

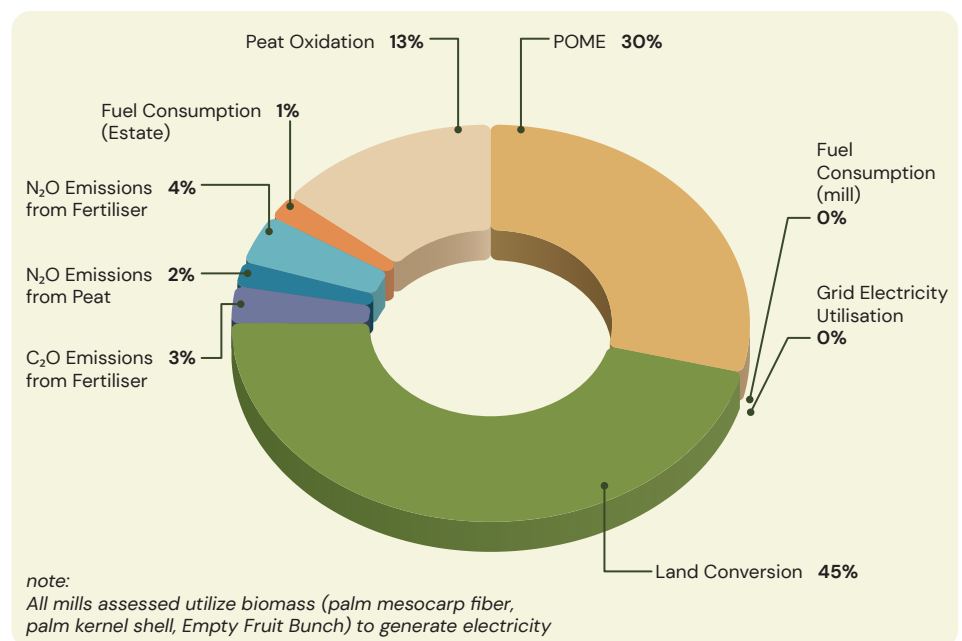
NET ZERO PATHWAY FOR THE PALM OIL SECTOR

The palm oil sector has often been associated to deforestation, peatland degradation, and significant greenhouse gas (GHG) emissions. However, with growing sustainability commitments, such as those driven by the RSPO, The sector now stands at a pivotal moment to redefine its role as part of the climate solution. With the adoption of sustainable production practices, conservation of High Conservation Value (HCV) and High Carbon Stock (HCS) areas, ecosystem restoration, improving waste management, and strong circular energy potential, palm oil has the potential to transform from a major emission source into a net carbon sink.

Key Contributors to Emissions in Palm Oil Production

GHG emissions from palm oil production are largely driven by land use changes and processing activities. Recent scientific assessments highlight both the challenges and potential. A 2025 life-cycle study of Indonesian refined palm oil found that producing one ton of oil emits in approximately 2.2 tons of CO₂-equivalent emissions, over half of these emissions stem from wastewater treatment, while around one-third are linked to land use changes, particularly deforestation and peatland conversion. Similarly, Our study on multiple mills and plantations in Indonesia revealed that land conversion was responsible for nearly half of total emissions, making it the primary contributor.

This reflects the carbon released when high-carbon landscapes are cleared for plantation development. Such emissions are typically immediate and substantial, highlighting the critical importance in preventing further deforestation and protecting High Carbon Stock (HCS) and High Conservation Value (HCV) areas. Smaller but notable sources include **N₂O emissions from fertilizer use (4%)** and **fuel consumption in estates and mills (about 2%)**, representing operational emissions that can be mitigated through energy efficiency and optimized fertilizer management. These mills use small amount of fossil fuels by optimizing the usage of biomass.



Regenerative Agriculture

- **Composting:** Composting organic waste helps reduce reliance on chemical fertilizers, enhances soil health and lowers greenhouse gas emissions.
- **Water Table Management (on Peatlands):** Maintaining peat water levels close to the surface (40–60 cm) prevents excessive oxidation and CO₂ release.
- **Smallholder Regeneration and Land Rehabilitation:** Supporting smallholders in replanting old, low-yield palms on existing land increases carbon efficiency (emission per ton of oil) while avoiding expansion.
- **Integrated Pest and Pollinator Management (IPPM):** Reducing chemical pesticide use and promoting biological controls lowers fossil-fuel-based agrochemical emissions and enhances ecosystem resilience.

Responsible Sourcing Practices

Avoidance is the foundation of any credible net zero pathway

- No new deforestation or peat conversion.
- 100% traceability and committed to sustainability policy
- Deforestation monitoring for all suppliers

Insetting Emissions

Insetting emissions in HCV and HCS areas measurable, verifiable, and aligned with Scope 3 reductions. Such insetting creates internal carbon value chains, linking sustainability performance directly to land stewardship.

Land Use Optimization

- Prioritize yield improvement over expansion; every 1% increase in yield can reduce emissions **intensity by 1–1.5% reducing pressure to expand new land.**
- Minimize unplanted areas as palm oil itself can sequester carbon 8–10 tCO₂ per Ha
- Adopt precision fertilization and integrated soil management

Technology Based Solutions

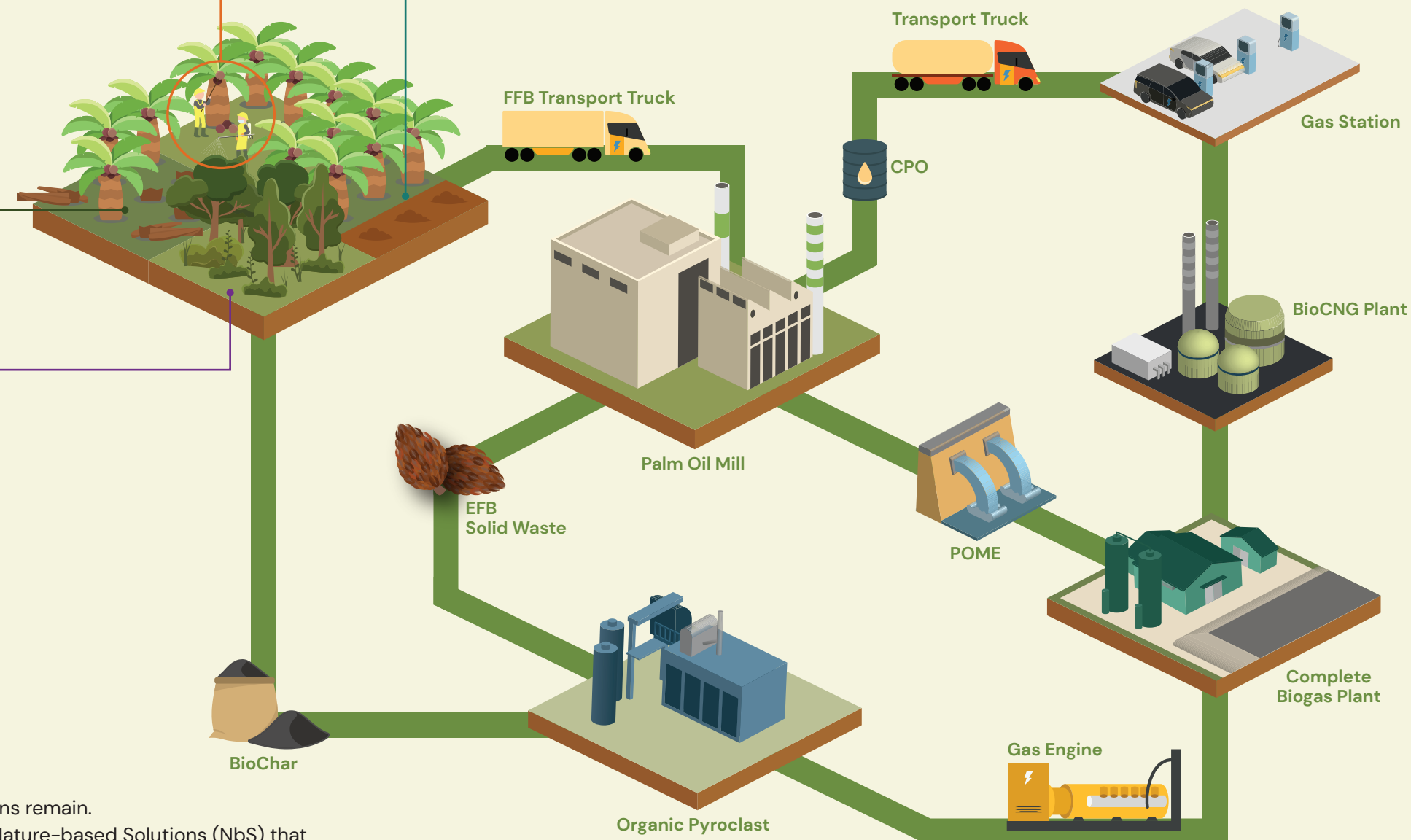
Replace open lagoons with covered biogas systems. This can reduce mill emissions by up to 70%, and generate renewable energy. This single intervention transforms a waste stream into a clean energy source.

Palm residues and effluents can be reused as renewable resources:

- **Bio-CNG generation:** Captured biogas can be upgraded into bio-compressed natural gas for mill operations, fleet fuel, or grid injection.
- **Biomass utilization:** Empty fruit bunches, mesocarp fibre, and palm kernel shells can produce heat and power, creating energy self-sufficient mills.

Processing Efficiency:

- Improve boiler and combined heat and power (CHP) systems, and recover heat in refining stages.
- Transition to biofuel or electric vehicles for internal transport.



Altogether, these emission sources demonstrate that the majority of palm oil's carbon footprint stems from **land use and waste management**, not from the crop itself. Addressing these emission hotspots through a structured

Avoid–Reduce–Reuse–Offset strategy can transform the palm oil industry into a net zero catalyst. With targeted interventions such as avoiding deforestation through responsible sourcing, capturing and utilizing methane, restoring peatlands, and supporting regenerative smallholder practices the palm oil sector has a credible pathway to significantly reduce emissions and move toward **net-zero and even net-sink outcomes**

Avoidance

Reduce

Replace

Offset

Least option when all mitigation efforts have been made

Even with full mitigation, some emissions remain.

Residuals can be neutralized through Nature-based Solutions (NbS) that enhance ecosystem carbon stocks and community resilience:

- **Reforestation and riparian restoration** within company boundaries.
- **Peatland rehabilitation** to prevent long-term CO₂ and CH₄ release.

illustrated by Daemeter

Daemeter is a leading independent consulting firm promoting sustainable development through responsible and equitable management of natural resources,

particularly in Asia's emerging economies. Based in Indonesia, we are a team of 40 in-house senior advisors, project managers, analysts, technical experts and field officers, representing decades of experience. With a diverse, multinational staff, Daemeter applies international standards, while understanding and respecting national context, local stakeholders and socio-political operating conditions.

We bring our expertise together through 5 Knowledge Areas



Sustainable Supply Chain



Social, Smallholders, and Livelihoods



Biodiversity, Conservation, and Restoration



Forest, Nature, Climate



Geospatial and Informatics

Other Practice Areas

- HCV & HCS Assessments Social
- Impacts, Labour & Human Rights
- Landscape Initiatives
- Monitoring & Evaluation
- ESG Due Diligence
- Capacity Building & Facilitation
- Policy Analysis

Forest, Nature, Climate

Leveraging climate finance and NBS to maximize the role of forests and communities in combatting climate change

FNC Services

Nature based solutions project

- Project feasibility study
- Project design and validation support
- Project monitoring and verification technical support
- Monitoring, Reporting & Verification (MRV)

Methodology Development

- Climate policy
- Sustainable low-carbon approaches
- REDD+
- Mitigation plan
- Climate adaptation resilience

Climate Sustainability Solutions

- Restoration and conservation strategies
- Safeguard, rating, and framework alignment
- Sourcing high-quality carbon project
- GHG inventory
- Carbon footprint
- Decarbonization
- Net zero strategy
- SBTi



Jl. Tangkuban Perahu No. 1
Taman Kencana, Bogor
Jawa Barat – 16128
Phone +62 251 8315 625

www.daemeter.org

for more **Forest, Nature, Climate** inquiries,
please contact:
noer.satyo@daemeter.org