

CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA



Diamond Building Products

- Saraburi, Thailand
- Building materials
- www.dbp.co.th/en
- Analysis period: 2019-2026

Closing the Loop in the Production of Building Materials

Business Spotlight

Diamond Building Products PCL (DRT)¹ is a listed company that manufactures, markets, and installs building products, from fibre-cement boards to concrete roof tiles, autoclaved aerated concrete (AAC) blocks, and ceiling panels. The company's circular economy journey began in 2017 after a risk analysis flagged ageing population, diminishing workforce, material scarcity, energy insecurity, and ecosystem decline as strategic threats to the business. In response, the company developed their Sustainability Strategies and Policy along with a structured Environment, Social and Governance (ESG) framework. This framework spurred the development of operational procedures to counter identified organisational risks and impact, including the integration of a circular economy framework, energy management systems (EnMS), smart factory practices, robotisation and automation, climate-change mitigation actions, biodiversity footprint tracking, and sustainable development process design (SD Design).

In the same year, DRT was selected by the Stock Exchange of Thailand (SET) as an 'Innovation Organisation', which led to a sustainability training programme for 70 senior managers and subsequent

projects. Between 2019 and 2025, the company invested THB 198.4 million (approx. EUR 5.1 million) and successfully recycled 211,165 tonnes of material, against THB 75.6 million (approx. EUR 1.9 million) annual returns, and cut its 2025 CO₂ emissions to 55.31 million kg CO₂e, down from a 2024 peak of 75.87 million kg, a 27% year-on-year reduction. DRT's near-term targets include reaching 1 MW of installed solar capacity by 2027 and reducing cement clinker use with graphene additives. The initiatives also saved the company ~32 million MJ of energy – about 10% of total energy consumption. Zero waste has also been achieved in the manufacturing of AAC blocks, and an ambitious target of zero waste for all company operations has been set for 2030.



Keywords

Building materials, Material substitution, Sustainable design, Zero waste



Innovation

Product/service design, Manufacturing, End of life management, Resource circularity, Resource efficiency, Resource substitution

¹ DRT is the SET listed company name while the company has changed its name to Diamond Building Products following its expansion of product lines beyond roofing tiles in 2011.

Context and baseline

DRT operates three manufacturing sites in Saraburi (DBP-1 and DBP-2), Chiang Mai (D-Mats), and Khon Kaen (CT-KK), employing roughly 1,000 people and reporting revenues of THB 4.97 billion in 2024 (approx. EUR 129 million). The business is materials- and energy-intensive: raw material inputs are dominated by local sand and cement with roughly 10% imported pulp and pigment. The core manufacturing steps – autoclaving, kiln curing, high-pressure grinding and cutting – are heavy users of steam, natural gas, electricity, and water.

The company's circular economy journey began in 2017, when DRT received the Innovation Company award from the Stock Exchange of Thailand (SET), and simultaneously, a parallel 5-day innovation-capacity programme for 70 executives was delivered by the Thailand Productivity Institute. At the time, DRT's overall operations showed no substantial recycled-material use; production waste and process steam were treated as waste with no recovery; there was neither an on-site renewable energy generation nor a formal energy-management system in the manufacturing lines; dust, steam, heat and noise were flagged as material issues; and the effects of climate change were identified as strategic risks, but these were not yet quantified in the company's reports.

An internal Manufacturing Technology and Innovation Committee (MTIC) was set up in 2019 to supervise circular economy investment and sustainability projects. Since then, DRT has successfully implemented 108 projects (2019–2025), which resulted in the cumulative replacement of 211,165 tonnes of virgin raw materials, cumulative energy savings of 32 million MJ (approximately 10% of DRT's total energy use), a 27% reduction in Scope 1+2 greenhouse gas (GHG) emissions between 2024–2025, and a 78.5% reduction in industrial waste output while achieving a 40% increase in production capacity over the same period. All the projects were led by DRT's own engineers with the technical collaboration of Thailand's National Metal and Materials Technology Center (MTEC), King Mongkut's Institute of Technology Ladkrabang (KMUTL), Kasetsart University (KU), and Chulalongkorn University (CU).

Innovation

DRT redesigned and innovated their manufacturing plants for fibre cement roofing tiles, concrete roofing tiles, fibre-cement boards, and autoclaved aerated concrete (AAC) blocks. Using the 'sustainable manufacturing design' approach, waste streams from one production line were reintroduced as raw material input to another, a practice known as 'industrial symbiosis'.

Between 2019 and 2024, the company recycled 19,275 tonnes of AAC brick offcuts, returned 10,152 tonnes of fibre-cement slurry via cross-line piping, captured 21,510 tonnes of AAC waste steam for earlier curing stages, and recovered 9,000 tonnes of wood-processing dust as raw material. In addition, the concrete-tile-scrap recycling line – commissioned in November 2021 – now recycles approximately 10,378 tonnes of scrap per year, exceeding its 7,200-tonne design target. Collaborating with their cement suppliers, DRT developed a formulation using hydraulic cement instead of Type 1 Portland cement – introduced in 2024 and rolled out across 100% of production lines by 2025. Moreover, it has replaced up to 25% of natural river/land sand with synthetic 'manufacturing sand' produced from quarry-dust waste. A flagship application of this design approach is the new AAC-2 production line (established during 2024–2025), which was designed from the outset as a zero-waste process to serve as the reference model for retrofitting DRT's other lines to achieve the Zero Waste to Landfill target by 2030.

DRT's circular innovations take place in design, manufacturing and end-of-life stages, and they affect the entire value chain and product life cycle. Products have extended durability and maximum structural efficiencies. Regarding end-of-life management in Thailand, local distribution networks often buy back post-use construction materials to resell to agricultural sectors or low-income consumers for structural reuse. Thus DRT actively focuses on designing and promoting systematic practices for recovery, reuse, repair, and repurposing to keep products functional and to completely divert materials from landfills.

Although the technical solutions were already independently known and were being practiced in the sector, synergistic deployment under a comprehensive circularity framework was innovative for Thailand and the building sector. Solutions are now co-created with a network of partners across DRT's value chain. On the supply side, hydraulic-cement substitution was developed jointly with cement manufacturers, who reduce clinker ratios in

the cement formulation, resulting in lower-carbon cement. In terms of research and development, DRT is working with MTEC on application of the material circularity indicator (MCI)² across their major product lines. Internally, the programme is implemented through decentralised 'Small Group Activities' (SGAs); these are small-scale employee-led pilots whose measurable results are then scaled through the Manufacturing Technology and Innovation Committee (MTIC). DRT is exploring partnerships with industrial peers, including a proposed feed of 50 tonnes per year of calcium silicate pipe-insulation waste from PTT PCL³ into its AAC production line.

During 2019–2024, the company invested THB 87 million (approx. EUR 2.3 million) for 27 robots and automation systems, resulting in the reduction of 135 workforces, which will be increased to 50 robots (resulting in the reduction of 150 workers) over the next five years.

The Internet-of-Things (IoT) programme delivered 21 projects during 2020–2024 with a total investment of THB 7.05 million (approx. EUR 183,000), reducing work hours in high-risk areas by roughly 14,934 work hours per year (equivalent to about 10 workers in each shift). By 2025, the IoT programme had grown to 27 projects. Finally, since 2019, DRT's solar-system installations have generated 0.46 MW (as of 2024) or 46% of its 1 MW target for 2027, avoiding a cumulative 1,447 t CO₂e since 2019.

Circular Economy impact

DRT contributes to the circular economy through the successful implementation of all three resource strategies, namely resource circularity, resource efficiency, and resource substitution.

Resource circularity: The company is applying a closed-loop model in which waste streams from one production line are fed into another line as raw material inputs. The use of recycled raw materials rose from 13,574 tonnes in 2019 to 40,000 tonnes in 2025, leading to a cumulative 211,165 tonnes of virgin resource-use avoided across the seven-year period and an equal amount of building material waste diverted from landfill. Recovery and reuse of steam within the AAC process (from the later-stage chamber to early-stages) helped save THB 5.6 million (approx. EUR 147,000). The use of recycled water increased 57%, from 24,240 m³/yr in 2018 to 38,000 m³/yr in 2025, or 64% of the new nature-based water treatment system's capacity installed in 2025.

Resource efficiency: On a per-product basis, waste generation fell from 24.77 kg/tonnes of finished product in 2024 to 21.39 kg/tonnes in 2025 (a 13.65% year-on-year reduction), and from 48.43 kg/tonnes in 2018 (a 56% reduction compared to baseline). Moreover, DRT achieved cumulative energy savings of approximately 32 million MJ during 2019–2024, roughly 10% of total energy consumption of the 2018 baseline. In 2025 alone, nine energy-management projects contributed a further reduction of approximately 673 t CO₂e, with 604,955 kWh/year of electricity savings, and 1,501,715 MJ/year of thermal-energy savings. Resource efficiency is also achieved in the supply chain, particularly by completing in 2025 the full replacement of Portland cement by hydraulic cement, which has a markedly lower carbon footprint. Water efficiency improved as evidenced by 3.72% year-on-year reduction in water intensity in 2025 to 0.02 m³ per tonne of product. This enabled an absolute reduction of annual freshwater extraction by 5% from 441,883 m³ to 421,918 m³.

Resource substitution: The rooftop solar system expanded from zero capacity in 2018 to 610 kW across three sites (Saraburi, Khon Kaen, Chiang Mai), avoiding 1,447 t CO₂e between 2019 and 2024. Regarding greenhouse gas emissions, the company has achieved a combined reduction of Scope 1 and Scope 2 emissions from 75,871 t CO₂e (2024) to 55,307 t CO₂e (2025), a 27% reduction.

On its own operating sites, DRT has constructed a nature-based wetland wastewater-treatment facility that has become an established habitat for regional bird species. The company has also invested in flue-gas and steam-vapour noise reduction so that fauna can thrive at the factory perimeter. End-of-life repurposing of demolition tiles and AAC blocks into planters, benches and paving keeps materials in use in the built environment rather than becoming landscape debris.



² See: <https://www.mtec.or.th/mci/>

³ PTT PCL: Thailand's national, majority state-owned oil and gas conglomerate.

Business and market impact

The portfolio of 108 projects implemented since 2019 has shown varied payback periods. On a quick-win, the Spacer Cleaning line at the NT8–NT11 board plant returned around THB 16 million a year against a THB 0.8 million investment – a payback of about three weeks. On a longer horizon, for infrastructure and material-recovery investments – such as the Double Knife CT5 line on the concrete-roofing-tile plant (THB 9.45 million for 1,250 tonnes per year of raw-material saving) and the DBP-2 lagoon water-treatment system (THB 2.9 million for 200 m³ per day of recycled water) – pay back is closer to a decade. On an aggregate basis, DRT reports an average payback of under three years across the full portfolio, reflecting a mix of quick-win yield-improvement projects and longer-horizon infrastructure investments.

DRT has launched end-to-end product-and-service models built explicitly around the ‘premium, eco-innovative’ market segment that appreciates the Reduce–Reuse–Recycle initiatives. This positions the company against rising import pressure from Chinese and Vietnamese manufacturers, as price competition alone favours the imports. In addition, DRT has been included in the SET ESG Ratings (formerly THSI) for eight consecutive years since 2017, in the Thaipat Institute’s ESG 100 continuously since 2015, and holds a 5-star rating in the Thai Institute of Directors (IOD) Corporate Governance assessment. Manufacturing operations are certified to ISO 9001 (quality management system), ISO 14001 (environmental management system) and ISO 45001 (occupational health and safety). With its sustained efforts, the company has proven to its shareholders that the sustainability investment programme has made the company more resilient to the major risks it identified almost a decade ago.

Stakeholders

DRT has engaged stakeholders at different stages of its value chain. For development, it engaged national policy agencies, academic institutions, and industrial partners. DRT’s own workforce, organised through the SGA model, has contributed significantly to the company’s success by innovating, testing, and implementing to bring new solutions to completion.

Concerning commercialisation, DRT works with a network of installers, contractors, modern-trade retailers and export distributors to translate concepts into on-site delivery. This distribution network extends into Cambodia, Laos, Myanmar, Vietnam and the Philippines. Third-party validators – the Stock Exchange of Thailand, Thaipat Institute and Thai IOD – also function as stakeholders in

commercialisation, providing the external credibility that supports DRT’s ‘premium, eco-innovative’ market positioning against price-based import competition.

On the community/social side, DRT actively engages local communities by donating or heavily discounting off-spec or non-standard products for use in low-income housing repairs or localised agricultural projects. Recycled paving blocks made from manufacturing sludge are donated to local public spaces like temples and schools to upgrade community infrastructure.

Furthermore, the circular economy frameworks support community employment. The nature-based wetland wastewater treatment facility contracts local community groups every 2 to 3 months for vegetation maintenance and harvesting. Additionally, the harvested narrowleaf cattail (*Typha angustifolia*) stalks are dried, bundled, and bought back to DRT by the community to use as sustainable, impact-absorbing protective packaging material to prevent tile breakage during logistics and long-distance transport.

Implementation

A core initial barrier for the company was resistance from mid-level management, particularly within departments responsible for product standardisation and compliance systems, which resulted from concerns over raw material and product changes. DRT’s response was to structure the circular-economy programme through decentralised Small Group Activities (SGAs). These groups were in charge of designing and carrying out small-scale pilot concepts, demonstrating measurable operational successes, and rewarding the teams that delivered them. Verified outcomes are then presented to executive leadership, gaining corporate backing and embedding the practice into the corporate culture. This bottom-up approach is what DRT credits for enabling a 78.5% reduction in total industrial waste output, while parallel investments in production capacity have resulted in a roughly 40% increase in production capacity over the same period.

Achieving the 2030 Zero Waste-to-Landfill target remains the central corporate milestone against which the full circular-design approach will be validated as a benchmark model for Thailand’s manufacturing sector. Beyond its own operations, DRT actively shares its sustainable-development frameworks – consulting and guiding industrial partners, academic institutions and interested organisations – to limit resource inefficiencies across the region.

Takeaways

DRT's experiences illustrate that in a material- and energy-intensive manufacturing business, the pathway to circularity is not through a single technology change, but rather through an integrated renewal and innovation programme, driven by circularity ambition and delivered through strong internal governance and in-house capabilities. First, DRT started its circularity journey from the top – a mega-forces risk assessment, change of leadership mindset, and management training. This method began even before the company invested in sustainability/circularity projects. Then ideas from the shop floor were solicited and staff were allowed to test solutions on a small scale before competing for the company's bigger investment. With this approach, DRT has been able to successfully implement over 100 projects largely using in-house engineering teams, with the added advantage that the results will last longer because of their ownership.

For the building-material sector, DRT proves that circular design pays back faster when it is built into new production lines from the outset, as with the AAC-2 zero-waste line, rather than being retrofitted onto existing equipment. Sustainability can be a justifiable commercial position against price-based import competition. Finally, value-chain partnerships can help circular models succeed more efficiently compared to what a single company could do. And finally, DRT's 2030 Zero Waste-to-Landfill target is the milestone that will determine whether this case moves from a laudable Thai example to a regional benchmark model.



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