Introduction of the latest Technology of Energy Conservation

--- To blue chip companies due to effective energy utilization ---

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Fuji Electric Co., Ltd.
Energy consumption trend of expansion

Energy consumption in the world continues to increase in the future, and especially the Asian region began to exceed Western Europe in the power consumption since 1994. Growth rate of the entire world has remained at an average of approx. 3.5% since 2000, however it has remained at an average of 7.5% and a very high growth rate in the Asia region.

Long-term power consumption is increased, the anxiety for the power supply to be higher.
Trends in energy prices

Rising the energy price

■ Energy high price trends ■

In the medium to long term, **energy costs are trend rising** with expansion of the energy demand.

In the result, **the proportion of energy as a percentage of the product cost to be increased**.

Reducing the energy consumption, it becomes an important factor to compete with other companies.

Enhanced importance of Energy Conservation for companies.

Energy prices rise and is also forced to cope with the problem of global warming.
Shift to environment-friendly energy

Energy shift

Energy configuration of Indonesia shifts from Oil accounted initially 90% to Natural gas and Coal. Hence, the policy shift to environment-friendly energy.

2006 : National Energy Blueprint
2010 : Vision 25/25
## Energy Conservation - related policies and regulations (1)

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<td><strong>Law</strong></td>
<td>No. 30/2007 on Energy</td>
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| **Government Regulation** | No. 70/2009 on Energy Conservation | • Mandatory on EC (Energy Management)  
• EE Standard and Label  
• Incentive/Disincentive |
| **Presidential Regulation/Decree** | No. 5/2006 on National Energy Policy | • National RE and EE Target  
• Energy Elasticity < 1 in 2025 |
• Target:  
  - Electricity 20%  
  - Fuel 10%  
  - Water 10%  
• Periodic reporting |
| **Ministerial Regulation** | No. 6/2011 on EE Label for Compact Fluorescent Light (CFL) | • Implementation of Label for CFL  
• Mandatory for CFL manufacturer  
• Self Declaration of Conformity (SDOC)  
• More star - more efficient |
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<td>No. 12/2012 on Fuel Saving</td>
<td>• The use non-subsidized fuel • Fuel saving 10% • Gov. Official and State-owned enterprises Vechicle - 1 June 2012 (Jabodetabek) - 1 August 2012 (Jawa – Bali) • Vehicles used by plantation and mining companies • Fuel saving for electricity generation • Monitoring</td>
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<td>No. 13/2012 on Electricity Saving</td>
<td>• Electricity saving 20% (Improvement of air system, lighting, &amp; supporting equipment) • Government/Reg. Gov Office • State-owned enterprises • Street lighting, etc. • Monitoring</td>
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<td>No. 14/2012 on Energy Management</td>
<td>• Mandatory of Energy Management for large energy users (&gt; 6,000 TOE) • The distribution of Authority (Gov, Reg.Gov.) • Monitoring of Energy Management Implementation • Incentive/Disincentive</td>
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Indonesian Energy Conservation Policy and Regulations to be reinforced.
Considered by classifying the energy

- Efficiency of energy supply
- MIERUKA (identifying problems and bringing them to the foreground)
- WAKARUKA (to know the weight of numbers, to understand the meaning of the graph)
- Energy optimization of production equipment
Individual management of energy

■ Energy management (MIERUKA) ■
Centralize energy data, such like electricity and gas, so that it can see from variety of perspectives utilizing IT technology.
With this way, "MIERUKA" is possible in individual units such as "area, equipment and products" from entire energy management. Moreover, KAIZEN items for energy conservation can be found.

◆ Entire management

From "Entire management" to "Individual management"

◆ Management by "area, equipment and products"

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Electric energy measurement (MIERUKA)

Primary
L1/R  L2/S  L3/T

Secondary

CT
Measurement unit
Why is the amount of energy use does not decreasing, even though production has been stopped?

Production results compared to the amount of energy used.

!!! FOUND OUT !!!

The energy is using by other than production.
Target of Energy Conservation

- Sectoral market size, growth rate -

Graph showing various sectors with their revenues and growth rates in 2013, 2014, and 2015, adapted from IHS.
Motor to be used in HVAC application (fan, pump)

**Cooling tower fan**
The heat dissipation of the cooling water to the atmosphere.

**Cooling water pump**
To transport the heat of the refrigerator to the cooling tower.

**Hot and cold water pump**
To transport the hot and cold water to the air conditioner, fan coil.

**Supply, ventilation and exhaust fan**
To transport hot and cold air and exhaust air.
General method of adjusting air flow, flow rate

■ Damper control
Adjust the air volume in the loss of the damper.

■ Valve control
Adjust the excess capacity of the fan.
Extra pressure according to closing the valve.

Required air volume

Method of closing air flow, flow rate by mechanical is large energy loss.

Required water flow

Adjust the excess capacity of the flow.
What is inverter?

Inverter

The equipment which can control the motor rotating speed by changing the frequency.
Damper control
The air flow is adjusted by the loss of damper.

Inverter control (Air flow is adjusted by motor rotating speed)

Required air volume

Fully opened damper

Adjust the excess capacity of the fan.

Commercial drive (50/60Hz)

Inverter control the frequency. (motor speed)
Energy Conservation theory

Amount of work adjusted by valve (electricity power)

- Pressure
- Required flow
- Flow

- Required energy of valve adjusting.
- Required energy of valve open.

Amount of work adjusted by inverter (electricity power)

- Pressure
- Required flow
- Flow

- Required energy of valve adjusting.
- Required energy of inverter drive.

50Hz

Adjusted valve

Valve open

Adjusted 40Hz by inverter

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Energy Conservation by inverter (Operational change)

Power consumption (kW)

Min. load : 18kW
Max. load : 31.5kW
Load capacity : 45kW

Design margin 30%
Required max. capacity

Energy Conservation by damper control
Energy Conservation by inverter control

Power consumption of equipment

Dry season
Rainy season

month
### Energy Conservation target (example) by the inverter (1)

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<tr>
<th>Business</th>
<th>Equipment</th>
<th>Point</th>
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<td>Wood processing, metal processing, etc.</td>
<td>Bag filter, blower motor for dust collector</td>
<td>Check if adjusting the air volume in the damper?</td>
</tr>
<tr>
<td>Factory, building, etc.</td>
<td>Air blower fan</td>
<td>Check if adjusting the air volume in the damper?</td>
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**Images:**
- Dust collector of wood processing
- Foundry dust collector
- Air handling unit (AHU)
- Adjusted by damper
Energy Conservation target (example) by the inverter (2)

**Business**: Chemical plant, etc.
**Equipment**: Cooling tower circulation pump
**Point**: Check if adjusting the flow rate in the valve.

**Business**: Factory, building, etc.
**Equipment**: Cooling water circulation pump of the refrigerator (chiller)
**Point**: Check if adjusting the flow rate in the valve.
Features of FUJI inverters (model map)

- **High performance**
  - High functionality

- **Simple performance**
  - Simple function

- **Low voltage AC drives for HVAC applications**
  - **FRENIC-HVAC/AQUA**
    - 3ph 200V 0.75 to 90 kW
    - 3ph 400V 3.7 to 630 kW

- **High Performance Vector Control Inverter**
  - **FRENIC-VG (Unit Type)**
    - 3ph 200V 0.75 to 90 kW
    - 3ph 400V 3.7 to 630 kW

- **High Performance Multifunctional Inverter**
  - **FRENIC-MEGA**
    - 3ph 200V 0.4 to 90 kW
    - 3ph 400V 0.4 to 630 kW

- **High Performance Inverter**
  - **FRENIC-Ace**
    - 3ph 200V 0.1 to 22 kW
    - 3ph 400V 0.4 to 22 kW
    - Single-ph 200V 0.1 to 2.2 kW

- **High Performance Compact Inverters**
  - **FRENIC-Multi**
    - 3ph 200V 0.1 to 15 kW
    - 3ph 400V 0.4 to 15 kW
    - Single-ph 200V 0.1 to 2.2 kW

- **Compact Inverter**
  - **FRENIC-Mini**
    - 3ph 200V 0.1 to 15 kW
    - 3ph 400V 0.4 to 15 kW
    - Single-ph 200V 0.1 to 2.2 kW
    - Single-ph 100V 0.1 to 0.75 kW

- **Variable Torque Load Inverters for Fans and Pumps**
  - **FRENIC-Eco**
    - 3ph 200V 0.75 to 110 kW
    - 3ph 400V 0.75 to 560 kW

- **High Performance Vector Control Inverter**
  - **FRENIC-VG (Stack Type)**
    - 3ph 200V 0.75 to 90 kW
    - 3ph 400V 3.7 to 630 kW

- **Direct parallel connection**
  - 3ph 400V up to 3000 kW
  - 3ph 690V up to 1000 kW

- **The only one product**
  - Stack type
  - Large capacity

- **The only one product**
  - Slim type
  - IP55 correspondence
  - Dedicated function for HVAC

- **Multiple rating**

- **22 3200 kW**

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Features of FRENIC-HVAC Series

- Built-in the equipment for noise measures
- Unnecessary the control panel and self-standing available (*1)

**Existing inverter**

**Control panel**

- For noise measure (separated option)
  - EMC filter
  - DC reactor

- Surge voltage suppression equipment

**Applied FRENIC-HVAC**

- Built-in the equipment for noise measures
  - DC reactor
  - EMC filter

- Slim shape allows to install to the narrow pillar. (*2)

- Motor wiring length becomes shorter in a stand-alone installation. FRENIC-HVAC can delete the surge voltage suppression equipment. (*3)

**Installation image**

- IP rating : IP55

*1 In the case of outdoor use, a simple panel might be required.
*2 Some capacity not covered.
*3 The motor is older, it may not be deleted.
Reduction of peripheral equipment

Existing inverter for fan, pump

Flow rate
Temp.
Pressure

controller

Sequence control

Controller is required.

Inverter for HVAC application
FRENIC-HVAC
FRENIC-EcoPlus

Flow rate
Temp.
Pressure

controller

Energy Conservation control software built-in.
Sequence control software built-in.

controller

Sequence control

Controller is NOT required.
Challenge to further Energy Conservation

Fixed waste is controlled by the inverter. (traditional control of inverter)

- Waste of adjusting by the valve or damper
- Waste of extra flow
- Waste of backing in the bypass

Controlled by the inverter to be the optimum value. (future control of inverter)

- Temperature difference constant control
- Estimated terminal pressure control
- Flow rate (pressure) controlled by two-way valve to be controlled by inverter.
- Wet-bulb temperature presumption control
What is the optimum value control...

Further Energy Conservation of existing inverter controlled facilities

- Reduce the speed of the equipment
- Control the speed of the equipment
Temperature difference constant control

■ Temperature difference constant control for cold water pump ■

Control the cooling water pump so that the temperature difference between the cooling water outlet and inlet all times a constant.

Reduce the pump power to less than half.

In some cases, controls the temperature difference between the inlet and outlet constant in HVAC equipment. If become a temperature difference is constant and does not circulate the coolant more than necessary, can be performed to save energy by lowering the rotational speed of the motor.
Estimated terminal pressure control for cold (hot) water of secondary pump

When the cooling (heating) load is light; less discharge flow rate of the pump, convey the cold (hot) water by lowering the water pressure of the secondary pump as per proper value.

Convert the flow rate signal to the target pressure in the linearization function. (There is a method for inputting a data value of 3 points, and method of entering a formula.) Lower/ upper limit setting on the linearize output is also possible.