Matchmaking and Dissemination Workshop

12th January, 2016 at Ahmedabad

Organised by

The Energy and Resources Institute (TERI)
Institute for Global Environmental Strategies (IGES)
Gujarat Energy Development Agency (GEDA)
Gujarat Industrial and Technical Consultancy Organisation Limited (GITCO)

Workshop summary

The matchmaking and dissemination workshop was organized on 12 January 2016 at Ahmedabad Management Association in Ahmedabad.

The objectives of the workshop were to discuss:

- Share technical details about selected energy efficient technologies from Japan
- Explore financing models to promote new technologies in industries
- Develop a longer-term cooperation between Hyogo (Japan) and Gujarat (India) on cleaner technologies

The event was organised by TERI in collaboration with two state level stakeholders - Gujarat Energy Development Agency (GEDA) and GITCO which is the nodal technical consultancy organisation at the state-level.

The inaugural session was attended by government representatives from both India and Japan. The Japanese side was represented by Mr Noriaki SUGA, Deputy Director, Environmental Management Bureau, Global Warming Solutions Division, Hyogo Prefectural Government and Indian side was represented by Mr I M Bhavsar, Chairman, Gujarat Energy Development Agency (GEDA) and Mr R. D. Barhat, Dy. Commissioner of Industries, Govt. of Gujarat. Dr Rabhi Abdessalem, IGES made a overview presentation on 'Opportunities and challenges to disseminate Japanese technologies' at the inaugural session.

The next session on matching Business to Business (B2B) focused on sharing some new Japanese technologies in compressed air and steam systems with Indian businesses. Technical details of compressed air system was shared by Mr Saito Tsukasa, formerly with Compressor System Division, Hitachi Industrial Equipment System Co. Ltd, Japan. Other technical presentations on 'Steam Management system' and 'Once through Boiler/ Waste heat recovery' was made by Mr Hayato KIDA, TLV, Japan and Mr Kenichiro IKEUCHI, Miura, Japan respectively.

The technical sessions were followed by a session on matching Businesses to Funding Agencies (B2F). This session focused on schemes dedicated to energy efficiency in India such as JICA and JBIC credit lines. Panelists from GEDA, GITCO, EESL and Bank of Baroda deliberated on possibilities/ways to channelize the finance towards Japanese technologies.

In the concluding session a panel discussion on policies to promote application of Japanese energy efficient technologies among industries in Gujarat was organised. The session, which was chaired by Dr Chandan Chatterjee, Director, The Centre for Entrepreneurship Development, Govt. of Gujarat, provided direction for deepening collaboration within an integrated framework and long-term perspective between Hyogo prefecture and Gujarat state. It was recommended to set-up a joint steering group to monitor the progress of activities on an annual basis and advise on strategic aspects of Indo-Japanese collaboration in the future.

About 60 participants from industry, government, consultancy agencies and funding organisations participated in the event.

Annexure 1: Agenda of the event

Workshop

Tapping opportunities for disseminating Japanese energy efficient technologies in Indian industries

Venue:
AMA, Ahmedabad

Date:
January 12, 2016

AGENDA

10:00-10:30 hr	**Registration**
Session 1: Inaugural Session	
10:30 – 11:30 hr	**Welcome Address** Mr Girish Sethi, Senior Director, Industrial Energy Efficiency Division, The Energy and Resources Institute (TERI) **Background presentation:** **Opportunities and challenges to disseminate Japanese technologies** Dr Rabhi Abdessalem, The Institute for Global Environmental Strategies (IGES), Japan **Special Address** Mr Noriaki SUGA, Deputy Director, Environmental Management Bureau, Global Warming Solutions Division, Hyogo Prefectural Government **Inaugural Address** Mr I M Bhavsar, Chairman, Gujarat Energy Development Agency (GEDA) – Guest of Honour **Keynote Address** Shri R. D. Barhat, Dy. Commissioner of Industries, Govt. of Gujarat
Session 2: Technical Session: Matching Business to Business (B2B) – Technical Presentations	
11:30 – 13:00 hr	**There are many energy efficient Japanese technologies that could find widespread applications in industry in India. The session focuses on sharing some new Japanese technologies in compressed air and steam systems with Indian businesses.** **Chairperson:** Mr Mayur Karmarkar, ICAI, Mumbai **Compressed air system: Opportunities and challenges for dissemination** Mr Saito Tsukasa, formerly with Compressor System Division, Hitachi Industrial Equipment System Co. Ltd, Japan **Steam Management system: Opportunities and challenges for dissemination** Mr Hayato KIDA, TLV, Japan **Once through Boiler/ Waste heat recovery: Opportunities and challenges for dissemination** Mr Kenichiro IKEUCHI, Miura, Japan
13:00 – 14:00 hr	**Lunch**

Session 3: Financial session: Matching Businesses to Funding Agencies (B2F) – Panel Discussion	
14:00 – 16: 00 hr	**Many financing mechanisms are available for promotion of energy efficient technologies among Indian industry. The session highlights some of the schemes dedicated to energy efficiency and will deliberate on possibilities/ways to channelize the finance towards Japanese technologies.** **Chairperson:** Mr Chandra Shekhar Thanvi, SIDBI **Background presentations:** **i) Opportunities for introduction of energy efficient technologies among Indian chemical industries: case studies and financing models** Mr Pawan K Tiwari, TERI **ii) Proposal for a matchmaking framework** Dr Rabhi Abdessalem, IGES **iii) JBIC credit line for energy efficiency** Ms. Kajal Kalanauria, SBI Caps **Panelists:** • Mr Rajesh Kansara, GEDA • Mr P N Pavan Kumar, EESL • Mr Nilesh Gajjar, GITCO • Mr Rajesh Kumar, Bank of Baroda, SME Loan Factory
16:00 – 16:30 hr:	**Tea break**
Session 4: Policy Dialogue to promote application of Japanese energy efficient technologies among industries in Gujarat	
16:30-17:25 hr	**With the economy of Gujarat growing at a rapid pace, it is an opportune time for the state to deepen the collaboration with industries in Japan for mutual benefit. The session provides direction for deepening collaboration within an integrated framework and long-term perspective between Hyogo prefecture and Gujarat state.** ***Chairperson:*** Dr Chandan Chatterjee, Director, The Centre for Entrepreneurship Development (A Govt. of Gujarat Organisation) **Panelists:** • Mr Prosanto Pal, TERI • Dr Abdessalem RABHI, IGES • Mr Noriaki SUGA, Hyogo Prefectural Government • Mr Ashit Shah, A Square Solution (Hitachi)
17:25-17:30 hr	**Concluding remarks** Mr Chetankumar Sangole, TERI

Background presentation on potential of transfer and application of low carbon technologies from Japan to India: Assessment and Matchmaking

Rabhi Abdessalem, IGES

12 Jan. 2016, Ahmedabad

About IGES: Outline

- **Name of the Institute**

The Institute for Global Environmental Strategies (IGES)

- **Establishment**
  March 31, 1998

IGES headquarters（Hayama, Kanagawa）

- **Location**

>Headquarter: Hayama, Miura-gun, Kanagawa

>Tokyo Office: Chiyoda-ku, Tokyo

>Kitakyushu Office: Kitakyushu-city, Fukuoka

>Kansai Research Centre (KRC): Kobe, Hyogo

>Overseas Offices: Bangkok (Thailand), Beijing (China)

IGES and its Global Network

About Kansai Research Centre (KRC)-Kobe

- **Established:** June, 2001
- **Research Focus:** "Business and the Environment"

- **tasks conducted within KRC:**

1) Low Carbon Technologies transfer and Application

2) Policies toward Low Carbon Technologies Diffusion

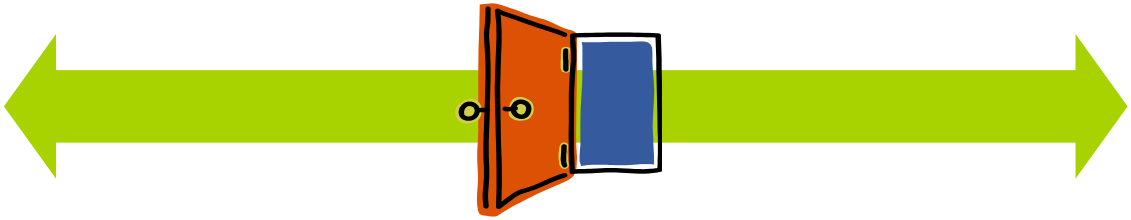
IGES Kansai Research Centre（Kobe, Japan）

Main Projects related to LCT transfer and application at KRC

1: Research on the promotion of the application of the Low Carbon Technology (LCT)	FY 2010 - FY 2013	India	JICA/JST
2: Expanding activities on the promotion of the application of the Low Carbon Technology (LCT)	FY 2014	India Vietnam Thailand	MOEJ
3: Technology Assessment and Verification of CO2 Emission Reduction in Asian countries	FY 2015	India Bangladesh Indonesia Mongolia Thailand Vietnam	MOEJ

Example of IGES-TERI project: ALCT (2010-2013)

Japan-India Environmental Technology Gateway



Science and Technology Research Partnership for Sustainable Development (SATREPS)

Japan Science and Technology Agency (JST)

Japan International Cooperation Agency (JICA)

Government Agreement G2G

Ministry of Environment and Forest (India) (MoEF)

Financial support

Facilitators

Supervision

Kyoto University (Graduate School of Engineering)

Collaboration

Institute for Global Environmental Strategies (IGES)

Collaboration

The Energy and Resources Institute (teri)

Technical support (dispatching experts)

Facilitators

Provision of sites for pilot projects

Japanese Companies (e.g.: Hitachi IES, Mayekawa, Yanmar, etc.)

B2B

Indian Small & Medium Enterprises (SMEs) (e.g.: Delta, Jagdish, Transauto, Caspro, Marvellous, Sankalp, Mass Flange, etc.)

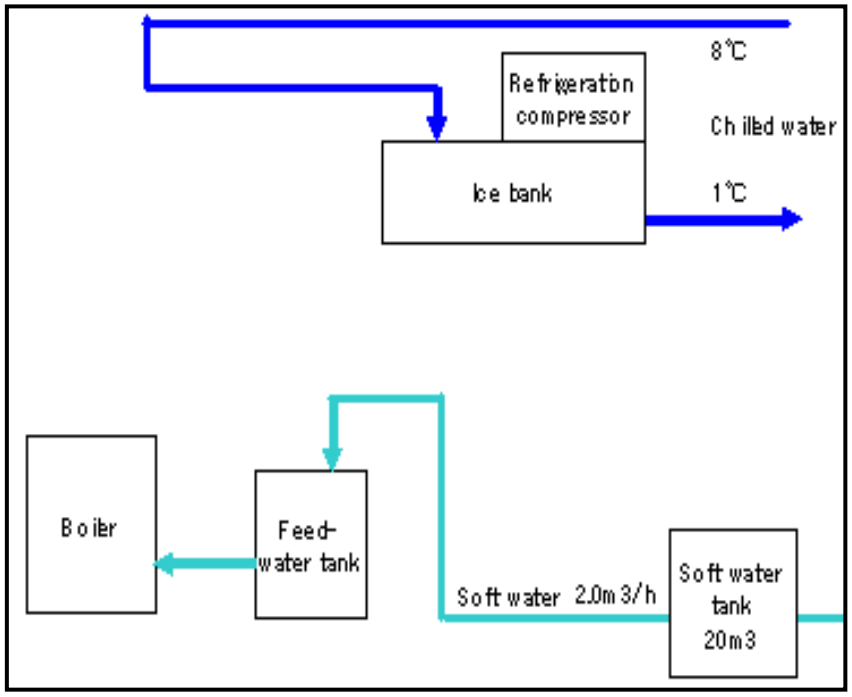
Summary of selected sites and pilot projects

	Technology	Japanese Companies	Total number of investigated sites	Number of selected sites for pilot projects	Location of pilot projects	SMEs
Hard Technologies	Gas Heat Pump	Yanmar	11	2	Rajkot	-Delta Technocast -Jagdish Technocast
	Electric heat pump	Mayekawa	13	2	Anand	-Amul
					Chandigarh	-Milkfed
Best Practices (Soft technologies)	Compressed air system	Hitachi (IES)	13	4	3 in Pune; 1in Noida	-Sankalp -Transauto -Mass Flange -DIC
	Induction furnace	Expert from Kobe Steel	8	2	Kolhapur	-Marvelous Metals -Caspro Metal

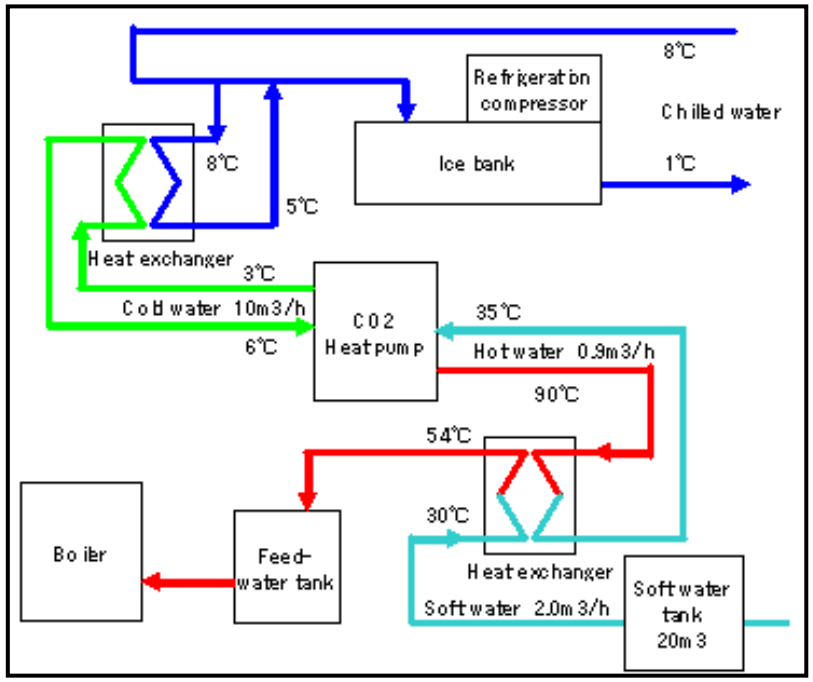
1) Demonstration of Electric Heat Pump (EHP)

❖ Application

- Preheating of boiler feed water & precooling of process chilled water
- Dairy, food processing, pharmaceutical, commercial buildings, etc.
- **Two pilot projects: 1 in "Milkfed" (Chandigarh) and 1 in "Amul" (Anand)**



Before



After

Demonstration of Electric Heat Pump (EHP) (continue)

❖ Benefits

- Reduction in fuel consumption of boiler and electricity consumption of chiller
- **Energy savings: 30%-40%**

2. Demonstration of Gas Heat Pump (GHP)

❖ Application

- Space cooling applications in industry and commercial buildings
- **Two pilot projects: 1 “Delta” and 1 “Jagdish”, both in Rajkot (Gujarat)**

Before

After

Demonstration of Gas Heat Pump (GHP) (continue)

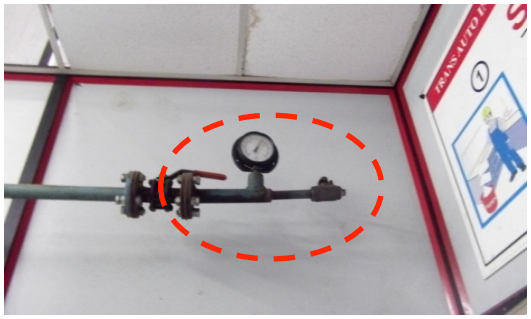
- **Benefits**
  - Switch from electricity to natural gas (NG)
  - **Energy savings: 35%-45%**

3. Awareness rising about best practices: E.g. Regarding compressed air system

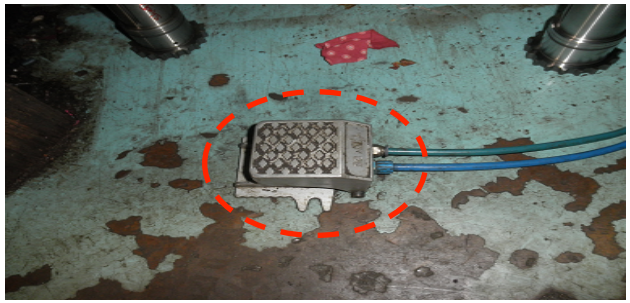
❖ **Application: Transauto, Sankalp, and Mass flange (Pune), and DIC (Noida)**

Examples of measures which have been taken by SME

Installation of new receiver and new air compressors (not inverter type)

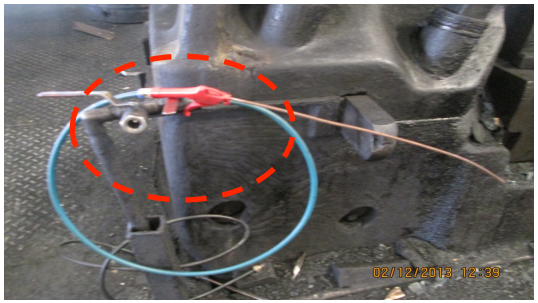


Adjusting pressure setting



Reduce air leakage through installing foot switch

Reconsider pipe size and design



Start the use of efficient air gun

❖ **Benefits**

- **Energy Saving: 20% -30%**

Notes:

-SME have taken almost all the proposed measures in PS reports, except the installation of inveter type air compressor. Additional 10%-20% could be achived by installing inverter type air compressor.

Capacity building and awareness raising (level1)

❖ Targeting SME at unit level:

Onsite capacity building for companies engineers and maintenance team during site visits (in total, more than 50 sites visited)

Capacity building and awareness raising (level2)

- Targeting SME at sector/ cluster level

Several cluster workshops to introduce technology to business entropreneurs and business associations

(in total 10 conducted)

IGES –TERI Joint Workshop
(Dec. 2011, Rajkot (India)

IGES –TERI Joint Workshop
Jan. 2012, Chandigarh (India)

Capacity building and awareness raising (level3)

❖ Targeting Indian experts (Training of Trainers)

Training workshops to Indian experts (In India and in Japan)

(in Total 3 (2 in India and 2 in Japan))

Capacity building and awareness raising (level4)

- Targeting Policy makers:

Interaction with policy makers through meetings, symposiums, etc.

IGES-TERI workshop
(Feb.2012 New Delhi- India)

India-Japan Energy Forum
(Sep.2013 New Delhi- India)

Summary of Major Achievements

Achievements

Achievement1 : A matchmaking process among various Japanese and Indian stakeholders to promote LCT application has been established;

Achievement2 : Actual/tangible reduction in CO2 emission has been generated;

Tech.	EHP		GHP		CA		IF	
Sites	**Amul**	**Verka**	**Delta**	**Jagdish**	**Mass flange**	**Sankalp**	**Caspro**	**Marvellous**
CO2 emission reduction	**33%**	**40%**	**47%**	**43%**	**25%**	**30%**	**20%**	**20%**

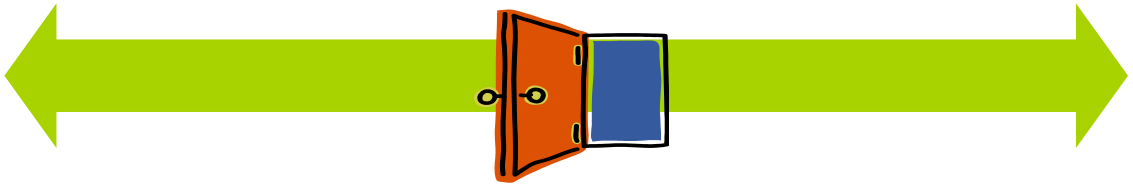
Achievement3: The awareness and technical capacity of various stakeholders, from India and Japan, have been concretely enhanced;

Achievement4: The project was well evaluated by sponsors, as well as attracted the interest of other relevant stakeholders, who are showing readiness to replicate this model of cooperation/collaboration in other countries, such as Vietnam and Thailand.

FY2014&FY2015:
Building up on previous achievement and strengthening partnership

Research stakeholders

Japan-India Environmental Technology Gateway



Ministry of Environment Japan (MOEJ)

G2G

Shakti Sustainable Energy Foundation

Financial support

Financial support (modest) and Assistance

Institute For Global Environmental Strategies

Collaboration

The Energy and Resources Institute

Technical support (dispatching experts)

Facilitators

Provision of sites for investigations

Japanese Companies
(e.g.: Hitachi IES, Mayekawa, Yanmar, Shinto, etc.)

B2B

Indian SME and Large industries

Investigation & capacity building regarding GHP (Sep. 2014)

Investigation & capacity building regarding Induction Furnace (Sep. 2014)

Investigation & capacity building regarding EHP (Nov. 2014)

Investigation & capacity building regarding Compressed Air (Oct. 2014 & Sep. 2015)

Investigation & capacity building rabout Once Through Boiler (Dec.2015)

nvestigation & capacity building about Steam Control&Management System (Dec. 015)

Enhance Matchmaking through workshops, seminars, etc.

Enhancing matchmaking and networking through direct interaction

Center of Entrepreneurship Development (Ahmedabad/ Sep. 29th 2014)

Rajkot Engineering Association (REA) (Rajkot/ Sep. 27th 2014)

JICA (India office) (Delhi/ Sep. 29th 2014)

NEDO (India office) (Delhi/ Sep. 29th 2014)

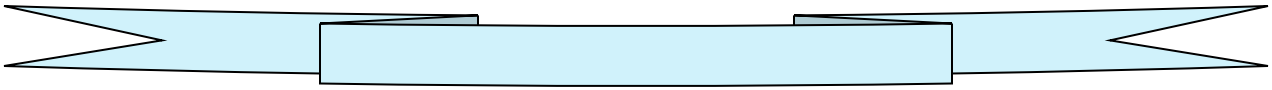
Examples of challenges /barriers identified to promote Japanese technologies in Indian SME

Challenges	Outline
High cost	-Equipments (manufacturing; assembly, spare parts, etc); Transportation; Custom duties; -Other cost, such as to dispatch experts/supervisiors, consultants, translation); -etc.
Limited technical capacity and awareness	-The technologies are new to India, so technical concepts, terminologies, functioning, etc, are also new. -Lack the knowledge on how to install, operate, and maintain these technologies. Lack of knowledge and tools of how to monitor, evaluate, and verify their impact. -SME are more interested in cost saving than any other benefit.
Indian/Site condition	-Technology should be customized to be applicable to Indian condition. For example, GHP units have to include software that responds to blackout issue, Additional filter required, etc. -Lack of inventory/history data (degital, logbook) for evaluation -Measurement tools are available, but more sophisticated ones are neded. -Non availability of spare pats of the technology (since it is new to Indian market).
Communication	-Language (not only limited ability to communicate in English and/or Japanese, especially to read reports and documents regarding the technologies provided by experts, but also to communicate various technical terms and concepts that needs face to face communication. -Facilities (T.V/Telephone conference, internet connection, internet speed, etc).
Others	-Many national holidays in Japan and India, those don't overlap; -Power voltage (110 Vs 220); Power supply (3 phase vs 2 phase); -Frequent black-out; -Climate: Winter, summer and monsoon (that each lasts for more than 3 months);

Conclusions

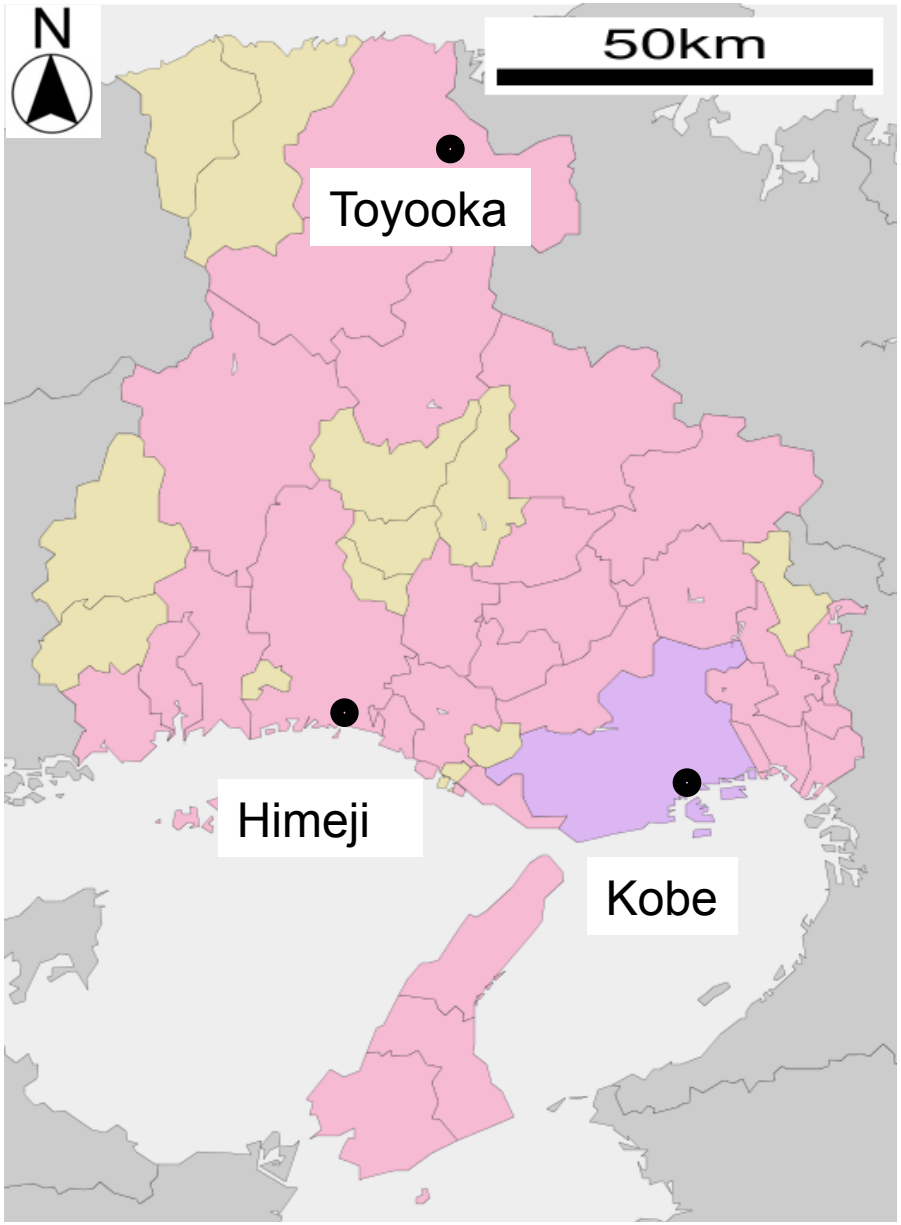
- Projects have demonstrated that significant energy and GHG saving is possible through adoption of Japanese EE technologies and best operating practices.
- Projects have seeded interest among stakeholders on the demonstrated technologies and built their local capacities
- The past and ongoing activities could serve as a model to promote cleaner technologies under bilateral/multilateral cooperation.
- Good network has been established with various stakeholders, from India and Japan, which should be used effectively to continue: identifying, creating and tapping opportunities, taking advantage of the boost for cooperation which is also taking place at high government level between the two countries.

Thank you for you attention



Location of Hyogo Prefecture

Outline of Hyogo



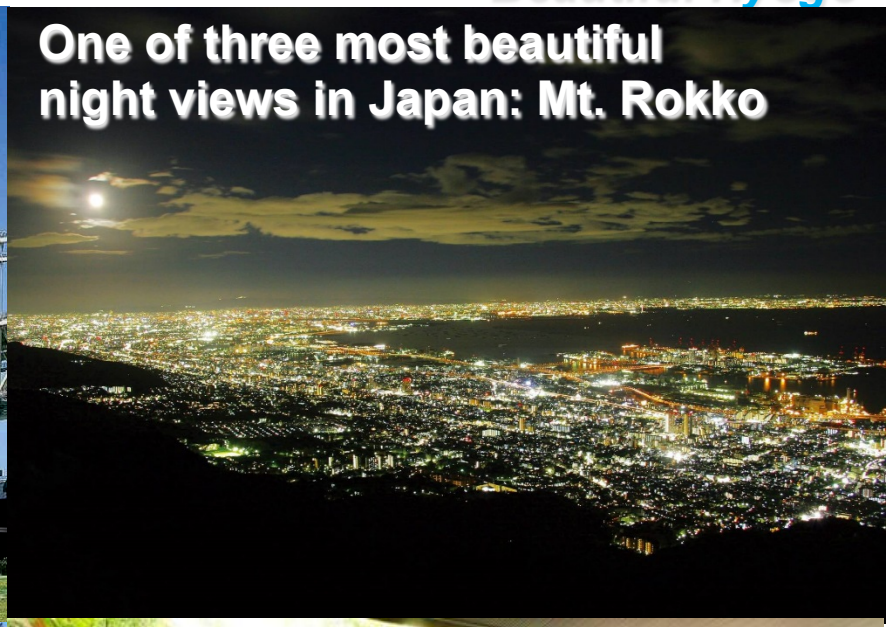
Basic data

Area: 8,396 km^2 (12th in Japan)
Population: 5.57 million (7th in Japan)
Real GDP: 20 trillion 631.4 billion yen
= 257.5 billion US dollars
∗Almost as large as that of Finland

The purple area is a Government Ordinance City, pink areas are cities, yellow areas are towns. Total 29 cities and 12 towns.

Enchanting spots in Hyogo Prefecture

Beautiful Hyogo



A Wealth of Manufacturing Industries

Beautiful Hyogo

- From Heavy Industry to SMEs
  - Total product shipment is approx. 14 trillion 347 billion yen, National share of 5.0% (ranked 5th in the nation)

(Source: 2012 Industrial Statistics)

Li-ion Batteries

Solar Panels

Railway vehicle electric equipment

Power Generation Turbines

Car Navigation

Ironmaking/steel plates

Motorcycles

Nickel batteries

Railway Vehicles

Ships

Tajima (Toyooka)

Tamba

Harima (Himeji and Kakogawa)

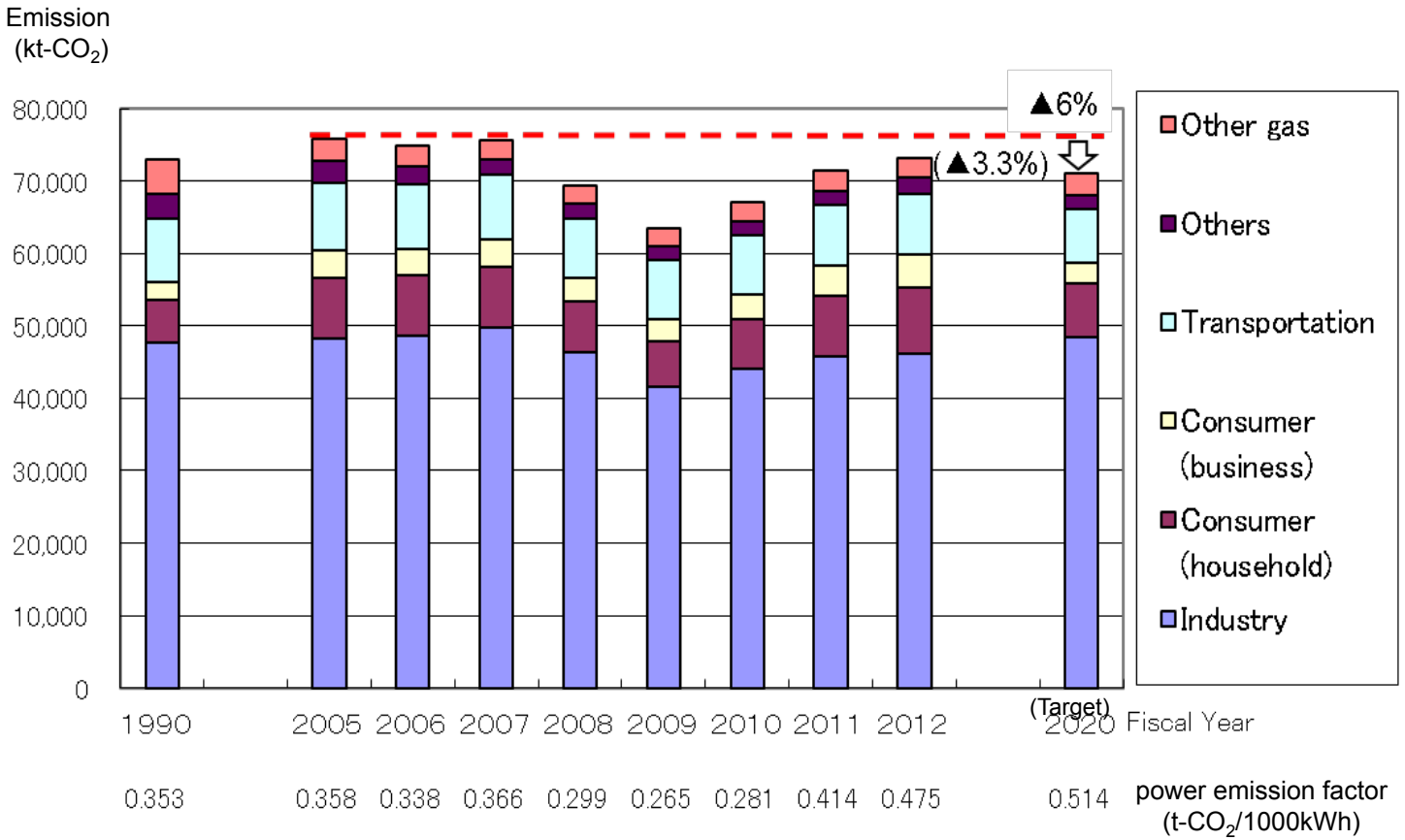
Settsu (Kobe and Hanshin)

Awaji

3rd global warming prevention (promotional) plan of Hyogo Prefecture (established in Mar. 2014)

*Setting of GHG reduction target in fiscal year 2020 in Hyogo Prefecture

Greenhouse gas emission in FY 2020 is to be reduced 6 % from FY 2005 level. (3% down from FY 1990) (Power emission factor is set to the value in FY 2012)

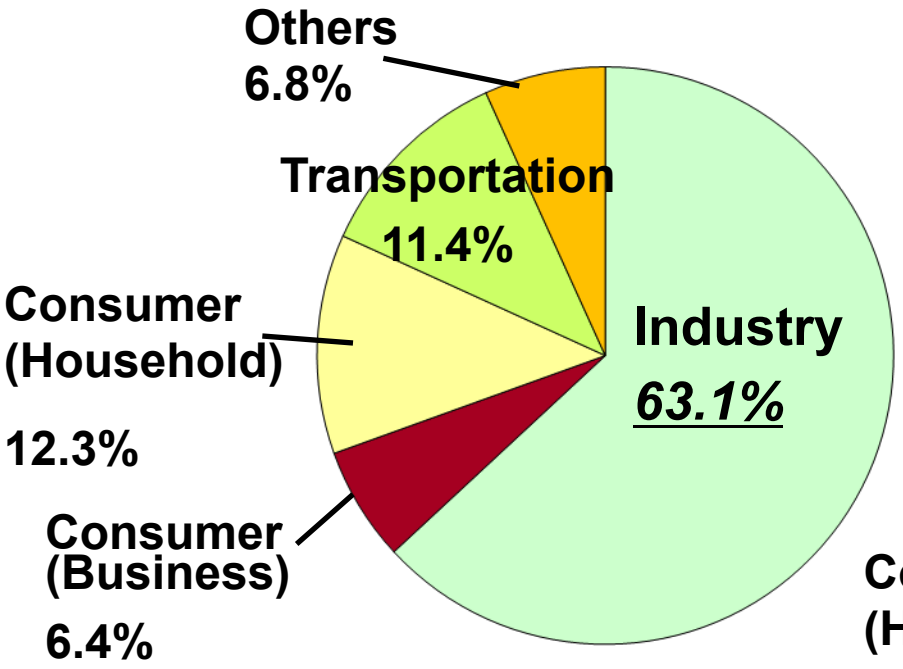


Greenhouse gas (GHG) emissions by sector in Hyogo Prefecture

Emissions in FY2012

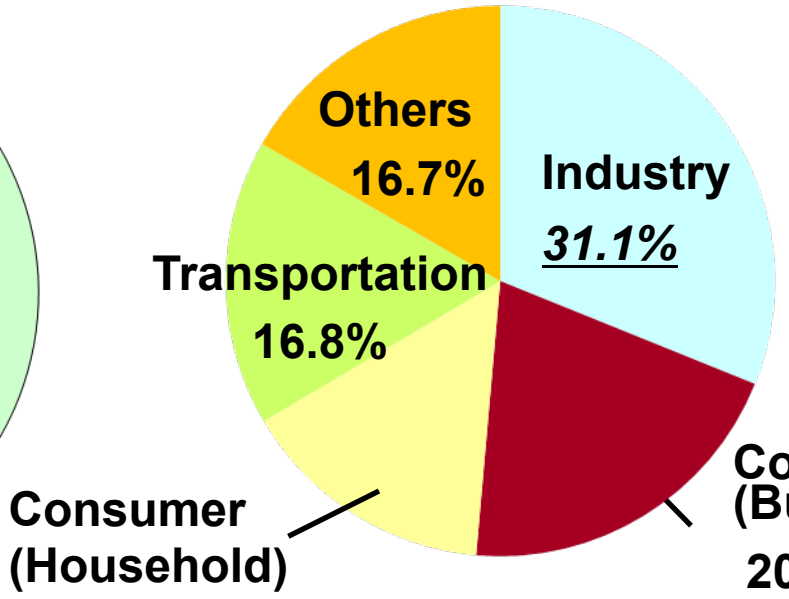
Hyogo Prefecture

73,280kt-CO2



Whole Japan

1,390,000kt-CO2



Created by Hyogo Pref. Gov. based on the document of Ministry of Environment of Japan

In Hyogo prefecture, emissions from industrial sector is large.

System for reporting GHG emissions in Japan

Business operators
(with energy usage of 1,500kl/year or more)

Japanese government

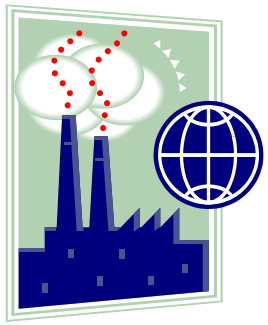
Citizens

Tabulation result in FY2012

Number of businesses reported: 11,372

Total emissions: 635.6million ton-CO_2

System for reporting GHG emissions in Hyogo prefecture



Submit CO_2 emission control plan

Report CO_2 emissions

Publicize

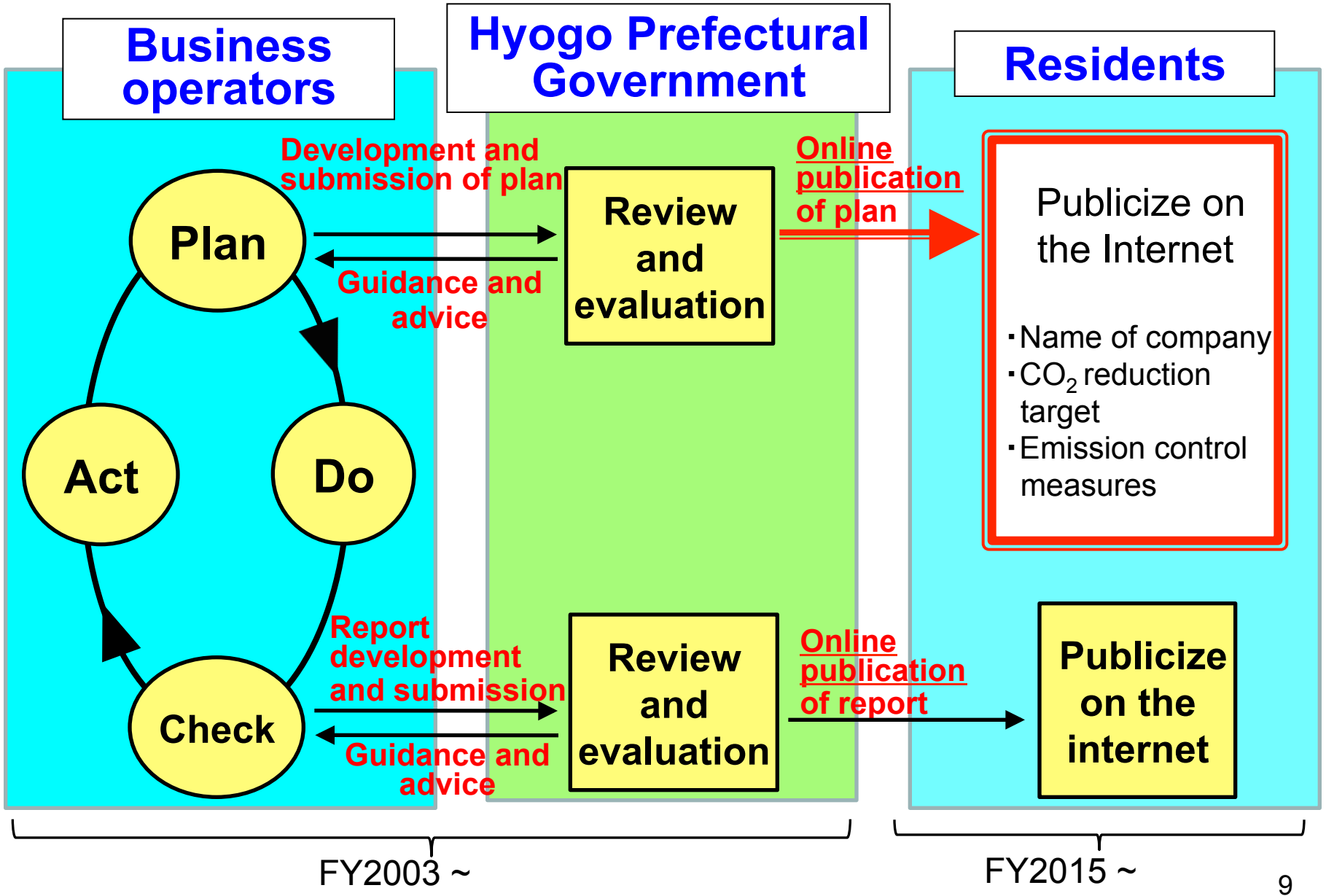
Business operators
(with energy usage of 1,500kl/year or more)

Hyogo prefectural government

Residents

Target business operators: 576
Total emissions: 35,640kt-CO_2

Planning System on Greenhouse Gas (GHG) Emission Control



Emission Control Plan of Greenhouse Gas
(Plan for publication)

Form4 （Regulation of Hyogo prefectural government 142.4）

Emission Control Plan of Greenhouse Gas for Publication

Address	
Corporate name	
Industrial sector	
Outline of business	
Factory name within prefecture	
Total GHG Emissions	（unit: t-CO_2 （CO_2 reduced quantity））

Base year （performance） （FY　　）	Present state （FY　　）	Target FY （plan） （FY　　）
–	–	–

Process of goal setting	
GHG Emission control measure (principal plan)	
CSR activities	

Example1: Food manufacture

Not yet disclosed at this time

Industrial sector	09　Food manufacturing
Outline of business	To refine flour and vegetable oil from the raw material like wheat and soybeans, etc.
Factory name within prefecture	△　△　food factory

Total GHG Emissions

(unit : t-CO_2 (CO_2reduced quantity))

Base year (performance) (FY 2009)	Present state (performance) (FY 2013)	Target FY (plan) (FY 2020)
19.8	19.8	17.8
—	compared with the base fiscal year +0.4%	compared with the base fiscal year -10 %

Process of goal setting

In oo factory of oo Corporation, the reduction plan by -1% each year has been implemented, with the target of 10% reduction of CO2 emission intensity by 2020 compared with FY 2009.

Since the operation amount is increased about 17% with which the amount of raw material used in FY 2009 is 770,854t and the amount in FY 2013 is 938,205t, not the CO2 emission but the basic unit is to be managed.

Contribution to reduction in CO2 is expected by managing CO2 emission intensity and continuing high-efficient operation.

CO2 emission in FY 2009…11,637t-CO2
CO2 emission in FY 2013…14,876t-CO2

GHG Emission control measure (principal plan)

Measures	Concrete content	Target reduction
Rational use of energy	Verification and implementation of equipment proper air pressure	To reduce 1% of electric power consumption at each equipment
	Optimisation of fan revolution speed	To reduce in electric power consumption by operating with proper revolution
	Review of the amount of compressed air consumed	To reduce electric power consumption by determining the amount of power consumption
	Improvement of air leakage, steam leakage, air, and heat loss	To improved them intensively by setting the eradication period
Equipment upgrades	Renewal to high-efficient equipment from aging equipment	Renewed deodorization equipment in 2012 Shall be renewed desolventising facility in 2015

Example2: Service (Hospital)

Industrial sector	8311　Hospital
Outline of business	Medical service
Factory name within prefecture	○　○　Hospital

Total GHG Emissions

（unit：t-CO_2（CO_2reduced quantity））

Base year（performance）（FY 2005）	Present state（performance）（FY 2013）	Target FY（plan）（FY 2020）
4,653	4,634	4,281
—	compared with the base fiscal year -0.4%	compared with the base fiscal year -8%

Process of goal setting

GHG emission in FY 2012 which is the final FY of the previous plan was 4,528t-CO2. It's ▲2.7% compared with the base FY.

But, in FY 2013, it increased 2.3% at 4,584t-CO2 due to extension of building (▲0.4% compared with the base FY).

The target to reduce 8% in 8 years between 2013-2020 has been set based on the target under Energy Conservation Law which the annual average reduction is 1% (7.2% reduction in 7 years compared with the base FY (2005)).

GHG Emission control measure (principal plan)

Measures	Concrete content	Target reduction
Thoroughness of low carbon type business activities like energy saving, etc.	Introduction of high-efficient fluorescent light in lighting equipment	To reduce 2% of CO2 emission by 2015 compared with FY 2012.
	Renewal of the main unit of absorption chiller	
	Improvement of co-generation power generator controller	To reduced 0.5% of CO2 emission by FY 2015 compared with FY 2012 through control optimisation of excess air ratio (compared with air-fuel ratio) at combustion.
	Review of operating hour of co-generation generator (Stop at 22:00 at present -> (change) stop at 20:00; applied only to November-March).	To reduce 1% of CO2 emission by FY 2015 compared with FY 2012.
Thoroughness of low carbon type business activity like energy saving, etc. and low carbonisation of production facility or office building	Inverter control for cold and hot water pump	To reduce 3% of CO2 emission by FY 2015 compared with FY 2012.
Rational use of energy	Improvement of heat efficiency by heat retention of steam valve	To reduce 0.5% of CO2 emission by FY 2015 compared with FY 2012.

Not yet disclosed at this time

Example of collaboration project between Hyogo prefecture and Gujarat state

[Example]

Developing a menu of GHG reduction measures

Business type/ Industry sector	Menu of GHG reduction	
	Category	Details
Food manufacture	Thoroughness of low-carbon type business activities, like energy saving, etc. [Soft measures]	- Improving air leakage, steam leakage, air/heat loss. - Sticking heat insulation sheet to hot-water tank - Introducing air curtain at the entrance of the freezer.
	Low carbonization of production facilities or office building [Hard measures]	- Changing existing fan-pump to inverter type - Replacing lighting to LED from fluorescent lamp - Introducing cold & hot water supply heat pump

Example of measures：Hard measures

Hyogo Prefectural Government office

Cold/hot water generator for air conditioning

Heat retaining by insulating cover

Example of measures：Soft measures

Cold water:
w/o insulating cover

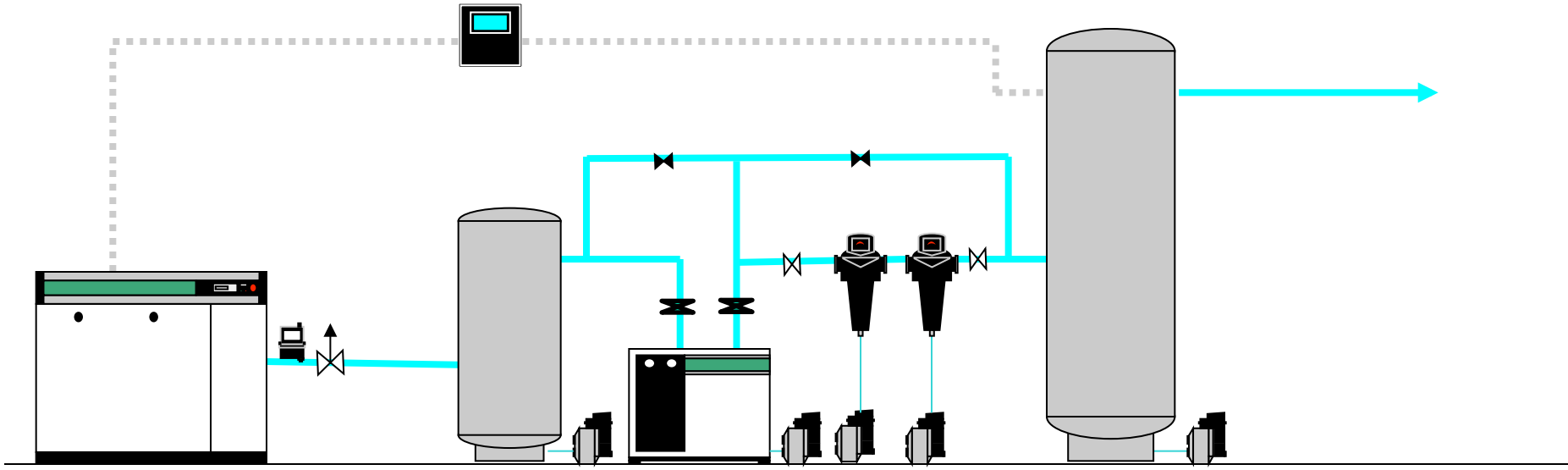
Hot water:
with insulating cover

Thank you very much

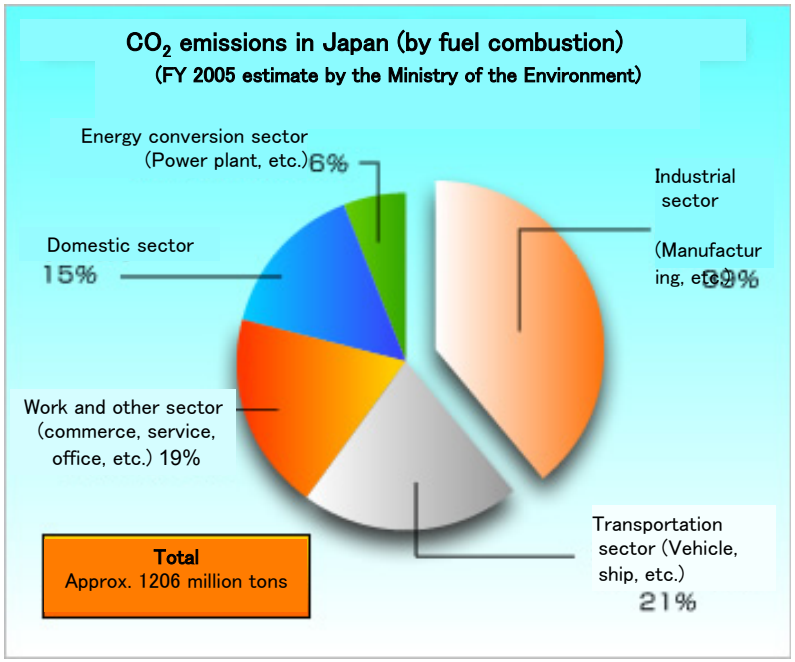
【Awaji】Naruto Whirlpools

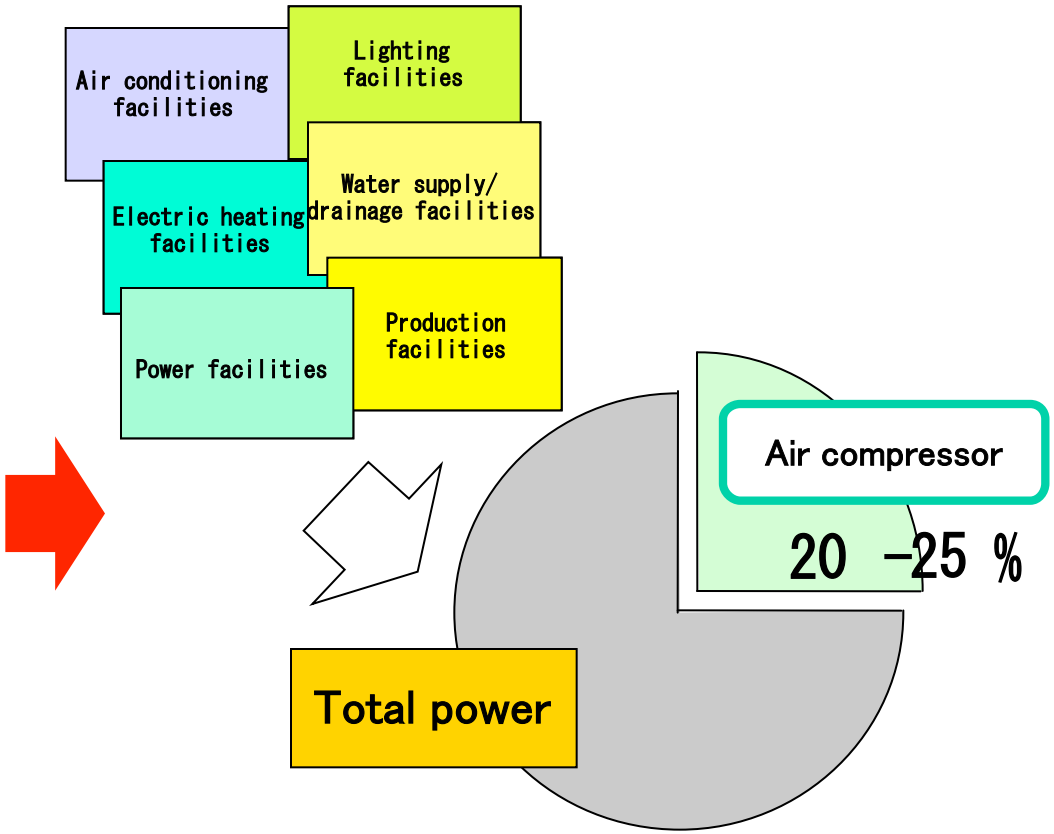
Low carbon technology of a compressor system

(Energy Saving and Environmentally Friendliness)



Energy Consumption in Japan





Energy consumed for the industrial sector (factories) accounts for approximately 40% of the total energy consumption in Japan.
It is considered that approximately a quarter of that amount is used by compressors.
In addition, compressors are regarded as machines whose energy consumption can be reduced relatively easily. As a result, energy saving through rotation control and multiple unit control is strongly requested by the Ministry of Economy, Trade and Industry as well.

Energy Saving from both Supply and Demand side

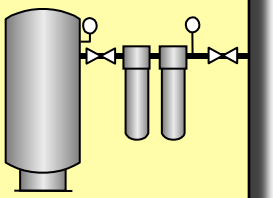
Energy Saving of air compressor

Decrease power consumption

Pressure Loss

Air Comp.

Aux.
Dryer
Filter
Tank



Piping

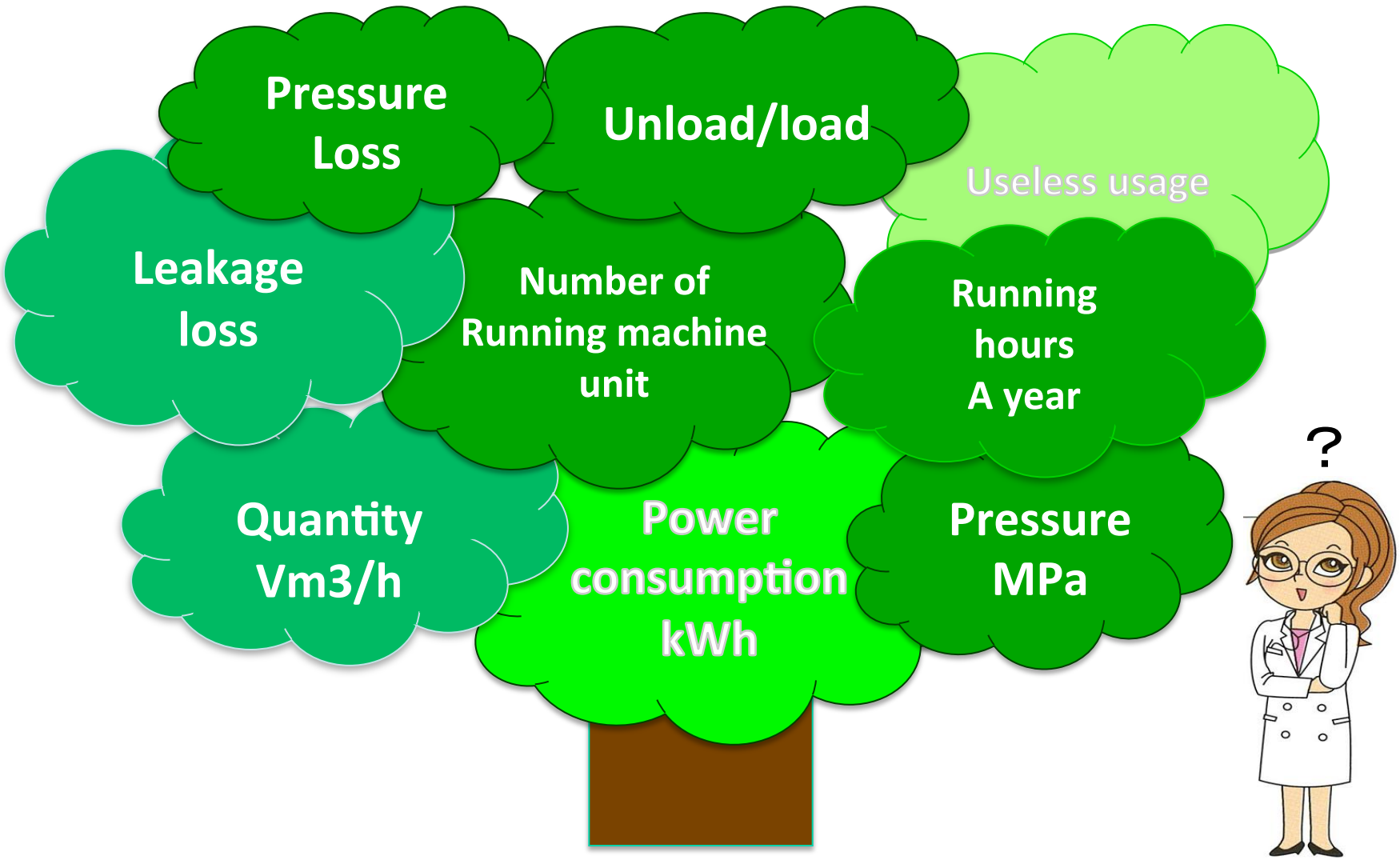
Leak

Pneumatic actuator
- Cylinder
- Nozzle
- Ejector

Decrease air consumption

Energy Saving of pneumatic actuators

What is cost of air compressor?



CO2 reduction=energy saving of the air system

Saving energy of compressed air system = Energy cost down

Energy cost (L kW) = pressure (P) x air consumption (V)

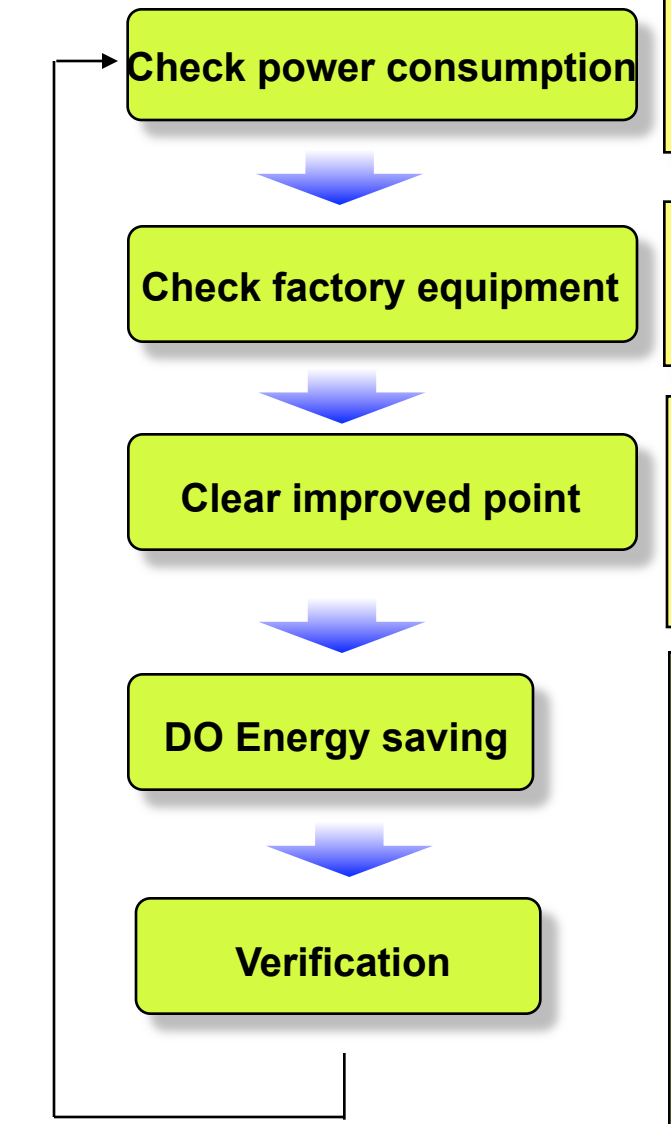
The policy for cost cuts useless

- Lower useless pressure (P)
- Reducing volume air consumption (V)
- Improvement (pressure loss, leak) of the loss

The point of the energy saving is to get rid of waste how, and to perform the following

1. **Making better capacity control (use the efficient machine)**
2. **Make efficient use of equipment**
3. **Appropriate pipe diameter and length = Design piping system**
4. **Counter measurement of leak**

Procedure for Energy Saving



Is it clear Electric power consumption for Air compressor and other main equipment.?

Is it clear piping in factory, running equipment and end pressure?

Where should be improved? And how much to be improved?
Target should be shared by both management and shop workers.

- Compressor replace to inverter or capacity matching…
- Lower discharge/end pressure.
- Divide the line into high and low pressure lines.
- Improve environmental condition such as ventilation and ambient temperature.
- Optimize size and route of piping and improve air leak.
- Install air receiver or larger sizing.
- Multi unit control.
- Optimal unloading.
- Periodical follow up for improvements.

In this practice, we verify the importance of proper pressures design at positions in air supply lines.

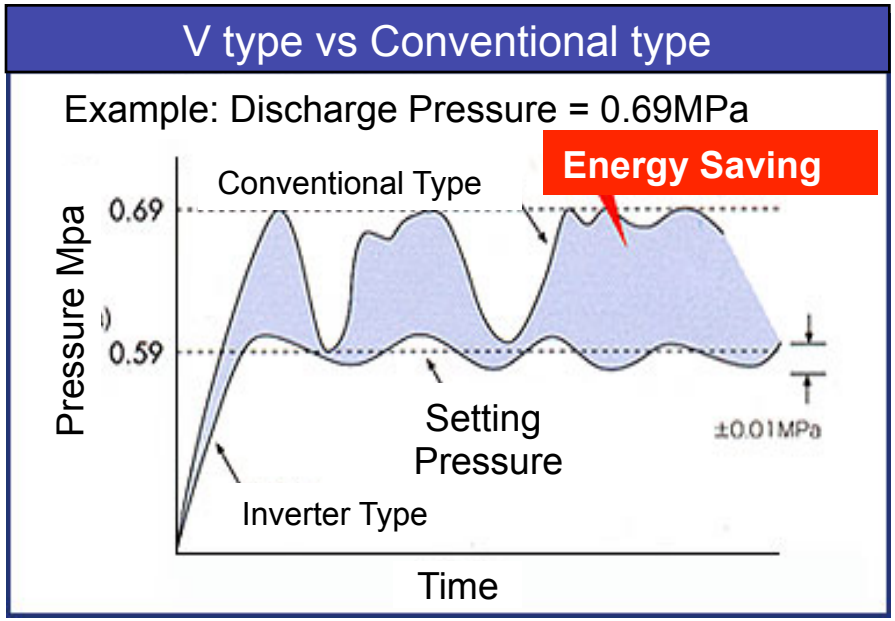
1. Air compressor
   How input power changes if compressor is driven by Inverter?

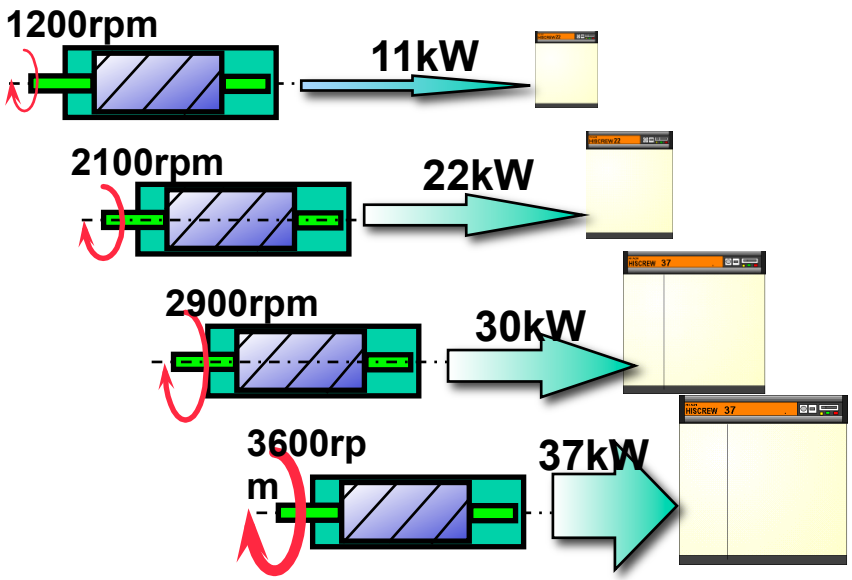
2. Piping system
   How pressure loss changes if size changed?
   How pressure loss changes if valve structure differs?

3. Local pressurization
   What is “booster compressor”?

Inverter Type: Ideal Choice for Energy Saving

- Controls revolution of compressor according to the load
  No waste of power & ideal capacity control.
- Operation with minimum pressure fluctuation
  Inverter type: Keep the setting pressure
  Conventional type: Fluctuate around the setting pressure *Refer to the below chart
- Operation stops during unload
  Avoid waste of electricity (Conventional type runs during unload & consumes unnecessary electricity.





37kW inverter compressor can be operated with 11kw class energy consumption

Example of energy saving for inverter compressor

■ Application procedure

Carry out energy consumption analysis for air compressor (37kW conventional model x 1 unit evaluation)

Analysis result

- Average load ratio: 52%
- Power consumption 23,600kwh/m

Details of improvement

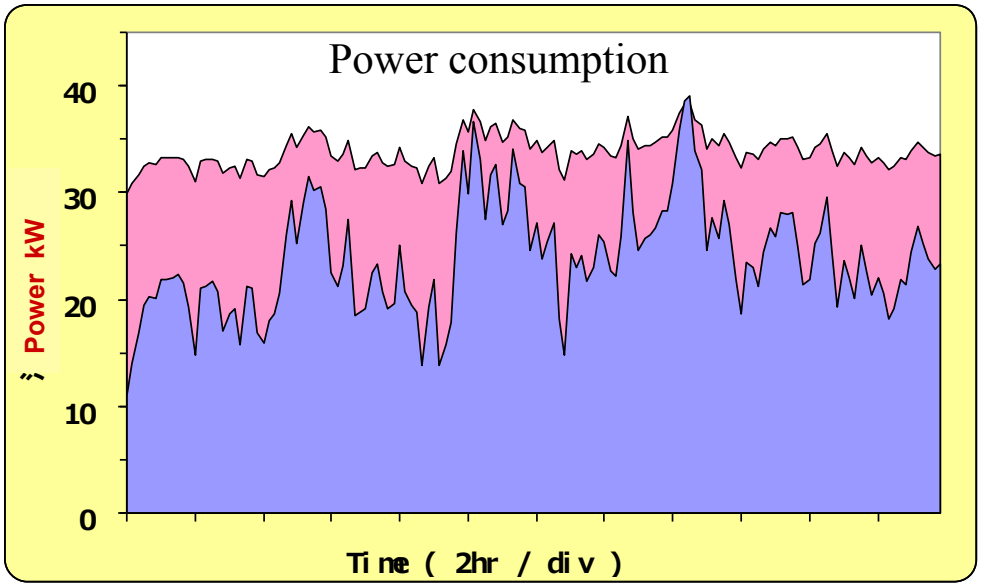
- 37kwh inverter compressor x 1 unit
- Power saving : 34%

■ Investment and effectiveness

- Apply to new 37kw Inverter compressor
- Efficiency of energy saving 560,000Rp/Year

■Other effectiveness

- CO2 reduction (▲34%) for environment protection
- Periodical overhaul and parts durability last long (per 8 years)
- Maintenance cost is reduced 30% (our company calculation)

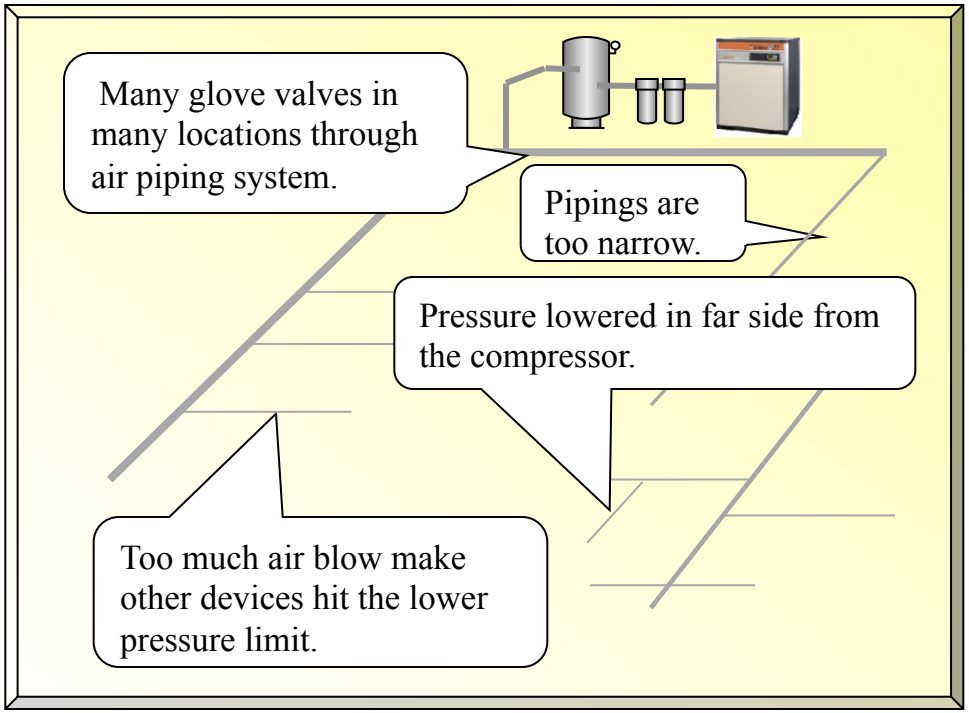


Pressure optimization by piping system redesign

What is efficient way for local low pressure demand.
Do you have similar cases like this in your factory?

1. **Unstabilized factory air.**
   [status] pressure far side from compressor unstable.
   Pressure down when other system ON.
2. **Due to budget allowance, no uniformity on air system such as devices, pipings (size, route, valves).**

What kind of improvement in this case?

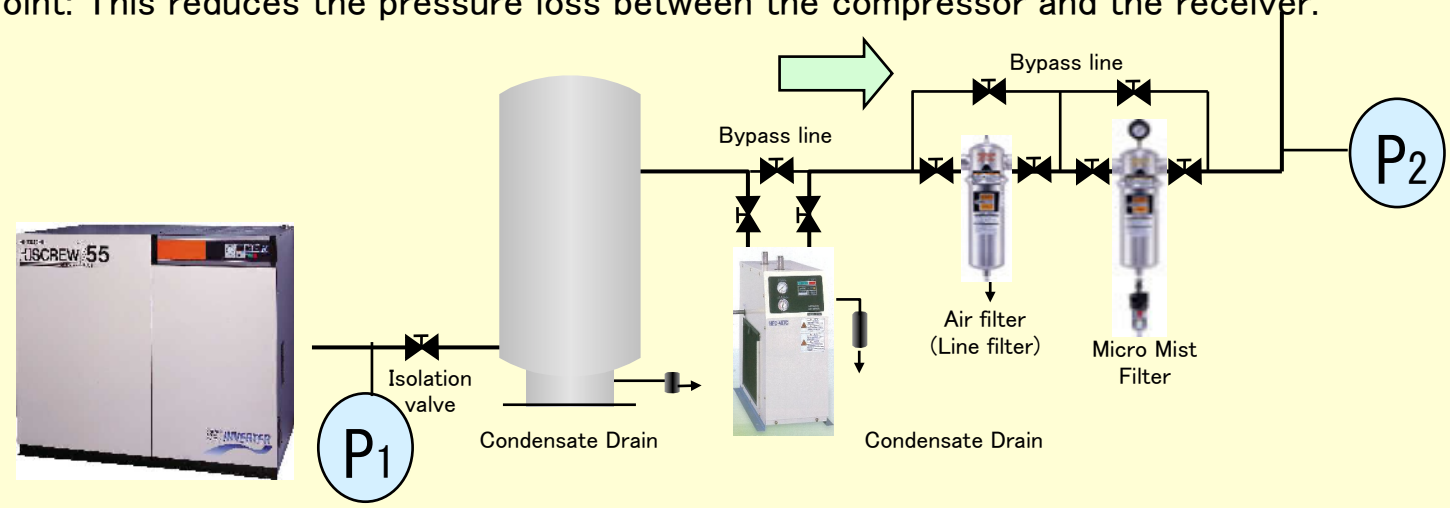


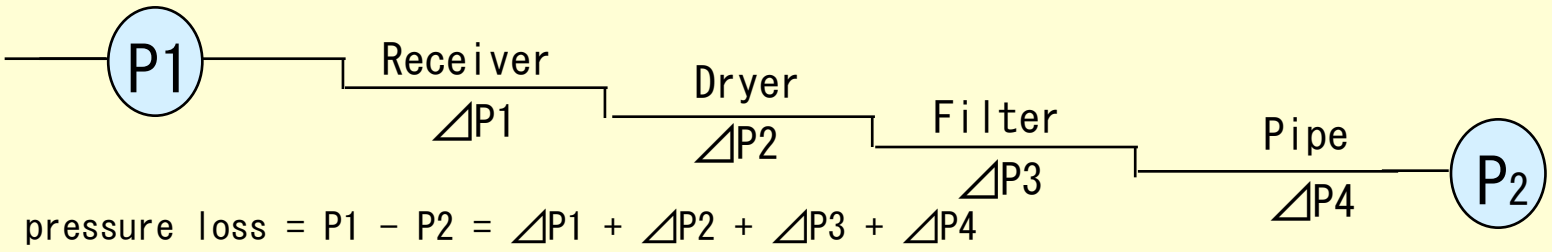
How loop piping, size, bend and valves effect proper pressure in system?

Pressure Loss of Compressor Equipment

Any system causes a pressure loss.
Think of how to minimize the loss.

Recommended layout (reference example): Compressor -> Receiver -> Dryer -> Filter
Point: This reduces the pressure loss between the compressor and the receiver.

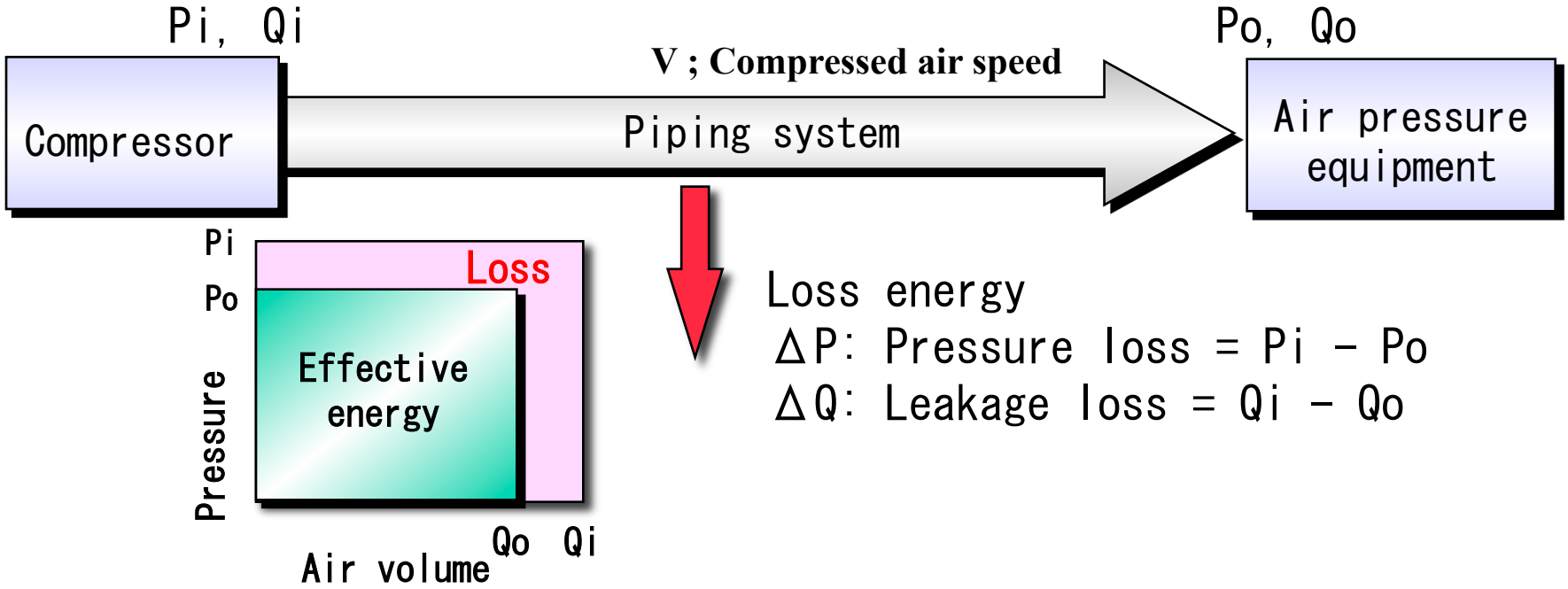




Total pressure loss = P1 - P2 = ⊿P1 + ⊿P2 + ⊿P3 + ⊿P4

To achieve a higher rate of energy saving, select a pipe with one size larger diameter than the one of the compressor's discharge pipe. Also, select air dryers and filters with one size larger capacity.

Pressure Loss through a Pipe



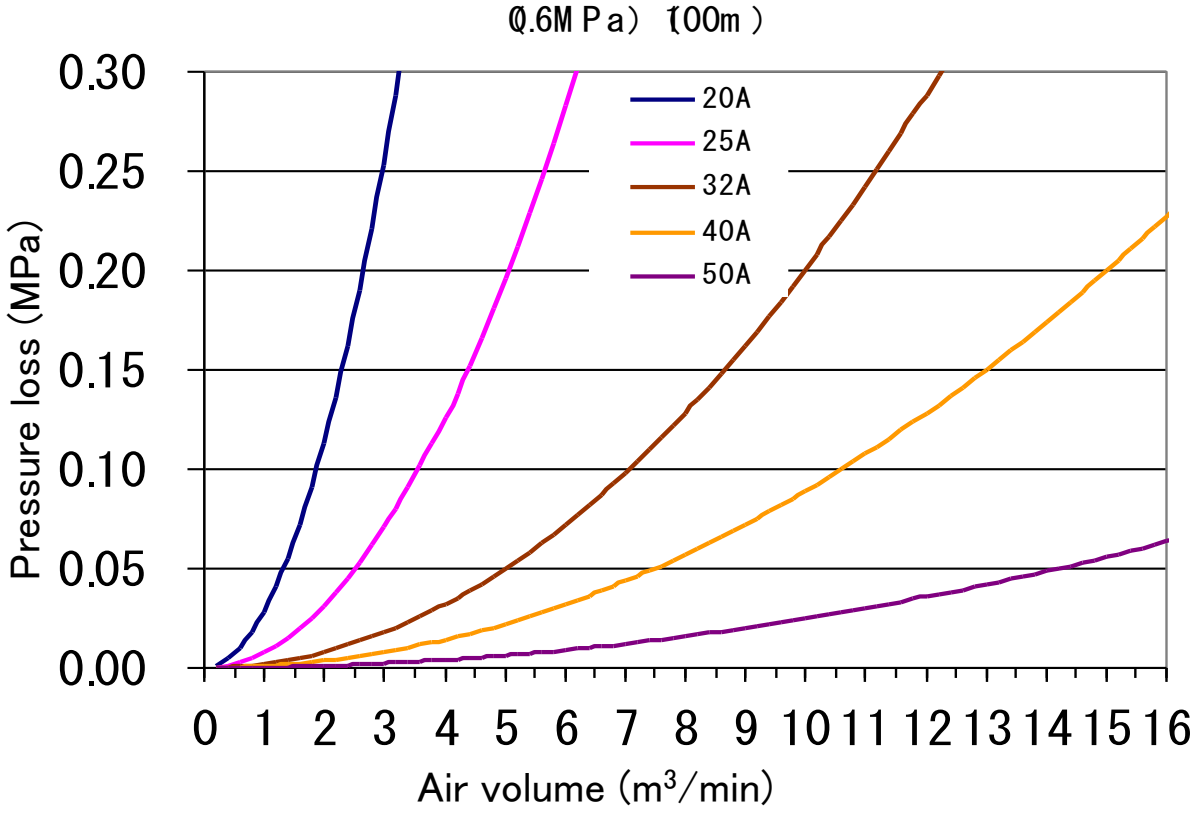
Loss energy
ΔP: Pressure loss = Pi − Po
ΔQ: Leakage loss = Qi − Qo

$$\text{Flow rate in the pipe } V\ (\text{m/s}) = \frac{Q_i \text{ Compressor's discharge air volume} \times Ps/Pd}{A \text{ Sectional area of discharge pipe} \times 60}$$

The flow rate in the pipe is desirably 4 to 5 m/s. − Economic speed

The smaller the pipe size, the higher the flow rate, causing a larger loss in
Accordingly an energy loss is generated, reducing the energy-saving effect.

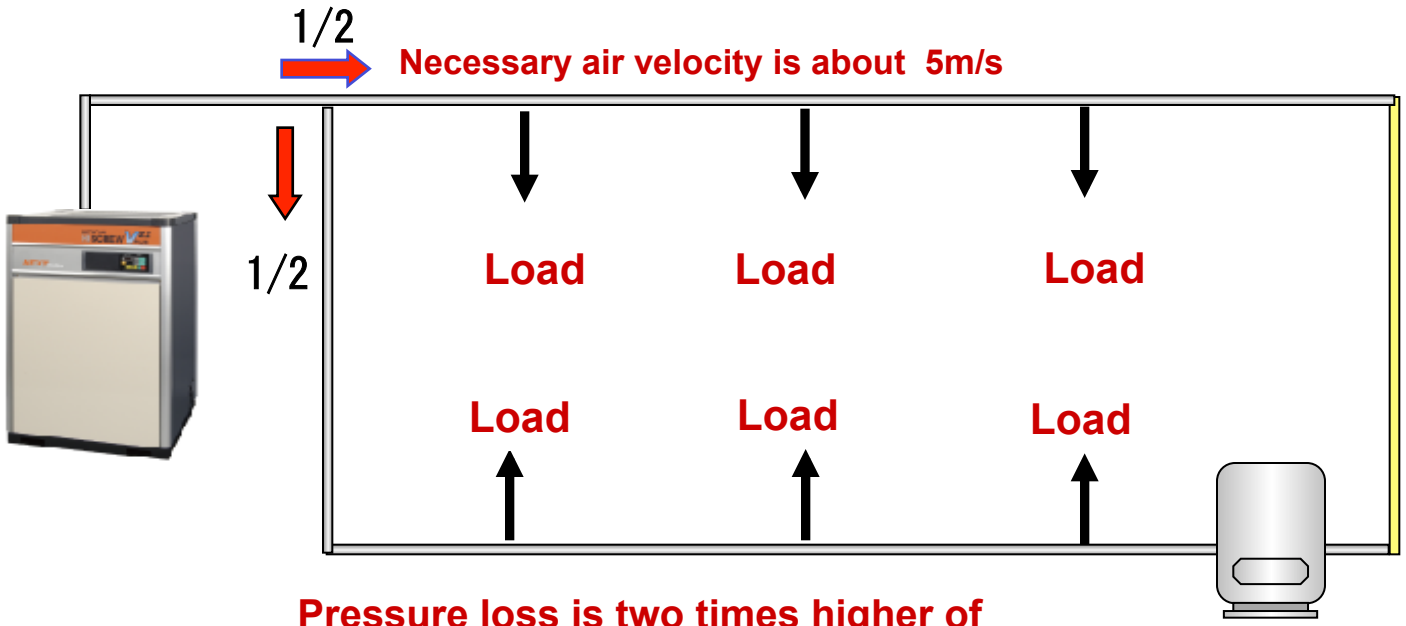
Let's Calculate an **Appropriate** Pipe Size.



$$\Delta P = 0.39\mu \times \frac{\ell}{d} \times \frac{\gamma v^2}{2g} \times 10^{-4}$$

ΔP	Pressure loss (MPa)
μ	friction coefficient
ℓ	length of piping m
D	diameter of pipe m
γ	density of air kg/m3 (0.1013MPa, 0 deg. C.)
V	speed of the air m/s
g	The gravity 9.81m/s2

Changing air velocity through internal pipe ･･･ loop piping



Pressure loss is two times higher of air velocity in proportion

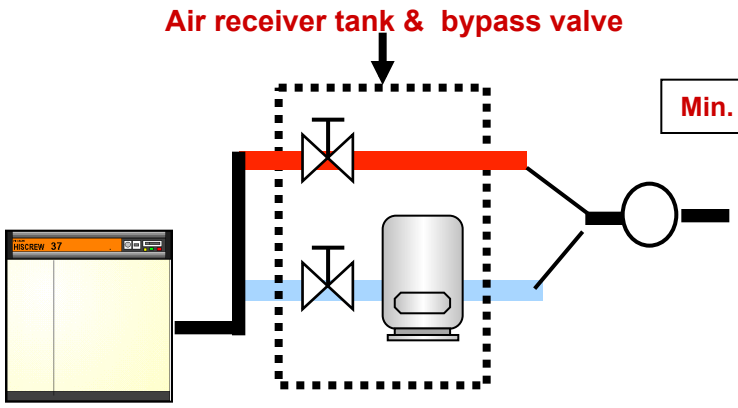
Pressure loss is minimized to one quarter, only to make loop piping!

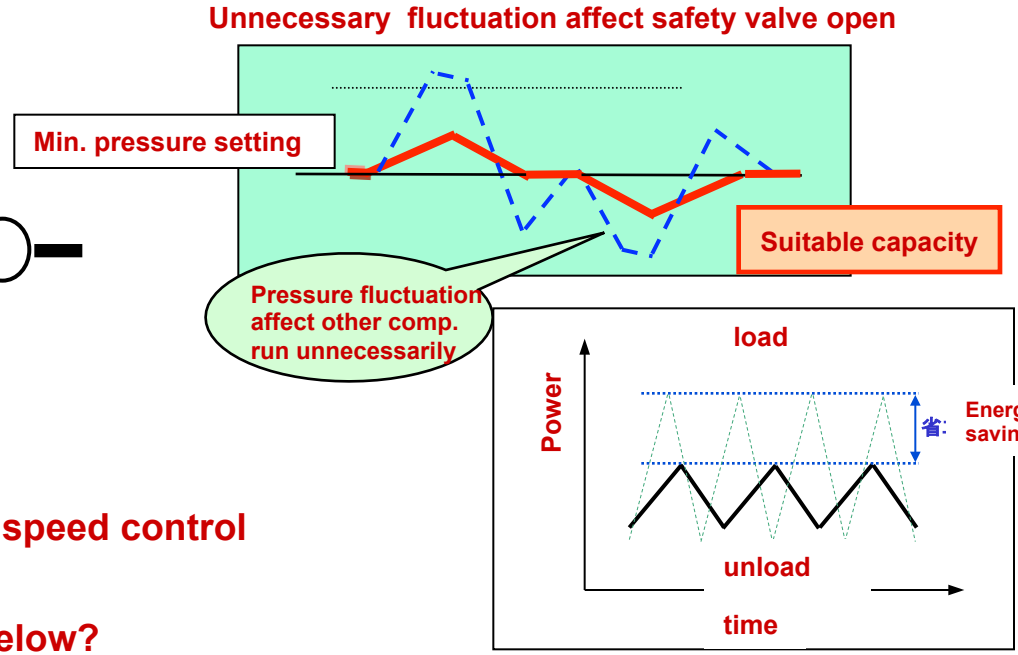
How much improvement can be made with loop piping?

Pressure loss become one quarter, only to make loop piping if there is imbalance among load.

How pressure fluctuation changes if air tank is installed.

Effect of receiver tank if pressure fluctuation occurs frequently





Ideal and effective operation by variable speed control compressor with air receiver tank

Do you have any familiar situation like below?

There are many possibilities to reduce extra power by changing air compressor's control operation with air receiver tank.

1. Air compressor's control commands unload operation frequently.

2. There are big gap of air consumption in specific period, and facilities run all day.

3. Air pressure is fluctuating frequently even if small amount of air is used. (unstable)

Any difference with / without air receiver tank?

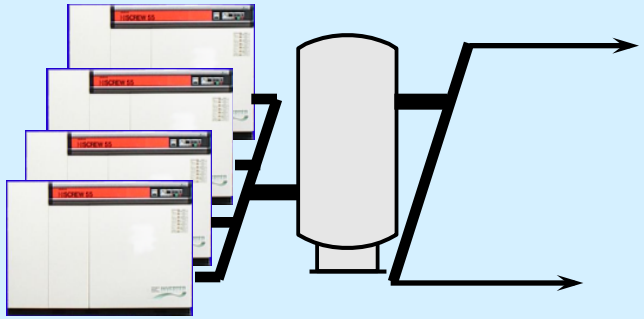
Improvement air compressor system

What is efficient way to pressurize higher locally within the air supply system?
Do you have similar cases below?

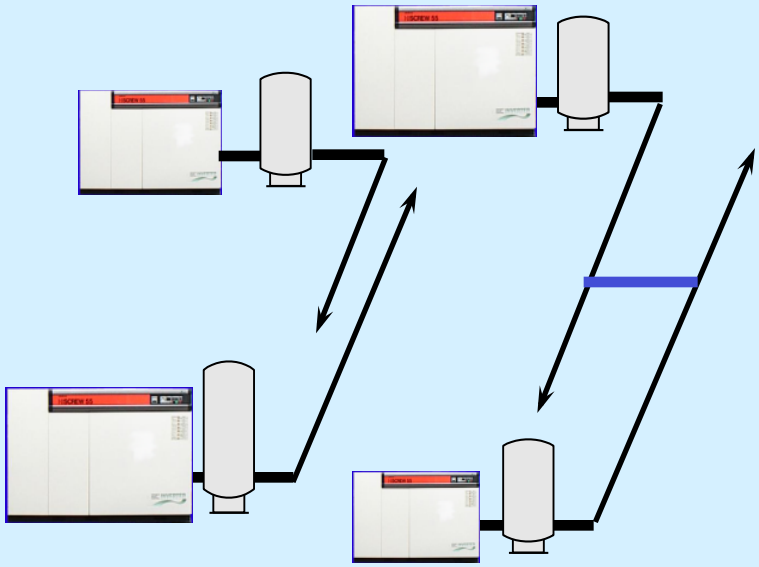
1. **Which is best installation 'Collective or Independent'**
2. **We are using many compressors.**
   -> you had better plan to install multi controller system
3. **Compressor is still operated even in not using air.**
   -> your factory has air leakage.
   -> you have to check,
   how much leakage are there and find leakage point.

Which Is More Energy Saving, Collective or Independent?

Collective setting



Independent setting

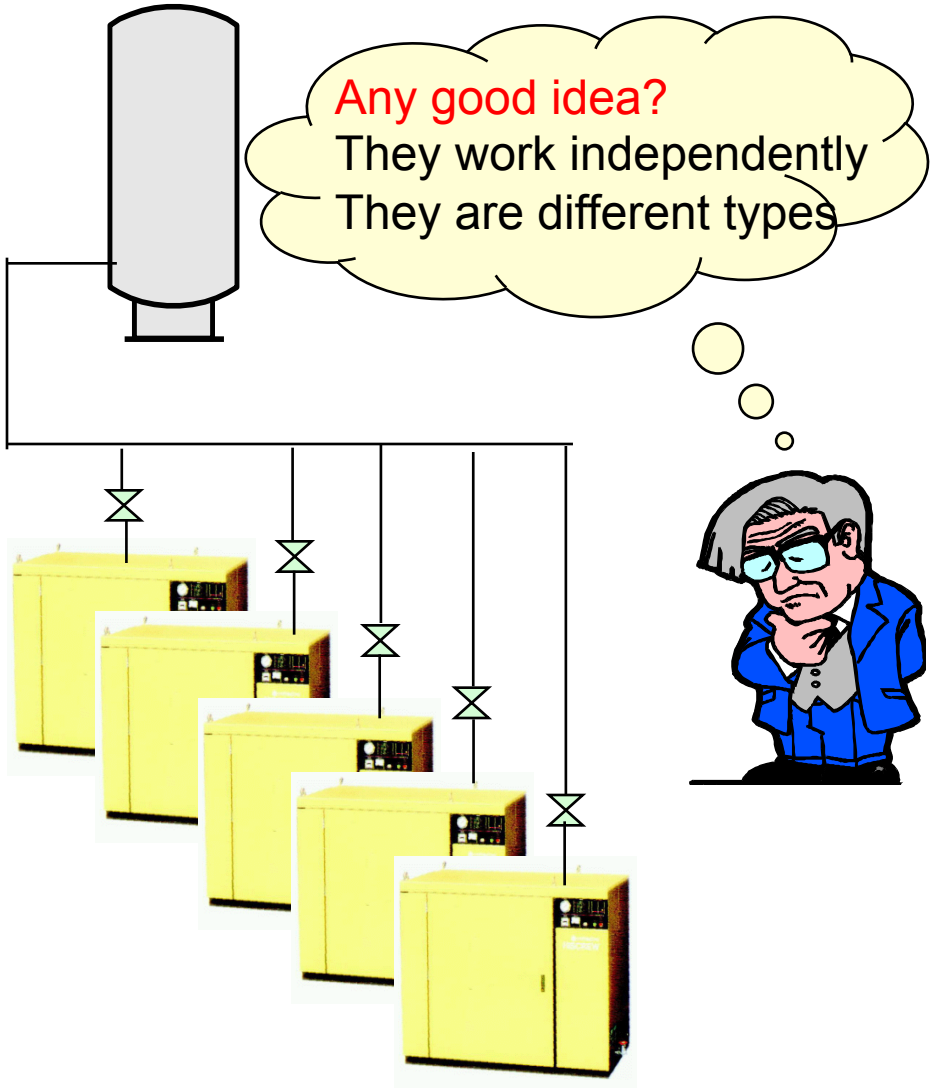


Setting Type	Collective	Independent
Daily Maintenance	Easy	Need to assign stuff for each line
Regular maintenance	Easy	Need maintenance in each line
Pressure flexibility	Need to operate with the highest pressure equipment (Some loss)	Able to apply appropriate pressure for each piece of equipment (Minimum loss)
Pressure loss	Some Piping tends to be long	Small Piping can be short Adjustment can be made in each line
Air leak	Affects whole air supply system	Affects only line with the leakage
Multi-unit Control	Available	Unavailable

Energy saving can be made by Inverter compressor for both collective & independent settings

1. Collective setting: Inverter compressor absorbs load fluctuation
2. Independent setting: Easy to accomplish energy saving

There Must Be A More Efficient Way



The best way!

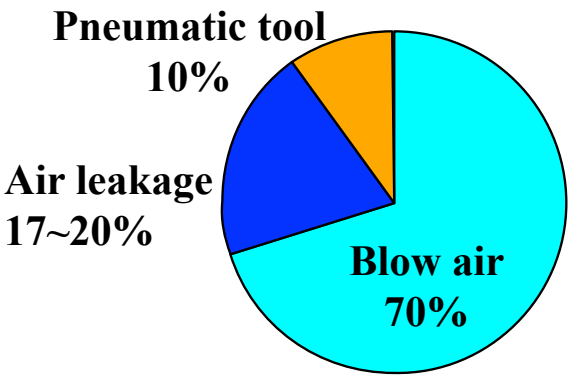
1. Select base load compressor and concentrate the load on it
2. Stop the extra compressor
3. Stop compressor according to need (Scheduled operation)

Multi Roller Ex

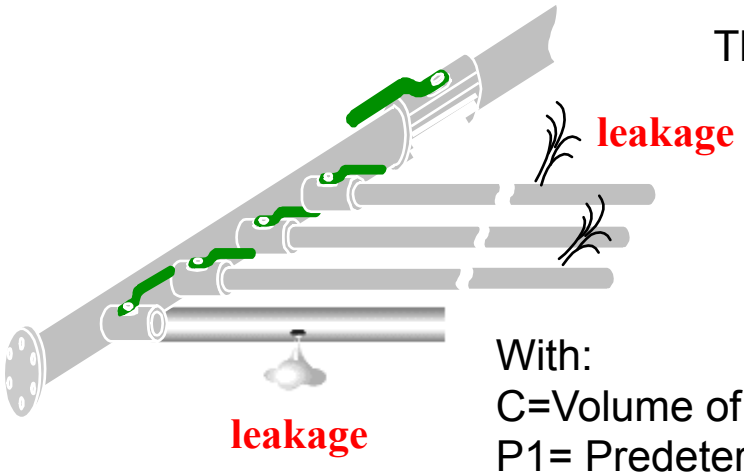
Operation leveling
with
Multi-Unit Controller

Leakage

Recommendation: determine total leakage and reduce it
Leakage Checking Method



1) Operate compressor at night, or holiday, and shut it down when achieving a predetermined pressure value.
2) When the compressor is shut down, due to the leakage, the pressure will automatically decrease. The amount of leakage can be known by measuring the time (t) taken to decrease the pressure by 0.1MPa.



The formula to determine the leakage (C) is given below:

$$C = \frac{(P1 - P2) \times V}{Po \times t}$$

With:
C=Volume of leakage (M3/min)
P1= Predetermined pressure (MPa) (gauge pressure + 0.101MPa)
P2= Pressure after leakage (MPa) (gauge pressure + 0.101MPa)
t=Time taken to reduce pressure from P1 to P2 (min)
Po= Atmospheric air pressure(MPa)
V= Piping capacity (Mm3) (In case of your company; ? m3)

The air leak point

[Leakage cases]

20% of leakage exists in a plant on average

point；valves
17．4L/min

point；air gun
49．2L/min

point；hoses
59．4L/min

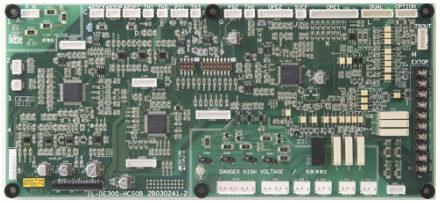
point；hose joint
59．4L/min

point；regulator
71．7L/min

point；coupler
27．7L/min

Is inverter compressor cost high?

The answer is “No”.
When you calculate cost for few years, you can pay back of this cost within 3 to 4 years.
(reducing power consumption = energy cost down = profit)



Torque controlled
during low speed

Cascade vector control

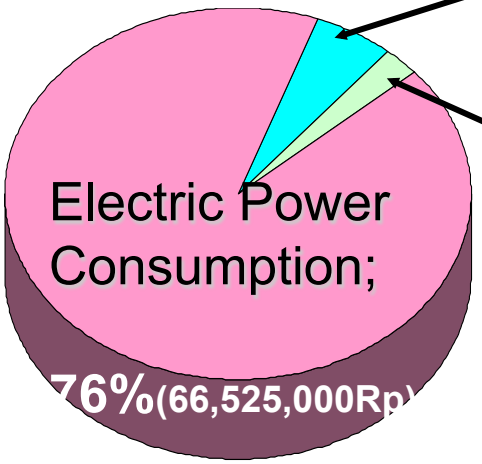
DCBL MOTOR

(permanent magnetic motor)

Check out energy cost -LCC and Specific Power Consumption

Note: LCC = Life Cycle Cost

Most of compressor LCC is power consumption.



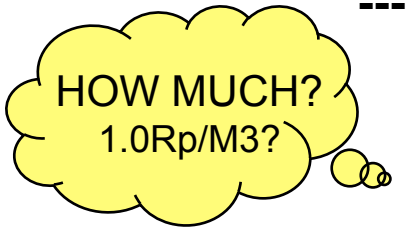
Maintenance: 14%
(12,100,000Rp)
Carry out periodical maintenance.

Initial: 10%
(8,220,000Rp)
(compressor, installation/ starting, piping, etc.)
Select better efficiency, better control.

<Example>
Oil flooded 75kW class rotary screw (standard type)
6000h/y operation, 7.5RpB/kWh
60% Load example
Total cost: 20 years average

Specific Energy Consumption

How much to for 1㎥ of compressed air?
--- Example of quick calculation (100%load)

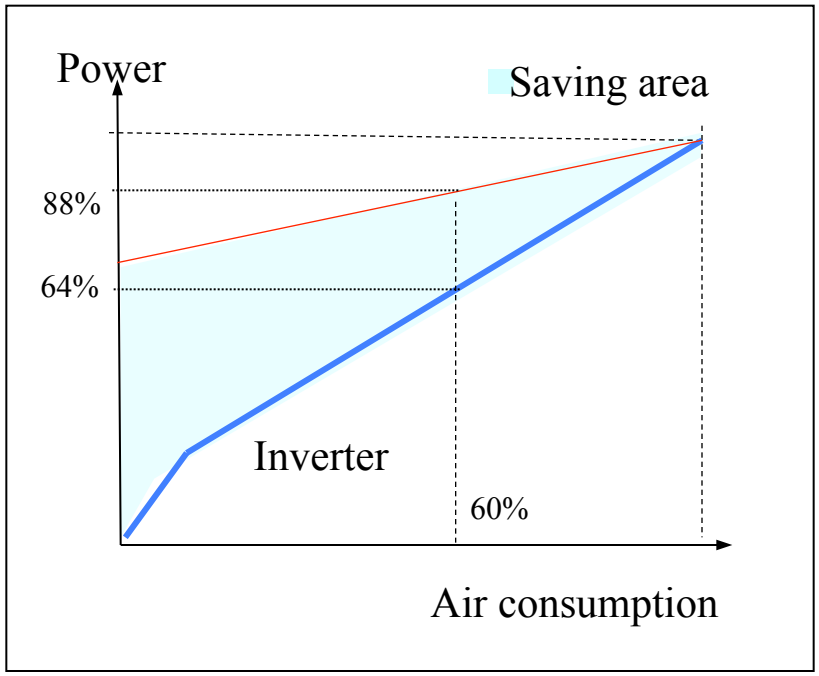


$$\text{Energy cost (0.8Rp／㎥)} = \frac{\text{Input Power 84 (kWh)} \times \text{Electricity cost 7.5 (B/kWh)}}{\text{FAD 13.2 (㎥/min)} \times 60 \text{ (min)}}$$

Improvement with air compressor

Improve on air compressor with variable speed control operation (inverter)

Unnecessary power is consumed when low load operation, If conventional type capacity control (standard U type) and Integral operation (I type).
Easy to reduce unnecessary power, only to adopt inverter control.



The electric power cost; 7.5Rp/kWh

At air consumption 60% 20years cost,
(only power consumption)

Same air consumption, but power consumption is much different between standard and inverter type.

Standard compressor ･･･ power consumption 88%
20years power consumption of Standard compressor
84kW x 0.88 x 6000h x 20y x 7.5Rp = 66,510,000Rp

Inverter compressor ･･･ power consumption 64%
20years power consumption of Inverter compressor
84kW x 0.64 x 6000h x 20y x 7.5Rp = 48,384,000Rp

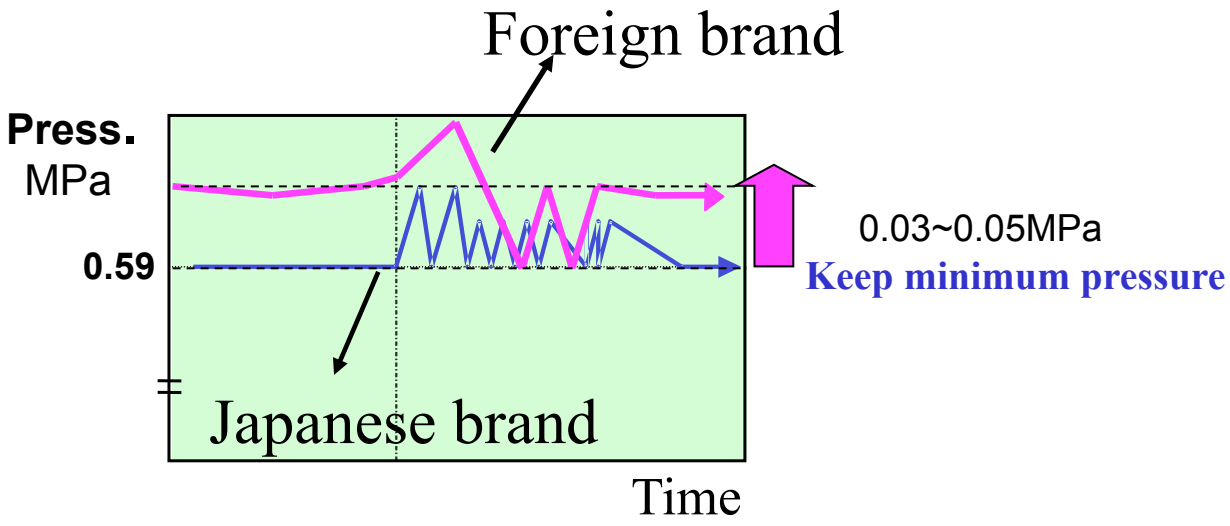
Inverter type payback period is 2.2 years.
Difference in price between standard and inverter type case, payback period is only one year.

What is different point between European brand and Japanese bran

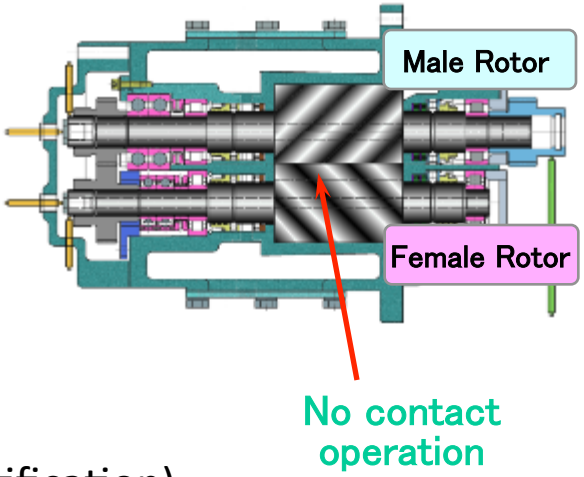
For inverter (VSD or VFD) compressor of Japanese brand

Motor is not only IE3 cord regulation but also permanent magnetic plus DCBL motor and controlled by high quality IGBT.
So, total efficiency of compressor system is 2~4% higher than Europe brand.

Sensing technology is also different as below, then Japanese brand can get higher efficient.



What is oil-free compressor?



High skill and materials are necessary to product.
Sealing is important even high speed operating.
Maintenance cost is higher than oil flooded type.
Efficiency is little less than oil flooded type.
Price is higher than oil flooded type, nearly double.

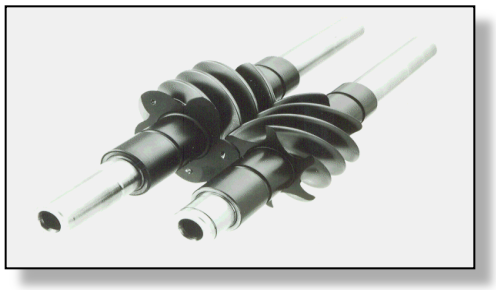
but

Oil free compressor can get very clean air (class zero certification).
It can use for high technology products and high quality use to grow up industries.

for

Electronics, semi-conductor, food, medical, textile, and others
Oil-free air can clear such as HACCP, FSSC22000 and GMP regulation.

- HACCP; Hazard Analysis Critical Control Point
- FSSC22000; Foundation for Food Safety Certification
- GMP; Good Manufacturing Practice



High technology put into these compressors

- Reciprocating compressor
- Screw compressor
- Scroll compressor
- Centrifugal compressor

CES Consulting & Engineering Service

A Chemical Company in India

One Day SSOP® Feasibility Study

TLV®

Survey Date: 9th December 2015
Report Date: 10th December 2015

TLV Members
Hayato Kida / Consulting Engineer
Ashwin Sanyal / TLV India Sales Manager

Steam System Optimization Program

SSOP®

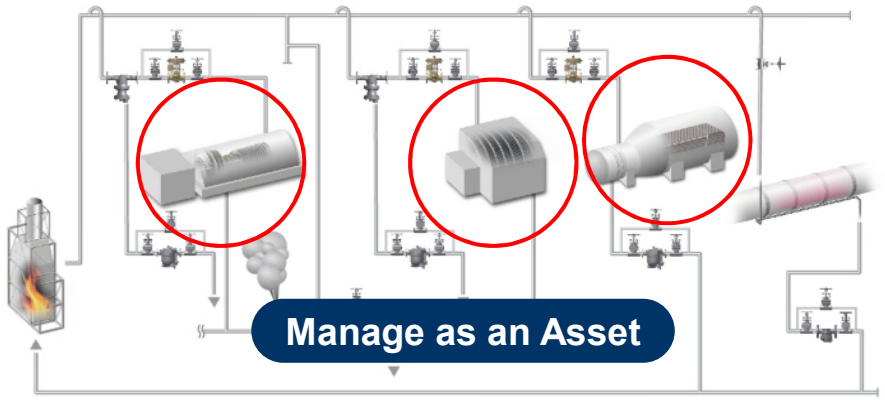
Peace of Mind through Steam System Optimization

TLV®


Typical Scenes from a Steam Plant


Peace of Mind

Steam Plant



Stand-alone management of equipment is inadequate

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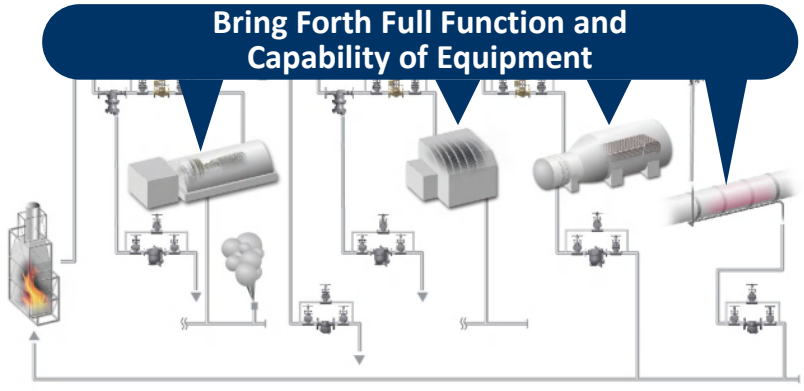
Contributing to Safe & Stable Plant Operation



Steam is an Asset

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The Structure of SSOP®

3 Phase **How can the entire steam system be optimized?**

Create optimum balance with the entire steam system treated as a valuable asset.

2 Phase **How can all SA (Steam Applications such as steam-using equipment, tracing) be optimized?**

Newly define everything from steam supply to condensate discharge as an asset.

1 Phase **How can all CDLs (ex. 10,000) be optimized?**

Necessary conditions for the steam system to function.

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The Structure of SSOP®

3 Phase **Steam System Balance**

⇨ Steam System (Electricity & BFW) Balance Optimization
⇨ Steam Load & Generation Balance Optimization

Optimize Steam System

2 Phase **BPSSM® (Best Practice of Steam System Management)**

⇨ Safety, Reliability & Productivity Improvements
⇨ Recover and Re-use Condensate and Waste Heat

Optimize Steam Applications

1 Phase **BPSTM® (Best Practice of Steam Trap Management)**

⇨ Eliminate Problems Caused by Condensate
⇨ Reduce Steam Loss

Create Infrastructure

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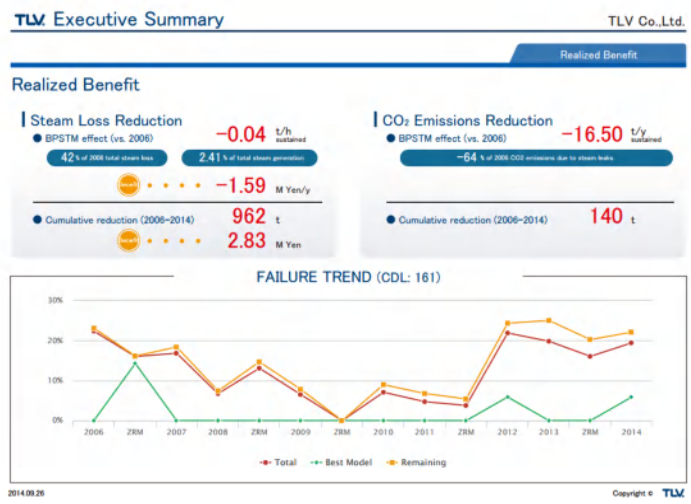
BPSTM.NET - Executive Summary



Feasibility Study Result Summary

Improvement Items

CDL survey item + 2 steam application items

Steam Reduction	:	120 kg/h
CO2 Reduction	:	166 t-CO_2/Year
Total Merit	:	1,317,000 INR/Year

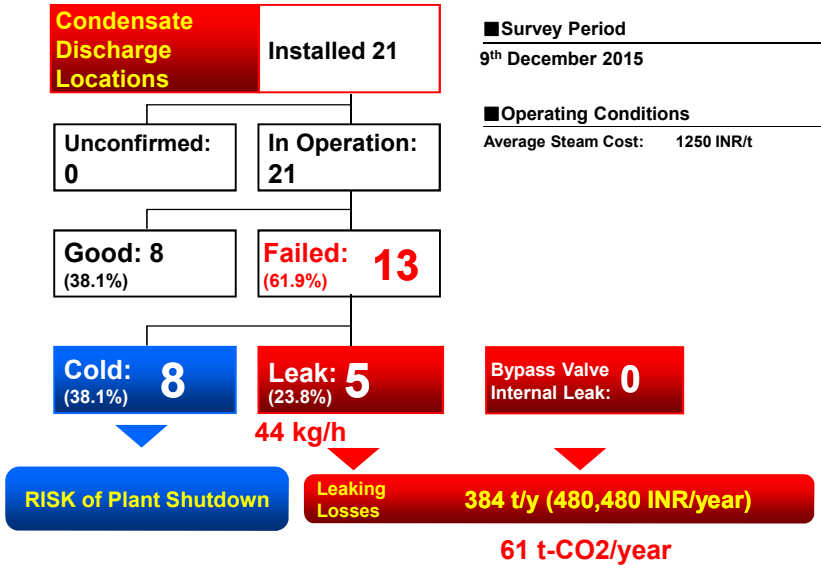
This time surveyed 21CDLs and 6 steam applications out of 118CDLs and 30 steam applications during one day.

Estimated Total Energy Saving Potential

Steam Reduction	:	629 kg/h
CO2 Reduction	:	865 t-CO_2/Year
Total Merit	:	6,881,000 INR/Year

Used following condition
CO2 emission factor:0.157 tCO2/tSteam (IPCC standard/Refinery Gas)
Operating hour:8760hours/year
Steam cost:1250 INR/t

BPSTM Result (Condensate Discharge Locations "CDL")



■Survey Period

9th December 2015

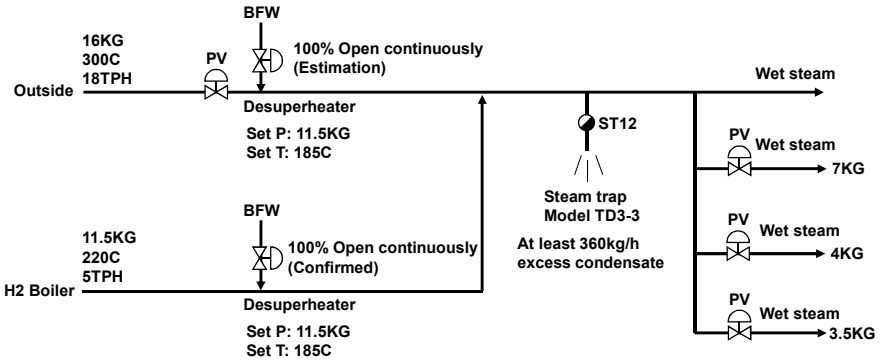
■Operating Conditions

Average Steam Cost: 1250 INR/t

Whole Plant

Improve steam quality by desuperheater set temperature change

Current Situation



Steam sturated temperature at 11.5KG is 189C, however the desuperheater set temperature is 185C. 11.5KG steam never reaches 185C, so excess water is injected to the steam line. Confirmed 450kg/h condensate is continuously discharged from steam main line that is abnormally high condensate discharge load from the steam trap at the steam main line.

Whole Plant

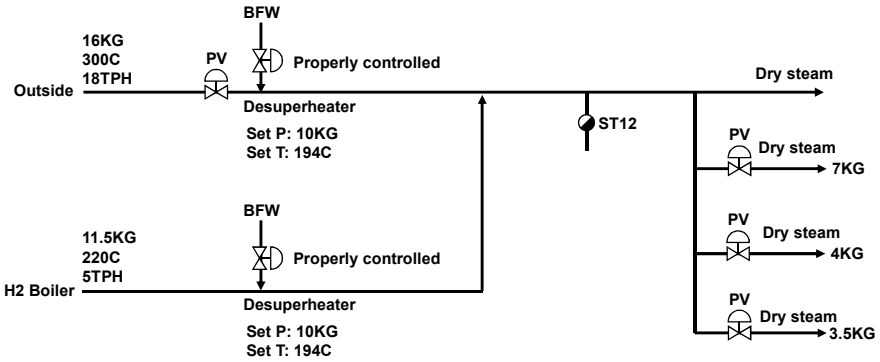
Improve steam quality by desuperheater set temperature change

Whole Plant

Improve steam quality by desuperheater set temperature change

Potential benefit: Steam reduction 76kg/h, 836,000 INR/year, 105 t CO2/year, Steam quality improvement

Opportunity



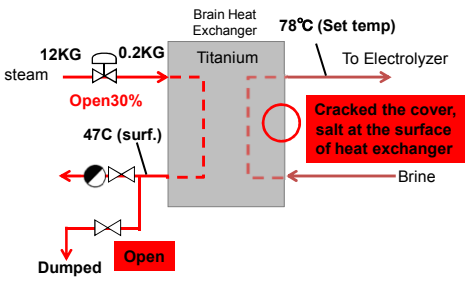
Change the steam set pressure to 10KG (Tsat=184C). Change the desuperheater set temperature to 194C (10C + Steam saturated temperature) . Excess desuperheater water is not injected steam line and reduce losses. Reduce risk caused by wet steam.

MC1

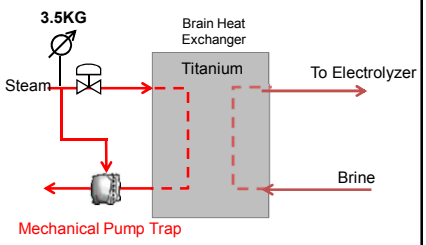
Reduce risk and steam loss from plate heat exchanger by pump trap

Potential benefit: Reduce risk of steam leakage and improve system reliability

Current



TLV Proposal



Heat
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Safety Reliability is one of the most important issue

for
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When
hich
can damage the costly equipment.

Next Action

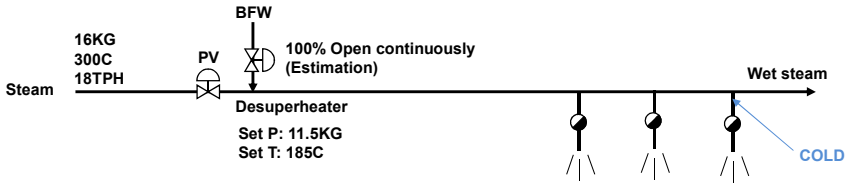
1) Implement improvement items

- **Many CDLs judged as Low temperature (less than 60% of steam saturated temperature)** 6 Low temperature CDLs out of 8 cold CDLs
- **Desuperheater temperature setting may affect this (too much condensate cannot be discharged by small steam traps)**
- **Recommend to review desuperheater setting first then re inspect CDLs**
- **Some valves in CDLs are wrongly operated (Steam trap inlet valve closed). Need whole area survey and optimize CDL operation.**

2) Survey for whole plant

- **This is feasibility study. The survey time was very short. However even this short period, there are some important findings. Need whole plant survey to maximize your profit.**

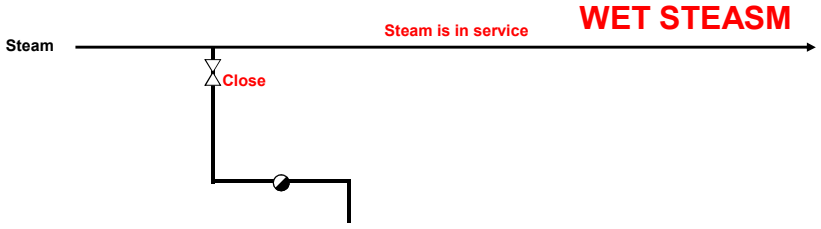
Next Action



Is this steam trap failure?
Is this because of too much water from desuperheater?

Normal steam trap survey cannot find this

Next Action



Normal steam trap survey could judge this trap as COLD!

SSOP Achievement

Surveyed 105 plants (in Japan)

CO2 emission reduction	320,000 t/year
Steam loss reduction	260 t/hour
Cost reduction	2.8 billion INR/year

Potential in India comparison by refinery capacity

India	Japan
4,355,000 barrels / day	3,916,700 barrels / day
22 Plants	23 Plants
	
FS CDL failure rate 61.9%	Japan CDL average failure rate 25.6%
? billion INR/year	2.8 billion INR/year

TLV Contact in India

Steam System Optimization Program(SSOP®) by TLV

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Visit our website: http://www.tlv.com

INTRODUCTION OF
ONCE-THROUGH BOILERS
&
MUTIPLE INSTALLATION SYSTEM

The Best Partner of
Energy, Water and Environment

MIURA

Company Profile

Name

MIURA Co., Ltd.

Location（所在地）

7 Horie, Matsuyama, Ehime
799-2696, Japan

Founded（創立）

December 1, 1927

Established（設立）

May 1, 1959

Capital（資本金）

9,544 million yen (82million dollars)

Issued stock（発行株式数）

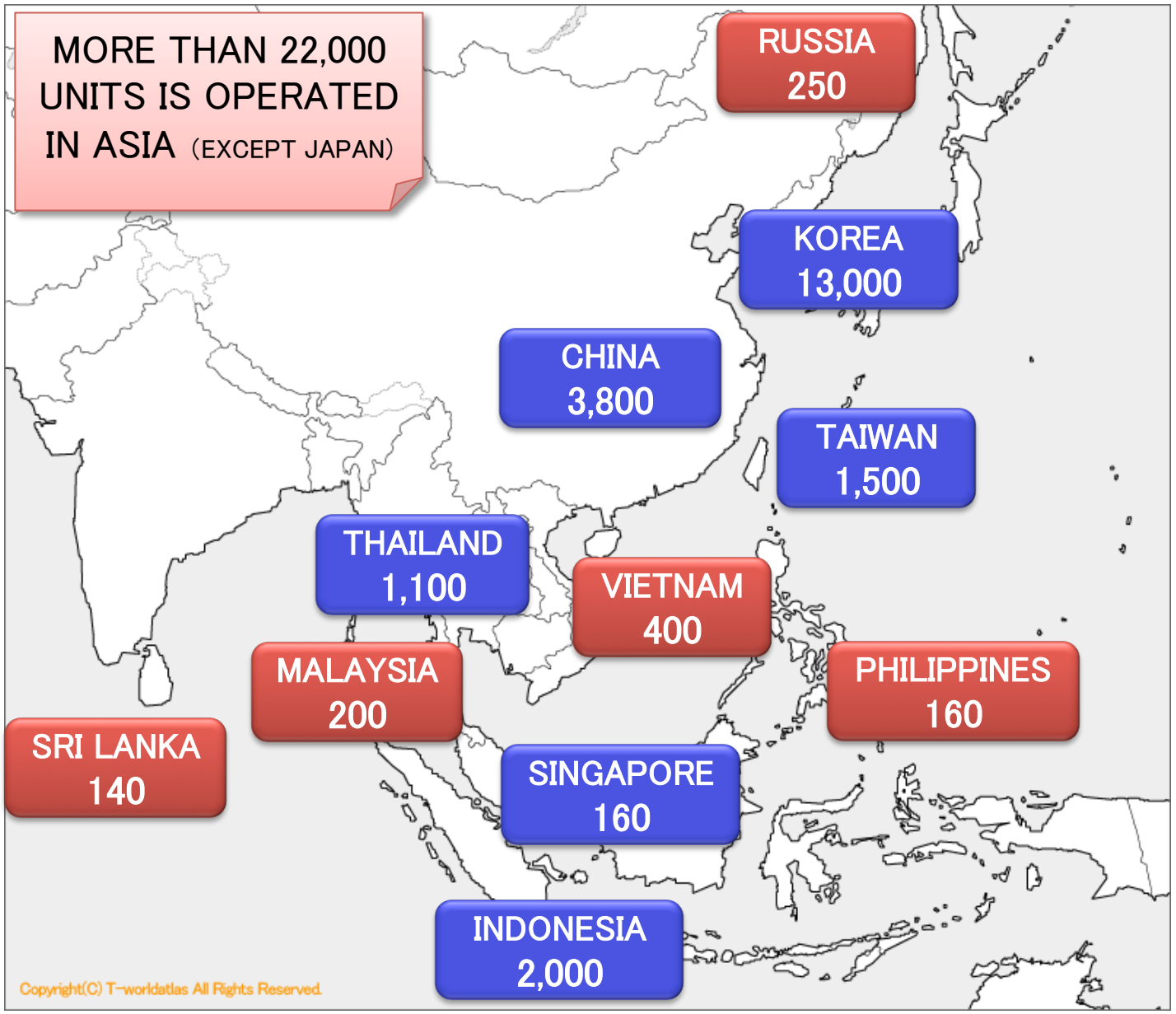
125.29 million
The first sections of the Tokyo Stock Exchange and Osaka Securities Exchange

Employees（従業員数）

4,409
Miura group total

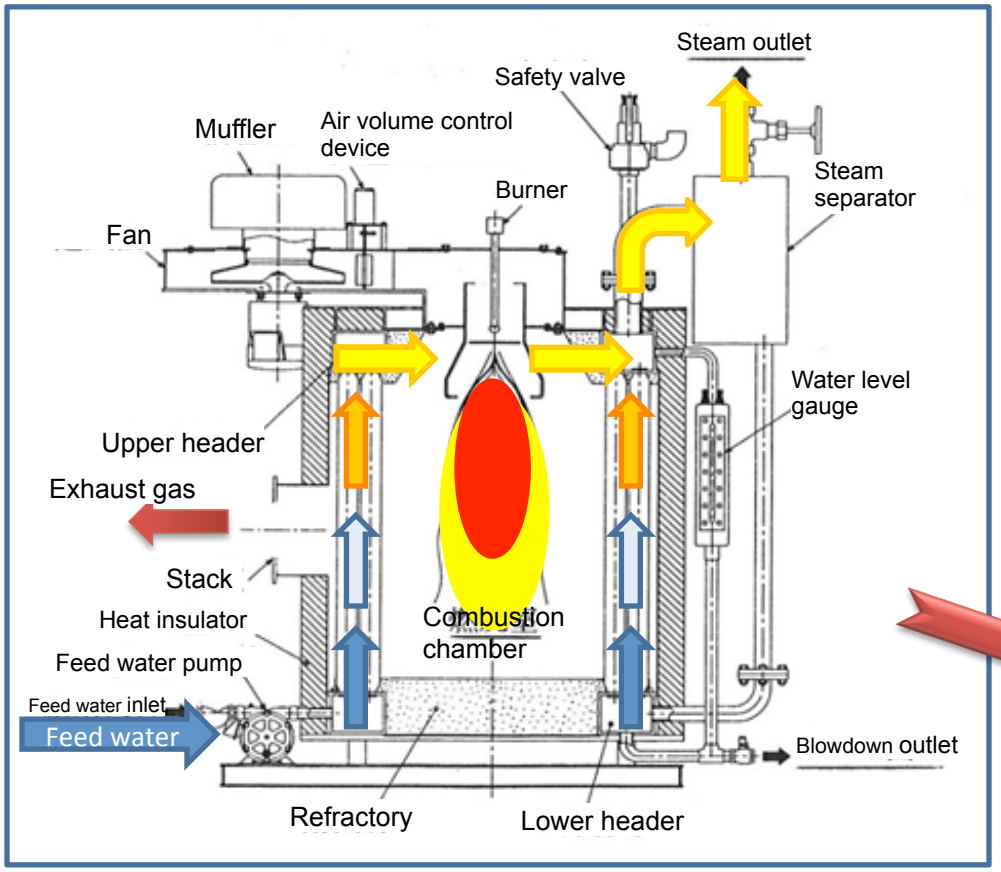
Miura Worldwide Expansion

Sales Result Unit （ASIA）



Structure and Safety of Once-through Boiler

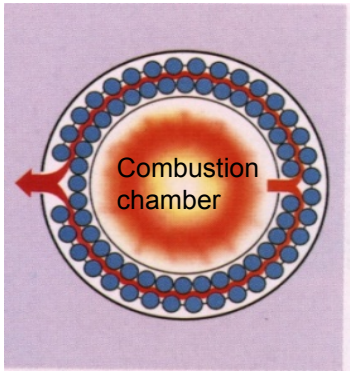
Sectional view of boiler



◆ This small boiler has a structure that does not include a drum and once-through stores a small amount of energy inside it, providing high intrinsic safety against destruction.

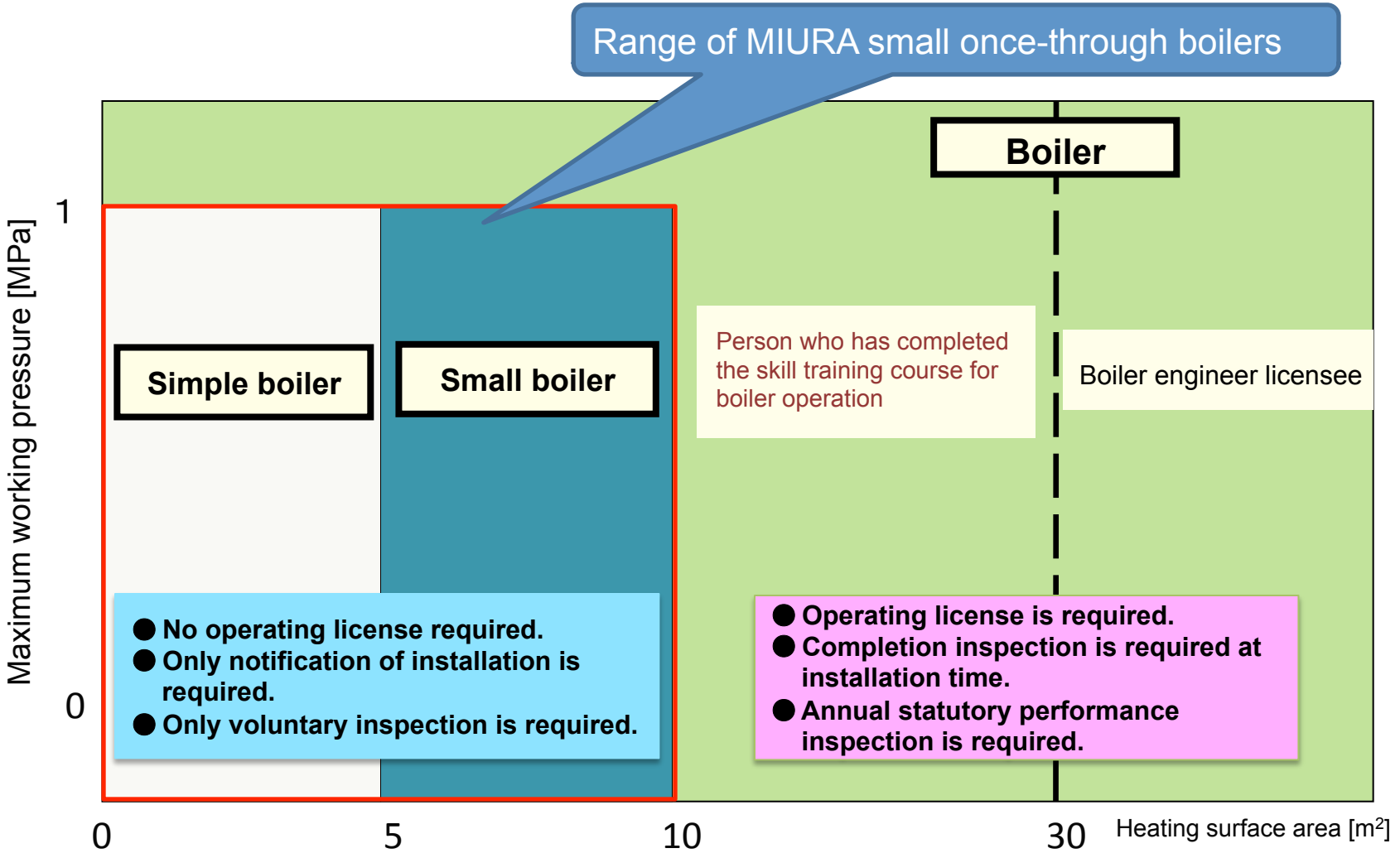
◆ It is compact and lightweight as compared with another boiler.

◆ The low water content results in a very short evaporation time, 3 to 5 min.



ω flow structure
with proprietary heat transfer fin

Legal regulations and requirements are relaxed.



Range of application of once-through boilers and operators

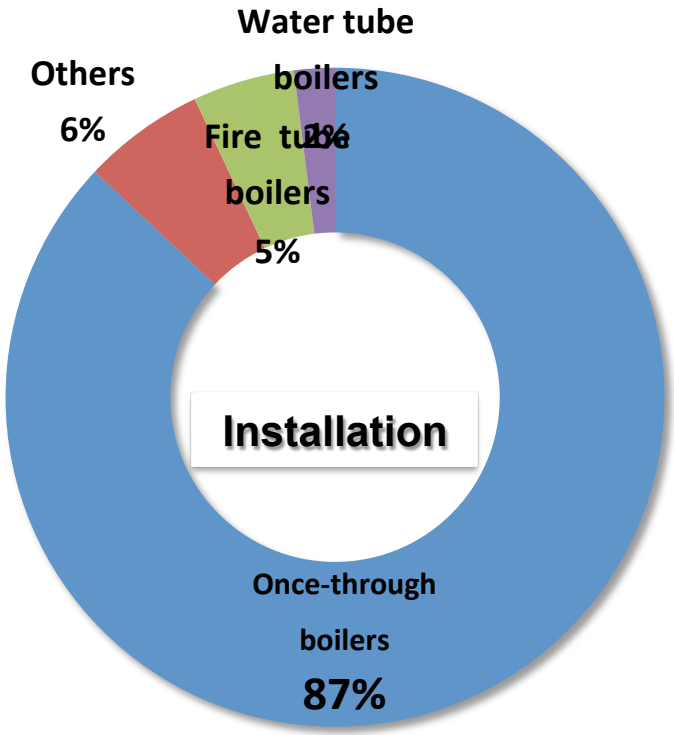
* Actually, there are also limitations of the cross-section area of boiler headers, and the inner diameter and internal area of the steam separator.

* Korea and Taiwan also has same part of exemption for the regulations

Number of boiler related fatalities by boiler type

Year	Boilers	Small boilers	Simple boilers
2012	1	0	0
2011	1	0	0
2010	0	0	0
2009	0	0	0
2008	1	0	0
2007	0	0	0
2006	2	0	0
2005	0	0	0
2004	1	0	0
2003	0	0	0
2002	3	0	0
2001	0	0	0
2000	0	0	0
Total	9	0	0

Source: Boiler & Crane Safety Association Homepage as of June 2014

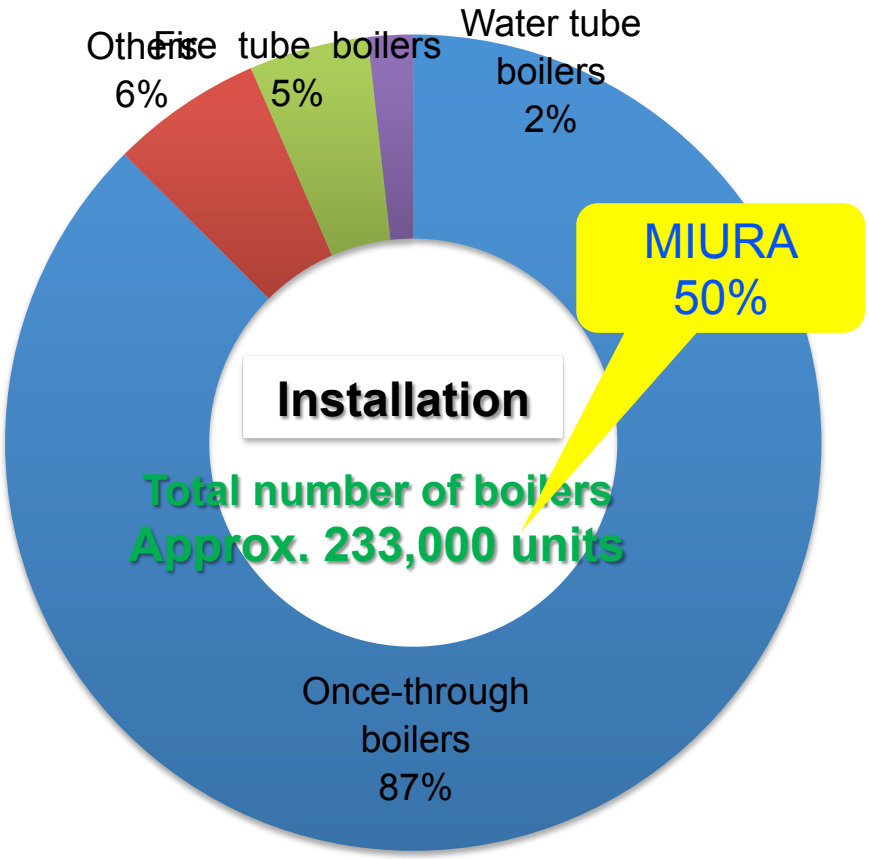


Boiler installation status
Boiler types installed by percentages

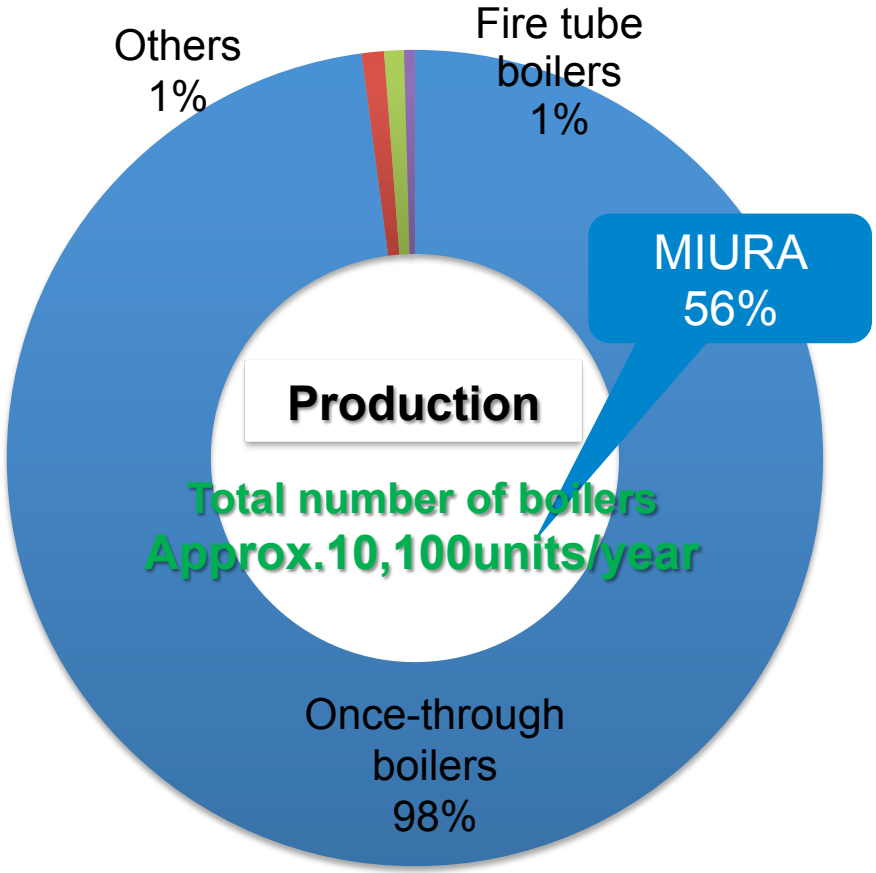
※ Above figures are our estimates

Boiler Market in Japan

（ excluding boilers for power plant）



Boiler installation status
Boiler types installed by percentages



Fiscal 2011 boiler production status
Boiler types produced by percentages

Above figures are our estimates

Relevant laws and Japanese Industrial Standards (JIS) for Japanese boiler standards

Range of MIURA small once-through boilers

Laws / Standards	Ministry	Laws	Technical standards	Standards	Design / Mfg.	Use
Mandatory laws and standards	Ministry of Economy, Trade and Industry	Electricity Business Act	Technical standards for thermal power generation equipment, Technical standards for welding of electric facilities	Interpretation of technical standards	○	○
	Ministry of Health, Labor and Welfare	Industrial Safety and Health Act	Ordinances related to Safety of Boilers and Pressure Vessels	Construction codes for boilers	○	○
				Japanese small boiler structural codes	○	○
Voluntary standards	—	–	–	JISB8201	○	×

The Ordinances related to Safety of Boilers and Pressure Vessels is compliant standards from JISB8201. The Industrial Safety and Health Act are applied to boilers for general industrial purposes except for power plant, and designed, made and inspected is based on this Act in Japan.

Features of Once-through Boiler

High Efficiency Boiler

EI-2000SG

✓ High Efficiency

- Maximum Efficiency of 96% is achieved !
- Original “special heat transfer fins” = ω flow structure, Economizer with superior corrosion-resistant

✓ Compact

- The high efficient boiler structure and smart layout of the products offer surprisingly space-saving, compared to conventional fire-tube boilers.

✓ Safety

- The once-through boiler offers a high level of safety !

Features of Once-through Boiler

Safety / High performance

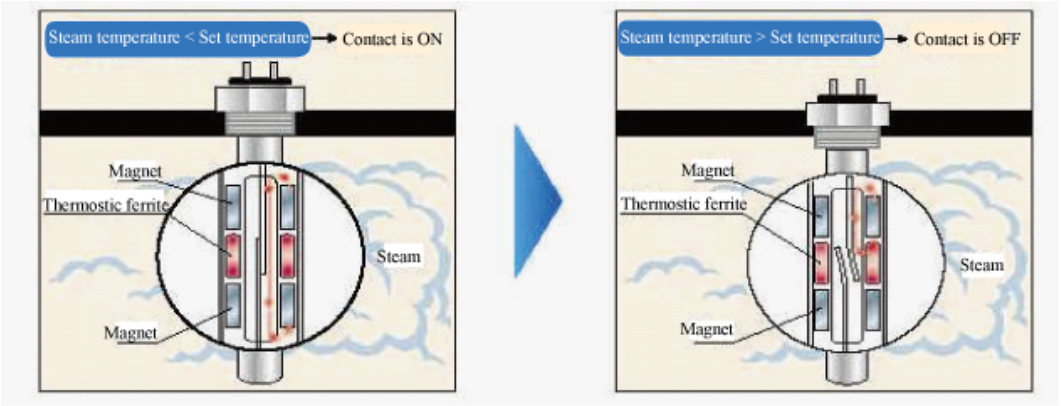
Further improvement in safety & reliable functions!

- Flame sensor with self-diagnostic function
  (Gas fired boilers only) *1

  The light detector is blocked regularly by a shutter, and the flame sensor performs a self check for failures.

- Steam pressure switch *1

  The boiler employs a highly reliable steam pressure switch. It is a fail-safe function utilizing a physical phenomenon that magnetic force drops off as the heat around a magnet is increased.

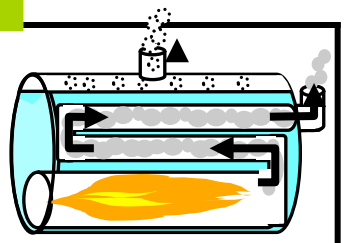


*1 : For the boilers with microcomputer specification

Comparison of Once-through Boiler & Fire tube Boiler

2 ton/h : 2 ton/h

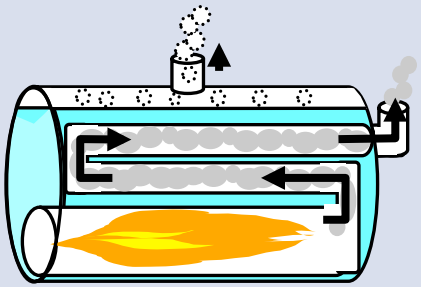
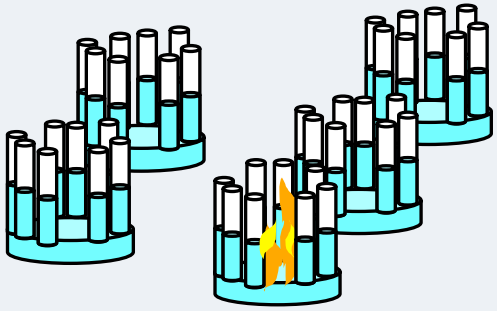
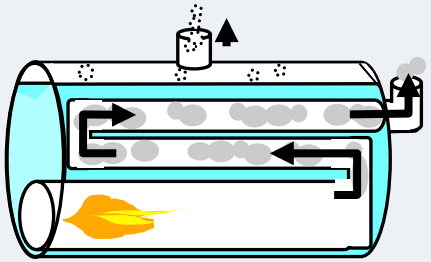
	Once-through boiler		Fire tube boiler
Water contents (Liter)	Low	120 < 2500	High
Time required to generate steam (min)	Short	5 < 50	Long
Radiatoin loss	Low	1 < 3	High



Energy saving / Design efficiency	High	Low

Note: Ratio with the same quantity of evaporation.
All values are actual measurement values based on Miura data.

Comparison of Radiation Loss

	Once-through Boiler	Fire tube Boiler
Steam Out Put 20 ton/h		
	52kg/h ＜ 160kg/h	
Steam Out Put 4 ton/h		
	10kg/h ＜ 160kg/h	

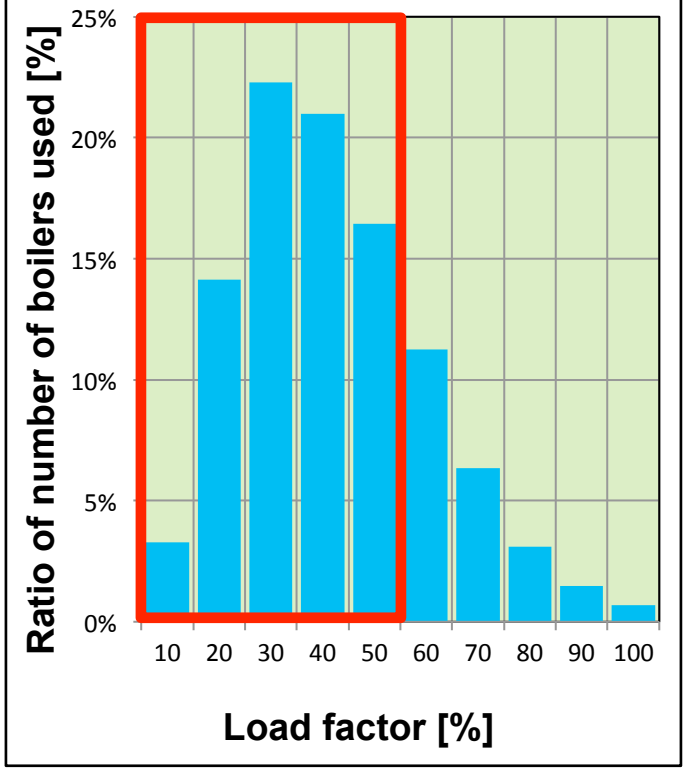
Radiation Loss Ratio：Once-through Boiler：0.26%

Fire tube Boiler　　：0.8%

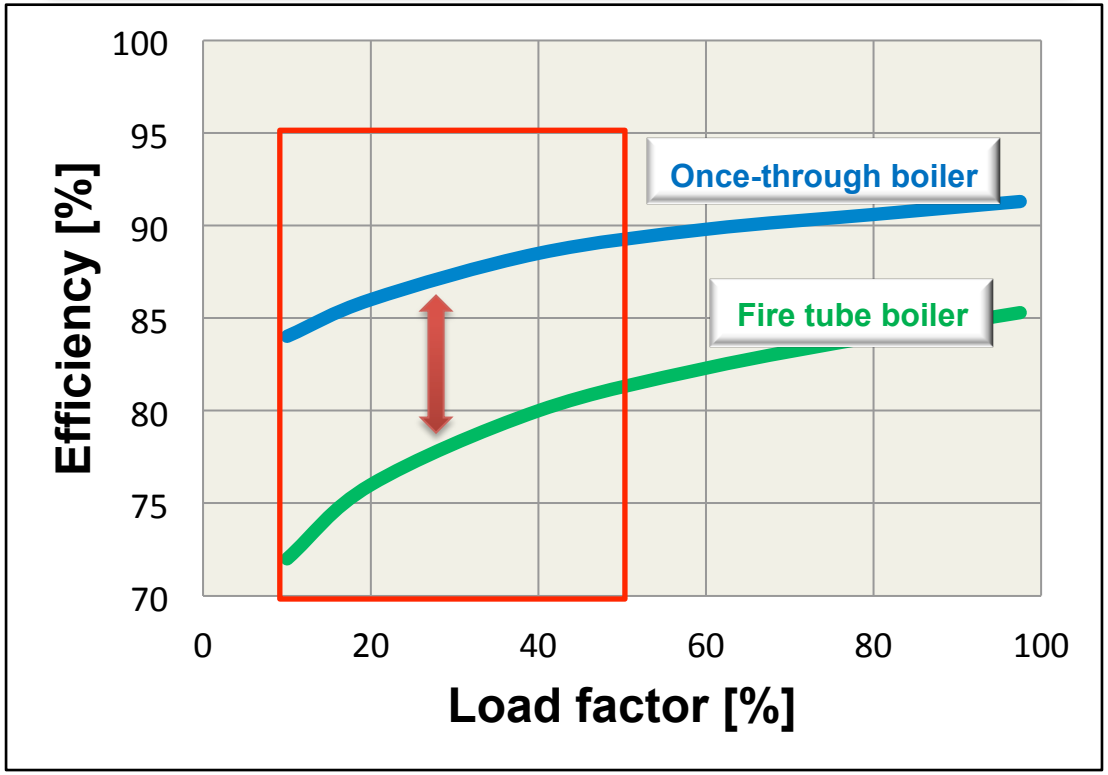
Steam Load Factor & Boiler Efficiency

Multiple Installation System of Once-through Boiler
VS Fire tube Boiler

About 80% of customers use their boilers at load factor of 50% or less.

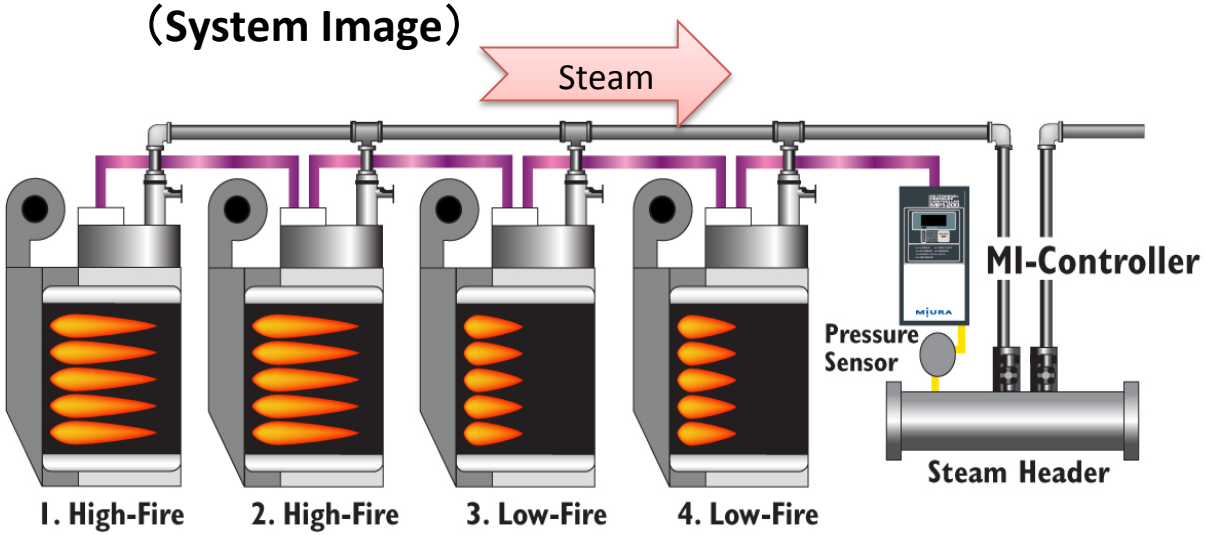


KEEP THE HIGHER EFFICIENCY THAN FIRE TUBE BOILER AT ALL LOAD AREA



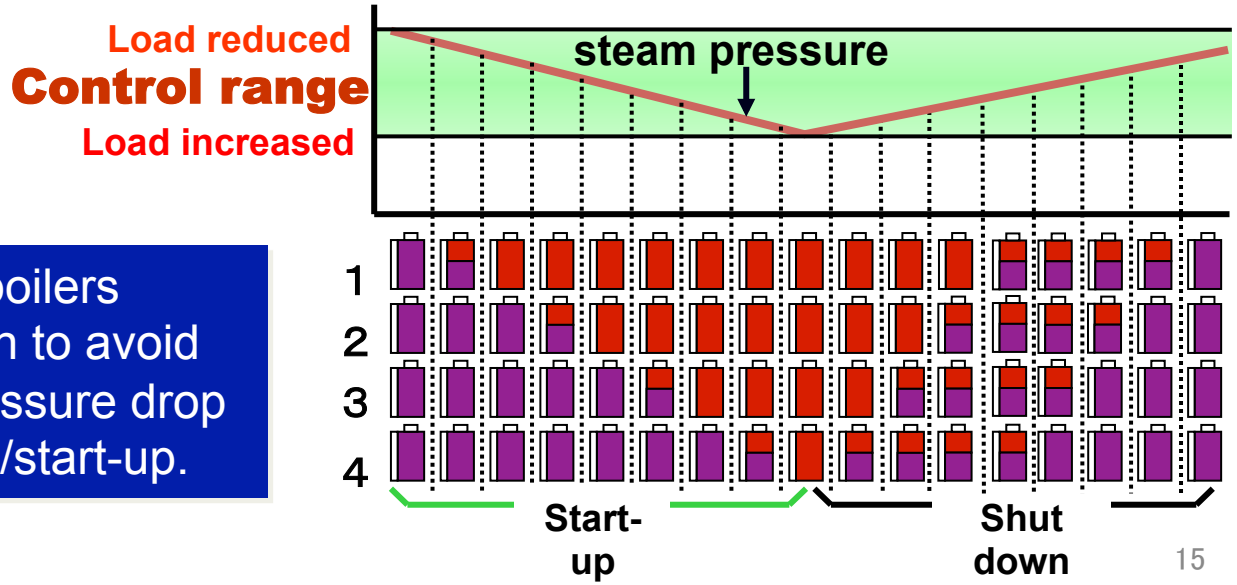
Multiple Installation(MI)System of Once-through Boiler

（System Image）



Once-through Boiler

（Control）



When the load reduces, boilers continue low fire operation to avoid purge loss and steam pressure drop due to purge at shutdown/start-up.

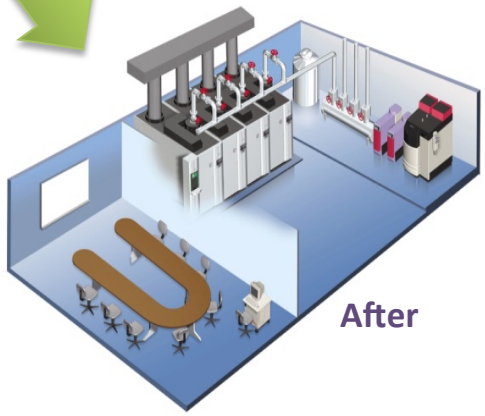
Features of MI System

- ✓ Multi-unit installation of high-efficiency once-through boilers can maintain higher level of operating efficiency than large-scale fire-tube boilers.
- ✓ Multiple installations take much less space than large-scale fire-tube boilers.

Space-saving

Anticipated energy-saving effect is approximately 10～30%

Before



After

Energy-saving Diagnosis

To implement improvement of the boiler system, it is necessary to understand the current situation at first. Using the methods of “Daily report analysis” which is grasping the efficiency of boiler operation and the steam usage through out the year or “Load analysis” which is measuring the instantaneous steam load by installing some sensor to the boiler.

<Example of daily report analysis>

添付資料

年間データ(トータル)　　○○○　様

年月	時間 (hour)	給水量 (L)	間欠ブロー (L)	連続ブロー (L)	蒸気量 (kg)	ガス量 (m3)	蒸発倍数 (kg/Nm3)	圧力 (MPa)	水温 (℃)	蒸気 (kg/h)	ガス (m3/h)	燃料温度 (℃)	ブロー率 (%)	効率1 (%)	効率2 (%)
12/01	744.0	5,612,730	37,750	477,160	4,986,805	53,715.0	32.82	0.59	76	6,676	72.2	35	9.2	83.6	84.7
12/02	696.0	5,692,820	36,840	507,550	5,210,780	56,797.0	32.57	0.59	76	7,487	81.6	35	9.2	83.0	85.0
12/03	744.0	5,409,780	39,030	545,510	5,575,395	61,975.0	32.51	0.59	76	7,626	83.3	35	9.1	82.6	85.0
12/04	720.0	5,144,330	39,200	532,550	5,418,580	59,792.0	32.17	0.59	79	7,526	83.0	35	9.3	81.5	85.0
12/05	744.0	5,731,460	38,970	504,560	5,046,394	56,670.0	31.62	0.59	76	6,785	76.2	35	9.5	80.3	84.6
12/06	720.0	5,493,140	35,780	471,930	4,880,988	56,096.0	30.76	0.59	75	6,751	77.9	35	9.2	78.5	84.9
12/07	744.0	5,352,300	31,050	473,590	4,729,984	54,889.0	30.56	0.59	75	6,352	73.7	35	9.4	78.0	84.7
12/08	744.0	5,373,000	26,190	457,020	4,756,255	54,374.0	31.06	0.59	76	6,395	73.1	35	9.0	78.9	84.8
12/09	720.0	6,136,000	39,370	523,010	5,416,444	62,801.0	30.62	0.59	80	7,523	87.2	35	9.2	77.5	85.1
12/10	744.0	6,326,500	39,880	540,780	5,600,140	62,583.0	31.77	0.59	76	7,527	84.1	35	9.2	80.9	85.0
12/11	696.0	6,113,790	39,210	512,260	5,427,994	59,894.0	32.17	0.59	74	7,799	85.1	35	9.0	82.2	85.0
12/12	744.0	6,839,870	39,970	556,930	5,905,461	62,801.0	33.49	0.59	77	7,937	84.1	35	8.9	83.2	85.0
<<合計>>	8760.0	71,249,720	439,240	6,104,950	63,014,921	702,169.0									
<<平均>>	730.0	5,937,477	36,603	508,746	5,251,243	58,514.1	31.88	0.59	77	7,193	80.2	35.0	9.2	81.1	84.9

低位発熱量　=　95.92　[MJ/Nm3]
燃料の供給圧力　=　220.65　[kPa]

給水の比重　=　0.9737　(77℃)
乾き蒸気のエンタルピ　=　2.76　[MJ/kg]

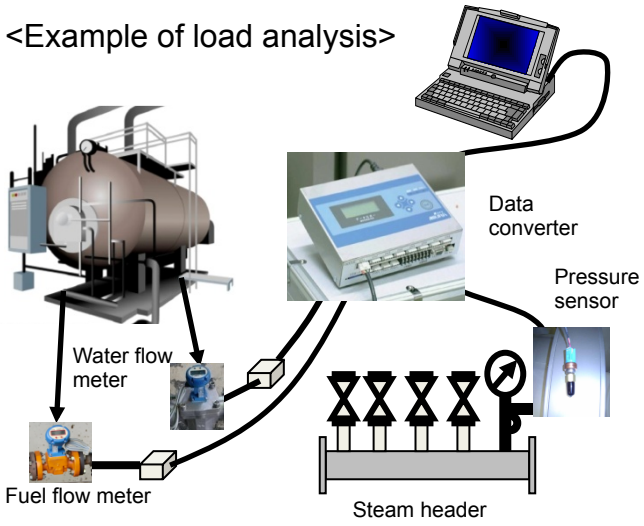
	年月	給水量 (L)	ブロー量 (L)	ガス量 (m3)	蒸気量 (kg/h)
最大時	12/12	6,839,870	594,900	62,801.0	7,937
最小時	12/07	5,352,300	504,540	54,889.0	6,352

(注記)　効率1 …… 日誌データから算出したボイラの運転効率

効率2 …… 弊社の分析によるボイラの運転効率

日毎のリストと値が一致していない部分もございますが、それは計算上の誤差の為です。

<Example of load analysis>



Example of MI System 1

Example of energy saving by boiler update (in Japan)

	BEFORE	AFTER	
EQUIPMENT	No Image		
BOILER TYPE	Firee tube boiler	Small once-through boiler	
BOILER CAPACITY	9.5 ton/h×1 14.4 ton/h×1	3 ton/h	
NUMBER OF BOILER	2	7	
FUEL	Japanese A-type fuel oil	Natural gas	
EFFICIENCY	84.8 %	96.5 %	14% UP
CO_2	430.6 ton/year	292.9 ton/year	32% DOWN

- Small once-through boiler is a standard of industrial steam equipment in Japan.
- MI system at large facility is expanding by enhancing the capacity of once-through boiler.
- The improvement of operating efficiency is in progress by the MI system upgrade and efficiency improvement.

	BEFORE	AFTER	
EQUIPMENT	No Image		
BOILER TYPE	Water tube boiler	Small once-through boiler	
BOILER CAPACITY	3.6 ton/h	2 ton/h	
NUMBER OF BOILER	2	3	
FUEL	Natural gas	Natural gas	
EFFICIENCY	79.6 %	96.9 %	22% UP
CO_2	1,014 ton/year	871 ton/year	14% DOWN

Example of MI System 2

Example of energy saving by boiler update (in Korea)

	BEFORE	AFTER	
EQUIPMENT			
BOILER TYPE	Fire tube boiler	Small once-through boiler	
BOILER CAPACITY	12 ton/h	2 ton/h	
NUMBER OF BOILER	1	5	
FUEL	Natural gas	Natural gas	
EFFICIENCY	84.4 %	93.0%	10% UP
CO_2	3,782 ton/ year	3,432 ton/year	9% DOWN

- Small once-through boiler and MI system are spreading in KOREA.
- Boiler installation to large facility is also progressing like Japan.
- Natural gas is the mainstream.

	BEFORE	AFTER	
EQUIPMENT			
BOILER TYPE	Water tube boiler	Small once-through boiler	
BOILER CAPACITY	15 ton/h	2 ton/h	
NUMBER OF BOILER	2	15	
FUEL	Natural gas	Natural gas	
EFFICIENCY	86.0 %	92.0 %	7% UP
CO_2	10.070 ton/year	9.413 ton/year	7% DOWN

Example of MI System 3

Example of energy saving by boiler update (in China)

	BEFORE	AFTER	
EQUIPMENT			
BOILER TYPE	Water tube boiler	Small once-through boiler	
BOILER CAPACITY	10 ton/h	2 ton/h	
NUMBER OF BOILER	3	12	
FUEL	Coal	Natural gas	
EFFICIENCY	72%	93%	(29%UP)
CO_2	26,888 ton/year	9,826 ton/year	(63%DOWN)

- Fire tube boiler or water tube boiler is the mainstream for industrial boiler equipment in China.
- Although coal, diesel oil, or natural gas is used as the boiler fuel, the boiler using coal fuel still exists over 80 % of the total number of current boiler.
- Significant energy-saving and the emissions-reduction of air pollutant is realized by adopting MI system of once-through boiler and the fuel conversion to gas.

	BEFORE	AFTER	
EQUIPMENT			
BOILER TYPE	Fire tube boiler	Small once-through boiler	
BOILER CAPACITY	7 ton/h	2 ton/h	
NUMBER OF BOILER	3	3	
FUEL	Diesel oil	Natural gas	
EFFICIENCY	82.20%	91.20%	(11%UP)
CO_2	3,355 ton/year	2,145 ton/year	(36%DOWN)

MI System Worldwide Expansion

The Record of Awards

Japan

1. Superior Energy Saving Device Commendation
2. National Invention and Innovation Commendation
3. Japan Society of Industrial Machinery Manufacturers President's Award
4. Science and Technology Agency Director General's Award
5. Japan Gas Association Technology Grand Prize
6. Japan Society of Mechanical Engineers Award

「Excellent prize of saving energy products」

「Nationwide invention commendation」

「Japan Society of Industrial Machinery Manufacturers President's Award」

「Science and Technology Agency Director General's Award」

Korea

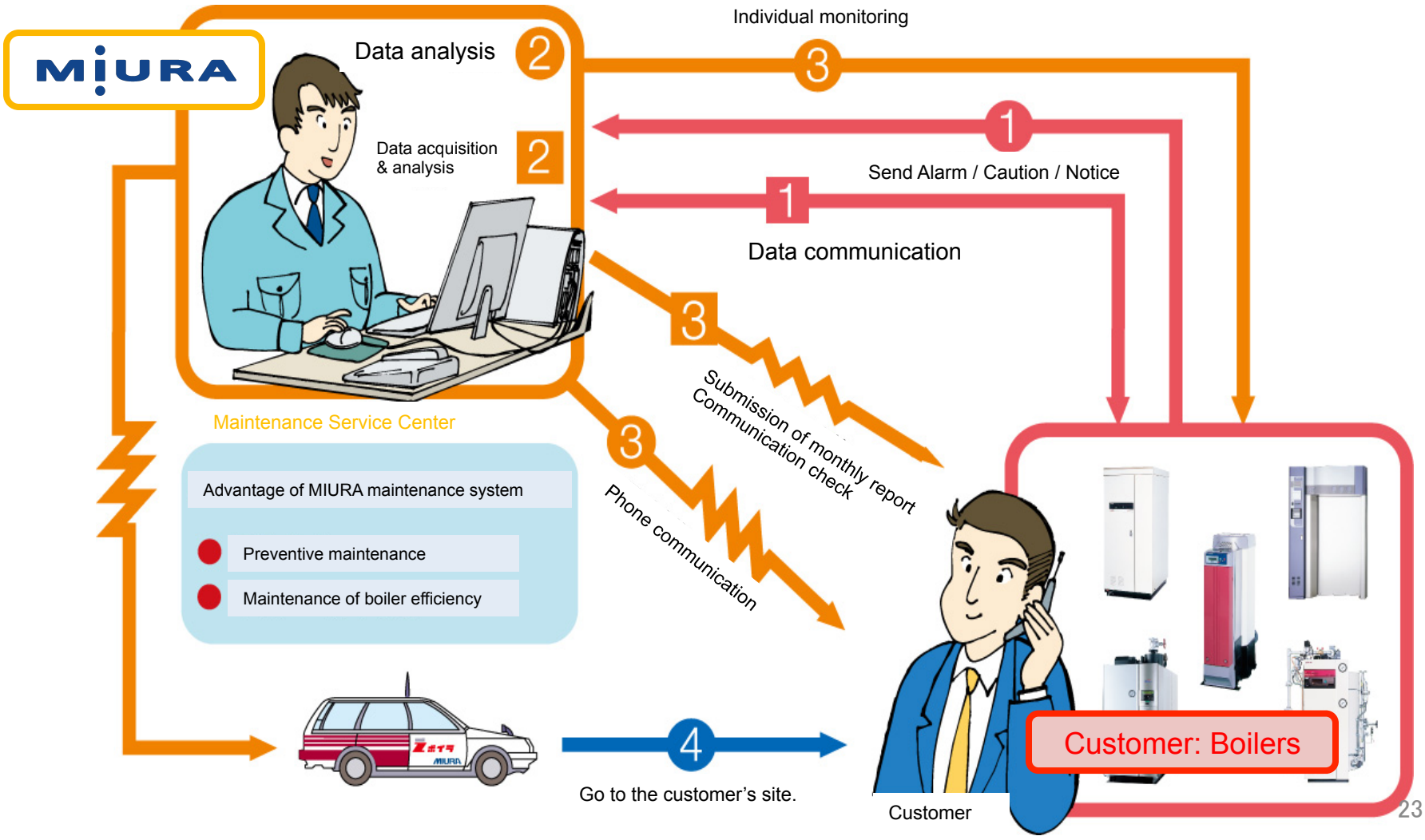
1.The 37th Korea Energy Efficiency Grand Prix「President Commendation」（Field of Energy savings and Efficiency improvement)
2. Certificate for energy saving boilers
3. Certificate for Low NOx. products.

China

1. Environment protection products of Shanghai city.
2. Energy saving products of China industry exhibition
3. Energy saving products of the ministry of China Industrial boilers.
4. High quality brand of China
5. Energy saving products of Shanghai city.
6. New high technology company, New high technology products.

Miura Online Maintenance System

A single telephone line allows MIURA to conduct online maintenance.



Features of Japanese small once-through boiler

- **High safety** due to the boiler structure and advanced technology
- **High system efficiency** due to the high boiler efficiency and Multiple Installation system (MI system)
- Contribution to **space saving** of your facility due to the compact and light weight design
- Recognition as **the standard of industrial boilers** in Japan
- **Popularization** even in East Asian and ASEAN countries

(Approximately 20,000 units have been exported from Japan or manufactured outside Japan.)

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http://www.miuraz.co.jp/en/

Discussion on ESCO based Financial Models for Energy Efficiency Projects

(Promotion of Energy Efficient motors in chemical industries)

By
Pawan Kumar Tiwari
Fellow
The Energy and Resources Institute

12th January 2016

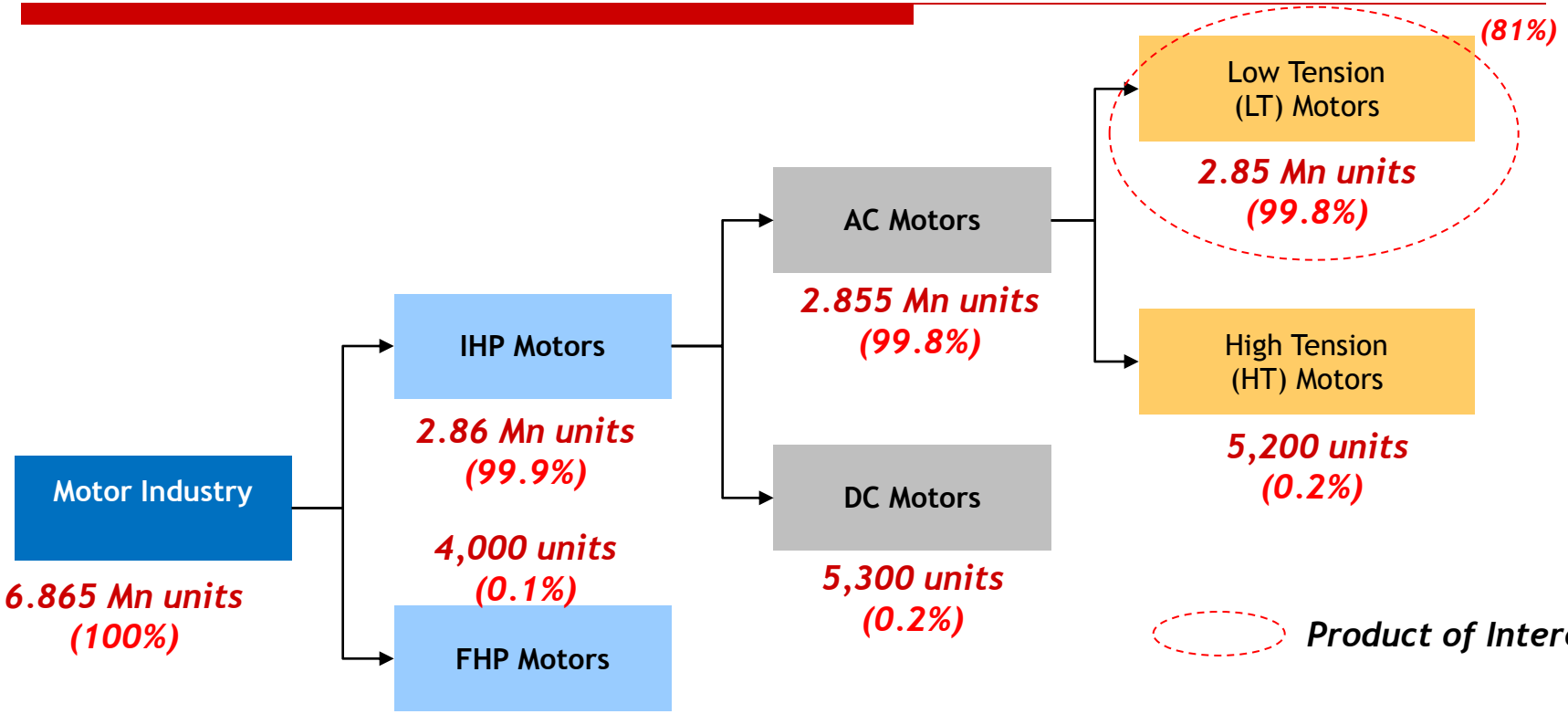
Structure of the presentation

1	Rationale
2	Project overview
3	Methodology
4	DISCOM based ESCO model
5	SPV based ESCO model
6	Financial indicator

Rationale

- Electric motor systems account for about 55% of global industrial electricity consumption and close to 70% of industrial electricity demand.
- In India, about 50% of the total electricity generated is consumed by industries, of which the major share is of electric motors.
- Electric motor driven systems include pumps, fans, compressors, blowers, agitators and so on.
- Energy efficient motors form a major component in contributing to the energy saving by way of increased efficiency of the system itself.

Motor - Market scenario



The share of the high efficiency motors highlights the need to promote the use of HEM in Industrial sector by devising some innovative financial mechanisms.

Project Overview

Objective

- Promotion of use of high efficiency motors in Chemical industries/ MSMEs using various financial models

Ankleshwar Chemical Cluster

- India is one of the largest producer of chemicals in the world
- In 2013, the sector had a turnover of US $160 bn and is growing at 11-12% .
- Electricity consumption by motors driven system accounts for about 80% of total electricity consumption in the chemical sector.
- Ankleshwar chemical cluster houses over 1,200 units manufacturing several chemicals such as dyes & pigments, pesticides, pharma API and so on.
- Cluster already sensitized on energy efficiency aspects during implementation of **SIDBI-WB-GEF project**

Motor profile - Ankleshwar

Cluster scenario#

- Basic data regarding capacity, end-use application, age and service history collected for 383 chemical units having population of about 5,091 electric motors.
- Most of the installed motors are standard category, except a few IE2 category.

Assessment study*

- Detailed assessment of electric motors conducted for 45 chemical units having about 454 electric motors.
- About 36% of total motors surveyed were re-wounded more than once.

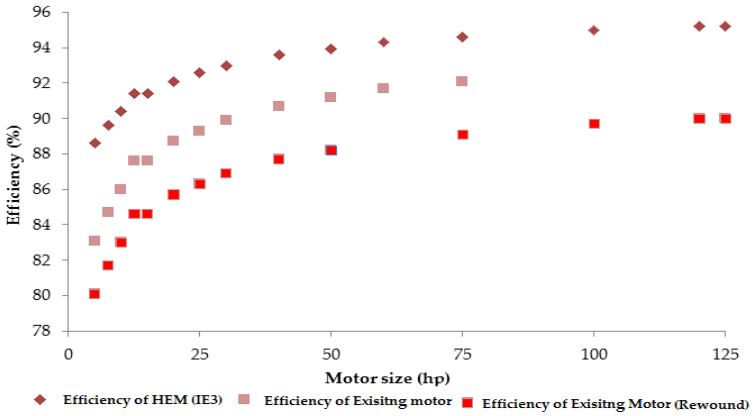
International Copper Association India
Copper Alliance

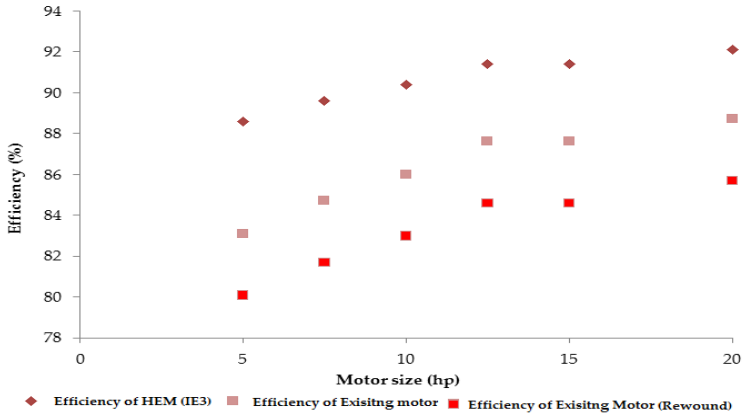
 # SIDBI-WB-GEF project in Ankleshwar chemical cluster; year 2012
*** Supported by The International Copper Association India (ICAI)**

teri

Study Summary

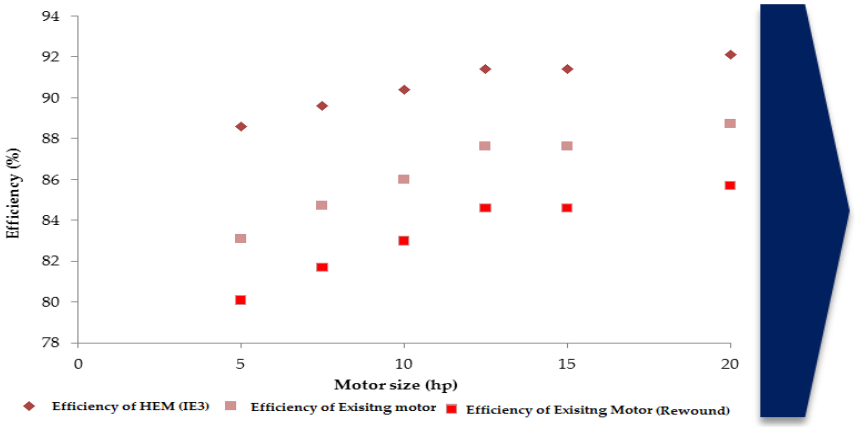
- Average improvement in efficiency is estimated to be 5.1%
- About 85% of the installed motors are below 20hp capacity.
- Estimated energy savings (5 to 20 hp motors) – 5.6% (fig 2)
- Simple payback period – about 2 years
- Four units have already adopted HEM during assessment period.





Approach for promotion under ESCO mode

Targeted category – up to 20 hp



Designing an implementable scheme for penetration of high efficiency motors

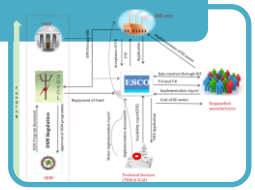
Approach :

Stakeholder Interaction

Industry survey

Analysis

DSM program



International Copper Association India
Copper Alliance

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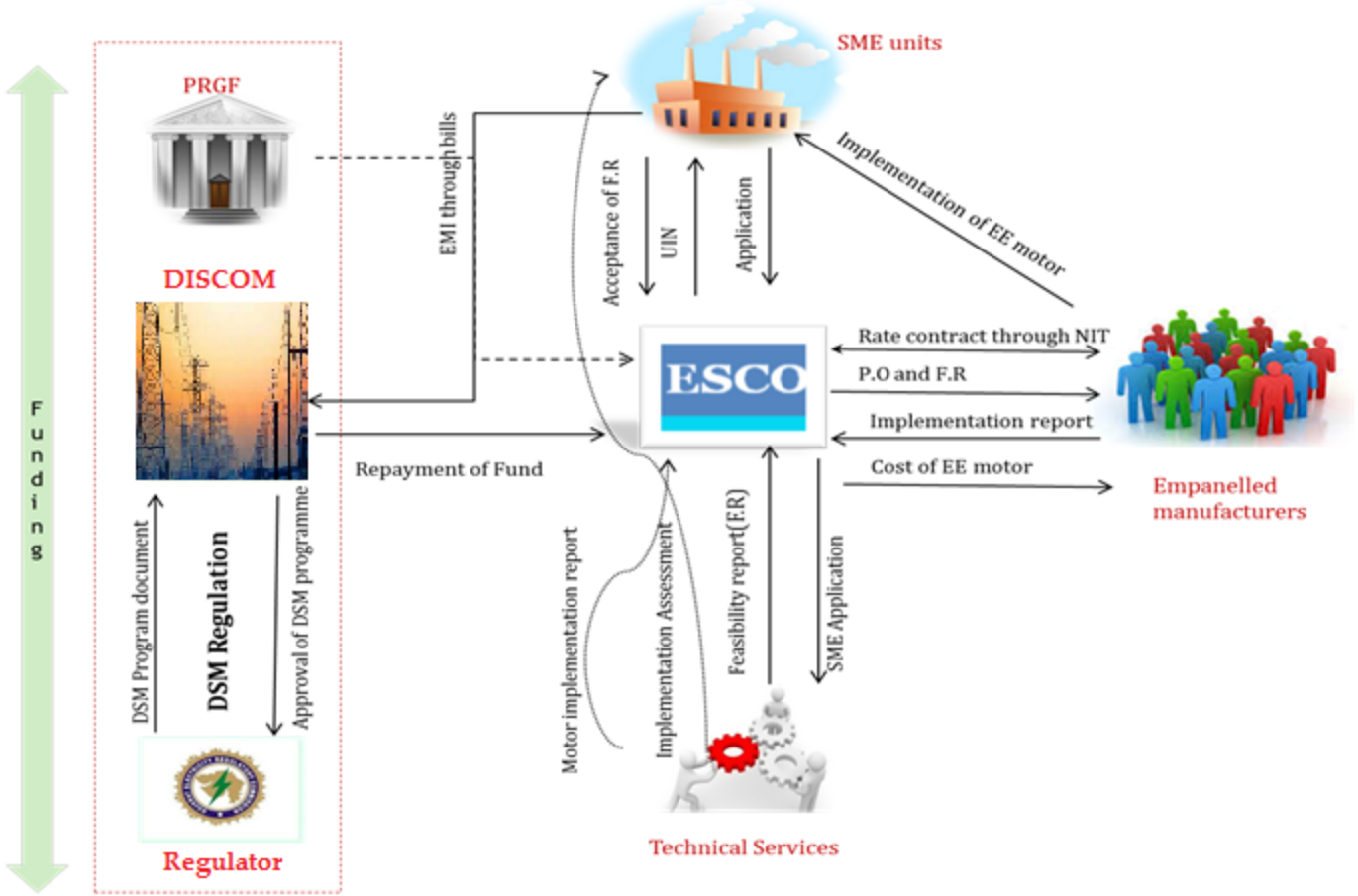
Institutional mechanism : DISCOM based ESCO model



Key observations:

- ✓ ESCO driven model(Repayment assured by DISCOM after approval of state regulator)
- ✓ Assured repayment as per service level agreement (SLA) between consumer and utility
- ✓ DISCOM may recover cost of project management through annual revenue requirement (ARR)
- ✓ Possible to explore rebate through ARR
- ✓ Mitigate risk of investment through partial risk guarantee fund (PRGF)

Role of key stakeholders

Technical Services

- ✓ Monitoring of overall program
- ✓ Preparation of feasibility reports
- ✓ Maintaining and upgrading data base
- ✓ Monitoring of implementation process
- ✓ Monitoring and verification

DISCOM

- ✓ Preparation of program document and approval from regulator
- ✓ Dissemination of program
- ✓ Collection of EMI through bills and repayment to ESCO

ESCO

- ✓ Financial assistance
- ✓ Third party validation
- ✓ Acceptance and validation of application
- ✓ Rate contract with manufacturers

Technology Providers

- ✓ Implementation of EE motor
- ✓ Maintaining the services (warrantee etc.)

Financial Analysis: Key financial parameters/assumptions

Parameter	Unit	Value
Average power purchase cost	Rs./kWh	4.05
Highest marginal cost of power purchase	Rs./kWh	4.50
Average tariff for the category	Rs./kWh	4.60
Utility administration costs	%	2%
M&V costs	%	1%
O&M costs	%	1%
Number of replacements	Nos	454
Consumption of old technology	kW	8.32
Consumption of new technology	kW	7.86
Hours of use	Hours	16
Annual days	Days/year	319
Escalation rate	%	5%
Discount rate	%	10.5%

Financial analysis for DISCOM

Net impact of investing in DSM programme should be zero : Benefits should be more than the costs

RIM Test

Ratepayer-Impact Measure (RIM) test measures the impact of implementing DSM program on non-participants

TRC Test

Total resource cost (TRC) test expresses the net benefit of implementing a DSM program

- Costs: Cost of appliance, program administration, marketing and monitoring costs, loss in revenue
- Benefits: Avoided power purchase cost

Key financial indicators

Particulars	Unit	Value
Number of motors (baseline study completed)	Nos	454
Average cost per motor*	Rs.	37,885
Total project cost	Rs.	17,199,790

Particulars	Unit	Value
Project implementation period	Months	30
Estimated time for installation of motors	Months	12
Recovery period after installation (EMIs)	Months	18
Average EMI (per motor)	Rs./month	2472

Return on Investment (ROI) for ESCO – 10.2%

* Motor size considered is 5-20 hp (avg 7.5kW)

Thank You

We appreciate the continued support of ICIA, India

Elements of application

- Unit information
  - ✓DICOM consumer No.
  - ✓Type (Public/ Private)
  - ✓Year of establishment
  - ✓Type of SME including DIC No.,
  - ✓PCB consent
  - ✓Promoters/Partners
- Electricity consumption

- **Project information**
  - ✓ Rated capacity(hp/kW)
  - ✓ Year of Purchase
  - ✓ Frame size
  - ✓ Rpm
  - ✓ Rewinding status
  - ✓ End Use application
- **Regarding operational parameters**
  - ✓ Average running hours/ day
  - ✓ Average operating days/week
- **Priority of manufacturer**

Elements of feasibility report

- ✓ Detailed comparison sheet on existing and proposed system
- ✓ Annual electricity and cost saving potential
- ✓ Equivalent GHG reduction
- ✓ Total project cost
- ✓ Simple payback period and other unit level financial indicators
- ✓ Equated monthly instalment (EMI)
- ✓ Estimated repayment period

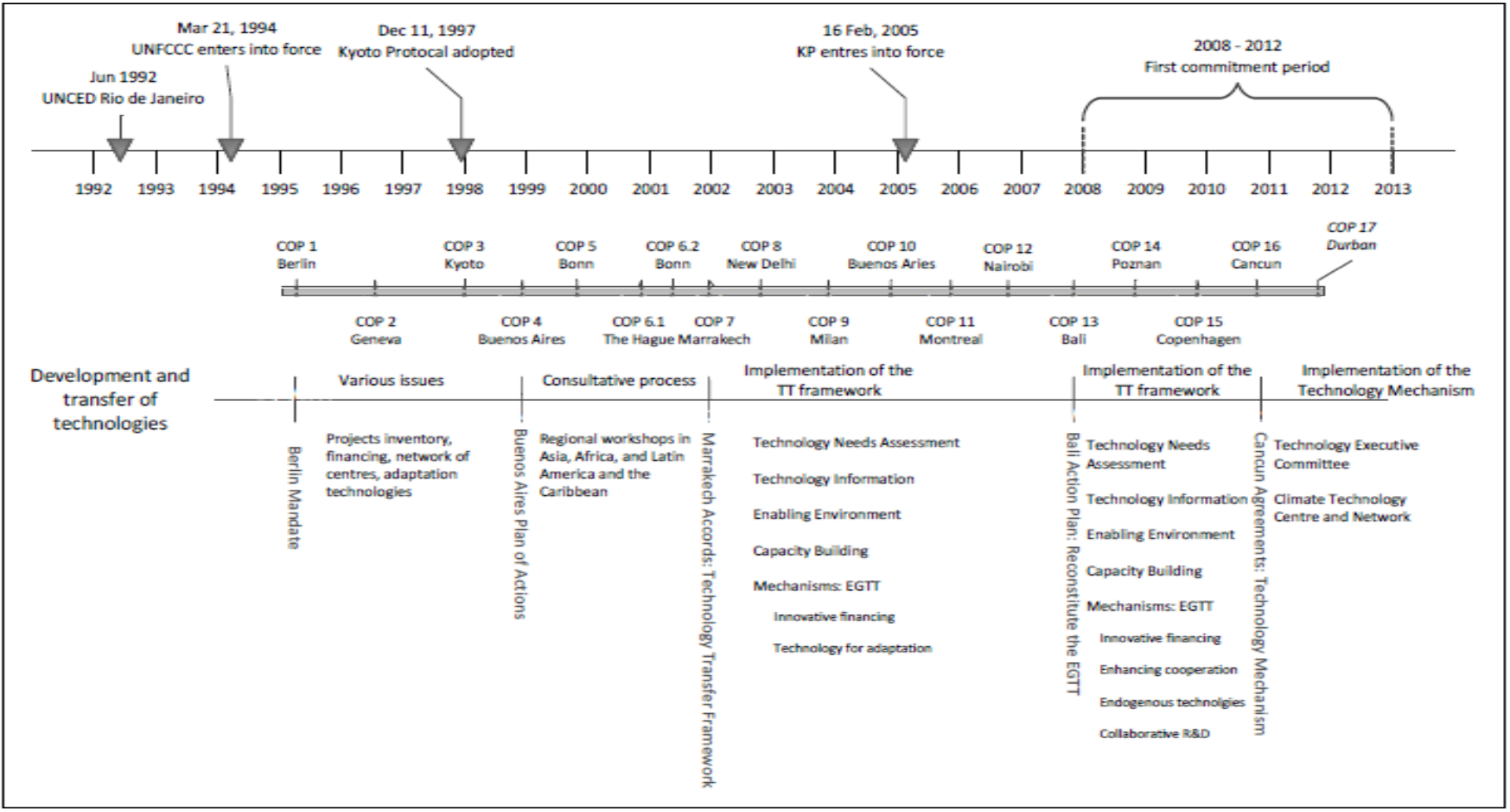
Tapping the opportunities for disseminating Japanese energy efficient technologies in Indian industries

Abdessalem RABHI, PhD.
Senior Policy Researcher, and Task Manager, IGES

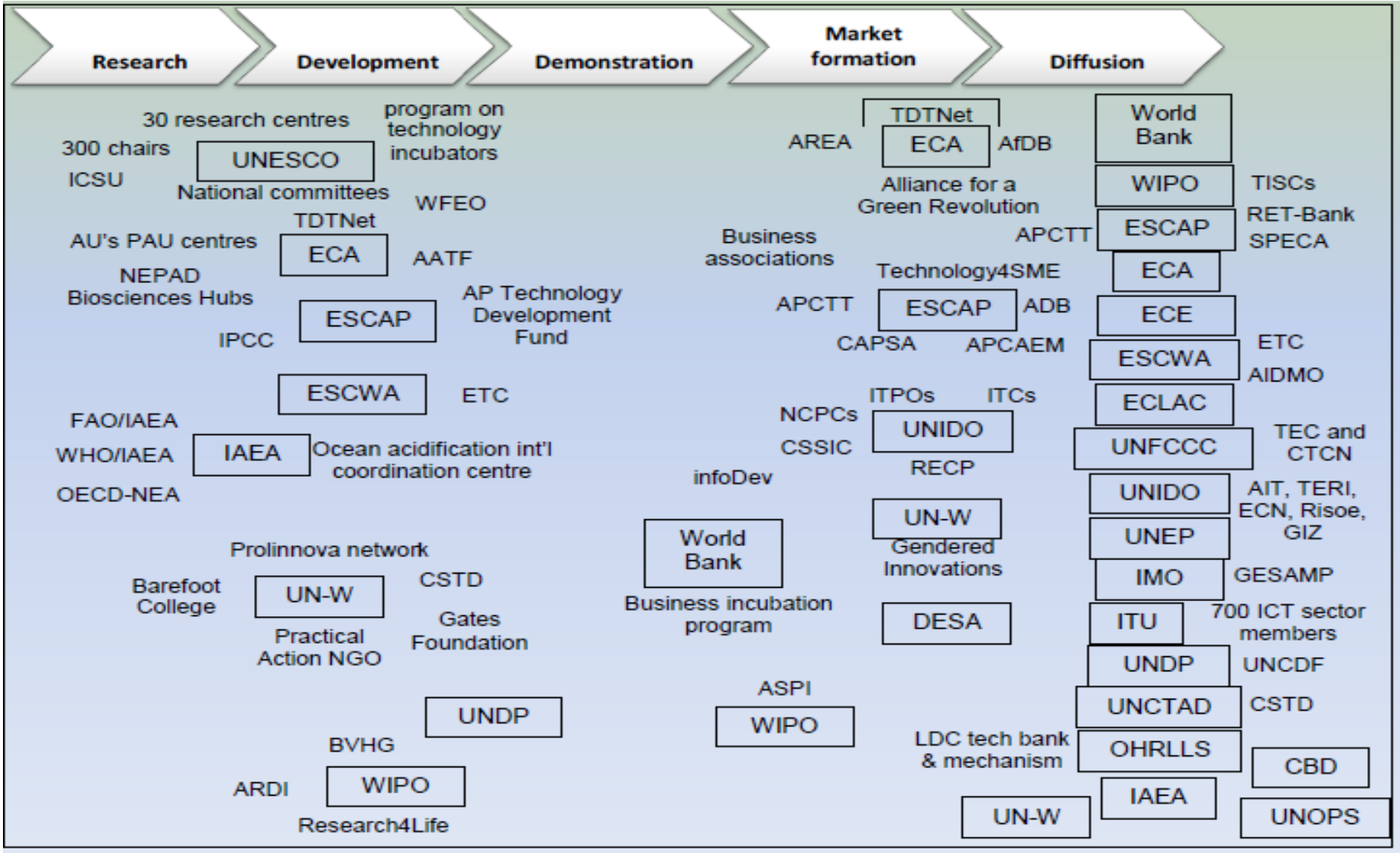
IGES
Institute for Global Environmental Strategies

Background: Technology Transfer: Still a hot topics and urgent issue

>Discussion about TT has been carried since early 90s, but there is still no consensus on what to do?, how to do it?, and who can play what role?



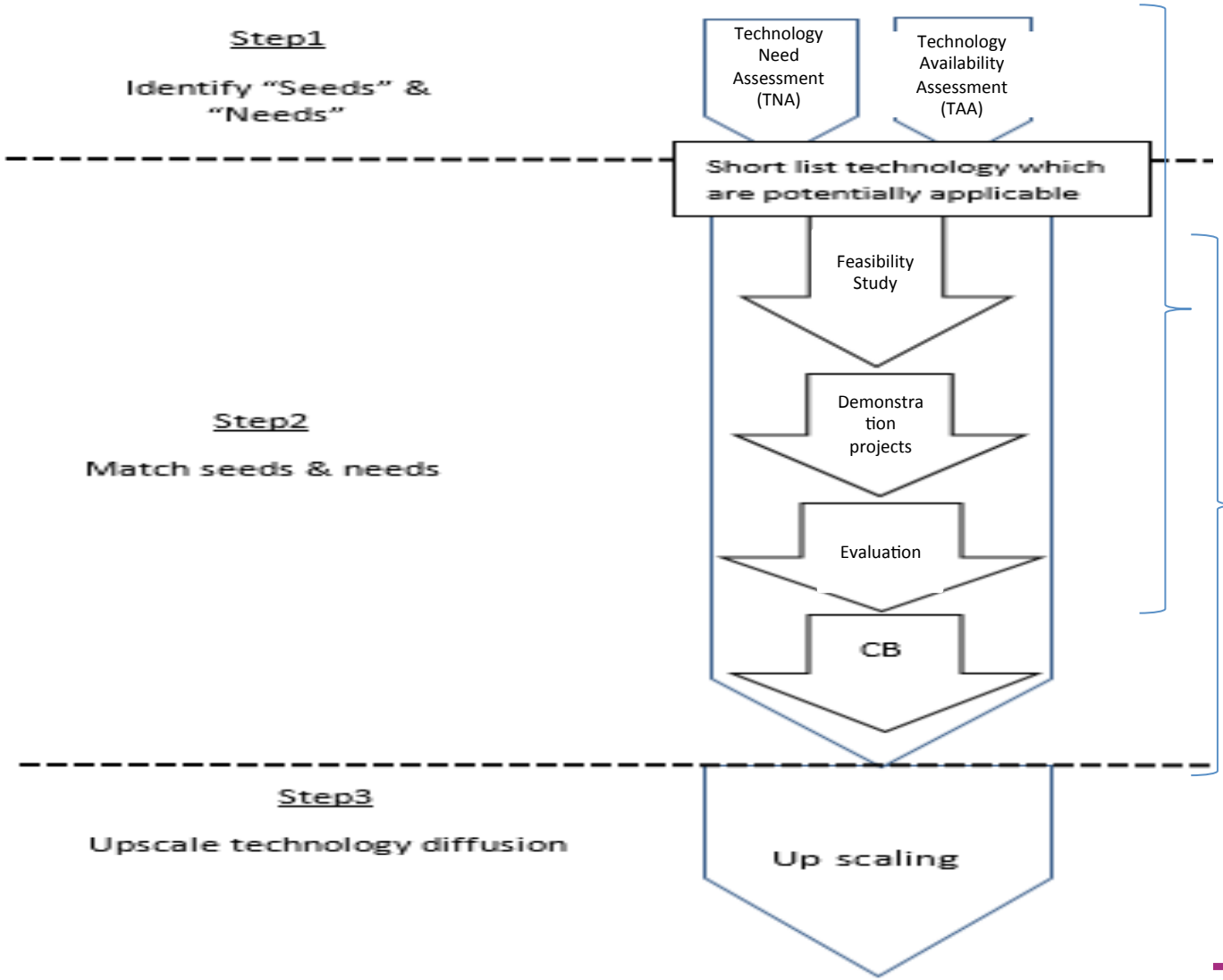
Background: Numerous schemes are available, but fragmented and uncoordinated



Great potential has been identified; but could not be tapped yet

Sites	Proposals for hardware/equipements installation	Estimated Energy saving (kWh/year)	Estimated emission reduction (Ton/year)	Estimated operation cost saving (Million JPY/year)	Initial cost (in Japan market) (1000JPY)	Estimated Pay back period (Year)
Company M (Forging) Co. Ltd	Install Inverter A.C (NL-0)	308,160	302	3,513,024	7,000	2.0
	Install Inverter A.C (NL-1)	308,160	302	3,513,024	7,000	2.0
	Install Inverter A.C (NL-2)	256,543	251	2,924,592	5,000	1.7
	Install two stages A.C	391,500	384	4,463,100	30,000	6.7
	Install Booster	108,864	106	1,241,050	3,000	2.4
Company A (Forging) Co. Ltd.	Install Inverter A.C	350,000	343	3,990,000	10,000	2.5
	Install 2 stage A.C	130,500	128	1,487,700	10,000	6.7
Company B (Textile) Co. Ltd.	Install Inverter A.C	60,830	56	693,462	3,000	4.3
Company A (Textile) Co. Ltd.	Install Inverter A.C	660,200	647	7,526,280	12,000	1.6
	Install high-efficiency drain trap	158,000	155	1,801,200	4500	2.5
Company M (Textile) Co. Ltd.	Install Inverter A.C	660,200	647	7,526,280	12,000	1.6
	Install Booster	109,000	107	1,242,600	1,400	1.1

-LCTT process should be wholly addressed rather than partially
-Single scheme may not be sufficient to address the whole process



Funding under SATREP (JICA/JST programme) (2010-2013)

Funding under JCM project (2014) & TA project (2015)

Funding under credit lines (ADB, GCF, JICA, JBIC, etc.) (2016 - ..)

Example of programs to be used for dissemination and scaling up

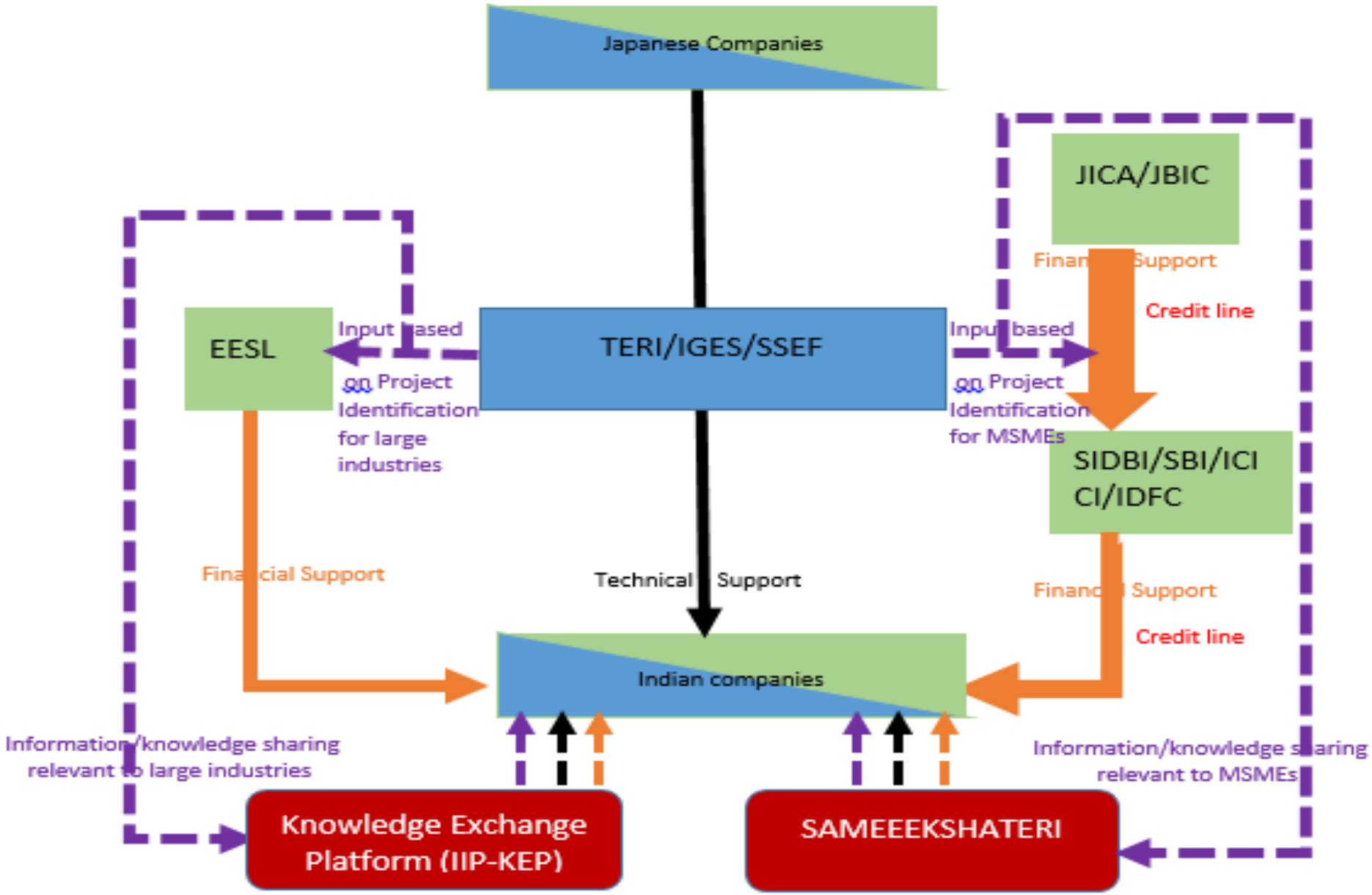
>E.g. of programs to be used for FS/DS and pilot projects (demonstration)

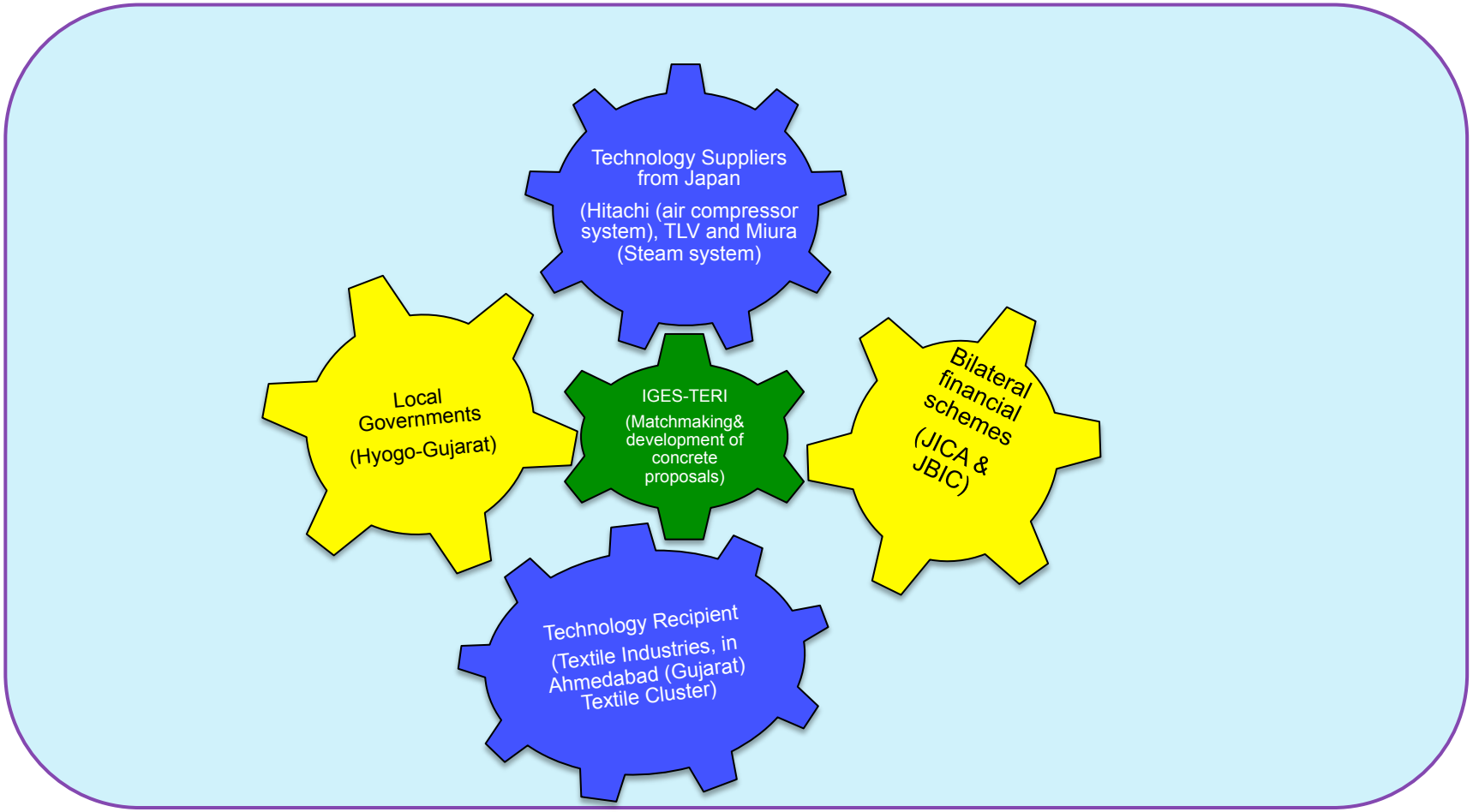
- MOEJ/GEC: Joint Crediting Mechanism (JCM),
- JICA: Public Private Partnership (PPP),
- ADB-UNEP-GEF: Climate Technology Network and Finance
- UNIDO-GEF:

>E.g. of programs to be used for commercialization (deployment & diffusion)

Examples of program from Indian side	• **Financial support through SIDBI** **-Technology Upgradation Fund for textile (TUFS)** **-Technology and Quality Upgradation Support to MSMS (TEQUP)** **-Credit Linked Capital Subsidies Scheme (CLCSS)** **-FPTUFS-scheme for food processing industries** • **BEE** can introduce these technologies to the designated consumers (DCs), who are identified under **PAT scheme, or by** exempting these technologies from import tax under the **FEEED** program. • **Energy Service Companies (ESCO)**
Examples of program measures by Japanese side	• **JBIC** : through their crediting J-MRV program. • **MOEJ: Joint Crediting Mechanism (JCM) (if signed)** • **Japanese makers: Joint venture, Licencing, FDI**
Others	**SAMEEEKSHA, LCS-RNet, LoCAR-Net, UNEP (CTCN),** are important channels through which these technologies could be deployed in India, whether through their funding options or through their information and knowledge dissemination activities to a wide range of stakeholders.

Financial schemes are already available, but matching them with promising project is missing.




Technology Suppliers from Japan
(Hitachi (air compressor system), TLV and Miura (Steam system)
Local Governments
(Hyogo-Gujarat)
IGES-TERI
(Matchmaking& development of concrete proposals)
Bilateral financial schemes
(JICA & JBIC)
Technology Recipient
(Textile Industries, in Ahmedabad (Gujarat) Textile Cluster)

Summary

-The issue is not the availability of financial schemes/ programs, but rather the availability of promising projects/proposals.

-Technology transfer process should be addressed wholly rather than partially: (i) identification of needs and availability, (ii) matching and testing, and (iii) up scaling and diffusion.

-JCM scheme should be effectively utilized as complementary with other existing schemes.

Japan Bank for International Cooperation

Green Line for SBI

SBI Capital Markets Limited

January 12, 2016

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Slide 04	JBIC – Introduction
Slide 05	JBIC – Mission
Slide 06	JBIC Green Line - Introduction
Slide 07	JBIC Green Line - Structure
Slides 08 - 09	Potential Eligible Factor / Technology
Slides 10 - 11	J-MRV Guidelines
Slide 12	Monitoring after Project Completion
Slide 13	Sanctioning Process

State Bank of India

- State Bank of India (SBI) is India's oldest (200 years history) and largest commercial bank in terms of assets, deposits, profits, branches, number of customers and employees with 16,333 branches in India, 191 international offices in 36 countries and more than 273.2 million active customers as of March 31, 2015.

- The Bank also had deposits, advances and a total asset base of Rs 15,767 bln (~$242 bln) , Rs 13,354 bln (~$205 bln) and Rs 20,480 billion (~$315 bln), respectively, as of March 31, 2015, the largest by each measure among banking institutions in India.

- SBI has made significant contribution towards promotion of Renewable Energy -

  - Commitment - SBI has committed financing of Rs.75,000 crore to renewable energy projects over the next 5 years subject to viability/feasibility of projects.

  - Green Banking Policy – Bank has introduced Green Banking Policy in 2007 which is being monitored by the top management.

JBIC - Introduction

- Japan Bank for International Cooperation (JBIC) is a Japanese Government Financial Institution.

- JBIC conducts its operations with a mission to contribute to the sound development of the Japanese and international economy.

- JBIC, has made a new start since October 1, 2008, as the international wing of Japan Finance Corporation (JFC), Japan's policy-based financing institution.

JBIC - Mission

- Promoting overseas development and acquisition of strategically important natural resources.
- Maintaining and improving the international competitiveness of Japanese industries
- **Promoting the overseas business for preserving the global environment such as preventing global warming (“Green”)**
- Responding to disruption in financial order in the international economy.

JBIC Green Line - Introduction

Under its Green mission, JBIC has provided line of credit to SBI.

Key Features

- Amount : **USD 90 million**

- Repayment Schedule: **First repayment on May 30, 2017 and final repayment date May 30, 2025** (equal instalment)

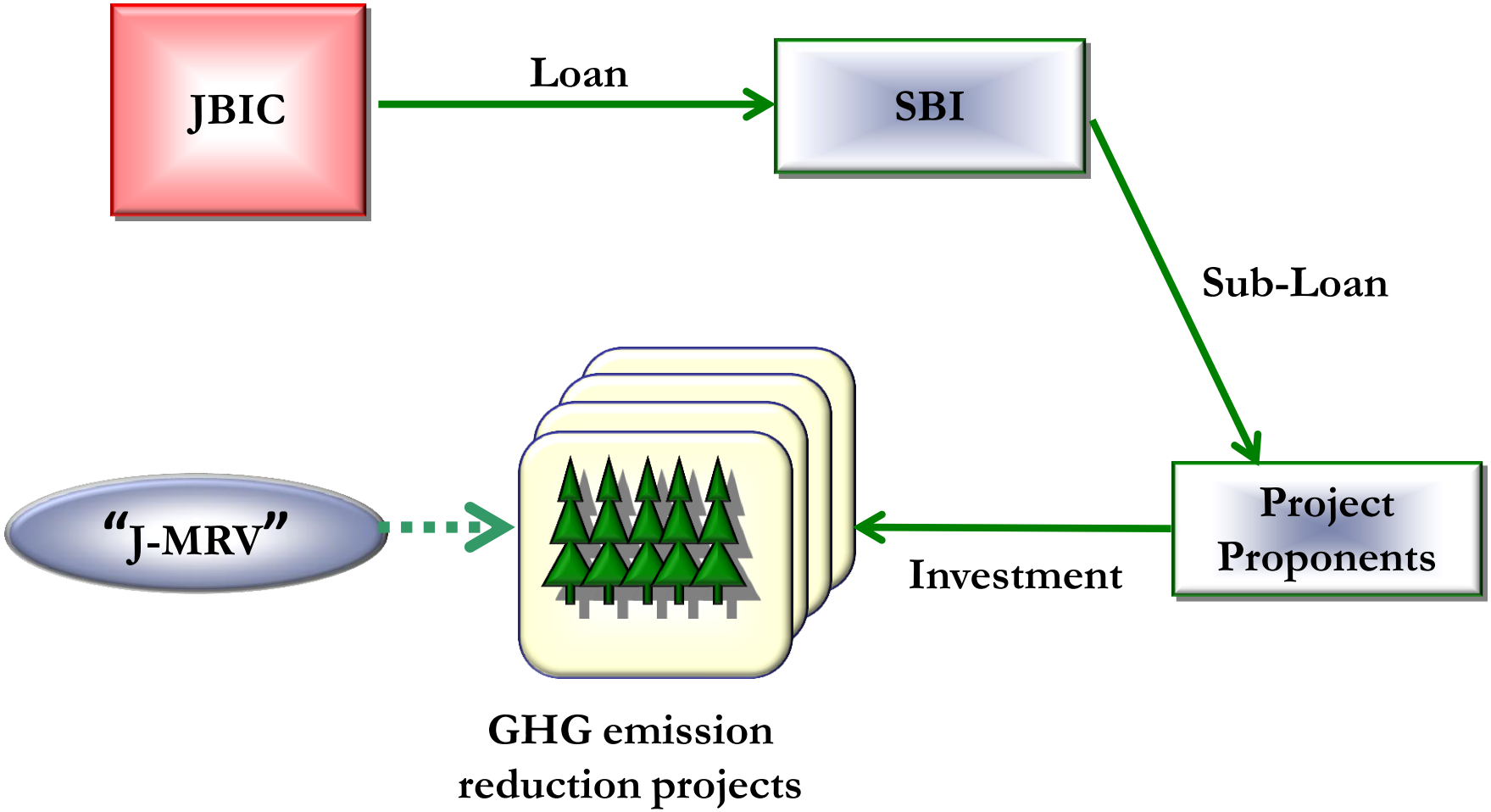
Eligibility Criteria

- Projects contributing to **preservation of global environment**, i.e. significant reduction of GHG emissions

- Acceptance of **JBIC-MRV** ('J-MRV") by the project proponent in terms of the numerical effect of the environment preservation

- Procurement in line with the "**Guidelines for Procurement under Untied Loans by Japan Bank for International Cooperation**"

JBIC Green Line - Structure



Potential Eligible Factor/Technology

Sector	Sub-Sector	Eligible Factors
Renewable Energy		- Solar Energy - Wind Energy - Geothermal Energy - Biomass Energy - Hydro Energy
Energy Efficient - Industry	1. Iron and Steel 2. Cement 3. Chemical/Petrochemicals 4. Non-ferrous Metals 5. Pulp/Paper 6. Other Industries	- Highly Efficient Equipment and Technology - Waste Heat and Gas Recovery - Rehabilitation/Efficiency Improvement in existing Plants - Energy Efficiency through utilizing of unused resources - New plants incorporating above factors

Potential Eligible Factor/Technology

Sector	Sub-Sector	Eligible Factors
Power and Water	1. Power Generation	- Gas-fired Power Generation - Rehabilitation/Efficiency Improvement in existing plants - Combined Heat and Power (Cogeneration) - Waste to Energy - Fuels Cells - Fuel Switching
	2. Transmission and Distribution	- Smart Grid - Grid Management System - Highly Efficient Rechargeable Batteries - Highly Efficient Transformers
	3. Water Treatment	- Water Recycling Systems

J-MRV Guidelines

1. **Objective of J-MRV**
   To ensure effective GHG reduction emissions in GREEN financed projects, JBIC reviews such effects through simple and practical Measurement Reporting Verification process both in (a) prior estimation and (b) ex-post monitoring.

2. **Emission reductions**
   Emission reductions = Baseline emissions – Project emissions

3. **Baseline emissions**
   i.e. The emissions in the absence of the project activities.
   Determined in accordance with individual methodology in the J-MRV Guidelines.

4. **Project emissions**
   a) Prior estimation : JBIC calculates amount based on data from F/S report (where applicable) before loan signing ("Planned Emission Reduction").
   b) Ex-post monitoring: JBIC also calculates the amount using collected data from the borrower for one year period after the project completion.

J-MRV Guidelines

5. Example: Renewable Energy Project

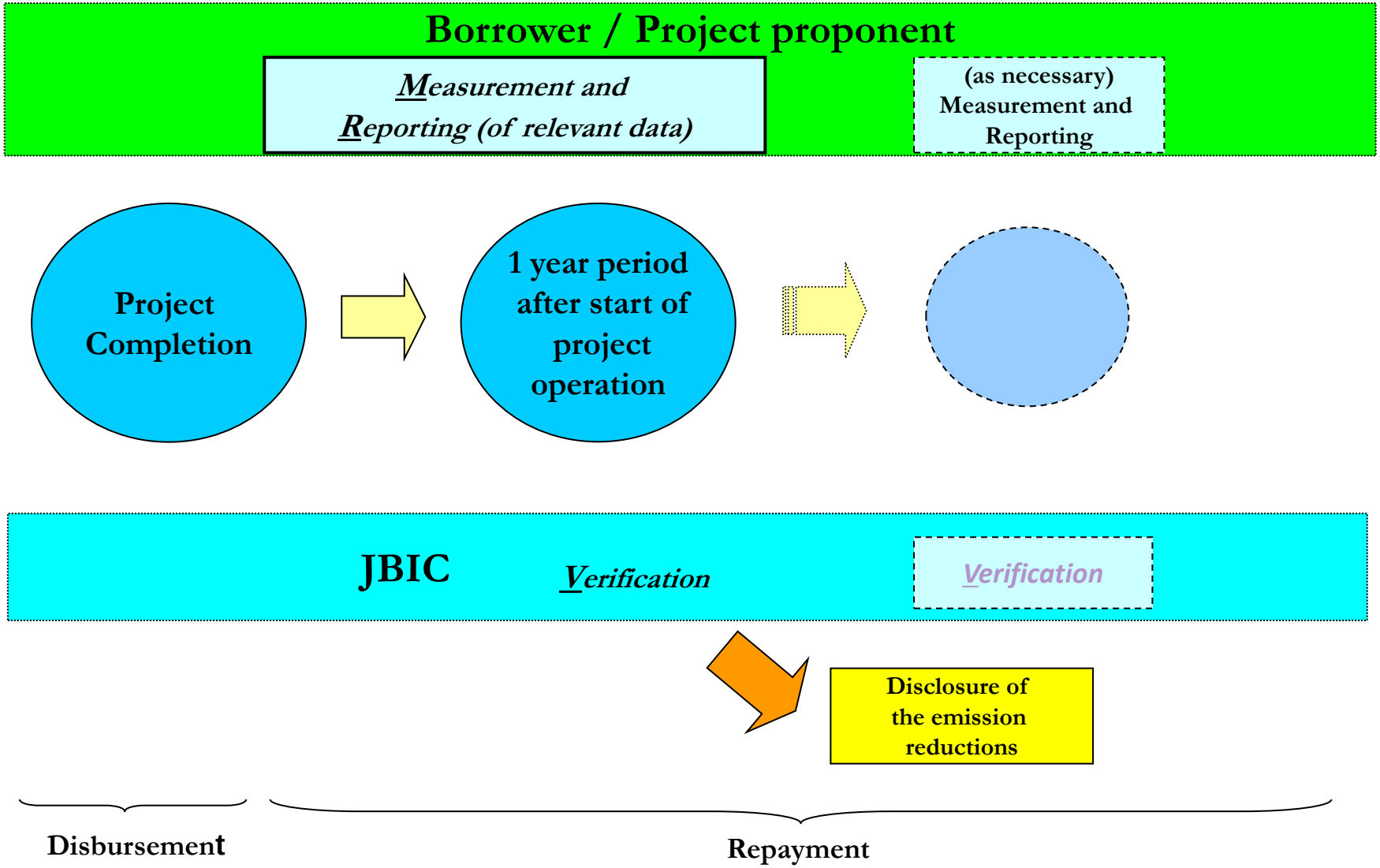
a) Baseline emissions
- Emissions per year which is based on the electricity amount to be generated in the absence of the project activities
- i.e. (electricity amount (MWh) equivalent to the project activities per year) x (emission factor (tCO_2/MWh) of the national grid)

b) Project emissions
- None (no CO_2 emissions from combustion of fossil fuel)

c) Planned Emission Reduction (by the project activities per year)
- (a) – (b) = ……. tCO_2 per year

d) Monitoring item
- Electricity amount (MWh) generated for 1 year after project completion

Monitoring after Project Completion



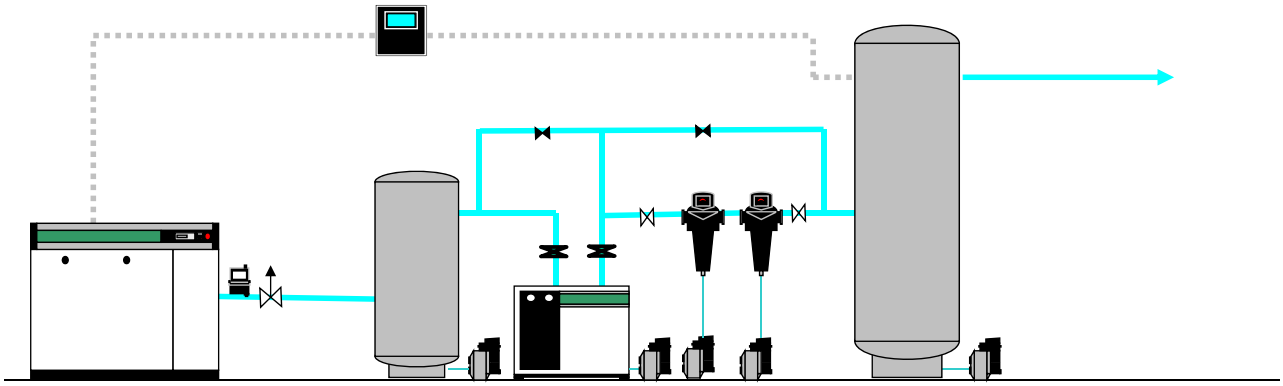
Sanctioning Process

- In Principal Sanction from SBI on the Project
- Detailed Appraisal Process at SBI
- Environment Approval on the project from JBIC (same can happen parallel with SBI approval process)
- Application to JBIC for approval of the Project (informal approval on the project can be taken parallel with SBI approval process)
- Final Sanction from SBI
- Loan Agreement signing between SBI and Project Proponent (facility subject to JBIC approval on Project)
- Final Sanction from JBIC
- Completion of condition precedent as per the loan agreement
- Disbursement of the facility from SBI Tokyo as an ECB

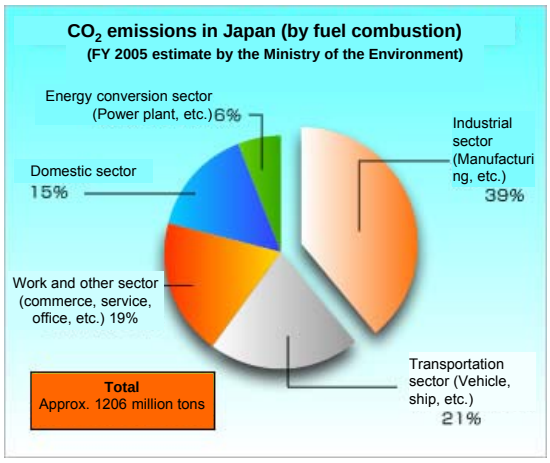
Thank You

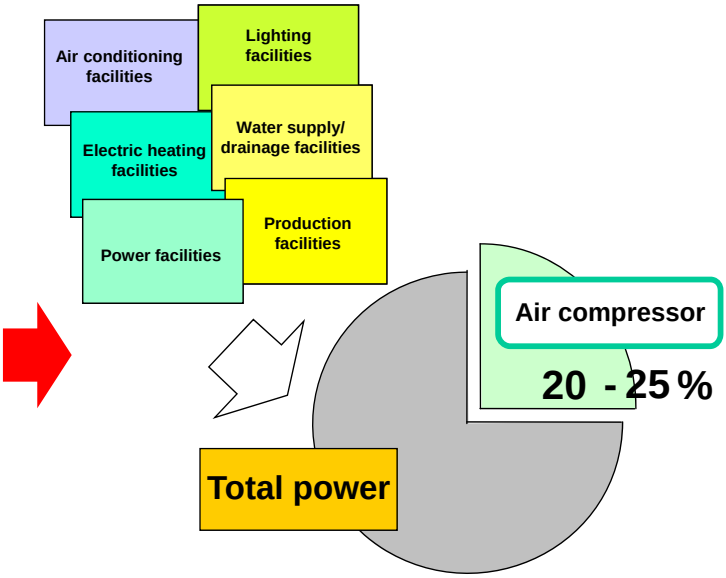
Low carbon technology of a compressor system

(Energy Saving and Environmentally Friendliness)



Energy Consumption in Japan

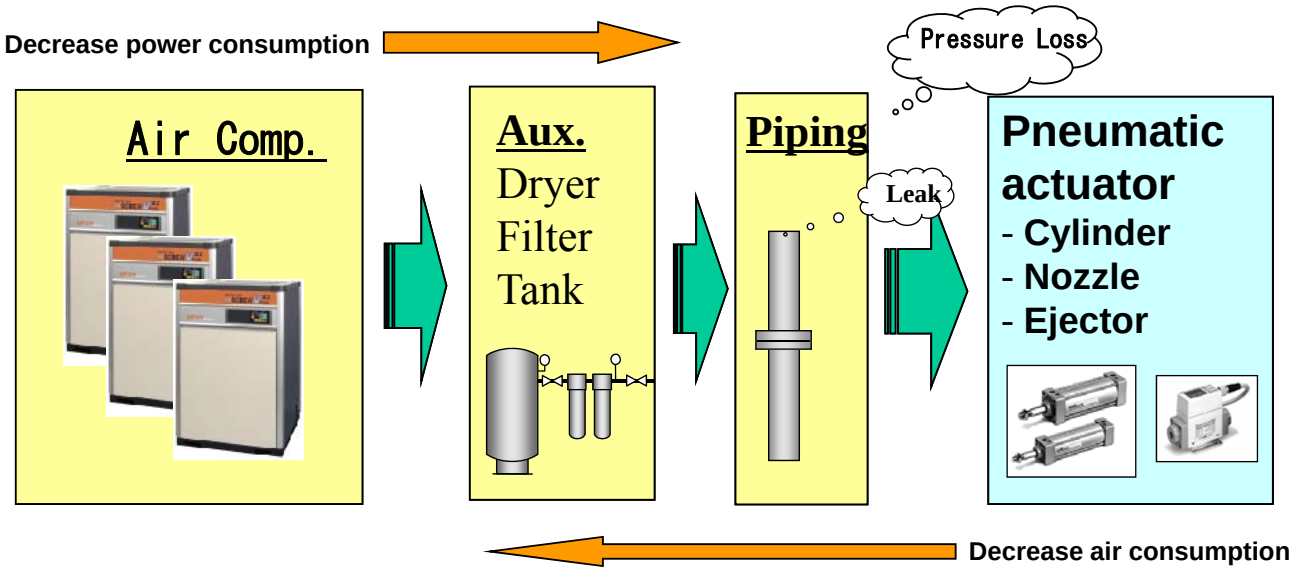




Energy consumed for the industrial sector (factories) accounts for approximately 40% of the total energy consumption in Japan.
It is considered that approximately a quarter of that amount is used by compressors.
In addition, compressors are regarded as machines whose energy consumption can be reduced relatively easily. As a result, energy saving through rotation control and multiple unit control is strongly requested by the Ministry of Economy, Trade and Industry as well.
Therefore energy saving for compressors needs to be addressed urgently.

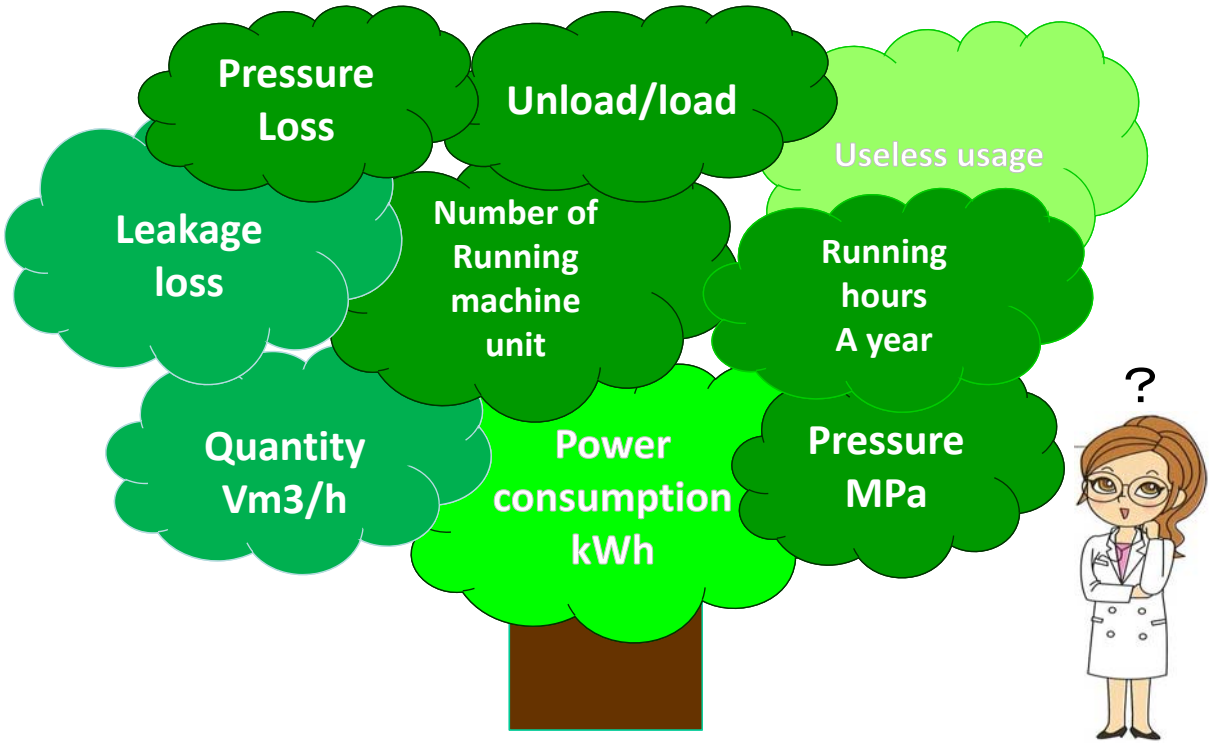
Energy Saving from both Supply and Demand side

Energy Saving of air compressor



Energy Saving of pneumatic actuators

What is cost of air compressor?



CO2 reduction=energy saving of the air system

Saving energy of compressed air system = Energy cost down

Energy cost (L kW) = pressure (P) x air consumption (V)

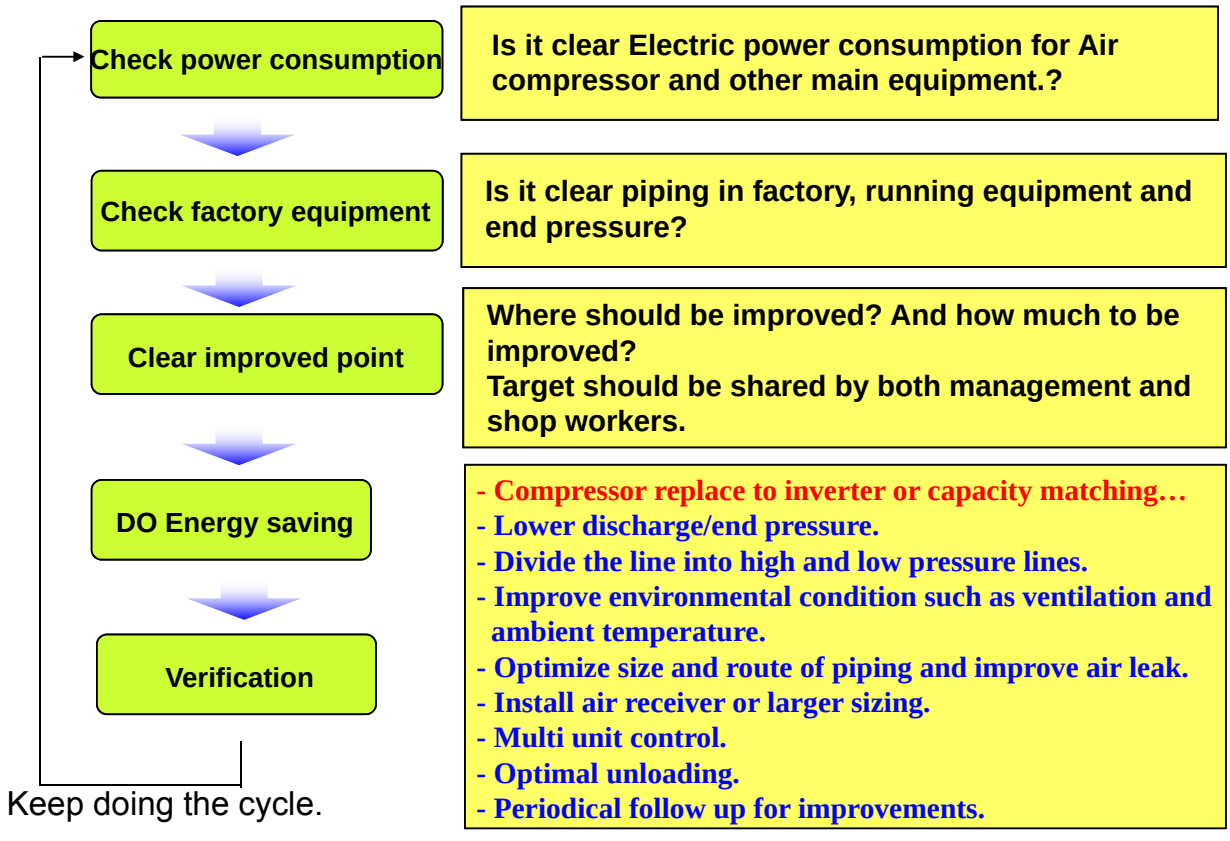
The policy for cost cuts useless

- Lower useless pressure (P)
- Reducing volume air consumption (V)
- Improvement (pressure loss, leak) of the loss

The point of the energy saving is to get rid of waste how, and to perform the following

1. **Making better capacity control (use the efficient machine)**
2. **Make efficient use of equipment**
3. **Appropriate pipe diameter and length = Design piping system**
4. **Counter measurement of leak**

Procedure for Energy Saving



In this practice, we verify the importance of proper pressures design at positions in air supply lines.

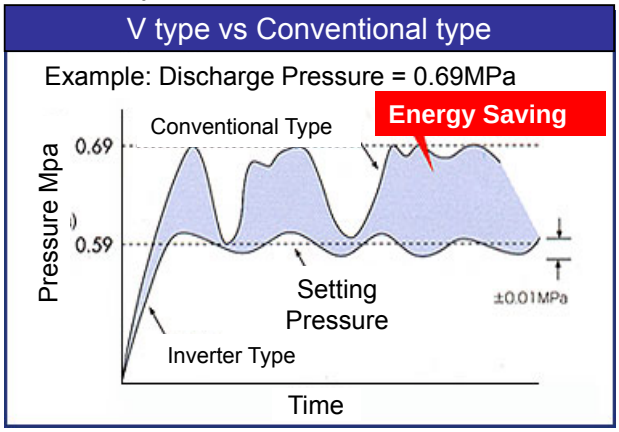
1. Air compressor
   How input power changes if compressor is driven by Inverter?

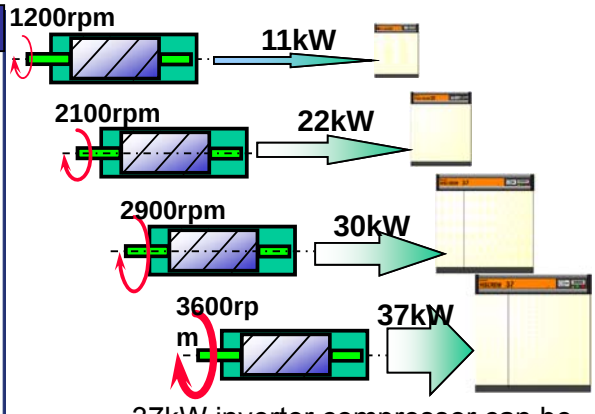
2. Piping system
   How pressure loss changes if size changed?
   How pressure loss changes if valve structure differs?

3. Local pressurization
   What is “booster compressor”?

Inverter Type: Ideal Choice for Energy Saving

- Controls revolution of compressor according to the load
  No waste of power & ideal capacity control.
- Operation with minimum pressure fluctuation
  Inverter type: Keep the setting pressure
  Conventional type: Fluctuate around the setting pressure *Refer to the below chart
- Operation stops during unload
  Avoid waste of electricity (Conventional type runs during unload & consumes unnecessary electricity.





37kW inverter compressor can be operated with 11kw class energy consumption

Example of energy saving for inverter compressor

■ Application procedure

Carry out energy consumption analysis for air compressor (37kW conventional model x 1 unit evaluation)

Analysis result

- Average load ratio: 52%
- Power consumption 23,600kwh/m

Details of improvement

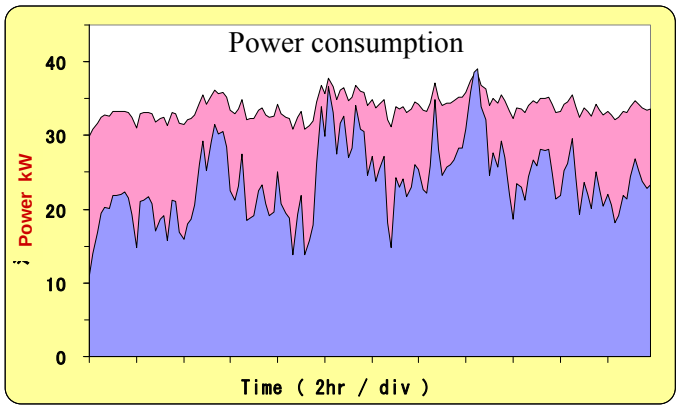
- 37kwh inverter compressor x 1 unit
- Power saving : 34%

■ Investment and effectiveness

- Apply to new 37kw Inverter compressor
- Efficiency of energy saving 560,000Rp/Year

■Other effectiveness

- CO2 reduction (▲34%) for environment protection
- Periodical overhaul and parts durability last long (per 8 years)
- Maintenance cost is reduced 30% (our company calculation)

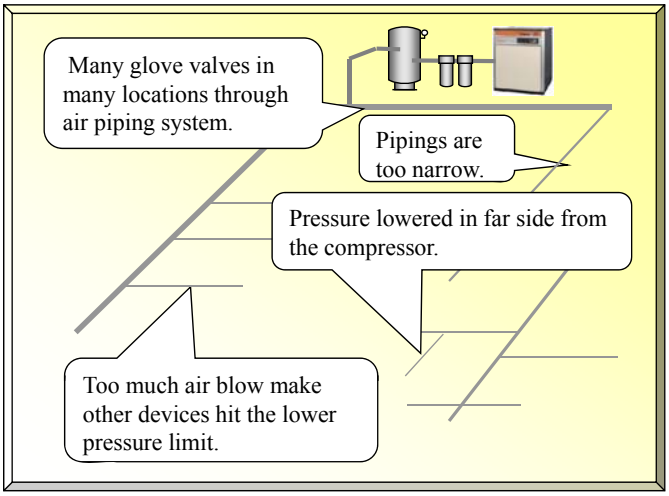


Pressure optimization by piping system redesign

What is efficient way for local low pressure demand.
Do you have similar cases like this in your factory?

1. **Unstabilized factory air.**
   [status] pressure far side from compressor unstable.
   Pressure down when other system ON.
2. **Due to budget allowance, no uniformity on air system such as devices, pipings (size, route, valves).**

What kind of improvement in this case?

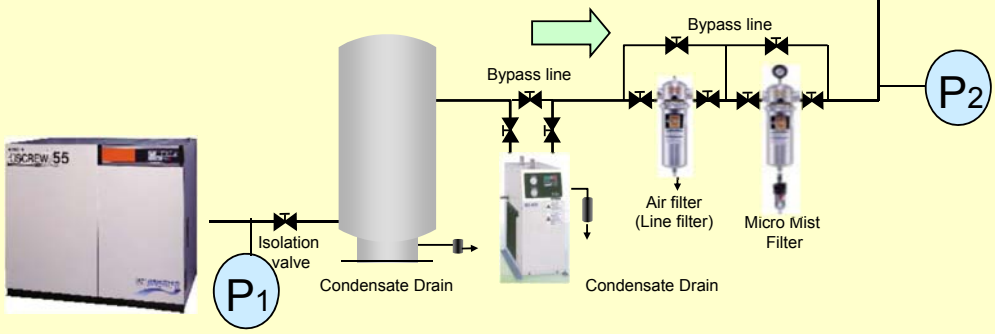


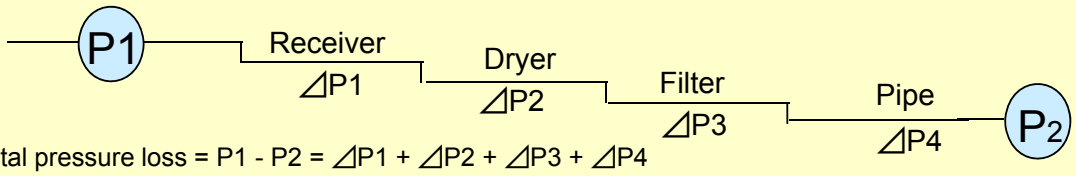
How loop piping, size, bend and valves effect proper pressure in system?

Pressure Loss of Compressor Equipment

Any system causes a pressure loss.
Think of how to minimize the loss.

Recommended layout (reference example): Compressor -> Receiver -> Dryer -> Filter
Point: This reduces the pressure loss between the compressor and the receiver.

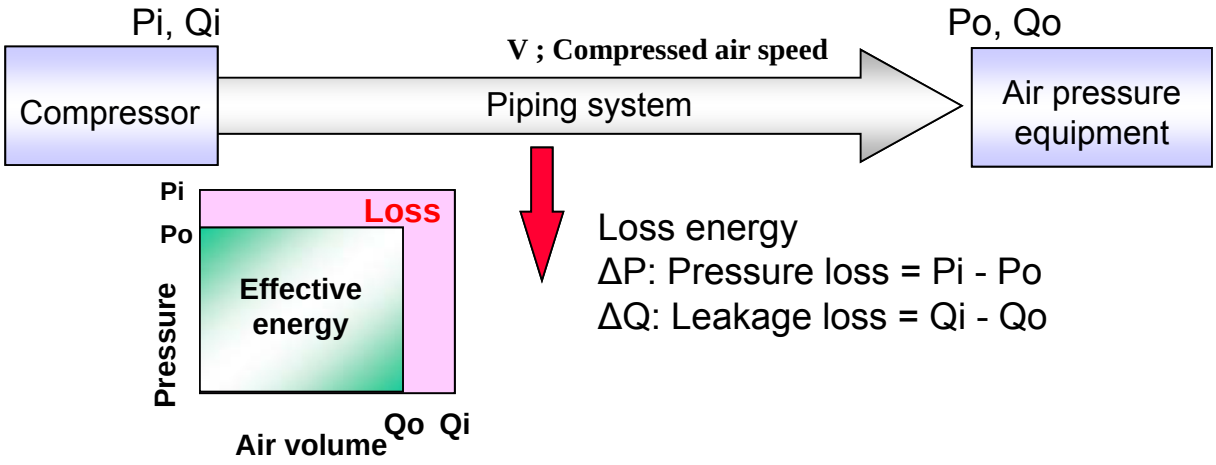




Total pressure loss = P1 - P2 = ⊿P1 + ⊿P2 + ⊿P3 + ⊿P4

To achieve a higher rate of energy saving, select a pipe with one size larger diameter than the one of the compressor's discharge pipe. Also, select air dryers and filters with one size larger capacity.

Pressure Loss through a Pipe



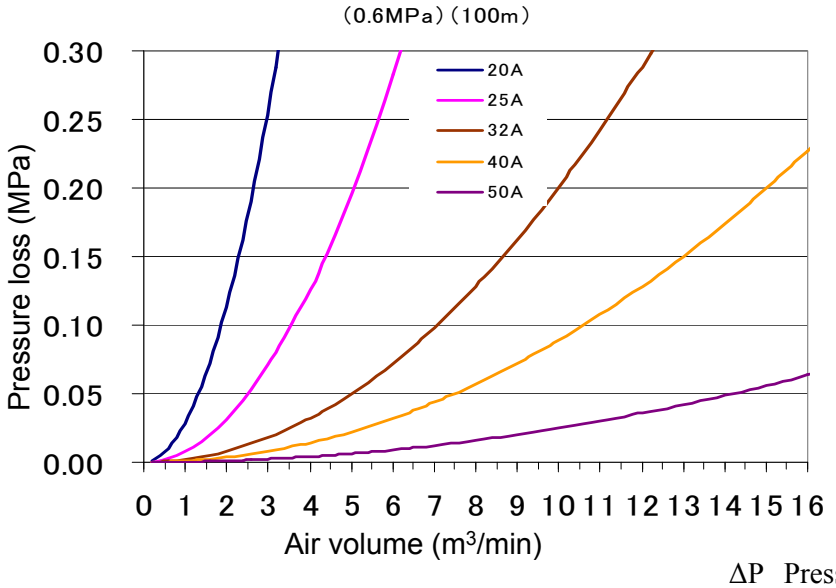
Loss energy
ΔP: Pressure loss = Pi - Po
ΔQ: Leakage loss = Qi - Qo

$$\text{Flow rate in the pipe. V (m/s)} = \frac{Qi \text{ Compressor's discharge air volume} \times Ps/Pd}{A \text{ Sectional area of discharge pipe} \times 60}$$

The flow rate in the pipe is desirably 4 to 5 m/s. - Economic speed

The smaller the pipe size, the higher the flow rate, causing a larger loss in the pipe. Accordingly an energy loss is generated, reducing the energy-saving effect.

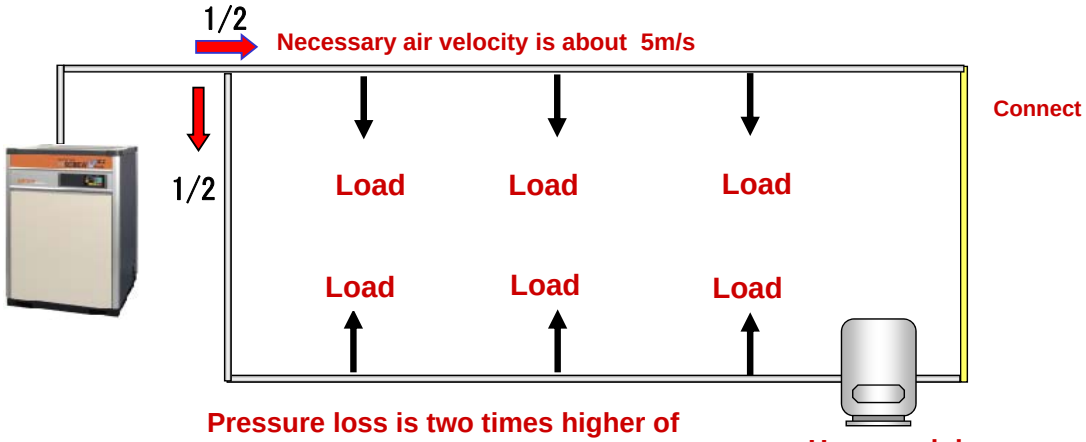
Let's Calculate an **Appropriate** Pipe Size.



$$\Delta P = 0.39\mu \times \frac{\ell}{d} \times \frac{\gamma v^2}{2g} \times 10^{-4}$$

ΔP	Pressure loss (MPa)
μ	friction coefficient
ℓ	length of piping m
D	diameter of pipe m
γ	density of air kg/m3 (0.1013MPa, 0 deg. C.)
V	speed of the air m/s
g	The gravity 9.81m/s2

Changing air velocity through internal pipe ･･･ loop piping



Pressure loss is two times higher of air velocity in proportion

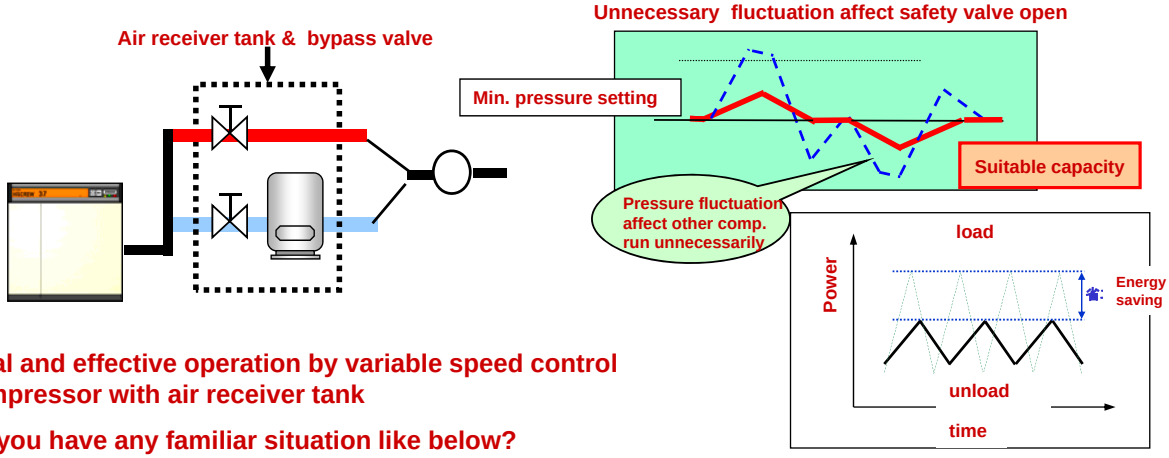
Pressure loss is minimized to one quarter, only to make loop piping!

How much improvement can be made with loop piping?

Pressure loss become one quarter, only to make loop piping if there is imbalance among load.

How pressure fluctuation changes if air tank is installed.

Effect of receiver tank if pressure fluctuation occurs frequently



Ideal and effective operation by variable speed control compressor with air receiver tank

Do you have any familiar situation like below?

There are many possibilities to reduce extra power by changing air compressor's control operation with air receiver tank.

1. Air compressor's control commands unload operation frequently.

2. There are big gap of air consumption in specific period, and facilities run all day.

3. Air pressure is fluctuating frequently even if small amount of air is used. (unstable)

Any difference with / without air receiver tank?

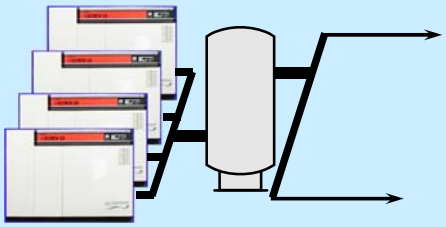
Improvement air compressor system

What is efficient way to pressurize higher locally within the air supply system?
Do you have similar cases below?

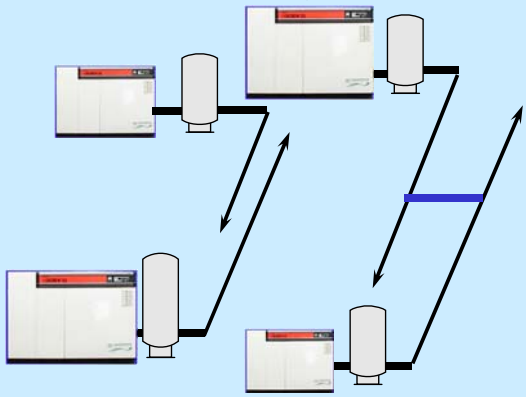
1. **Which is best installation 'Collective or Independent'**
2. **We are using many compressors.**
   -> you had better plan to install multi controller system
3. **Compressor is still operated even in not using air.**
   -> your factory has air leakage.
   -> you have to check,
   how much leakage are there and find leakage point.

Which Is More Energy Saving, Collective or Independent?

Collective setting



Independent setting

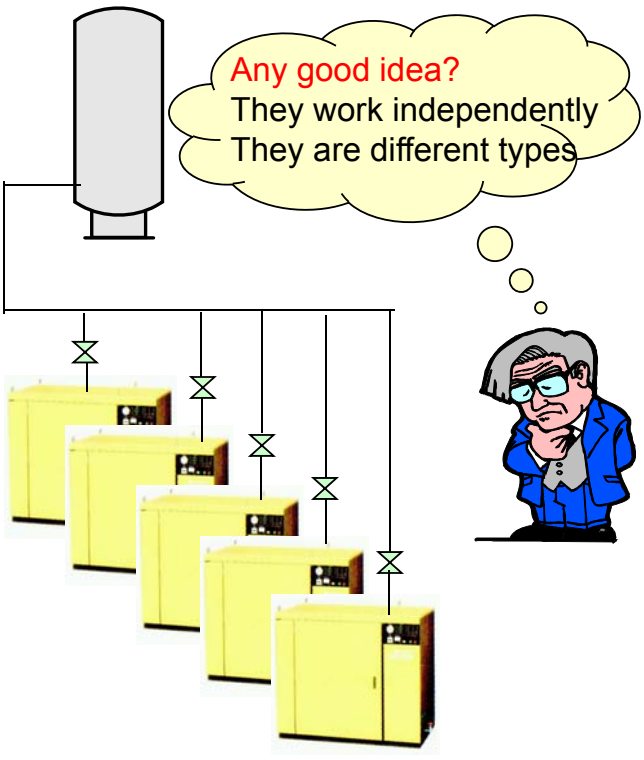


Setting Type	Collective	Independent
Daily Maintenance	Easy	Need to assign stuff for each line
Regular maintenance	Easy	Need maintenance in each line
Pressure flexibility	Need to operate with the highest pressure equipment (Some loss)	Able to apply appropriate pressure for each piece of equipment (Minimum loss)
Pressure loss	Some Piping tends to be long	Small Piping can be short Adjustment can be made in each line
Air leak	Affects whole air supply system	Affects only line with the leakage
Multi-unit Control	Available	Unavailable

Energy saving can be made by Inverter compressor for both collective & independent settings

1. Collective setting: Inverter compressor absorbs load fluctuation
2. Independent setting: Easy to accomplish energy saving

There Must Be A More Efficient Way



The best way!

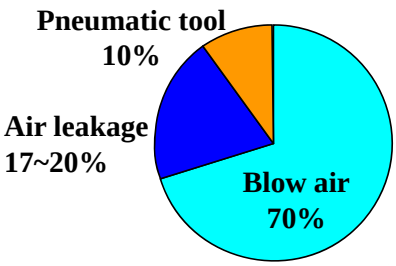
1. Select base load compressor and concentrate the load on it
2. Stop the extra compressor
3. Stop compressor according to need (Scheduled operation)

Operation leveling with Multi-Unit Controller

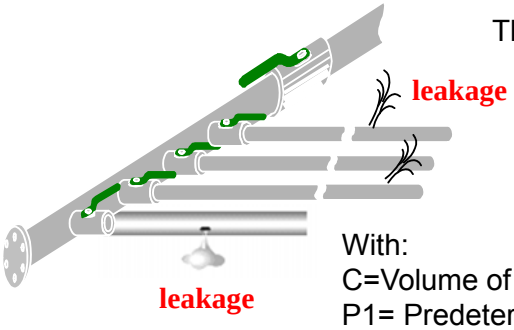
Multi Roller Ex

Leakage

Recommendation: determine total leakage and reduce it
Leakage Checking Method



1) Operate compressor at night, or holiday, and shut it down when achieving a predetermined pressure value.
2) When the compressor is shut down, due to the leakage, the pressure will automatically decrease. The amount of leakage can be known by measuring the time (t) taken to decrease the pressure by 0.1MPa.



The formula to determine the leakage (C) is given below:

$$C = \frac{(P1 - P2) \times V}{Po \times t}$$

With:
C=Volume of leakage (M3/min)
P1= Predetermined pressure (MPa) (gauge pressure + 0.101MPa)
P2= Pressure after leakage (MPa) (gauge pressure + 0.101MPa)
t=Time taken to reduce pressure from P1 to P2 (min)
Po= Atmospheric air pressure(MPa)
V= Piping capacity (Mm3) (In case of your company; ? m3)

The air leak point

[Leakage cases]

20% of leakage exists in a plant on average

point;valves
17. 4L/min

point;air gun
49. 2L/min

point;hoses
59. 4L/min

point;hose joint
59. 4L/min

point;regulator
71. 7L/min

point;coupler
27. 7L/min

Is inverter compressor cost high?

The answer is “No”.
When you calculate cost for few years, you can pay back of this cost within 3 to 4 years.
(reducing power consumption = energy cost down = profit)

Torque controlled during low speed

Cascade vector control

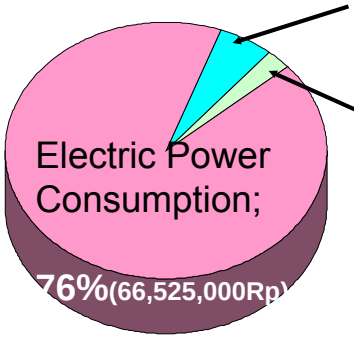
DCBL MOTOR

(permanent magnetic motor)

Check out energy cost -LCC and Specific Power Consumption

Note: LCC = Life Cycle Cost

Most of compressor LCC is power consumption.



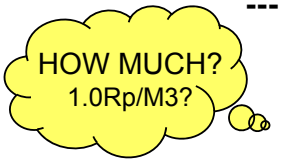
Maintenance: 14%
(12,100,000Rp)
Carry out periodical maintenance.

Initial: 10%
(8,220,000Rp)
(compressor, installation/starting, piping, etc.)
Select better efficiency, better control.

<Example>
Oil flooded 75kW class rotary screw (standard type)
6000h/y operation, 7.5RpB/kWh
60% Load example
Total cost: 20 years average

Specific Energy Consumption

How much to for 1㎥ of compressed air?
--- Example of quick calculation (100%load)

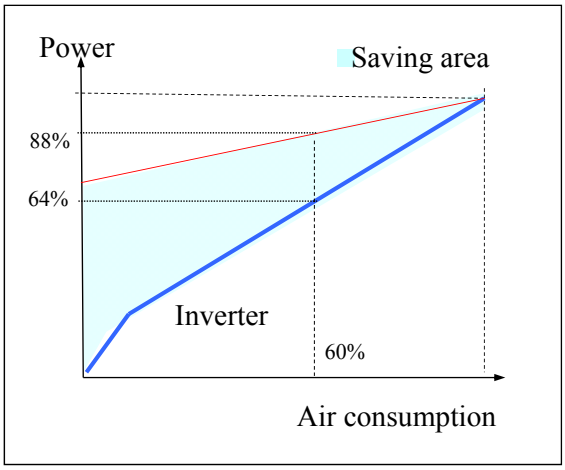


$$\text{Energy cost (0.8Rp/㎥)} = \frac{\text{Input Power 84 (kWh)} \times \text{Electricity cost 7.5 (B/kWh)}}{\text{FAD 13.2 (㎥/min)} \times 60 \text{ (min)}}$$

Improvement with air compressor

Improve on air compressor with variable speed control operation (inverter).

Unnecessary power is consumed when low load operation, If conventional type capacity control (standard U type) and Integral operation (I type).
Easy to reduce unnecessary power, only to adopt inverter control.



The electric power cost; 7.5Rp/kWh

At air consumption 60% 20years cost,
(only power consumption)

Same air consumption, but power consumption is much different between standard and inverter type.

Standard compressor ・・・ power consumption 88%
20years power consumption of Standard compressor
84kW x 0.88 x 6000h x 20y x 7.5Rp = 66,510,000Rp

Inverter compressor ・・・ power consumption 64%
20years power consumption of Inverter compressor
84kW x 0.64 x 6000h x 20y x 7.5Rp = 48,384,000Rp

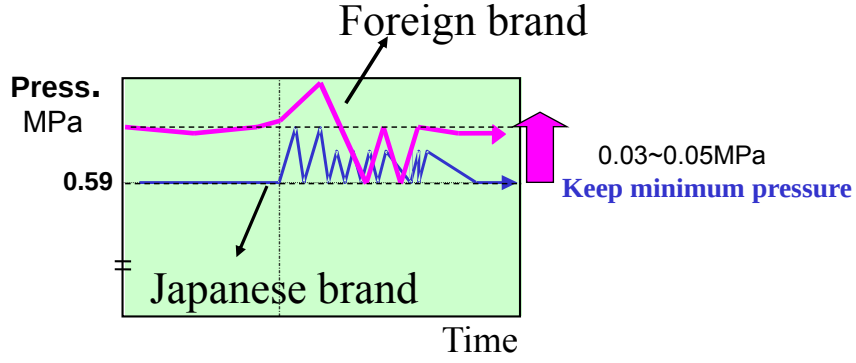
Inverter type payback period is 2.2 years.
Difference in price between standard and inverter type case, payback period is only one year.

What is different point between European brand and Japanese brand

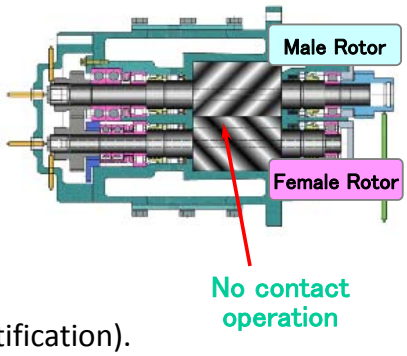
For inverter (VSD or VFD) compressor of Japanese brand

Motor is not only IE3 cord regulation but also permanent magnetic plus DCBL motor and controlled by high quality IGBT.
So, total efficiency of compressor system is 2~4% higher than Europe brand.

Sensing technology is also different as below, then Japanese brand can get higher efficient.



What is oil-free compressor?



High skill and materials are necessary to product.
Sealing is important even high speed operating.
Maintenance cost is higher than oil flooded type.
Efficiency is little less than oil flooded type.
Price is higher than oil flooded type, nearly double.

but

Oil free compressor can get very clean air (class zero certification).
It can use for high technology products and high quality use to grow up industries.

for

Electronics, semi-conductor, food, medical, textile, and others
Oil-free air can clear such as HACCP, FSSC22000 and GMP regulation.

- HACCP; Hazard Analysis Critical Control Point
- FSSC22000; Foundation for Food Safety Certification
- GMP; Good Manufacturing Practice

High technology put into these compressors

- Reciprocating compressor
- Screw compressor
- Scroll compressor
- Centrifugal compressor

1. 今日は多くの生産工場で、重要な熱源として欠かすことの出来ない蒸気ボイラについて、私ども三浦工業の貫流ボイラシステムによる省エネルギー技術の一端をご説明させて頂きます。

２．まず始めに、私ども三浦工業の概要を簡単にご説明いたします。

三浦工業は１９５９年に設立され、今年で５６年目となりました。

「熱・水・環境のベストパートナー」のスローガンのもと、蒸気ボイラを中心に、お客様への省エネルギー提案、蒸気を使用する機器の製造・販売・メンテナンスを、一貫して行なっている会社です。

３．次に弊社の海外展開について説明させていただきます。

現在の所ご覧のようにアジア及び米州圏を中心に展開しております。

青いマークが当社の現地法人のある国で、中国、韓国、台湾、シンガポール、インドネシア、カナダ、アメリカ、メキシコ、ブラジル、タイ、オランダの１１ヶ国となります。

全体では黄色マークの販売店を含め世界１８ヶ国で事業活動を行なっております。　また、日本以外では中国、台湾、韓国、インドネシア、アメリカ、カナダの６ヶ国に工場があり、各国、地域の法律や使用環境にマッチした製品を製造しています。

４．次にアジア圏の実績についてフォーカスして見ますと、ご覧のように日本を除き約２２，０００台の三浦のボイラが稼動しており、各国の生産設備の現場でお役に立っています。

因みに日本を含めた全世界では約１４万台のボイラをお使い頂いております。

５．それでは本題の貫流ボイラの特徴についてご説明いたします。

まず基本的な構造ですが、一般的には図のようにドーナツ状の上下管寄せの間を、円筒状に配列した垂直水管で連結したものとなっています。　下部管寄せに給水された水が、水管内を上昇するにしたがい加熱されて蒸気となり、上部管寄せを通り汽水分離器内で水分を分離され、蒸気が取り出されます。

このように、貫流ボイラは主として水管で構成され、煙管ボイラのような大きなドラムを持たない構造で、内部に保有するエネルギー量が少ない事から、破壊に対する安全性が極めて高いボイラと言えます。

また、保有水量が少ないため、ボイラ起動を３～５分と非常に短時間で行う事が可能です。

6．こちらの図は、日本国内における貫流ボイラ及び取扱者の適用区分を示しております。
最高使用圧力 1MPa 以下、伝熱面積 10m2 以下の貫流ボイラは小型ボイラに、さらに伝熱面積 5m2 以下の場合、簡易ボイラに区分されます。
それを超えるボイラはボイラに区分されます。
三浦ボイラはこの赤枠内の小型貫流ボイラに区分され取扱資格不要、設置届け申請のみでよく、法的な検査も必要ありません。また、韓国、台湾でも日本同様に 1MPa、10m2 以下の貫流ボイラの取扱は有資格者の必要が無く、講習の受講のみで取扱が許可されています。
・取り扱い資格が不要です。
・設置時の落成検査が不要です。
・法定性能検査が不要です。

7．こちらの表は２０００年から２０１２年の間の、日本国内におけるボイラ事故による死亡者数を、ボイラ種別で整理した統計資料となります。円グラフのように、８７％と市場で数多く稼動している小型及び簡易貫流ボイラは、死亡者数がゼロであることが分かります。このように、三浦の主力製品である小型・簡易貫流ボイラは、安全性が極めて高いことがお分かりいただけると思います。

8．そして、市場を示すものがこのグラフとなります。　左のグラフは、日本国内のボイラ種類別の設置台数割合の推定値です。総台数約 233,000 台に対し、貫流ボイラが 87%を占めております。　なお、この貫流ボイラの中での三浦の割合は 50%となっております。
一方、右のグラフは 2011 年 1 年間のボイラ種類別の製造台数割合の推定値です。　2011 年年間総製造台数約 10,100 台に対し、貫流ボイラが 98%を占めており、年々貫流化が進んでいることがお分かりいただけると思います。なお、この場合の三浦の割合は 56%となっております。

9．ここで、日本国内のボイラ規格に対する法令と JIS 規格に関してご説明します。

厚生労働省所管の「労働安全衛生法」の規定に基づき、「ボイラ構造規格」及び「小型ボイラ構造規格」が定められています。
この「ボイラ及び圧力容器安全規則」は、任意規格の JISB8201 に準拠した規格です。
日本の発電用ボイラを除く産業用ボイラは全て労働安全衛生法に基づき設計・製造･検査されています。
インドの法令規格においても、日本の法令規格「ボイラ構造規格」及び「小型ボイラ構造規格」を認可して頂きたいと考えております。

１０．写真は海外仕様のガス焚きボイラの一例です。弊社開発の高効率のボイラ構造や、水位制御方式、エコノマイザの採用等により、従来の炉筒煙管ボイラの半分以下の大きさで、ボイラ効率 ９６％以上の性能を発揮する、高効率でコンパクトなボイラとなっています。　また、前述のように構造的に安全性が高く、合わせて独自の多重安全制御を採用する事で、安心してお使いいただけるものとなっています。　このような特長により、貫流ボイラは産業用ボイラとして広く普及し、いまや日本のスタンダードとなっています。
（日本独自のボイラ構造規格の枠組みによる規制も緩やかなため普及した）

１１．さらなる安全性を追求し、安心できる機能を充実させています。
例えば、火炎監視装置に自己診断機能を追加し、燃焼中にシャッターを使用し定期的に火炎を遮断し火炎センサ自身の故障診断を実施します。また、缶体には蒸気圧力スイッチを採用し、磁石を加熱することで磁力が無くなる物理現象を利用したフェールセーフな機能です。
このような安全機能を２重３重に設けてお客様により安心してボイラをご使用していただけます。

１２．さて、数々の特徴を持つ貫流ボイラと従来の炉筒煙管ボイラを簡単に比較してみましょう。　図に有るように同じ蒸発量 2ton/h のボイラで比較すると、保有水量は貫流が 120L に対し煙管が 2500L と約 20 倍もあります。　これにより、貫流ボイラが起動時に要する熱量が極めて少なく約 5 分で蒸気圧力が立ち上がるのに対し、煙管ボイラでは 10 倍の約 50 分も掛かる事になります。

同時にボイラ停止時には放熱で捨てる熱量が多いことを示しています。

また、貫流ボイラは煙管ボイラに比べて非常にコンパクトであり、ボイラ表面からの放熱ロスも約 1/3 と非常に少ないという特徴があります。

以上のことから貫流ボイラは煙管ボイラと比較して、前述の安全性の高さと共に、省エネ性の高いボイラで有る事が判ります。

１３．次に最大蒸気負荷量 20ton/h、最少 4ton/h という、具体的なボイラ設備の場合の放熱損失の比較をして見ましょう。構成は、貫流ボイラが 4ton/h×5 台の多缶設置システム、炉筒煙管ボイラは 20ton/h×1 台です。

図のように 20ton/h の最大負荷で運転している場合の放熱ロスは、蒸気量換算で貫流ボイラが 52kg/h、煙管ボイラが 160kg/h となります。

一方これが最少負荷の運転になると夫々10kg/h と 160kgh となり、その差は大きくなります。

これは貫流ボイラの多缶設置システムでは、必要な蒸気量に合わせて必要な台数のボイラだけを運転するという、合理的な運転方法によるものです。

１４．変わりまして、右の図は実際のボイラ設備が、平均的にどの程度の蒸気負荷率で運転されているのか、弊社で約１４，０００件のサンプル分析を行った結果です。

これより、多くは蒸気使用負荷率 20～50%程度の範囲で運転されていることが判り、10%から 50%の範囲を合計すると全体の約 70%強にもなります。

一方、右のグラフは貫流ボイラの多缶設置システムと、従来の炉筒煙管ボイラ単缶の場合の、ボイラ設備の運転負荷率とボイラ運転効率の関係を示したものです。　一般的に運転負荷率が小さくなるとボイラ効率が低下する傾向に有りますが、前述の放熱損失比較の例からも、運転負荷率が低い領域においても、貫流ボイラシステムは低下が少ないという特徴があります。　これにより、貫流ボイラシステムを用いる事で、実際のボイラ運転状況において、大幅な効率改善が可能となります。

１５．これは貫流ボイラの多缶設置システムの具体例です。

設備に必要な複数台の貫流ボイラと蒸気ヘッダ圧力でボイラ運転を制御する台数制御装置で構成されています。

生産設備側の蒸気要求を蒸気ヘッダの圧力として読み取り、必要な台数のボイラを最も効率の良い運転状態となるように制御を行ないます。

また、極力ボイラを停止しないように制御を行ないますので、蒸気の負荷変動に対してもすばやく追従する事が出来ます。

このように貫流ボイラの多缶設置システムは、高い運転効率と安定した蒸気供給を実現するものです。

１６．私ども三浦はこの貫流ボイラ多缶設置システムを MI システムと名づけ、広くご提案をさせて頂いております。

また、ご覧の絵のようにボイラ自体が非常にコンパクトであるため、従来の炉筒煙管ボイラ設備の１/２以下のスペースで設置が可能であり、工場設備スペースの有効利用がはかれるという特徴もあります。

このように貫流ボイラを用いた MI システムはボイラ設備の効率化の切り札として是非ご検討をいただければ幸いです。

１７．さて、ここでボイラ設備の改善を行うには、現状を把握する事が必要です。

そのためには、第一ステップとしてボイラ日誌データを基に、年間を通じての蒸気使用量やボイラ運転効率の把握を行う【日誌分析】を行います。

また、より詳しいデータ得るためには、右の絵に有るように実際のボイラに各種センサーを取り付け、瞬間的な蒸気使用負荷等を計測する【負荷分析】の手法を用い、問題点の「見える化」を行ないます。

弊社は、海外でもこの分析と貫流ボイラシステムを用いた改善提案のサービスを行なっています。

１８．それでは、具体的な省エネルギー事例をご紹介いたします。

まず日本の事例ですが、左は炉筒煙管ボイラ 2 台、23.9ton/h の設備を、小型貫流ボイラ 3ｔ/ｈ×7 台と台数制御装置に更新した事例です。

更新後の実測データにより、蒸気システムの運転効率で 14%の改善が認められ、合わせて年間約 140 トンのＣＯ２削減と、燃料費のコストダウンが可能となりました。

日本ではこの実績を踏まえ、大型水管ボイラの領域も貫流ボイラシステムに変わって行きつつあります。

１９．続いてお隣韓国の事例です。

韓国でも日本に続き貫流ボイラ化が進んでおり、どんどん省エネが進んでいます。

２０．これは中国の事例です。

中国は産業用ボイラの約８０％が依然石炭を使用し、低いボイラ運転効率と共に、大量の大気汚染物質の排出により、社会問題となっています。

左の事例はまさに石炭ボイラから三浦のガス焚き貫流ボイラシステムに更新したものですが、運転効率で 29%の改善、CO2 排出量 63%削減、そして硫黄酸化物、窒素酸化物が夫々99%、82%と大幅に削減できました。

２１．このように、日本で発展を遂げた三浦の貫流ボイラシステムは広く世界に進展し、省エネと環境保全のお役に立っています。

22. 国内各省庁、学会、協会などより優秀省エネルギー機器への認定や科学技術長官賞などをいただいております。
また、海外でも同様の受賞をしています。例えば昨年には外国企業では初の韓国エネルギー効率大賞　大統領表彰を頂いています。
このような受賞は、各国でも高い省エネ機器として三浦ボイラが認められた証拠であるともいえます。

23. こちらの図は三浦独自のオンラインメンテナンスの仕組みを表したもので、通信機能を持ったボイラとメンテナンス拠点を電話回線で結び、データ通信を行ないます。

万一ボイラに問題が発生した場合は、メンテナンス拠点に異常通信が送られます。

そして得られた情報を分析する事により、メンテナンススタッフがお客様に電話アドバイスを行うと共に、修理が必要な場合は迅速に対応いたします。

また、拠点からの通信でボイラの状態を適宜把握する事により、故障やボイラ効率の低下を未然に防止することが可能となります。

このシステムも順次海外に展開を進めています。

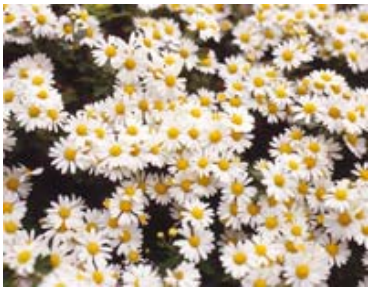
２４．最後に“日本の小型貫流ボイラの特徴”をまとめますと
ボイラの構造、及び先進技術による、高い安全性の確保ができる。
高いボイラ効率と多缶設置システム（MI システム）による高いシステム効率の維持ができる。

小型・軽量設計により設備の省スペース化が可能である。
日本の産業用ボイラのスタンダードであるとの認識。
東アジア、アセアン諸国にも普及しています。
（日本輸出及び現地製造実績 約２０，０００台）

２５．私どもは、ごらん頂きましたように高効率の上記システムをご提案することで、安全安心はもとより、省エネルギーを実現し、合わせて環境対策へのお手伝いをさせていただければと考えております。今後とも宜しくお願いします。

12th January,2016





Planning System on Greenhouse Gas (GHG) Emission Control in Hyogo Prefecture

'Habatan' mascot of Hyogo Prefecture

Noriaki SUGA

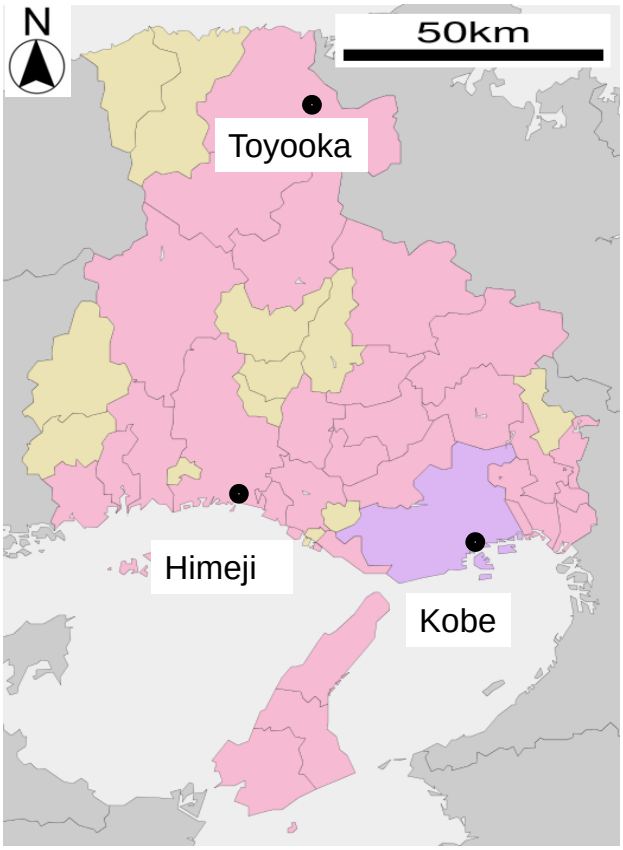
Deputy Director
Global Warming Solutions Division
Environmental Management Bureau
Hyogo Prefectural Government

Location of Hyogo Prefecture

Beautiful Hyogo

Outline of Hyogo

Beautiful Hyogo



Basic data

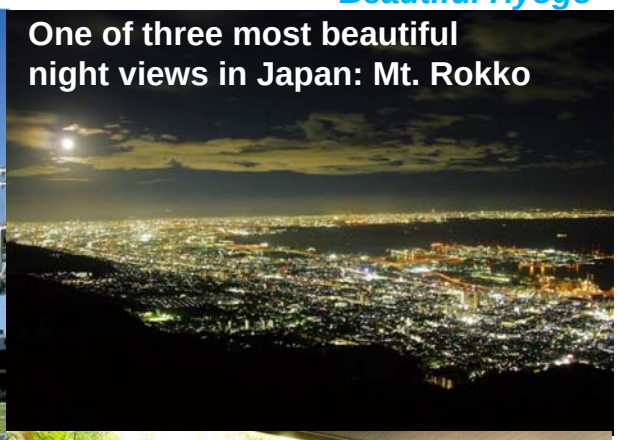
Area: 8,396 km^2 (12th in Japan)
Population: 5.57 million (7th in Japan)
Real GDP: 20 trillion 631.4 billion yen
= 257.5 billion US dollars
*Almost as large as that of Finland

The purple area is a Government Ordinance City, pink areas are cities, yellow areas are towns. Total 29 cities and 12 towns.

Enchanting spots in Hyogo Prefecture

Beautiful Hyogo


The world longest suspension bridge: the Akashi Kaikyo Bridge (3,911 m)


One of three most beautiful night views in Japan: Mt. Rokko


The Greatest Castle in Japan: Himeji Castle (World Heritage)

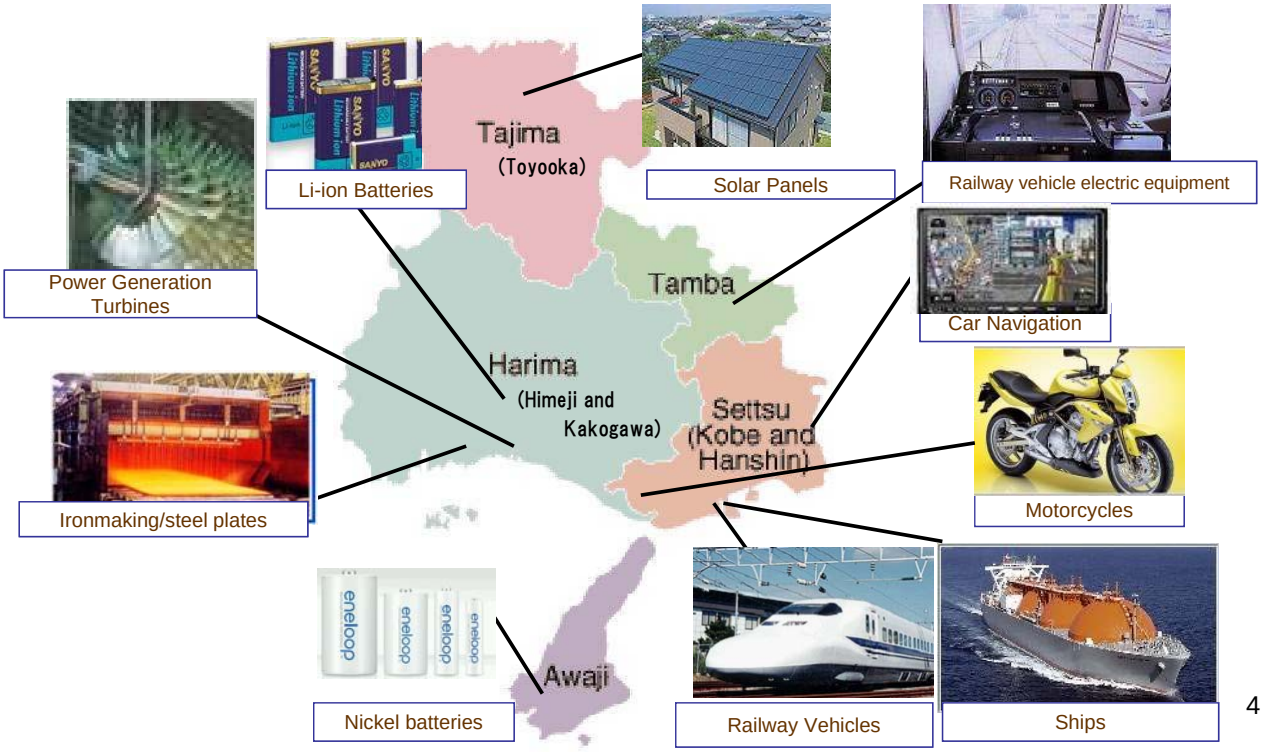

The nation's top hot spring Destination: Kinosaki Hot Springs

A Wealth of Manufacturing Industries

Beautiful Hyogo

- From Heavy Industry to SMEs
  - Total product shipment is approx. 14 trillion 347 billion yen, National share of 5.0% (ranked 5th in the nation)

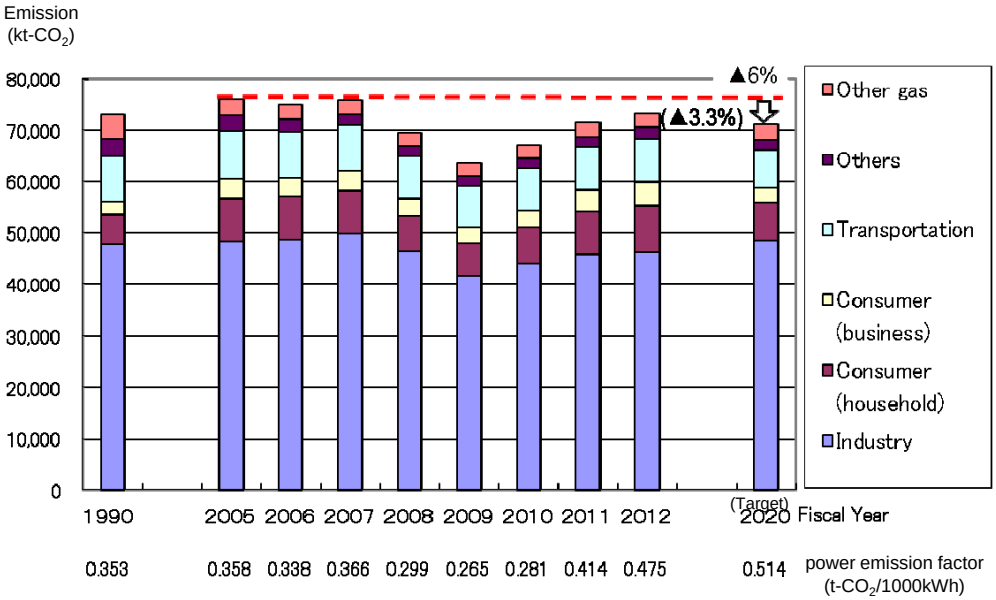
(Source: 2012 Industrial Statistics)



3rd global warming prevention (promotional) plan of Hyogo Prefecture (established in Mar. 2014)

*Setting of GHG reduction target in fiscal year 2020 in Hyogo Prefecture

Greenhouse gas emission in FY 2020 is to be reduced 6 % from FY 2005 level. (3% down from FY 1990) (Power emission factor is set to the value in FY 2012)

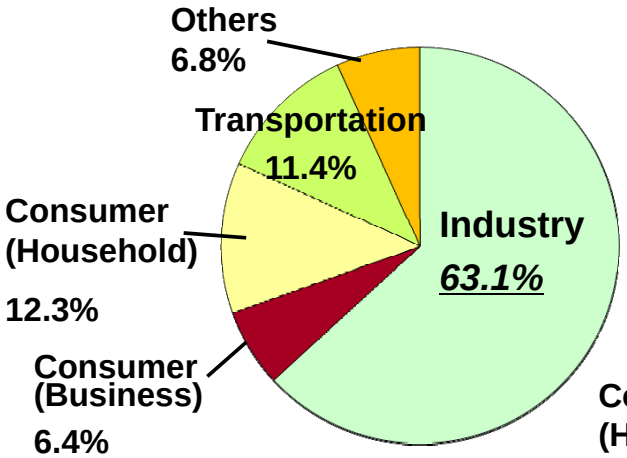


Greenhouse gas (GHG) emissions by sector in Hyogo Prefecture

Emissions in FY2012

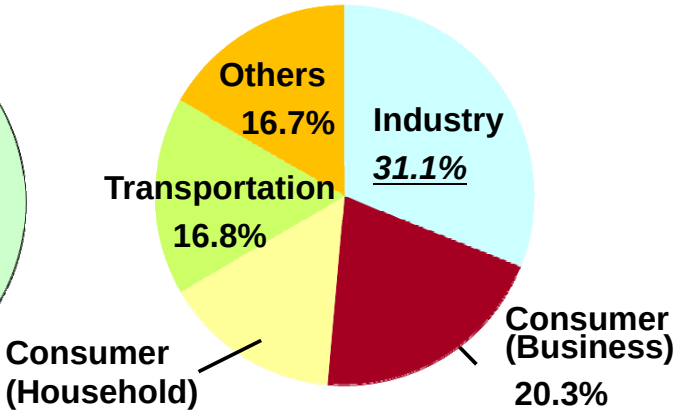
Hyogo Prefecture

73,280kt-CO2



Whole Japan

1,390,000kt-CO2



Created by Hyogo Pref. Gov. based on the document of Ministry of Environment of Japan

In Hyogo prefecture, emissions from industrial sector is large.

System for reporting GHG emissions in Japan

Business operators
(with energy usage of 1,500kl/year or more)

Japanese government

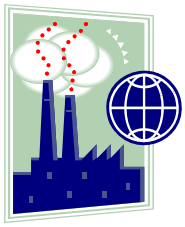
Citizens

Tabulation result in FY2012

Number of businesses reported: 11,372

Total emissions: 635.6million ton-CO_2

System for reporting GHG emissions in Hyogo prefecture



Submit CO_2 emission control plan

Report CO_2 emissions

Publicize

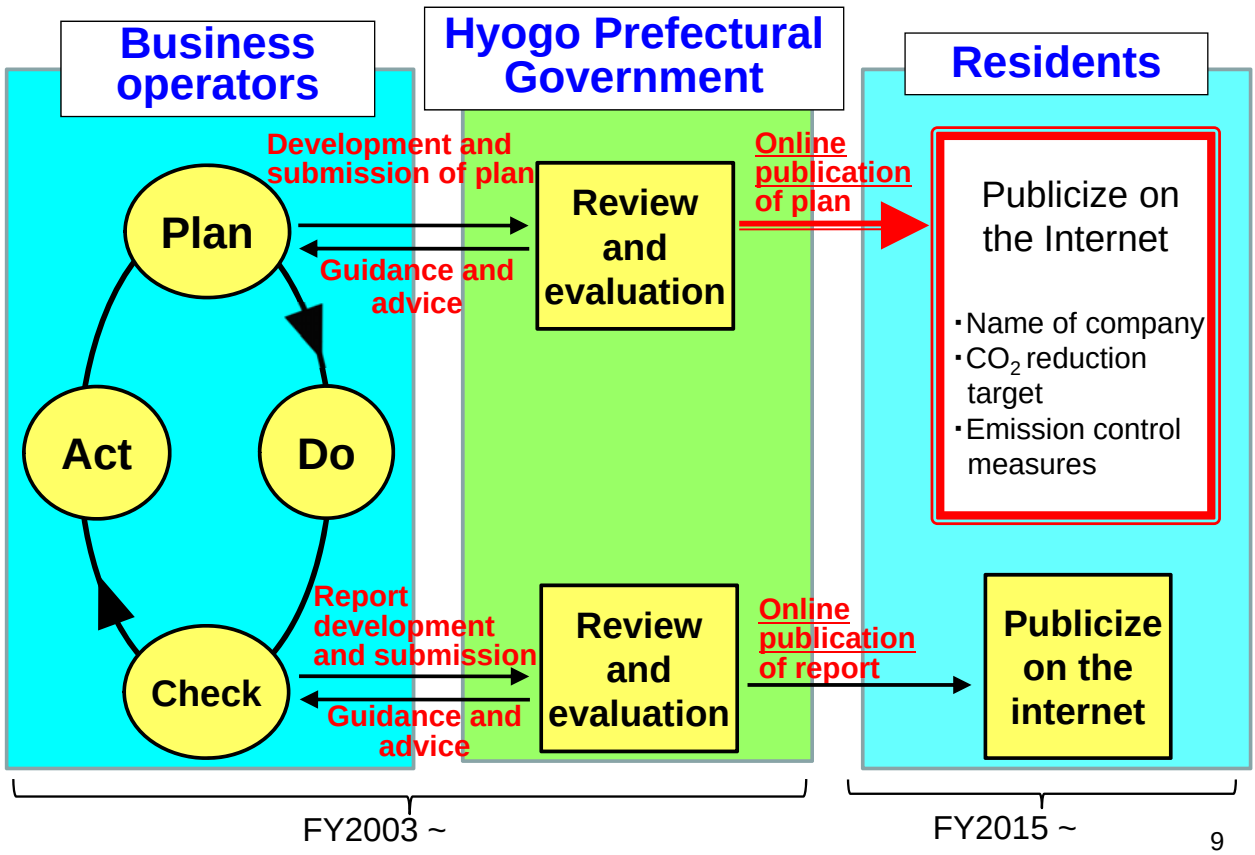
Business operators
(with energy usage of 1,500kl/year or more)

Hyogo prefectural government

Residents

Target business operators: 576
Total emissions: 35,640kt-CO_2

Planning System on Greenhouse Gas (GHG) Emission Control



Emission Control Plan of Greenhouse Gas
(Plan for publication)

Form4 （Regulation of Hyogo prefectural government 142.4）

Emission Control Plan of Greenhouse Gas for Publication

Address	
Corporate name	
Industrial sector	
Outline of business	
Factory name within prefecture	
Total GHG Emissions	（unit: t-CO_2 （CO_2 reduced quantity））

Base year （performance） （FY ）	Present state （FY ）	Target FY （plan） （FY ）
–	–	–

Process of goal setting	
GHG Emission control measure (principal plan)	
CSR activities	

Example1: Food manufacture

Industrial sector	09 Food manufacturing
Outline of business	To refine flour and vegetable oil from the raw material like wheat and soybeans, etc.
Factory name within prefecture	△ △ food factory
Total GHG Emissions	（unit ; t-CO_2 （CO_2reduced quantity））

Base year (performance) （FY 2009 ）	Present state (performance) （FY 2013 ）	Target FY (plan) （FY 2020 ）
19.8	19.8	17.8
–	compared with the base fiscal year +0.4%	compared with the base fiscal year -10 %

Process of goal setting	In oo factory of oo Corporation, the reduction plan by -1% each year has been implemented, with the target of 10% reduction of CO2 emission intensity by 2020 compared with FY 2009. Since the operation amount is increased about 17% with which the amount of raw material used in FY 2009 is 770,854t and the amount in FY 2013 is 938,205t, not the CO2 emission but the basic unit is to be managed. Contribution to reduction in CO2 is expected by managing CO2 emission intensity and continuing high-efficient operation. CO2 emission in FY 2009…11,637t-CO2 CO2 emission in FY 2013…14,876t-CO2
GHG Emission control measure (principal plan)	

Measures	Concrete content	Target reduction
Rational use of energy	Verification and implementation of equipment proper air pressure	To reduce 1% of electric power consumption at each equipment
	Optimisation of fan revolution speed	To reduce in electric power consumption by operating with proper revolution
	Review of the amount of compressed air consumed	To reduce electric power consumption by determining the amount of power consumption
	Improvement of air leakage, steam leakage, air, and heat loss	To improved them intensively by setting the eradication period
Equipment upgrades	Renewal to high-efficient equipment from aging equipment	Renewed deodorization equipment in 2012 Shall be renewed desolventising facility in 2015

Not yet disclosed at this time

Example2: Service (Hospital)

Industrial sector	8311 Hospital
Outline of business	Medical service
Factory name within prefecture	○ ○ Hospital

Total GHG Emissions

(unit : t-CO_2 (CO_2reduced quantity))

Base year (performance) (FY 2005)	Present state (performance) (FY 2013)	Target FY (plan) (FY 2020)
4,653	4,634	4,281
–	compared with the base fiscal year -0.4%	compared with the base fiscal year -8%

Not yet disclosed at this time

Process of goal setting

GHG emission in FY 2012 which is the final FY of the previous plan was 4,528t-CO2. It's ▲2.7% compared with the base FY.

But, in FY 2013, it increased 2.3% at 4,584t-CO2 due to extension of building (▲0.4% compared with the base FY).

The target to reduce 8% in 8 years between 2013-2020 has been set based on the target under Energy Conservation Law which the annual average reduction is 1% (7.2% reduction in 7 years compared with the base FY (2005)).

GHG Emission control measure (principal plan)

Measures	Concrete content	Target reduction
Thoroughness of low carbon type business activities like energy saving, etc.	Introduction of high-efficient fluorescent light in lighting equipment	To reduce 2% of CO2 emission by 2015 compared with FY 2012.
	Renewal of the main unit of absorption chiller	
	Improvement of co-generation power generator controller	To reduced 0.5% of CO2 emission by FY 2015 compared with FY 2012 through control optimisation of excess air ratio (compared with air-fuel ratio) at combustion.
	Review of operating hour of co-generation generator (Stop at 22:00 at present -> (change) stop at 20:00; applied only to November-March).	To reduce 1% of CO2 emission by FY 2015 compared with FY 2012.
Thoroughness of low carbon type business activity like energy saving, etc. and low carbonisation of production facility or office building	Inverter control for cold and hot water pump	To reduce 3% of CO2 emission by FY 2015 compared with FY 2012.
Rational use of energy	Improvement of heat efficiency by heat retention of steam valve	To reduce 0.5% of CO2 emission by FY 2015 compared with FY 2012.

Example of collaboration project between Hyogo prefecture and Gujarat state

[Example]

Developing a menu of GHG reduction measures

Business type/Industry sector	Menu of GHG reduction	
	Category	Details
Food manufacture	Thoroughness of low-carbon type business activities, like energy saving, etc. [Soft measures]	- Improving air leakage, steam leakage, air/heat loss. - Sticking heat insulation sheet to hot-water tank - Introducing air curtain at the entrance of the freezer.
	Low carbonization of production facilities or office building [Hard measures]	- Changing existing fan-pump to inverter type - Replacing lighting to LED from fluorescent lamp - Introducing cold & hot water supply heat pump

Example of measures: Hard measures

Hyogo Prefectural Government office

Cold/hot water generator for air conditioning

Heat retaining by insulating cover

Example of measures: Soft measures

Cold water:
w/o insulating cover

Hot water:
with insulating cover

Thank you very much

【Awaji】Naruto Whirlpools

CES Consulting & Engineering Service

A Chemical Company in India

One Day SSOP® Feasibility Study

TLV®

Survey Date: 9th December 2015
Report Date: 10th December 2015

TLV Members
Hayato Kida / Consulting Engineer
Ashwin Sanyal / TLV India Sales Manager

Steam System Optimization Program

SSOP®

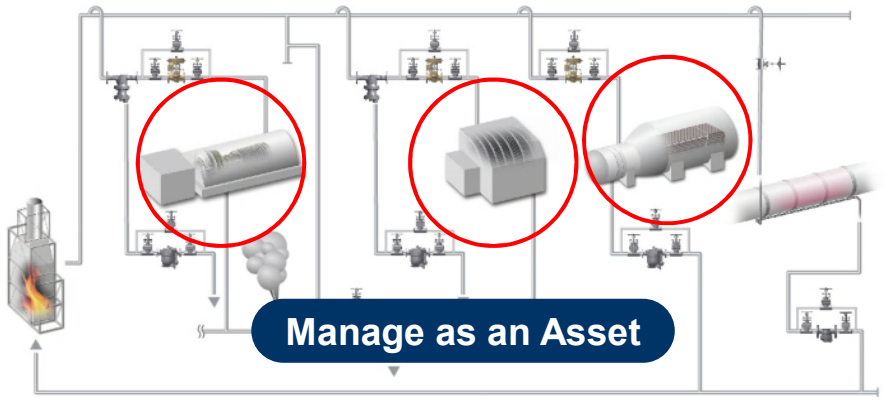
Peace of Mind through Steam System Optimization

TLV®


Typical Scenes from a Steam Plant


Peace of Mind

Steam Plant



Stand-alone management of equipment is inadequate

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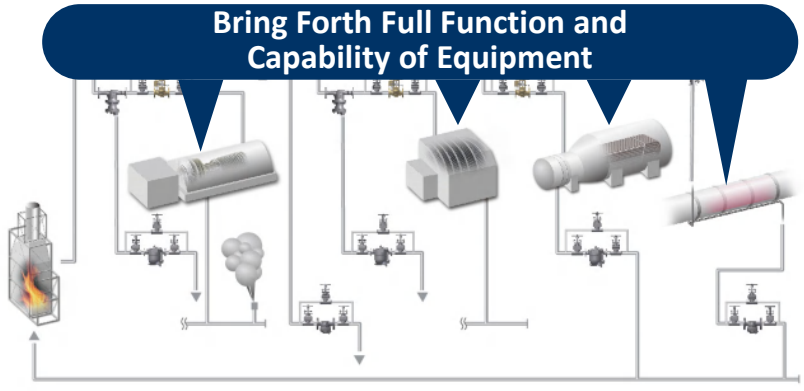
Contributing to Safe & Stable Plant Operation



Steam is an Asset

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The Structure of SSOP®

3 Phase **How can the entire steam system be optimized?**

Create optimum balance with the entire steam system treated as a valuable asset.

2 Phase **How can all SA (Steam Applications such as steam-using equipment, tracing) be optimized?**

Newly define everything from steam supply to condensate discharge as an asset.

1 Phase **How can all CDLs (ex. 10,000) be optimized?**

Necessary conditions for the steam system to function.

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The Structure of SSOP®

3 Phase **Steam System Balance**

⇨ Steam System (Electricity & BFW) Balance Optimization
⇨ Steam Load & Generation Balance Optimization

Optimize Steam System

2 Phase **BPSSM® (Best Practice of Steam System Management)**

⇨ Safety, Reliability & Productivity Improvements
⇨ Recover and Re-use Condensate and Waste Heat

Optimize Steam Applications

1 Phase **BPSTM® (Best Practice of Steam Trap Management)**

⇨ Eliminate Problems Caused by Condensate
⇨ Reduce Steam Loss

Create Infrastructure

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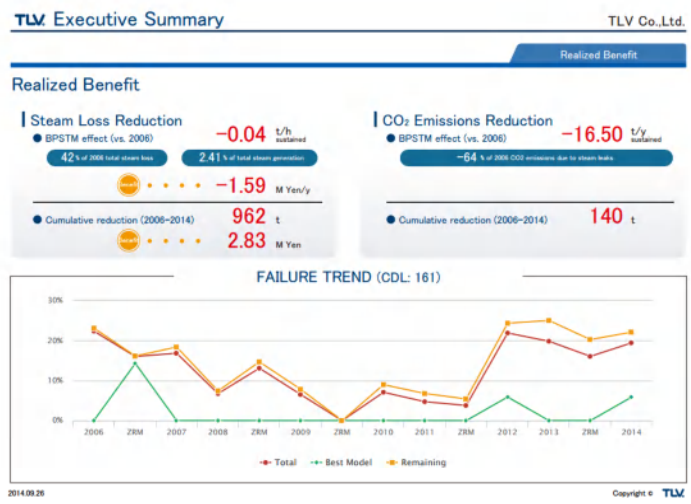
BPSTM.NET - Executive Summary



Feasibility Study Result Summary

Improvement Items

CDL survey item + 2 steam application items

Steam Reduction	:	120 kg/h
CO2 Reduction	:	166 t-CO_2/Year
Total Merit	:	1,317,000 INR/Year

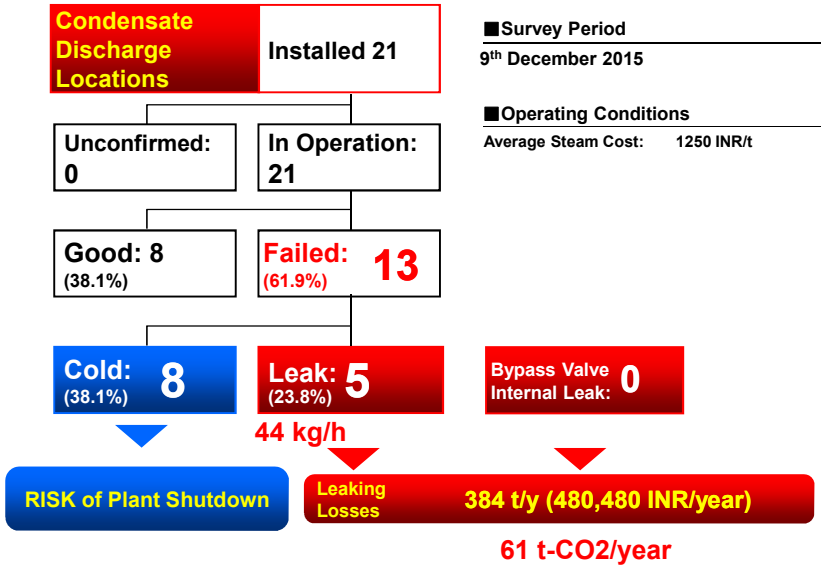
This time surveyed 21CDLs and 6 steam applications out of 118CDLs and 30 steam applications during one day.

Estimated Total Energy Saving Potential

Steam Reduction	:	629 kg/h
CO2 Reduction	:	865 t-CO_2/Year
Total Merit	:	6,881,000 INR/Year

Used following condition
CO2 emission factor:0.157 tCO2/tSteam (IPCC standard/Refinery Gas)
Operating hour:8760hours/year
Steam cost:1250 INR/t

BPSTM Result (Condensate Discharge Locations "CDL")



■Survey Period

9th December 2015

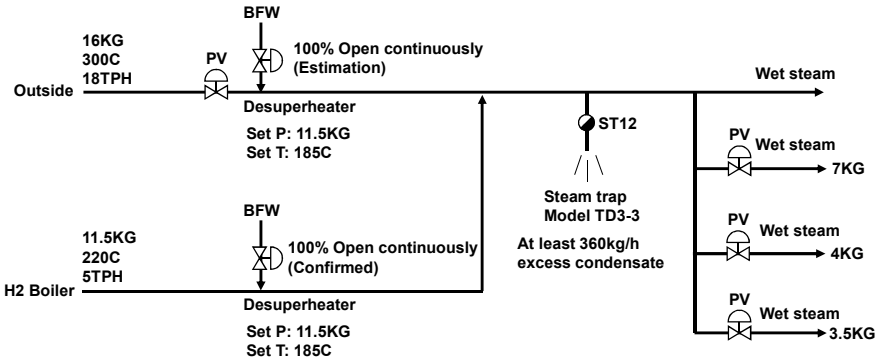
■Operating Conditions

Average Steam Cost: 1250 INR/t

Whole Plant

Improve steam quality by desuperheater set temperature change

Current Situation



Steam sturated temperature at 11.5KG is 189C, however the desuperheater set temperature is 185C. 11.5KG steam never reaches 185C, so excess water is injected to the steam line. Confirmed 450kg/h condensate is continuously discharged from steam main line that is abnormally high condensate discharge load from the steam trap at the steam main line.

Whole Plant

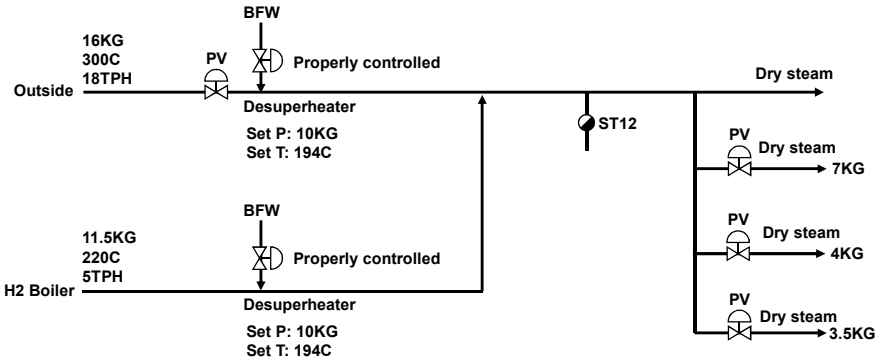
Improve steam quality by desuperheater set temperature change

Whole Plant

Improve steam quality by desuperheater set temperature change

Potential benefit: Steam reduction 76kg/h, 836,000 INR/year, 105 t CO2/year, Steam quality improvement

Opportunity



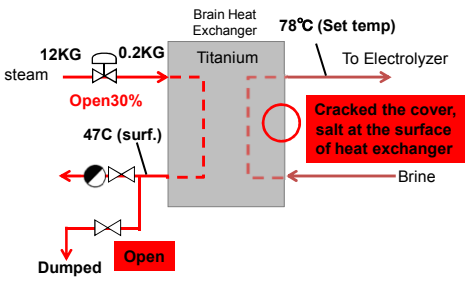
Change the steam set pressure to 10KG (Tsat=184C). Change the desuperheater set temperature to 194C (10C + Steam saturated temperature) . Excess desuperheater water is not injected steam line and reduce losses. Reduce risk caused by wet steam.

MC1

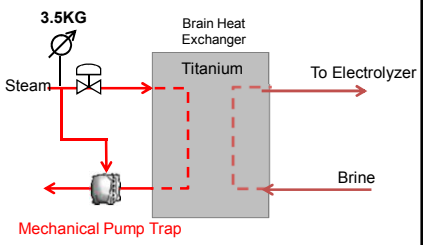
Reduce risk and steam loss from plate heat exchanger by pump trap

Potential benefit: Reduce risk of steam leakage and improve system reliability

Current



TLV Proposal



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Safety Reliability is one of the most important issue

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can damage the costly equipment.

Next Action

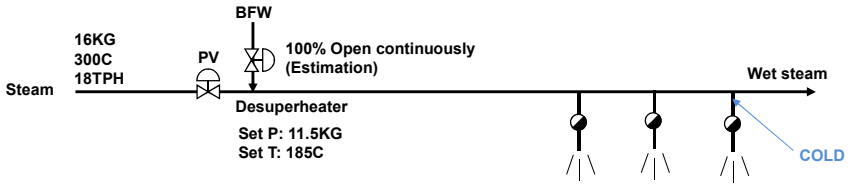
1) Implement improvement items

- **Many CDLs judged as Low temperature (less than 60% of steam saturated temperature)** 6 Low temperature CDLs out of 8 cold CDLs
- **Desuperheater temperature setting may affect this (too much condensate cannot be discharged by small steam traps)**
- **Recommend to review desuperheater setting first then re inspect CDLs**
- **Some valves in CDLs are wrongly operated (Steam trap inlet valve closed). Need whole area survey and optimize CDL operation.**

2) Survey for whole plant

- **This is feasibility study. The survey time was very short. However even this short period, there are some important findings. Need whole plant survey to maximize your profit.**

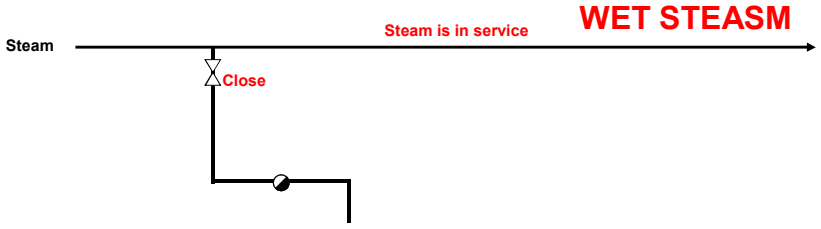
Next Action



Is this steam trap failure?
Is this because of too much water from desuperheater?

Normal steam trap survey cannot find this

Next Action



Normal steam trap survey could judge this trap as COLD!

SSOP Achievement

Surveyed 105 plants (in Japan)

CO2 emission reduction	320,000 t/year
Steam loss reduction	260 t/hour
Cost reduction	2.8 billion INR/year

Potential in India comparison by refinery capacity

India	Japan
4,355,000 barrels / day	3,916,700 barrels / day
22 Plants	23 Plants
	
FS CDL failure rate 61.9%	Japan CDL average failure rate 25.6%
? billion INR/year	2.8 billion INR/year

TLV Contact in India

Steam System Optimization Program(SSOP®) by TLV

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Annexure 3: Selected photographs of the event