



**TECHNOLOGY INVESTMENT
ROADMAP DISCUSSION PAPER
SUBMISSION**

SOUTHERN GREEN GAS
Level 6, 30 Collins Street, Melbourne

1. Introduction

Thank you for the opportunity to participate in the Australian Government's *Technology Investment Roadmap discussion paper*. Southern Green Gas is a renewable energy company pioneering world-first technology aimed at creating carbon-neutral fuels; **renewable methane and renewable methanol**.

Our technology has been recognised by ARENA who are supporting our demonstration project at the Wallumbilla gas hub in Queensland. This project will be realised through our partnership with natural gas transmission company, APA Group, and will jointly allow us to showcase the capability of the technology in a real-world setting. The commitment of ARENA and APA provides an endorsement of our technology and our vision as to how it can contribute to Australia's transition towards lower carbon-intensive future.

Through the production of renewable methane, we are creating a scalable pathway to carbon neutral natural gas which has the potential to create **a major new export market for renewable LNG**.

As the most effective hydrogen carrier, **renewable methane presents an enormous opportunity for Australia to reach its objective to be a top three supplier of hydrogen into Asian markets by 2030 and to realise the first technology stretch target - "H2 under 2"**.

Additionally, our technology delivers "firm" renewables with the potential to fuel existing gas fired power stations and despatch renewable electricity on demand thereby **creating the pathway to 100% renewables in the electricity sector**.

Our technology can also be applied to the production of renewable methanol and decarbonising heavy transport through carbon neutral liquid fuel.

As our technology which comprises of process modules will be aggregated in the thousands, we will create major production projects in Australia utilising advanced manufacturing. It is anticipated the market opportunity for the technology, domestic and export, would support world scale manufacturing.

We look forward to working with the Australian Government to realise the nation's transition to the desired low emissions future.

2. About Southern Green Gas

Founded in 2018, Southern Green Gas was established to commercialise carbon neutral fuels.

Through Australian and international R&D, we have developed a package of proprietary processing technologies that extract water vapour and CO₂ from the atmosphere, use solar energy to produce hydrogen, and combine hydrogen and CO₂ to form methane gas or methanol liquid.

The benefits of our technology and business approach are as follows:

- **Delivering carbon neutral fuels through existing infrastructure.** Renewable methane, being interchangeable with natural gas, can utilise existing infrastructure (gas pipelines, gas power stations, LNG export facilities) and therefore will maximise the utilisation of this infrastructure and avoid stranded assets. Renewable methanol can be used in existing petrol and diesel engines with relatively minor modifications and can be exported through existing ports and methanol shipping tankers.
- **Achieving cost parity with fossil fuels.** Our goal is to reach "8 by 28", that is \$8/GJ by 2028. At this price, methane would compete with natural gas in Eastern Australia. By 2028,

significant shortfalls in gas supply to Eastern Australia are predicted – renewable methane could avert this decline. Further, meeting this cost target also supports achievement of “H2 under 2”.

- **Delivering firm renewables.** As hydrogen storage is included in our modules, the technology delivers “firm” renewables. Renewable methane can fuel existing gas fired power stations and despatch renewable electricity as the demand requires, creating the pathway to 100% renewables in the electricity sector.
- **Creating major new export industry.** Renewable methane, via the LNG network, can supply into the existing mandated renewable electricity markets in Japan, Korea, Singapore, Germany and UK. As an ideal hydrogen carrier, renewable methane also presents a viable pathway for Australia to reach its objective to be a top three supplier of hydrogen into Asian markets by 2030.
- **Displacing liquid fuel imports.** Australia imports the majority of liquid fuels (refined product and crude oil feedstock). We aim to produce renewable methanol in Australia at price parity with petrol and diesel thereby increasing fuel security and balance of payments.
- **Creating new manufacturing capability based on smart jobs and advanced manufacturing processes.** Historically, Australian manufacture has been sub-world scale, however given the growing demand for carbon neutral fuels, the manufacture of our process modules in Australia would be world scale (comparable to Tesla gigafactories).
- **Substantially increasing business investment and employment growth in regional areas.** Renewable fuels production projects will be based in regional Australia with the associated module manufacturing facilities to also be located in regional areas.

2.1 Technology overview

Through a modular, scalable approach we have developed a technology package capable of producing methane or methanol sustainably, solely from renewable sources.

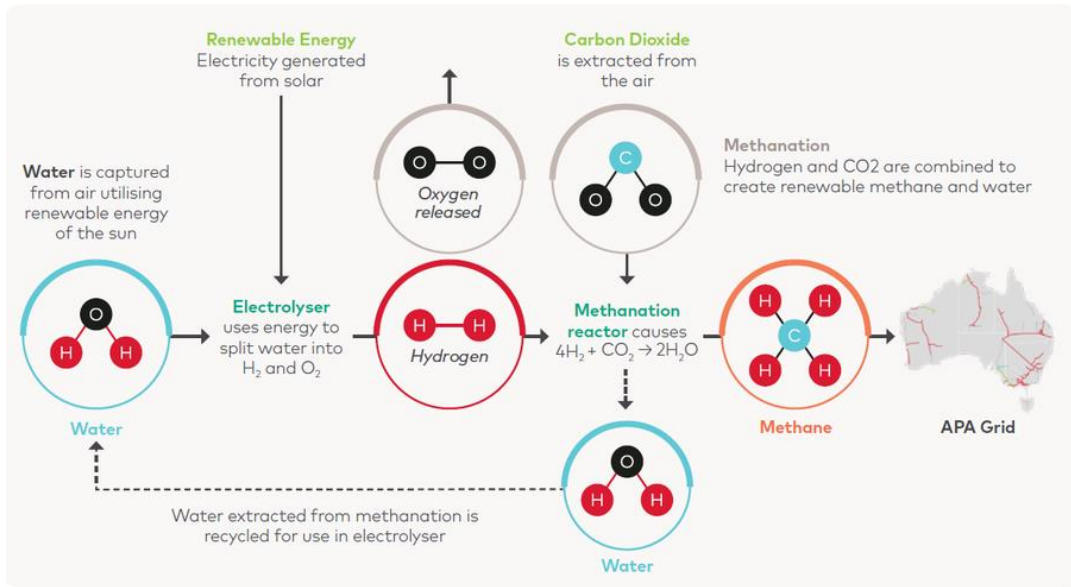
Commercialisation will occur through world scale projects in regional Australia taking advantage of the co-location of:

- World class solar resource
- Abundant low-cost flat land
- Major gas pipeline infrastructure

Each project will comprise thousands of process modules coupled to solar PV panels, with each module's methane production aggregated and injected into the existing gas pipeline system.

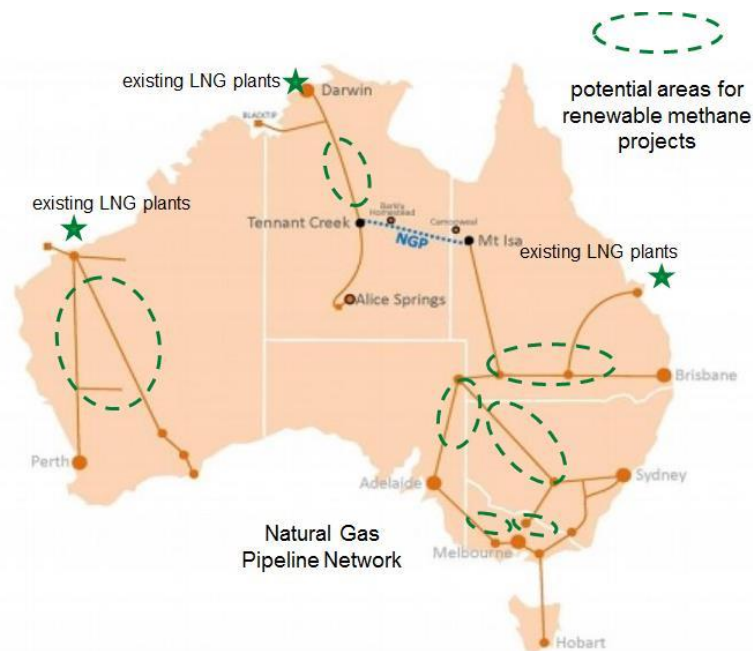
The CO₂ released at the point of use is completely offset by the CO₂ extracted from the air during production **ensuring carbon neutrality**. The process, outlined at Figure 1, is therefore completely sustainable.

Figure 1: Renewable Methane Creation Process



Our technology is designed to be sited alongside existing gas transmission pipelines with potential areas for deployment shown at Figure 2. As Australia’s largest gas transmission operator, it is intended that our partnership with APA Group will enable this roll out to a significant degree.

Figure 2: Potential areas for renewable methane projects



The renewable methanol production process is very similar to that of methane with hydrogen and CO₂ catalytically converted in a methanol synthesis reactor. Being liquid at room temperature, methanol can be piped or trucked to local markets or exported.

2.2 The market for renewable methane

Hydrogen is the lightest gas and storage is considerably more costly than liquid fossil fuels. Methane is an efficient hydrogen carrier providing more hydrogen when used in conventional reforming (33%) than other carriers such as ammonia (17%) or methylcyclohexane (6%).

Renewable methane presents a carbon neutral pathway to grow the hydrogen economy without new pipeline investment and with a speed-to-market advantage. It is therefore an attractive option for the natural gas transition.

Renewable methane can be used in a number of renewable fuel applications, including generation of electricity from existing gas-fired power stations, heating homes, fueling CNG (zero emission) vehicles and fuel cell electric vehicles (upon reforming back into hydrogen).

Our initial target markets are those with government mandated renewable electricity goals, namely Japan and Korea that have set renewable electricity targets of 22-24% and 20% by 2030 respectively. This is equivalent to twice the total electricity demand in Australia. Both countries are lagging in their achievement of these targets (Japan – 5%; Korea – 18%), due mainly to the high cost of indigenous renewables. In Japan alone, to supply the unmet portion of the renewable electricity target would require investment of up to \$50 billion in renewable ethane facilities.

Shipping is another emerging market for carbon neutral fuel. With phasing out of high sulphur fuels as the IMO introduces emissions targets, LNG is actively being considered as a replacement bunker fuel which presents scope for the introduction of renewable LNG.

2.3 The market for renewable methanol

Our technology can also be applied to the production of renewable methanol. Australia imports most of its liquid fuels (petrol, diesel); some 35,000 megalitres per annum. Production of renewable methanol in Australia with price parity to petrol and diesel is a key feature of our business plan. This is a methanol target market of 56mtpa.

Methanol is also being actively considered as a replacement bunker fuel for ships representing a potential methanol market of 800mtpa.

2.4 Southern Green Gas business model

Positioned as both a manufacturer and project developer, we intend to be a vertically integrated organisation supported by partnerships with transmission operators, such as APA Group and international trading houses to facilitate gas supply to Asia.

Local manufacture is central to our business model. We are actively pursuing relationships with major industrial companies to establish a new suite of manufacturing businesses in Australia that will directly contribute to the Australian national imperative to expand domestic engineering and manufacturing capability post COVID-19 and generate opportunities for smart jobs.

Cost reduction will be achieved by economies of manufacture, similar to photovoltaics with an initial production target of one million modules per annum.

2.5 Wallumbilla demonstration project

Through our partnership with the APA Group and financial support from ARENA, the Wallumbilla Renewable Methane Demonstration Project will demonstrate the technical and commercial viability of renewable methane production.

Commencing in 2021 and operating over a 12-month period, the project will be located at APA's Wallumbilla major gas hub in southern Queensland and see the deployment of a renewable methane module generating gases for use on site.

The validation of the technology will provide the foundation we require to scale, including securing additional investment, gas supply partnerships and manufacturing facilities.

3. Southern Green Gas discussion question response

a) The challenges, global trends and competitive advantages that should be considered in setting Australia's technology priorities

Australia has three co-located competitive advantages; abundant low-cost flat land, world's best solar resource (quality and quantity) and gas infrastructure. This allows the production of hydrogen at the lowest cost globally. To facilitate hydrogen's transport and export, whilst maximising use of existing infrastructure, it can be converted to renewable methane.

In an environment with growing demand for cleaner energy sources, Australia's dependency on fossil fuel commodities presents a growing risk. Many of its traditional markets are already moving towards a requirement for Australian energy commodities and manufactured products to be based on carbon neutral energy inputs.

To ensure the longevity of Australia's LNG trade, albeit in a sustainable way, renewable methane presents an opportunity to decarbonise the sector with minimal disruption.

Another important global trend the Australian Government should consider in setting its technology priorities is Industry 4.0 Automated manufacture would negate Australia's disadvantage of relatively high labour rates and increase the attractiveness of local manufacture of low emission technologies.

b) The shortlist of technologies that Australia could prioritise for achieving scale in deployment through its technology investments

The Australian Government is promoting natural gas as the preferred transition fuel, notwithstanding its carbon intensity as a fossil fuel and significant challenges in bringing major new gas fields into production. Hydrogen, is a vastly better option as the transition fuel for Australia due to the following:

- Zero-carbon impact when produced from renewable energy
- Production can occur wherever there is abundant sunshine
- The timing to achieve volume production and delivery could be comparable with, or faster than, the discovery, development and delivery of new natural gas production
- Greater energy storage than batteries
- Implicitly reinforces Australia's commitment to a zero-carbon future

We therefore endorse the inclusion of hydrogen within the shortlist of technologies and urge its prioritisation by the Australian Government, including hydrogen carriers such as renewable methane.

The production of hydrogen to meet projected demand will require significant gigawatts of solar PV. Printed solar, which has one tenth of the weight of silicon based solar PV (which is mostly imported), has the potential to realise a cost lower than 5c per watt. Furthermore, several Australian universities are currently pursuing its development. Due to the importance of this technology and local R&D opportunities, it is recommended it be treated as a priority area.

Secondly, the key technology that facilitates the production of renewable methane, which has the potential to be a nationally significant fuel, is CO₂ extraction from the atmosphere. With its ability to mitigate against climate change and the multiple use cases for CO₂, this technology should also be prioritised.

Finally, as noted above the technology for automated manufacture should be a national priority to enable the development of clean technology manufacturing sector in Australia. Our technology in particular would greatly benefit from the Industry 4.0 Advanced Manufacturing Forum and potentially access to Germany's capability supported by the Australia-Germany Advisory Group.

c) Goals for leveraging private investment

As an ARENA stakeholder, we support their continuation for an additional 10 years at a minimum with a funding allocation that supports scale level projects. Given the investment certainty ARENA provides for the private sector, we recommend a decision regarding their continuation is expedited.

In our own experience as a startup in Australia, venture capital opportunities are limited relative to other markets. One significant investment avenue which should be unlocked for technology commercialisation is Australian superannuation funds. With a value of approximately A\$1.9 trillion, these funds could be an attractive vehicle directed towards scaling emerging clean technologies.¹

d) What broader issues, including infrastructure, skills, regulation or planning, need to be worked through to enable priority technologies to be adopted at scale in Australia while maintaining the support of local communities

Continued investment in STEM, particularly in regional areas, will facilitate local community support for low carbon industrial investments.

We foresee significant economic benefit derived by regional communities in the shift towards global supply chains based on the movement of clean energy originating in their jurisdictions.

Our business footprint for example is regionally focused with production projects and manufacturing facilities to be located in regional areas of the country yet connected to the world through existing land and sea-based infrastructure. This model will allow us to tap into local skill sets and build capability as needed as we meet our objective of deploying one million plus modules across Australia.

¹ Austrade, "Australia has the fourth largest pension fund assets in the world", *austrade.gov.au*, 22 February 2019, <https://www.austrade.gov.au/news/economic-analysis/australia-has-the-fourth-largest-pension-fund-assets-in-the-world> (accessed 16 June 2020)