EST
Energy Solution Technology

The Path to Sustainable Cold Chain Logistics

Innovative Green Energy Solution for Indonesia and Beyond



Energy Solution Technology

Innovative Environmental Energy Solutions for Our Planet and Humanity!

To tackle the high costs of energy-intensive logistics and achieve sustainable green logistics, we develop and produce products that reduce greenhouse gases and protect the environment. These include PCM (Latent Heat Material) based cooling systems, hybrid systems, and mobile cooling storage solutions.





INDONESIA

The Need for Cold Chain in Indonesia

- Indonesia produces abundant agricultural and fishery products, but the lack of cold chain infrastructure leads to high post-harvest losses and threatens food security.
- Unstable power supply and rising energy costs make conventional refrigeration inefficient, highlighting the need for energy-saving and sustainable solutions.
- Growing urbanization, increasing food demand, and the push for global exports require the establishment of an affordable and reliable cold chain system.

A sustainable and innovative solution is urgently needed to address these pressing challenges.



Why Indonesia needs the PCM Cold Chain Solution

1 **TEMPERATURE STABILITY**

- PCM(Latent Heat Material) technology is engineered to maintain consistent temperature over long periods.

2 **ENERGY SAVINGS**

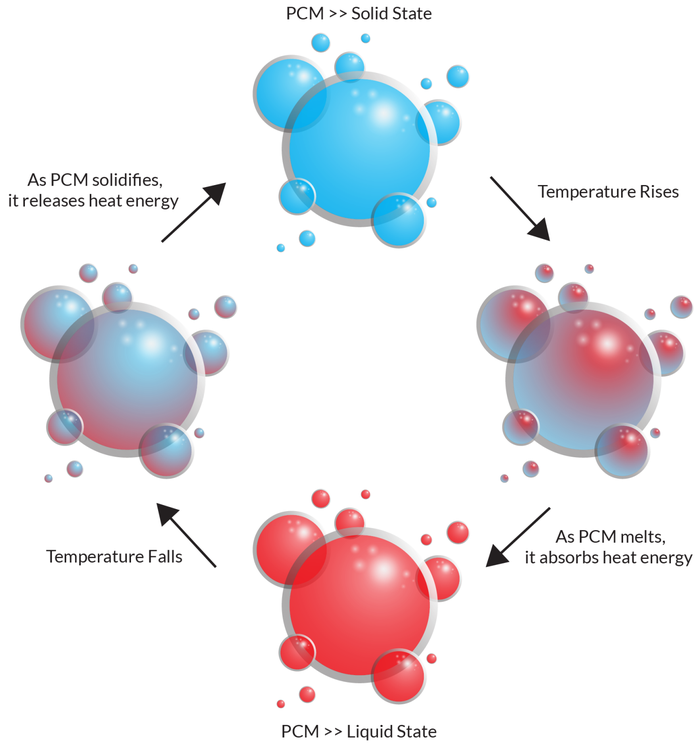
- PCM reduces the need for external power by using its thermal storage and release process, providing an eco-friendly cooling solution

3 **FLEXIBILITY**

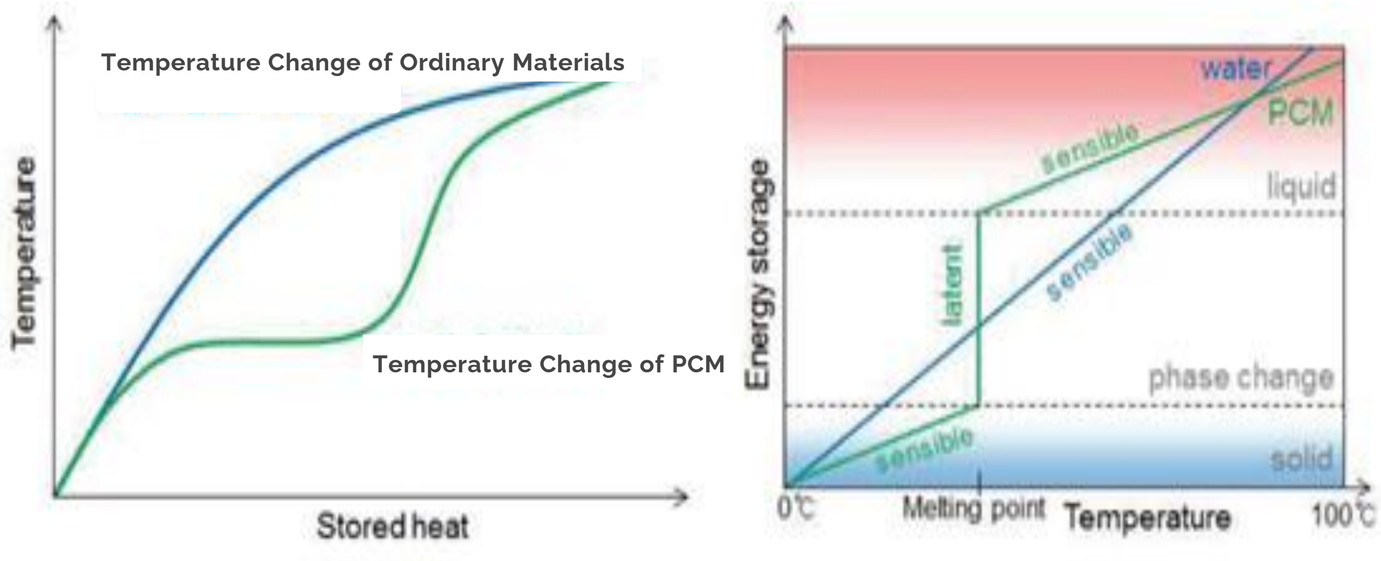
- The PCM-based cold chain is well-suited not only for road trucks but also for rail, sea, and multimodal logistics applications.

What is PCM (Phase Change Material)

- PCM(Latent Heat Material) stores and releases energy through a phase change while maintaining a constant temperature.
- It can absorb or release large amounts of heat without noticeable temperature fluctuations.
- PCM works like a thermal battery, enabling energy saving and stable temperature regulation in cooling and heating systems.



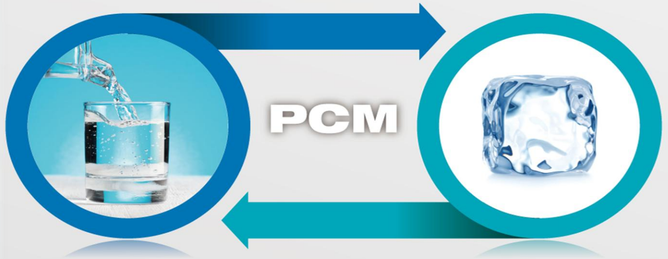
- PCM(Latent Heat Material) Thermal Energy Cycle -



- Comparison of Temperature and Energy Storage in PCM vs. Water -

PCM Applications in Cold Chain Transportation

Maintaining chill or freezing temperature even when the vehicle engine is turned off







PCM container

PCM Truck Configuration



Refrigeration System



Controller

















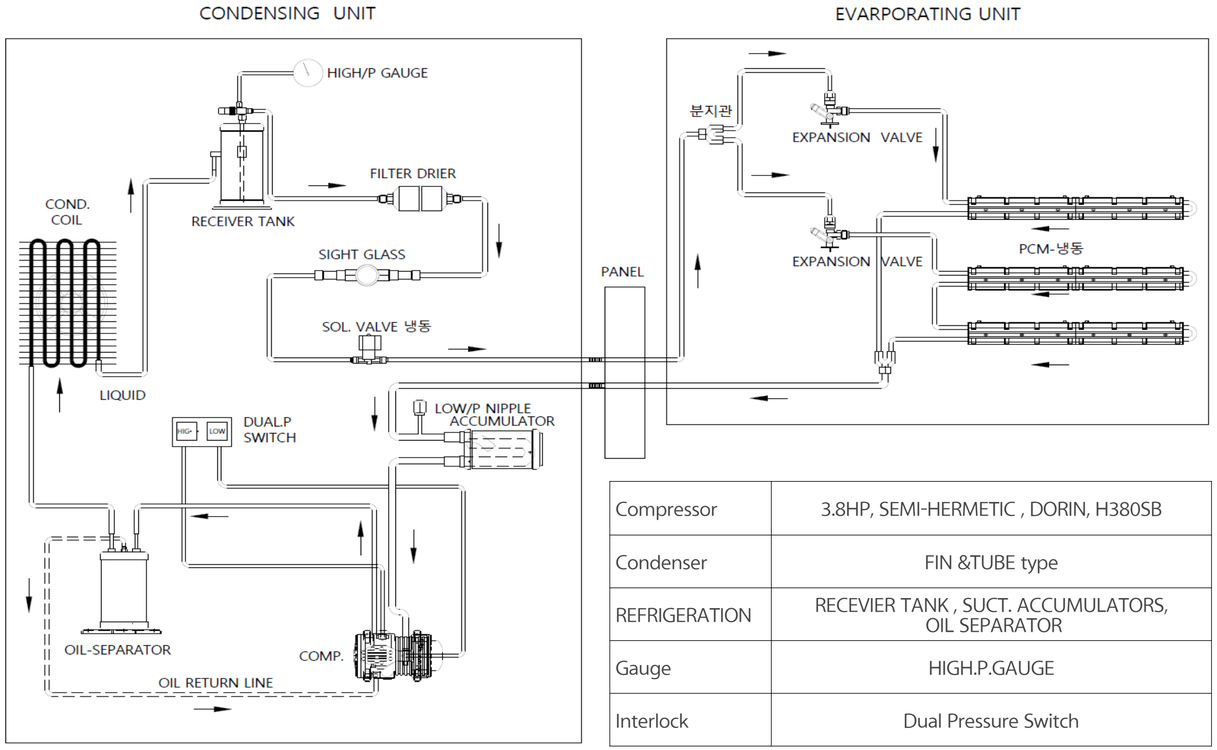
PCM Application(Reefer Truck)

- Unlike conventional trucks that constantly run compressors to generate cold, PCM trucks store cooling energy in advance and release it gradually, making them more efficient, stable, and eco-friendly.

- While conventional refrigerated trucks may face temperature fluctuations depending on engine or external power,
  PCM systems continuously release stored cooling energy to keep a stable temperature, ensuring food safety and quality even during long trips or stops.



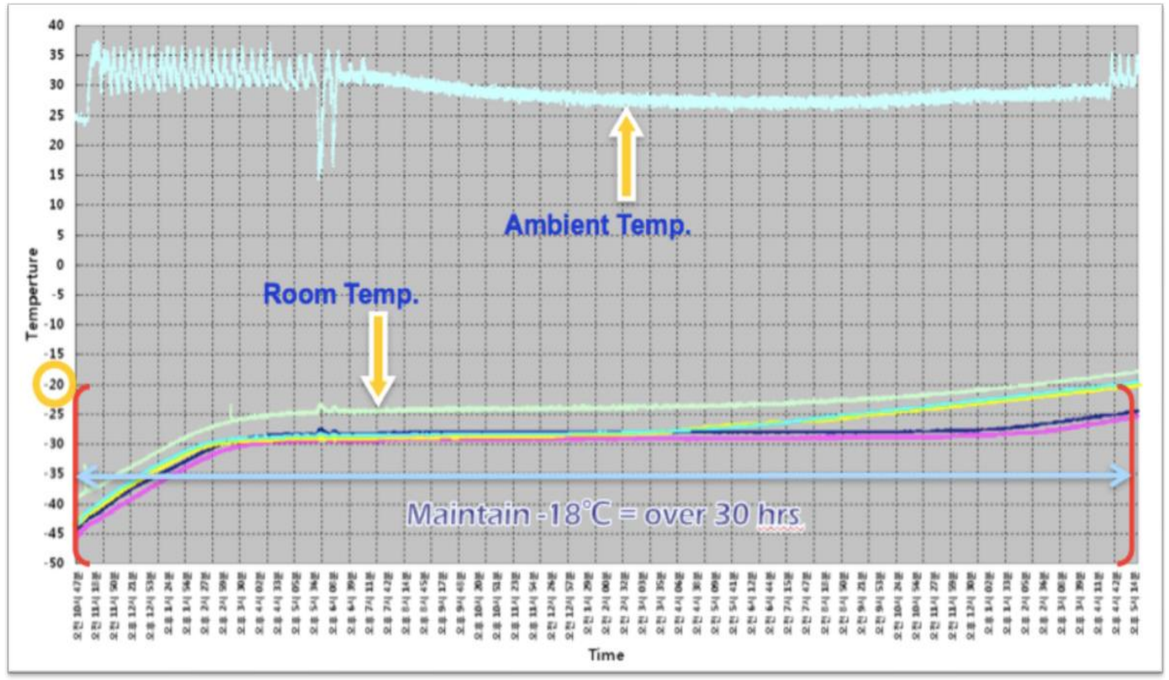
- PCM(Latent Heat Material) Thermal Energy Cycle -



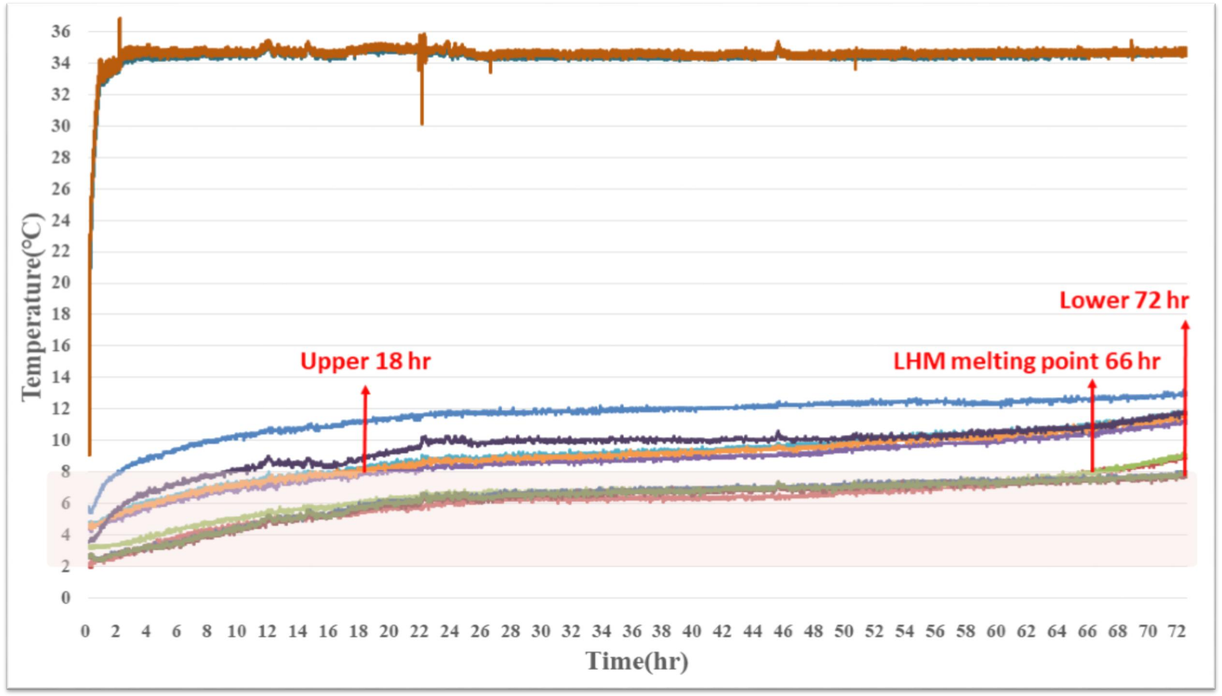
Compressor	3.8HP, SEMI-HERMETIC , DORIN, H380SB
Condenser	FIN &TUBE type
REFRIGERATION	RECEVIER TANK , SUCT. ACCUMULATORS, OIL SEPARATOR
Gauge	HIGH.P.GAUGE
Interlock	Dual Pressure Switch

Temperature retention with PCM Technology

- PCM system enables freezers to hold **-18˚C for over 30 hours** and chillers to keep safe refrigeration conditions for **up to 72 hours**, highlighting its effectiveness for cold chain logistics and temperature-sensitive storage.



- PCM Freezer temperature graph -



- PCM Chiller temperature graph -

Field Data for Cost-Benefit Analysis 1

TRUCK	ELECTRICITY		DIESEL		COST	EMISSION
	KWh	USD	Litre	USD	USD	KgCO2
Normal Reefer Truck	-	-	190	77.37	77.37	696
PCM Reefer Truck	3.7	3.35	125	50.90	54.25	459
COST SAVING			65	26.47	**23.12**	237
				34%	30%	34%

Benefit

SAVE 30%

** Jakarta between Surabaya Round Trip : 8 times/month, 96 times /year*

SAVING COST per Return TRIP = 46.25 USD

SAVING COST per MONTH = 369.92 USD

SAVING COST per YEAR = 4,439.09 USD

Information

. Truck Type : 6 Wheel Truck CDD120PS
. Destination : Surabaya - Jakarta
. Distance : 790 km
. Time : 27 hours
. Date : October 2012
. Electric Tarrif : USD 0.11/kwh
. Diesel : USD 0.41/liter
. Charging Time : 8 hours

Field Data for Cost-Benefit Analysis 2

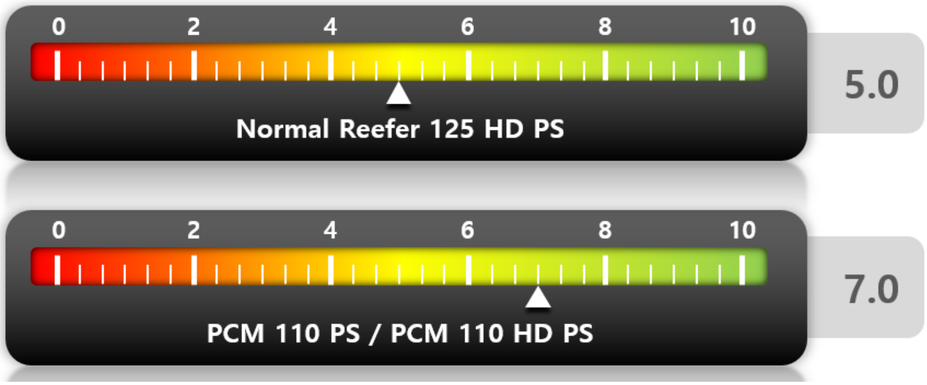
	TRUCK	DIESEL(ltr/km)	PRICE 2013	DIFFERENCE(Rp)	NOTE
1	110 PS Truck	1 : 7	19,618.28	1,393.55	*from 125 HD*
2	110 HD PS Truck	1 : 7	20,468.89	850.61	*from 125 HD*
3	125 HD PS Truck	1 : 5	21,011.83		

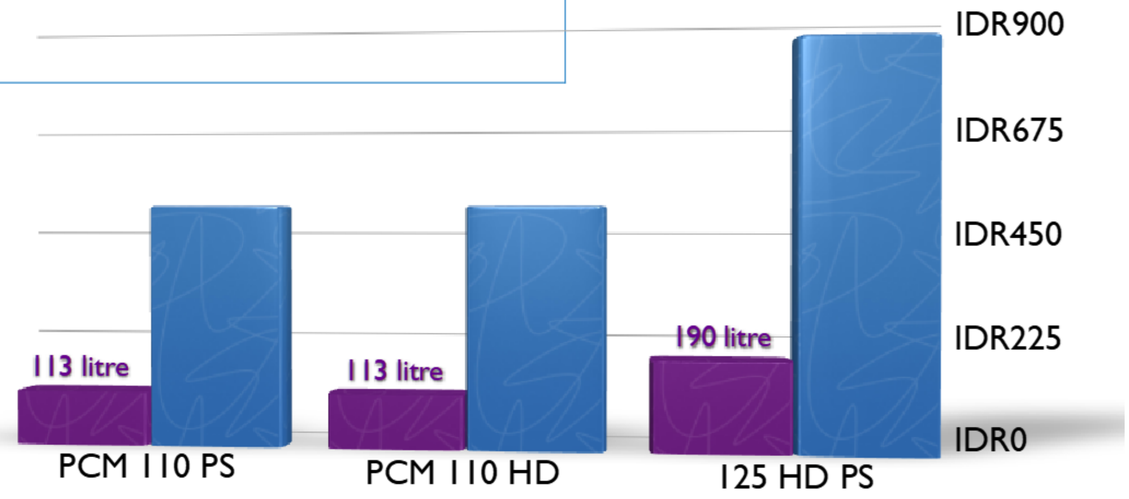
** Illustration between Jakarta to Surabaya (790km)*

	TRUCK	DIESEL(ltr/km)	PRICE 2013	DIFFERENCE(USD)	NOTE
1	PCM 110 PS Truck	113	45.96	32.06	
2	PCM 110 HD PS Truck	113	45.96		
3	Normal 125 HD PS Truck	190	77.21		

SAVE

Extra 40%





PCM Applications in the World































RAILWAY

Environmental Benefits of Rail Logistics

1 ENERGY EFFICIENCY

- Rail transport consumes significantly less fuel and reduces carbon emissions.
- Rail emits only 25% of the carbon dioxide compared to road transport for the same freight volume.

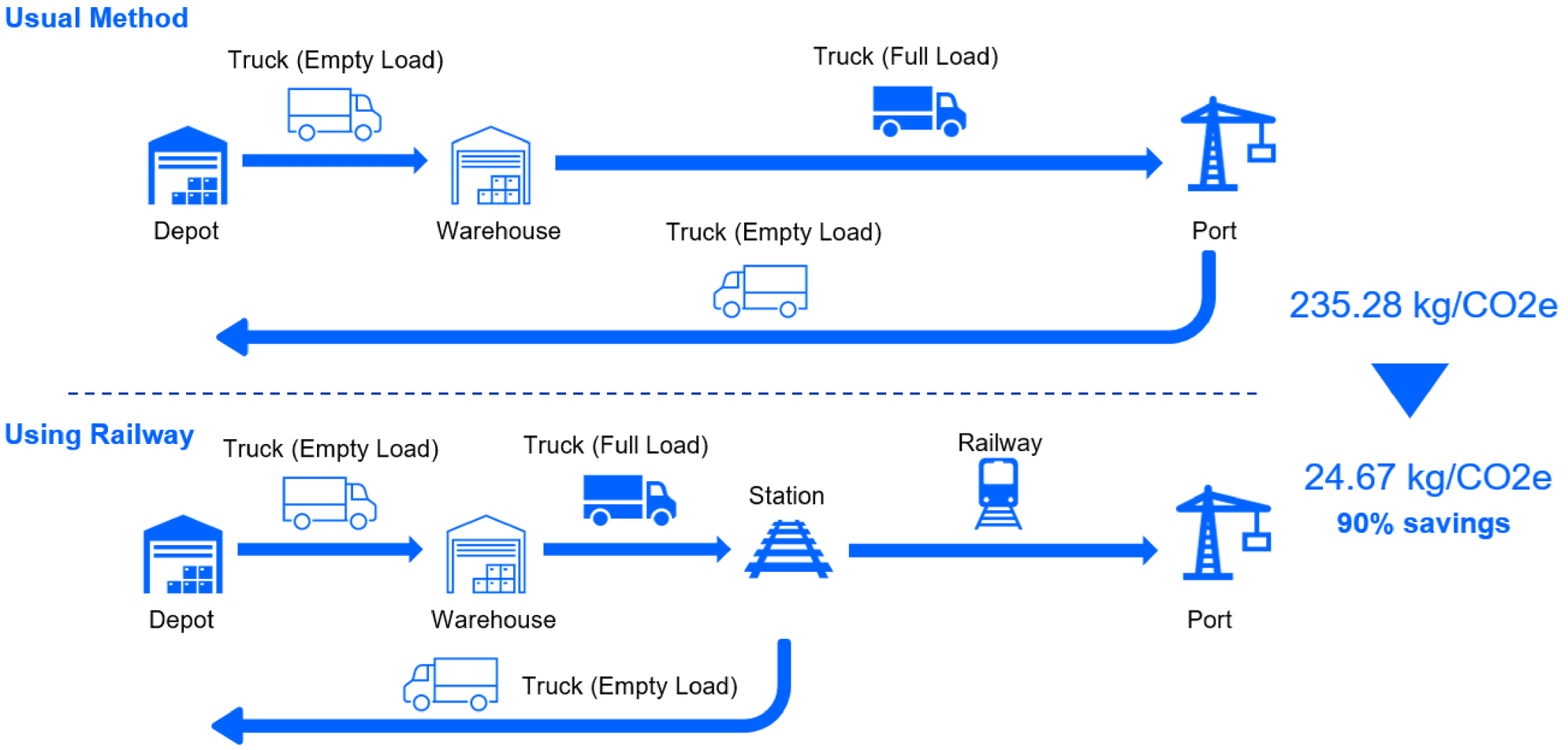
2 ALLEVIATION OF TRAFFIC CONGESTION

- While road networks in Indonesia often experience heavy traffic, rail provides consistent and predictable operations.

3 STABLE TRANSPORTATION

- Rail is less susceptible to weather disruptions (typhoons, floods) and offers a more controlled temperature environment for sensitive goods.

PCM Rail logistics environmental benefit



PCM Rail Logistics in Indonesia

PCM Refrigerated containers are optimized for maintaining thermal stability over long distance and larger volumes of perishable goods.



- **Prolonged Cooling Performance :**

  Maintain a stable temperature for up to 2 days during transport

- **Reusable :**

  PCM containers can be reused multiple times, leading to cost savings

- **Ease of Use :**

  Once charged, PCM can provide cooling without the need for continuous power supply

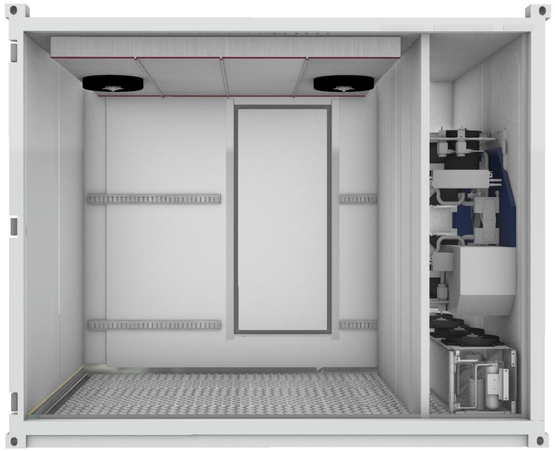
PCM Refrigerated Container

No	Description	Normal Reefer Container		PCM Container	
		20"	40"	20"	40"
1	Material (Skin)	Steel plate	Steel Plate	Steel plate	Steel Plate
2	Material (foam)	Polyurethane	Polyurethane	Polyurethane	Polyurethane
3	Outside Dimension (LxWxH)	6,058x2,438x2,591	12,192x2,438x2,591	6,058x2,438x2,591	12,192x2,438x2,591
4	Inside Dimension (LxWxH)	5,455x2,290x2,262	11,690x2,250x2,247	5,255x2,090x2,062	11,490x2,050x2,047
5	Capacity (m3) CBM	28	59,1	23	49
6	Load Capacity (Product) (kg)	11.500	18.000	11.000	17.000
7	Weight (gross) (kg)	24.000	30.480	24.500	31.480
9	Refrigeration System	AIR COOLING TYPE	AIR COOLING TYPE	PCM TYPE	PCM TYPE
10	Power (Kw)	7	11	4	8
11	Freezing Time (hour)			12 / 20	12 / 20
12	Usage Time after Machine off	0	0	>30	>30
13	Setting Temperature	<-18	<-18	<-18	<-18





PCM Refrigerated Container











MARITIME

Environmental Benefits of Maritime Logistics

1 **REGULATION COMPLIANCE**

- Many vessels restrict engine operation during voyages or while docked
- PCM ensures reliable cooling while meeting these safety and regulatory requirements.

2 **COST SAVING**

- Unlike conventional refrigerated trucks that must keep the engine running on
- PCM maintains cold temperatures without engine power, reducing fuel and operating costs.

3 **QUALITY ASSURANCE**

- Stored cooling energy ensures stable temperature during long voyages or power interruptions, safeguarding food and pharmaceutical product

PCM maritime logistics in Indonesia



Surabaya	Ferry	Banjarmasin	Ferry	Surabaya
21-OCT 17:00	21-OCT 24:00	22-OCT 21:00	23-OCT 18:00	25-OCT 01:40
After charging move to t he port and boarding	Depart and stay on ferry about 30 HRS	Arrival	Depart and stay on Ferry about 32 HRS	Arrive to station

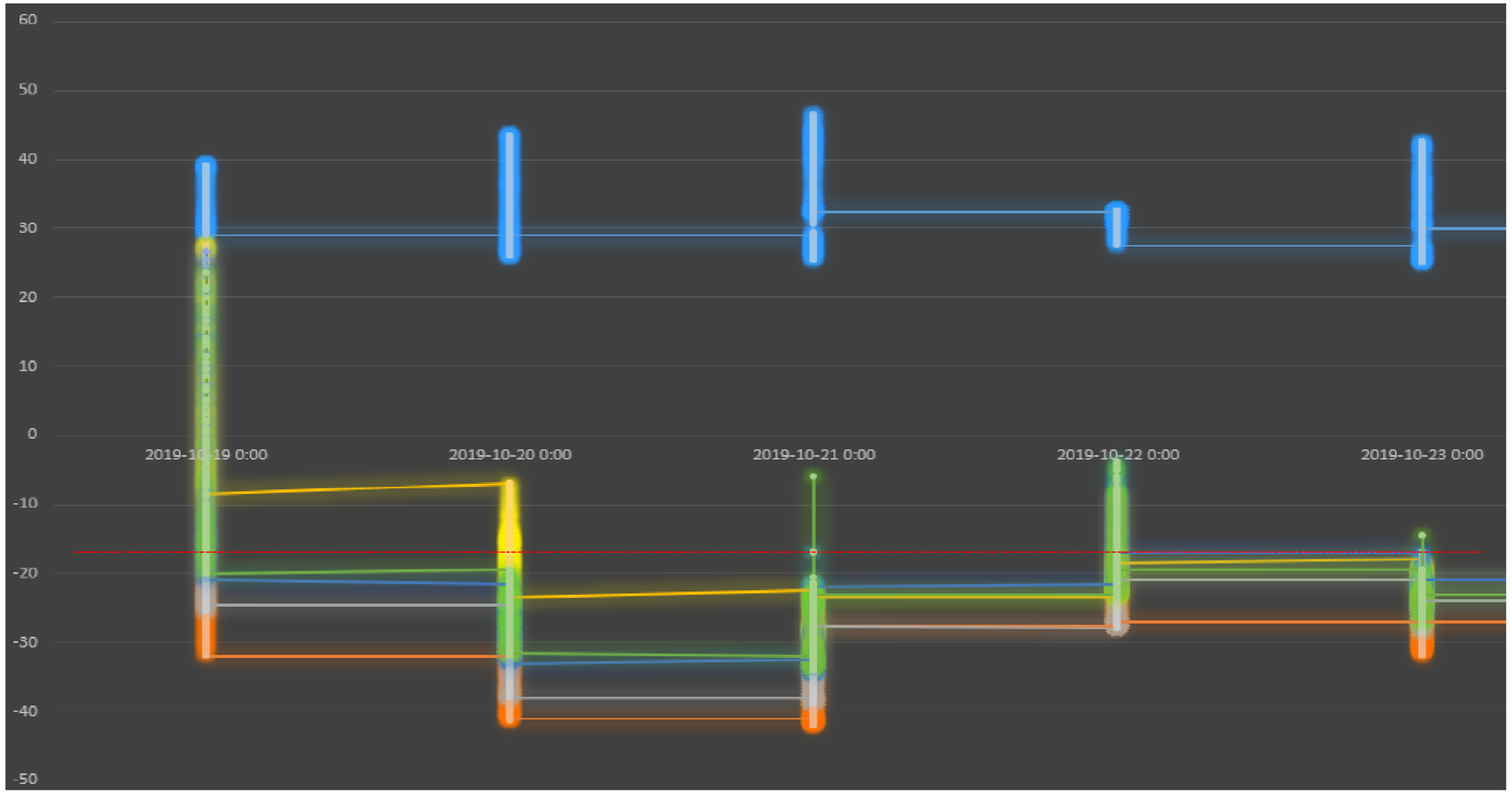
Maritime logistics field test result in Indonesia

Between Surabaya and Banjarmasin
19-OCT 15:00 – 22-OCT 21:00

arvento Mobile Systems



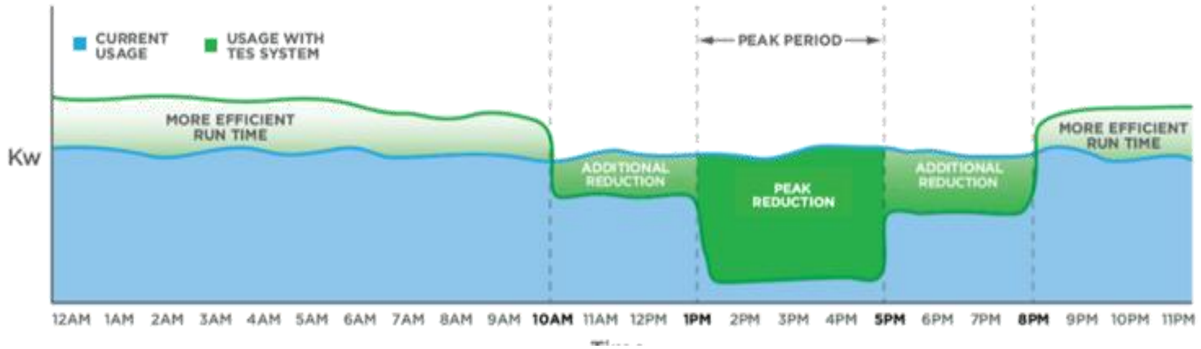




PCM Based Maritime logistics strategy in Indonesia



PCM, TES Storage







- **Energy Efficiency:**

  Cold storage systems store cooling energy during off-peak hours and release it when needed, reducing energy consumption and costs.

- **Temperature Stability:**

  Maintains consistent temperatures, ensuring optimal conditions for perishable goods like food, pharmaceuticals, or chemicals.

- **Cost Savings:**

  By utilizing off-peak electricity rates and reducing peak load demands, cold storage lowers operational costs.

- **Environmental Benefits:**

  Reduces reliance on fossil fuels and greenhouse gas emissions by optimizing energy use.

- **Extended Shelf Life:**

  Precise temperature control preserves the quality and freshness of stored goods, minimizing waste.

- **Reliability:**

  Provides a stable cooling source, even during power outages, if paired with backup systems.

- **Scalability:**

  Can be tailored to various warehouse sizes and cooling needs, offering flexibility for different industries.

Field Data for Cost-Benefit Analysis 3

COLD STORAGE	ELECTRICITY			DIESEL			COST
	KWh	Hours	Rp	Litre	Hours	Rp	Rp
Normal Cold Storage	3.7	24	111.750	5	1	52.500	164.250
PCM Cold Storage	3.7	8	37.000	-	-	-	37.000
COST SAVING			74.000			52.500	127.250
			Electricity Saving 66%			Generator Saving	77%

Information

. Date : October 2012
. Electric : Rp. 1.250 / kwh
. Diesel : Rp. 10.500 / ltr
. Charging Time : 8 hours

SAVING COST per DAY = Rp. **74.000**

SAVING COST per MONTH = Rp. **1.776.000**

SAVING COST per YEAR = Rp. **21.312.000**

+

Low Maintenance

EXTRA Generator

ETC.

PCM Modular Refrigerated Container





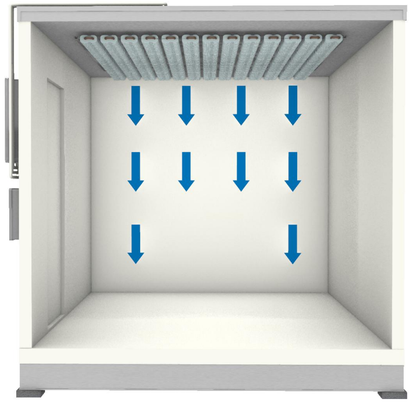


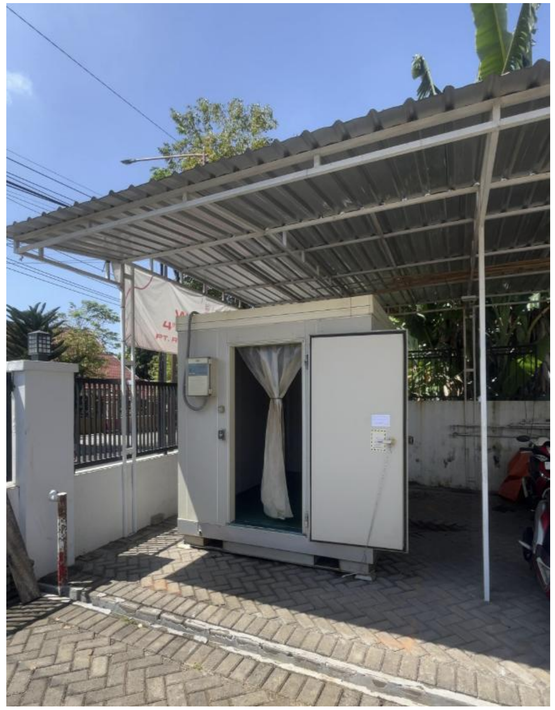


ETC.

PCM Modular
MINI Cold Storage











ETC.

PCM Modular
MINI Cold Station

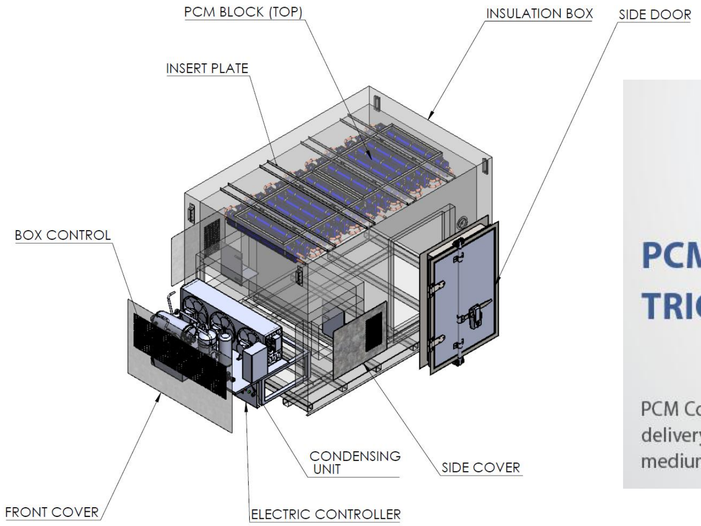








PCM
First/Last mile Solution















- **Cold Storage 3-Wheel Motorcycles:**
  Deployed in Indonesia, with exports planned for Cambodia, Philippines and other South East countries.
- **Urban Delivery Demand:**
  Rising need for temperature-sensitive product delivery in narrow alleys due to urbanization and e-commerce growth.
- **Economical Solution:**
  Provides a practical and cost-effective system for urban logistics.
- **Local Impact:**
  Strong interest from local communities, driven by growing market.

ACTIVE & PASSIVE

PCM Refrigerated Unit Load Device























ACTIVE & PASSIVE

PCM BOXes



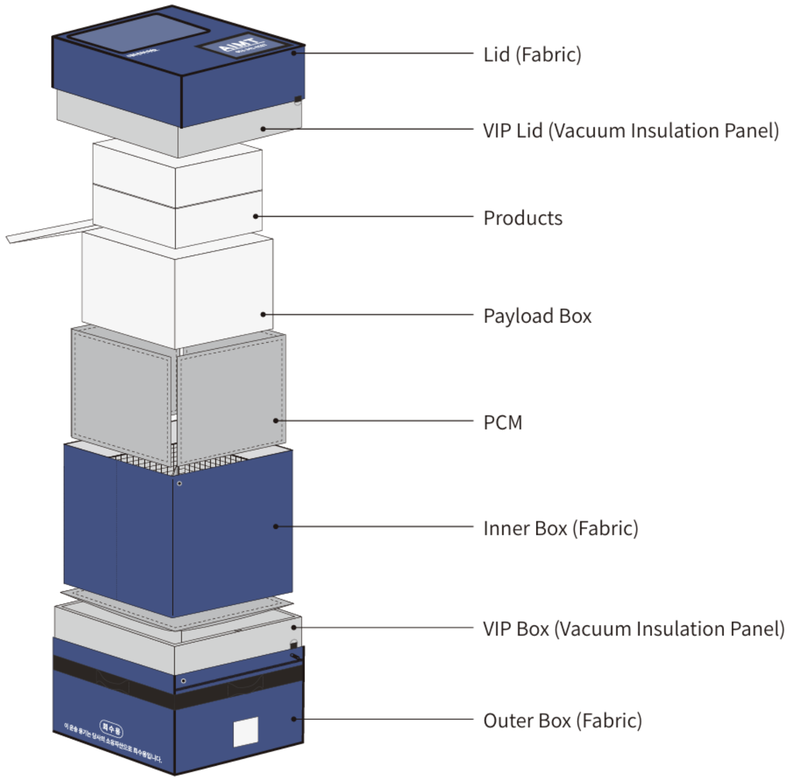




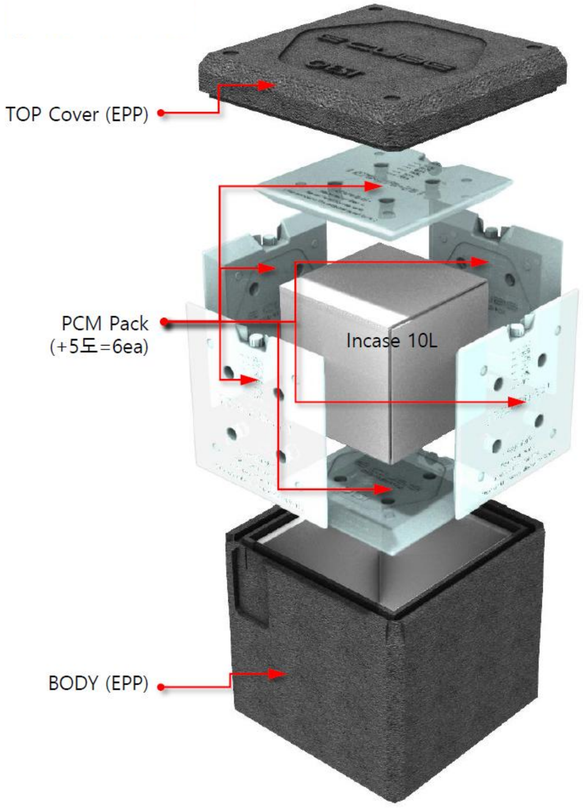




Schematic Diagram







ACTIVE & PASSIVE

PCM Refrigerated Unit Load Device











ACTIVE & PASSIVE

Dry Container PCM ULD Solution



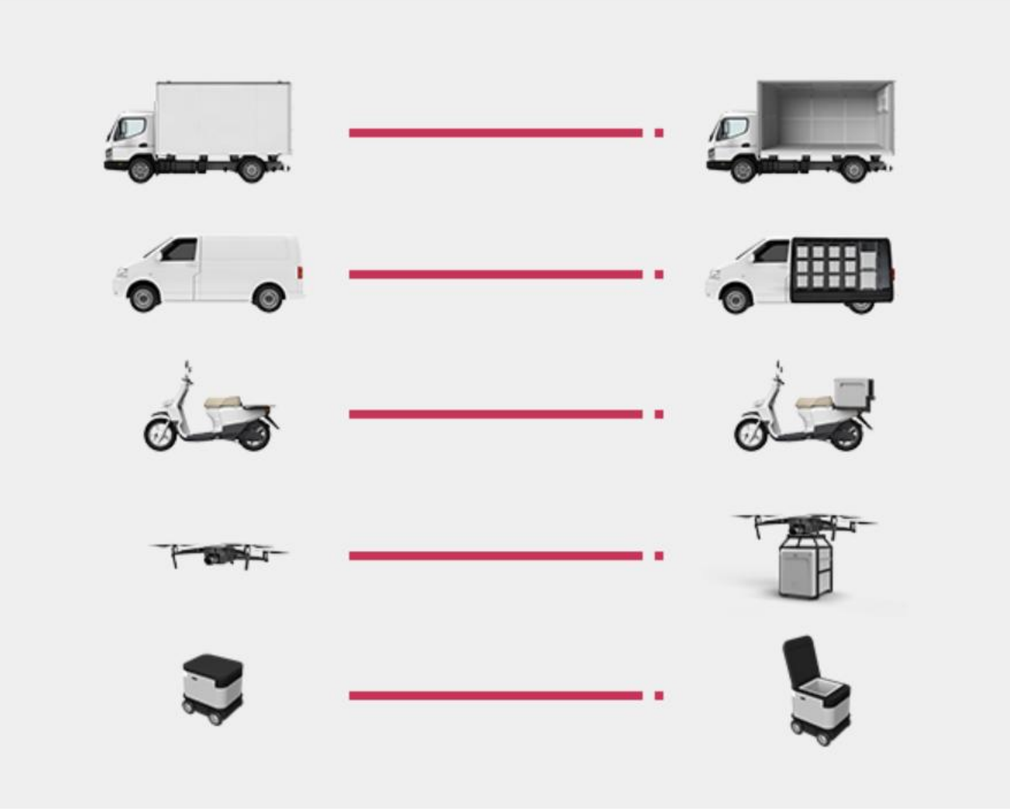
ACTIVE & PASSIVE

Dry Container PCM ULD Solution



ELECTRIC

Temperature Control for Middle & Last mile



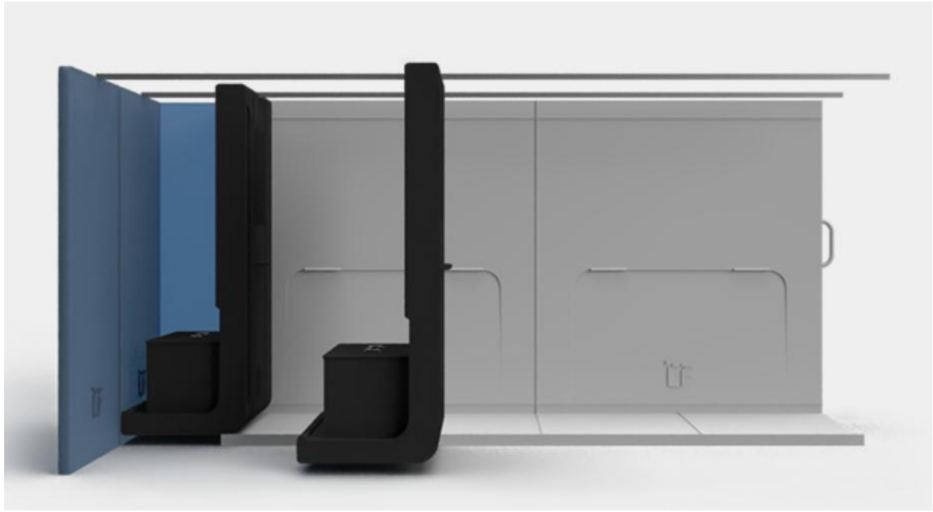


USAGE



ADR: For Transport

VSR: For Storage



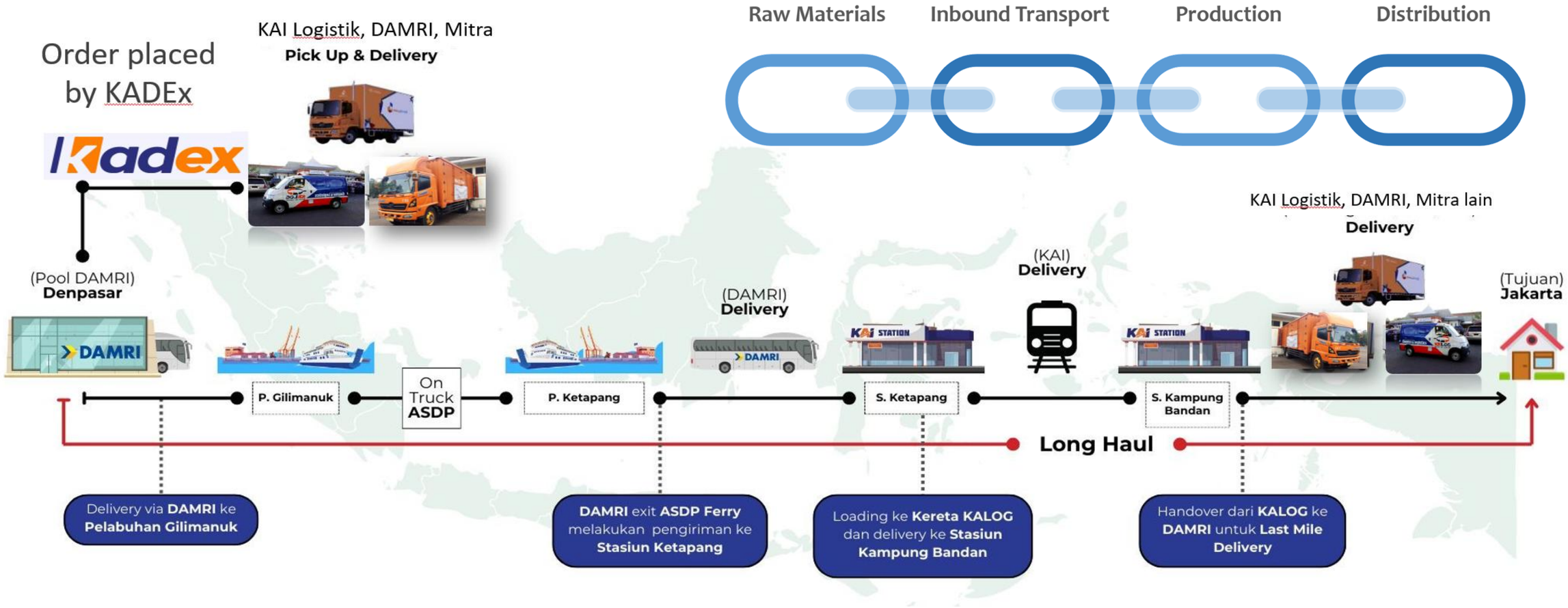
USAGE



For Transport

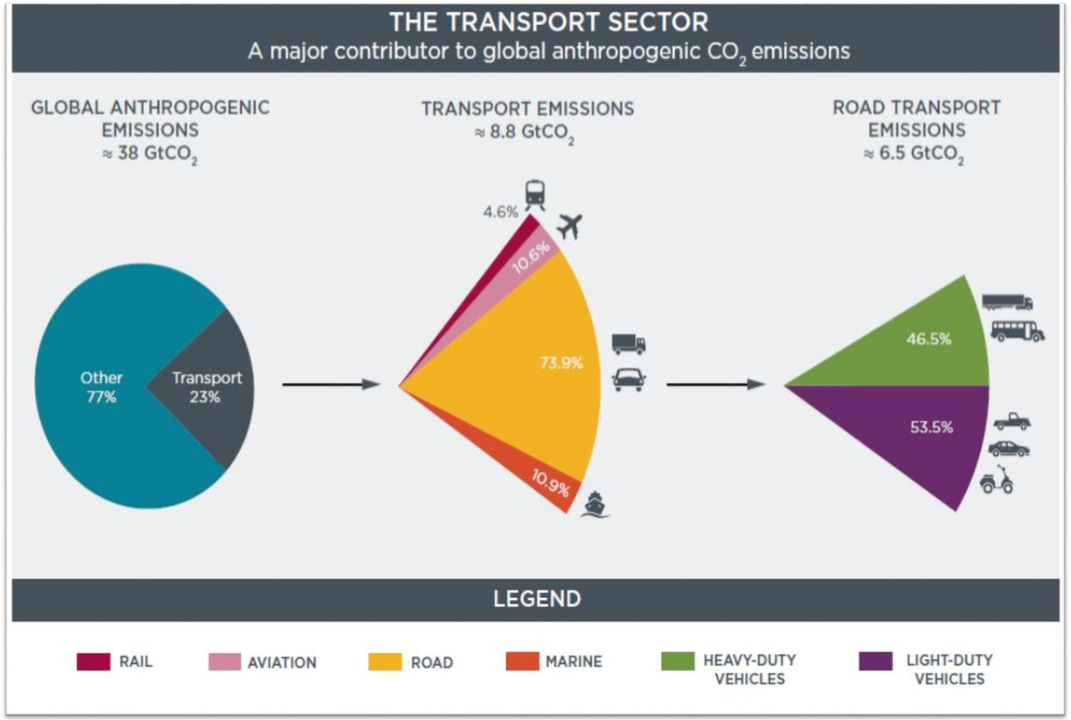
Multimodal Cold Chain System in Indonesia

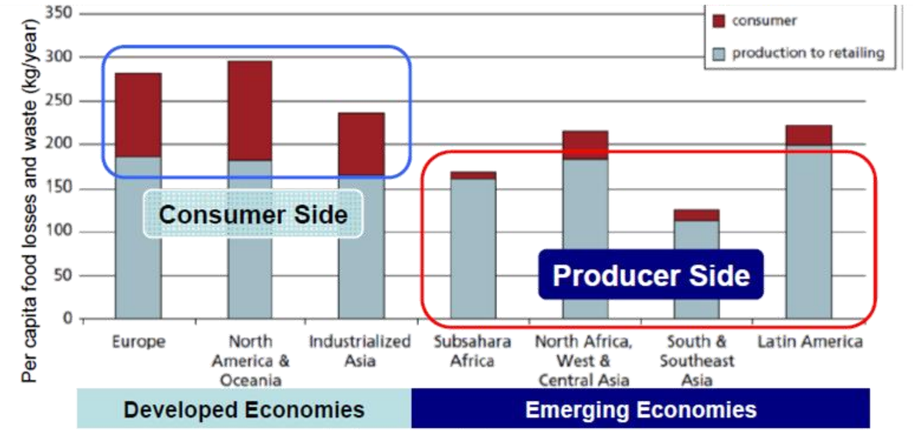
- Integrating rail hubs with key road routes to optimize time and reduce costs
- PCM containers can be easily linked with sea freight, providing stable temperature control across different transportation modes
- Efficient and eco-friendly solutions for the last mile of the supply chain, ensuring temperature stability until the end consumer



Sustainable Cold Chain with PCM Technology

- We apply PCM technology to develop innovative cold chain solutions in Southeast Asia.
- Our goal is to reduce carbon emissions during transportation.
- By addressing the shortage of reliable cold chain systems, we minimize resource waste from production to storage and distribution.
- This contributes to environmental protection, improved public health, and higher local incomes.





Latest Initiative – 5th June, 2013
USDA/EPA launched **the U.S. Food Waste Challenge**, calling on others across the food chain —including producer groups, processors, manufacturers, retailers, communities, and other government agencies - to join the effort to reduce, recover, and recycle food waste.

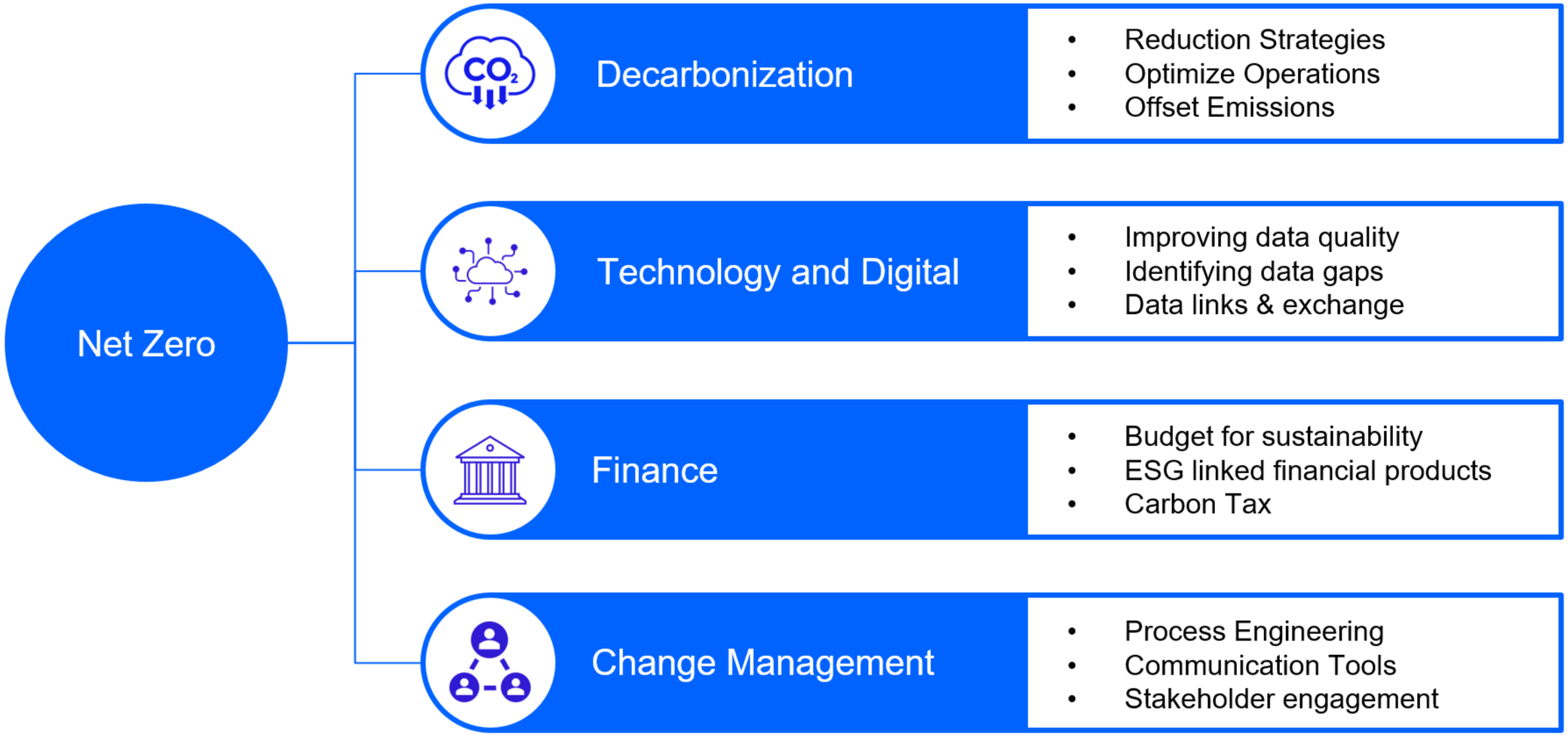
Awareness of Communities

- Poor storage facilities
- Lack of refrigeration
- Lack of primary processing facilities
- Poor transportation
- Inadequate market system and facilities
- Poor packaging

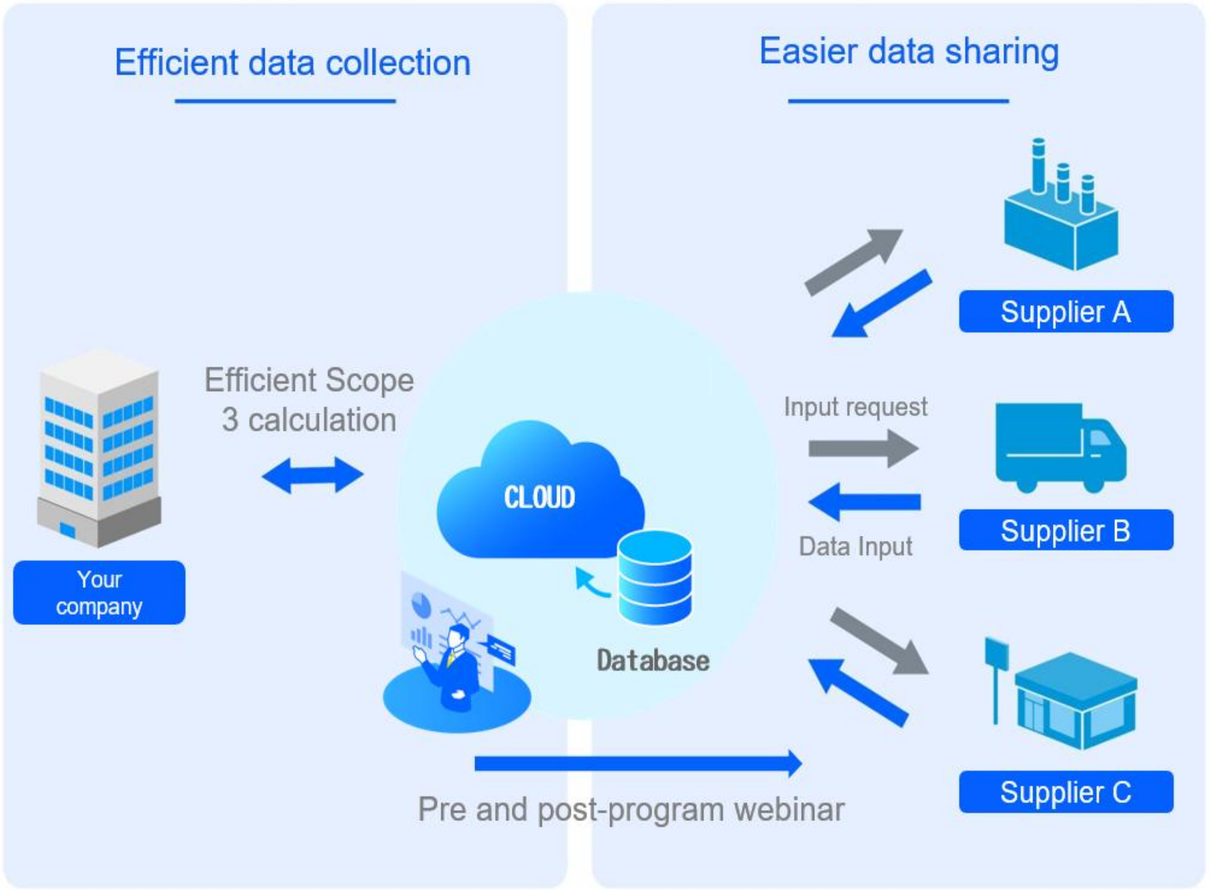
Need for Cold Chain Infrastructure

Source: FAO "Global Food Losses and Food Waste", 2011

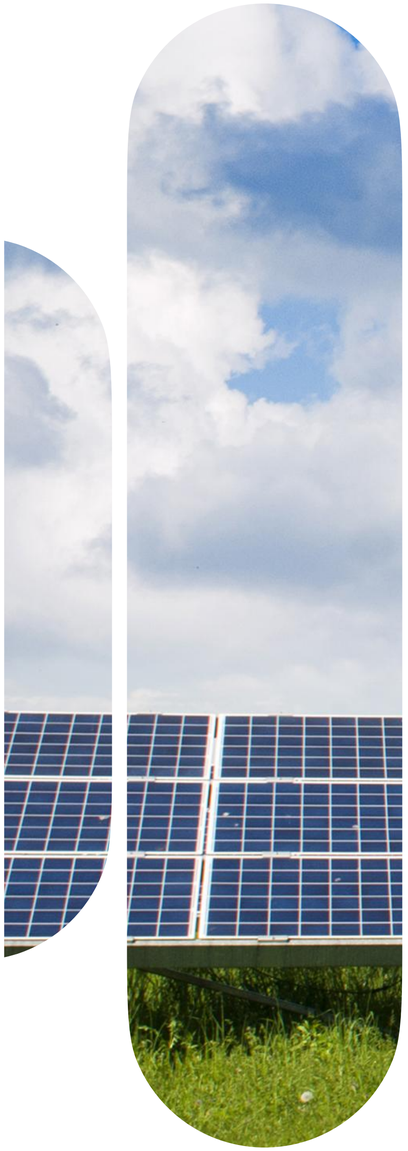
Sustainable Cold Chain with PCM Technology



Sustainable Cold Chain with PCM Technology



- Although Indonesia has set relatively modest goals compared to other nations, it is imperative to start building a cold chain logistics infrastructure with eco-friendly technologies, such as PCM technology.
- Utilizing IT, as shown in the diagram, to digitize data collection, enhance cloud-based calculations, and facilitate efficient data sharing with suppliers is critical.
- Preparing this foundation now will ensure a sustainable and future-ready logistics system for Indonesia.



EST
Energy Solution Technology

