Green Factory EMS

based on Renewable Energy and Energy Efficiency

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LS IS

Contents

Case Study : LSIS Cheon-An Factory

1) Enforcement of energy management by objectives

- **Transglobal energy policies have focused on energy demand management rather than energy supply.**
  - To follow this international trend, Korean government announce a long-term strategy related to energy policies, and announced a plan of energy demand management in June 2009.
  - Through those national policies, energy policy paradigm is changing into energy demand management.

Motivation

- Pilot project of energy management by objectives ('09.11)
  - Subjects : 15 business fields, 47 factories (38 co mpanies)* (11.20)

- **The law of Green Growth Korea was enforced (' 10.04) the government appointed 374 organizat ions to implement energy management by obje ctives. ('10.09)**
  - **They consist of 167 companies which consu me energy usage more than 500TJ and emit 1 25,000tCO2 And 207 factories that consume m ore than 100TJ and emit 25,000tCO2.**

    → Those appointed organizations have appro ximately 58.2% CO2 emissions of the Korea, a nd 85.1% of the industrial companies.

- **Energy Management System (ISO 50001)**
  - **will be adopted by Korea Energy Management C orporation. (A, AA, AAA Rating)**
  - **In June 2011, international standards of EMS will be established**

For example) CO_2 emission & Energy Usage of factories in LS industrial systems

Factory	'07		'08		'09		Average	
	TCO_2	TOE	TCO_2	TOE	TCO_2	TOE	TCO_2	TOE
Cheon-an	7,587	1,904	10,458	2,094	7,864	2,437	8,636	2,145
Cheong-ju	17,186	8,436	16,490	8,095	15,772	7,741	16,483	8,091
SUM							25,119	10,236

1TJ ≒ 23.88TOE

Appointed Factory (2010) : ≥ 2,400TOE & TOE ≥ 25,000tCO_2

Appointed Company (2010) : ≥ 12,000TOE & TOE ≥ 125,000tCO_2

- **GHG·Energy management by objectives is the institution which set targets and manage energy usage, CO_2 emission of the appointed factories.**
  - 374 organizations which are appointed by Korean government must adhere to the goal for energy saving and GHG emission reduction.
- **To do this, it is essential to introduce Energy Management System.**
- **Since the criteria of GHG-Energy management by objectives is going to be lowered, then the appointed organizations will increase.**

	Usage (TJ)	GHG (tCO2)
Company	≥ 500	≥ 125000
Factory	≥ 100	≥ 25000

	Usage (TJ)	GHG (tCO2)
Company	≥ 350	≥ 87500
Factory	≥ 90	≥ 20000

	Usage (TJ)	GHG (tCO2)
Company	≥ 200	≥ 50000
Factory	≥ 80	≥ 15000

- **EMS (ISO 50001) will be enacted as international standards (ISO PC242)**
  - EMS is the method for increasing energy efficiency which is approved internationally and officially.
  - ISO PC242 is going to enact ISO 50001, it'll be finished in June 2011.
- **In Korea December 2007, KS A 4000 was enacted and Korea was performed EMS pilot certification on 14 large energy consumer companies.**

Energy Management System

- EMS is enterprise energy improvement activity which develop principals and goals related energy saving and m akes plans to implement.

Energy consumption monitoring

Metering System

power gas water hot

- Amount of electric used
- Amount of LNG used
- An output by item
- The amount of GHG

Integrated monitoring DB

Integrated moni toring system

Energy consumption analysis

- Construct Energy Map by each process, by each equipment, and by each energy source
- Point out main control factors relate d to energy efficiency
- Correlation analysis between energy usage and control factors (Using statistic method)
- Detect an important main control fac tor

Energy improvement activity

related to Energy Management ※PDCA

- Saving goal/ Setting project/practice
- Progress/ Performance management
- Analysis improvement effect
- Continuous management
- Improve energy saving and efficiency (saving cost)

※ PDCA : Plan Do Check Act

- **The objective of F-EMS is reducing the amount of energy usage and CO2 emission by managing energy efficiently.**
  - To achieve the objectives, quantification should be performed by monitoring and analyzing energy usage above all.

Step 3

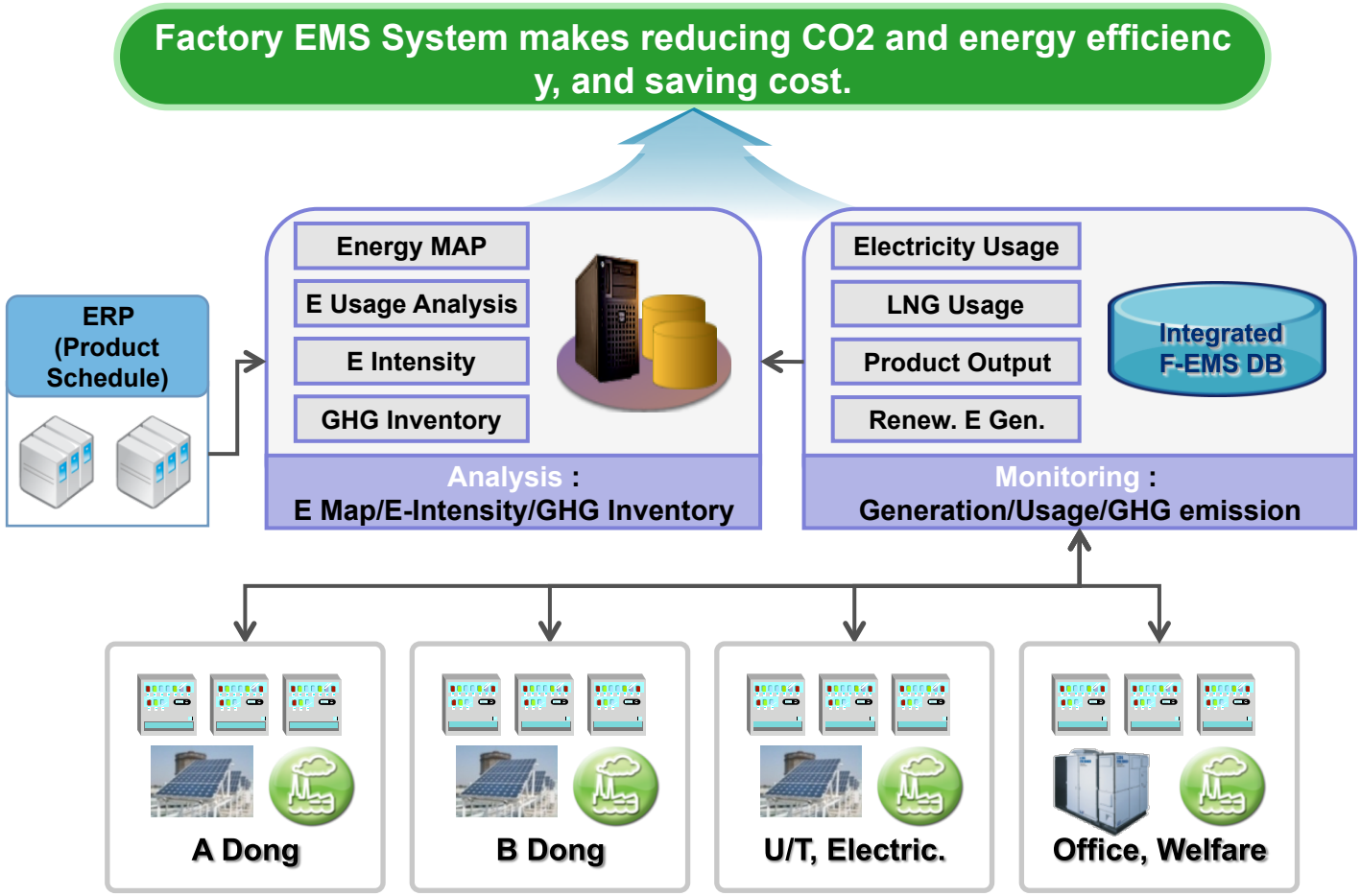
Improvement activity
- Construct Renewable E.
- Utilize analysis result
- Maximize energy saving

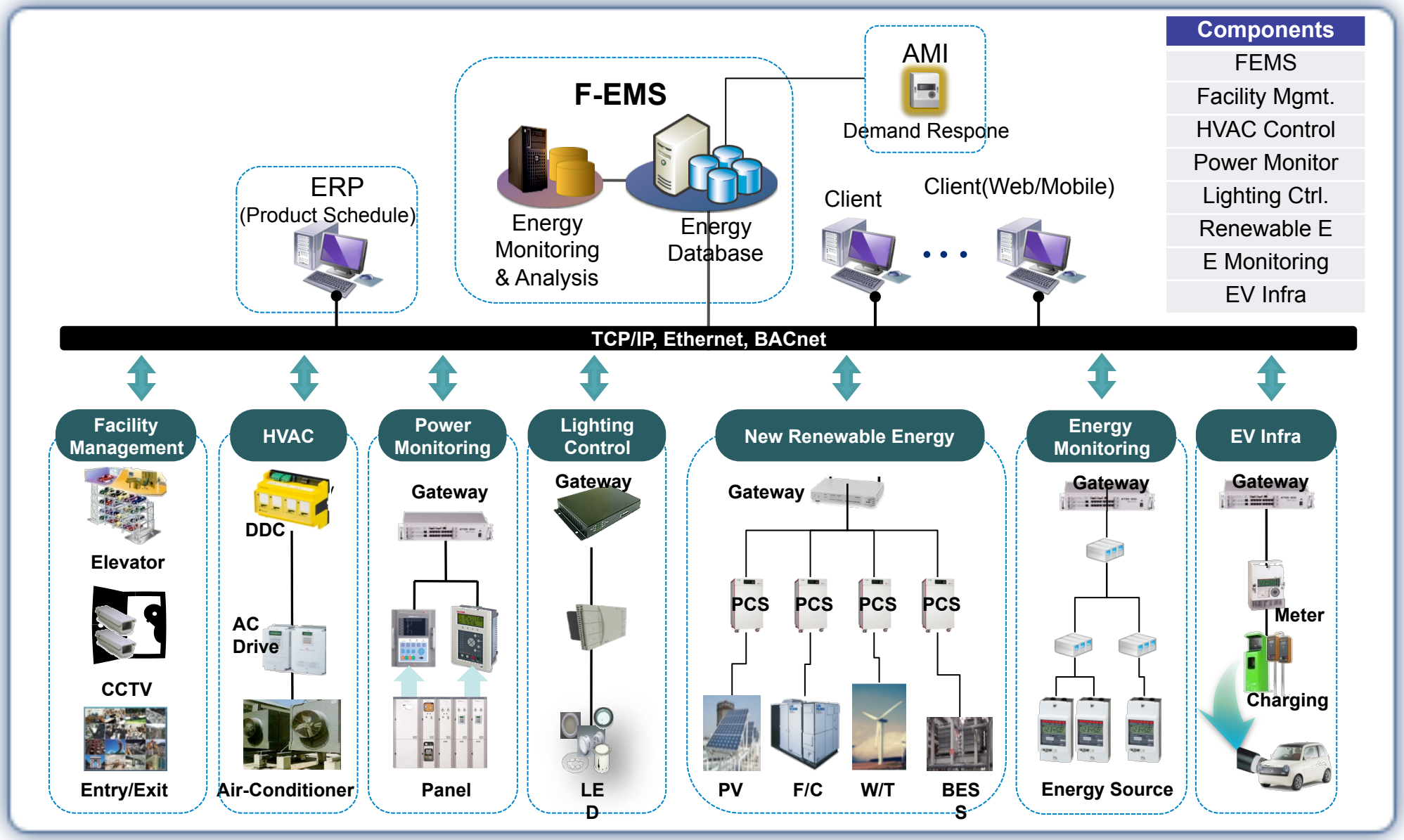
Step 2

Construct monitor & analyze system
- Check Energy Flow
- Time-series forecast
- Detect Control Factors

Step 1

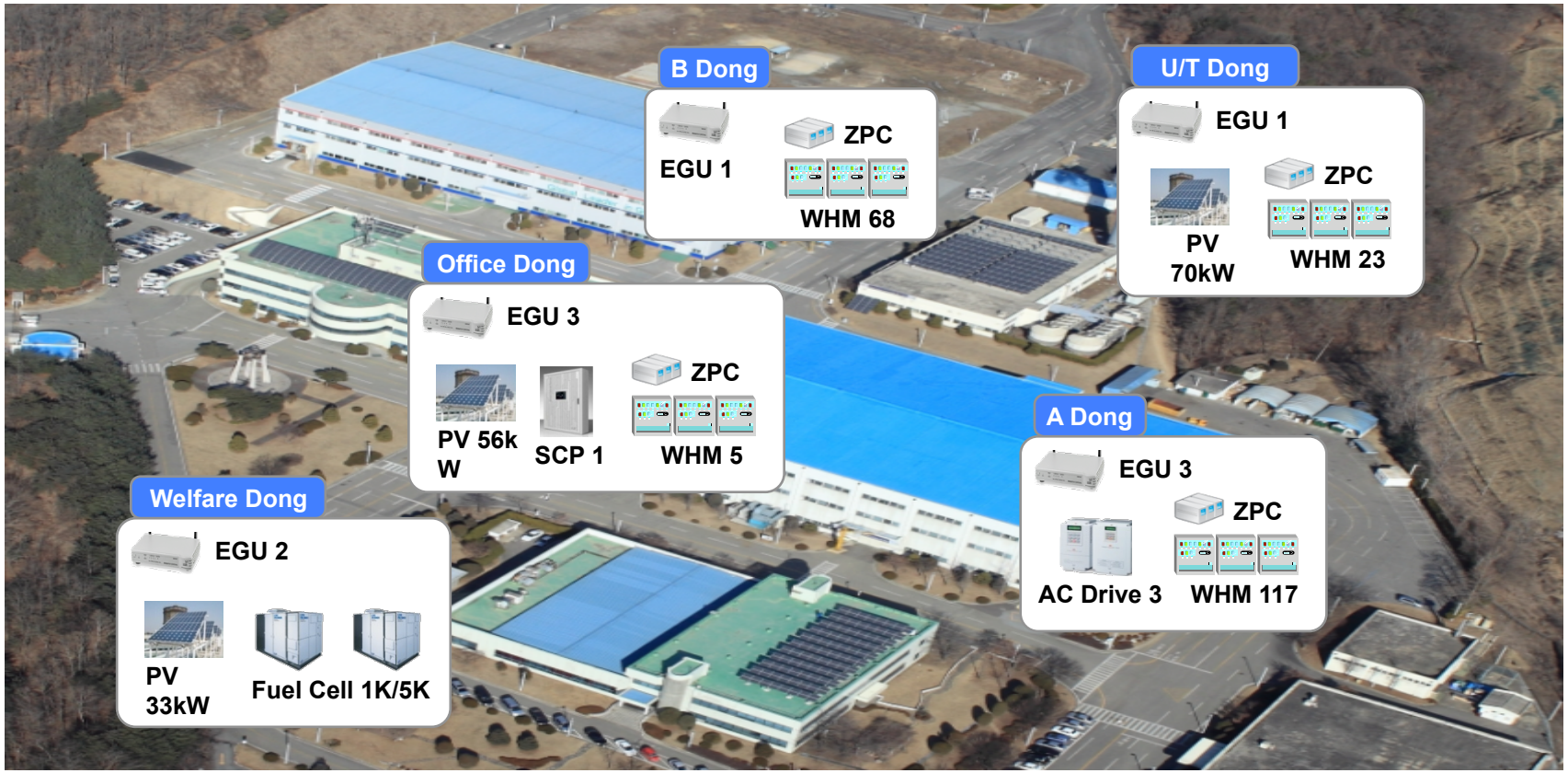
Energy Measuring Infra
- Investigate Site Measuring Level
- Survey Major Equip
- Install Measuring Sensor




Components
FEMS
Facility Mgmt.
HVAC Control
Power Monitor
Lighting Ctrl.
Renewable E
E Monitoring
EV Infra
AMI
Demand Respone
F-EMS
Energy Monitoring & Analysis
Energy Database
ERP
(Product Schedule)
Client
Client(Web/Mobile)
TCP/IP, Ethernet, BACnet
Facility Management
Elevator
CCTV
Entry/Exit
HVAC
DDC
AC Drive
Air-Conditioner
Power Monitoring
Gateway
Panel
Lighting Control
Gateway
LED
New Renewable Energy
Gateway
PCS
PCS
PCS
PCS
PV
F/C
W/T
BESS
Energy Monitoring
Gateway
Energy Source
EV Infra
Gateway
Meter
Charging

3) Case Study (LSIS Cheon-an factory)

- About 160kW photovoltaic generation modules are equipped, they can reduce 82 tons of CO2 per year.
- 3 Inverters have been installed to operate and control power efficiently.
- F/C was equipped as power & hot water source of VIP, employee restaurants, and welfare building.
- To monitor and analyze energy consumption of whole sites, 213 local sub meters based on power line technology have been equipped.



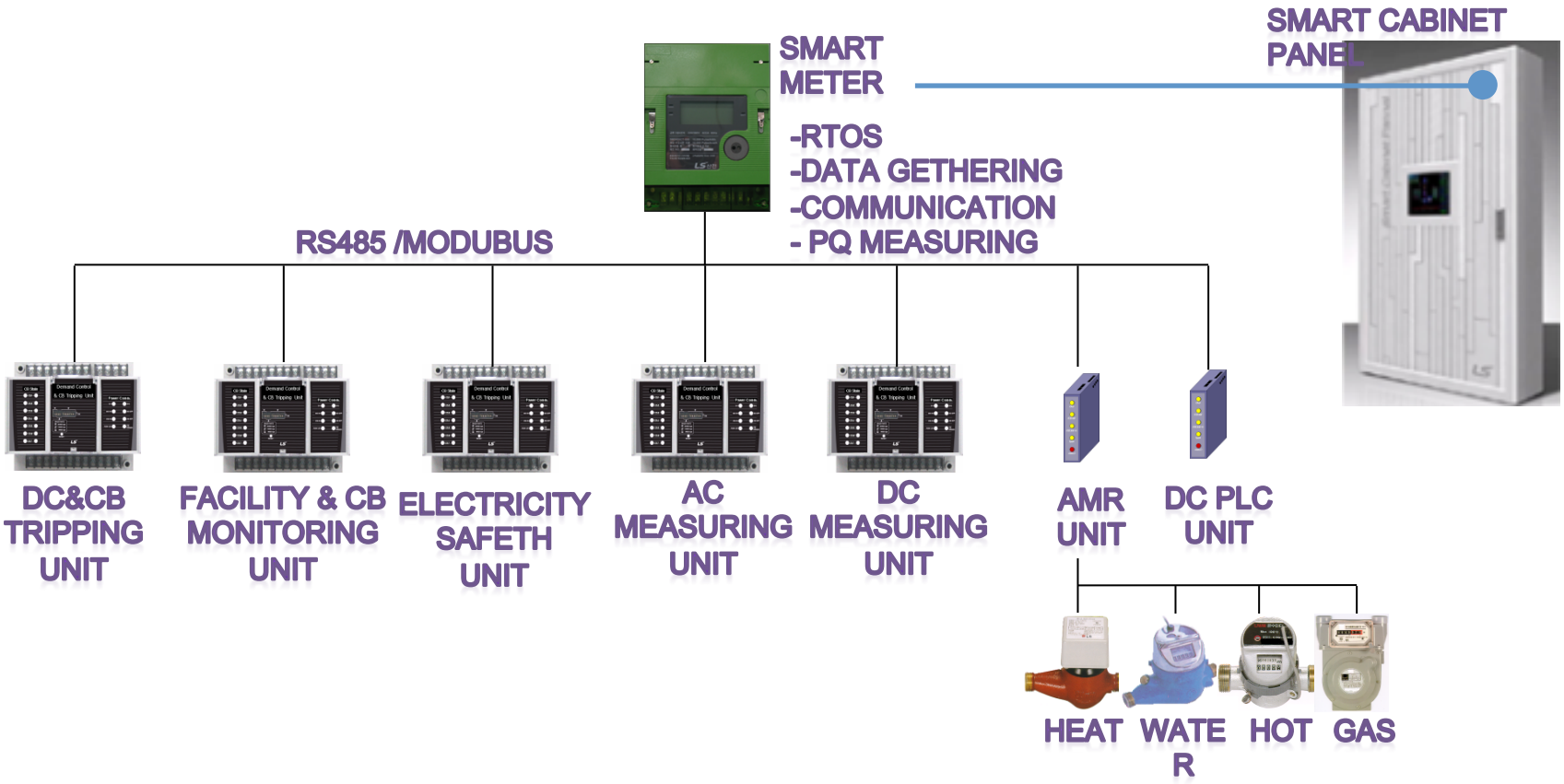
- **When we run the system, we can see the green energy generation status of the whole factory.**
  - By each building in the factory, display generated output a day, CO2 emission, also energy saving cost.
- **Linked with weather information**
  - Can see present temperature and weather information of the local factory.

- **This shows solar energy generation status among renewable energies.**
  - It displays the whole solar energy generation status and by each building current generating output, accumulat ed power generation, and energy saving cost.
- **displays inverter's information in detail (**inverter's fault information, inverter power and measuring value)

- **Shows current status of operating AC Drive**
  - By installing 3 inverters on the Clean-Room air-conditioner, we can control power efficiently.
- **displays inverter specifically which monitors reference frequency & current Frequency, output voltage/current, motor velocity.**

- **Smart cabinet panel real time monitoring display**
  - Smart cabinet panel contains total energy information device that can monitor and analyze power quality, electricity safety monitoring, facility monitoring, demand control, and automatic meter reading, and so on.

- **Smart Cabinet Panel (SCP) is composed of**
  - Smart Meter, DC & CB Tripping Unit, Facility & CB Monitoring Unit, Electricity Safety Unit, AC Measuring Unit, DC Measuring Unit, AMR Unit, DC PLC Unit.



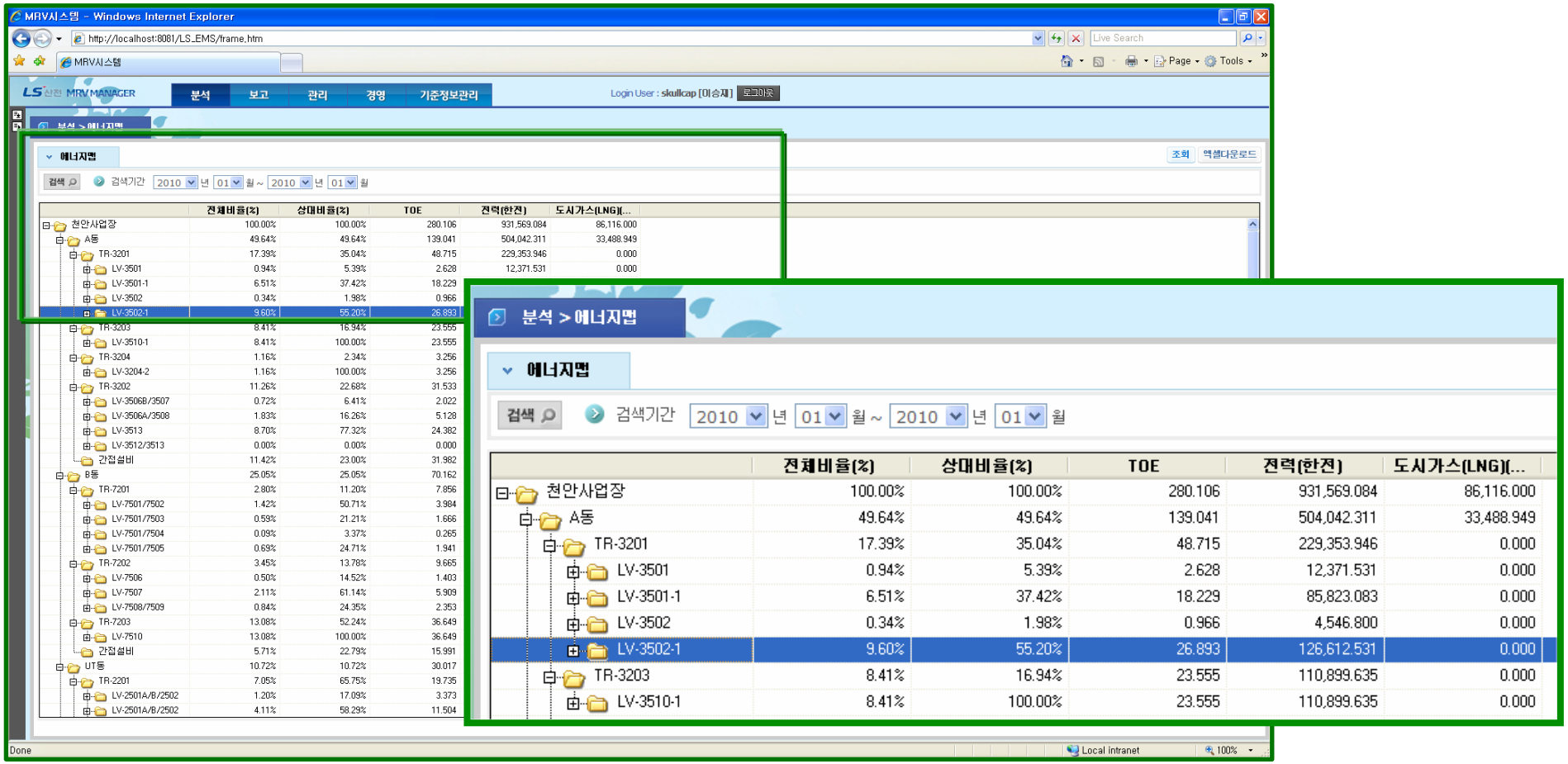
5) Monitoring energy usage/CO_2 emission

- **shows energy usage amount, CO_2 emission, energy source status, and amount of production by each building and by whole factory**
  - By this, we can understand easily differences of the whole factory's energy usage and CO2 emission between today and yesterday, and between last month and this month.

6) Monitoring energy usage and co_2 emission by each floor

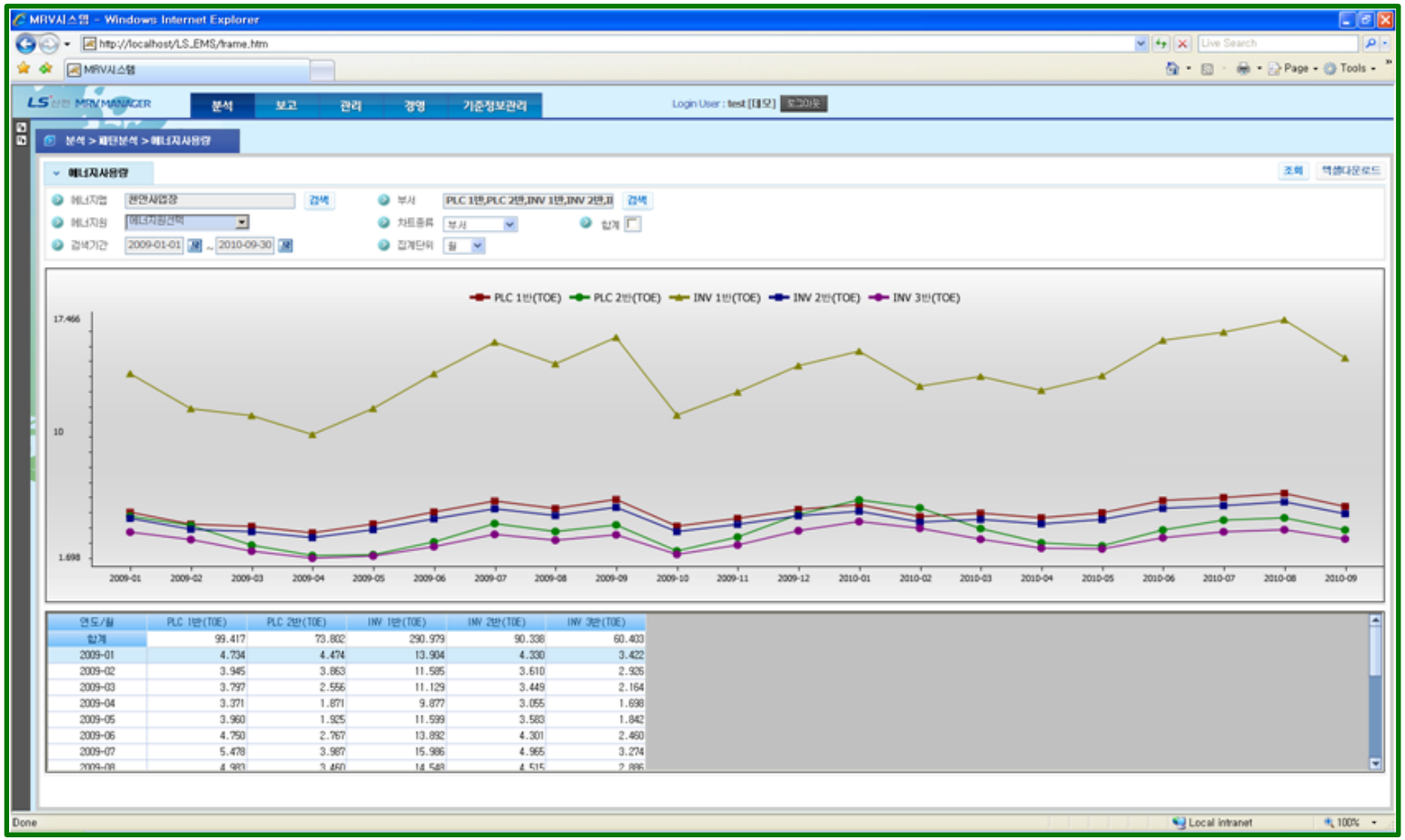
- **Displaying energy usage, production outputs and co_2 emission by each floor.**
  - By this, we can understand easily differences energy usage and CO2 emission between today and yesterday by each floor in a building.
  - It also provides energy usage trend for 7 days and current state of usage by each energy source.

- **See the whole energy flow based on local sensors, and review individual energy usage of the factory.**
  - displays partly energy usage amounts based on tree-formation energy map by the whole ratio, by relative ratio , by TOE.
  - Can see the whole energy usage information, at a glance.



8) Energy usage pattern analysis by each department

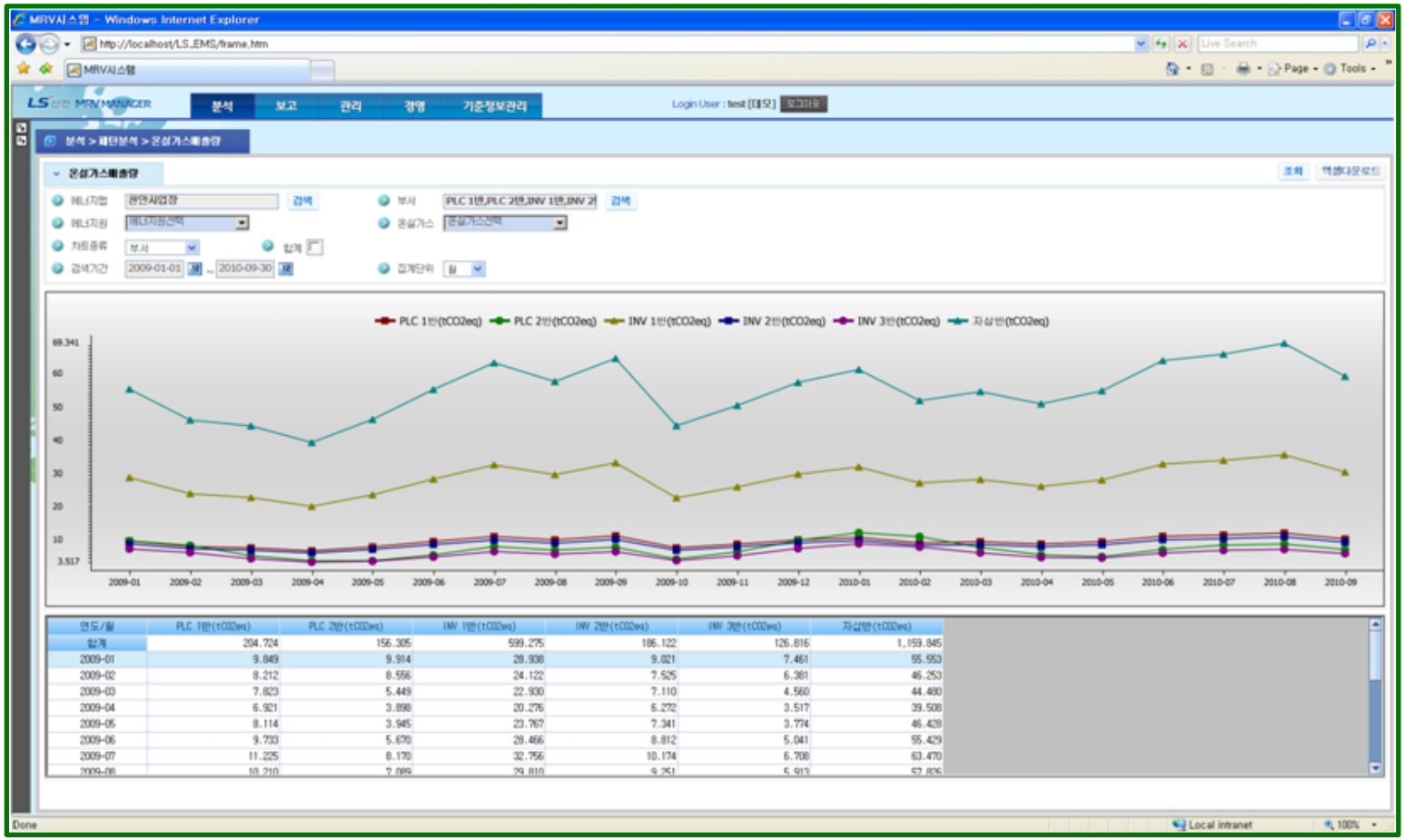
- **This display can check energy usage trend by conditions in detail. For example, energy map, energy sou rce and department,**
  - And, we can check by each year, by each month, and by each day.
  - Furthermore, can compare above things by each condition.



연도/월	PLC 1반(TOE)	PLC 2반(TOE)	INV 1반(TOE)	INV 2반(TOE)	INV 3반(TOE)
합계	99.417	73.802	290.979	90.338	60.403
2009-01	4.734	4.474	13.904	4.330	3.422
2009-02	3.945	3.863	11.585	3.610	2.926
2009-03	3.797	2.556	11.129	3.449	2.164
2009-04	3.371	1.871	9.877	3.055	1.698
2009-05	3.960	1.925	11.599	3.583	1.842
2009-06	4.750	2.767	13.892	4.301	2.460
2009-07	5.478	3.987	15.986	4.965	3.274
2009-08	4.983	3.460	14.548	4.515	2.886

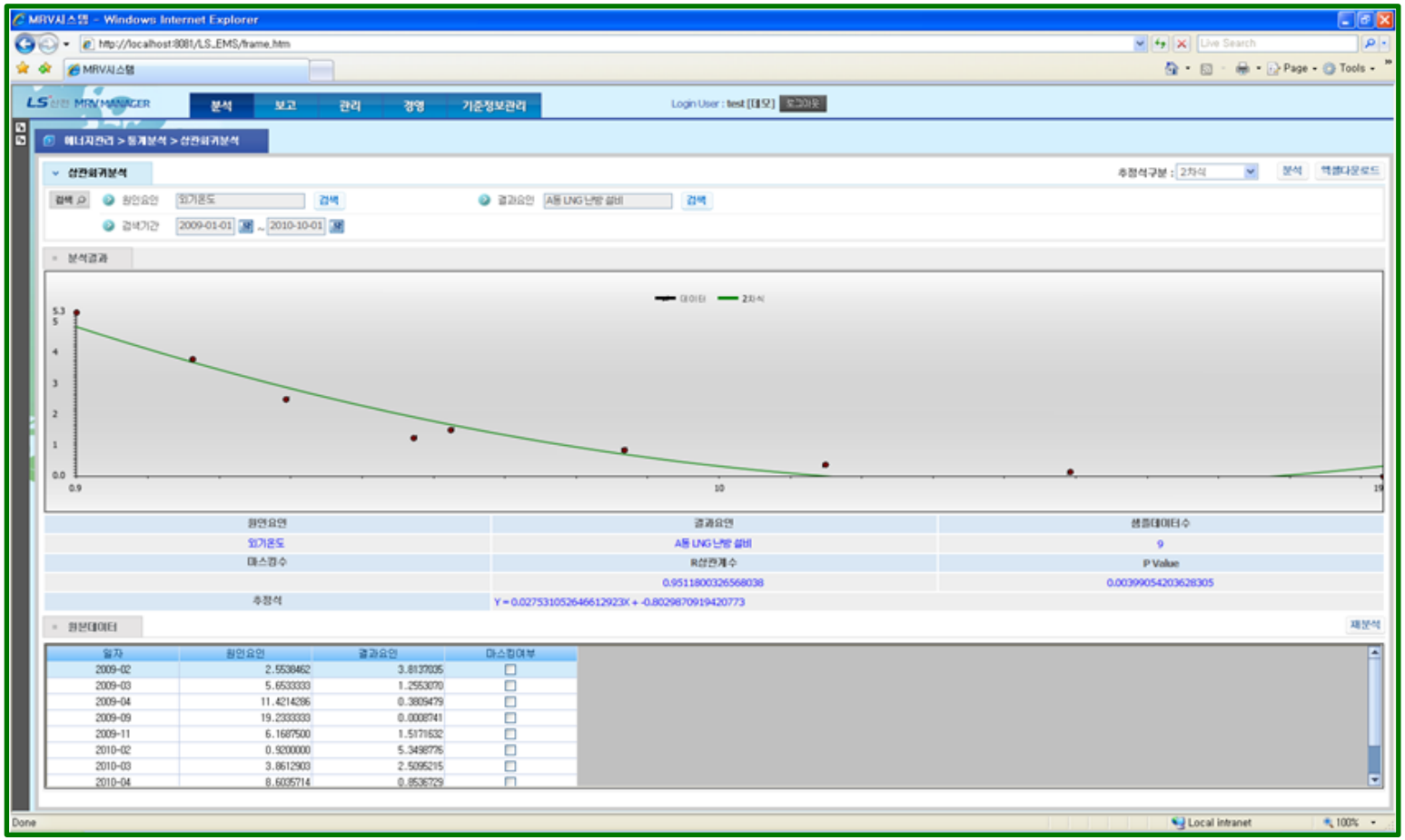
9) GHG pattern analysis by each department

- **It is possible that you can check green house gas emission trend by each department, by energy map, a nd by energy source, etc.**
  - We can check by each year, by each times.
  - Furthermore, we can compare those things by the condition.

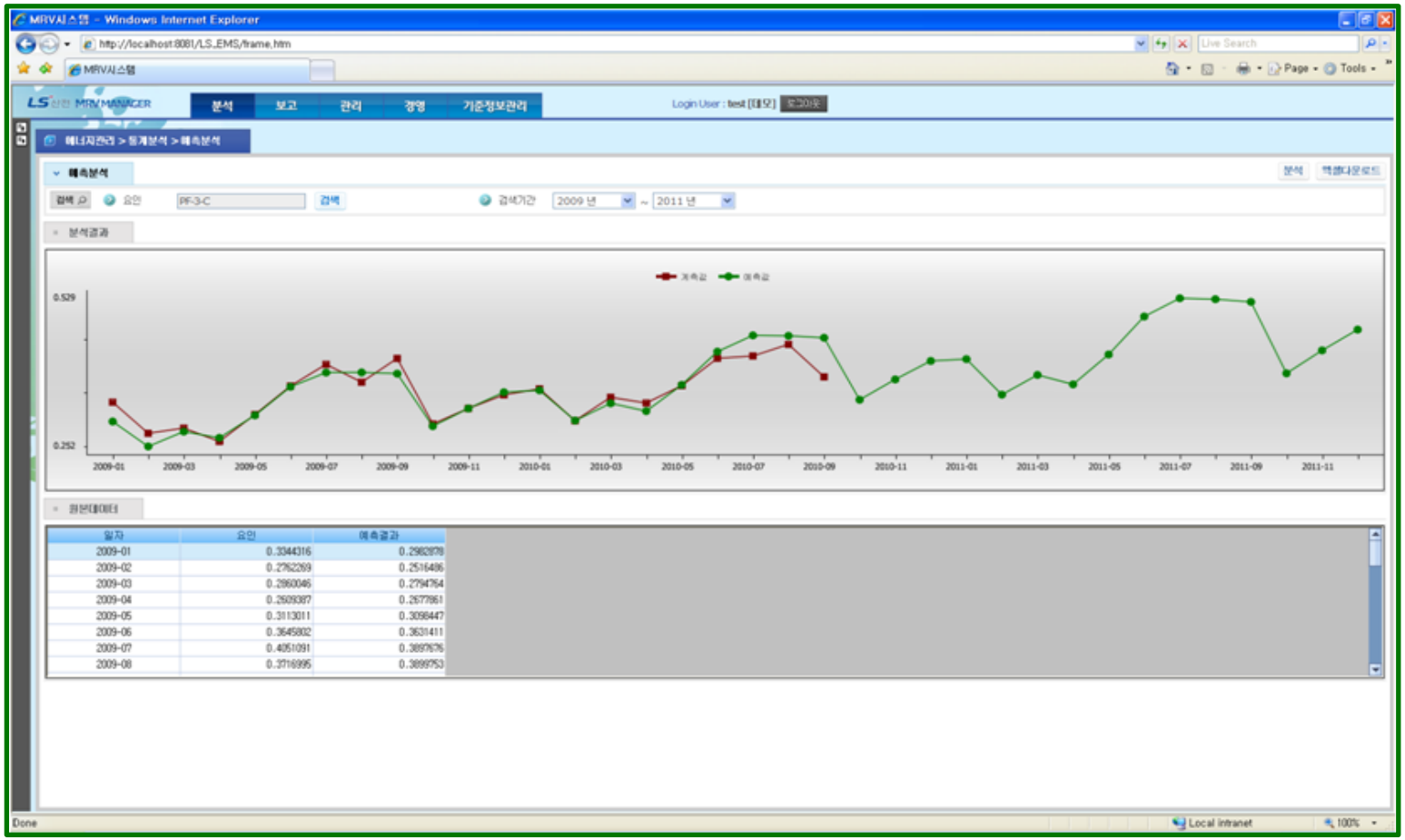


Correlation regression analysis

- It investigates cause factor which influences major effect factor by using correlation regression analysis.
- It is possible that the degree of correlation between cause and effect factor can be expressed as quantity.

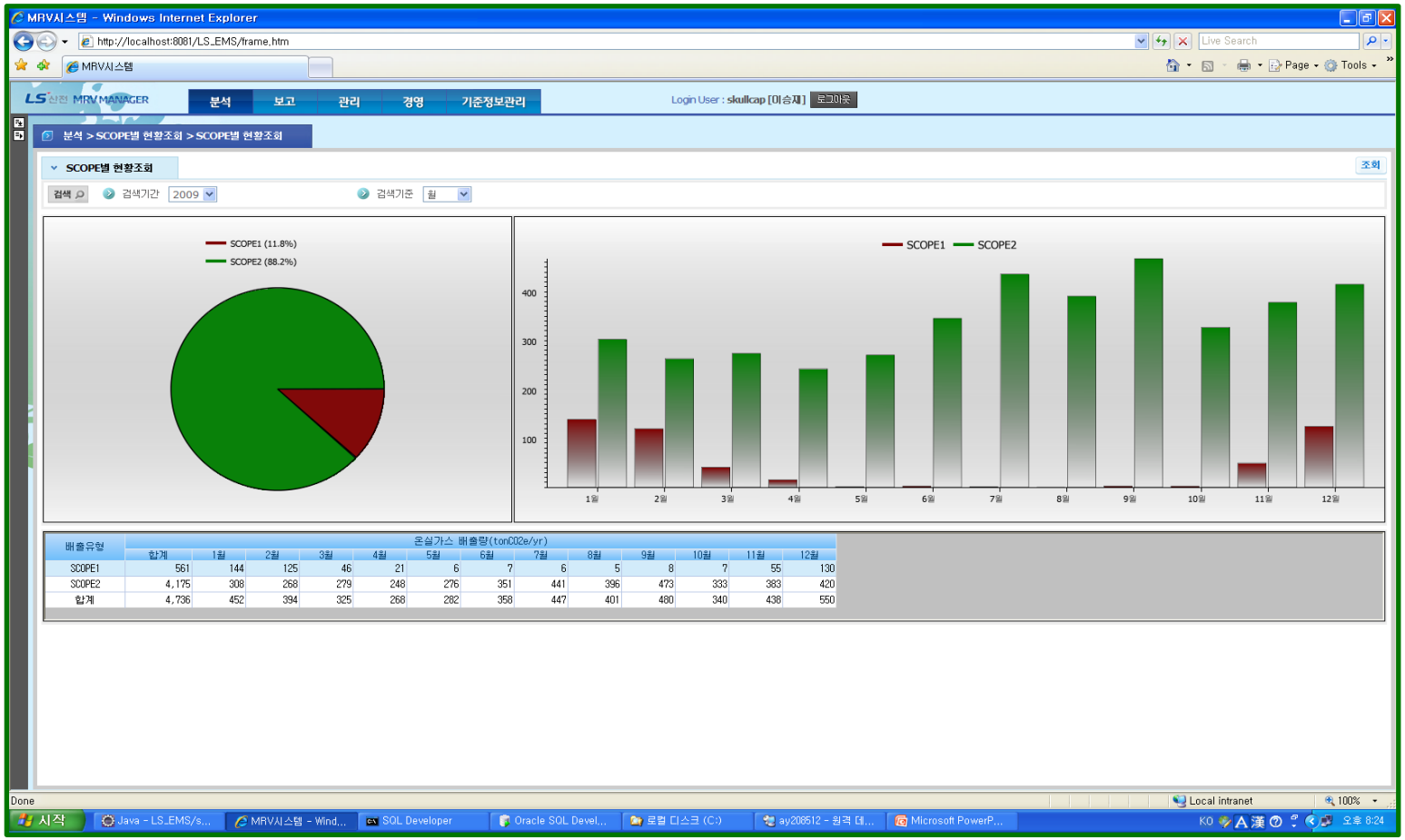


- **Energy Usage Forecast Analysis**
  - Energy usage forecast analysis method is statistic method to forecast based on the past data.
  - Monthly forecasting output is presented and we can compare real value with forecast to verify.
  - This graph shows forecast data as green line and real value as brown line.



12) Current status of GHG emission by SCOPE

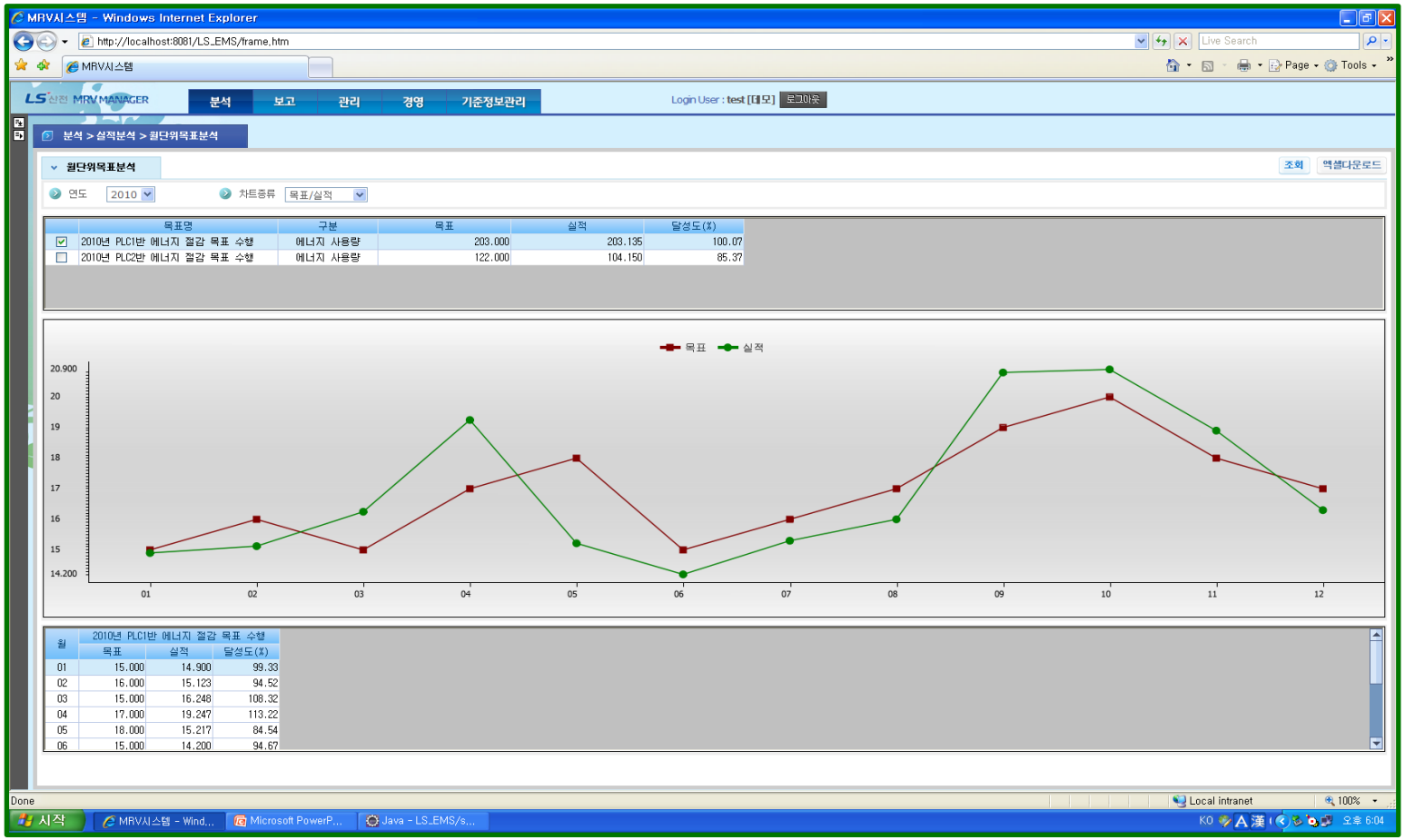
- **GHG emission can be grouped into Scope1 and Scope 2 and we can check them by each scope.**
  - GHG emission consists of direct emission which is generated when people do some activities, and indirect em ission which is made by using electric generated from others.
  - Like chart below, Cheon-an factory has 88% indirect emission and 12% direct emission.



배출유형	온실가스 배출량(tonCO2e/yr)												
	합계	1월	2월	3월	4월	5월	6월	7월	8월	9월	10월	11월	12월
SCOPE1	561	144	125	46	21	6	7	6	5	8	7	55	130
SCOPE2	4,175	308	268	279	248	276	351	441	396	473	333	383	420
합계	4,736	452	394	325	268	282	358	447	401	480	340	438	550

13) Energy reduction comparison analysis display

- **We can compare factory's performance with government goal by performing constrained GHG/energy m anagement, by each month and by each year.**
  - Compare each department's performance through degree of achievement (%) of their goals.
  - Brown line is target line, green line is result line.



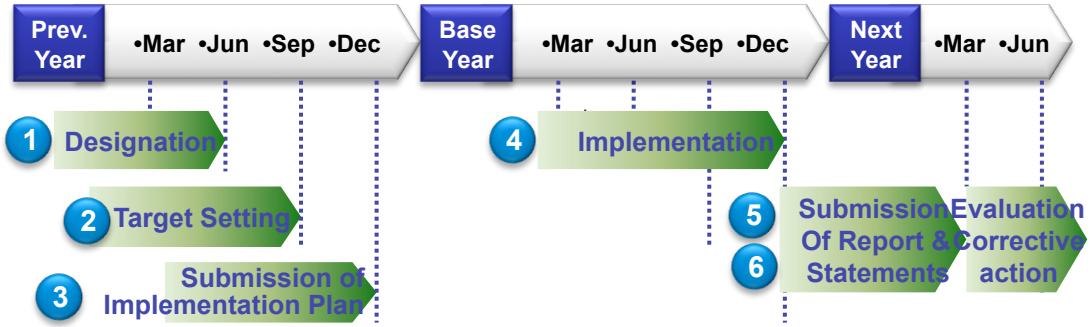
- **Provides mobile service based on Smart Phone**
  - can monitor efficiency of each green energy generation in the cheon-an factory through android phone.
  - is possible to compare generation capacity of renewable energy with current generation output.
  - can monitor CO2 emission amount and energy saving cost by renewable energy.
  - In addition, we monitor detail information of inverter for AC Drive and Smart Cabinet Panel.

PV Fuel Cell SCP AC Drive Smart Meter

- As you know, constrained energy management is official institutions for reducing CO2 and saving energy efficien tly in large factories.
- As I said before, 374 organizations which are appointed by Korean government must have the energy saving go al and comply with them. To do this, it is essential to introduce Energy Management System.

PROCESS

Milestones



Target Company/Factory

	Usage (TJ)	GHG (tCO2)
Company	≥ 500	≥ 125000
Factory	≥ 100	≥ 25000

	Usage (TJ)	GHG (tCO2)
Company	≥ 350	≥ 87500
Factory	≥ 90	≥ 20000

	Usage (TJ)	GHG (tCO2)
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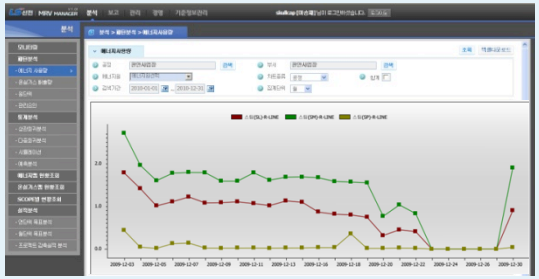
F-EMS

1 2 Designation/Target Setting



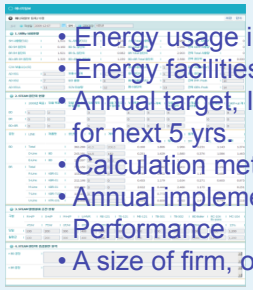
Time series Analysis → Forecasting Design ated year and Target Value

4 Implementation

항목	당월	전월	08년 11월	단위
에너지사용량	2,600	10,600	10,600	TOE
CO2 배출량	120	520	520	TonCO2
제품생산량	1,200	1,100	1,100	Ton
제품물량 에너지원단위	4	14	14	TOE/Ton
에너지비용	12,000	56,000	56,000	천원
에너지비용 원단위	100	600	600	TOE/천원
매출액	12,000	10,000	10,000	천원
부가가치 에너지원단위	100	100	100	TOE/천원

Implementation performance of Reduction targe t in Real-time monitoring

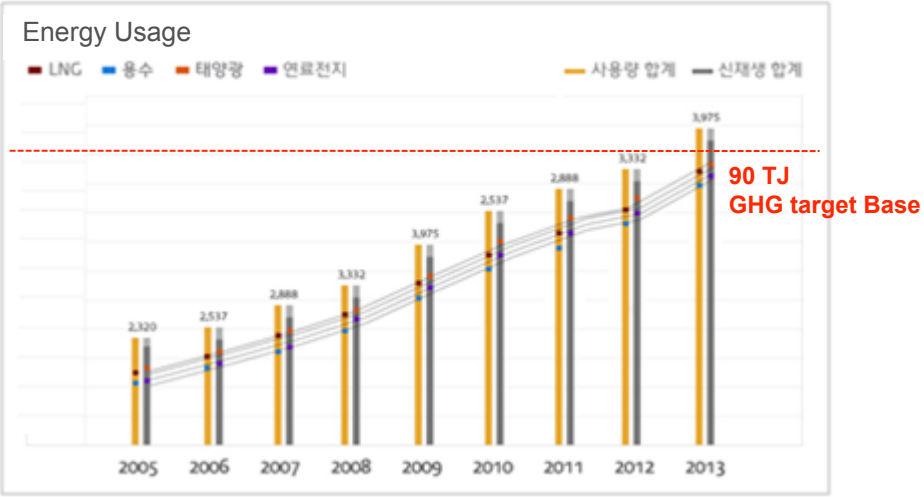
3 5 6 Submissions



- Energy usage in business sites
- Energy facilities, Emission sources list
- Annual target, Implementation plan for next 5 yrs.
- Calculation method/ Monitoring method
- Annual implementation/Reduction Performance
- A size of firm, output etc. statement

Report/Print Monitoring results

- **Our F-EMS helps setting energy saving strategy by monitoring and analyzing energy consumption, and can take an early action for the government policy.**



F-EMS current situation analysis → GHG target management system strategy establishment

[Assumption] 2012 year Cheon-an Factory

- For 3 yrs.('09~'11yr.) Average energy usage 90TJ excess
- For 3 yrs.('09~'11yr.) Average GHG quantity of emission 20,000 TCO_2 excess

2013 year GHG reduction target setting and performance reporting target

Energy usage and GHG quantity of emission reduction strategy establishment

- renewable energy development and expand an application
- Production department energy reduction KPI enforcement
- Electricity supply efficiency improvement project development
- Steam supply efficiency improvement project development
- Green Factory item development

- **KS A 4000 (EMS) was announced in December, 2007, was verified by certification pre-test from 2008 to 2010. It will be implemented with international standards ISO50001_EnMS from June 2011.**
  - EMS certification system gives certificate by evaluating current state of EMS construction and energy saving performance.

STANDARD

KS A 4000

- P: • Management Responsibilities Energy management planning
- D: • Implementation & Operation
- C: • Checking and Evaluation
- A: • Management review

1. Energy intensity(KPI) decrease (2~4 percent compared with the pre yrs.)
2. Energy saving by project performance (2~4% percent of the whole business usage)
3. performance of purchasing high energy efficiency and low energy consumption equip. (Purchasing performance 50~90percent)

F-EMS

1. Target → Project → Performance Mgmt. : PDCA establishment
2. Energy aspect analysis : Energy map/Main facility
3. Equipment list & management : Management tool of Energy supply/Using facility
4. Management of Documents/records/regulations : policy/manual/procedure document supply
5. Management of evaluation requirement: Verification checklist

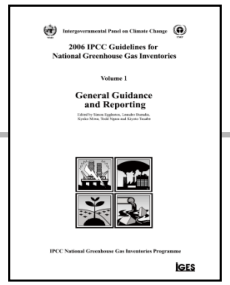
[F-EMS monitoring sector]
- factory energy consumption
- facility energy consumption
- Energy intensity
- GHG emission by Mon./Yr.

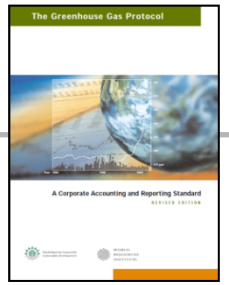
EMS grade evaluation: evaluation score above 85% : AAA (The best), evaluation score above 70% : AA (Excellent), Standard Satisfaction : A (Normal)

- It defines greenhouse gas emission sources and makes a list. To do this, we need to set organization and operation boundary, also, develop gathering form of GHG data.
- We calculate the amount of GHG emission by considering energy usage and emission factors.

PROCESS

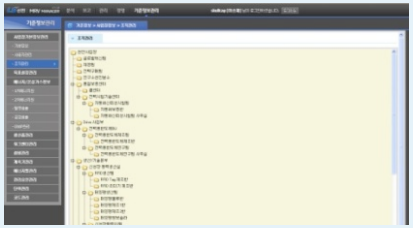
1. Setting Organization & Operation boundary
2. Definition of Energy Flow
3. Definition of Greenhouse Gas Emission Sources & list
4. Developing Gathering Form of GHG Data & Emission Factor
5. Data Gathering & Emissions Calculation
6. Development of Inventory QA/QC
7. Supporting Internal Audit & Verification
8. Preparing Greenhouse Gas Inventory Report





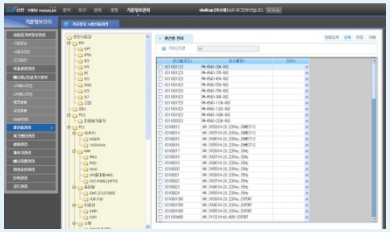
F-EMS

1 Setting/ Management of Organization & Boundary



4 Management of Emission Factor & Methodology

2 3 Greenhouse Gas Emission Sources & list



5 Calculation of Greenhouse Gas Emission

- Establishment of High Level Greenhouse Gas Inventory
- Obtaining Inventory Verification

Thank you for your attention.