Advanced
Remanufacturing and
Technology Centre

ARTC

Achieving Sustainable Manufacturing through Energy Efficiency Monitoring and Analytics System (E2MAS)

Towards a greener and smarter manufacturing landscape in Singapore

The Singapore Manufacturing 2030 Vision envisions manufacturing to become smarter, greener, and more connected. The Advanced Remanufacturing and Technology Centre (ARTC), a research institute under the Agency for Science, Technology and Research (A*STAR) collaborates closely with public agencies, institutes of higher learning and industry on four strategic R&D themes to support Singapore in becoming a strategic advanced manufacturing hub.

ARTC's 4 R&D Themes:

- Advanced Manufacturing Processes
- Autonomous Manufacturing
- Resilient Value Chain
- Net-Zero Manufacturing

Shaping a Net-Zero Manufacturing Future with ARTC

In response to rising environmental concerns and tightening of regulations, the manufacturing industry faces a crucial need to accelerate the decarbonisation transformation of manufacturing's footprint.

ARTC is dedicated to advance decarbonisation in manufacturing through four key innovation areas.

In-service smart health diagnostics to continuously monitor activity levels

Agile disassembly technologies for flexible and safe disassembly

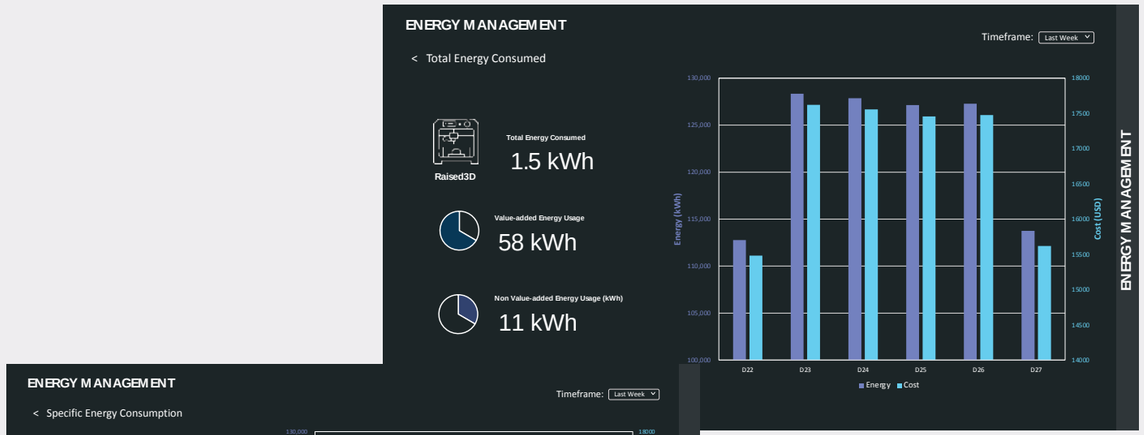
Repair and regenerative technologies to extend service life and enhance performance

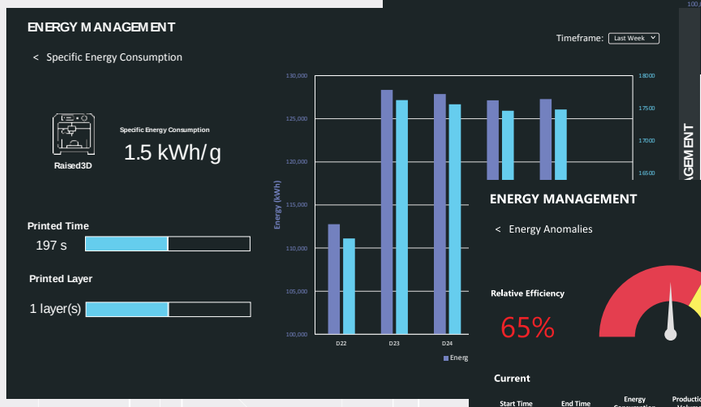
Data-driven smart energy, water and waste management to provide informed decision making for resource efficiency improvement

Energy Efficiency Monitoring and Analytics System (E2MAS)

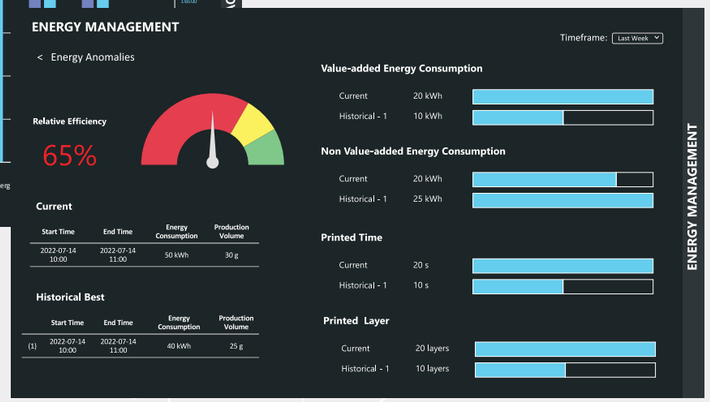
Developed by ARTC, the Energy Efficiency Monitoring and Analytics System (E2MAS) allows companies to assess real-time energy efficiency. By leveraging E2MAS's monitoring and analytics capabilities, companies can identify hotspots of excessive energy usage and analyse them to take actionable steps for tangible improvements in energy efficiency.

Overview of total energy consumption

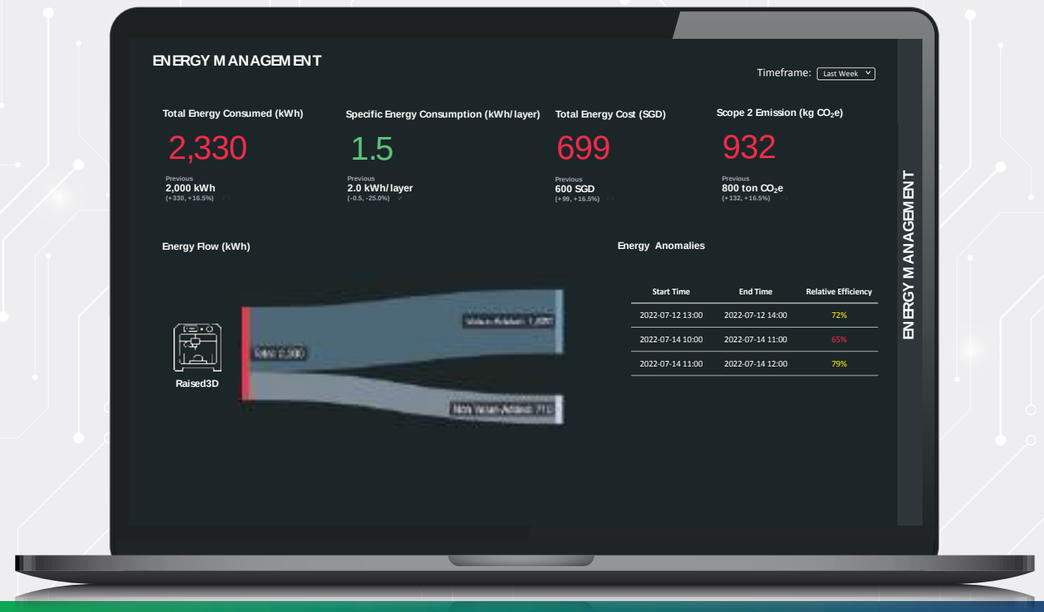


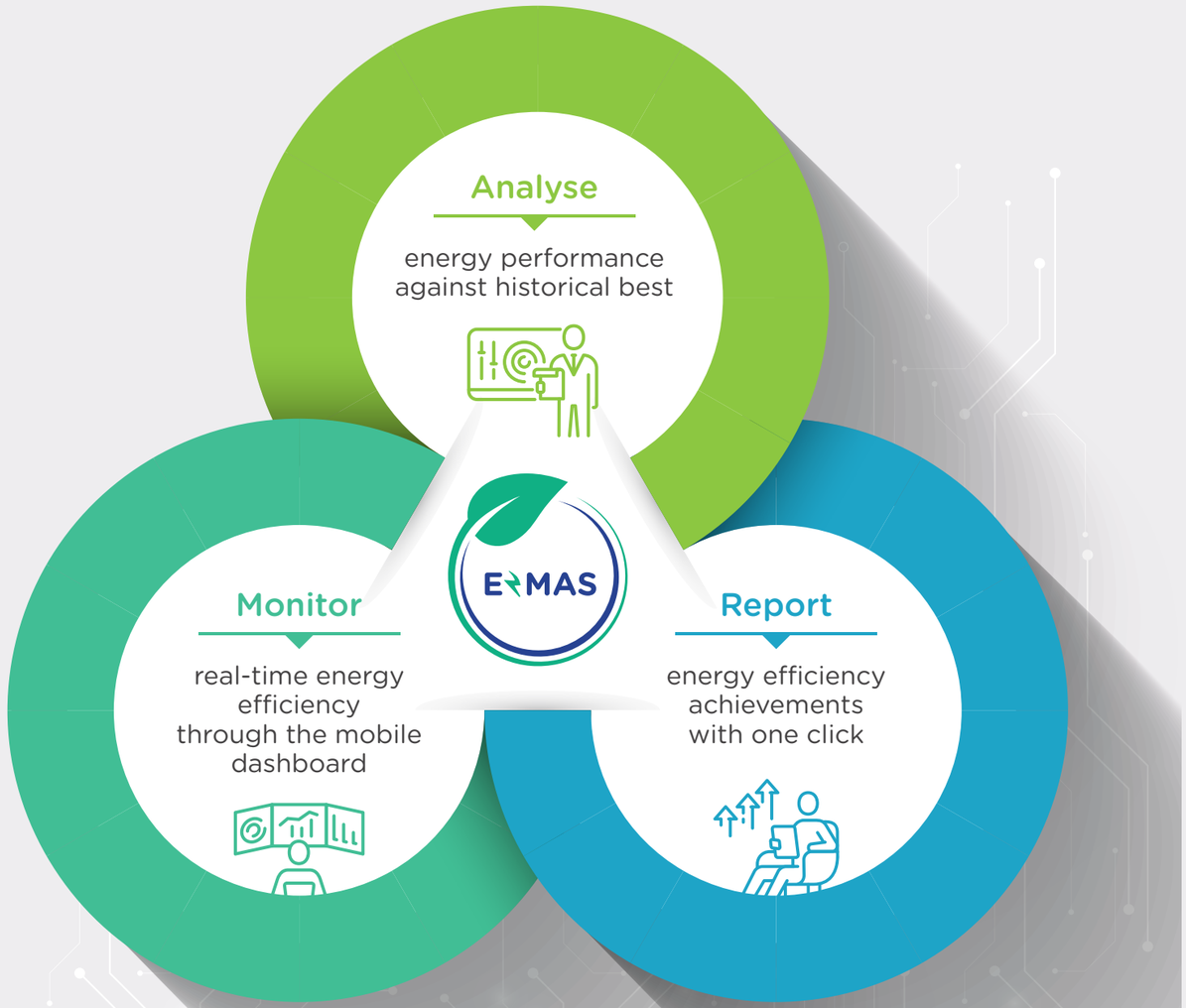


Specific energy consumption by machine



Identification of anomalies by comparing historical data





A mobile dashboard that provides real-time energy efficiency monitoring

- Identify major equipment that consume high amounts of energy
- Visualise energy usage profile

Benchmark energy performance against historical best

- Identify hotspots through immediate alerts on abnormal energy consumption
- Provide actionable recommendations in fine-tuning for optimal performance
- Analyse potential cost savings and efficiency improvements

Generate reports on energy efficiency achievements with a single click

- Provide energy analysis report for informed decision making and regulatory reporting purposes

The Technology Behind E2MAS

The E2MAS is a state-of-the-art smart energy management system that optimises production processes and reduces energy usage. Developed by ARTC's Sustainable Operations Management and Design team, E2MAS studies and manages a diverse range of production machines, uncovering hidden benefits from energy-efficient manufacturing. Through advanced analytics, E2MAS can seamlessly correlate real-time production output with energy usage.

Its **five analytical modules** will empower companies to leverage performance indicators for data-driven decision-making, guiding them toward achieving net-zero manufacturing.

Energy performance indicators and benefits for the analytical modules in E2MAS:

Analytical Module		Energy Performance Indicators	Benefits
1	Real-time energy efficiency analysis	Specific energy consumption (kWh/pc, kWh/activity, kWh/$)	To monitor equipment's energy performance and utilisation rate
2	Real-time benchmarking	Relative efficiency (%, to indicate perfomance gap between current and historical best)	To establish baseline, identify improvement potential and set target
3	Online causal analysis	Operating factors with recommendations	To identify causal factors and provide recommendation for fine-tuning
4	Comparison analysis	Relative efficiency (%, to indicate performance gap between current and most efficient machine)	To compare the machines in same functional cluster and identify the efficient machines
5	Live carbon footprint assessment	Carbon footprint (kg CO_2 eq.)	To assess greenhouse gas emission by the process

CASE STUDY 1

LHT Holdings Limited

A publicly listed company in the timber industry for more than 30 years, piloted the E2MAS, which assesses its equipment's energy efficiency in real-time and identify hotspots of excessive energy usage. Power meters have been installed at the pallet assembly and polishing machines to detect energy anomalies and quantify energy efficiency gaps.

The tool has supported in:

- Analysing hotspots to derive quantifiable energy improvement potentials
- Understanding day-to-day energy usage of its manufacturing processes
- Embedding the best practices in energy management

Impact

- Achieved a **20% reduction** in energy consumption
- Achieved a **20% reduction** in carbon emission
- Reduced effort required through auto report generation for management review

CASE STUDY 2

Singnergy Corporation Pte Ltd

The pioneer and world leader in energy-efficient drying technologies, specialising in super-quick drying technologies for a wide range of applications, is maximising the equipment resource efficiency with the smart E2MAS.

The tool has supported in:

- Analysing hotspots to identify critical factors for energy efficiency improvements
- Assessing the drying equipment remotely to monitor its energy efficiency in real-time and identify hotspots of excessive energy usage
- Providing full visibility for Singnergy to alert their clients in advance and provide them with proper equipment usage

> *"The innovation broadens Singnergy's business applications and positions the company with a leading-edge competitive advantage in the waste recycling sector through its high yield and energy-efficient solution"*
>
> **Mr KT Chua, Managing Director, Singnergy Corporation Pte Ltd**

SINGNERGY

Impact

- Reduction in customers' complaints
- Increase in equipment performance with proper usage

CASE STUDY 3

Sanwa-Intec Asia Pte Ltd

A local SME that manufactures plastic products, has deployed E2MAS for its plastic injection moulding machines. The deployment was conducted through Sanwa-Intec's system integrator partner, Iplast 4.0, which acquired necessary data from the company's system for analytics.

The tool has supported in:

- Benchmarking the selected 6 injection moulding machines via real-time energy efficiency analysis
- Allowing dynamic insights and target improvements in manufacturing processes

SANWA

iPlast

Impact

- Increased visibility on **energy efficiency by 80%**
- Improved energy efficiency and **reduced carbon footprint by 20%**

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