DENSO

Crafting the Core

DENSO "Lean & Clean" Factory toward CO_2 Neutrality

Agenda

1. Outline of DENSO
2. CO_2 Neutrality Effect & DENSO Challenge
   -DENSO "Lean & Clean" Factory-
3. Lean Mfg. & Lean Automation
4. Lean Energy
5. Clean Energy

16th February 2023
Dr.Theerawat Limpibunterng
Siam DENSO Manufacturing Co.,Ltd.

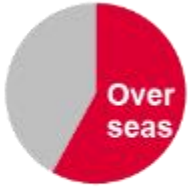
DENSO Group: Group Profile & Key Figures

DENSO is known as ‘World Leading Automotive Parts Supplier’ for more than 70 years, continuously focuses on R&D for its best.

Established
Dec. 1949

Consolidated Rev.
5.5 Trillion Yen

Employees
170,000



Global Network

Overseas Revenue Ratio
57%

Patents hold Globally
41,500

Medals Won at World Skills Competitions
69

DENSO Group Overview: Main Products

Powertrain


Gasoline engine system


Diesel common-rail system


Discharge system



Starter, Alternator


Hybrid system

Information & Safety


Display


Head-up display


Milliwave radar


ETC


Laser radar

Electronic Control


Computer on automobiles (ECU)



Semi-conductor

Thermal Management


Car Air-Conditioning


Compressor


Engine cooler


Radiator

Non-automobile


QR scanner

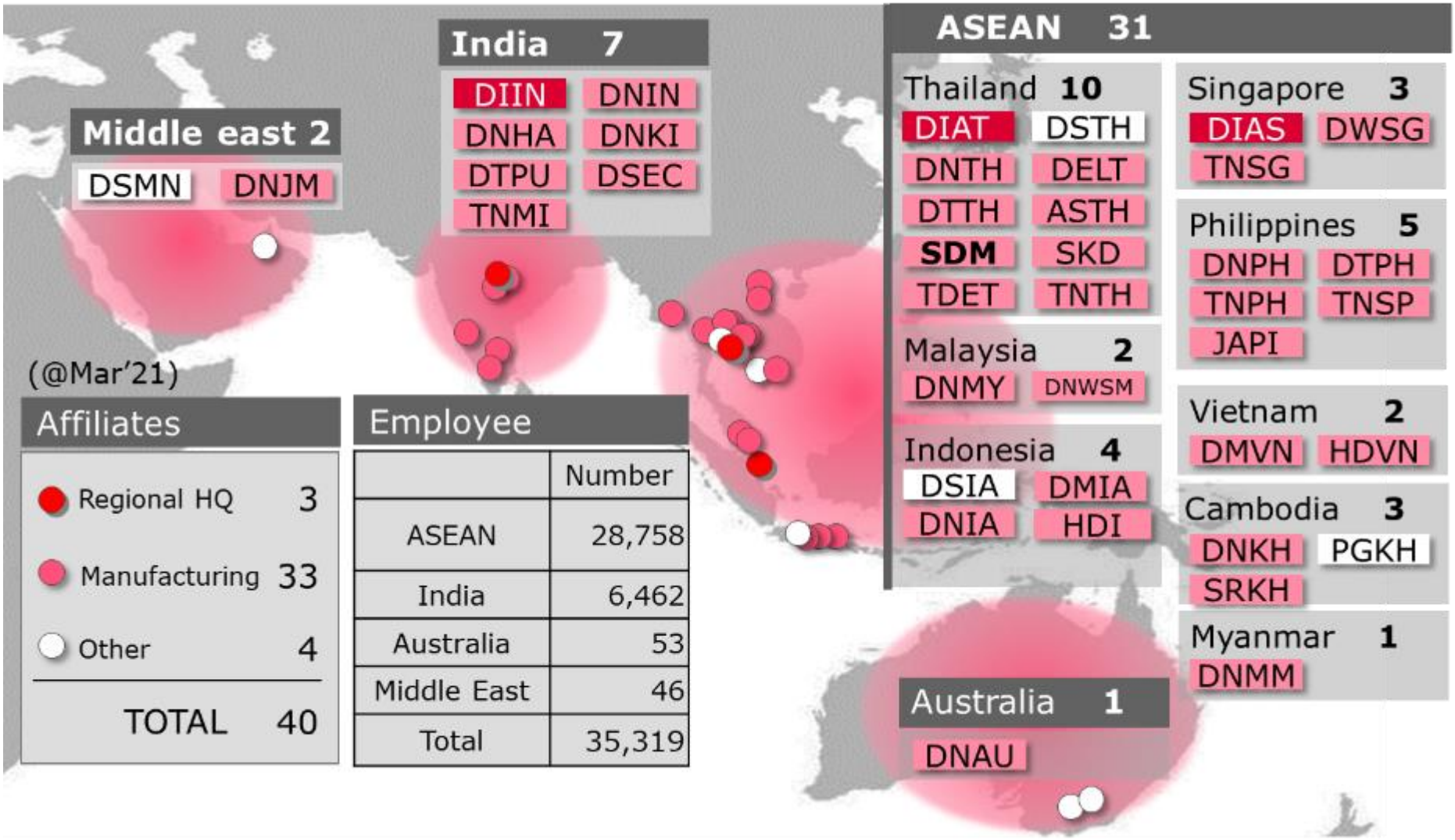

Robot


Spot A/C


CO2 Boiler

Strength: Integration of several elements & engineering

DENSO's Asia Business



Affiliates	
Regional HQ	3
Manufacturing	33
Other	4
TOTAL	40

Employee	Number
ASEAN	28,758
India	6,462
Australia	53
Middle East	46
Total	35,319

40 Operations in Asia with HQ & Mother plant in Thailand.

"DENSO will eliminate CO_2 emissions by 2035"

Our goal is to eliminate CO_2 emissions by 2035. We will work on two separate goals: developing products that contribute to decarbonization, and reducing CO_2 emissions from manufacturing at plants.

(excerpt from Nikkei Online *One of the biggest media in Japan)

Key issue for Asia

Firstly focus on Scope 1 & 2

We will focus on three fields.

(1) Manufacturing

The focus is how to reduce CO_2 emissions from plants in the product manufacturing process.

(2) Mobility products

We will develop broad technologies, from increasing the fuel efficiency of internal combustion engines to EVs, HVs, and FCVs. We will carefully allocate our resources.

(3) Energy use

We will develop systems for collecting and reusing CO_2 in the atmosphere and CO_2 emissions from plants and offices.

Our Target

2025 : Achieve CO_2 neutrality for electricity
2035 : Achieve CO_2 neutrality for electricity & gas

DENSO's Factory Direction in Asia

Lean & Clean

Realize CO2 free factory by improving productivity to reduce energy consumption with continuous kaizen (waste elimination) in factory over all before replacing the minimized energy to clean energy

1. Lean Mfg. & Automation

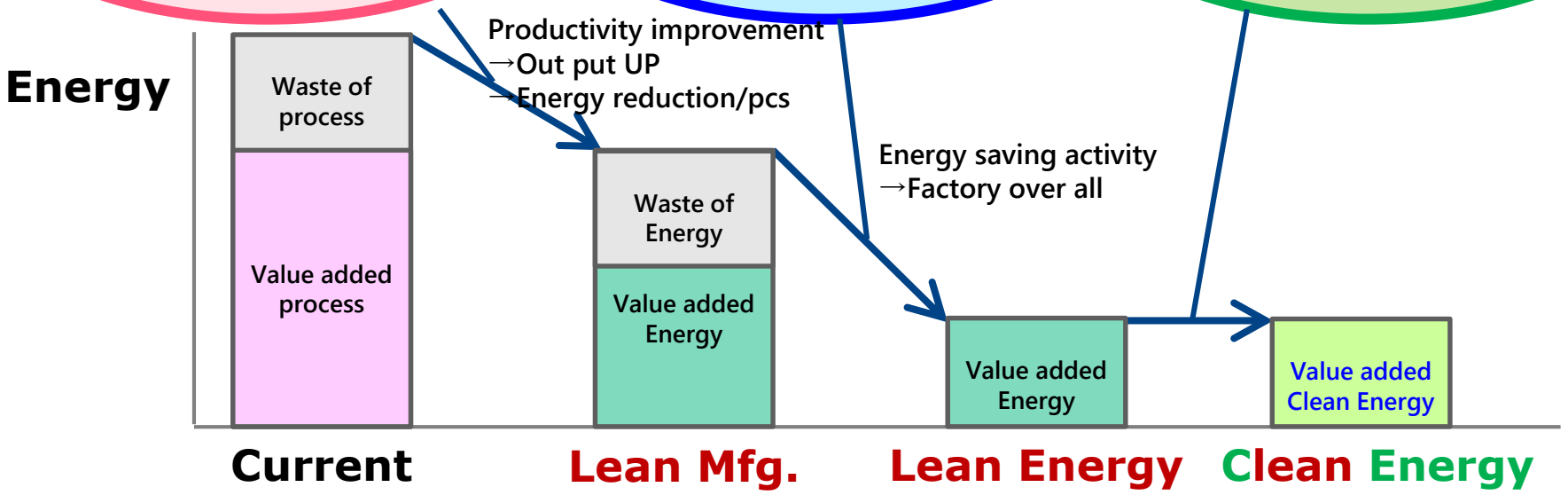
Productivity improvement
Lean Mfg.→ Lean Automation

2. Lean Energy

Visualize waste→Kaizen : Energy JIT
Reduce energy：1/N Machine, Reuse

3. Clean Energy

RE Self generation
RE Purchasing



Aim to achieve CO2 Neutrality with Cost competitiveness

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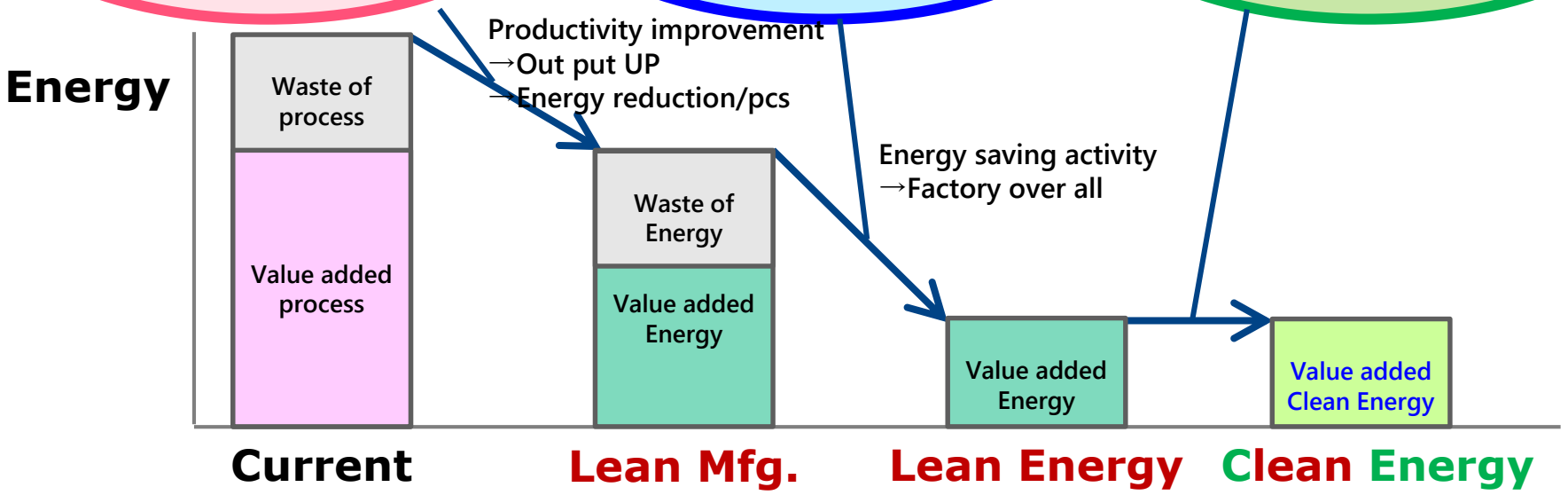
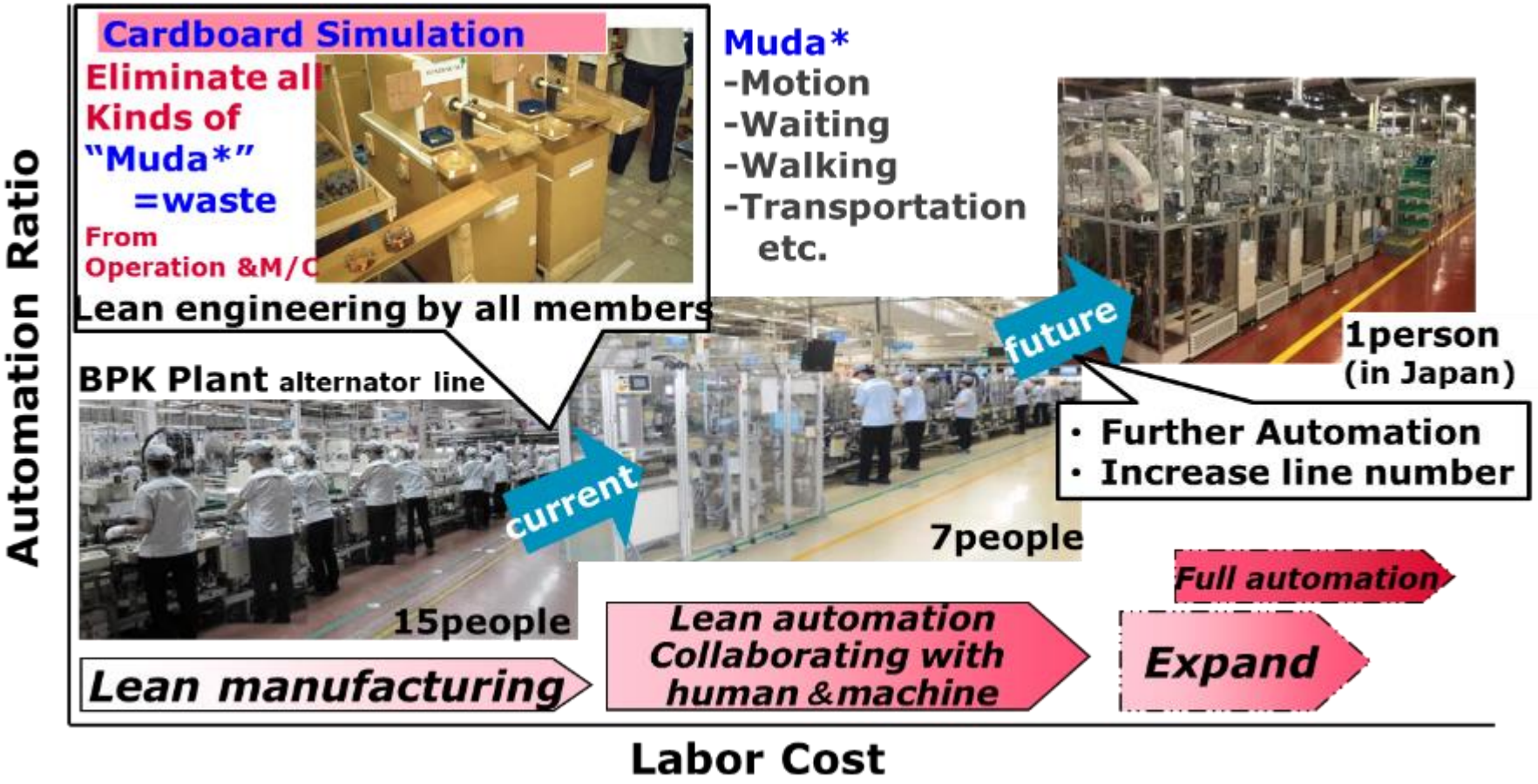


Aim to achieve CO2 Neutrality with Cost competitiveness

Lean Manufacturing & Automation in Asia

Promote **Lean Mfg. & Lean Automation** to maximize productivity and minimize all wastes & resources (investment, machine, manpower, energy)

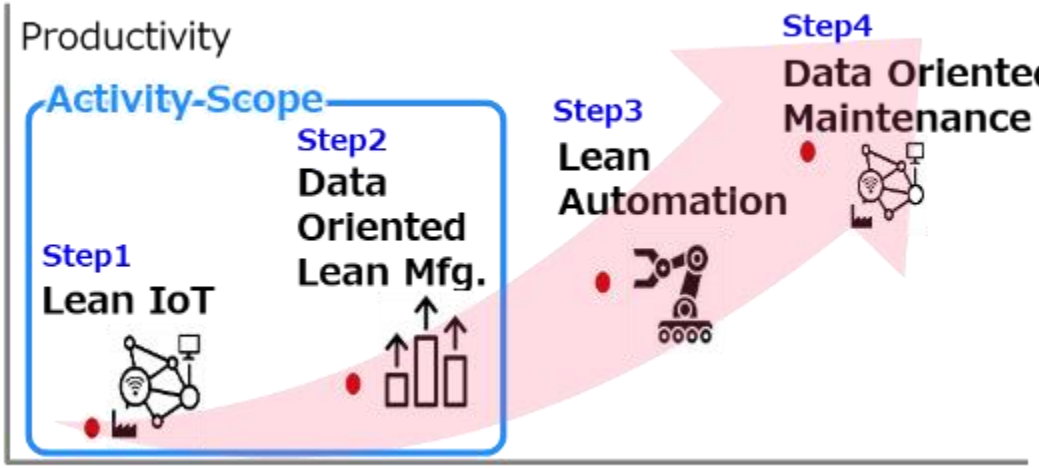


Productivity: >Double, ROI: <1Year

IoT for Lean Manufacturing & CO_2 Reduction

Ex. Cutting line

DENSO Lean Automation Kaizen Process



Activity Detail

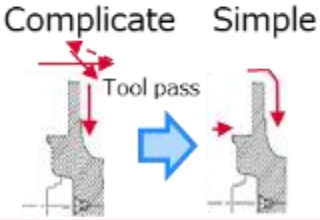
【Step1】 IoT visualization

Find **real bottle-neck** from data & prioritize Kaizen

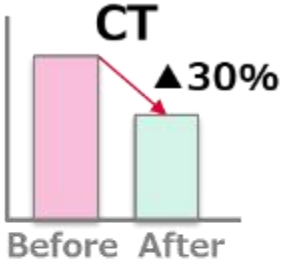
【Step2】 Data Oriented Kaizen

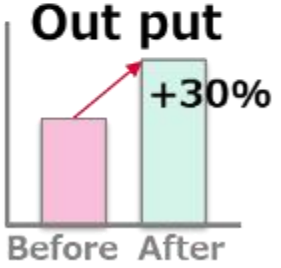
Data + DENSO know-how
→Propose effective idea

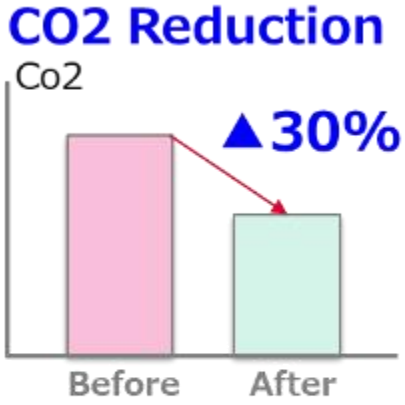
- Cutting tool integration
- Tool life improvement
- Tool pass reduction



Result







-Loss, Over time reduction
-Out put improvement
→Electricity/Air reduction

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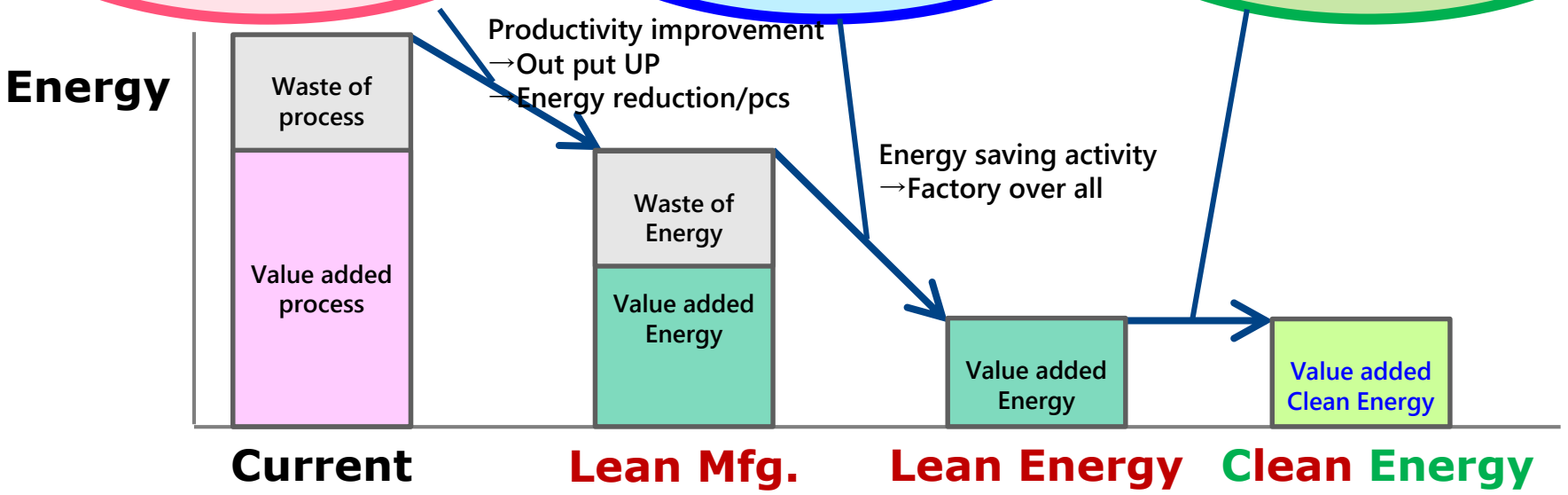
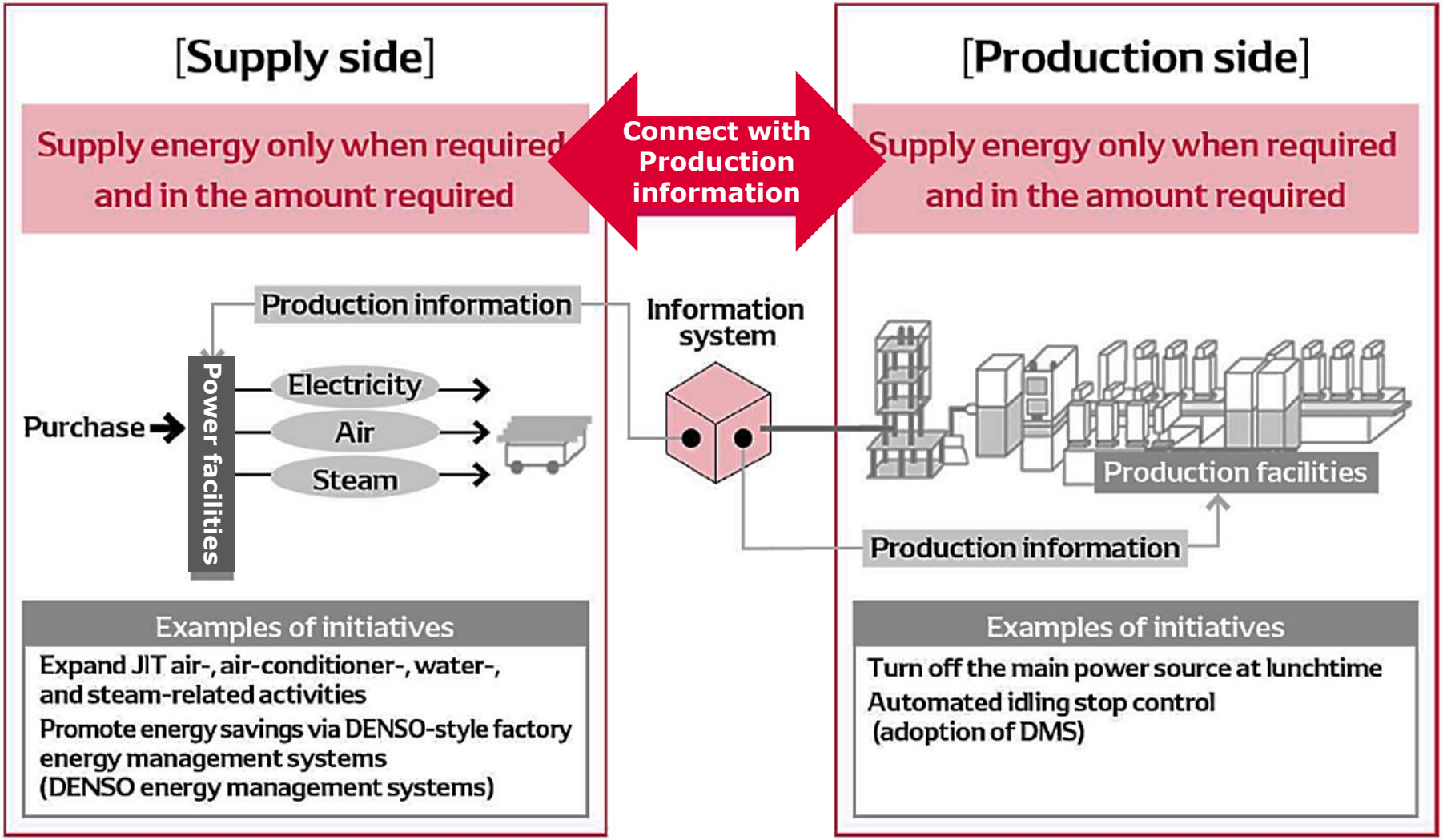
RE Self generation
RE Purchasing



Aim to achieve CO2 Neutrality with Cost competitiveness

Energy JIT: Eliminate Energy Waste First

【Thinking way】 Consider energy as part, not infrastructure



Optimize energy demand ⇔ supply as “Timing”, “Place” ,“Amount”

IoT Visualization for Energy JIT

Visualize invisible loss → Increase awareness → Quick idea & action

Supply

①Factory Level

Electricity

MDB
Main Distributer Box

Air

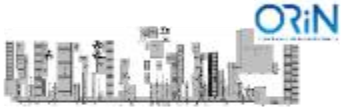
Compressor

ORiN

Air Compressor (13MC)

Demand

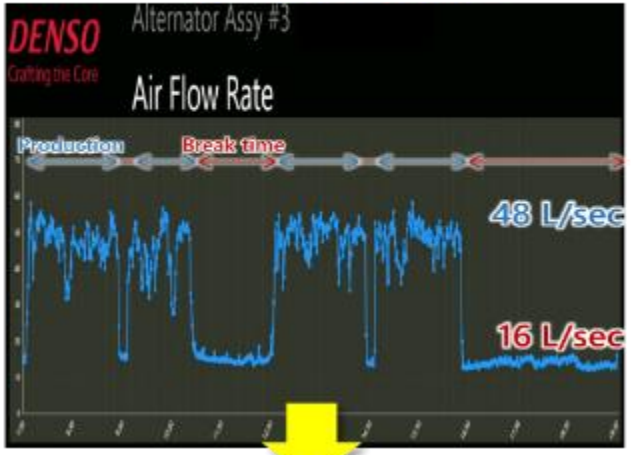
②Production Line Level



Air Flow Rate [L/sec]

Non-production Air loss 30%

Before: Air loss 30%



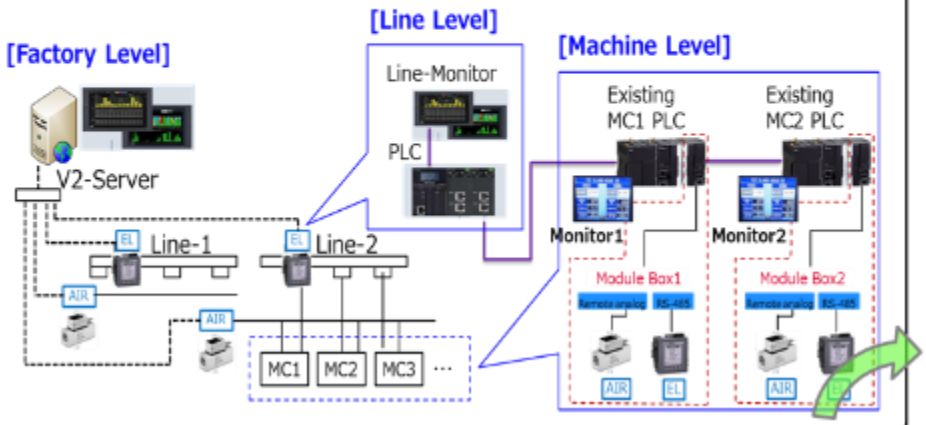
After: Reduce loss by half

Asia Energy Reduction Tech. Development

Concept: Low-cost Add-on module + Applicable to current machine

Energy Visualization

Utilize existing system resources

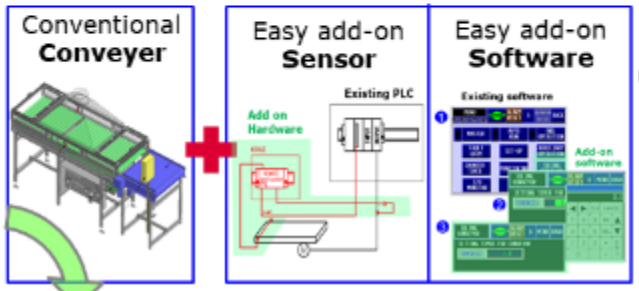


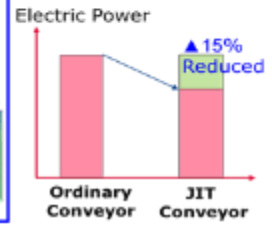
Energy Just-In-Time

Easy Add-on function/unit

Idling stop function

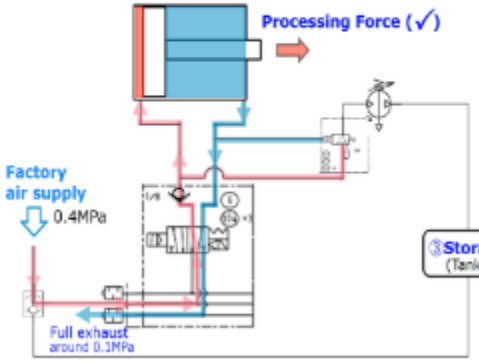
JIT Conveyer





Energy Reuse/Recovery

Reuse of waste air/energy

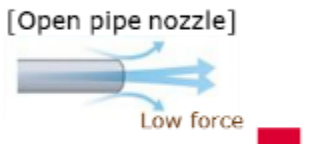


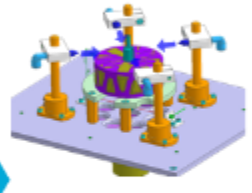
Thinking way
①**Recovery** exhaust air
②**Power-up** low air pressure by booster
③**Storage** High pressure by air tank
④**Return** Air to main supply(Hybrid system)

Energy Reduction

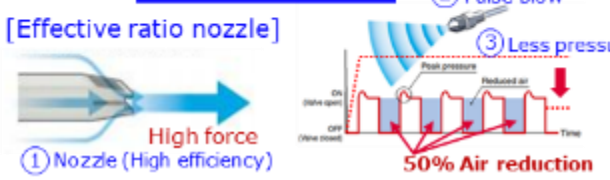
1/N energy optimization

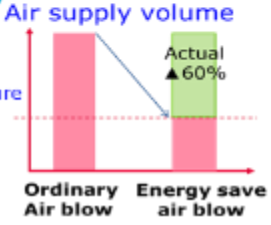
Current Constant Air Blow





Pulse Air Blow





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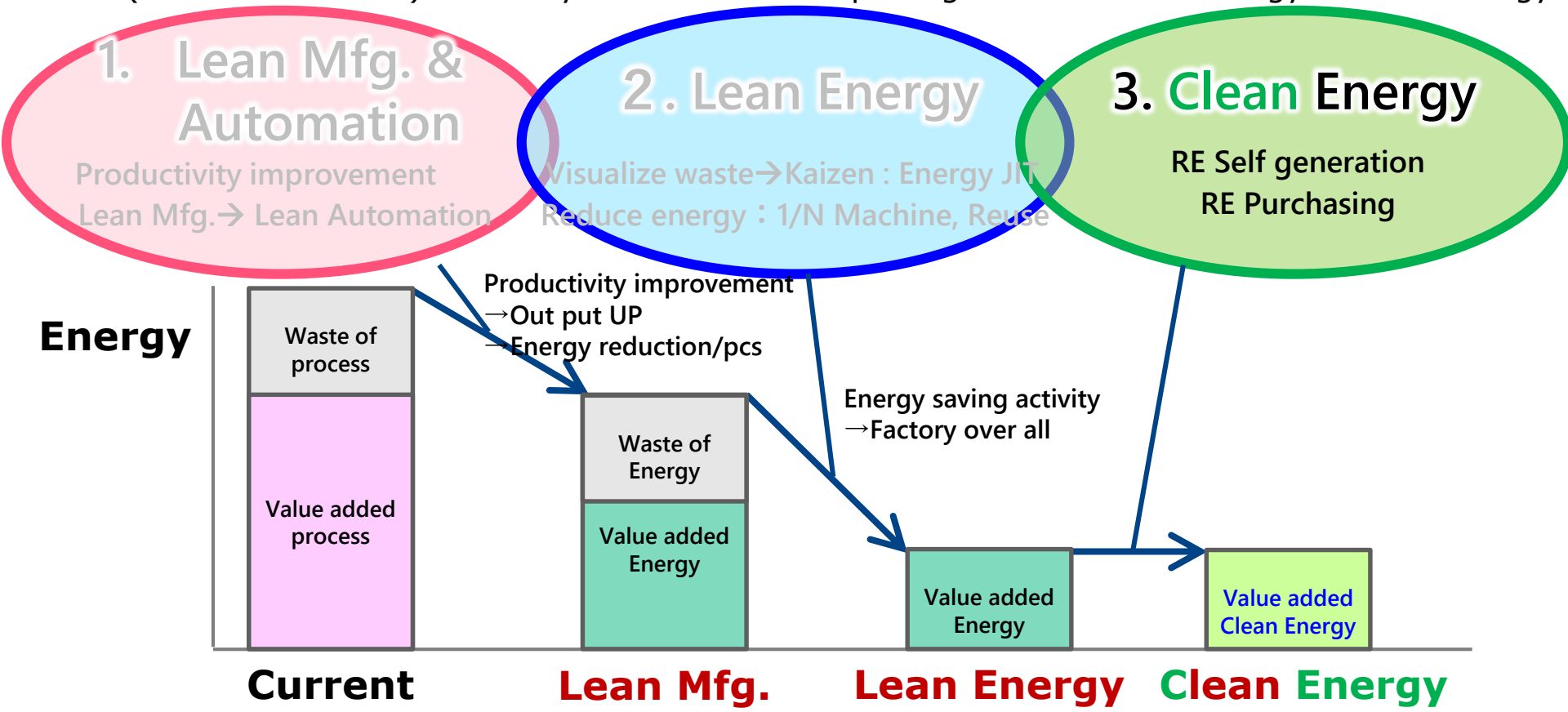
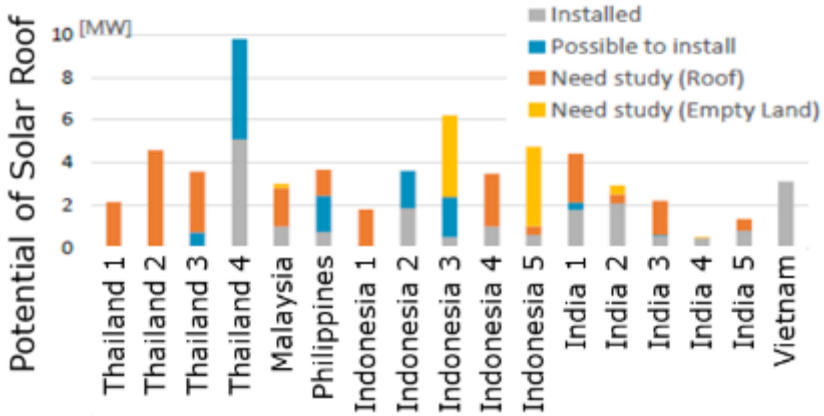


Aim to achieve CO2 Neutrality with Cost competitiveness

RE Self-Generation

【Thinking way】 Continuous effort to increase energy generation

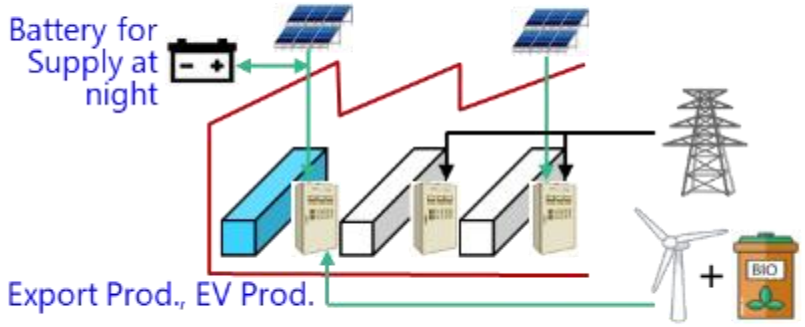


- Proactively promote solar roof installation at all factories by 2025
- 17 factories in Asia with possibility around 30 MW + potential 15 MW
- Study various concept to optimize RE for each factory necessity

RE supply to whole factory

Ex. Siam DENSO Manufacturing (Thailand)

RE supply to specify line



Smart Micro Grid direct supply

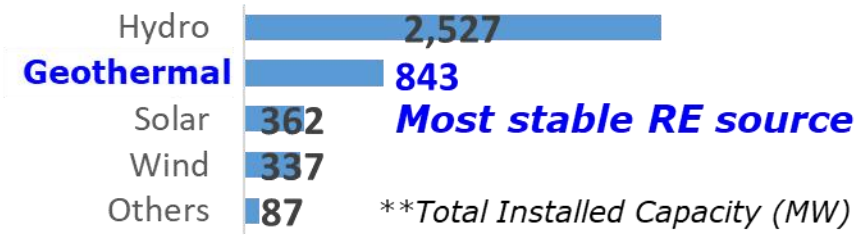
However only internal RE generation is not enough.
RE purchasing is key issue to achieve competitive CO_2 Neutrality.

RE Purchasing: Rich RE Country

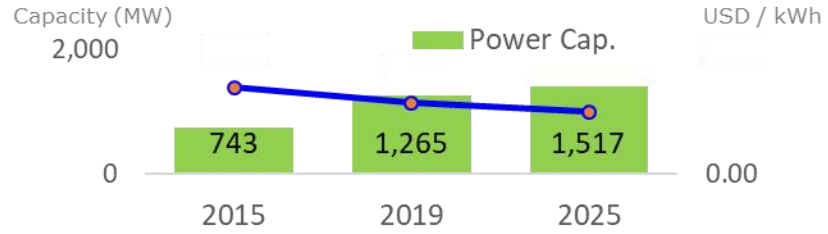
【Thinking way】 Utilize country strength to realize CO_2 Neutrality

DENSO Philippines Case Study

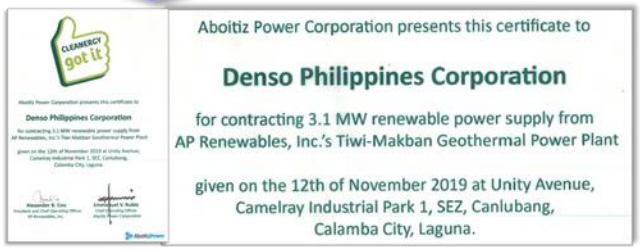
❑ High RE Sources: 30%



❑ Geothermal Capacity & Cost Forecast



Strategy 1
Quickly switch to RE to avoid one time big investment


Aboitiz Power Corporation presents this certificate to

Denso Philippines Corporation

for contracting 3.1 MW renewable power supply from AP Renewables, Inc.'s Tiwi-Makban Geothermal Power Plant

given on the 12th of November 2019 at Unity Avenue, Camelray Industrial Park 1, SEZ, Canlubang, Calamba City, Laguna.

Strategy 2
Sustain environmental back-up energy with continuous purchased energy reduction

- Continue install solar roof 16,000 sqm
- Complete 2.25 MW RE self-generation in 2025

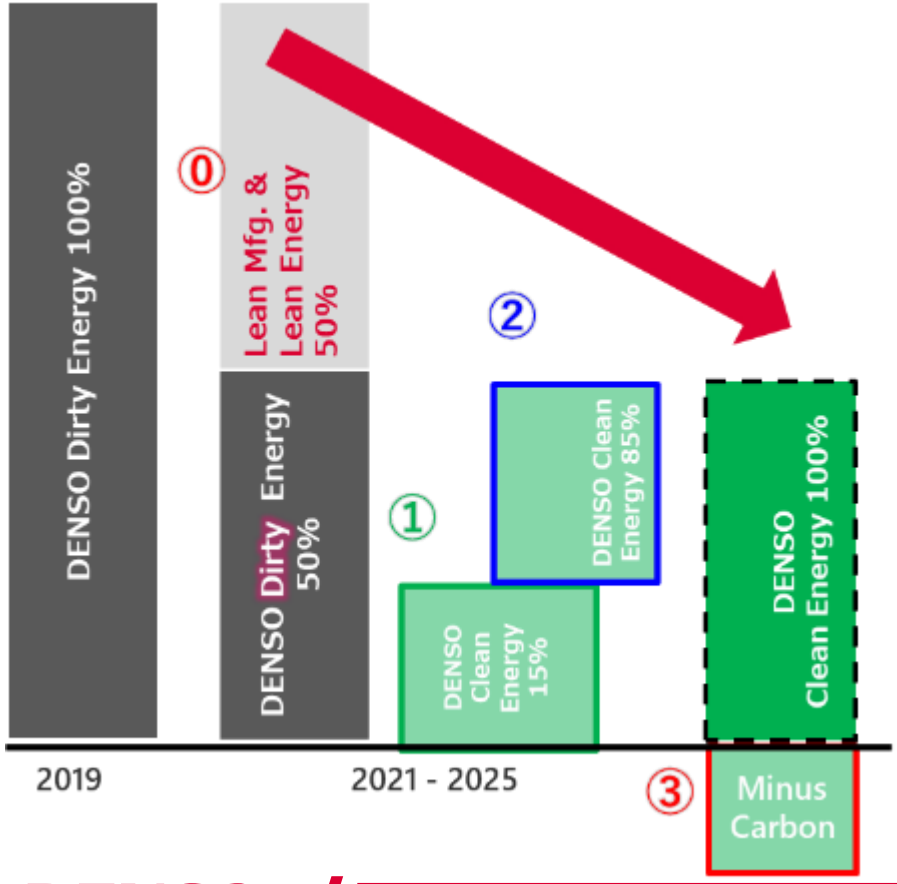
DENSO Philippines has achieved CO_2 Neutrality so far.

RE Purchasing: RE Unpurchaseable Country

Thai DENSO Group Case Study

Collaborate with "Federation of Thai Industries" to realize **"Lean & Clean Factory" model** and expand to other industries to contribute as **"Minus Carbon"**

- DENSO group contributes strong points of Lean manufacturing & Lean Energy
- FTI supports for promoting RE purchasing realization

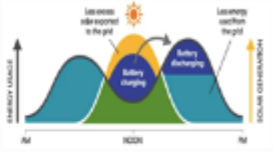


⓪Reduce Energy 50%

0.1 Lean Mfg. & Lean Automation
0.2 Lean energy

①Self Generation

1.1 Storage excess energy
1.2 Sell at noon use at night



②RE Purchasing

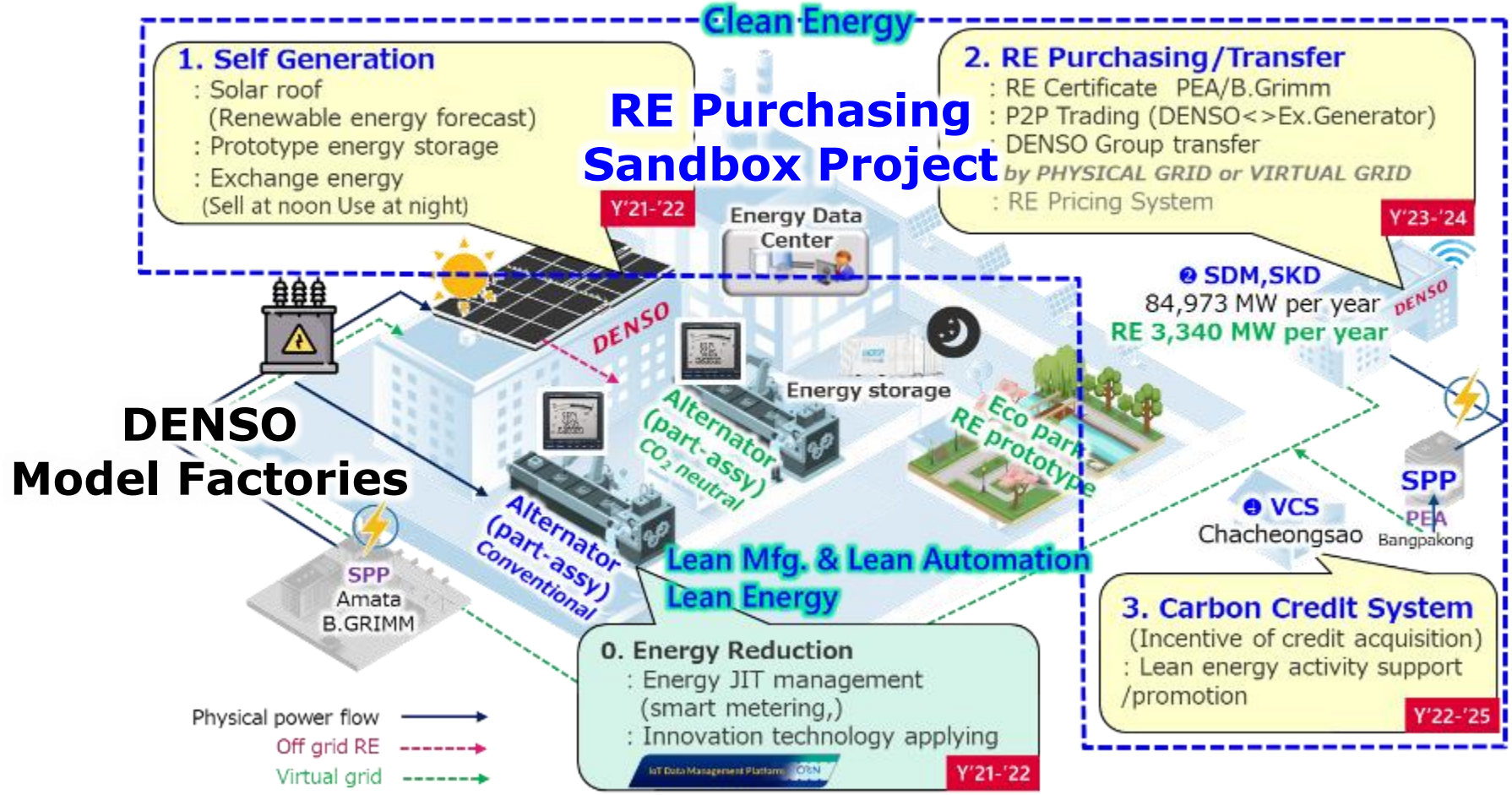
2.1 Purchase RE from outside (Virtual power plant)
2.2 RE transfer in DN group

③Energy Saving Expansion

3.1 Sharing know-how of energy-saving
3.2 Transfer of Carbon credit from energy-saving support

RE Purchasing: RE Unpurchaseable Country

Currently apply this model to Sandbox project of Thai Government in order to test and verify RE purchasing regulation in Thailand.



DENSO

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