

# Investing in the Circular Bioeconomy Transition: Sustainable Food, Fibre and Energy<sup>1</sup>



# Introduction

**Humanity stands at a pivotal crossroads. As the world's population approaches 10 billion later this century, the challenge of sustaining economic growth while preserving planetary health has never been more urgent.**

The 21st century is defined by a convergence of crises—climate change, biodiversity loss, resource depletion, and mounting waste—that threaten the foundations of our societies and economies. Traditional models of production and consumption, built on linear “take-make-dispose” systems and fossil resource dependence, underly these pressures and are proving unsustainable in the face of them.

In response, a new vision for economic development is emerging: one that seeks to harmonise human prosperity with ecological integrity. The circular bioeconomy offers a pathway to this future, reimagining how we produce, use, and reuse the energy and materials that underpin modern life. By leveraging renewable biological resources and closing waste, materials, and energy loops, the circular bioeconomy decouples growth from environmental harm, fostering systems that are sustainable by design. Oversimplified, circularity comprises the efficient use and reuse of resources, and bioeconomy includes the production of renewable biological resources and their conversion into value added products.<sup>2,3</sup>

Governments have increasingly recognised the circular bioeconomy as a pathway to sustainable growth. More than 60 countries have adopted national bioeconomy strategies or roadmaps, often aiming to boost food and energy security, foster innovation, and meet climate targets. Alongside bioeconomy plans, more than 70 countries have official circular economy roadmaps.

Land, forests, and agriculture are key enablers of the circular bioeconomy. The agriculture and forestry sectors will together need to support transitions in land management, renewable energy, materials, and the built environment.

Recent outlooks suggest that total consumption of agricultural and fisheries commodities will increase 13% by 2034,<sup>4</sup> and that agriculture, wood fibre, and bioenergy demand will rise 35–56% by 2050.<sup>5,6</sup> From now to 2050, consumption will increase in food and animal feed production from approximately 20 billion tonnes per annum (tpa) to 27–31 billion tpa, and demand for forestry wood supply will rise from 2 billion to 3–3.4 billion tpa, and wood-based energy – including subsistence energy – from 1.9 billion to potentially 2.3 billion tpa.<sup>6</sup> The investment needed to increase supply to meet anticipated demand in 2050 is expected to be approximately \$70 billion per annum in the forestry sector and likely \$300–\$400 billion per annum in the agriculture sector.<sup>6</sup> These projections may increase further if there is systematic growth in substituting biobased products for fossil fuels and high embodied energy materials.

This article reflects on the challenges and opportunities for investors in meeting this growing demand for sustainable food, fibre, and energy. It explores how production can be increased; how improved investment allocation can increase efficiency, allowing conservation and production to co-exist; and how public policies are being designed to accelerate the transition.

Continued economic growth in a world with  
**10** billion people later this century will require investment in a series of sustainability driven transitions



## Recent outlooks suggest:

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## From now to 2050 up to:

**55%**

increase in **food and animal feed** production

**70%**

increase in demand for **forestry wood supply**

**21%**

increase in demand for **wood-based energy**

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per annum in the forestry sector

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These projections may increase further if there is systematic growth in substituting biobased products for fossil fuels and high embodied energy materials.

\* Projections are in USD

# How important is the bioeconomy today and how important could it become in the next 25 years?

The bioeconomy encompasses both conventional agriculture and forestry production, as well as a spectrum of biobased materials like cellulosic fabrics, new food production technologies like precision fermentation, pharmaceuticals, engineered wood products, new energy technologies such as syngas and jet fuel, bioplastics, across a broad range of materials, processes, and production flows (Figure 1).

McKinsey Global Institute suggests that 60% of all materials used in human society could be biobased in future decades.<sup>7</sup> This bioeconomy transition is analogous to the energy transition in that it includes both a demand pull from the need to decarbonise the economy and a technology push as new biobased innovations become competitive with less sustainable alternatives. The European Environment Agency estimates that substituting all fossil-based plastics in the European Union with bio-based alternatives would result in annual greenhouse gas emissions reductions of 30%, in addition to many other health and environmental benefits.<sup>8</sup>

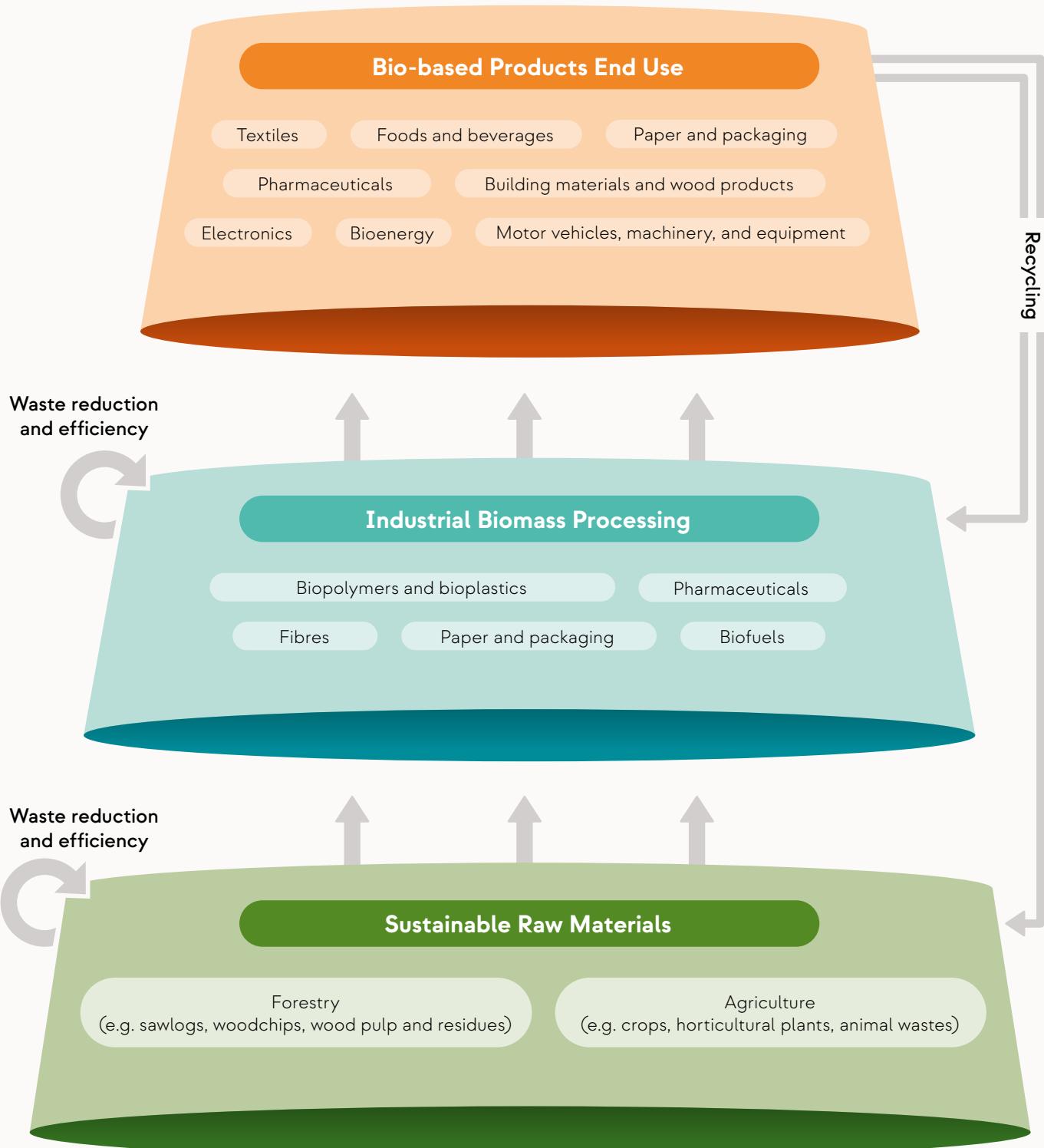
Given the uncertainties inherent in projecting how quickly bioeconomy drivers and technologies will evolve, current outlooks are relatively conservative. In the forestry sector, for example, the United Nations Food and Agriculture Organization (FAO) suggests that mass timber construction and cellulosic fibres will be the two major drivers of additional wood demand over the next 25 years but will still only increase demand by 5-10% versus a business as usual growth scenario (e.g. increasing industrial roundwood demand from 2 billion cubic metres today, to 3.3 billion in 2050 with the additional substitution demand, versus 3.1 billion in 2050 in the base case).<sup>6</sup> This is unlikely to substantially impact the demand for existing non-renewable and high embodied energy materials like concrete, steel, plastics, and polyester fabrics. Bioenergy, both subsistence and industrial, and biofuel demand growth is also uncertain, with the FAO reviewing multiple studies that suggest limited growth in biomass-based energy demand.<sup>6</sup> Studies by the Intergovernmental Panel on Climate Change and International Energy Agency, however, suggest the potential for much higher bioenergy demand associated with Bioenergy with Carbon Capture and Storage (BECCS) technologies in any scenario that realistically has the global economy achieving net zero emissions by 2050.<sup>10, 11</sup>

As noted, demand for agricultural products is likely to expand by 35-56% over the next 25 years, but with higher demand growth in middle- and lower-income countries.<sup>5</sup> Per capita caloric intake of animal protein is expected<sup>4</sup> to increase with rising incomes in high- and middle-income economies. This increase in food demand is expected to be met by increases in agriculture production driven, in part, by biotechnology, greater global trade in food, and better supply chains reducing waste.<sup>12, 13</sup> Agriculture may be disrupted through the bioeconomy transition as technologies like precision fermentation reduce demand for naturally produced food ingredients such as proteins, oils, dairy, and egg products.<sup>14, 15</sup>

The bioeconomy transition will also be a function of geopolitical influences and public policy choices. The war in Ukraine has accelerated European efforts to produce syngas from agricultural and household waste streams. Denmark's Biomethane decree, for example, will replace 100% of natural gas imports with biomethane by 2035.<sup>16</sup> In 2023, many countries joined in an effort to expand the use of wood in the built environment and reduce the growth in demand for concrete and steel at the United Nations Framework Convention on Climate Change COP28 in Dubai.<sup>17</sup> Any systemic carbon price signal would also shift competitive dynamics between petroleum-based and high embodied energy materials on the one hand and biobased materials and energy systems on the other. While the bioeconomy transition is seen as a key element in addressing climate change, it has also drawn concern about impacts on nature if production systems continue to expand by replacing natural ecosystems like rainforests or savannahs.<sup>18</sup>

How important is the bioeconomy today and how important could it become in the next 25 years?

**Figure 1:** Variety of biomass materials and production flows<sup>9</sup>



# Investing in sustainable production systems for agriculture and forestry

Improved and more efficient production systems for agriculture and forestry will be central to a circular bioeconomy transition.

Not only will these production systems need to be more efficient, but they will also need to be more resilient to climate change and alterations to natural ecosystem services like water regulation or pollination. Land management systems will also need to substantially reduce greenhouse gas emissions and shift from negatively impacting to positively contributing to nature conservation and restoration. Biotechnologies, and other crop improvement technologies are steadily enhancing efficiency and productivity as well as resistance to pests and diseases of agriculture and forestry crops.<sup>19</sup> However, this has also led to a narrowing of agriculture and forestry diversity. FAO estimates, for example, that 75% of agriculture is based on 12 crop species and five animal species.<sup>20</sup> Forestry is increasingly reliant on intensive tree plantations for incremental production, and this is becoming more concentrated on species like Eucalyptus, pine, and spruce. It may be a continuous race between genetic manipulation and the need for adaption or resilience to a changing global environment. As discussed below, how production systems evolve to meet rising demand while also meeting key sustainability objectives is a central question in a bioeconomy transition.

Other developments will also improve productivity and efficiency. Enhanced monitoring systems and increasingly sophisticated geospatial and temporal analytics will improve land use allocation and land management decisions at a much more granular level. Expanding interest from investors in forestry and agriculture is allowing for asset recapitalisation, driving more innovation and faster adoption of new technologies.<sup>21</sup> Improved infrastructure, refrigeration, supply chain effectiveness, and technologies in crop protection – including wildfire resilience and response capabilities in forestry – can increase the quantity of

food and fibre reaching the end consumer without requiring more land.

This relentless progress of efficiency can lead to lower commodity prices in agriculture, and potentially further rationalisation of the producer base.<sup>4</sup> The long history of farming, and to a lesser degree forestry, as being based on small-scale enterprises, often family enterprises, is under pressure from highly efficient and well capitalised corporate farming operations. The trend, at least in many developed countries, seems to be that the most successful farmers buy out less successful farmers and slowly evolve to agribusiness scale and then these agribusinesses are sold to larger agribusiness consolidations and institutional investors.

Forestry and agriculture must also move to rapidly reduce net greenhouse gas emissions, move away from conversion of natural systems to production systems, and ultimately become both climate and nature positive by embedding conservation and restoration at a landscape scale. This is driving the new concept of a natural capital asset class which can integrate forestry and agriculture production, climate solutions, and nature conservation and restoration. Driven by emerging sources of option value – carbon, water and biodiversity markets and payment schemes, land leasing for renewable energy, and more dynamic allocation of land use at a landscape scale – this new asset class could potentially both increase resilience and improve risk adjusted returns. It is interesting to note that the International Sustainable Forestry Coalition, an international organisation representing the world's major forestry sector firms launched in 2023, was formed with the mission to accelerate the transition to a climate and nature positive circular bioeconomy.

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# Innovation in the production and distribution of agricultural and forestry materials

A key component to accelerating the bioeconomy transition is that supply chain systems and processing infrastructure make full use of harvested materials and add value to the timber and agricultural produce.

In the case of forestry, FAO estimates that about 50% of a tree is normally utilised for the primary product like lumber, but only 30% of the remaining residual material ends up in secondary products like wood fibre, particleboard, or wood pellets.<sup>6</sup> If 70% of the residual material was utilised, it would be like adding 500 million cubic metres of new supply to the forestry sector. Agriculture is similar, in that an estimated 40% of food produced is spoiled or wasted through inefficient harvesting, storage, and distribution.<sup>22</sup>

Resource utilisation can be transformed by investment. Putting in place the infrastructure like ports, refrigeration, processing precincts, and processing ecosystems can move towards 100% utilisation and the ability to link primary and secondary processing together and get products successfully to market.

In forestry, for example, there is increasingly an emphasis on co-locating or linking primary breakdown, which might be a sawmill, with a value-added facility like a cross laminated and glue laminated timber plant as well as a waste stream processing like biochar, wood plastic composite materials, or bioenergy. Developments are also occurring in crop monitoring to optimise harvest timing, using robotics in harvesting and processing, and electrifying transport and processing so the industry can be largely powered by renewable energy.

Recycling and re-use expands the supply of materials further, especially in the forestry sector. If we took the earlier example of increasing waste utilisation, alongside increasing recycling rates and re-use, and expanding highly productive plantations in areas of marginal agriculture, there could be substantial

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## Agriculture:

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**40%** of food produced is spoiled or wasted through inefficient harvesting, storage, and distribution.

increases in bioeconomy feedstock. For example, increasing utilisation of the 2 billion cubic metres of industrial roundwood stock adds 500 million cubic metres of additional products. Recycling 50% of that total will create a further 1 billion cubic metres of feedstock. Adding another 30 million hectares of plantations on degraded land largely in the global south, as suggested by the FAO, would also add another 500 million cubic metres of feedstock. Collectively this would double the forestry feedstock.

Agriculture could similarly increase the product delivered to the consumer by optimising harvest, creating processing ecosystems across direct consumer goods like apples and secondary products like apple juice and apple sauce, and utilisation of any waste into biogas. Supply chains can also be significantly improved. Meat can be sold and transported as boxed, chilled beef if renewable energy-based refrigeration infrastructure was available in the markets where the meat is sold. Curing, drying, and packaging systems can extend shelf life and further reduce wastage. The earlier example of technology-driven innovations in food ingredients, for example, also increases capacity and streamlines the production of processed foods like ice cream, industrial cheeses, infant formula, and protein bars.<sup>14</sup> Much like in forestry, reducing wastage and spoilage effectively, and adding new industrial processes, increases the net production from the existing farmed or ranched land base.

#### Example

## 2 billion m<sup>3</sup>

[Existing industrial feedstock]

### + 500 million m<sup>3</sup>

[Increasing utilisation of existing feedstock]

### + 1 billion m<sup>3</sup>

[Recycling 50% of existing feedstock]

### + 500 million m<sup>3</sup>

[From newly planted forested land]

## 4 billion m<sup>3</sup>

[Doubling the existing feedstock]



# Public policy frameworks to accelerate investment in a climate and nature positive circular bioeconomy transition

## Governments are recognising the importance of the circular bioeconomy transition.<sup>13,23</sup>

Bioeconomy strategies are being promulgated around the world in Europe, India, China, Brazil, Japan, and beyond.<sup>24</sup> The G20, hosted by Brazil in 2024, had the bioeconomy transition as a key theme, which has been continued by the South African presidency in 2025.<sup>25</sup> Governments can intervene to accelerate the adoption of bioeconomy systems in multiple ways, from supporting basic and applied research to subsidising or removing regulatory barriers to transitions like mass timber construction, adoption of cellulosic fabrics, utilisation of synthetic food ingredients, and biobased energy systems and fuels.<sup>13</sup> Governments can also drive change through price signals like carbon markets or nature conservation markets, repricing waste to encourage recycling and reuse, and giving tax breaks for investments that increase efficiency and extend resource utilisation.<sup>23</sup> Governments can also reconsider policy questions like controls on genetic engineering to increase productivity and reduce pesticide use.

Often, the barriers to bioeconomy transitions are more than just economic. In many countries, the expansion of mass timber construction has been hampered by slow modernisation of building codes, fire codes, architectural codes, and contractor education. Existing industries may lobby against changes. For example, there is likely to be competition between mass timber and steel construction, bioplastics and petrochemical plastics, synthetic dairy proteins and milk, cellulosic fabrics and polyester, and so on. The government of Florida in the United States, for example, is seeking to make cultivated meats illegal.<sup>26</sup> The oil and gas industry, seeing peak oil consumption on the horizon owing to electric vehicle penetration, has resisted a global plastics treaty to protect the petrochemical industry.<sup>27</sup> This resistance to change, however, generally breaks down when consumers begin to prefer new products and cost competitiveness undercuts the price advantage of existing industry.<sup>15</sup>



# Investment opportunities by geographic region and segment

The circular bioeconomy transition theme is accessible to investors across a range of asset classes, risk profiles, and liquidity profiles.<sup>25</sup>

Ownership of rural land, with leasing of agricultural and forestry production, is a relatively low risk entry point. Alternatively, investing in forestry and agricultural production, which may or may not include owning or leasing land, is a conventional real asset class. Investments in processing activities or firms can be integrated with the real assets as private equity, or as a thematic in listed equity selection. There are also specialised venture capital funds that provide access to private firms in the start-up or growth phase, driving the technologies and enabling services that support the circular bioeconomy transition.

There are geographic and currency considerations. Many investors may prefer investments in their own currency or in developed countries, and the circular bioeconomy theme is available across multiple regions. For example, the U.S. has hundreds of billions of dollars of value in forestry and agriculture assets. Australia and New Zealand are also seen as low-risk jurisdictions with substantial investible assets. Europe tends to be more tightly held but is also one of the major regions for agricultural and forestry production. In Latin America, Brazil, Uruguay, and Chile have large pools of assets, although in the case of Brazil<sup>28</sup> there are some restrictions on foreign investment in land ownership. Emerging markets like Southeast Asia and Africa have substantial market demand but a higher risk profile and more transaction costs for investors. China and East Asia have substantial industries across both forestry and agriculture but have attracted limited foreign investment to date.

Investors can select traditional assets like forestry and agriculture land, or they can invest across the landscape in natural capital or landscape funds that integrate forestry, agriculture, climate solutions, and nature conservation and restoration. Likewise, there is a range of risk return profiles across production – from very low risk timber plantations or cropping and grazing assets to higher risk horticulture, greenhouse production systems and processing – and from conventional processing like sawmills and abattoirs to high-tech or emerging industries like engineered wood products, precision fermentation, or dissolving pulp mills for cellulosic fabrics.

Increasingly, investors are setting systemic objectives for portfolio decarbonisation or in supporting a natural positive outcome. These investors may select within asset classes for activities like regenerative or organic agriculture, forests with high carbon removal capacity, areas with degraded land that might be used for carbon removals or nature restoration, or new industries that substitute for fossil fuels or reduce impacts on nature. Investors and investment managers are also increasingly seeking standardised metrics that can allow portfolio allocations to be simulated and monitored for climate and biodiversity outcomes as well as risk and return characteristics.<sup>1, 9, 29</sup>

## Investor examples

### The U.S

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### Australia and New Zealand

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### Europe

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### Latin America

Brazil, Uruguay, and Chile have large pools of assets, although in Brazil, there are some restrictions on foreign investment in land ownership.

## Emerging markets

### Southeast Asia and Africa

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### China and East Asia

have substantial industries across both forestry and agriculture but have attracted limited foreign investment to date.

# Conclusion

**The bioeconomy transition theme incorporates an expansive set of investment opportunities that cut across large swathes of the global economy from food to fibre to energy to materials.**

The slowing but still expanding growth of global population at least until late this century, combined with the continuous growth of the global economy, will force systemic changes to address sustainability challenges. The circular bioeconomy provides new opportunities and pathways for sustainable continuous economic growth. Sustainable food and materials investments appear to be an area where increased allocations will deliver exposure to high growth and increased valuations. In New Forests' experience, there are already areas, like forestry assets in Australia and New Zealand, where asset prices have increased four to fivefold over the past decade because of emerging option values associated with these assets.<sup>30</sup>

In any transition, there are winners and losers. Some agriculture segments may be disrupted by technology, and some regions may have productivity curtailed by

climate change, water shortages, or land degradation. Systems that impact nature through dependencies on deforestation or excessive synthetic chemical use may also be under public policy pressure to reduce impacts, affecting profitability. Investing in transitions can be uncertain because there is no track record to judge expected performance. There are equal risks, however, in investing in traditional asset management strategies and industries that are increasingly exposed to disruption.

Society sits at a crossroads, requiring us to embrace a new vision for economic development: one that seeks to harmonise human prosperity with ecological integrity. The circular bioeconomy offers a pathway to this future and an opportunity for investors.

## The circular bioeconomy provides:

### New opportunities and pathways for sustainable continuous economic growth.

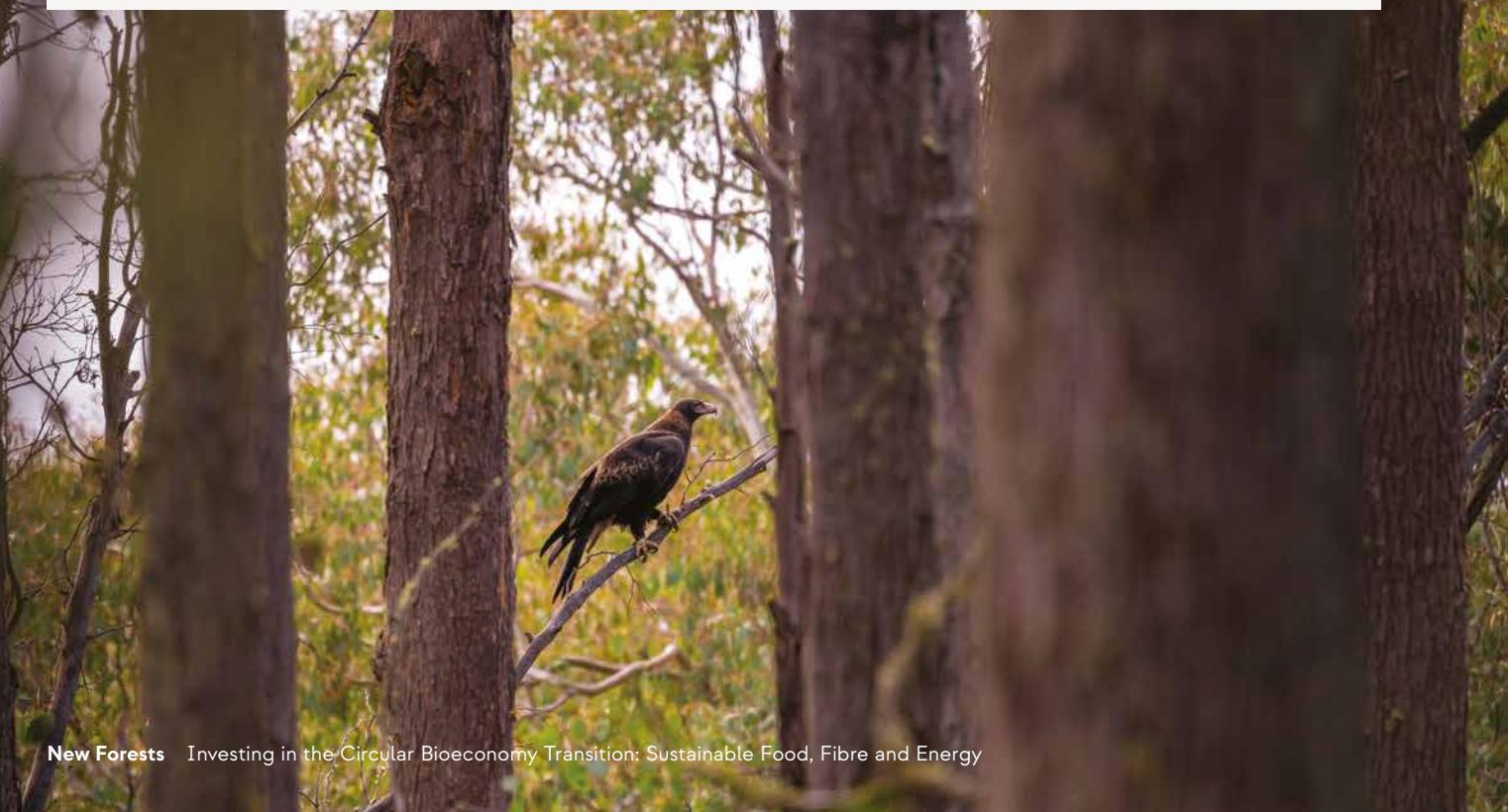
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- 1 This article is for informational purposes only and does not constitute legal, financial, or investment advice. Readers should seek independent professional advice before making any investment or financial decisions. Neither New Forests nor the author accepts any liability for actions taken based on the content of this article.
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