

# Australia's Bioenergy Roadmap

Appendix – Public Policy

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Australian Government  
Australian Renewable  
Energy Agency

**ARENA**

## Table of Contents

<b>1. Key findings.....</b>	<b>2</b>
<b>2. Appendix overview .....</b>	<b>3</b>
<b>3. Policies and support mechanism for bioenergy .....</b>	<b>3</b>
<b>4. Global case studies .....</b>	<b>4</b>
<b>5. Australia's current policy landscape.....</b>	<b>13</b>
<b>6. Bibliography .....</b>	<b>16</b>
<b>7. Acknowledgement and disclaimer .....</b>	<b>19</b>
<b>8. Authors .....</b>	<b>20</b>

## 1. Key Findings

**Consistent and sustainable policy support is integral to establishing and growing a bioenergy industry.** This policy support can however take many forms with differing levels of strategic, regulatory and financial support. In all countries reviewed as part of this Roadmap, growth in bioenergy is largely policy driven, highlighting the difficulties in developing standalone commercial business cases.

**Examples of mechanisms, schemes and policies that can drive further uptake of bioenergy include:**

- In the road transport market, historically, volume-based biofuel mandates have been the main support mechanism. More recently, technology-agnostic policies targeting greenhouse gas emissions reductions in the transport sector have emerged, such as in Germany, Sweden and California.
- In the aviation and marine markets, preferential blending mandates and treatment under certificate-based schemes targeting the broader transport sector have been enacted.
- In renewable gas markets, assistance has been provided through blending targets and mandates, feed-in-tariffs and guarantee-of-origin certificate schemes.
- In the renewable heat market, renewable targets, feed-in-tariff, and reverse-auction mechanisms.
- In the renewable electricity market, technology-agnostic, certificate-based schemes are common in many countries. Feed-in-tariffs incentivising new technologies are progressively being replaced with contracts-for-difference coupled with reverse-auction mechanisms, such as in Germany and the UK.
- **Bioenergy's environmental sustainability is a consistent consideration internationally.** Sustainably sourced biomass can be considered through eligibility criteria, sub-targets or additional incentives complementing other policies. Guarantee-of-origin certificate schemes enable retailers and consumers to trace the sustainability of bioenergy and provide additional revenues to producers.
- **Waste policies, including waste levies and selective bans applied on landfills, have proven effective to promote higher steps in the waste utilisation hierarchy, including Waste to Energy (WtE).** California, Germany and Sweden have either banned organics in landfill or have targets to reduce the amount of organic waste sent to landfill. Australia is adopting similar targets through its National Waste Strategy.
- In Australia, bioenergy has mainly received support through various grant and financing programs at both the federal level via ARENA and CEFC and at the state level.
- Several Australian states have developed roadmaps, strategies and policies relevant to bioenergy. These provide strategic support to bioenergy, support specific bioenergy markets and target bioenergy resources. These can be used as a foundation to provide greater policy support, coordination and clarity at the federal and state levels.

## 2. Appendix overview

This appendix provides a snapshot of a range of policies and mechanisms for supporting bioenergy overseas and in Australia. It also provides insights into the bioenergy strategies of five countries with developed bioenergy initiatives, including the United States (US), Canada, Sweden, Germany and the United Kingdom (UK).

## 3. Policies and support mechanism for bioenergy

There are a number of policies and mechanisms to support bioenergy. Table 1 summarises the main policies and support mechanisms employed and classifies them into key categories. [1].

**Table 1 – Policies and support mechanisms for bioenergy**

Policy type	Description
<b>Strategic support</b>	
<b>Strategy and/or roadmap</b>	Sets the strategic direction for establishing a bioenergy industry or low carbon future, including technology roadmaps. This may be accompanied by an action plan for policy implementation and research and development.
<b>Regulatory support</b>	
<b>Targets and/or mandates</b>	Targets or mandates can set a volume of demand or supply to be met with renewable energy or specifically bioenergy. They can also be designed to achieve a level of emissions reductions. Liable entities may demonstrate compliance through the relinquishment of tradeable certificates, which provide a source of income to bioenergy projects. Aspirational targets may also be set.
<b>Sustainability frameworks</b>	Sustainability frameworks set criteria for the social and environmental impacts (including lifecycle assessments) of biomass. Guarantee-of-origin certificates can provide verification regarding the sustainability of bioenergy.
<b>Waste levies and/or bans</b>	Levies for waste disposal can incentivise alternative utilisation of waste, including for bioenergy projects. Alternatively, jurisdictions may choose to ban organic waste disposal in landfill.
<b>Economic support</b>	
<b>Capital grants</b>	Capital grants reduce the upfront investment cost of bioenergy projects and improve returns to investors. Governments may choose to run competitive tenders and award funding to most attractive projects. Capital grants are typically applied to small-scale projects or projects in demonstration phase.
<b>Soft loans and loan guarantees</b>	As an alternative or complement to capital grants, governments may provide low-interest or subordinated loans to facilitate access to private finance and reduce the cost of capital.
<b>Contracts-for-difference (CfD)</b>	Under a CfD, governments fund the difference between the market price and contract price so that bioenergy project developers are guaranteed a minimum price per unit of bioenergy produced. The contract price (or 'strike price') reflects the cost of investing in a particular technology and is usually established through a reverse-auction mechanism.
<b>Feed-in-tariffs (FiT)</b>	Under a FiT, bioenergy project developers receive a fixed amount for bioenergy production over an established time period (such as 15 years). A FiT may be set according to technology type (such as anaerobic digestors) or eligibility criteria (such as sustainably sourced biomass).
<b>Tax treatment</b>	Tax incentives, credits and exemptions can reduce the cost of bioenergy projects. Governments may choose to reduce tax rates or waive certain taxes for equipment that are inputs to bioenergy projects. Governments may also provide credits or exemptions to offset energy production taxes. Alternatively, a carbon tax can promote investment in low emissions technology.

## 4. Global case studies

This section compares support mechanisms for different end-use applications of bioenergy using five case studies: the US, Canada, Sweden, the UK and Germany.

### Introduction

**There are several geographic and commercial drivers for the development of bioenergy industries in Europe, North America and countries with large agricultural resources, such as Brazil and Indonesia.**

Key drivers of bioenergy industry development include:

- Reducing emissions in multiple sectors of the economy
- Supporting economic development and job creation
- Improving liquid fuel security
- Enhancing waste recovery.

These drivers have prompted a range of policy mechanisms to support bioenergy industry development in a number of countries and regions.

For the purposes of this analysis, three criteria were used to select countries:

- 1. Established strategy:** the country has published a bioenergy roadmap or renewable energy strategy with reference to bioenergy.
- 2. Industry maturity:** the country has a mature bioenergy industry built on multiple bioenergy pathways with clear policy support.
- 3. Comparability:** the country's industry structure and governance are similar to Australia's.

Using the above criteria, the following five case studies were selected.

#### 1. The United States of America (US)

The US has a strong agricultural sector. Support for the agricultural sector and concerns for liquid fuel security have led to the US becoming a global leader in biofuels production [2].

The US has a goal to produce one billion tonnes of biomass resources for its bioeconomy by 2030 [3]. California can provide further insights on policy support, where emissions reduction policies have driven growth in biogas and biofuels.

#### 2. Canada

Canada has a large forestry sector with a strong focus on sustainable production. Canada envisages becoming a global leader in the use of forest biomass in the bioeconomy.

Support for bioenergy has been led by Canadian provinces, and policies implemented by Alberta, British Columbia, Ontario and Quebec have also been considered.

#### 3. Sweden

Sweden is a leader in heat generation from bioenergy, with more than half of Sweden's heat generation coming from bioenergy [4]. This has historically been driven by a greater need for residential heat through district heating, liquid fuel security, and later, emissions reduction policies.

Sweden now has the overarching goal of becoming the world's first fossil-fuel-free society which may increase bioenergy's role in hard-to-abate sectors. Sweden's tax incentives have also promoted biofuels and biomethane in transport.

#### 4. The United Kingdom (UK)

The UK's growth in bioenergy production for electricity and heat generation is driven by emissions reduction policies.

The UK is also emerging as a leader in biomethane injection into the gas grid [5].

This means the UK can provide insights on policy support for multiple end-use applications. The UK has previously published a bioenergy strategy and has more recently broadened the scope to developing the UK's bioeconomy.


#### 5. Germany

Germany has a mature biogas sector with growing biomethane production, with over ten thousand biogas plants installed [5]. This has been mainly driven by efforts to reduce emissions in electricity generation. Germany has also implemented an emission reduction mechanism in the transport sector.

Similar to the four other reference countries, Germany is pursuing the development of its bioeconomy to reduce reliance on fossil feedstocks.

For context, annual bioenergy production and end-use applications are presented for each case study in Table 2.

**Table 2 – Comparison of bioenergy production and end-uses**

						
<b>Bioenergy production</b>						
<b>Primary energy supply</b>	2010 bioenergy production (mtoe)	89.3	12.3	11.5	24.8	6.6
	Share of total primary energy supply	4%	5%	23%	8%	3%
	2018 bioenergy production (mtoe)	107.3	13.4	12.2	30.0	15.2
	Share of total primary energy supply	5%	4%	25%	10%	9%
<b>Markets</b>						
<b>Electricity generation</b>						
	2018 electricity generation from bioenergy (TWh)	59	7.1	9.3	45.1	32.1
	Share of total electricity generation	1%	1%	6%	7%	10%
<b>Heat generation</b>						
	2018 heat generation from bioenergy (PJ)	36.7	2.1	93.2	35.2	3.6
	Share of total heat generation	8%	9%	53%	7%	5%
<b>Green gas</b>						
	Number of biogas plants	2,200	200	280	10,551	994
	Number of upgrading plants <sup>1</sup>	5	11	45	203	96
	Annual biogas production (TWh)	86.1	4.7	2	120	25
<b>Transport</b>						
	2017 biofuels production (mtoe)	36.9	1.1	1.1	33.3	<1
	Share of transport consumption	6%	4%	20%	5%	4%

Source: IEA [4] [5] [6]

<sup>1</sup> This is the number of plants upgrading biogas to biomethane. Most countries inject biomethane into the gas grid for electricity or heat generation downstream. Sweden is an example where more than half of the biomethane produced is used as a vehicle gas.

## Comparison of support mechanisms

This section discusses the support mechanisms that have facilitated bioenergy development in the selected case studies.

It is divided into strategic support for bioenergy and support mechanisms for heat and electricity generation, biomethane grid injection, and biofuels and waste and resource policies.

### Strategic support for bioenergy

Recently, many countries have published strategies focusing on the bioeconomy rather than only on bioenergy (see Table 3).






With respect to the case-study countries in particular:

- The US has published three national assessments that have calculated its potential supply of biomass to support the development of its bioeconomy. The US envisages producing one billion tonnes of biomass resources by 2030 for the production of bioproducts including biofuels [3].
- Canada’s forest bioeconomy framework contributes to Canada’s shift to a clean, innovative and sustainable future. It was developed with broad stakeholder consultation including those from the forestry sector, academia and research, indigenous groups, bioenergy firms, gas utilities and financial institutions [7].

- The UK’s national bioeconomy strategy envisages the United Kingdom will be a global leader in developing, manufacturing, using and exporting bio-based solutions by 2030. The strategy was developed in collaboration with industry and the research community to set a comprehensive list of actions [8].
- Germany published its national bioeconomy strategy in 2020, which set out two key guiding principles: (1) harnessing biological knowledge and responsible innovation for sustainable, climate-neutral development and (2) using biogenic raw materials for a sustainable, circular economy [9].
- Sweden does not have a dedicated strategy for bioenergy or the bioeconomy. However, Sweden’s climate change strategy supports the use of bioenergy.

Different drivers have motivated the development of the bioenergy industry in each case study. These are summarised in Table 3, along with any published roadmaps or strategies.

**Table 3 – Summary of roadmaps or strategies for bioenergy and key drivers**




Country	Roadmap or strategy	Key drivers
	<ul style="list-style-type: none"> <li>• Bioeconomy Blueprint (2012)</li> <li>• The Billion-Ton Report series (2005; 2011; 2016)</li> </ul>	<ul style="list-style-type: none"> <li>• Regional economic development</li> <li>• Energy security</li> </ul>
	<ul style="list-style-type: none"> <li>• California Bioenergy Action Plan (2011)</li> <li>• Forest Bioeconomy Framework for Canada (2018)</li> <li>• Canada’s Bioeconomy Strategy (2019) (industry-led)</li> <li>• British Columbia Bioenergy Strategy (2008)</li> </ul>	<ul style="list-style-type: none"> <li>• Emissions reduction</li> <li>• Waste recovery</li> <li>• Regional economic development</li> <li>• Regional economic development</li> <li>• Emissions reduction</li> </ul>
	<ul style="list-style-type: none"> <li>• Sweden does not have a dedicated bioenergy strategy; there is a focus on bioenergy in Sweden’s climate change strategy.</li> </ul>	<ul style="list-style-type: none"> <li>• Energy security</li> <li>• Emissions reduction</li> </ul>
	<ul style="list-style-type: none"> <li>• National Policy Strategy on the Bioeconomy (2013)</li> <li>• National Bioeconomy Strategy (2020)</li> </ul>	<ul style="list-style-type: none"> <li>• Emissions reduction</li> <li>• Waste recovery</li> </ul>
	<ul style="list-style-type: none"> <li>• United Kingdom Bioenergy Strategy (2012)</li> <li>• National Bioeconomy Strategy to 2030 (2018)</li> </ul>	<ul style="list-style-type: none"> <li>• Emissions reduction</li> <li>• Waste recovery</li> </ul>

### Support mechanisms for electricity and heat generation

Support mechanisms for renewable electricity and heat generation typically target a range of low emissions technologies to achieve least cost abatement.

Europe, California and multiple provinces in Canada have well-developed policies to support bioenergy, amongst other renewable energy technologies, for electricity and heat generation (see Table 4).

**Table 4 – Support mechanisms for renewable electricity and heat generation**

					
<b>Target</b>	 (California)				
<b>Contracts-for-difference</b>					
<b>Feed-in-tariff</b>	 (California)	 (Ontario)			 
<b>Grants</b>		 (Ontario, Alberta, Quebec)			
<b>Tax treatment</b>					

 Electricity generation       Heat generation

### Electricity generation

**In the UK, Sweden and California, renewable energy targets have increased renewable electricity generation.**

Under the UK Renewables Obligation [10], Swedish Electricity Certificate System [11] and Californian Renewables Portfolio Standard [12], electricity suppliers are required to source an increasing portion of their sales from renewables. Electricity suppliers demonstrate compliance by purchasing certificates from accredited large-scale generators, including bioenergy plants.

**Feed-in-tariffs for renewable electricity generation are the main support mechanism for anaerobic digestion. They have been employed in Germany, the UK, Sweden, Ontario and California [5].**

Feed-in-tariffs have been an important support mechanism for driving growth in biogas production. In particular, biogas accounts for approximately three-quarters of Germany’s electricity generation from bioenergy, where feed-in-tariffs have been in place since 2000 [4].

Also, a bonus for energy crops from 2004 to 2012 has resulted in the majority of the biogas produced in Germany coming from agricultural feedstocks, mainly maize (in 2018, 83 per cent of Germany’s electricity generation from biogas used agricultural feedstocks). Concerns for sustainability replaced support for energy crops with a bonus for biowaste [5].

**As these schemes come to an end and markets mature, countries are choosing contracts-for-difference awarded through reverse auctions as the main support mechanisms for renewable electricity generation.**

The UK Renewables Obligation closed to new entrants in 2017. Contracts-for-difference are now the main support mechanism for large-scale renewable electricity projects, where 20-year contracts are awarded via competitive auctions [13].

Similarly, Germany has implemented a competitive auction system, which began in 2017, to replace feed-in-tariffs [5] for renewable electricity generation (including that from biomass).



Although Ontario offers feed-in-tariffs for electricity generation from anaerobic digestion, most Canadian projects are funded through waste management and climate change grant programs at the regional, provincial or federal level [5].

### Heat generation

Indirect support for renewable heat generation was available through support for combined heat and power systems fuelled by biomass through the aforementioned policies. Sweden and the UK have implemented additional mechanisms focused on renewable heat generation.

**In Sweden, bioenergy for heat generation has received stable policy support for several decades, mainly through tax treatment.**

Sweden is a clear leader in heat generation from bioenergy, where heat loads are very high and district heating is highly developed [14].

- In the 1970s, Sweden began promoting biomass for heat generation through favourable taxation. This was driven by concerns for fuel security following the oil crisis.
- Sweden’s main driver has since shifted to emissions reduction and in the 1990s, Sweden implemented a carbon tax. The carbon tax has promoted conversion of fossil fuels to biomass for heat generation.

**The UK supports bioenergy for heat generation through the Renewable Heat Incentive, which provides a feed-in-tariff to a range of renewable heat technologies.**















This has resulted in a significant increase in the use of biomass for small and medium-scale heating applications as well as anaerobic digestion and biomethane injection to the gas grid [13]. This support mechanism contributed to the UK’s target of 12 per cent of UK homes being heated by renewable energy by 2020.

### Support mechanisms for biomethane grid injection

While feed-in-tariffs are commonly used to promote renewable electricity generation from biogas, they can also be used for biomethane grid injection.

Also, Sweden has used tax exemptions to support biomethane as a vehicle fuel (see Table 5).

**Table 5 – Support mechanisms biomethane grid injection**

					
<b>Mandate</b>	 (California)				
<b>Grants</b>		 (Quebec)			
<b>Guarantee of origin</b>					
<b>Feed-in-tariff</b>		 (British Columbia, Quebec)			
<b>Tax exemptions</b>					

**Feed-in-tariffs have increased investment in biogas upgrading for grid injection.**

Within Europe, Germany has the most developed biogas sector, where anaerobic digestion has been supported by feed-in-tariffs since 2000. The major driver for biomethane injection in the gas grid was the introduction of the biogas upgrading bonus as part of the feed-in-tariffs. This bonus was available from 2009 to 2014, and investment stalled once removed [15].

The UK is an emerging leader in biomethane production. In the UK, biomethane injection into the grid is currently eligible for a feed-in-tariff (4.92 pence (A\$ 0.90) per kWh) under the Renewable Heat Initiative [16]. However, this scheme also closes in 2021 with no clear replacement policy announced. Similar to Germany’s experience, this is likely to stall investment in the UK.

In Canada, British Columbia and Quebec both offer feed-in-tariffs for renewable gas.

**Germany and the UK both have guarantee-of-origin certificate schemes for biomethane.**

These certificates ensure the traceability of biomethane exchange between producers, retailers and consumers.

They prove to the consumer the origin and sustainability of the renewable gas that they have purchased. Guarantee of origin certificates can provide complementary revenues to the sale of biomethane and are tracked through national registries.

In the EU, the European Renewable Gas Registry (ERGaR) aims to bring together national registries across Europe to enable cross-border trading of renewable gas. Both Germany and the UK are members of ERGaR [17].

**California aims to reduce methane emissions by 40 per cent by 2030. The California Public Utilities Commission is considering the adoption of a renewable gas procurement program.**



















Similar to the California Renewables Portfolio Program, this program will require gas utilities to annually procure renewable gas through long-term offtake agreements (to achieve a goal of at least 20 per cent of total volume of gas delivered to customers by 2030) [18].

**Support mechanisms for biofuels**

**Targets or mandates are the main support mechanism for biofuels (see Table 6). These may be volume-based or structured around emissions reduction potential.**

To complement these policies, incentives for certain feedstocks, caps on conventional biofuels and sub-targets for advanced biofuels are also employed.





**Table 6 – Support mechanisms for biofuels**

					
<b>Volume-based mandate</b>	 (US)	 (Canada)			
<b>Emissions-based policy</b>	 (California)	 (Alberta)			
<b>Grants and/or loan guarantees</b>	 (US)	 (Canada)			
<b>Feed-in-tariff</b>	 (US)				
<b>Tax exemptions</b>					

**Historically, volume-based mandates have been used to increase the blending of bioenergy in transport fuels.**





These are typically supported by trading mechanisms, where producers are awarded certificates per unit of volume of biofuels (for example, one certificate per litre of bioethanol). See examples below.

**Table 7 – International volume-based biofuel mandates**

Country	Comment
	The US Renewable Fuel Standard places yearly volume requirements on fuel suppliers with an overall target of 36 billion gallons (164 billion litres) of biofuels by 2022. Conventional biofuels are capped at 15 billion gallons (68 billion litres) per year and there are increasing targets for advanced biofuels [19]. In addition, the Advanced Biofuel Payment Program makes payments to biofuels producers based on the production volume of advanced biofuels [20]. Also, the Biodiesel Tax Credit has been extended from 2017 to 2022. Biodiesel producers are eligible for \$US 1 per gallon (\$AU 0.33 per litre) [21].
	The UK Renewable Transport Fuel Obligation requires fuel suppliers to supply an increasing amount of renewable transport fuels (12.4 per cent by 2032). Crop-derived fuels were capped at four per cent in 2019, decreasing to two per cent by 2032. Also, biofuels derived from certain wastes and residues are eligible for double certificates per litre. The obligation also has a sub-target of 2.8 per cent of advanced fuels by 2032 [22].
	Blending mandates in Canada were led by the provinces. British Columbia, Alberta, Saskatchewan, Manitoba and Ontario had blending mandates of 5 to 8.5 per cent bioethanol and two to four per cent biodiesel. Canada has since adopted federal blending mandates of five per cent bioethanol and two per cent biodiesel [2].
	Germany also has a blending mandate for advanced biofuels of 0.5 per cent by 2030 and conventional biofuels are capped at 6.5 per cent [2].

Recently, some countries have moved away from mandating a volume of biofuels towards support mechanisms that focus on reducing greenhouse gas emissions in the transport sector. Under these technology-neutral mechanisms, biofuels are favoured depending on their emissions reduction potential. See examples in Table 8 below.

**Table 8 – International technology-neutral mechanisms**

Country	Comment
	In 2011, California implemented a Low Carbon Fuel Standard that aims to decrease the carbon intensity of California's transportation fuels. The carbon intensity for each fuel is compared to a declining benchmark each year. Low emissions fuels generate certificates and fuels above the benchmark generate a deficit. This must be met through purchasing certificates [23].
	Canada is also in the process of implementing a Clean Fuel Standard (scheduled to begin in 2022), modelled on the California standard and a similar standard implemented in the Canadian province British Columbia. It will aim to achieve 30 million tonnes of annual reductions in greenhouse gas emissions to 2030 and reduce the carbon intensity of liquid fuels by 15 per cent by 2030 relative to 2010 [24].
	In 2015, Germany transitioned from a blending mandate to a greenhouse gas emissions reduction quota with the goal of achieving a six per cent decrease in its transport fuel mix by 2025. This led to an increasing number of biofuels from wastes and residues as they provided greater emissions reductions than crop-based biofuels. Biofuels that contribute to the mandate cannot be double counted towards the greenhouse gas emissions quota [2].
	In Sweden, all biofuels are exempt from energy and carbon taxes. In 2018, Sweden implemented an emissions quota-based mandate system, targeting emissions reduction of 4.6 per cent for petrol and 21.3 per cent for diesel in 2020. Sweden's emissions reduction target for domestic transport (excluding aviation) is 70 per cent by 2030, compared to 2010 levels. This corresponds to approximately 50 per cent of biofuels blending [2].

**Emissions reduction-driven, technology-neutral policies favour mature technologies. As such, they can be complemented by mechanisms encouraging less mature technologies.**

Policies based on emissions quotas are unlikely to stimulate demand for higher cost, less developed technologies despite their long-term potential. Germany provides an example where these policies are combined with mandates for advanced biofuels or additional support to less commercially mature technologies.

**Biofuels policies at the national level continue to focus primarily on road transport, despite aviation and marine sectors' significant contribution to greenhouse gas emissions.**

The aviation industry recognises the need to reduce emissions. The International Air Transport Association (IATA)'s climate change strategy has a target of 50 per cent reduction in net aviation greenhouse gas emissions by 2050, compared to 2005. The IATA has identified the use of sustainable biofuels as a key pathway to reduce emissions in the aviation sector [25].

Similarly, the International Maritime Organisation adopted in 2018 a strategy on reduction of greenhouse gas emissions from ships [26].

**Although there are few examples at a national level for support of renewable aviation fuels, momentum is growing in Europe<sup>1</sup>.**

The EU's Renewable Energy Directive II allows aviation biofuels to contribute a greater amount (1.2 multiplier) to the region's renewable transport target [2]. The recent European Green Deal aims for Europe to be carbon neutral by 2050 and includes a range of measures to reduce greenhouse gas emissions and promote biodiversity and sustainable production [27].

For aviation, the European Commission will reduce free allowances to airlines under its Emissions Trading Scheme, encouraging airlines to pursue biojet fuels. Furthermore, the European Commission will consider the legislative options to increase production and utilisation of sustainable fuels for different modes of transport, including aviation and marine [28].

In 2018, Norway implemented a blending mandate requiring aviation fuel suppliers to blend 0.5 per cent of biofuels in their jet fuel from 2020. Such biofuels must be produced from wastes and residues [29].

Following Norway, Sweden is also considering implementing a blending mandate for biojet fuels. A report commissioned by

the Swedish Government in 2019 proposed a blending mandate starting at one per cent in 2021, rising to five per cent in 2025 and 30 per cent by 2030 [30].

Furthermore, in 2020 the French Government published a roadmap for SAF development. This included a blending mandate of two per cent in 2025, five per cent in 2030 and 50 per cent in 2050 [31].

Rather than blending mandates, the UK Government has brought together government and representatives from the environmental, aviation and aerospace sectors under the name of the Jet Zero Council (JZC) to collaborate on reducing greenhouse gas emissions in the aviation sector. The UK seeks to establish itself as a world leader in the sustainable aviation sector, with the ambition of flying the first zero-emissions long-haul passenger plane [32].

Shipping is also under increasing pressure to reduce local emissions with limited regulations for greenhouse gas emissions requirement of fuels.

In 2016, the International Marine Organisation agreed to a 0.5 per cent cap on sulphur in its fuels by 2020. The strategy recognised measures that could indirectly support emissions reduction efforts such as the development of robust lifecycle greenhouse gas emissions guidelines for alternative fuels [2].

## Waste and resource policies

As highlighted in previous sections, policies can be designed to incentivise or limit the use of certain resources for bioenergy production. For example, biofuels mandates can cap the volume of conventional biofuels.

**Sustainability frameworks can also determine eligibility for policy support.**
















Table 9 shows that all countries considered have implemented sustainability criteria for bioenergy.

The EU has implemented sustainability criteria for biofuels and bioliquids used to meet countries' targets under the EU Renewable Energy Directive. These criteria exclude feedstocks that have come from land with high biodiversity or carbon stock value [33].

The UK has extended these criteria to all bioenergy receiving subsidies from the UK Government [34]. The US Renewable Fuel Standard sets requirements for feedstocks to come from certain land types. Blenders are required to keep detailed records to allow traceability [19].

<sup>1</sup> Though Europe emerges as the leading region in terms of support to SAF, it should be noted that the Californian LCFS also applies to SAF.

**Table 9 – Summary of waste and resource policies**

					
<b>Sustainability frameworks</b>					
<b>Waste levies and/or bans</b>	 (California)				

**Certification can provide certainty for sustainably sourced biomass from the forestry sector.**

Canada has 347 million hectares of forest and nearly 85 per cent of Canada’s wood pellet production is exported to Europe. Approximately 166 million hectares of Canada’s forests are independently certified as sustainability managed (this accounts for approximately 40 per cent of the world’s certified forests) [35].

The 2018 Forest Bioeconomy Framework for Canada aims to stimulate new economic activity through the provision of sustainably sourced forestry resources.

**Waste levies, waste reduction targets or waste bans can indirectly support bioenergy by creating demand for alternative waste treatment routes and help with the business case of bioenergy projects by avoiding waste disposal costs.**

Of the case studies, the following waste policies were identified:

- California aims to reduce landfill disposal of organic waste by 50 per cent by 2020 and 75 per cent by 2025 from the 2014 level [36].
- Germany has prohibited landfilling for waste with an organic matter content of more than five per cent since 2002.
- The UK landfill tax was introduced in 1996 and reached almost £94.15 (\$AU 174.50) per tonne in 2020 [37].
- In Sweden, landfilling of organic waste has been banned since 2005 [38].

Waste incineration for energy production is a debated topic in the EU, where 80 million tonnes of household waste are burnt each year. Waste reduction advocates argue that WtE projects encourage waste when the focus should be on reducing, sorting and recycling.

Recently, the European Commission published its updated Best Available Techniques Reference Document for Waste Incineration after consultation with industry, environmental groups and EU member states. This document sets out new requirements for monitoring pollution from waste incineration [39].

## 5. Australia's current policy landscape

In this section, support mechanisms implemented by the federal, state and territory governments are discussed.

It is divided into strategic support for bioenergy, and support mechanisms for heat and electricity generation, biomethane grid injection, and biofuels and waste and resource policies.

### Strategic support

**Steps have already been taken by various state governments towards addressing such policy opportunities.**

Currently, Queensland and South Australia have both published roadmaps dedicated to bioenergy or the broader bioeconomy [41] [42]. In 2014, Western Australia's Department of Agriculture and Food published a biomass scoping study that outlined opportunities for bioenergy from agricultural wastes and residues [43].

**Other jurisdictions have published strategies and roadmaps for renewable energy more broadly.**

Victoria's Renewable Energy Roadmap, Tasmania's Energy Strategy and New South Wales's Renewable Energy Action Plan all support developing the bioenergy industry [43]. The Northern Territory's Renewables Roadmap highlighted the significant challenges it faces in developing a bioenergy industry due to limited access to enough feedstock [44].

**Bioenergy may also be recognised through waste strategies, such as the ACT's Waste Management Strategy, which recognises the potential for bioenergy.** However, further direction on industry development may be required to inform investment decisions.

### Support mechanisms for heat and electricity generation

**The Large-scale Renewable Energy Target (LRET) can provide revenue support to bioelectricity generation through the allocation of large-scale generation certificates (LGCs). To date, few bioenergy projects have been accredited under this scheme.**

Eligible bioenergy projects include those that use energy crops, wood waste, agricultural waste, bagasse, black liquor and landfill and sewage gas. However, bioenergy projects only make up approximately nine per cent of accredited projects.

Of the accredited bioenergy projects, 43 per cent use landfill gas [45]. It was noted by the Roadmap stakeholders that the LRET does not adequately consider bioenergy for heat, gas and transport, and in fact has created an incentive for biogas to be used for electricity generation rather than reduce emissions in gas consumption.

The Clean Energy Regulator has approved enough capacity to guarantee that the 2020 Renewable Energy Target of 33,000 GWh hours of additional renewable electricity will be met. This target currently remains fixed to 2030. This means that the value of LGCs is likely to decline over time as more projects are accredited, noting that the equivalent Australian Carbon Credit Unit (ACCU) price is likely to act as a floor price for LGCs. Without further expansion of the target, LGCs are unlikely to provide significant revenue for bioenergy projects.

Given that the Renewable Energy Target was focused on electricity generation, other bioenergy markets such as heat generation, gas and transport have not benefited from this policy measure to date.

## Support mechanisms for biomethane grid injection

### Policy support for biomethane injection into the gas grid is developing.

The Australian Government's Emissions Reduction Fund (ERF) is a voluntary scheme where Australian carbon credit units (ACCUs) are awarded per tonne of carbon stored or abated to projects under eligible methodologies [46]. These ACCUs can be sold to the Australian Government or on the secondary market. While there are methods that reward capture of landfill gas and anaerobic digestion, this is either flared or used for electricity generation.

Under the current method design, ACCUs cannot be earned for biomethane grid injection. However, the development of methods for biomethane has been announced by the Government in December 2020 and is being led by the Clean Energy Regulator. Method scoping, planning and co-design processes have been completed. Consultation on draft methodologies will occur in Q4 2021. This will ultimately allow biomethane from waste and agricultural methods to reduce emissions and receive Australian carbon credit units.

There is currently no guarantee of origin scheme for renewable gases in Australia. This was recommended in Australia's National Hydrogen Strategy.

### Uncertainty around digestate regulation limits biogas project developers from maximising its use.

Digestate is a nutrient-rich material that can substitute chemical fertilisers on agricultural land. However, there is inconsistent regulation for digestate between states and territories. Digestate can be classified as a waste, biosolid or compost depending on the state or territory and the level of treatment done on the digestate.

These different classifications of digestate make it difficult to consistently value this part of a biogas project [47].

## Support mechanisms for biofuels

### Queensland has implemented blending mandates for renewable transport fuels.

In Queensland, liable retailers are required to supply four per cent of total regular unleaded petrol sales with bioethanol and liable wholesalers are required to supply 0.5 per cent of total diesel sales with biodiesel. Biofuels must meet a set of sustainability criteria and the feedstocks used must be certified under the relevant standard, such as the Program for the Endorsement of Forest Certification [48].

In New South Wales, volume fuel retailers are required to meet six per cent of their petrol sales and five per cent of their diesel sales with bioethanol and biodiesel, respectively [49]. However, less than three per cent of the state's petrol sales are currently met with bioethanol and less than 0.1 per cent of the state's diesel sales are being met with biodiesel.

The New South Wales Government passed the Biofuels Amendment Act in 2016 to address issues attributed to the limited success of the bioethanol mandate. The legislation restricted exemptions available to liable parties (for increasing fuel prices, reduced feedstock availability or high commodity prices), required greater accessibility of biofuels and targeted greater compliance [50].

However, persisting industry challenges including difficulty forming supply contracts, high feedstock costs, low market maturity and consumer acceptance continues to limit the effectiveness of such mandates. Indeed, these challenges were also identified in the Queensland Government's review of its mandates in 2019.

Other states and territories are yet to introduce biofuel mandates.

### At the national level, support to specific biofuels produced domestically is available through the Fuel Security Services Payment.

In the 2021-22 Budget, the Australian Government secured commitments from the major refineries to continue operating until at least 2027 through the Fuel Security Services Payment and support for major refinery infrastructure upgrades to deliver ultra-low sulfur petrol. The Australian Government also committed to bring forward the industry-wide review of the petrol and diesel standard to 2021 (originally scheduled for 2022). The aim of this review is to identify a pathway towards Euro 6-equivalent fuel standards by 2027 at the latest. Bioethanol represents a potential solution for high-octane, low-aromatics fuel.

The excise for biofuels will increase annually, with final rates to be based on a percentage of rates that apply to diesel (50 per cent for biodiesel) and petrol (32.77 per cent for bioethanol).

Additionally, tax credits are available for petrol or diesel used in machinery, plant equipment and heavy vehicles. These credits do not apply to bioCNG or bioLNG and other renewable fuels such as E85 or B100 [51].

## Resource and waste policies

**Australia is moving towards a circular economy, with increasing focus on waste management in recent years.**

In 2018, the Australian Government published the National Waste Policy and in 2019, Australia's environment ministers agreed to the National Waste Policy Action Plan.

As part of this action plan, COAG had agreed to a timetable to ban waste exports, starting in July 2020. The export ban will increase the amount of waste material that stays in Australia to be recycled and reprocessed into value-added products, including energy. The action plan also sets a target to halve the amount of organic waste sent to landfill by 2030 [51].

**All states and territories except for the Northern Territory have levies in place for waste sent to landfill**, which can provide indirect regulatory support for bioenergy projects [52].

However, the differential between the landfill levies means that waste is sometimes being transported to states where disposal costs are cheaper. Harmonising these waste levies would incentivise alternative waste treatment routes.

**Australia is known globally as a leader in sustainable forestry.**

In Australia, forest managers and owners have the option of certifying their forests under the global Forest Stewardship Council (FSC) or the Responsible Wood Certification Scheme, which is recognised by the Program for the Endorsement of Forest Certification (PEFC) and uses the Australian Forestry Standard (AS4708-2007).

Currently, 27 million hectares are certified under the Responsible Wood Certification Scheme (compared to 11 million hectares in 2011) and 1.2 million hectares are certified under the FSC. Wood and wood-based products can be traced through the supply chain using the chain of custody certification provided by these schemes [53].

Also, regional forestry agreements are long-term plans for sustainable management and conservation of Australia's native forests. They cover commercial native forestry regions in Victoria, New South Wales, Western Australia and Tasmania. They seek to balance the economic, social and environmental demands on forests by setting obligations and commitments for forest management and are developed from scientific studies, as well as consultation and negotiation with stakeholders [54]



## 6. Bibliography

- [1] IEA, "How2Guide for Bioenergy Roadmap Development and Implementation," 2017.
- [2] IEA, "IEA Bioenergy Task 39 - Implementation Agendas: 2018-19 Update, Compare and Contrast Transport Biofuels Policies".
- [3] US Department of Energy, "2016 Billion-Ton Report," 2016.
- [4] IEA, "Data and statistics," [Online]. Available: [https://www.iea.org/data-and-statistics?country=WORLD&fuel=Energy%20supply&indicator=Total%20primary%20energy%20supply%20\(TPES\)%20by%20source](https://www.iea.org/data-and-statistics?country=WORLD&fuel=Energy%20supply&indicator=Total%20primary%20energy%20supply%20(TPES)%20by%20source). [Accessed 6 April 2020].
- [5] IEA, "IEA Bioenergy Task 37 - Country Report Summaries 2019," 2019.
- [6] IEA, "IEA Bioenergy Countries' Report," 2018.
- [7] Canadian Council of Forest Ministers, "A Forest Bioeconomy Framework for Canada," 2017.
- [8] UK Government, "Growing the bioeconomy - A national bioeconomy strategy to 2030," 2018.
- [9] German Government, "National Bioeconomy Strategy," 2020.
- [10] G. Gardon Grimwood and E. Ares, "Energy: The Renewables Obligation," House of Commons Library, 2016.
- [11] IEA, "The Electricity Certificate System," [Online]. Available: <https://www.iea.org/policies/3875-the-electricity-certificate-system>. [Accessed 6 May 2020].
- [12] California Energy Commission, "Renewables Portfolio Standard - RPS," [Online]. Available: <https://www.energy.ca.gov/programs-and-topics/programs/renewables-portfolio-standard>. [Accessed 6 May 2020].
- [13] IEA, "United Kingdom - 2018, Bioenergy policies and status of implementation," 2018.
- [14] IEA, "Sweden - 2018 Update, Bioenergy policies and status of implementation," 2018.
- [15] Centre for Energy, "Biogas and Biomethane in Europe - Lessons from Denmark, Germany and Italy," 2019.
- [16] Ofgem, "Non-Domestic RHI tariffs and payments," [Online]. Available: <https://www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi/contacts-guidance-and-resources/non-domestic-rhi-tariffs-and-payments>. [Accessed 9 June 2020].
- [17] ERGaR, "About ERGaR," [Online]. Available: <http://www.ergar.org/about-us/>. [Accessed 9 June 2020].
- [18] LegiScan, "California Senate Bill 1352," [Online]. Available: <https://legiscan.com/CA/text/SB1352/2019>. [Accessed 27 May 2020].
- [19] US EPA, "Overview for Renewable Fuel Standard," [Online]. Available: <https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard>. [Accessed 6 May 2020].
- [20] US Department of Agriculture, "Advanced Biofuel Payment Program," [Online]. Available: <https://www.rd.usda.gov/programs-services/advanced-biofuel-payment-program>. [Accessed 6 May 2020].
- [21] US Department of Energy, "Biodiesel Income Tax Credit," [Online]. Available: <https://afdc.energy.gov/laws/396>. [Accessed 7 May 2020].
- [22] UK Department of Transport, "RFTO Guidance Part One," 2019.

- [23] California Air Resources Board, "Low Carbon Fuel Standard," [Online]. Available: <https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard>. [Accessed 7 May 2020].
- [24] Government of Canada, "Clean Fuel Standard," [Online]. Available: <https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-standard.html>. [Accessed 6 May 2020].
- [25] IATA, "Sustainable Aviation Fuel Roadmap," 2015.
- [26] IMO, "UN body adopts climate change strategy for shipping," [Online]. Available: <http://www.imo.org/en/MediaCentre/PressBriefings/Pages/06GHGinitialstrategy.aspx>.
- [27] European Commission, "A European Green Deal," [Online]. Available: [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en). [Accessed 20 August 2020].
- [28] European Commission, "Sustainable Mobility - The European Green Deal".
- [29] Greenair, "Norway's government introduces a 0.5 per cent blending mandate for advanced aviation biofuels from 2020," [Online]. Available: <https://www.greenaironline.com/news.php?viewStory=2532>. [Accessed 18 August 2020].
- [30] Greenair, "Proposal for Sweden to follow Norway's lead and mandate use of sustainable aviation fuels from 2021," [Online]. Available: <https://www.greenaironline.com/news.php?viewStory=2574>. [Accessed 18 August 2020].
- [31] Greenair, "French government announces launch of roadmap and deployment targets for a national sustainable aviation fuel industry," [Online]. Available: <https://www.greenaironline.com/news.php?viewStory=2659>. [Accessed 18 August 2020].
- [32] UK Government, "Press release: PM commits 350 million pounds to fuel green recovery," [Online]. Available: [https://www.gov.uk/government/news/pm-commits-350-million-to-fuel-green-recovery?utm\\_source=1005137f-bbb1-4615-95d4-c2b6c1633072&utm\\_medium=email&utm\\_campaign=govuk-notifications&utm\\_content=immediate](https://www.gov.uk/government/news/pm-commits-350-million-to-fuel-green-recovery?utm_source=1005137f-bbb1-4615-95d4-c2b6c1633072&utm_medium=email&utm_campaign=govuk-notifications&utm_content=immediate). [Accessed 18 August 2020].
- [33] European Commission, "Sustainability Criteria," [Online]. Available: [https://ec.europa.eu/energy/topics/renewable-energy/biofuels/sustainability-criteria\\_en](https://ec.europa.eu/energy/topics/renewable-energy/biofuels/sustainability-criteria_en). [Accessed 12 May 2020].
- [34] Ofgem, "Biomass sustainability," [Online]. Available: <https://www.ofgem.gov.uk/environmental-programmes/ro/applicants/biomass-sustainability>. [Accessed 12 May 2020].
- [35] Government of Canada, "Forest certification in Canada," [Online]. Available: <https://www.nrcan.gc.ca/our-natural-resources/forests-forestry/sustainable-forest-management/forest-certification-canada/17474>. [Accessed 9 June 2020].
- [36] CalRecycle, "Organic Materials Management and Climate Change," [Online]. Available: <https://www.calrecycle.ca.gov/climate/organics>. [Accessed 9 June 2020].
- [37] UK Government, "Landfill Tax rates," [Online]. Available: <https://www.gov.uk/government/publications/rates-and-allowances-landfill-tax/landfill-tax-rates-from-1-april-2013>. [Accessed 9 June 2020].
- [38] IEA, "Sweden - 2018 Update, Bioenergy policies and status of implementation," 2018.
- [39] F. Neuwahl, G. Cusano, J. Gomez Benavides, S. Holbrook and S. Roudier, "Best Available Techniques (BAT) Reference Document for Waste Incineration," 2019.
- [40] Australian Government, "Technology Investment Roadmap Discussion Paper," 2020.
- [41] Queensland Government, "Queensland Biofutures, 10-Year Roadmap and Action Plan," 2016.
- [42] Jacobs, "Bioenergy Roadmap for South Australia," 2015.
- [43] Bioenergy Australia; KPMG, "Bioenergy State of the Nation Report," 2018.

- [44] Renewable Energy Expert Panel, "Northern Territory Roadmap to Renewables, Fifty percent by 2020," 2017.
- [45] Clean Energy Regulator, "Register of accredited power stations".
- [46] Clean Energy Regulator, "About the Emissions Reduction Fund," [Online]. Available: <http://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund>. [Accessed 9 June 2020].
- [47] ENEA, "Biogas opportunity for Australia," 2019.
- [48] Queensland Government, "Queensland biofuels mandates," [Online]. Available: <https://www.business.qld.gov.au/industries/manufacturing-retail/retail-wholesale/selling-fuel-qld/qld-biofuels-mandates>. [Accessed 20 April 2020].
- [49] NSW Government, "Biofuels Statutory Review, Discussion Paper," 2019.
- [50] A. Allen, "Economic Assessment of Commonwealth and State Biofuel Policies," Meat & Livestock Australia, Sydney, 2017.
- [51] Australian Government, "Waste export ban," [Online]. Available: <https://www.environment.gov.au/protection/waste-resource-recovery/waste-export-ban>. [Accessed 28 May 2020].
- [52] Parliament of Australia, "Waste and recycling industry in Australia," 26 June 2018. [Online]. Available: [https://www.aph.gov.au/Parliamentary\\_Business/Committees/Senate/Environment\\_and\\_Communications/WasteandRecycling/Report/c04](https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/WasteandRecycling/Report/c04). [Accessed 23 April 2020].
- [53] Australian Government, "Forest Certification in Australia," [Online]. Available: <https://www.agriculture.gov.au/forestry/australias-forests/certification>. [Accessed 27 May 2020].
- [54] Australian Government, "Regional Forest Agreements," [Online]. Available: <https://www.agriculture.gov.au/forestry/policies/rfa>. [Accessed May 27 2020].

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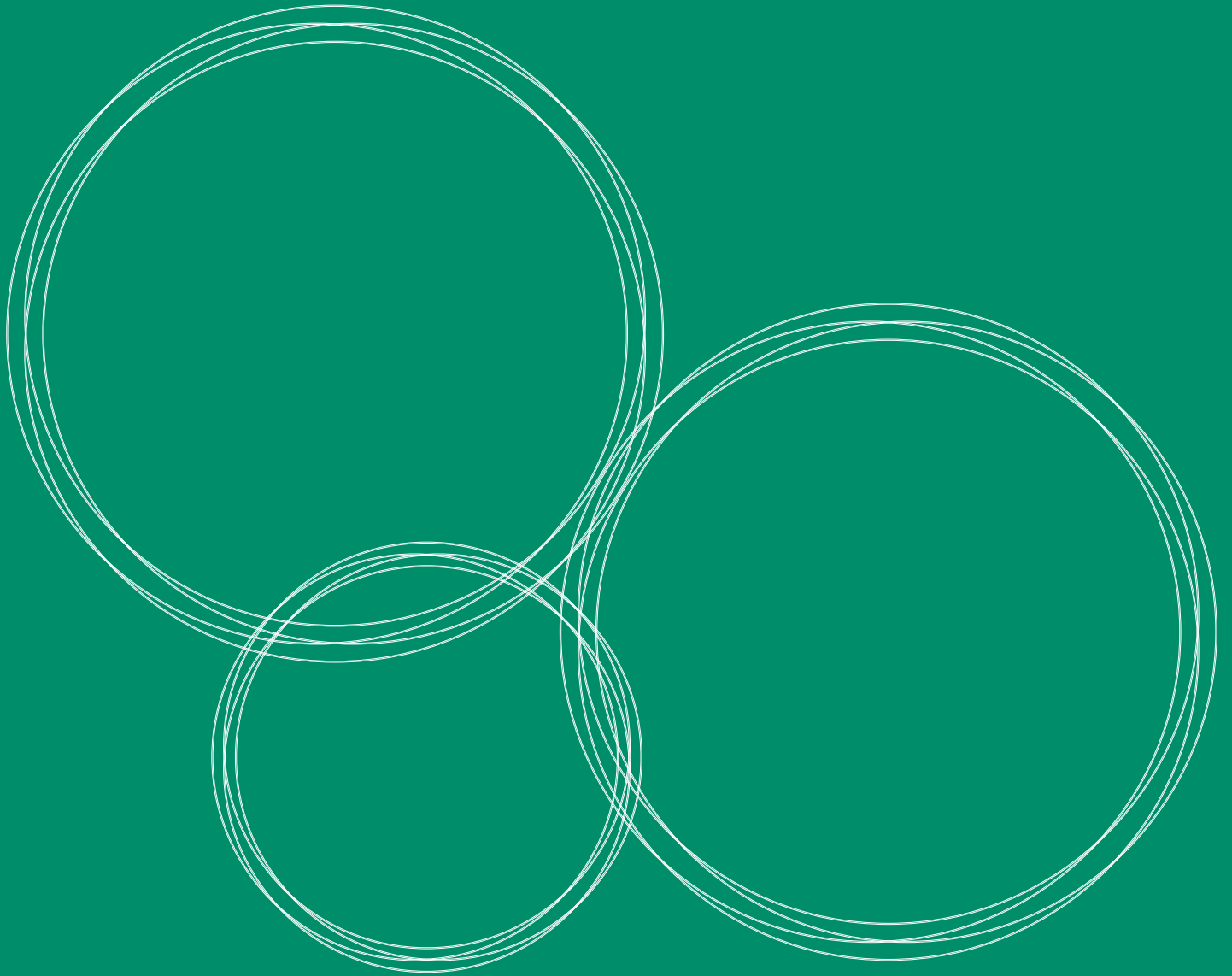
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