(Energy)Lab

Cleantech startups and the SDGs:

A taxonomy and state-of-play for impact investors

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About EnergyLab:

EnergyLab is Australia's largest cleantech startup accelerator and innovation network dedicated to the clean energy transition. We provide a springboard for the top energy and clean technology startups in the region, and we connect talented founders, innovative companies, top-flight professionals and experts, and impact-driven investors in a network designed to drive and support cleantech and energy innovation. To find out more visit energylab.org.au.

About EnergyLab's research:

EnergyLab prepares reports such as this to help facilitate productive conversation around energy and cleantech innovation, to help promote and support energy and cleantech entrepreneurship, and to facilitate investment into ground-breaking companies and solutions. For more EnergyLab publications head to energylab.org.au/publications.

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Executive summary

Achieving the Sustainable Development Goals (SDGs) is expected to take significant and well-targeted investment.

Fortunately, institutional investors have allocated significant volumes to sustainable investments, and are increasingly pledging to invest in alignment with the SDGs and other sustainability goals. There are also plenty of opportunities for the private sector to contribute towards the SDGs while generating suitable returns for shareholders, further suggesting that investment is likely to flow to sustainable development outcomes. However, targeting these investments continues to be a contentious process, and investors and governments continue to look for ways to identify supportive investments, enable and encourage private capital allocation to these investments, and measure and demonstrate alignment.

As we have noted before,[1] investment in early-stage businesses provides one obvious way for investors to lean into sustainable development.

We largely focus on cleantech startups (i.e. high-growth businesses deploying environmentally beneficial technology), which are particularly effective at contributing to the SDGs because they're often purely focused on relevant problems. Furthermore, they have the potential to scale rapidly, generating outsized impact on issues like climate change, biodiversity loss and ocean plastic. Investing in cleantech startups is also more likely to meet 'additionality' criteria, an important but difficult hurdle for impact investors.

But determining which cleantech startups contribute to which SDGs (if any) isn't straightforward.

Part of the problem is that startups are private and, as such, there is a lack of data available on startups and what exactly each one does. Part of the problem is the complex, overlapping and interrelated nature of the SDGs and their 169 targets and 231 unique indicators. And another part is the shortage of guidance necessary to know when an action is significant for an SDG.

In this report, we've created a taxonomy to try to make SDG-aligned investing in startups easier, with a particular focus on cleantech startups and the environmental SDGs.

We've created thirty-seven categories of cleantech startups, covering most types of startups in Australia that contribute towards the environmental SDGs. For each of these categories, we've assigned an SDG they primarily contribute towards as well as any SDGs they secondarily support.

We've also categorised over 300 Australian cleantech startups against the taxonomy and analysed the results.

This allowed us to assess the distribution of Australian cleantech startups by focus area as well as differences between startups focusing on each environmental SDG.

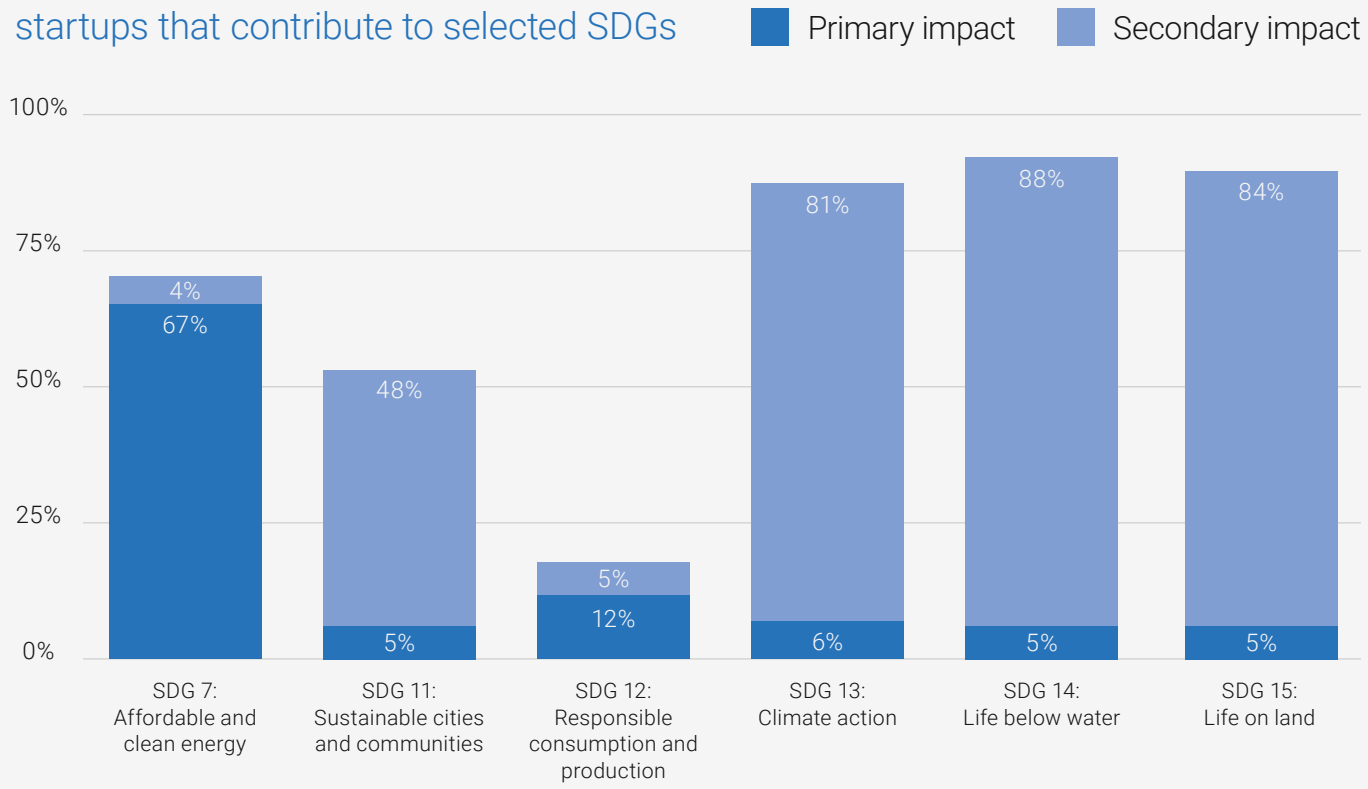
[1] Tilbury, James 2019 Clean development financing: Creating an investment pipeline for decarbonisation. app.energylab.org.au/research/clean-development-financing

We find that over two-thirds of cleantech startups in Australia are clean energy startups, which contribute to four specific SDGs (sometimes more).

About 80% of cleantech startups are led by men, and only about 10% of cleantech startups are deep tech startups (i.e. based on new scientific discovery or meaningful engineering innovation). We also find that the 'Life below water' SDG is the best-served SDG when secondary impacts of cleantech startups are considered. On the other hand, we find that while the 'Responsible consumption and production' SDG has the second-largest number of startups primarily targeting it, the fewest startups contribute towards this SDG when secondary impacts are taken into account.

Figure 1:

Proportion of Australian cleantech startups that contribute to selected SDGs



While there are proportionally more clean energy startups in Australia than other cleantech startups, many more are needed to decarbonise the energy sector. The evident contrast with other SDGs is indicative of the extent of the even greater shortage in other areas, with more startups in all categories needed to help achieve the SDGs.

At EnergyLab, we are working to address these shortages through a range of internal and external programs designed to increase the number of cleantech startups, within and outside the energy sector. We're also working to address the gender imbalance through initiatives such as our Women in Clean Energy Fellowship.

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Introduction

Focusing on startups might seem a strange choice for many trying to solve climate change or environmental problems.

After all, they're just a type of business, and by definition some of the smallest forms of business at first. Many in the environmental movement would consider business the cause of environmental problems, not the solution. Those motivated to solve large, environmental problems are often more likely to be found working to change policy from various angles.

However, we believe startups are unique in their ability to have an outsized positive impact on society, including on climate change and other environmental challenges.

We don't dismiss the transformative power of policy change. We do however believe that starting, supporting, and investing in startups is a path similarly capable of enabling large-scale, positive change. Larger companies are generally more powerful but are often prevented from innovating quickly by inertia and by the gravity of short-term results. Startups are not constrained in these respects and are designed to grow fast and disrupt industries, sometimes changing society as they go. These changes can be good, bad, or neutral. Often these changes mostly improve the quality of life of already well-off people, but that's not all startups are capable of.

At EnergyLab, we're trying to take advantage of the transformative power of startups to have an impact on a very particular part of society: its emissions intensity.

Few industries throughout history needed to be disrupted as thoroughly and quickly as emissions-intensive industries today. Climate change calls for urgent and drastic changes in the way we produce, travel, and consume. It has become apparent over the last decade or two that many emissions-intensive industries won't change quickly enough of their own accord. With vested interests often hobbling the government's ability to intervene to the extent necessary, startups and technology may be our best bet.

Let's consider a non-environmental example. Can you imagine if a government proposed a policy that would change market conditions so that businesses who sold physical books, music and movies would quickly lose the majority of their market share to businesses that sold these goods in digital format? Probably not, but it's easy to imagine (because it's already happened) startups coming along and enabling that exact change. We believe cleantech startups have the same potential to transform emissions-intensive industries like the energy sector, helping us modernise and decarbonise quicker than otherwise imaginable.

Cleantech startups could play a role in solving many other environmental problems as well.

While arguably the most urgent environmental problem facing society today, climate change is not the only challenge. We also have, for example, oceans filling up with plastic and being drained of life, accelerating biodiversity loss, and various finite resources being depleted at frightening rates. These are all issues that many cleantech startups are tackling and could help solve even more quickly with adequate investment.

As a result, when investors talk about wanting to invest in environmental outcomes, we believe they should pay more attention to cleantech startups.

Institutional investors typically only invest a small portion of their funds into startups, through intermediaries such as venture capital funds, and these investments are generally targeted at all startups (many of which are consumer software startups). By comparison, even a relatively small, targeted investment in cleantech and impact-oriented startups could have a large impact on sustainable development outcomes.

When large investors think about aligning their portfolios with sustainable outcomes, they often do so within the frame of the SDGs.

The Sustainable Development Goals provide a useful framework as they are quite comprehensive and widely accepted. They have their challenges, such as being rather numerous and a tad incoherent, but they're considered by most to be the primary holistic framework with which to consider a broad range of social and environmental priorities. More specific and environmentally focused frameworks exist in some regions (for example the EU taxonomy for sustainable activities), but the SDGs are a familiar framework across regions.

In this report, we attempt to make investing in environmental outcomes through startups easier by building a startup taxonomy for the environmental SDGs.

We present a categorisation approach for early-stage companies that will hopefully make it easier for investors to identify if a startup will help achieve the SDGs in general, and which SDGs that startup does and doesn't significantly contribute to.

We also present the results of analysing over 300 Australian cleantech startups.

We look at which of the environmental SDGs are most and least served by Australian early-stage high-growth companies, taking both primary and secondary impacts into account. We also look at the startups primarily targeting each environmental SDGs by the gender of the main founder, the capital intensity of their operations, and whether or not they're also a deep tech startup (i.e. based on new scientific discovery or meaningful engineering innovation).

The SDGs and Australia's performance

Most people are familiar with the SDGs, although depth of understanding varies.

There are 17 SDGs in total, and beneath them sit 169 targets and 231 unique indicators designed to measure progress against those targets. The SDGs and their accompanying targets were adopted by 193 UN member states at a special summit in 2015 as part of 'The 2030 Agenda for Sustainable Development'. They were developed to replace and expand upon the Millennium Development Goals (MDGs), which expired in the same year.

The SDGs were designed to increase cohesion across the agendas and policy priorities of national governments.

They are intended to encompass the most important priorities for human development at this point in history. The basic idea is that if we can achieve all seventeen of those goals, then we will have created a largely fair, prosperous and sustainable world.

Figure 2: The seventeen SDGs

The Sustainable Development Goals (SDGs) are globally agreed goals for a fair, prosperous and sustainable world

Icons from https://www.globalgoals.org/resources

The SDGs are widely used and just as widely criticised.

One of the most common complaints by those trying to use the SDGs as an analytical tool is that there is a large degree of overlap and interaction between the SDGs. For the management consultants reading, they are practically the opposite of MECE (mutually exclusive and collectively exhaustive) which means for the rest of us that some priorities can be found in multiple SDGs and most SDGs drive or are affected by other SDGs.

As an example, the 'Affordable and clean energy' SDG (#7) is almost a complete subset of the 'Climate action' SDG (#13), with the former including sustainable energy, and the latter including sustainable energy and a range of other climate-related goals. The one area where the two don't overlap is on increasing the affordability of energy, as although this features in SDG 7, it is not always positive for climate mitigation.

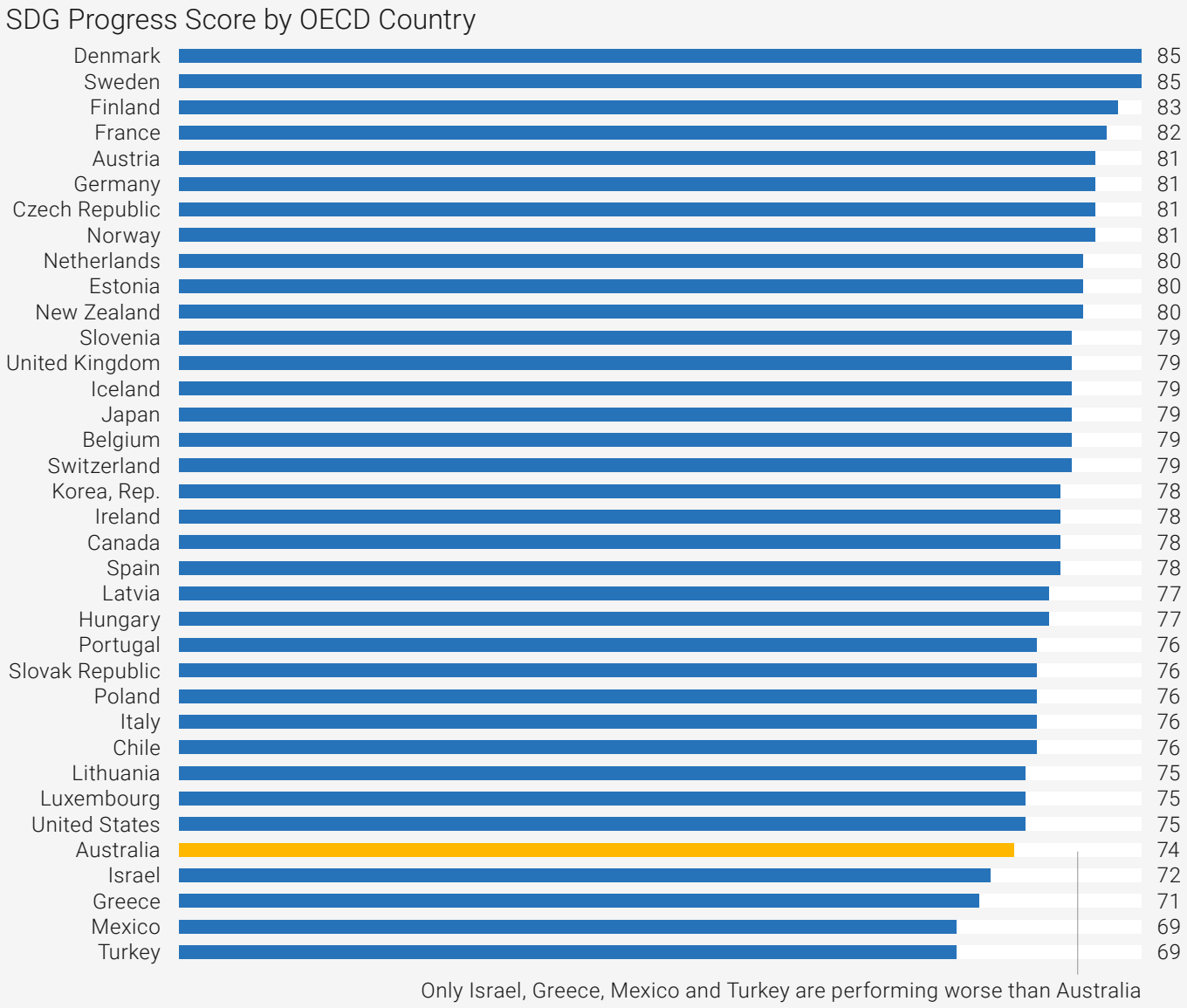
However, despite their shortcomings, the SDGs are used by a range of different parties from

development planning through to investment assessment. When it comes to the SDGs it is worth remembering that the best standard is not always the most elegant option, but the one that most people use.

Australia's progress towards the SDGs is poor compared to other OECD countries.

Each year since the inception of the SDGs, Bertelsmann Stiftung and the UN Sustainable Development Solutions Network (SDSN) have published a comprehensive assessment of each country's progress towards each SDG. They also wrap these up into a total ranking of how well each country is performing. As can be seen in Figure 3, Australia is one of the worst performers in the OECD.

Figure 3: Australia's performance against the SDGs



Source: Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G. (2019): Sustainable Development Report 2019. New York: Bertelsmann Stiftung and Development Solutions Network (SDSN). Accessed from http://dashboards.sdgindex.org on 19 March 2020.

Australia is performing particularly poorly on environmental SDGs.

The SDGs can be very roughly divided into environmental and social/economic SDGs, as summarised in Figure 4. This is an imperfect split because there are social and economic components and implications of the environmental SDGs and vice versa, but it's a useful frame for analysis. Within the social and economic SDGs, Australia has achieved one ('Good health and wellbeing') and only has one with significant challenges remaining ('Zero hunger' – an unusual title for an SDG which also includes obesity rates, the factor which is driving Australia's poor performance). Out of the environmental SDGs, significant challenges remain for three out of seven - 'Climate action', 'Affordable and clean energy', and 'Responsible consumption and production'.

Figure 4: Australia's progress towards social and environmental SDGs

Australia is performing particulary poorly on environmental SDGs

Social and economic SDGs - only one with significant challenges remaining

Environmental SDGs - significant challenges remain for three out of seven

- Significant challenges remain
- Challenges remain
- Major challenges remain
- SDG achieved

Source: Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G. (2019): Sustainable Development Report 2019. New York: Bertelsmann Stiftung and Development Solutions Network (SDSN). Accessed from http://dashboards.sdgindex.org/#/AUS on 20 March 2020.

Investing in the SDGs

Significant investment is required to achieve the SDGs, including in Australia if we want to catch up with the rest of the developed world.

The United Nations has estimated that achieving the SDGs will take between US$5 to $7 trillion of investment per year.[2] When it comes to environmental SDGs, Citibank identified "… physical investment needs or opportunities in water, energy, and the circular economy alone of $1.5 trillion per year".[3] The above are only rough estimates, but the point is clear: it's going to take a huge amount of investment to achieve the SDGs.

Many institutional investors in Australian and overseas have committed to helping achieve the SDGs.

In June 2019, HESTA announced it would start to align its $50 billion in assets with the SDGs.[4] Two months later, Cbus "become the first Australian super fund to support the development of a new Sustainable Development Investments framework" to help align their investment with the SDGs.[5] VicSuper has invested $3 billion so far in sustainable investments relevant to eight of the SDGs.[6] ROBECO, with $235 billion in ESG assets, has committed to contributing to the SDGs and is now working to integrate SDG considerations across its investment process.[7] Other institutional investors have made similar commitments, and more are likely to follow.

However, it's one thing to want to invest in or support the SDGs and entirely another thing to actually do it.

Despite the likely honest intent of fund managers to use their investment power to help achieve the SDGs, they face native constraints and an unclear pathway to action. On the constraint side, they need to generate suitable returns for their beneficiaries, and as such need to find investments that can generate appropriate levels of risk-adjusted returns and help achieve the SDGs at the same time. Such win-win investments do exist but can be hard to find (particularly at a suitable scale) and supply currently isn't meeting demand. On the pathway side, investors face the added challenge of determining whether a particular investment is helping achieve the SDGs or not.

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[2] UN 2014 Investing in the SDGs: An Action Plan for promoting private sector contributions https://unctad.org/en/PublicationChapters/wir2014ch4_en.pdf

[3] Citi 2018 United Nations Sustainable Development Goals: Pathways to Success – A Systematic Framework for Aligning Investment https://ir.citi.com/7j2s2nqtELM9wj%2BLPFyUEZg6IVNRbOBx6JI8xOatZypf0Wdw3NVImP36o8NbTqHDrU%2Bam4E7meA%3D

[4] White, Amanda 2019 HESTA maps investments against SDGs https://www.top1000funds.com/2019/06/hesta-maps-investments-against-sdgs

[5] Cbus 2020 United Nation's Sustainable Development Goals and responsible investing https://www.cbussuper.com.au/about-us/news/investment-news/united-nations-sustainable-development-goals-and-responsible-investing

[6] Jones, Sarah 2019 VicSuper hits $3 billion sustainability target https://www.investmentmagazine.com.au/2019/10/vicsuper-hits-3-billion-sustainability-target

[7] Robeco 2020 About Us https://www.robeco.com/au/about-us; Robeco 2020 Sustainable Development Goals (SDG) https://www.robeco.com/en/key-strengths/sustainable-investing/glossary/sustainable-development-goals.html

Determining the SDG-relevance of an investment is less straightforward than one might think.

Investing in a solar farm is clearly helping achieve the 'Affordable and clean energy' and 'Climate action' SDGs and is a type of investment that can generate good risk-adjusted returns at an appropriate scale for a superannuation fund. But what about investing in a supermarket chain? Are they contributing towards the SDGs by helping to achieve the 'Zero hunger' SDG? If you answered 'Yes' to that question then you're not alone, but further thought may lead you to change your answer.

In Australia, we've largely achieved the part of the 'Zero hunger' SDG that calls to reduce the prevalence of undernourishment. The reason that Australia performs so poorly on that SDG is because the UN SDSN included the prevalence of adult obesity as an indicator, which Australia performs poorly on (and is getting worse at). As such, as much as I appreciate our supermarket chains' relentless quest to drive down the price of frozen cheesecake, you'll probably agree that a possible investment in them won't be doing much to achieve the SDGs.

An even harder challenge in impact investing is the question of additionality.

That is, whether or not an investment was causal in achieving an impact outcome. If one hadn't invested in that company, what would the outcome have been? Would someone else have invested and helped the company achieve the same impact? Additionality is particularly hard to argue when making investments in listed companies because (outside of share issuances) the money an investor exchanges for shares does not go to the company but rather someone else who is selling their shares. Buying shares puts upwards pressure on the share price, which benefits the company, but most wouldn't consider that impact material outside of special circumstances. Investing in startups, on the other hand, is more plausibly additional, as there is no guarantee that a startup would have raised capital if the investor didn't step in – more on that in a moment.

Investing in startups to achieve the SDGs

Relatively little has been written on investing in startups to achieve the SDGs.

One notable Australian exception is the Impact Investment Group's Impact Report, which includes an assessment of how the startups they've invested in through their Giant Leap fund have contributed towards some of the SDGs. Other than that, not much has been said about SDG-aligned startup investing. This is not surprising as institutional investors are leading the SDG-investing drive (at least in Australia) and they typically allocate quite a small portion of capital to startups. This is done through venture capital firms and there are very few of those aligned to the SDGs. However, we believe that investing in startups can be a powerful way to contribute towards the SDGs.

One of the benefits of investing in a startup is that early-stage businesses can be entirely focused on activities with an SDG impact.

Typically, startups sell a narrow range of products and services. If a startup's focus happens to align with the SDGs (such as with a company that collects and repurposes waste) then it's likely that the better the business does, the more positive impact it will have. Large companies tend to sell a greater variety of products and services – some of which align with the SDGs, others that don't – which makes it harder to assess the impact of investing in that company with respect to contributions towards the SDGs.

Another benefit of investing in startups is that investors can have a much higher degree of confidence that their investment is additional.

Raising capital isn't easy for any type of startup anywhere, but it's particularly challenging for cleantech startups in Australia. By investing in an Australian cleantech startup, investors can be quite confident that the investment is effectively additional. At the very least, investors can be confident that their investment sped up the startup's capital-raising process. Founding CEOs spend an arguably excessive amount of time raising capital for their companies to grow, time that could be spent improving their business (and their impact).

Finally, at a more fundamental level, startups have the potential to change the social or environmental impacts of whole sectors.

Investing in listed entities generally does not significantly change industries, or catalyse or drive social or environmental outcomes, as most of these organisations tend to be established and often even incumbent by the time they are listed. Startups, on the other hand, explicitly aim to shake up business-as-usual, disrupt whole industries, and create a future that's different to what might otherwise have been the case.

There are examples of startups changing the face of society in a wide range of domains, but Tesla presents one of the best examples within clean energy. It's possible that if Tesla was not founded (and if investors like Elon Musk hadn't poured so much money into it) that electric vehicle (EV) penetration would be much lower than it is today, and on a slower uptake trajectory. Not because of the cars that Tesla has sold, but rather because it raised the profile of EVs in consumers' minds and forced larger auto companies to accelerate their development and deployment of electric models.

Figure 5: Why cleantech startups are impactful

Investing in startups is one way to meet SDG-aligned investment commitents

Direct

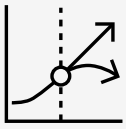
Many investments have at best ambiguous links to the SDGs. Investing in a grocery chain may sound like it aligns with reducing poverty, but that's not their business goal.

Cleantech startups, on the other hand, have more direct relevance to the SDGs. There is nothing ambiguous about the impact of a startup wholly focussed on selling more solar panels.

Additional

Even for listed equities wholly aligned to the SDGs, such as Tesla, it is questionable whether purchasing its shares should be considered an impact investment - if you didn't invest, someone else likely would.

Investing in startups is different - if you don't invest, there is no guarantee that someone else would have invested, resulting in more demonstrable impact.



Disruptive

Business-as-usual won't get us to a world where all the SDGs (or even some of them) are met.

Many startups aim to redefine business-as-usual, disrupting industries to set the economy on a significantly different path. Many cleantech startups aim to create a step-change in the environmental sustainability of the economy.

However, as with larger businesses, determining whether a particular startup contributes towards the SDGs or not isn't always straightforward.

For some startups, it's obvious that they help achieve the SDGs. Investing in a clean energy startup clearly contributes towards 'Affordable and clean energy' SDG. And you can identify most clean energy startups very quickly – they're likely to be doing something with solar panels, wind turbines, energy storage or electric vehicles.

But what about bioenergy – is that clean energy? If they're taking food waste destined for landfill and turning it into biogas that displaces natural gas, then certainly. But what about bioenergy derived from crops? What if the increased demand for crops leads to land clearing and the associated greenhouse gas emissions and biodiversity loss? That bioenergy startup isn't looking so clean after all, but you probably couldn't tell that from their name and 140-character blurb.

It gets even harder when one considers environmental differences between countries.

As another example, take bees. Bees play an important role in pollinating not only the crops we rely upon for food but also other plants and are therefore important for biodiversity. As a result, investing in Australian startups that support bee health is surely an SDG-aligned investment, right? Not necessarily, as those startups often focus on introduced bee species that compete with Australia's native species and have a detrimental impact on biodiversity. These startups are still great initiatives for improving farmer livelihood and food security, and the detrimental environmental impacts can be managed, but it's hard to argue that investing in said startups is aligned with the environmental SDGs.

It's also harder than one might expect to determine which SDGs a startup does and does not contribute to. Consider these questions:

- Installing solar panels on rooftops clearly contributes toward the 'Affordable and clean energy' SDG but does it also contribute to the 'Sustainable cities and communities' SDG?
- The 'Responsible consumption and production' SDG calls for less consumption, so do all energy efficiency technologies contribute towards that goal as they reduce fossil fuel consumption?
- Reducing the amount of plastic in the oceans is a major focus of the 'Life below water' SDG, and plastic generally gets in the oceans because it is produced on land. So, does any measure which reduces plastic production and waste contribute towards that SDG?
- Does a fossil-fuel-based technology that makes energy more affordable belong in the 'Affordable and clean energy' SDG?[8]

If you trace all the flow-on implications (and were creative enough) you could probably argue that almost any activity has a positive and negative impact on every SDG, but that's not particularly useful. So, where should one draw the line? There is an art and science to drawing a line in the sand, a balance we've tried to achieve with our taxonomy.

[8] Our answers to these questions are Yes, No, Yes and No. Our rationale for such judgement calls can be found in the appendix.

Developing a taxonomy for SDG-aligned startup investing

Taxonomies are useful tools for drawing on previous research and thinking to make quick decisions.

We could (and in fact did) map hundreds of startups individually to each of the SDGs. However, such an activity is time-consuming and not particularly replicable. If an investor wants to assess a startup or a portfolio of startups for SDG-relevance, then they need a quicker approach.

A similar dilemma faces investors worldwide trying to determine whether investments in debt, infrastructure, or equities are green or just greenwashed. To help address this problem, the European Commission published a 'taxonomy for sustainable activities'[9] to provide clarity regarding which activities are environmentally friendly and help direct capital towards sustainable outcomes. Other related efforts include APG's taxonomy for Sustainable Development Investments,[10] which guides their investment decisions. We've created a similar tool for investing in cleantech startups.

We have developed a taxonomy to make SDG-aligned startup investing easier.

As discussed, it's far from straight-forward determining which SDGs (if any) a startup does and does not contribute to. We've tried to make it relatively quick and easy to determine not only if a startup is relevant for the SDGs but also what SDGs it contributes to most directly. We've done this by creating thirty-seven cleantech categories and assigning them each one primary SDG and up to five secondary SDGs.

Our taxonomy focuses on six environmental SDGs.

As discussed previously, although the distinction is somewhat subjective, many would classify SDGs 6, 7, 11, 12, 13, 14 and 15 as predominantly environmental. We focused on these SDGs because they overlap with our area of expertise, are some of the areas Australia is performing most poorly on and, according to Citibank, are potentially best-suited to private investment.[11] We only exclude SDG 6 ('Clean water and sanitation') from our analysis as, according to the UN SDSN, Australia is close to achieving this SDG[12] and we're not aware of enough Australian cleantech startups focusing on SDG 6 to make analysis significant.

[9] European Commission 2019 EU taxonomy for sustainable activities https://ec.europa.eu/info/publications/sustainable-finance-teg-taxonomy_en

[10] APG 2017 Sustainable Development Investments https://www.apg.nl/en/publication/SDI%20Taxonomies/918

[11] Citi 2018 United Nations Sustainable Development Goals: Pathways to Success – A Systematic Framework for Aligning Investment https://ir.citi.com/7j2s2nqtELM9wj%2BLPFyUEZg6lVNRbOBx6JI8xOatZypf0Wdw3NVlmP36o8NbTqHDrU%2Bam4E7meA%3D

[12] SDSN 2019 Sustainable Development Report Dashboards – Australia https://dashboards.sdgindex.org/#/AUS

Our taxonomy identifies primary and secondary SDG impact for each category.

Due to the interdependent and overlapping construction of the SDGs, stating a category of startups contributes to one SDG more than another can be a rather subjective exercise. However, we believe such a judgement can not only be reasonably made but is also useful for categorising startups and therefore analysing the differences between types of cleantech startups. For that reason, we have assigned a primary SDG to each category – the SDG that they have the most significant and direct positive impact on.

However, most cleantech startups contribute towards more than just one SDG. For example, every clean energy startup contributes to the 'Climate action' SDG, and also indirectly to the 'Life on land' and 'Life below water' SDGs by reducing emissions and therefore biodiversity loss and ocean acidification respectively. Therefore, most categories have been assigned one or more secondary SDGs. In deciding which activities primarily and secondarily counted towards each SDG, we delved into the targets and indicators that sit under each SDG and assessed the degree to which an activity contributed towards each one, as well as the overarching intent of the SDG (necessary as the targets and indicators are numerous but still not exhaustive).

Table 1 summarises our taxonomy.

To determine which SDGs a startup contributes to, first find the category that most closely fits what the startup does. Pick the most specific category available (e.g. driving efficiency is driving optimisation and not broader energy efficiency). Further details on what types of startups are included in each category and why that category has been assigned to each SDG can be found in the appendix.

Table 1: Cleantech startup SDG taxonomy summary

Industry	Category	7 Affordable and Clean Energy	11 Sustainable Cities and Communities	12 Responsible Consumption and Production	13 Climate Action	14 Life Below Water	15 Life on Land
Energy	Large-scale renewable energy	Primary	NA	NA	Secondary	Secondary	Secondary
	Distributed renewable energy	Primary	Secondary	NA	Secondary	Secondary	Secondary
	Large-scale energy storage	Primary	NA	NA	Secondary	Secondary	Secondary
	Distributed energy storage	Primary	Secondary	NA	Secondary	Secondary	Secondary
	Green hydrogen	Primary	NA	NA	Secondary	Secondary	Secondary
	Smart grid	Primary	NA	NA	Secondary	Secondary	Secondary
	Demand management	Primary	NA	NA	Secondary	Secondary	Secondary
	Energy efficiency	Primary	Secondary	NA	Secondary	Secondary	Secondary
Transport	Electric vehicles	Primary	Secondary	NA	Secondary	Secondary	Secondary
	Electric transportation services	Primary	Secondary	NA	Secondary	Secondary	Secondary
	Electric vehicle charging	Primary	Secondary	NA	Secondary	Secondary	Secondary
	Carpooling	Secondary	Primary	NA	Secondary	Secondary	Secondary
	Driving optimisation	Secondary	Primary	NA	Secondary	Secondary	Secondary
	Last-mile transport	Secondary	Primary	NA	Secondary	Secondary	Secondary

Industry	Category	7 AFFORDABLE AND CLEAN ENERGY	11 SUSTAINABLE CITIES AND COMMUNITIES	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	13 CLIMATE ACTION	14 LIFE BELOW WATER	15 LIFE ON LAND
Waste	Urban organic waste-to-energy	Primary	Secondary	Secondary	Secondary	Secondary	Secondary
	Urban organic waste recycling	NA	Secondary	Primary	Secondary	Secondary	Secondary
	Non-urban organic waste-to-energy	Primary	NA	Secondary	Secondary	Secondary	Secondary
	Plastic recycling	NA	NA	Primary	NA	Secondary	NA
	Other waste recycling	NA	NA	Primary	NA	NA	NA
	Marine plastic recovery	NA	NA	Secondary	NA	Primary	NA
	(Single-use) plastic alternatives	NA	NA	Primary	NA	Secondary	NA
	Food waste and spoilage prevention	NA	NA	Primary	Secondary	Secondary	Secondary
	Sharing economy	NA	NA	Primary	NA	NA	NA
Built environment	Smart cities	NA	Primary	NA	NA	NA	NA
	Green buildings	Secondary	Primary	Secondary	Secondary	Secondary	Secondary
Agriculture	Precision agriculture	NA	NA	NA	Secondary	Primary	Secondary
	Traditional chemical fertiliser substitutes	NA	NA	NA	Secondary	Primary	Secondary
	Pesticide reduction	NA	NA	NA	NA	NA	Primary
	Vertical farming	NA	NA	NA	Secondary	Secondary	Primary
	Animal produce alternatives	NA	NA	NA	Primary	Secondary	Secondary
Environment	Automated reforestation and restoration	NA	NA	NA	Secondary	Secondary	Primary
	Carbon sequestration	NA	NA	NA	Primary	Secondary	Secondary
	Climate finance	NA	NA	NA	Primary	Secondary	Secondary
	Carbon offsetting	NA	NA	NA	Primary	Secondary	Secondary
	Carbon accounting	NA	NA	NA	Primary	Secondary	Secondary
	Personal footprint calculators	NA	NA	NA	Primary	Secondary	Secondary
	Species tracking	NA	NA	NA	NA	Secondary	Primary

The state-of-play for SDG-aligned cleantech startups in Australia

Data collection

Collecting startup data can be hard for most investors as there is no comprehensive database of all startups.

There are some great attempts out there, such as AngelList, Crunchbase and PitchBook. However, these platforms typically only capture startups once they've raised a significant amount of capital or the founder uploads their profile themselves, which many don't bother doing or won't do because they're operating in stealth mode. There are other means of collecting startup data, but startups are generally too small (at first) for it to be worth the effort for most. Other startups don't advertise themselves as cleantech startups or having environmental benefits, which makes them hard to find. Startups can also be quite ephemeral as a category of businesses. They come and go more rapidly than larger businesses, and also pivot more regularly, potentially completely changing what they do and therefore their relevance to the SDGs.

EnergyLab is fortunate to possess what is potentially the most comprehensive and up-to-date database of Australian cleantech startups.

We run programs for all stages of clean energy startups across Australia, and so we're lucky to have received an application for support from the majority of Australian clean energy startups, often before they tell anyone else they're considering launching a startup. We also run Australia's only cleantech angel investment network, which has broadened our reach outside the clean energy sector to any startups with an environmental benefit. In the last year, we've also helped launch two cleantech accelerators in other verticals and work closely with other accelerators with an interest in cleantech startups. On top of that, we have conducted extensive desktop research to find any cleantech startup with a web presence that we might have missed across the years.

We've categorised over 300 of these Australian cleantech startups against our SDG taxonomy and analysed the results.

The taxonomy, in turn, maps each startup to primary and secondary SDGs, allowing us to see which SDGs are best served and conduct comparative analysis. In the following sections, we summarise this analysis, drawing out some of the interesting findings from our research, including an analysis of startup capital intensity, scientific basis and founder gender of startups primarily addressing each environmental SDG.

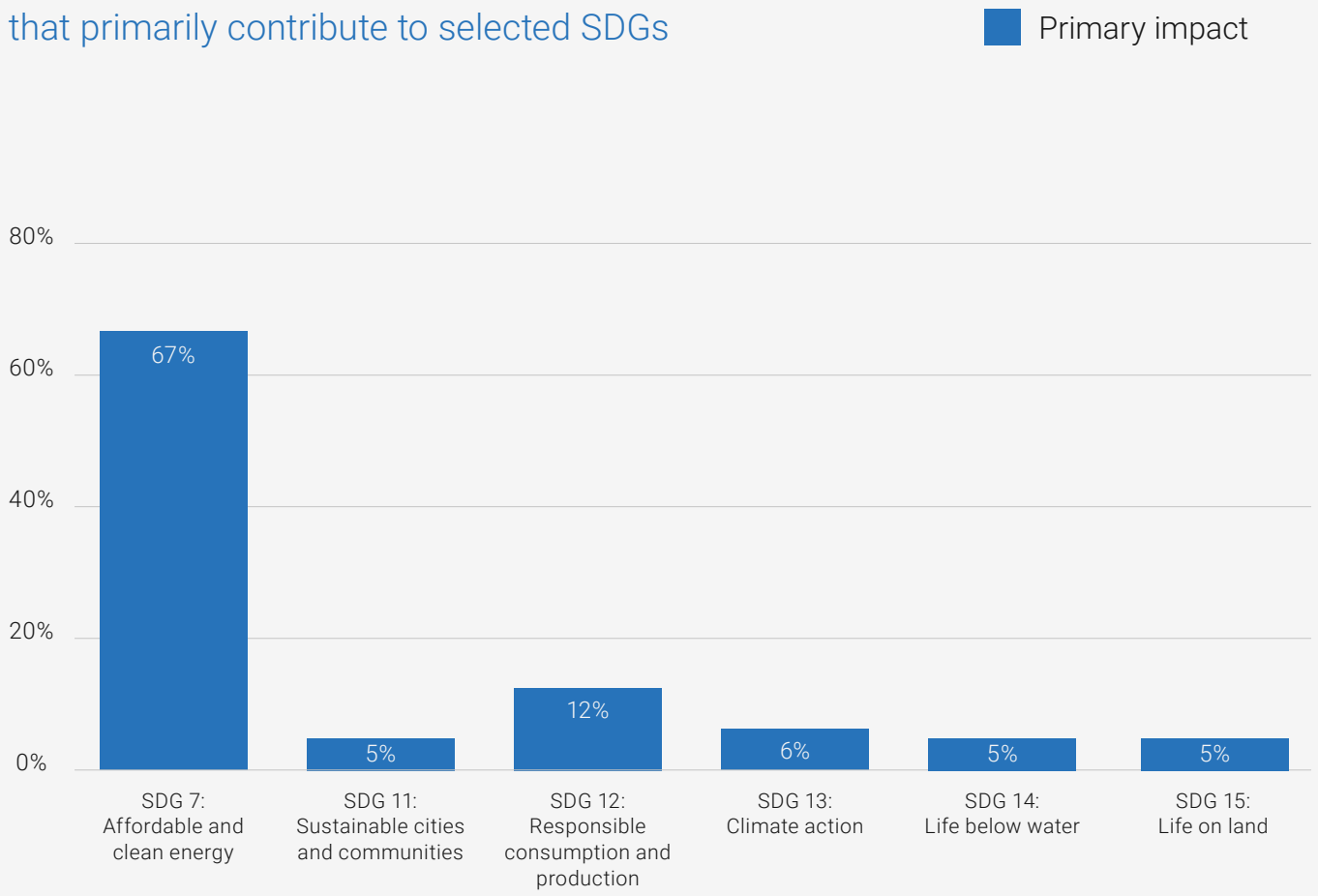
Primary SDG impact

Approximately two-thirds of Australian cleantech startups are primarily focused on addressing SDG 7, 'Affordable and clean energy'.

These startups are increasing the uptake of technologies such as renewable energy, energy storage, demand management, electric vehicles, and green hydrogen. 'Responsible consumption and production' is the next most popular SDG, with just over 10% of Australian cleantech startups trying to reduce the amount of waste generated and increasing the amount of waste that is recycled or repurposed. The four other SDG categories are all receiving similar levels of attention, with about 5% of cleantech startups primarily targeting each of them.

Figure 6:

Proportion of Australian cleantech startups that primarily contribute to selected SDGs



Why so many more clean energy startups?

A fair criticism of our database is that it is likely to be biased towards energy startups (we are called EnergyLab after all). We have done our best to mitigate against that by conducting extensive desktop research, drawing on data from the cleantech angel investment network we run (which considers all environmentally-focused startups, not just those in energy), and working with cleantech accelerators in other sectors. However, some bias likely still exists. And yet, this bias would have to be very powerful to generate the above results, suggesting to us that there is something more than bias at play.

We would note that this distribution also has our categorisation approach to thank – because energy decarbonisation is one of the key challenges for climate mitigation, the activities which fall under the 'Affordable and clean energy' SDG are essentially a subset of the 'Climate action' SDG. As such, many startups which readers might consider climate-related end up being in SDG 7. Nonetheless, even assuming some bias and with this categorisation approach in mind, the lack of startups focused on activities contributing to non-energy environmental SDGs is notable.

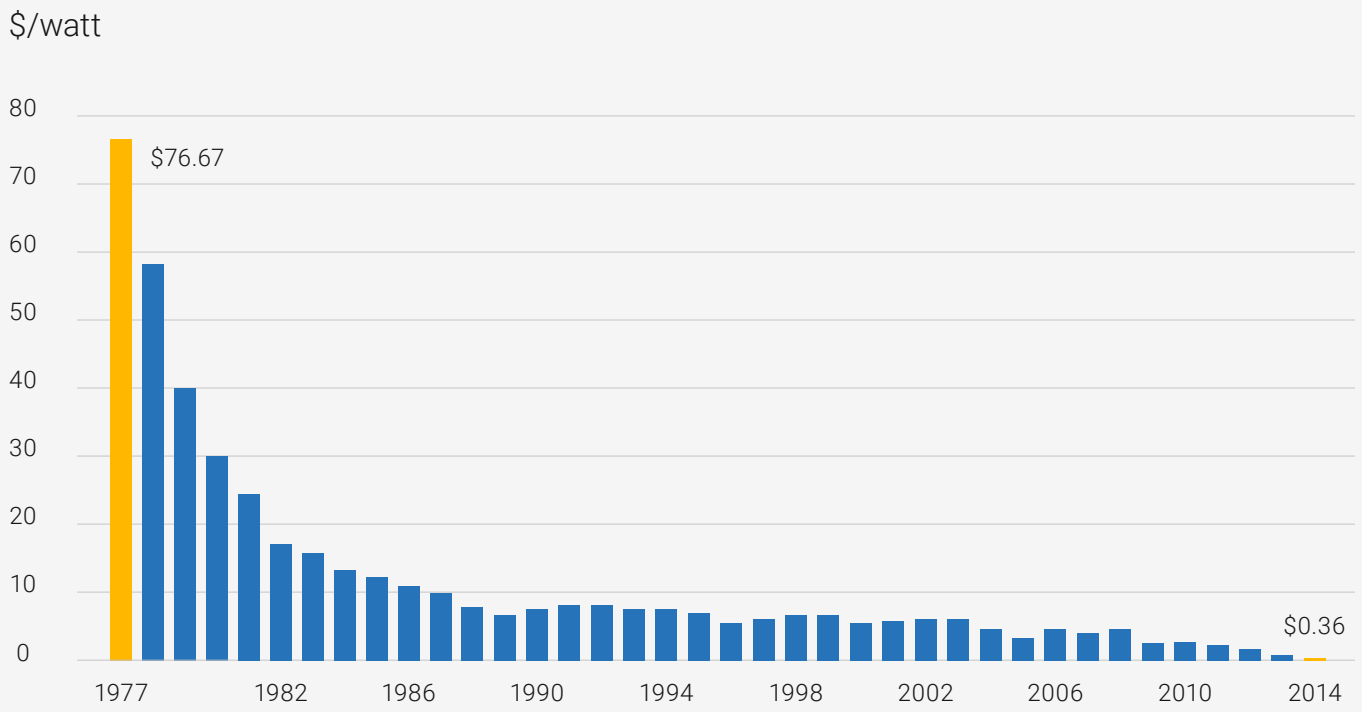
To understand why there are more clean energy startups than other types of cleantech startups, one needs to look at the relative competitive position of new technologies in each sector.

In our view, clean energy startups are presently favoured by very competitive underlying technology. However, in contrast, other cleantech startup types are not so lucky, with startups focusing on non-energy environmental SDGs presently finding it harder to identify profitable niches. Let us take a moment to unpack what we mean by this statement.

- **Technology competitiveness for cleantech solutions can be improved through development support, or via market interventions.** A core component of the competitive position of a technology is the cost of delivering a product or service to the customer or end-user. The cost competitiveness of new technologies is determined not just by the cost of the new technology, but also by the cost of incumbent technologies. The cost of new technology can be reduced through increased research, development, and deployment. The cost of competing technologies might be increased through regulation, such as by internalising the cost of greenhouse gas emissions through a carbon price. Either type of action improves the cost competitiveness of the new technology relative to existing technologies.

- **Take solar photovoltaics (PV) as an example.** At first, PV was incredibly expensive, costing about $77/watt in 1977, as shown in Figure 7, and not at all competitive with other incumbent energy generation technologies in almost all circumstances. Over the following four decades, focused spending, R&D effort, and targeted policy have driven down the cost of PV to a fraction of what it was – $0.36/watt in 2014, a number that continues to fall. Due to these efforts, solar PV is now cost-competitive with traditional forms of energy generation, and therefore the basis of many successful businesses.

Figure 7: Price history of silicon PV cells ($/watt)[13]



[13] Diamandis, Peter 2014 Solar Energy Revolution: A Massive Opportunity https://www.forbes.com/sites/peterdiamandis/2014/09/02/solar-energy-revolution-a-massive-opportunity/#69b3e076c900 (based on Bloomberg New Energy Finance and pv.energytrend.com data)

- **Electric vehicles (EVs) are an example of a technology on the cusp of cost broad cost competitiveness.**
  At the time of writing, you could argue that EVs are more or less expensive than internal combustion engine (ICE) vehicles depending on how exactly one calculates the total cost of ownership and the market under consideration. However, what does appear clear, is that if innovation continues as it has, EVs will eventually be cheaper than ICE vehicles in most markets for many vehicle types. This future would arrive earlier if EVs were subsidised by more governments or if more ICE vehicle owners had to pay for the negative externalities associated with their vehicle's local air pollution and greenhouse gas emissions.

- **Producing materials from recycled materials, on the other hand, appears to be a long way off cost competitiveness in many areas.**
  More innovation could be conducted to drive down the cost of producing products with recycled materials. However, more usefully perhaps, governments could introduce virgin aggregates tax to increase the cost of producing products from virgin materials and consequentially improving the cost competitiveness of businesses that produce the same end products in a more sustainable fashion. However, until progress is made on either front, startups wanting to help address SDG 12 in this way need to find niches where it is currently more cost-competitive to use recycled materials, or find customers willing to pay a premium for the environmental benefits.

- **Similar dynamics can be seen across other technologies aiming to solve environmental problems, presenting non-energy environmental startups with a larger challenge.**
  As another example, lab-grown meat is currently more expensive than farming cattle, but its cost competitiveness is likely to improve through technology development over time, and possibly by internalising the cost of greenhouse gas emissions from farming cattle. Overall, startups focusing on non-energy environmental SDGs presently find it harder to identify profitable niches than clean energy startups, and this is in large part due to the underlying market conditions and cost competitiveness of the technologies these startups are commercialising.

Secondary SDG impact

As previously discussed, we assigned each cleantech startup category a primary SDG and up to five secondary SDGs.

Primary SDG impacts, as covered above, are the SDGs startups most directly and significantly address. However, as noted earlier, the SDGs are rather interrelated, with some SDGs impacting several others. To capture this information, each category of cleantech startup was also assigned a set of secondary SDGs (where relevant) – all SDGs that said startups might affect directly or indirectly beyond the primary SDG.

Renewable energy startups are a particularly good example of these types of interrelated impacts. This category of startup was primarily assigned to the 'Affordable and clean energy' SDG and secondarily to the 'Climate action, 'Life below water' and 'Life on land' SDG for flow-on benefits of mitigating climate change.

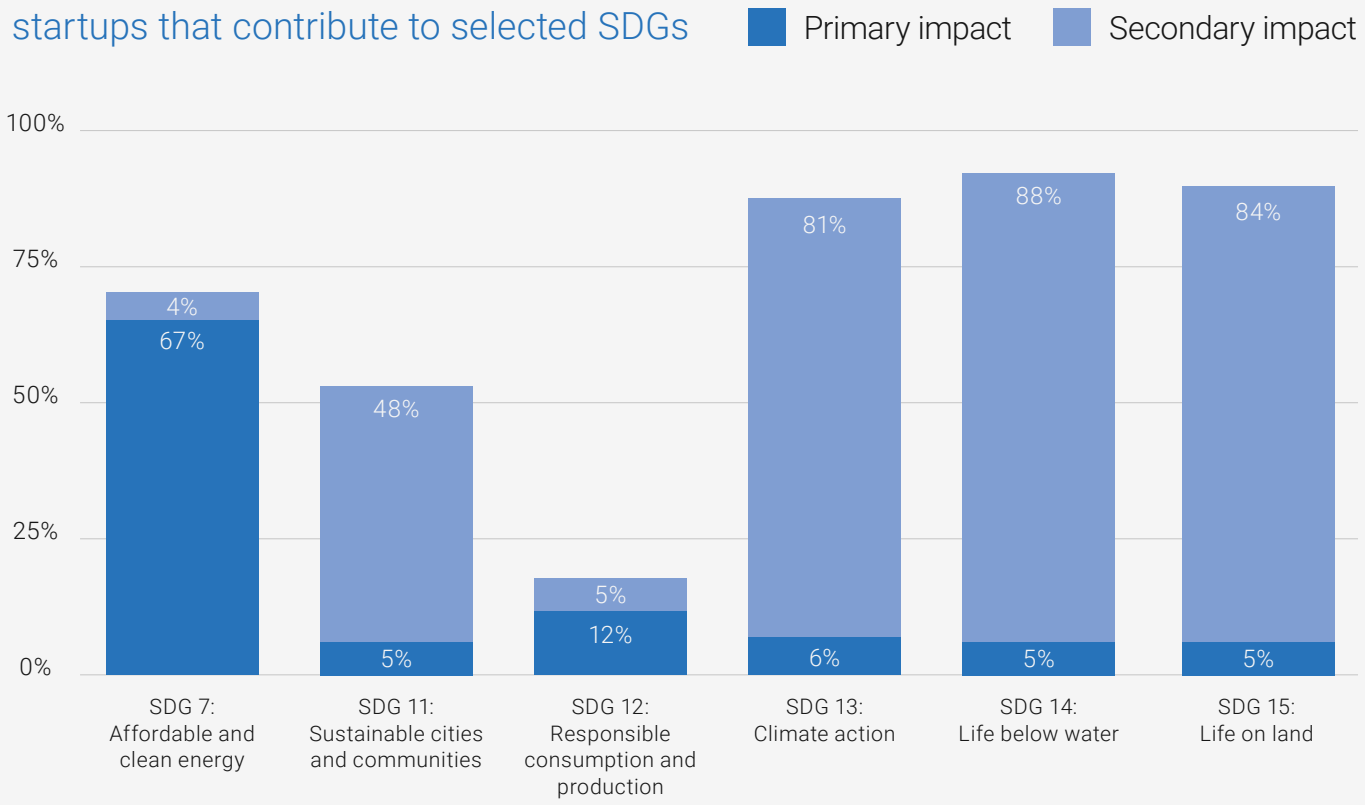
When secondary impacts are considered, 'Life below water' is the best-served SDG.

Some of the main focus areas of this SDG are reducing ocean acidification (predominantly caused by greenhouse gas emissions), nutrient pollution (largely due to chemical fertiliser runoff from farms) and ocean plastics. In our taxonomy, there are only two ways to primarily contribute towards 'Life below water' – collecting marine plastic and reducing chemical fertiliser use (and therefore runoff into waterways, causing eutrophication), through either precision agriculture or chemical fertiliser alternatives. There are other ways of directly contributing towards the 'Life below water' SDG but most are non-profit endeavours, and therefore not captured by our dataset.

While few startups address 'Life below water' directly, most do indirectly. Close to 90% of cleantech startups indirectly contribute towards 'Life below water' through reducing emissions or by reducing plastic waste, which reduces the amount of plastic that finds its way into the ocean. This is an accidental by-product for most entrepreneurs, but there are an increasing number of cleantech startups aiming to reduce plastic production, consumption and waste with the express aim of reducing the amount of plastic waste in the ocean.

Figure 8:

Proportion of Australian cleantech startups that contribute to selected SDGs



Investing in clean energy startups specifically impacts at least four SDGs when secondary impacts are considered:

SDG 13:
Most obviously, clean energy startups reduce emissions and therefore contribute to the 'Climate action' SDG.

SDG 15:
Climate change is a major driver of biodiversity loss, and clean energy startups reduce that by reducing emissions, hence supporting the 'Life on land' SDG.

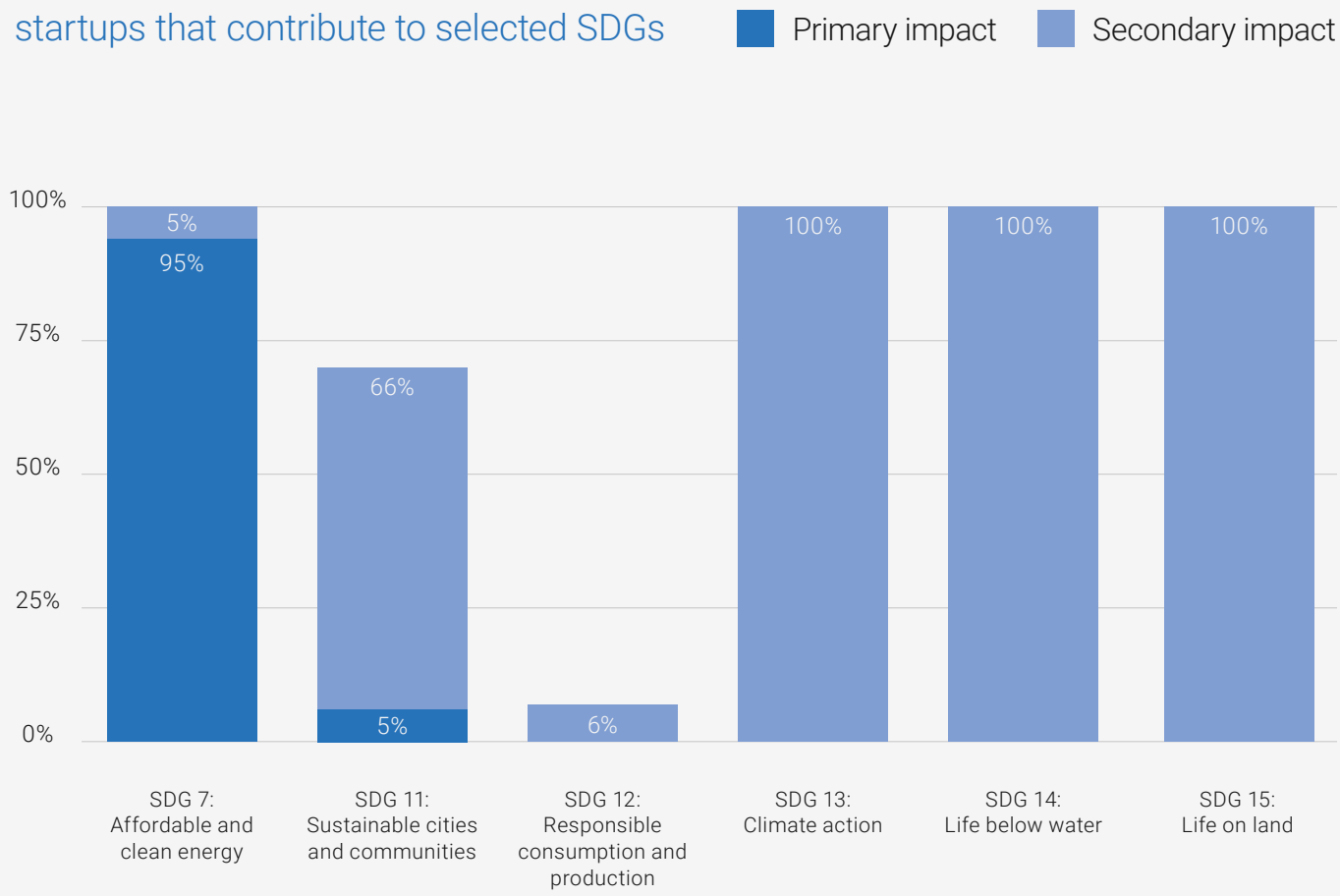
SDG 14:
Rising greenhouse gas emissions also increases ocean acidification, an important metric for the 'Life below water' SDG.

SDG 11:
Many clean energy startups contribute towards the 'Sustainable cities and communities' SDG by reducing the environmental footprint of buildings through energy efficiency and distributed energy resources like rooftop solar and household batteries. Other clean energy startups reduce particulate emissions in cities (an important indicator for this SDG) by increasing the uptake of electric vehicles.

SDG 12:
Some clean energy startups also contribute towards the 'Responsible consumption and production' SDG through organic waste-to-energy.

Figure 9:

Proportion of Australian clean energy startups that contribute to selected SDGs



Capital-intensity

Australian cleantech startups are roughly equally split between low, medium and high capital-intensity.

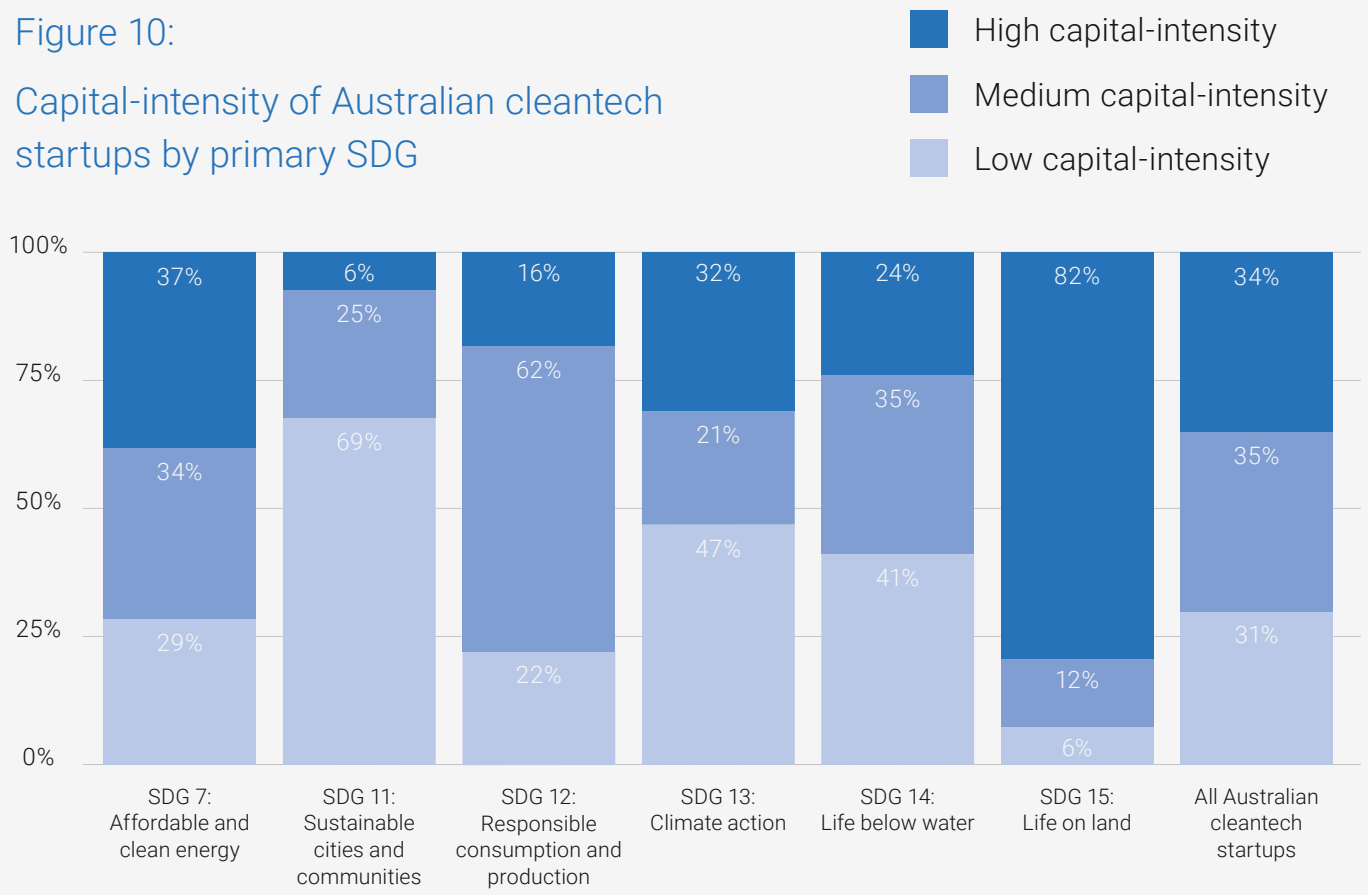
Low capital intensity startups include those based on software (e.g. mobile apps or software-as-a-service) or pure business model innovations. I.e. no physical product is involved, unless 100% paid for, built, delivered, installed and maintained by a third party from the start, such as by facilitating investment into solar panels. Medium capital intensity startups typically involve IoT or other electronics that are relatively cheaper per unit. In this category, we've also included startups that are selling slightly more expensive equipment that is none-the-less affordable for most entrepreneurs to purchase or make themselves to generate their first sales. High capital intensity startups typically involve heavy machinery such as bioenergy equipment, large battery installations, and custom industrial drones and robotics.

There is a large variance in capital-intensity between startups primarily targeting each SDG.

'Life on land' has the highest proportion of high-capital-intensity startups working on it. This is due to the dominance of startups using heavy equipment for agriculture or land restoration purposes. Startups primarily focusing on the 'Sustainable cities and communities' SDG, on the other hand, are the least capital-intensive. This category is dominated by startups using software and IoT to reduce the environmental impact of cities.

Figure 10:

Capital-intensity of Australian cleantech startups by primary SDG



Deep tech

Deep tech is poorly represented across most categories, despite being critical for achieving many of the SDGs.

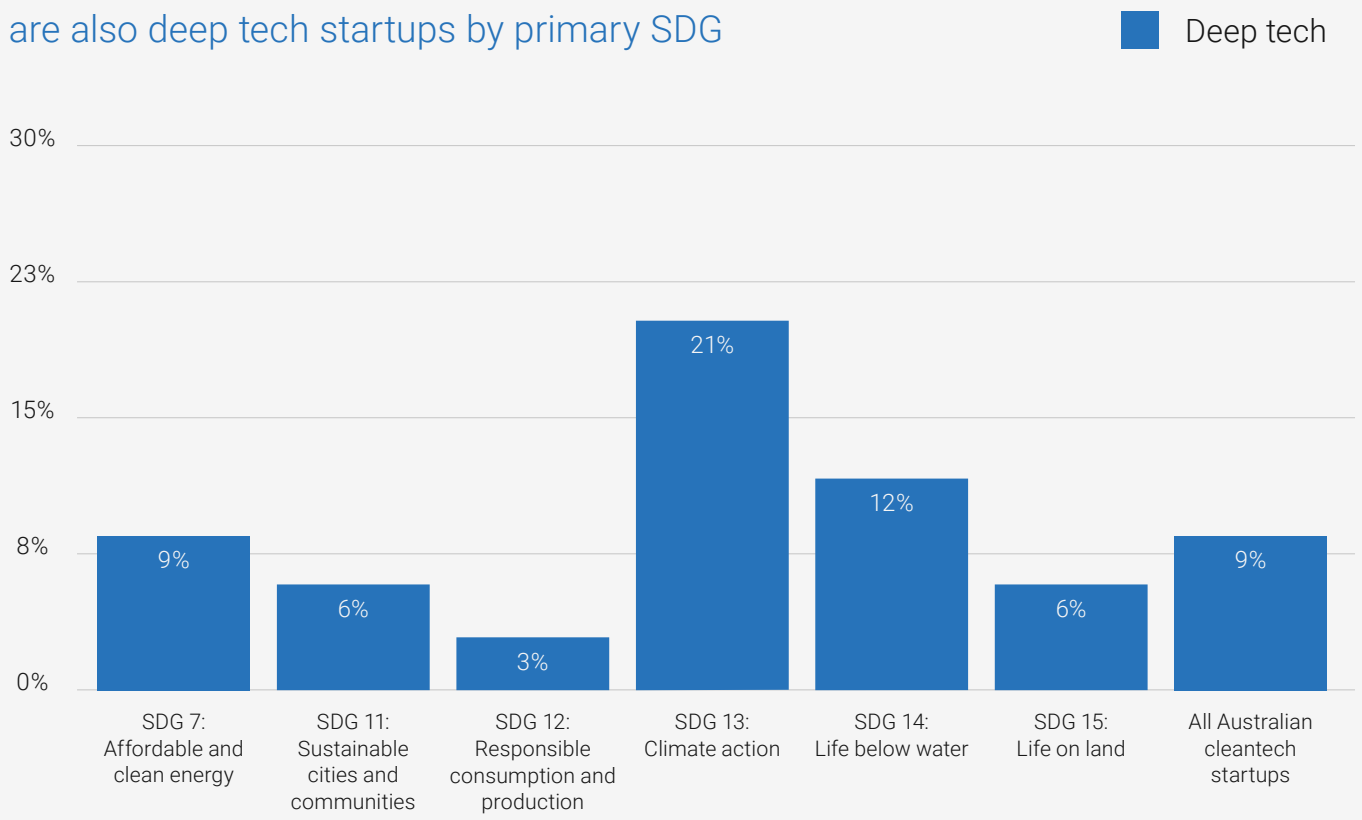
Deep tech startups are defined as commercialising a technology that has been developed after years of skilled research, often within a university, CSIRO or a company R&D department. One of the main challenges of deep tech startups is transferring the intellectual property (IP) to the startup from the entity it was developed in. However, once that is done, that IP becomes a significant competitive advantage, highly valued by customers and consequently a lot of investors.

Less than 10% of the startups in our database are classified as deep tech,

with the remainder repurposing and combining existing technology, making more incremental improvements on existing technology, or developing business model or financing solutions. This could be cause for concern as while we have a lot of the technology we need to solve environmental issues like climate change, we are also likely to need more fundamental breakthroughs, and therefore more deep tech startups, to achieve all the SDGs.

Figure 11:

Proportion of Australian cleantech startups that are also deep tech startups by primary SDG



Startups primarily targeting the 'Climate action' SDG were most likely to be deep tech startups.

The nature of how the SDGs are constructed has a lot to do with this. One of the main solutions to climate change is rolling out renewable energy and supporting technologies. Thanks to decades of research and development, a lot of these technologies are already commercially viable, and it's just a matter of finding the business model and financing innovations to roll them out as quickly as possible. However, as discussed, due to the way the SDGs and our taxonomy are constructed, none of these startups are grouped under the 'Climate action' SDG. What's left are startups working in areas that often do require more R&D, such as lab-grown meat and carbon sequestration.

Gender

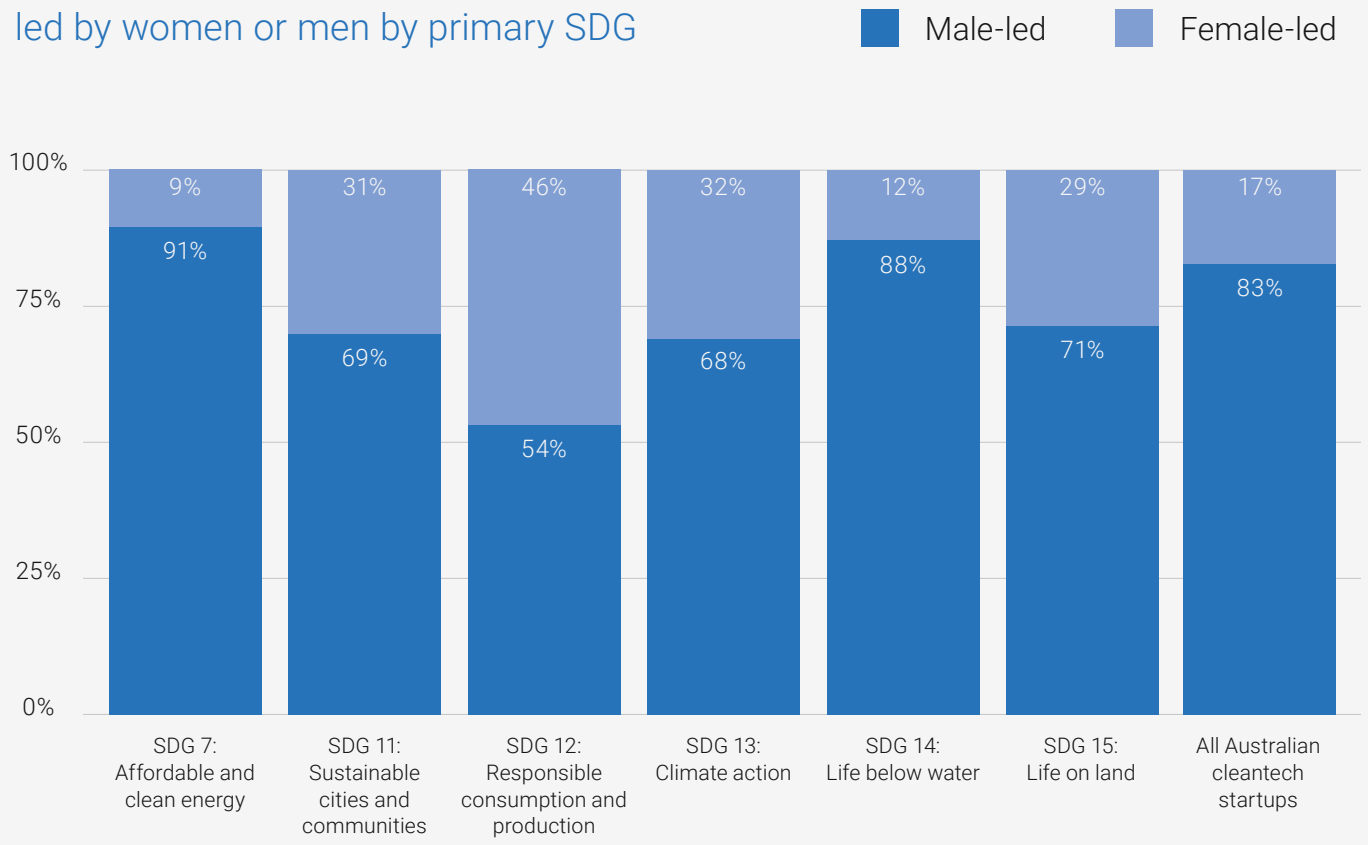
The gender balance of founders varies greatly depending on the focus of cleantech startups, with 'Affordable and clean energy' having the fewest female-led startups and 'Responsible consumption and production' having the most.

In a somewhat simplified analysis, we categorised each startup in our database as being male-led or female-led. In line with our experience trying to address gender equality within our portfolio, we found that across the board there are many more male-led than female-led cleantech startups – the startups we reviewed had approximately an 80:20 split.

However, when we break the analysis down by primary SDG a more interesting pattern emerges. Women are significantly more likely to be working on waste reduction and circular economy startups than other categories. They're also more likely to work on the climate SDG directly, which means that they are working on the issue through a means other energy decarbonisation. Gender equality is lowest amongst clean energy startups, with only about 10% being female-led, a statistic we have been working to put a dent in with initiatives such as our Women in Clean Energy Fellowship.

Figure 12:

Proportion of Australian cleantech startups led by women or men by primary SDG



Conclusion

In this report, we've laid out what we hope will be a useful tool for impact investors – a taxonomy for assessing the relevance of cleantech startups to the SDGs.

Investors can use this taxonomy for determining the degree to which one startup or a portfolio of startups contributes to the SDGs, informing their decision to invest in a startup or back a fund manager. The taxonomy may also be useful for startups and startup support organisations like accelerators and incubators to communicate their contribution to the SDGs more clearly.

However, to reach its full potential, we acknowledge this taxonomy likely requires further refinement in collaboration with others.

There are many opportunities for expansion, such as expanding the taxonomy to the remaining SDGs and adding categories relevant to developing countries. Adding negative categories may also be useful, enabling the user, for example, to identify startups which are detrimental to the SDGs, or to more explicitly identify startups that may appear to contribute towards the SDGs but don't upon closer inspection.

There are likely many categories missing. While extensive, our cleantech startup database is not exhaustive, and therefore we're likely to have missed categories of cleantech startups that don't have many startups in it. Even if we haven't, entrepreneurs will inevitably come up with creative new ways to address the SDGs that defy our current categories.

This taxonomy will become more valuable if more investors use it.

Taxonomies are useful for comparing different portfolios but that's only meaningful if those analysing each portfolio are using the same taxonomy. The more people that agree with a taxonomy, the more people will use it. Our categorisation includes making judgement calls that not everyone may agree with. We welcome debate on these points to arrive at a taxonomy that as many people as possible are aligned to.

While not specific to the SDGs, a common definition of capital intensity and what is and isn't deep tech could also be useful.

Different people will have different perspectives on whether a startup is deep tech and the degree to which it is capital intensive. It may be beneficial for the startup community to agree on more specific definitions so analysis like that presented in this report can be more meaningfully compared to analysis conducted by others. This would allow cleantech startups to be contrasted against startups in general, and for startups in different countries to be compared.

Overall, we hope this report will help direct more capital towards cleantech startups aiming to contribute towards the SDGs.

Developing a taxonomy is not particularly ground-breaking. But a huge amount of effort has been put into developing taxonomies in other areas of investing for a good reason. While a simple tool, they can be quite powerful for making it easier for capital to flow where it is needed. We hope that this taxonomy similarly helps investors interested in contributing to the SDGs more confidently back cleantech startups.

Appendix: Taxonomy category explanations

Energy

Large-scale renewable energy

Description	Selling electricity and/or heat generated from renewable sources such as wind, solar, biomass, geothermal, hydro, wave and tidal. Includes selling, leasing or financing equipment to do so. Also includes selling products and services to renewable energy project developers, operators and asset owners to increase profits and reduce risk. Differentiated from 'Distributed renewable energy' by being large-scale and therefore typically located outside urban areas.
Primary SDG	 **Secondary SDGs** 
Rationale	Increasing the uptake of renewable energy is the focus of SDG Target 7.1 "By 2030, increase substantially the share of renewable energy in the global energy mix". By reducing emissions from the energy sector, renewable energy also contributes towards SDG 13 and as reducing emissions results in less ocean acidification and biodiversity loss, renewable energy contributes towards SDGs 14 and 15 as well.

Distributed renewable energy

Description	Renewable energy generation technologies that can be deployed in smaller unit sizes and therefore are more appropriate to urban areas, such as rooftop solar. Similar to 'Large-scale renewable energy', includes products and services that increase the profitability and uptake of distributed renewable energy.
Primary SDG	 **Secondary SDGs** 
Rationale	As per large-scale renewable energy. Also contributes towards SDG 11 as often installed in cities such as on the rooftops of buildings, supporting target 11.6 "By 2030, reduce the adverse per capita environmental impact of cities…"

Large-scale energy storage

Description	Any form of large-scale energy storage, including lithium-ion batteries, pumped hydro and flywheels. Includes financing and business model innovations to increase the uptake of energy storage as well as software and IoT devices that increase the return on investment from energy storage assets. Differentiated from 'Distributed energy storage' by being large-scale and therefore typically located outside urban areas.
Primary SDG	 **Secondary SDGs** 
Rationale	Supports renewable energy uptake by counteracting the intermittency of most renewable energy sources, a major impediment to further uptake. As a result, contributes towards the same SDGs as increasing renewable energy uptake.

Distributed energy storage

Description	Energy storage technologies that can be installed in smaller unit sizes and therefore able to be installed in residential and commercial buildings.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	As per large-scale renewable energy. Also contributes towards SDG 11 as often installed in conjunction with local renewable energy generation in urban areas.

Green hydrogen

Description	The production, transport and storage of hydrogen produced from renewable resources. Including the production and retrofitting of vehicles and equipment to take hydrogen as a fuel source.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Hydrogen is a possible substitute for fossil fuels in many applications that doesn't produce greenhouse gas emissions when consumed. Green hydrogen is hydrogen that is produced in a way that doesn't result in greenhouse gas emissions and therefore contributes towards SDG 7 and, by helping to mitigate climate change, SDGs 13, 14 and 15.

Smart grid

Description	Tools that help energy utilities better manage the demands placed on them by distributed energy resources.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	One of the impediments to generating 100% of electricity from renewable sources is the increased complexity placed on grid operators, particularly if that renewable energy generation is distributed. Startups in this category provide utilities with digital tools that help them accommodate more renewable energy in the grid.

Demand management

Description	Demand response, demand management, demand-side participation and other practices that help match demand for electricity with supply from intermittent renewable energy sources.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Similar to energy storage, demand management startups facilitate the uptake of renewable energy by counteracting generation intermittency.

Energy efficiency

Description	Software and hardware that reduces energy consumption. Including digital tools and business models that increase the uptake of energy-efficient equipment.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Energy efficiency in the focus of target 7.3 "By 2030, double the global rate of improvement in energy efficiency". Due to the carbon intensity of the energy sector, reducing energy use also reduces greenhouse gas emissions (SDG 13) and consequentially ocean acidification (SDG 14) and biodiversity loss (SDG 15). Most startups in this category reduce energy use in cities, so SDG 11 is also supported.

Transport

Electric vehicles

Description	The manufacture, distribution or sale of electric vehicles and electric vehicle components, or the retrofitting of internal combustion engine (ICE) vehicles to electric.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	An argument could be made for primarily assigning electric vehicles to SDG 7 or 11. The former was decided upon as electric vehicles are crucial for the decarbonisation of the energy sector through displacing fossil fuel use and providing flexible demand and storage capacity to offset the intermittency of renewable energy sources, enabling both road transport and other electricity consumption to become emissions-free. Also supportive of SDG 11 by improving local air quality, part of target 11.6.

Electric transportation services

Description	Carpooling, car sharing, ride-hailing, logistics and other transportations services that exclusively use electric vehicles.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	As per 'Electric vehicles'.

Electric vehicle charging

Description	Manufacturing, installing or managing electric vehicle charging infrastructure.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	As per 'Electric vehicles'. One of the main barriers to increased uptake of electric vehicles is a lack of charging infrastructure. Therefore, any startup that increases the accessibility of electric vehicle charging also supports the uptake of electric vehicles and supports the same SDGs.

Carpooling

Description	Products and services that facilitate or otherwise increase the uptake of carpooling practices. Not including services that focus on one person driving one other person/group; must involve one vehicle servicing at least two trips.
Primary SDG	11 SUSTAINABLE CITIES AND COMMUNITIES
Secondary SDGs	7 AFFORDABLE AND CLEAN ENERGY; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Again, an argument could be made for carpooling primarily supporting SDG 7 or 11. We've primarily assigned carpooling to SDG 11 because it directly relates to target 11.2 "By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all" as well as 11.6, which calls for reducing the environmental impact of cities and improving air quality. Carpooling also reduces fossil fuel consumption and therefore contributes to SDG 7, and consequentially SDGs 13, 14 and 15.

Driving optimisation

Description	Data, analytics, and machine learning that reduces the energy consumed by vehicles in an urban area e.g. through workforce and route optimisation, or by influencing driver behaviour.
Primary SDG	11 SUSTAINABLE CITIES AND COMMUNITIES
Secondary SDGs	7 AFFORDABLE AND CLEAN ENERGY; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Similar to 'Carpooling', assigned to SDG 11 as reducing the distance travelled by vehicles in cities contributes to target 11.6 by reducing the environmental impact and fine particulate matter in urban areas. Also reduces fuel consumption, and therefore contributes towards SDG 7, and consequently SDGs 13-15.

Last-mile transport

Description	Bikes and scooters (electric or human-powered), sold directly or through sharing platforms, to complement public transport services and replace car travel in urban areas.
Primary SDG	11 SUSTAINABLE CITIES AND COMMUNITIES
Secondary SDGs	7 AFFORDABLE AND CLEAN ENERGY; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	As per 'Carpooling', although impacts the SDGs by replacing rather than reducing the use of fossil-fuel-powered vehicles.

Waste

Urban organic waste-to-energy

Description	Equipment and logistic systems that facilitate the conversion of organic waste generated in urban areas to energy (electricity, gas, liquid, or solid). May also produce bioproducts such as biochar.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Converting organic waste to energy typically involves diverting it from landfill and becoming a major component of the waste sector's carbon footprint, and therefore supports SDG 12 as well as SDG 13 (and consequentially SDG 14 and 15). However, organic waste-to-energy has been primarily classified as SDG 7 rather than 12 as there are arguably better uses of organic waste than converting it to energy from a responsible consumption and production perspective. If collecting organic waste from urban areas, reduces the environmental footprint of cities and therefore contributes to SDG 11 as well.

Urban organic waste recycling

Description	Diverts food waste produced in cities from landfill to be used to produce fertiliser or other products (even if those products are not then used in urban areas). Excluding organic waste-to-energy (captured by the urban and non-urban waste-to-energy categories).
Primary SDG	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Secondary SDGs	11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Reduces waste and because it does so in urban areas, improves the sustainability of cities. By diverting organic waste from landfill, reduces emissions and therefore climate change, supporting SDGs 14 and 15.

Non-urban organic waste-to-energy

Description	As per 'Urban organic waste-to-energy' but utilising waste generated outside cities, such as agricultural organic waste.
Primary SDG	7 AFFORDABLE AND CLEAN ENERGY
Secondary SDGs	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	As per 'Urban organic waste-to-energy' but doesn't contribute to SDG 11 as doesn't directly reduce the environmental impact of cities.

Plastic recycling

Description	Anything that increases the proportion of plastic waste that is recycled, even if non-plastic waste is also reduced in the process. Includes making and selling products made out of recycled plastic as that improves the economics of plastic recovery.		
Primary SDG	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	**Secondary SDGs**	14 LIFE BELOW WATER
Rationale	Increasing the recycling of plastic directly supports target 12.5 "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse" among others in SDG 12. Recycling plastic also reduces the amount that can find its way into the oceans, supporting SDG 14.		

Other waste recycling

Description	Anything that increases the amount of waste that is recycled that doesn't fit into one of the other categories above.		
Primary SDG	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	**Secondary SDGs**	
Rationale	Waste recycling startups that contribute towards more than one SDG should be captured by other categories. Therefore, anything that falls into this category should only contribute to SDG 12.		

Marine plastic recovery

Description	Processes and technology that collect plastic from the oceans and disposes of it correctly.		
Primary SDG	14 LIFE BELOW WATER	**Secondary SDGs**	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Rationale	Startups that collect plastic from the oceans directly support target 14.1 "By 2025, prevent and significantly reduce marine pollution of all kinds". These startups typically then recycle the plastic recovered or ensure it is disposed of responsibly, supporting SDG 12.		

(Single-use) plastic alternatives

Description	Replacing single-use plastics with more durable products (which may or may not be made out of plastic themselves) or replacing plastic products with biodegradable alternatives made from materials such as crustacean shell waste.		
Primary SDG	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	**Secondary SDGs**	14 LIFE BELOW WATER
Rationale	Primarily contributes to SDG 12 and supports SDG 14 as less plastic production leads to less plastic in the oceans.		

Food waste and spoilage prevention

Description	Reducing food waste using sensors, chemicals and packaging to prevent the spoilage of food in the supply chain, or by matching unsold or unsaleable food with consumers.
Primary SDG	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Secondary SDGs	13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	SDG target 12.3 aims to "halve per capita global food waste at the retail and consumer levels". Reducing food waste also reduces emissions and therefore supports SDGs 13-15.

Sharing economy

Description	Tools that facilitate sharing of products rather than purchasing new ones. Note this is a narrower definition of 'sharing economy' than used by others.
Primary SDG	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Secondary SDGs	
Rationale	Sharing products such as household tools reduces the resources consumed to provide the same service.

Built environment

Smart cities

Description	Data collection and analytics to improve the sustainability of cities, which must include reducing air pollution to be assigned to this category.
Primary SDG	11 SUSTAINABLE CITIES AND COMMUNITIES
Secondary SDGs	
Rationale	These startups help reduced fine particulate matter (indicator 11.6.2) through measurement and analysis that helps councils implement pollution control measures. They may also have other sustainability benefits for cities. No secondary impacts have been assigned as the measures used to improve city sustainability may or may not impact other SDGs, and often do so indirectly.

Green buildings

Description	Digital tools to reduce the environmental impact of the construction and use of buildings.
Primary SDG	11 SUSTAINABLE CITIES AND COMMUNITIES
Secondary SDGs	7 AFFORDABLE AND CLEAN ENERGY; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 13 CLIMATE ACTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Touches on all aspects of the environmental SDGs. Primarily allocated to cities as that SDG focuses on reducing the environmental impact of cities, of which building construction and use is a large component. Green buildings almost always include energy efficiency measures and other means to reduce greenhouse gas emissions. They also typically reduce material consumption in the construction and/or use of the building.

Agriculture

Precision agriculture

Description	Reducing the amount of fertiliser used in farms, and potentially also pesticides, water and other inputs, by determining and taking into account the variability of crops. Excludes startups predominantly focused on increasing livestock productivity.
Primary SDG	14 LIFE BELOW WATER
Secondary SDGs	13 CLIMATE ACTION; 15 LIFE ON LAND
Rationale	It may seem counterintuitive to primarily assign sustainable fertiliser to SDG 14 rather than SDG 15. However, reducing eutrophication caused by nutrient pollution is a major focus of SDG 14 and fertiliser runoff into waterways is a significant contribution to that problem in Australia. Conversely, SDG 15 does not refer directly to nutrient pollution and its relevance is only indirectly through the impact of fertiliser use on terrestrial biodiversity, to which there is weaker link in Australian than that between fertiliser use and aquatic ecosystem health. Reducing fertiliser use also contributes to SDG 13 because of the greenhouse gas emissions associated with fertiliser production and use.

Traditional chemical fertiliser substitutes

Description	Sustainable products that replace or reduce the need for traditional chemical fertilisers.
Primary SDG	14 LIFE BELOW WATER
Secondary SDGs	13 CLIMATE ACTION; 15 LIFE ON LAND
Rationale	As per 'Precision agriculture'.

Pesticide reduction

Description	The reduction of pesticide use through more targeted application or substituting with mechanical or biological alternatives.
Primary SDG	15 LIFE ON LAND
Secondary SDGs	
Rationale	Reducing pesticide use supports biodiversity and therefore SDG 15. While pesticide runoff does impact marine ecosystem health, SDG 14 was not assigned as a secondary SDG as the impact is currently considered to be low in Australia. Further study on the interaction between pesticide use and aquatic ecosystems may necessitate this category to be updated in the future.

Vertical farming

Description	Growing food in stacked layers, often in a controlled environment.
Primary SDG	15 LIFE ON LAND
Secondary SDGs	13 CLIMATE ACTION; 14 LIFE BELOW WATER
Rationale	Vertical farming is a controversial topic, with heavy debate on its financial and environmental merit. Its critics point most often to the limited number of crops that can be grown economically and its energy intensity. However, we included it in the taxonomy for its potential to increase food production without requiring additional land for agriculture. Land clearing is one of the largest contributors to biodiversity loss and greenhouse gas emissions (and therefore ocean acidification). As a result, vertical farming is considered primarily to contribute to SDG 15 and secondarily to SDG 13 and 14.

Animal produce alternatives

Description	Anything that reduces the need to farm animals, including edible bugs, lab-grown meat and dairy, and plant-based alternatives.
Primary SDG	13 CLIMATE ACTION
Secondary SDGs	14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	This category primarily focuses on finding alternatives to beef and dairy, which is a major source of greenhouse gas emissions.

Environment

Automated reforestation and restoration

Description	The use of drone and related technology for seeding and planting to make land restoration and reforestation efforts more efficient and effective.
Primary SDG	15 LIFE ON LAND
Secondary SDGs	13 CLIMATE ACTION; 14 LIFE BELOW WATER
Rationale	Primarily attributable to SDG 15 as "Forest area as a proportion of total land area" is the first indicator for that SDG. Secondarily attributable to SDG 13 due to the carbon sequestration and SDG 14 for the flow-on benefits of reducing ocean acidification.

Carbon sequestration

Description	Businesses that sequester greenhouse gas emissions or facilitate doing so. Often involves sequestering carbon into an agricultural product or construction material that can be sold profitably.
Primary SDG	13 CLIMATE ACTION
Secondary SDGs	14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Supports SDG 13 by helping to mitigate climate change and therefore SDGs 14 and 15.

Climate finance

Description	Financial products that direct capital towards climate solutions and away from carbon-intensive industries. Startups that primarily direct finance towards specific technologies such as large-scale renewables energy generation should be placed in the corresponding category.
Primary SDG	13 CLIMATE ACTION
Secondary SDGs	14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Supports SDG 13 by helping to mitigate climate change and therefore SDGs 14 and 15. Startups in this category may also support other SDGs depending on where finance is directed but often this is an indirect side-effect that can't be controlled by the startup.

Carbon offsetting

Description	Selling or facilitating the sale of carbon offsets.
Primary SDG	13 CLIMATE ACTION
Secondary SDGs	14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Supports SDG 13 by helping to mitigate climate change and therefore SDGs 14 and 15.

Carbon accounting

Description	Tools that help businesses account for and reduce their carbon footprint.
Primary SDG	13 CLIMATE ACTION
Secondary SDGs	14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	Measuring and monitoring an organisation's carbon footprint is an essential practice in any effective policy to reduce that carbon footprint.

Personal footprint calculators

Description	Tools to measure and reduce personal carbon footprints.
Primary SDG	13 CLIMATE ACTION
Secondary SDGs	14 LIFE BELOW WATER; 15 LIFE ON LAND
Rationale	As per 'Carbon accounting' but for individuals rather than organisations. Startups in this category are typically focused on helping individuals reduce their carbon footprint rather than just calculating it.

Species tracking

Description	Tools that support conservation efforts by monitoring the presence and movement of species, particularly those at risk of extinction.
Primary SDG	15 LIFE ON LAND
Secondary SDGs	14 LIFE BELOW WATER
Rationale	Data on endangered species can support conservation efforts. Tools that collect this data could support biodiversity on land and below water, but we've primarily assigned this category to SDG 15 as that was the main focus of startups found in this category.