

The background of the entire page is a close-up photograph of corn cobs in a field. The corn cobs are yellow and partially covered by dry, brown husks. The lighting is warm, suggesting a sunset or sunrise, with soft shadows and highlights on the corn and leaves. The focus is sharp on the corn cobs in the foreground, with a slightly blurred background of more corn plants.

Bird & Bird

# Turning Waste into Watts

Legal Insights for Bioenergy Investment in Singapore

2025

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# Introduction

Bioenergy represents a promising pathway towards sustainable energy transition. It encompasses the production of energy from organic materials, known as biomass, such as municipal solid waste, agricultural residues, forestry waste, algae, and energy crops. As a versatile renewable energy source, biomass can be refined into liquid fuels, known as biofuels, that can serve as alternatives to fossil-based fuels, such as gasoline, jet, and diesel fuel. As the world grapples with climate change, energy security challenges, and urban waste management, bioenergy offers a renewable alternative that can significantly reduce greenhouse gas emissions whilst providing a reliable baseload power generation.

Bioenergy supports circular economy principles by transforming organic waste into valuable energy resources. This waste-to-energy model particularly benefits land-scarce, pollution-conscious countries seeking to optimise their waste management systems. Singapore has several waste-to-energy incineration plants, where heat from combustion generates superheated steam and the steam drives turbogenerators to produce electricity.

For investors considering bioenergy opportunities in Singapore, understanding the legal landscape is crucial for developing successful projects and managing risk. The bioenergy sector presents a complex intersection of environmental law, corporate finance, regulatory compliance, and international trade. This article provides investors with essential legal insights to navigate regulatory frameworks, manage stakeholder interests, optimise risk allocation, and structure successful investments.

The key legal considerations for bioenergy investors and project developers include: (i) compliance with multiple regulatory frameworks spanning energy, environmental, and corporate law; (ii) sophisticated project structuring to optimise risk allocation and tax efficiency; (iii) comprehensive due diligence on feedstock supply chains and sustainability credentials; and (iv) proactive management of evolving ESG requirements and cross-border trade regulations.



# Business of Bioenergy

## Investment Trends and Market Growth

The global bioenergy market has experienced substantial growth, with the International Energy Agency (IEA) reporting that use of modern bioenergy has risen on average by 4% annually between 2010-2023, with particularly strong growth in ASEAN due to abundant biomass resources and increasing energy demands. The IEA forecasts sustained global growth in bioenergy demand, with investment projected to rise by 13% in 2025 to USD 16 billion. Demand for wood pellets in East Asia, particularly Japan and South Korea, continues to grow as those countries phase out coal. Indonesia's forestry and agroindustry residues could meet part of that wood pellet demand, provided supply chain and certification issues are addressed. Countries such as Thailand, Malaysia, and Indonesia have emerged as major bioenergy producers, whilst Singapore is gaining traction as a financing and technology hub for bioenergy innovation and investment.

A few notable deals in recent months illustrate the promising growth of biomethane. In May 2025, Sojitz Corporation invested in a holding structure of the special purpose company, IOC GPS Renewables Pvt. Ltd. (IGRPL) established jointly by GPS Renewables Private Limited (GPSR) and Indian Oil Corporation Ltd. (IOCL), the largest state-owned oil company in India, which designs, constructs, operates, and provides maintenance for biomethane plants in India. Through this investment, Sojitz will enter the biomethane production and sales business in India.

Technological advances, supportive policies, and corporate sustainability commitments have fuelled the bioenergy investment growth. The sector attracts interest from industries seeking to decarbonise, such as the maritime, aviation, and power sectors.

A good example is the launch of Malaysia's first Centralised Biomethane Injection Station in May 2025. Gas Malaysia Green Ventures Sdn Bhd (GMGV), a wholly owned subsidiary of Gas Malaysia Berhad (Gas Malaysia) spearheads the Centralised Biomethane Injection Station, which receive biomethane from surrounding palm oil mills and offers a centralised solution for injecting biomethane into the natural gas grid. The station is scheduled to be fully operational by the second half of 2025.

## Key Players and Technologies

The bioenergy ecosystem encompasses diverse technologies and market participants. Global investment in bioenergy has seen significant capital flowing into biomass power generation, biogas facilities, and advanced biofuel production.

- Biomass power generation utilises wood pellets, agricultural residues, and energy crops to produce heat and electricity.
- Biogas production from organic waste represents another significant growth area, particularly in urban environments where waste management challenges create compelling business cases.
- Advanced biofuels, including sustainable aviation fuel (SAF) and renewable diesel, have attracted substantial investment from airlines and logistics companies seeking to decarbonise their operations.

There is also wider ecosystem of collaborative ventures such as the FEHR-neustark- ABH alliance where the CO<sub>2</sub> captured at ABH's biogas plant during biomethane production is transported to the FEHR demolition concrete production facility. There, it is injected into the demolition material using neustark's mineralization technology, where it is mineralized within hours, creating a sustainable carbon sink.



## Corporate Structuring and Financing

Bioenergy projects may require complex corporate structures to accommodate multiple stakeholders, manage regulatory requirements, optimise tax efficiency, and plan for potential exit strategies. Possible structures include special purpose vehicles (SPVs) for individual projects to ring-fence risks and facilitate project financing, holding companies for portfolio management, and joint ventures between technology providers, feedstock suppliers, and off-takers.

Bioenergy joint ventures pool resources, expertise, and funding to DBO bioenergy projects, such as waste-to-energy (WTE) or sustainable aviation fuel (SAF) facilities. A good example is Rexus Bioenergy, a Singapore-based renewable power generation company formed through a joint venture (JV) between Sobono Bioenergy of Sobono Group and V8 Environmental, to invest, develop and operate the REXus WWtE Plant. This joint venture is founded on bioresource valorization that amplifies the combined attributes of both JV partners. Typical joint venture structures in this space focus on risk allocation, decision-making rights, profit sharing, and exit mechanisms.

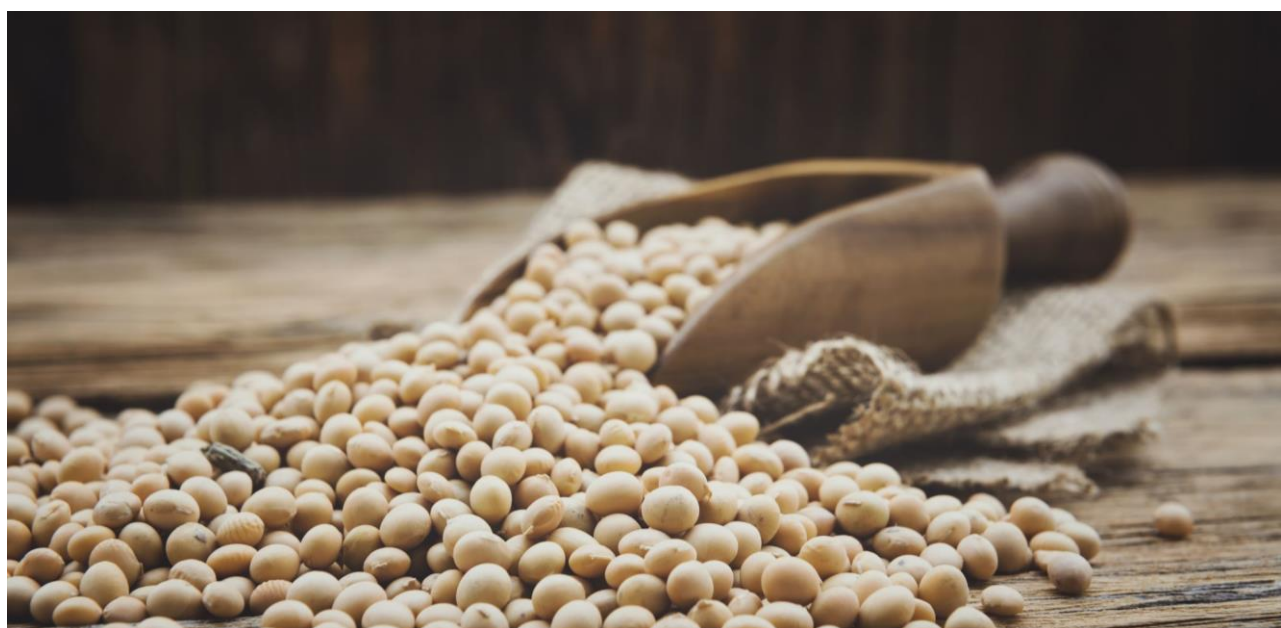
Financing structures can be sophisticated, combining debt and equity from multiple sources. Project finance remains the dominant model for large-scale facilities. The emergence of innovative financing structures, including green bonds, blended finance mechanisms, and sustainability-linked loans, has created new opportunities for bioenergy projects. For instance, DBS Bank issued a green loan to Rexus Bioenergy to finance the construction of a 13-megawatt biomass power plant, which is scheduled for completion in 2026.

## Due Diligence Considerations

Investors should conduct comprehensive legal due diligence covering multiple areas of risk. This includes assessing intellectual property rights and licensing agreements. Feedstock supply agreements require careful review of sustainability characteristics, force majeure provisions, and price adjustment mechanisms. Off-take contracts might also be evaluated for creditworthiness of counterparties, termination rights, and compliance with sustainability certification and renewable energy standards. Legal due diligence should plainly verify that all necessary permits and licences are in place.

## Investor Protection and Contractual Safeguards

Investors should negotiate for robust investor protection mechanisms in their agreements with bioenergy project developers. Key contractual provisions may include comprehensive insurance requirements covering technology and environmental risks, and detailed reporting obligations on operational and financial performance. Investors should negotiate appropriate representations and warranties from project developers, including compliance with all applicable laws and the accuracy of technical and financial projections. Indemnification provisions should address potential environmental liabilities and regulatory non-compliance.



# Legal Landscape

## Regulatory and Policy Frameworks

Singapore's regulatory approach to bioenergy reflects its broader commitment to becoming a regional clean energy hub. The Electricity Act 2001 and Gas Act 2001 provide the foundational framework for energy projects, whilst the Environmental Protection and Management Act 1999 governs environmental compliance requirements. The Energy Market Authority (EMA) serves as the primary energy regulator, overseeing licensing, grid connection, and market participation for bioenergy facilities.

The Singapore Green Plan 2030 has established ambitious targets for renewable energy deployment, creating a supportive policy environment for bioenergy investments. The bioenergy sector benefits from government support through agencies such as the EMA and National Environment Agency (NEA).

## Licensing and Environmental Compliance

Bioenergy projects may require multiple licences, including electricity generation permits and environmental permits for emissions, water discharge, and waste management. Complex licensing necessitates early regulatory engagement and comprehensive environmental impact assessments.

Environmental compliance represents a critical consideration for bioenergy project developers and investors, particularly given the sector's sustainability credentials. Bioenergy from palm oil causes significant deforestation of tropical forests and peatlands, leading to greenhouse gas emissions and loss of biodiversity. Indonesia is a stark example of such issues. Rapeseed (oilseed rape) bioenergy faces issues with chemical use (herbicides, pesticides, fertilizers) that can pollute soil and water, impacting non-target plants and aquatic life. Tree-based bioenergy (burning wood pellets) has substantial negative impacts, harming biodiversity and ecosystems, and being generally more expensive and environmentally damaging than other renewable options like solar and wind energy. To safeguard the environment instead of exacerbating existing issues, bioenergy projects should demonstrate compliance with air and water quality standards, noise regulations, and biodiversity protection requirements. The use of imported biomass feedstock also merits additional considerations around sustainability certification and supply chain due diligence. Projects in Europe and Asia, which are increasingly focused on utilizing waste from agriculture, livestock, and food processing to produce biomethane, would likely benefit from overarching environmental guidelines for project development, rather than piecemeal legislation which adds to complexity and costs of undertaking such projects.

Land use planning presents unique challenges in Singapore's constrained environment. Bioenergy facilities must comply with zoning regulations and planning permissions. The government has taken the lead to promote land use efficiency through innovative approaches, including co-location with waste and water treatment facilities. For instance, the NEA is developing an Integrated Waste Management Facility (IWMF), which will be co-located with the Public Utilities Board's (PUB) Tuas Water Reclamation Plant (TWRP). Once construction for the IWMF is progressively completed from 2027 onwards, the co-located facilities will jointly enable land use optimisation and resource recovery from a water-energy-waste nexus.

## International Issues and Cross-Border Trade

The international dimension of bioenergy trade introduces additional legal complexities, particularly around sustainability standards and carbon accounting. The European Union's Renewable Energy Directive (REDII) establishes sustainability criteria for the production of agricultural raw material for biofuels, bioliquids and biomass. As various jurisdictions develop their own localised standards, international traders will have to navigate a complex web of compliance requirements.

ASEAN's commitment to regional energy integration through initiatives like the ASEAN Power Grid and Trans-ASEAN Gas Pipeline creates opportunities for cross-border bioenergy trade. However, differing national regulations, technical standards, and pricing mechanisms present ongoing challenges that require careful legal structuring and risk management.

Trade agreements and bilateral investment treaties could provide important protections for bioenergy investors, particularly in emerging markets where regulatory frameworks may be less developed. Understanding the interaction between international trade law and domestic energy regulations is essential for structuring cross-border investments and managing political risks.

# Risks & Opportunities

## Risks

Bioenergy investments face several categories of legal risk that require careful assessment and mitigation. Regulatory risk represents a significant challenge, as changes in government policy, environmental standards, or incentive schemes can materially impact project economics.

Project development risks include permit delays, site acquisition challenges, and potential opposition from local communities or environmental groups. These risks are particularly acute for larger facilities that may face more stringent environmental review and public consultation.

ESG compliance is critical as investors and lenders increasingly incorporate sustainability criteria into their investment decisions. Projects are often assessed for genuine environmental benefits, safeguards against biodiversity degradation, and compliance with sustainability certification requirements. Failure to meet ESG standards can result in reputational damage, loss of financing, and regulatory sanctions.

Supply chain risks present ongoing challenges for bioenergy operators, particularly those relying on imported feedstock. Sustainability certification requirements, quality standards, and logistics constraints can all impact project viability. The COVID-19 pandemic highlighted the vulnerability of global supply chains and the importance of diversifying sourcing strategies and developing resilient procurement frameworks.

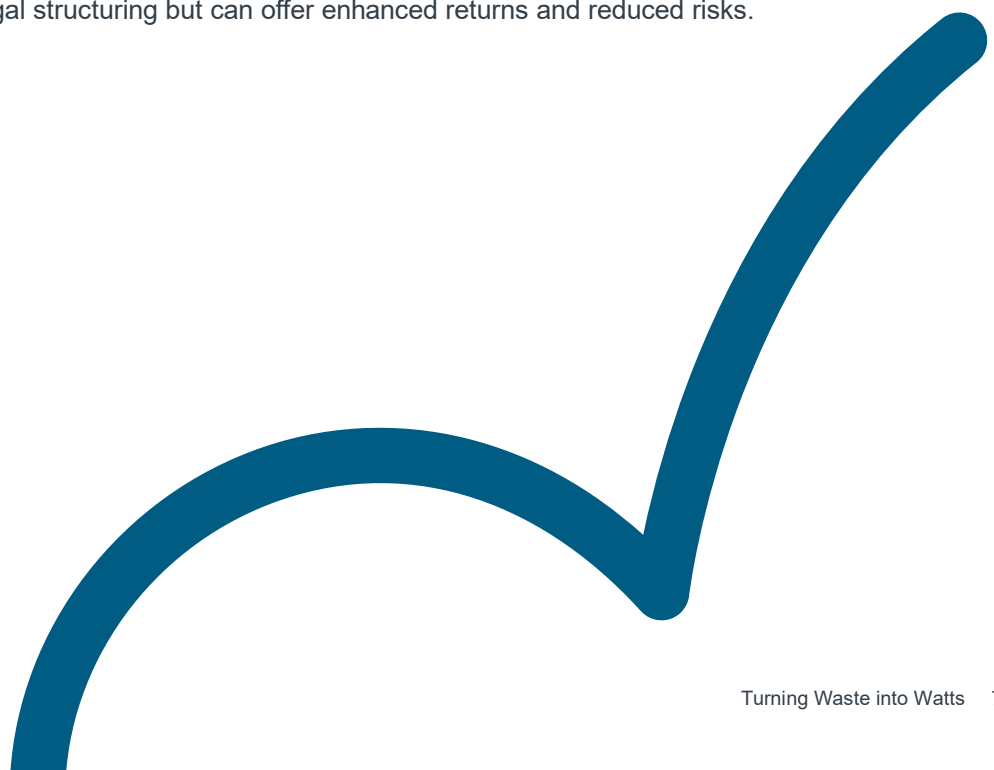
## Opportunities

Despite these risks, the bioenergy sector presents significant opportunities for investors. Carbon credit markets create new revenue streams for projects demonstrating emissions reductions, while Renewable Energy Certificates (RECs) provide additional monetisation opportunities.

Green financing has emerged as a major growth driver, with banks increasingly providing preferential terms for qualifying bioenergy projects. Green bond issuance for bioenergy has grown substantially, providing access to long-term, competitively priced capital.

Public-private partnerships offer attractive structures for projects providing multiple public benefits such as waste management, rural development, and energy security. Governments are increasingly recognising the value of private sector expertise and capital in delivering bioenergy infrastructure, leading to innovative partnership models.

The integration of bioenergy with other renewable technologies, such as solar and wind power, creates hybrid project opportunities providing more reliable and cost-effective energy solutions. These integrated approaches require sophisticated legal structuring but can offer enhanced returns and reduced risks.





# Future Outlook

Looking ahead, the bioenergy sector's development will likely be shaped by policy developments, regulatory clarity, green finance opportunities, and cost-effective and environmentally friendly innovations. Success requires understanding the interplay and confluence of technological availability, climate science, sustainability metrics, and stakeholder engagement.

As the bioenergy sector matures, we anticipate the development of standardised approaches to contract terms, regulatory compliance, and risk management across jurisdictions. These approaches could be facilitated by national regulations and international standards for the bioenergy supply chain, which could be crucial for market growth, particularly in emerging markets. Close consultation between regulatory authorities, industry associations, and international organisations are important for the development of bioenergy regulations and standards that are practical, enforceable, and supportive of genuine environmental benefits.

Regulatory sandboxes and pilot programmes are helpful tools for testing innovative bioenergy technologies and business models. Singapore's Green Economy Regulatory Initiative (GERI) aims to support businesses in seizing green growth opportunities and innovating green products and services through regulatory sandboxes. The regulatory sandbox approach could enable energy technology companies to test new solutions in a controlled environment and under relaxed regulations with managed risks, thus providing valuable learning points for regulators, funders and industry participants.





# Conclusion

Bioenergy represents a critical component of the global energy transition, offering significant participation opportunities for investors, developers, and regulators. The sector's growth potential would need to be supported by favourable policies, technological advances, and increasing corporate and consumer demand for clean energy solutions.

Realising the potential of bioenergy requires clear and concise legal frameworks that address the complex challenges associated with the sector's development, particularly around environmental protection. The future growth of the bioenergy sector will depend on continued collaboration between government and industry to develop these legal frameworks.

For stakeholders in the bioenergy sector, success requires not only technical and commercial expertise but also sophisticated legal expertise to navigate the regulatory landscape and to structure transactions that deliver both financial returns and environmental benefits. Investors who undertake comprehensive due diligence and proactively address legal considerations are best positioned to capture the significant opportunities in the region's growing bioenergy sector whilst mitigating regulatory, environmental, and commercial risks.

*This article is produced by our Singapore office, Bird & Bird ATMD LLP. It does not constitute legal advice and is intended to provide general information only. Information in this article is accurate as of 15 October 2025.*

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# Thank you

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