Lean Emissions Alliance

Clean Energy Finance Corporation

Expert Review

Request For Submissions

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Lean Emissions CEFC Submission

1 Background – Our Funding Context

The Lean Emissions Project is focused on developing technologies that convert waste methane into high value energy products. We have been developing our technologies in partnership with the University of Queensland over the last six years, and thereby have developed some experience with the funding environment for clean energy projects in Australia.

In 2009, Australia's Greenhouse Gas Inventory included 5.4 MT of waste methane emissions *(*)*, however a significant proportion of this waste could be harvested and converted to clean energy products, from such sources as coal mines (1.25 MT), oil and gas development (667 kT), intensive agricultural feedlots (83.3 kT), and landfill (525kT) or sewage plants (123kT). If even half of this waste methane could be captured and converted into fuel, using a small-scale, efficient gas-to-liquids system, it would be sufficient to displace >20% of annual petrol supply.

One of the significant limitations to re-using all of this waste methane is that current utilisation technologies that convert methane into energy products are financially unattractive with waste gas. Typical problems constraining the economics of waste methane sources are that they are often:

1. Small Sources: Volumes of waste methane are too small to make utilisation profitable with current technologies, thus many small sources of methane are simply flared (i.e. destroyed without producing value)
2. Dilute Sources: Volumes of waste methane are often diluted by air or CO2 below the profitable utilisation limit (i.e. can only be used for low-value utilisation technologies, hence dilute gas is low-value gas)

The Lean Emissions Project is focused on leveraging advances in nanotechnology to develop two key technologies, which will revolutionise the economics of waste methane utilisation, namely:

1. Low Cost Gas Concentration: Dilute waste methane has low value and cannot be concentrated economically with existing gas separation technologies (e.g. membranes, adsorption etc). We are developing a gas concentration system that is driven by waste energy (i.e. almost zero operating costs).
2. Small-scale, Fuel Production (Gas-to-Liquids or GTL): Waste methane sources are often small and remote from infrastructure, and current fuel production systems are too inefficient and produce too much CO2 to be viable at small scale. We are developing a small-scale Gas-to-Liquids (GTL) technology that produces fuel ethanol at high efficiency with zero emissions

The Lean Emissions Project developed its technology initially through the Australian Research Council's (ARC) Industry Linkage Program, but since then has uncovered a number of gaps in funding and barriers to developing clean energy technologies.

In our view the issues are:

- SCOPE: In general, Commonwealth Clean Energy Funding Initiatives have too narrow a focus (i.e. almost wholly on electricity generation), do not fully anticipate the true technology problems that need to be resolved in the sector, and do not use sophisticated measuring techniques which assess the value of projects in the best way. Thus they typically fund projects that result in very limited changes to the techno-economic constraints, and thereby they may not achieve their broader objectives.
- MARKET GAP: In Australia, there are Government grants available for scientifically developing new technologies (e.g. ARC grants), and there is support available for the deployment of proven technologies (e.g. commercially proven). However there is a significant gap in the funding for the commercial proof of new technologies, and thereby many high-value technologies remain commercially undeveloped

(*) Source: Australian Greenhouse Emissions Information System, Department of Climate Change and Energy Efficiency. (Thu Dec 08 2011 12:22:20 GMT+1000 (EST))

2 Scope of the CEFC

In our view, the directors of the CEFC need to carefully consider their scope of application. A narrow definition of the term "Renewable Energy and/or Low Emissions Technologies" would see support being only provided for a few electricity generation technologies produced by true renewable resources (e.g. wind, solar, geothermal, biomass etc).

We propose this definition should be extended to include clean energy from waste, both electricity and fuel, as significant volumes of fuel and energy could be derived from Australia current waste products. Of particular interest is waste methane, as it represents 20% of Australia's total Greenhouse Gas Inventory (2009 Total Methane 113.9 MT CO_2-e versus Total Emissions 564.5 MT CO_2-e), and significant proportions could be harvested and converted into clean energy products.

We acknowledge the current difficulties of electricity production from small volumes of methane, where, due to underlying economics of the conventional conversion processes (e.g. engine-generator, turbine etc), small-scale electricity generation is economically unattractive and cannot compete against large-scale generators. Thus we propose that new methods of economically utilising sources of waste methane (e.g. conversion to fuel) should be sought that change the techno-economic status quo, so substantial parts of this resource can be harvested and converted into clean energy products.

In addition, we propose this definition also be extended to include key ancillary equipment, necessary for clean energy production (e.g. low cost means of purifying gases), and that additional focus from the CEFC will be granted if it can be shown that the proposed system would result in a significant change in the techno-economic status quo.

Ultimately, the theme of this submission is that the CEFC must seek to change the techno-economic status quo, and support commercial proofs of novel game-changing technologies, and first of a kind's (FOAK), leaving commercial deployment to commercial investors.

2.1 How do you expect the CEFC to facilitate investment?

We expect the CEFC to be focused on funding near term and mid-term, game-changing technologies. These technologies will be at different stages of their development lifecycle, with a few large, late-stage projects being offset by a larger number of smaller, early stage ones.

The function of the CEFC is to provide key funds to overcome specific development risks at particular stages of a technology's commercialisation, where commercial investors are unprepared to fund the project alone. Thus we see it acting in a catalyst role to overcome key hurdles in the technology development (see Section 3).

We expect the CEFC to have a qualification process, by which we can engage with them, and prove the viability and importance of our technology. It is critical that this qualification process be designed so that the true value of the potential new technology can be appraised (see Section 2.2).

2.2 Are there principles beyond financial viability that could be used to prioritise investments, such as emissions impact or demonstration affect?

While financial viability of the proposed technology is important, it should not be the prime determinant of funding priorities. The CEFC has limited funds, and must seek to gain the greatest advantage possible within those limits.

Ultimately, the objective of the CEFC funds are to change the techno-economic status quo, so the aim must be to prove and commercialise new technologies that will significantly reduce the cost of producing clean energy in Australia. While there may be many worthy projects that reduce the emissions from a single site, these demonstrations should not primarily be funded by the CEFC, as they are not game changers.

Technologies are part of larger systems, and cannot easily be compared by their individual emissions reduction potential, or their demonstration affect. Instead, reviewers must have a good understanding of the present techno-economic constraints, and focus their attention on the game changers.

Realistically, the CEFC must assess and prioritise the level of techno-economic change engendered by a new technology, and assess in detail those projects that will radically change the status quo, and thereby significantly impact the cost of clean energy production.

Therefore the detailed assessment of a project should include its development history, current development stage, and assessment of the risks of the next stage of development.

2.3 What are the opportunities for the CEFC to partner with other organisations to deliver its objectives?

One of the key opportunities for CEFC in seeking to catalyse clean energy technology developments is to leverage its funds in concert with commercial investors. The role of the CEFC is primarily to cover risk that is unacceptable commercially, but this does not mean it must fund the entire development.

Instead the focus is on covering the larger percentage of critical stages (e.g. prototype development, pilot plant etc), so that commercial investors can still be involved. As a true investor, rather than a provider of grants, CEFC also has the potential to develop longer-term partnerships with commercial investors so that the developments can be fully commercialised and its investment finally realised.

3 The Market Gap and Overcoming It

Over the last six years of development in clean energy technologies, Lean Emissions has come across a number of gaps and barriers to commercialisation. However, some definitions of the commercialisation process are needed in order to describe these barriers.

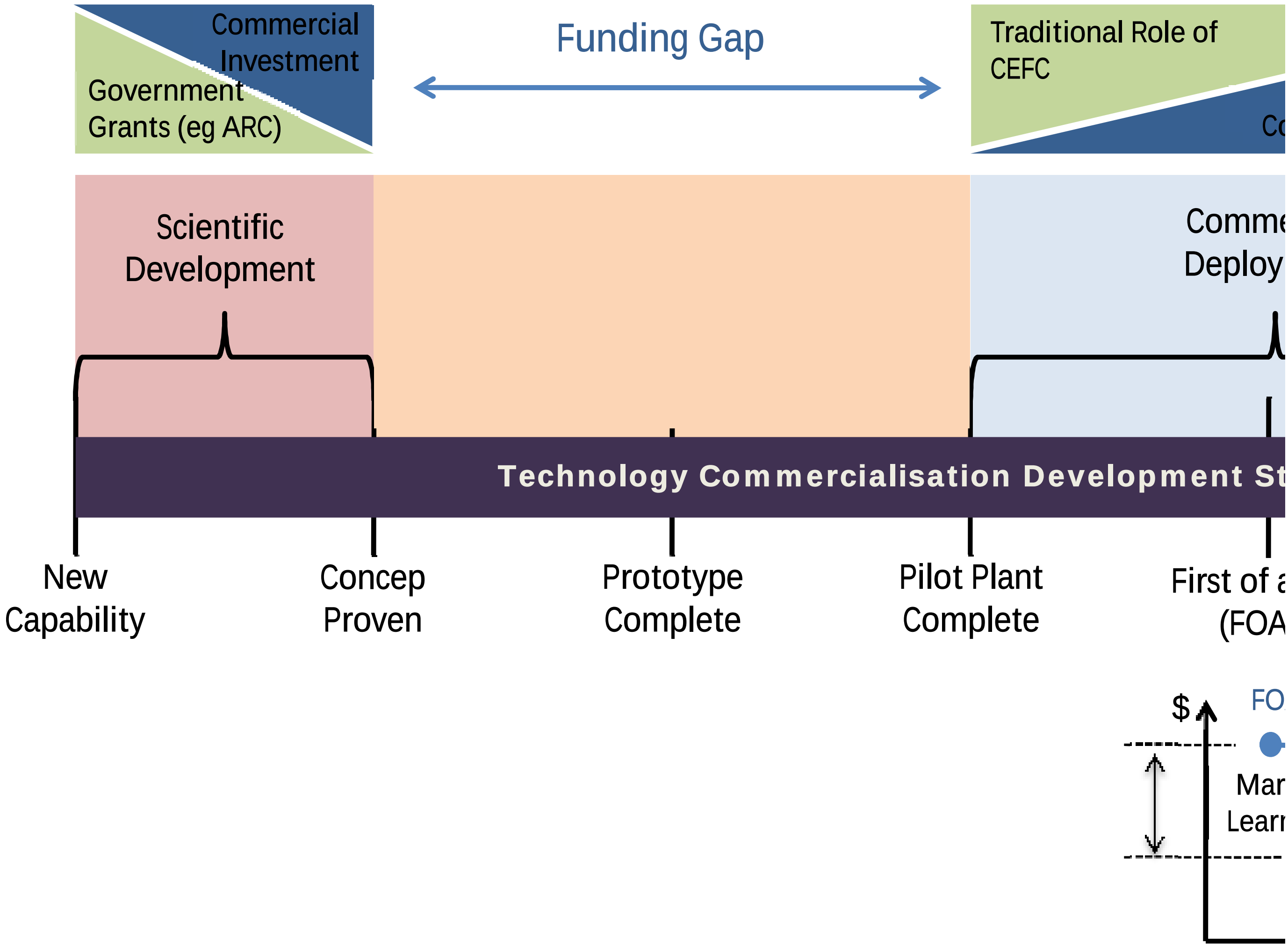
In general, we can say that any technology must go through at least six stages for full commercialisation:

1. New Capability: A scientist has developed a new capability and must prove it
2. Proven Concept: A scientist has developed a proof of concept that demonstrates the new capability
3. Completed Prototype: A scientist develops a system prototype, demonstrating the value of the new capability
4. Completed Pilot Plant: Engineers develop a pilot plant, providing sufficient commercial proof for investors
5. First of a Kind (FOAK): Engineers develop the FOAK, which is expensive and has poor functionality
6. Nth of a Kind (NOAK): After much market evolution, the NOAK technology is low cost and high functionality

In our experience we have found that commercial investors are only interested once the commercial value has been proven (i.e. following the deployment of a pilot plant). Once the pilot plant has proven the commercial viability and scalability of the system, then investors can be developed to fund the Commercial Deployment.

During the Scientific Development, we have found that the existing competitive grants schemes (e.g. ARC) are sufficient to get the concept proven. However, we have found an obvious funding gap in the Commercial Proof stage, and have found it almost impossible to get funding for prototypes and/or pilot plants.

Thus, we see a large gap between the scientific proof of a new capability and the commercial proof of the capability. In our view, the CEFC would do well to focus some of its resources on this gap.



3.1 How could the CEFC catalyse the flow of funds from financial institutions?

The CEFC can catalyse significant funds from financial institutions by assisting Clean Energy Development Projects to develop through the Commercial Proof stage, enabling them to meet the requirements of the commercial investors.

The CEFC can deploy funds to help push game-changing technologies through the process of developing a commercial proof, thereby covering the high-risk, non-commercial aspects of the development project.

3.2 What experiences have firms in the clean energy sector had with trying to obtain finance; have term, cost or availability of funds been the inhibitor?

In our experience, lack of a commercial proof point (i.e. a pilot plant) is the true inhibiting factor constraining the development of clean technologies in Australia. Once a technology has been proven at the pilot scale, then commercial investors are prepared to work with developers and fund the scale up and deployment of a FOAK system.

However, if the developer has a game-changing technology with a proven concept, but as yet has not developed the prototype or the pilot plant (e.g. 4-yrs of development to reach FOAK), then Australian commercial investors are not prepared to fund this gap.

Thus our experience is that many high-value, game-changing technologies languish undeveloped, while commercial funds are spent on developing near-term technologies with only small, incremental benefits to the techno-economic status quo.

We see three problems:

1. Inappropriate selection criteria by Government funding bodies (e.g. CEFC) focuses funds on near-term projects, with limited or incremental benefits (i.e. no focus on game-changers)
2. Commercial investors are reluctant to fund projects until they have presented a commercial proof such as a pilot plant, where accurate economics for scale-up can be determined
3. A significant Funding Gap exists between the Scientific Development and the Commercial Deployment stages, and high-value, game-changing technologies cannot easily be commercially developed in Australia

3.3 What non-financial factors inhibit clean energy projects?

Clean Energy Projects are complex as they are generally seeking to improve the techno-economic status quo, and thereby accurate assessment of them requires a good understanding of the constraints in the sector. However, government bodies are only beginning to develop the technical expertise to understand the true constraints in the sector and thus source their information from the public domain.

This can lead the government to focus on technologies that have no real, long-term viability, but have short-term public appeal and/or tick the clean energy boxes in a theoretical way, without any chance of widespread practical deployment. A good example is the issue of bio-fuels in Australia.

Bio-fuels are an attractive to a large part of the voting demographic, as they seem at first glance to have many advantages (e.g. fuel security, good for agricultural sector, good for environment etc). However, the evidence of the last few decades of development demonstrates that this is not the case, and that mostly bio-fuel projects find it difficult to gain sufficient market scale.

Australia has limited arable land, and there are significant climate impacts on our agricultural sector. Shifting large proportions of this land towards fuel-crops will permanently impact the micro-economic climate causing food prices to soar. It is expected that this problem will become even more extreme in the future as increasing periods of drought reduces agricultural productive area (http://www.scientificamerican.com/article.cfm?id=planet-likely-to-become-increasingly-hostile).

The USA has developed extensive bio-fuels programs, and the US military in partnership with a slew of airline companies (e.g. Boeing, Virgin etc) has even tried unsuccessfully to develop a bio-jet fuel industry. While the fuel production technology is well developed for jet fuel, the two over-riding factors are that:

- The energy required to harvest and produce the fuel is often greater than the energy contained within the fuel, so there is really no environmental benefit
- The large-scale production of fuel from agriculture has negative impacts on the cost of food (http://www.scientificamerican.com/article.cfm?id=bio-jet-fuel-struggles-to)

Thus, many decades of development has demonstrated that bio-fuels based on crops, or some form of low-cost sugar, are unviable within most countries due to limited agricultural land and high energy of production. Australia has held a number of Senate enquiries, which have arrived at the same conclusion (e.g. Australian Senate Standing Committee, 2007, Australia’s future oil supply and alternative transport fuels; Australian Government Biofuels Taskforce, 2005, Report of the Biofuels Taskforce to the Prime Minister, August 2005)

Despite this mountain of evidence and the conclusions of internal enquiries, Australian State and Federal Governments continue to fund and develop bio-fuel projects that have no prospect of ever being economically viable. The constraints of the funding are set so that fuels made from waste can not be considered eligible for support, and thus large amounts of public funds are squandered.

]In summary, we believe that it is essential that the CEFC view the utilisation of waste methane to produce clean energy products as essential, and fund the development of projects which seek to improve the techno-economics of waste methane utilisation.

3.4 Are there special factors that inhibit energy efficiency projects?

In our view, the term energy efficiency projects, is considered in too restricted a context, when in fact most clean energy projects are focused on reducing the amount of energy used in a process. In addition, technologies that may reduce the energy usage in a key unit operation (e.g. gas separation) of a clean energy system also fall outside of the normal definition of an energy efficiency project.

In large systems, energy use is proportional to cost, where the capital cost is proportional to the energy required to make and sell the system (i.e. embodied energy), and the operating cost is proportional to the energy required to run the system. Thus, developing more effective, cleaner technologies requires novel systems and/or unit operations that:

- Require less energy to construct (i.e. lower capital cost)
- Require less energy to operate (i.e. lower operating cost)
- Produce less emissions, per output (i.e. lower emissions intensity)

Again, we see the issue here as one of narrow definitions, which inhibit the development of true game-changing technologies, by qualifying them out of the funding process. As an example, consider the situation of a developer seeking to fund the commercialisation of a step-reduction in the use of energy to separate gases. Assume they have achieved a scientific demonstration of proof of concept.

We note for background, that the global gas separation industry is worth in excess of USD60 billion per year, as gas supply is critical for many major industrial and manufacturing processes. In addition, in a carbon-constrained economy, the need for gas separation increases exponentially as many processes become more efficient if a stream of pure gas (e.g. oxygen) is substituted for air, and there is also the need to separate out any carbon compounds from waste emissions.

For the developer, the issue is that their technology is designed to displace a single unit operation within more complex systems (e.g. steel making, energy production etc), and that while offering significant reductions in energy use when compared to competitors, it is difficult to get funding for single operations, outside of a total system context.

Thus the developer might have the means of fundamentally reducing the total energy used to separate gases across the entire industry, but be unable to gain support to develop the technology through to the Commercial Proof Point. Essentially, the Government funds are framed so as to disqualify step-improvements in critical unit operations, as they cannot form part of a total system context until they are developed past the Pilot Plant Stage.

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