regulator may put limits on the timing of certain activities or their location.

Known examples of direct regulation include government mandates for car fuel blending to reduce emissions; regulation for car fuel not to contain lead; efficiency and emissions standards for car engines. Direct regulation must focus on the policy outcomes, not specific technologies, however.

Tax and regulation are also important mechanisms for creating a suitable environment to attract investment to an emerging market, by providing certainty for investment. In turn, a favourable investment environment creates an opportunity for new market entrants and external capital in-flow.

Australia does not have a tax on emissions or emissions trading scheme in place.

At the National level, the Safeguard Mechanism identifies the maximum emissions thresholds for key polluters. Safeguard Mechanism has been criticised for setting thresholds based on historical data, and therefore, too low. The Department of Climate Change, Energy, Environment and Water (DCCEEW) is consulting on options to reform the Safeguard Mechanism to help industry reduce emissions in line with Australia's climate targets. The Australian Government proposes:

- gradually reducing baselines to help Australia reach net zero emissions by 2050
- introducing credits for facilities that emit less than their baseline
- providing tailored treatment to emissions-intensive, trade-exposed facilities so businesses are not disadvantaged compared to international competitors and emissions do not increase overseas.

At the State level, several State governments now have emission reduction and Net Zero targets. These latest developments are starting to provide some level of guidance for investment.

Significantly, **Australia does have a history of renewable energy policy** driven by the Renewable Electricity Target, supported by the National Greenhouse and Energy Reporting Scheme and Renewable Energy Certificates GreenPower and renewable energy certificates (cleanenergyregulator.gov.au).

The Renewable Gas Target could provide a similar driver for developing market for gas-based clean energy sources, supported by the Green Energy Certificates for green hydrogen (cefc.com.au)

Market-based schemes

Market-based schemes could stimulate the development of a dedicated low emissions energy industries. As well as creating demand (similar to tax or regulation), market-based schemes change the nature of the commodity being sold (e.g. from hydrogen technology to carbon abatement potential - low emissions energy or heat).

Key attributes of market-based schemes include:

- Emissions target
- Sector-based target
- **Obligated parties**
- Accounting method – 'deemed upfront' method of accounting for emission reduction is preferred from the investment perspective, as it represents a lower risk for business and investors. There is a short term investment required to fund the cost of technology and distribution/installation. The return revenue is related to the successful provision, distribution and installation of low emission technologies.
- Upfront allocation of carbon credits
- Participation of new entrants in delivery of low emission technologies
- Trading of carbon credits.

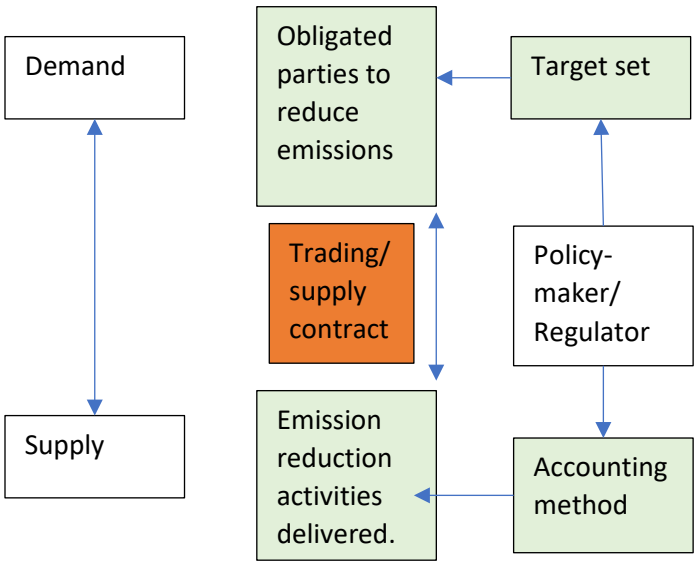

Figure 1 Market-based schemes – key elements

Example obligated parities of relevance to the hydrogen market may include ammonia production; heavy-duty line haul trucking, mining industry (Australian hydrogen market study (cefc.com.au)

Example – NSW Energy saving certificates scheme

NSW Energy saving certificates scheme is an example of a market-based scheme to promote energy efficiency and new entrants in the efficiency market. The scheme provides a framework that approved suppliers work under to provide and install energy saving upgrades for households and businesses. The suppliers calculate how much energy will be saved following the planned upgrade. These calculated savings are then converted into certificates. These certificates are registered with the scheme administrator, IPART. The certificates are then bought by the scheme participants, which includes electricity companies or other energy market participants, **who are required by law to meet specific energy saving targets.** NSW Energy saving certificates (Energy certificate schemes | NSW Climate and Energy Action).

Subsidies/ tax credits

Incentive-based policy instruments are the main alternative to direct regulation. Subsidies and tax credits are market compatible forms of direct government intervention, incentivizing the sought outcome. Tax subsidy provides a monetary reward for every unit of emission avoided.

Taxes and subsidies/credits have different distribution effects – from companies/households to government vs from the government to household and companies. Because of that, taxes and subsidies have different effects on emissions in the medium run.

An emissions tax increases the average cost of doing business in a particular sector. Investment flows elsewhere (investment flows from polluting sectors to clean energy sectors). An emission avoidance subsidy reduces the average cost of doing business in that sector. Investment flows to that sector.

As opposed to subsidies for emissions reductions, subsidies and tax credits could also be focused on clean industry development itself. For example, the US Investment Reduction Act (IRA) tax credits are production-based and focus on incentivising production of clean energy (I.e. renewable energy and hydrogen). The IRA tax credits have **a time limit, and act as a catalyst to invest in the industry before the time limit expires.** (Refer to Finance and funding mechanisms section for more detail)

Industry Comments:

- *Policy that creates confidence in demand and demonstrates when and where demand will occur (i.e. Line of Sight). The Line of Sight is particularly important when forming consortiums, as each participant has different signals needed to achieve Final Investment Decision.*
- *Longer term planning is required*

Finance and funding mechanisms

Governments provide financing support at the early stages of technology development and diffusion. Key types of finance mechanism that can be used to support the development of the hydrogen sector are grants, loans, and subsidy mechanisms targeted for the sector development.

Grants

Grants are the most common form of financial mechanism currently used in supporting growth of the hydrogen sector, primarily consisting of a government funded financial support to alleviate the risk of existing cost gaps. The advantage of grant support is that it can be deployed in support of any opportunity, at any stage in development and as an immediate cash injection. To achieve specific objectives, they are usually targeted with specific conditions, supporting certain sectors, stages of development or technical requirements. **This is particularly useful in emerging markets where uncertainty is high due to a lack of strategic direction. Consequently, grants are usually deployed during the early stages of development where project risk is highest.**

Example – UK Net Zero Hydrogen Fund (NZHF)

- The UK Government setup the Net Zero Hydrogen Fund (NZHF) with the aim to accelerate the development of low carbon hydrogen projects to create a diverse and secure decarbonised energy system in the UK. The fund is designed to support projects proposing to use proven technologies where commercial readiness and prompt roll out is demonstrated.
- The fund is structured into four strands, for which applications are dependent on project maturity and required support.
- The strands consist of both a grant and subsidy mechanism with project requirements determining which can be accessed. For example, projects requiring operational support must only apply for strands that include a hydrogen business model (HBM), a financial support mechanism designed to subsidise operational costs to stimulate the hydrogen market. The HBM is provided alongside set grant funds as a long-term revenue support contract.
    - Strand 1: DEVEX support for early projects to cover front end engineering design (FEED) studies and post-FEED studies
    - Strand 2: CAPEX for projects that do not need an HBM – a project applying for this strand must exist on its own merit and solely require CAPEX support
    - Strand 3: CAPEX for projects requiring an HBM
    - Strand 4: CAPEX for carbon capture usage and storage (CCUS) projects requiring an HBM
- Competition windows vary dependent on which strand projects wish to apply for. Available funding at this stage is set at £90 million, split across strands 1 and 2, with anticipated additional future windows to give projects in their infancy extended opportunity to apply.

The scale of deployed grant funding in Australia has been commensurate with the infancy of the industry. The intention for these initial funding stages has been to support feasibility, FEED and demonstration projects. Simultaneously, grant funding is used to encourage match funding from the private sector through reduction of financial risk (increasing debt service ratios, revenue streams and reducing payback periods making investments more attractive). Grants are only provided for short periods, until projects demonstrate the ability to operate sustainably (i.e. <5-year periods).

The majority off financial support in Queensland has been through grant funded mechanisms, $170m in hydrogen specific support (an additional $4.5b of eligible support via the Queensland Energy Jobs Plan) via $80m hub creation funding, and further export, industry, R&D and other opportunities. The implications have been similar to other global efforts albeit on a smaller scale.

Industry Comments:

"Policy that can be put in place for longer terms than the political cycle is more useful than a grant. A grant is only good for immediate use but a policy that secures prices of electricity or product price in future will attract more external and international investment. "

"Many projects have just had a scattering of small-scale funding which hasn't been useful as most projects are significant in cost. Doesn't help if funding is only targeted at certain aspects that are seen as currently affordable, need to target all stages of value chain, get a successful project off the ground versus announcing a whole bunch and having none of them go through."

"Key barriers or challenges that QLD has faced are getting projects off the ground. 100 desktop studies is great but if none of them progress to demonstration then what is the point. There are restrictive barriers around how funding can be used and focus needs to be on deploying this for single purpose, not 100 various options. You need policy or support to get one single flagship project up and running and then others will follow."

"Funding to target Network creation instead of FCEV deployment. The Hume highway funding was a good example of funding that doesn't mandate numbers of vehicles but the creation of a network that can service a number of vehicles. A similar concept could be applied to a Brisbane-Gladstone network with funding allocated to developing portions of the network with desired capacities. This would provide strong signals to align with vehicle OEMs and network operator plans"

"Subsidies or early support should be provided to draw players into the market, with the purpose of clipping the ticket of future commodities or products, like export royalties. This requires a longer-term view than most political cycles will tolerate".

"Queensland has government organisations that operate significant portions of the supply chain. This should be capitalised on by streamlining planning, costs, decision making, etc. The lack of operational projects suggests this is not the case. Similarly, this advantage should feed into policy that encourages more international or external investment, but again this is not being demonstrated."

"Streamlining process such as the fast 41 (US) should be developed to expedite the environmental review and permitting process for certain infrastructure projects, by creating a single point of entry for the review and by establishing timeframes for agencies to complete their reviews. QLD doesn't have this type of option that reduces delays and uncertainty in the environmental review and permitting process, which can often be lengthy and costly for infrastructure projects."

Loans

Loans provide financial borrowing mechanisms from banks or other financial institutions. In doing so, borrowers incur a debt, which entails paying back with interest and within a given period of time. Loans are similar to grants however often involve **much large sums and vary based on repayment schemes and conditions.** This latter point is important as they can be tailored to fit the cashflow, growth and risk profile of different projects.

Loans can be equally applied to any sector or staged project. Benefits include large fund access and ability to tailor repayment schedule to specific time and project. **Loans will naturally be deployed to scenarios where there is more definition of what the strategy and objectives are, in contrast to grants which are intended for making projects bankable and more exploratory reasoning.**

Types of loans based on conditions of provision:

- **Debt capital or equity/share capital** - Debt capital involves financing directly into a project with promise of repayments later, whereas equity capital involves financing in exchange for part ownership of the project. A combination of both is required as equity funding is often limited to non-majority shares and has never previously been sufficient on its own to develop a scalable market in a renewable energy technology.
- **Secured or guaranteed loans** - Secured loans are backed by physical assets/collateral and subsequently incur lower interest rates, stringent borrowing limits, and longer repayment periods. The less stringent requirements reflect the transfer of risk caused by the asset guarantee. In contrast unsecured loans usually require more comprehensive financial assessment on provision of funds.
- **Direct or partial loans** - Direct loans involve full amortization of repayments over the lifetime compared to a partial loan where repayments are only made on a portion of the loan value (meaning a lower interest rate) and a balloon payment at the loan maturity date. Partial loans are advantageous as they allow the the borrower to make minimal payments while they wait for their cash flow to increase. Additionally, the lender doesn't have to take on significant duration risk as the period is shortened via the balloon payment. This suits the profiles of start-ups and businesses where the market is not fully mature and it can take time to realise adequate cashflow. On the flipside, direct loans usually result in a high overall interest repayment
- **Contingent loans** – Contingent loans are loans structured in such a way that certain terms and conditions (interest, grace period, repayment, amortisation schedule, etc.) are dependent/ contingent on certain trigger events or milestones. Contingent loans are normally structured upfront, e.g. by linking repayment conditions to certain milestones. Such loans could be beneficial to hydrogen projects to help mitigate some of the underlying risks. For example, repayment flexibility could be introduced to deal with project execution risk, or technology performance risk. There are various specific contingent loans including:
    - **First-loss guarantee:** A first-loss guarantee would act as a direct financing enabler, whereby a guarantee from an appropriate public funding source would be made available in support of lenders, subject to pre-defined parameters. This could be an attractive option for senior lenders as it would reduce their risk exposure where it is highest. When projects are successful, the public guarantee would not be called and therefore would not result in an actual draw on public resources. Such an instrument could stimulate the early rollout of new technologies, subject to phasing out as the need for public support diminishes

- **Liquidity facility**: A liquidity facility could provide a buffer to senior lenders for the phasing of project cash flows, helping reduce risks related to temporary deviations from predicted cash flows. It could be triggered under certain debt service or operational performance scenarios, e.g. project cash flow shortfalls or a reduced senior debt service capacity. The facility would bring additional cash into the project when triggered, which could then be used to cover the project's expenses, including senior debt service. Such a resource could be relevant in cases where liquidity risks, rather than debt service capacity, need to be addressed. Given the high risk, this financing resource would require risk-sharing support from public sources.

Example – US Loans Program Office

The US Loans Program Office (LPO), part of the Department of Environment, helps projects get access to debt capital, flexible financing and committed partners, where private finance is not available. The LPO has access to US$35b in loan and debt financing and distribution is split over 3 streams of finance:

- **Innovative energy**: This provides direct loan financing to organisations developing technology that supports decarbonisation and which is not widely deployed. This encompasses imitative that
  - Utilise new or significantly improved existing technology;
  - Avoid, reduce or sequester greenhouse gases;
  - Are located in the United States;
  - Demonstrate a reasonable prospect of repayment.
- **Advanced Technology Vehicles Manufacturing**: This provides affordable debt capital to support growth of the automotive value chain. This stream is primarily composed of direct loans to support U.S. manufacturing of fuel-efficient, advanced technology vehicles and qualifying components.
- **Tribal energy**: This provides direct and partial loan guarantees for large scale energy developments owned by federally recognized native communities.

Loan Guarantee Program for Domestic Manufacturing of Fuel Cell Vehicles

- The U.S. DoE provides grants or loan guarantees through the Loan Guarantee Program for the domestic production of efficient hybrid vehicles, plug-in hybrid electric vehicles, all-electric vehicles, and hydrogen fuel cell electric vehicles.
- **The program is not intended for research and development projects**. DoE may issue loan guarantees for at least 50% of the amount of the loan for an eligible project. Eligible projects may include the deployment of fueling infrastructure, including associated hardware and software, for alternative fuels. For loan guarantees of over 80%, the loan must be issued and funded by the Treasury Department's Federal Financing Bank.

Example – Germany funding mechanisms

Germany has a range of policy mechanism that are encouraging and fostering the development of international hydrogen projects outside Germany and the EU, with the intent to proliferate German capabilities, influence and economic benefits. These include:

- **Investment loan guarantees**: A Guarantee portfolio of 28.3 billion euros designed to protect direct investments of German companies in developing, emerging and transition countries, up to duration 20 years. It allows a 95% refund of the covered investment in the event of war, expropriation, expropriation-like acts.
- **Export credit loads**: Loan guarantors provide cover for the export of Germany commodities, that meet environmental and social standards, in the event of a no-payment scenario.
- **Untied Loan Guarantee**: Similar to the export credit loan, guarantors provide insurance nets to safeguard the importation of critical commodities and resources that contribute to sustainable and macroeconomic development
- **H2-Uppp:** H2-Uppp is a funding mechanism that supports marketing introduction of hydrogen and power-to-X projects in target countries. The initiative focuses particularly on building cooperation and the setup of partnerships via PPP approaches with EU/German organisations and the host country parties.

Industry Comments:

- *"Linking hydrogen investment more clearly to decarbonsation goals of big investors so they can consider wider benefits of investment and link to their investment decarb targets – linked to taxonomy again"*
- *"Conditional loans or funding triggered when growth or targets are demonstrated. Funding that is also linked to growth."*
- *"For example, funding meeting KPI's unlocks new funding or preferential interest rates. Sustainability linked loans – example being lowering interest rates, if KPIs are achieved."*
- *and incentivized taxonomy rules that allow easier flow of institutional money into this sector.*
- *Institutional banking often waits for private sector to take the first step to de-risk landscape – policy that de-risks, so this can be quicker.*
    - *For example, taxonomy that illustrates clear link to electrolyser or ammonia production or specific elements of the industry. clear, palpable projects associated with each of those taxonomy points.*
    - *Simplification of classification and clarity to limit the identification risk for financial institutions.*
- *Loans can provide strong support, but nobody wants to have financial support that they will have to pay for via interest, particularly as nobody has a bankable project that will ensure that interest can be paid back. Similarly, investors won't lend money with lower interest rates as they don't have confidence in the projects bankability and performance. Question is how do you increase this investor confidence?*
- *Public private first loss capital to come in and crowd in those investments as there is always commercial disadvantage. There is a first mover disadvantage. There's a disadvantage on learning. There's a disadvantage on supply chains. There's a disadvantage on regulation. Electrolyser price won't come down for 5-10 years, we can't wait for that to be the case.*
- *Lower infrastructure discount rate to encourage long term investment.*

Tax credit and subsidies

Subsidies are a subset of grant that comprise direct contributions, tax breaks and other special assistance that governments provided to offset operating costs over a time period. In this sense, subsidies support the sustainability of operating projects as opposed to making projects bankable, as with grants and loans.

The most common **use for subsidies has been around the consumer-side and stimulation of demand by bridging cost gaps.** These include vehicle subsidies to encourage transport demand and tax credits for production of green hydrogen. The advantage of subsidies is that they encourage investment in supply and demand by providing a long-term forecast of financial support. As they progress, subsidies can be altered to match development (reduction if accelerated growth or increased if less than forecast). **Subsidies target existing bankable projects with the intention to support continued and sustainable growth, such as further consumption of hydrogen and products and adoption of key behaviours. Key benefit being that they are adaptable to evolving circumstances and provide financial forecast and consequently investor confidence in projects.**

Example – US Inflation Reduction Act 2022

The *Inflation Reduction Act of 2022 (IRA)* includes clean energy tax credits and other provisions that would increase domestic renewable energy production. The IRA's clean energy incentives include provisions supporting domestic production of clean hydrogen and fuel cell technologies.

The act is split into various streams that tackle different elements such as:

- **The Clean Hydrogen Production Tax Credit** which creates a 10-year incentive for clean hydrogen production tax credit with up to $3/kg. Projects can also elect to claim up to a 30% investment tax credit. The level of the credit provided is based on carbon intensity (upper limit of $4kgC0_2/kgH_{2)}$ and provides a varying, four-tier incentive depending on the carbon intensity of the hydrogen production pathway.
- **The Clean Vehicle Credit** which maintains the existing $7,500 for the purchase of FCEV by creating a qualified new clean vehicle credit built on the 30D credit for plug-in battery electric vehicles. The credit is reduced or eliminated if:
    - a certain percentage of the critical minerals utilized in battery components are not extracted or processed in the United States or a Free Trade Agreement country or recycled in North America; the percentage required increases from 40% in 2024 to 80% in 2026
    - The electric vehicle is not assembled in North America or if the majority of battery components are sourced outside of North America; the percentage increases from 50% in 2024 to 100% in 2028.

Contracts for difference

A Contract for Difference (CfD) is a financial contractual agreement between two parties, a seller and a buyer. Within the context of energy, CfDs are between producers of energy and purchasers of energy, usually a government affiliated body. They are designed to provide price certainty, support inward investment and, over time, bridge the cost gap between new technologies and those already established in the market.

CfDs stipulate that the purchaser will pay the seller any difference between the current market value of a product and its value at the time of contracting. If there is a deficit between the closing market value and the contracted price, then the seller is obliged to make up the difference. However, the opposite is also true, that if the closing market value is higher than the contracted price then the seller forfeits the difference and the buyer benefits.

Contracts typically have terms requiring producers to meet certain capacity thresholds with 6-12 months of signing before the payment schedule commences, which is typically 15 to 20 years.

From this basic structure there are different approaches that can be taken on price support and setting of the contract price. Each of these areas are addressed in turn.

Price support

CfDs may be structured on a fixed price, a fixed premium, or on a variable basis.

1. Fixed price. Market insight would dictate an appropriate price for the anticipated cost of production. This price would be paid on a per unit of energy basis throughout the contract length, which typically range from 15 to 20 years. Changing market value during the length of the contract would have no impact. This price may be set by auction. In administering CfDs for the power sector, the UK's Low Carbon Contracts Company allocates different technologies to different auctions blocks to ensure a degree of broad support.

2. Fixed premium. Producer would be paid a fixed amount in addition to the market price, paid on a per unit of energy basis throughout the contract length. The value of the fixed premium could be determined on the basis of costs of the fuels being displaced or on anticipated costs of production, e.g. the cost of carbon capture technology additional to steam methane reformation.

3. Variable premium. Producer is paid a premium throughout the contract, on a per unit of energy basis. This premium is calculated as the difference between production costs (and associated financing costs and equity return), and the market price for that unit of energy. It is to be expected that in the early years of new energy technologies the differential will be high but that this will narrow over time and eventually inverse. The market price for hydrogen may depend on the use case and differ accordingly.

Setting of the contract price

For each CfD price support option production costs could be bilaterally negotiated between producers and government. Alternatively, an auction or allocation process could be developed. The cost of production is producer specific and expected to change over time, particularly with hydrogen input costs reducing. Prices would be expected to be adjusted in line with indexation, important to accommodate fluctuations in hydrogen input energy costs over time.

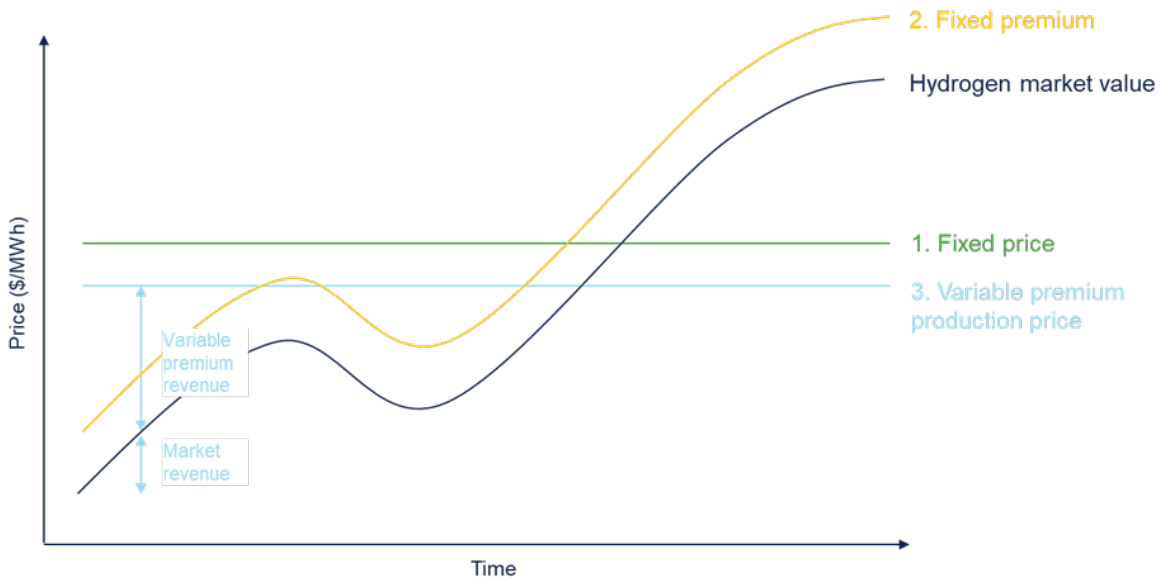

Figure 2 Price support options for Contracts of Difference

CfDs are well established mechanism within the energy sector. Several jurisdictions have CfD mechanisms in place to support low carbon electricity production and many are exploring how they can be deployed to support hydrogen. While this section details schemes that are well progressed others are emerging, including in Norway. The European Union will run a Contracts for Difference pilot project during 2023, supported by the European Hydrogen Bank.

Example – Contracts for Difference UK and Netherlands

Low Carbon Contracts Company's Contracts for Difference (United Kingdom)

- This UK Government backed mechanism is the principle means of supporting low carbon electricity generation, helping the country meet its climate change targets with least cost impact on energy consumers.
- Administered by the Low Carbon Contracts Company, this CfD mechanism uses an auction process to allow prospective developers to bid for capacity at their nominated chosen 'strike price', which reflects the cost of electricity generation for particular technologies. The CfD is structured to pay them any difference between this and the 'reference price', which reflects the average market price for electricity. Successful developers enter a 15-year private law contract with the Low Carbon Contracts Company, a government-owned company.
- In the most recent auction, running December 2021 to July 2022, 6.9GW offshore wind and 2.2GW of solar was allocated, along with further GW of other low carbon technologies.
- Electricity suppliers are required by regulation to fund the CfD payments made by the Low Carbon Contracts Company with charges passed to billpayers.

SDE++ (Netherlands)

- SDE++ contractual agreements support renewable energy or CO2 reduction in the Netherlands. The scheme subsidises the difference between a 'base rate' cost of the technology production cost that reduces CO2 and the market value of the energy produced, known as the 'corrective amount'. The market value reflects the wholesale energy costs as well as any value derived from Guarantee of Origin certificates.
- Awarded contracts last for periods of 12 or 15 depending on the technology. Production of energy in the form of electricity, heat, renewable gas, hydrogen gas or advanced renewable fuel with any of the technologies are eligible. CO2 capture is also eligible.
- For the 2022 application round SDE++ is split into five phases. During each phase a developer can apply for support up to certain intensities per tonne of CO2 emissions reduced. This limit increases from phase to phase, from EUR65/tonne CO2 in the first phase to EUR300/tonne CO2 in phase five. Applications are processed one a first come, first served basis, continuing until the budget is allocated.

Example – Contracts for Difference H2 Global

This Power-to-X scheme is an auction-based Contracts for Difference mechanism that subsidies the difference between supply and demand prices for low carbon energy. The difference is paid for by Hydrogen Intermediary Network Company GmbH using funding from the German government.

The scheme supports two competitions. First, producers bid their lowest supply price. Second, buyers bid the highest price they are willing to pay. Through this approach the difference between the prices in minimised. The demand side contracting is short term, meaning the further price minimisation as the market price of hydrogen rises over time.

Industry input regarding policy mixes required to reduce uncertainty

Table 2 Queensland market participant insight on policy considerations for the hydrogen industry in Queensland

Key market uncertainties	Policy consideration
Economic driver to create demand for clean technologies, including hydrogen	In the absence of the economic driver, a policy driver (e.g. decarbonization target) is required to facilitate demand for technologies that would support decarbonization outcomes. The most effective policy mechanisms are tax and/or regulation, placing the obligation on all users and producers to achieve overall outcomes (regulating outcomes, but not the means). This creates an equal playing field and certainty in the investment environment for investment in clean technologies, including hydrogen.
Timing and scale of demand	Policy that creates confidence in demand and demonstrates when and where demand will occur (i.e. Line of Sight). The Line of Sight is particularly important when forming consortiums, as each participant has different signals needed to achieve Final Investment Decision. Longer term planning is required
Procurement lead time uncertainty	Policy that signals to international OEM that Queensland is serious about hydrogen market development, with detail about the scale and timing of potential market, and mechanisms to develop market demand. The objective is to encourage OEM to locate business operations in Queensland and/or Australia. Greater certainty about procurement will enable businesses to have greater certainty in relation to meeting business operational timeframes.
First mover risk and funding	Policy that provides early support to draw the players to the market, with the consideration of
Cost differential	Incentivising the development of a low carbon energy system and disincentivising sources of high emissions.
Technology readiness	Suitable policy intervention to support different technology readiness levels, from ideation through to R&D to commercialisation.
Coordination risk	Systematic policy response, with different individual policy levers to be pulled at different times (and to different extents) to move the industry over time from its current position to its intended one.

Summary

- A range of measures and policy mechanisms have been developed to support emerging markets to-date in various institutional contexts. Some of these existing mechanisms maybe suitable for supporting the emerging Queensland hydrogen industry. Table 2 provides a summary of policy mechanisms and their suitability for certain stages of the technology and industry development cycles.
- Given the price differential between the high and low carbon emissions technologies, tax or regulation / or creation of obligated parities to reduce emissions are required to stimulate both innovation and diffusion of low emission technologies.
- A tax on carbon emissions or regulation requirements for specific sectors (where emissions are high, this includes all sectors where hydrogen technology could provide a viable contribution) are required to provide a financial dis-incentive and/or obligation to act.
- Market-based schemes that create obligated parties to reduce emissions and provide a range of incentives for low emission technologies is an alternative way to stimulate demand for low-emission technologies in particular sectors. Market-based schemes should be used to achieve the primary policy goal (i.e. emissions reduction), not a derived policy goal (i.e. increase in hydrogen technology)
- Sectors with existing use of grey hydrogen (and existing processes and infrastructures) are the natural sectors for early adoption/ transition/technology and market development.
- A range of measures are required to bring all actors of the value chain in action simultaneously, for an emerging market that is lacking production-side and demand-side infrastructures, and faces supply-chain shortages.
- Different measures should be deployed at different times to respond to the situation, and we indicate which measures are suitable for what in Table 2. The situation and therefore the response is different for each sector, and sometimes subsectors.
- Government (state and federal) is well suited to coordinate this time structured package of measures, setting out clear expectations of industry.
- Creation of new institutions may be required, such as
    - Financing/ Loan body targeted at financing low-emission technologies (these would also require policy clarity with respect to low-emission technologies)
    - Parties required to administer the CfD
- Scaling-up application of hydrogen technologies to particular industrial applications will be require time and knowledge sharing between users and technology providers. Knowledge sharing between the different players is required towards creating a common market and a positive business case for the hydrogen technology.
- Caution is required not to dis-advantage Australian broader energy and industrial goals through policy commitments to large-scale export industry of hydrogen or its derivates.

Table 3 Innovation and diffusion stage policy mechanisms

	Policy mechanism	What it does?	Advantages	Disadvantages	Relevance to Hydrogen market
Innovation stage	**Patents**	Legal framework to protect market share for the patent holder	The monopoly rents reward the innovator	The efficiency loss due to monopolistic supply vs welfare gain from accelerated innovation	
	R&D funds and tax credits	Government provides R&D subsidies and tax breaks for specific technologies/ activities	Direct funds to businesses Encourage knowledge spill-overs	Rewards effort; rather than outcome Governments are bad at picking winners; the public sector does not bet its own money and thus lacks a key device to discipline risk taking	
	Procurement – minimum standards	Government specifies the outcome (min standards for emissions or efficiency); but not technology	Rewards success Creates incentive to innovate: the ability to force out the competition		Require defining specific outcomes to be rewarded. Reward could be guaranteed via procurement
Diffusion stage	**Tax**	Tax on emissions	Corrects the negative externality		Would apply to all activities; does not directly relate to the hydrogen technology
	Tax credits and subsidies to achieve specific outcomes				Additional credit amounts for domestic content, energy

	Policy mechanism	What it does?	Advantages	Disadvantages	Relevance to Hydrogen market
					communities, and low-income communities.
	Contracts for Difference – fixed price		Certainty for QLD producers Simple Single price throughout contract and no price discovery required	Significant cost Significant market intervention over long time horizon Price setting difficult, risking insufficient investment if too low and over-subsidy if too high	
	Contracts for Difference – fixed price premium		High certainty for QLD producers with an additional value above input costs High value for QLD producers Single premium, maintained throughout life of contract	Significant cost Significant market intervention over long time horizon Premium setting difficult High risk of over-subsidy as differential fixed through life of contract and risk of insufficient support	
	Contracts for Difference – variable premium		Adjusts in line with the market value, ensuring value for money	Level of support may be less than alternatives, leading to investor uncertainty Complexity Premium setting difficult	

	Policy mechanism	What it does?	Advantages	Disadvantages	Relevance to Hydrogen market
	Direct regulation – minimum standards/ mandates	Minimum standard requirement for the outcome sought (environmental quality; energy efficiency; local content?)/ not the technology		No incentive to innovate beyond the target Bureaucracy cost	Safeguard mechanism US IRA provisions introduced local content requirement for steel in all renewable energy projects to stimulate the local production of green steel; and as a consequences assist with green steel via hydrogen.
	Market Schemes Targets/Quota obligations and Tradable Green Certificates	The government specifies a certain share of total electricity production or consumption that must come from renewable energy. Producers of green energy receive green certificates	Provide some certainty about potential income	Needs to be well designed and allocated	Green certificates – Renewable gases