Energy & Greenhouse Gas Management System in Refineries

Oct. 19th 2011

Chon, Son-Gyu (全宣奎 部長)

Energy Management Team

GS Caltex Corporation

Contents

Part Ⅰ: Business Environment

1. Global Green Growth Policy
2. Greenhouse Gas Management Plan in Korea
3. Cleaner Fuel Requirements

I -1. Global Green Growth Policy

- **Increase in global energy demand and necessity for responding climate change escalate the need for sustainable development through green growth.**
- **Major countries set green growth policies such as efficient energy consumption, building low carbon society and green job creation.**

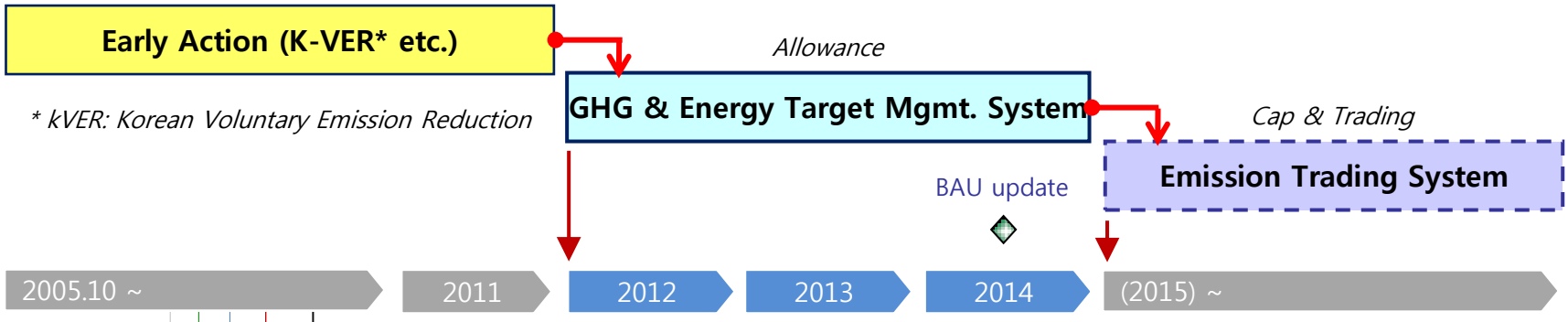
Global Green Growth Policies

EU	▷ Lead 'Market' Initiative - Financial Market & Carbon Trading - Carbon Tax, Non-tariff Barrier - Energy Management System (EN16001, ISO50001)
U.S.A.	▷ Regulation : (EPA*) Mandatory Reporting of Greenhouse Gases Rule - Facilities with 25kTon GHG or more to submit annual reports to EPA ▷ Green Jobs : (DOE**) - Invest $150 billion for 10 years to create 5 million green jobs
China	▷ Promote New & Renewable Energy Industry - Invest $74 billion for 10 years to promote new & renewable energy

** EPA : Environment Protection Agency ** DOE : Department of Energy*

I -2. GHG Management Plan in Korea

❑ 'Green Growth' as a new growth paradigm in Korea



- (Aug. '08) New National Vision 'Low Carbon Green Growth'
- (Feb. '09) Established 'Presidential Committee on Green Growth'
- (Jul. '09) Announced 'National Strategy for Green Growth'
- (Dec. '09) Legislated 'The Framework Law on Low Carbon, Green Growth'
  : Targeting 30% reduction from the 'BAU' scenario by 2020
- (Jul. '10) Launched 'Global Green Growth Institute'

▷ **New Policy**
- 'GHG & Energy Target Management System'(2012~), 'Emission Trading Scheme'(2015~)
- Renewable Portfolio Standard (RPS, 2012~) and Renewable Fuel Standard (RFS, on the table)

▷ **Promote Green Industries**
- Invest $ 83.6 billion into green sectors for the next 5 years (2% of GDP)

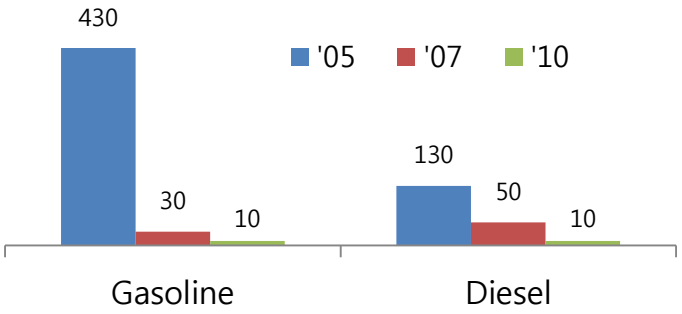
I -3. Cleaner Fuel Requirements

❑ World class fuel specification sharpens the competitiveness in exports

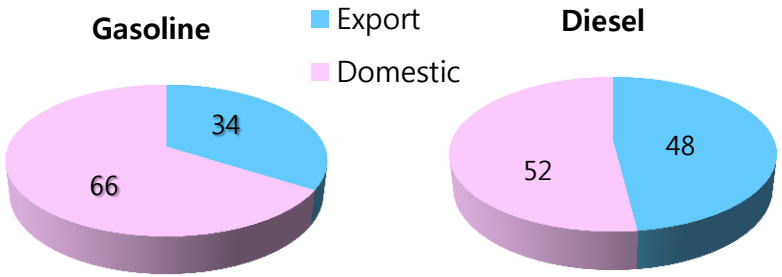
▷ Korea is taking the lead of fuel specification

▷ It helps the competitiveness in exports of Korean refiners

Sulfur Specification in Korea (ppm)



Product Distribution (GS Caltex, 2010)



❑ Meanwhile, it bears fixed & variable cost & GHG increase of refineries

▷ For Cleaner Fuel Production, Refiners should bear fixed and variable cost

- Fixed Cost : Hydro-treating units
- Variable Cost : Hydrogen Consumption (about 100 million USD for 50,000 NM3/hr)

▷ Also, GHG emission surges (about 500kTCO2e from 50,000 NM3/hr hydrogen plant)

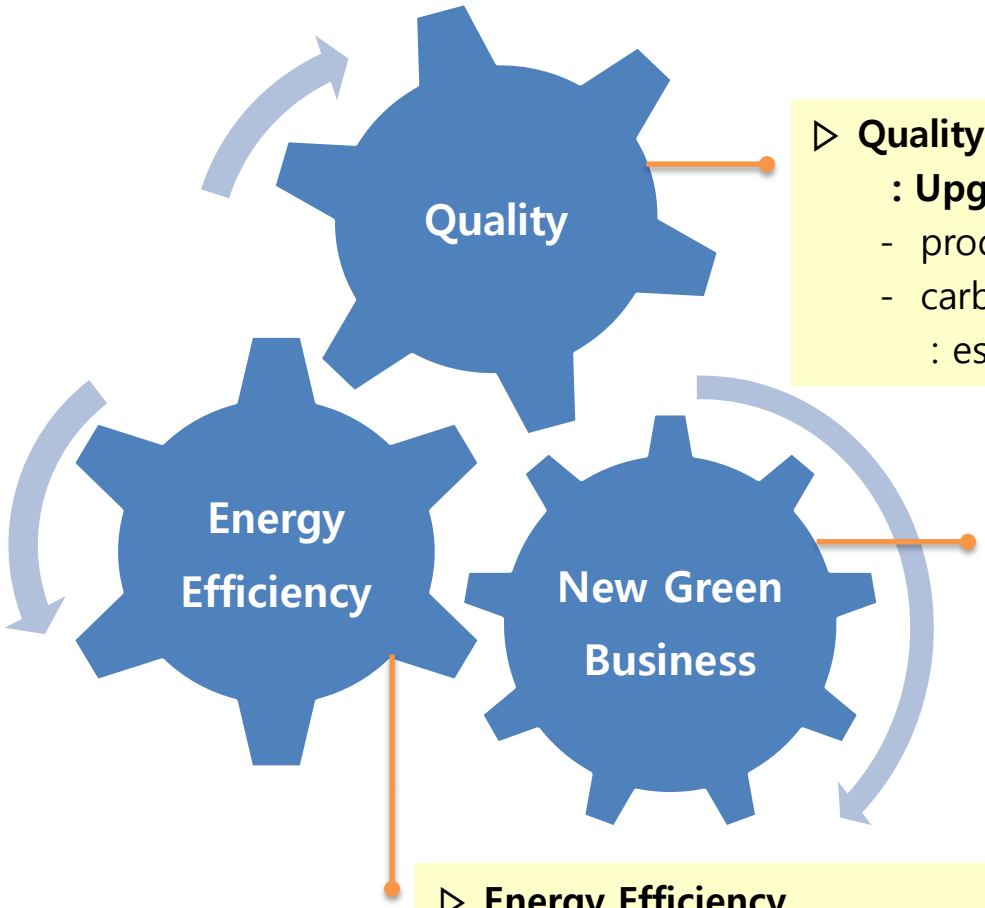
- Hydrogen Plant is one of the heaviest GHG sources (20~50% of refinery GHG production)

Part Ⅱ : Green Growth Strategy of GS Caltex

1. Quality - Upgrading & Greening
2. New Green Business Development
3. Energy Efficient Refinery

II-1. Green Growth in GS Caltex

❑ Green Growth in GS Caltex has been evolved into three categories



▷ **Quality of product & workplace**
: Upgrading & Greening
- produce greener fuel product from upgrading units
- carbon footprint management
: establish safe & reliable facilities

▷ **New Green Business Development**
- develop green material & device
- develop green energy solutions

▷ **Energy Efficiency**
- establish energy efficient complex (smart energy user)
- active energy saving and GHG reduction activities

II-2.1 Quality - Upgrading & Greening

❑ Upgrading Facilities produce greener products from heavy oils

▷ large-scale investments in order to take the lead in the green market.

▷ No. 3 heavy oil upgrade unit (VR-HCR) started commercial operations in December 2010 and No. 4 HOU (VGO-FCC) is to be completed by 2013.

Upgrading

▷ 'Heavy Oil Upgrading Units' (FCC, HCR, VR-HCR, VGO-FCC ('13))
- enhance cleaner fuel production
- boost local economy and create jobs

▷ Global refinery upgrading capacity ; % of distillation capa.

.

Capacity, Thousand bpcd	Installed 2010	Additions 2011~2015	Forecast 2016
Crude distillation	93,100	8,175	101,275
Upgrading	32,543	6,339	38,882
%	35%	78%	38%

Source : IEA and Muse, Stancil & Co.

❑ Greening, - 'Carbon Footprint Management'

▷ Total Green Facilities encompassing 'workplace', 'service station' and 'society'

Greening

▷ Remediation of contaminated soil
▷ HSE Program
▷ ODA (official development assistance)
▷ VOC[1] recovery / TMS[2] / LDAR[3]
▷ CSR[4] through GSC Foundation

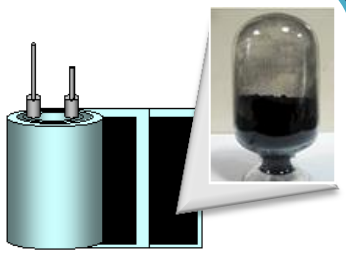
1) VOC: Volatile Organic Compound, 2) TMS: Tele-Monitoring System, 3) LDAR: Leak Detection And Repair, 4) CSR: Corporate Social Responsibility

II-2.2 New Green Business Development (1/2): Energy material device

❑ **With multi-faceted R&D activities, GS Caltex engages in such businesses as core materials of rechargeable battery and thin-film battery**

▷ To cope with possible EV market expansion, technologies for efficient energy storage should be closely monitored and explored ; global high-efficient-battery market will grow 30% per annum.

Energy material device business | Eco-friendly energy solution business

Anode & Cathode Material (for LIB[1]))	Carbon Material (for EDLC[2]))	Thin film battery	Fuel Cell
			
▪ Cathode : 2kTon/yr (under construction) ▪ Anode : 1kTon/yr (under construction)	▪ 300Ton/yr Plant (running) ▪ Scheduled to increase capa.	▪ 700K cell/yr. (running)	▪ Green-home Project

1) Lithium Ion Battery, 2) Electric Double Layer Capacitor

II-2.2 New Green Business Development (2/2): Energy solution

❑ Also, GS Caltex is focusing on eco-friendly energy solutions

Energy material device business | **Eco-friendly energy solution business**

Waste to Energy

- 100 ton/day unit (contract)

Rare Metal Recovery

- From used catalyst
- 20kTon/yr. Capa.

Bio-Diesel

- 100kTon/yr Unit is running

Others

- Sulfur Polymer Concrete
- Photovoltaic energy
- Rare Metal Mining
  - Lithium

II-2.3 Energy Efficient Refinery

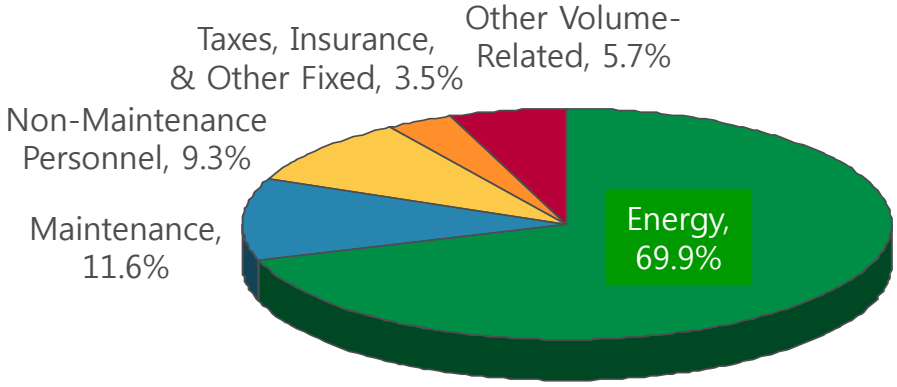
❑ From Performance Indices, Energy Efficiency & Operation Availability Come First

Profitability Index = Function { Energy Efficiency (EII), Operational Availability (OA), etc.. }

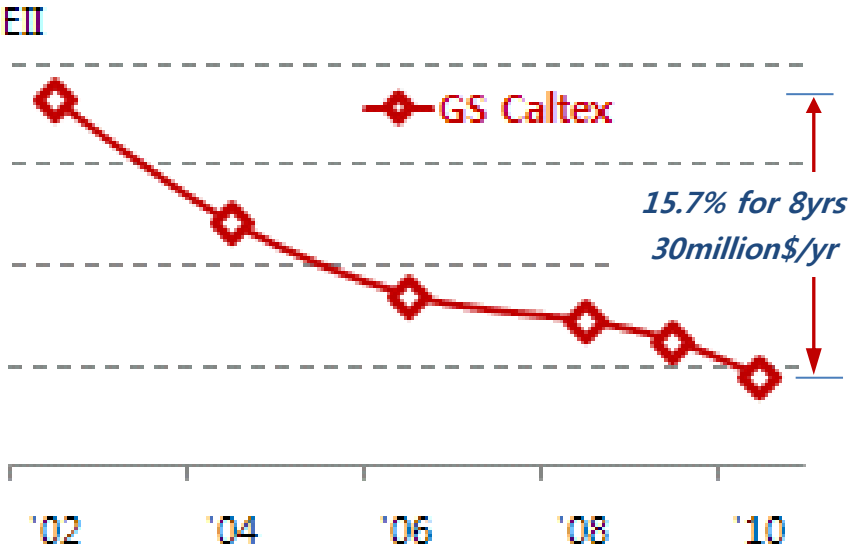
** Energy Intensity Index (EII) = % of Actual Energy / Standard Energy, The Lower, The More Efficient*
** Return on asset (ROA) = Profit to Sales Ratio (function of EII) × Asset Turnover (function of OA)*

❑ GS Caltex is deploying consistent effort to achieve better energy efficiency

▷ Energy cost is the dominant factor → Energy management is the core for 'viability of refineries'
▷ GS Caltex has been achieving about 2 folds of average refineries' EII improvement for a decade



Source : 2008 Solomon Study - Asia/Pacific



Part Ⅲ : Energy & GHG Management System in GS Caltex

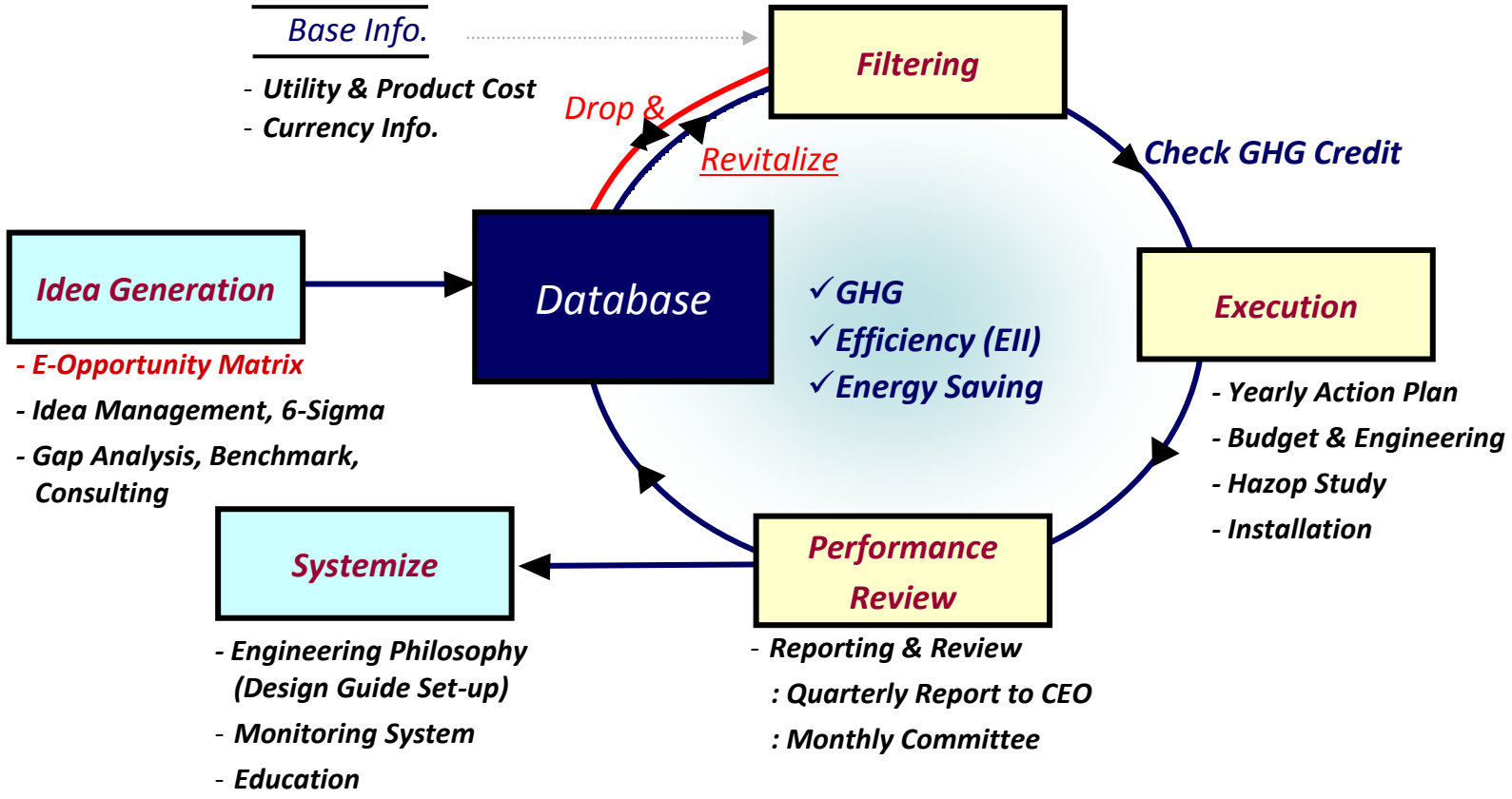
Ⅲ-1. Commitment & Culture

❑ Strong Commitment, Management System and Culture

▷ Performing regular performance review based on strong commitment

▷ Energy cost or GHG reduction ideas should be centralized (database) and reviewed regularly

E-Database Mgmt. Cycle



Ⅲ-2. Centralized Activities & Consistent Implementation

❑ **Established core energy teams to centralize energy & GHG related activities for the following reasons**

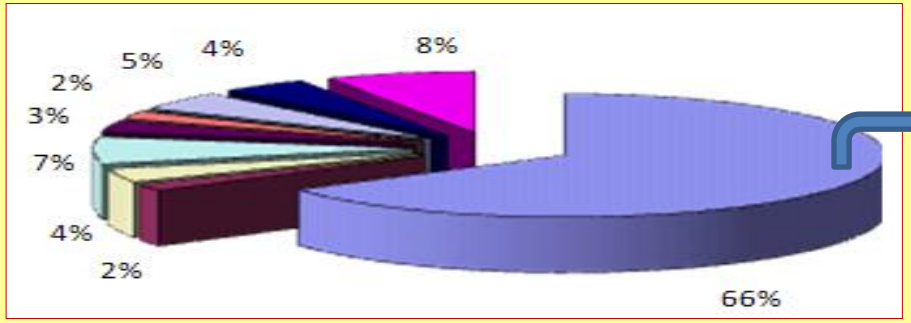
- ▷ Proactive management
- ▷ Top down approach for a bigger impact
  : some energy items become tangible only when we deploy centralized activities
- ▷ Expertise cultivation
- ▷ Change management (to overcome internal inertia)

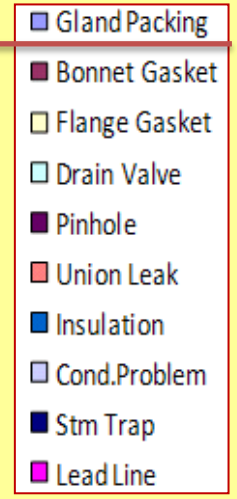
Examples ;
- Furnace Optimization
- Stripping Steam Control
- Reflux Optimization
- Heat Exchanger Fouling
- Maximize Hot Feed, etc…

❑ **It's all about 'consistent implementation'**

- ▷ Most items are kind of 'hard work rather than rocket science'

Example : Steam Valve Leak Taskforce Activity



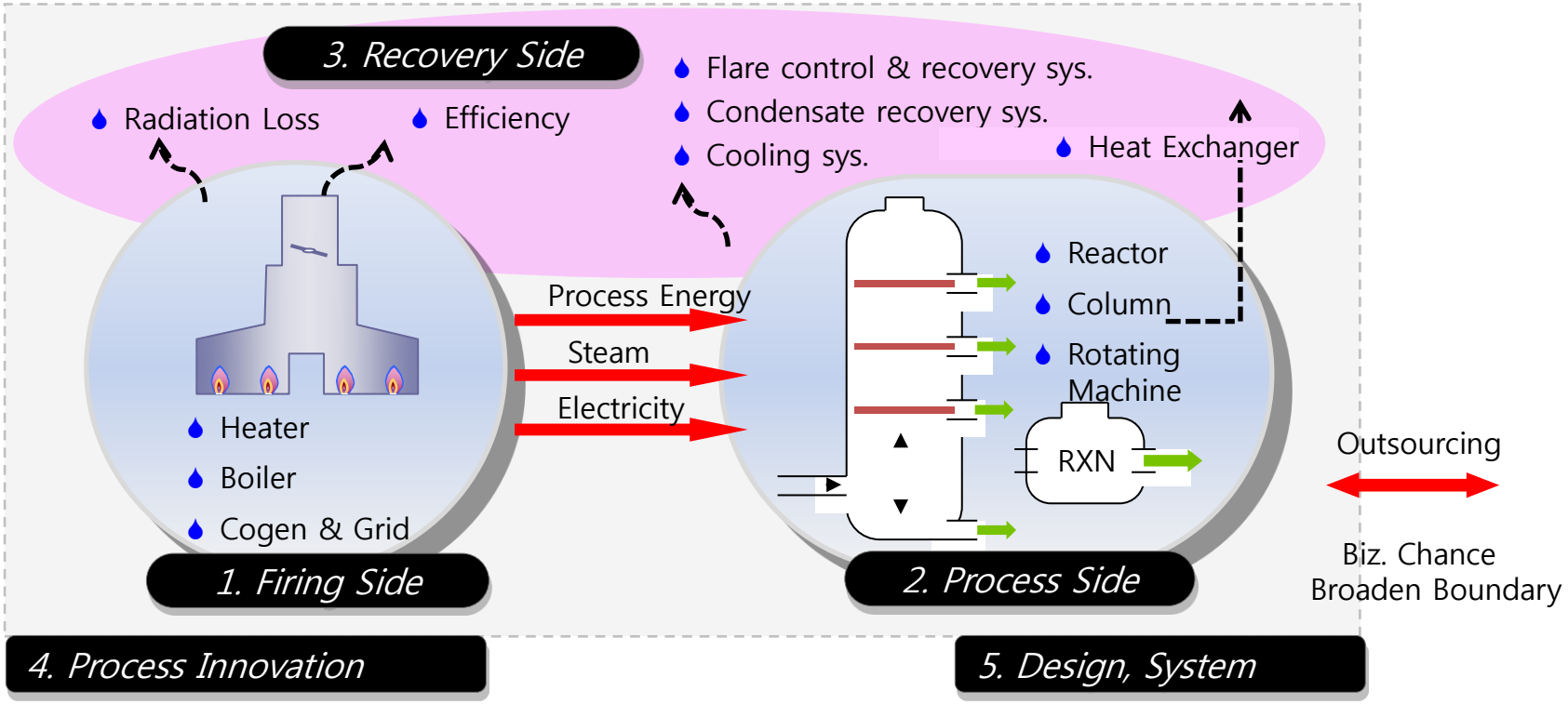


- ✓ *Result : 1,000 Point Fixed (energy loss worth 1Mil.$/yr.)*
- ✓ *Pareto Diagram Result : Valve Gland Leak (66%)*
- ✓ *Obstacles : Seems Negligible, Multi-Department Job, Gray Area (Tank Farm etc.),…*

❑ Opportunity Matrix

▷ Logical & through opportunity finding in terms of a) energy efficiency increase, b) energy unit cost reduction, c) new business development

▷ Major Potential Areas 1. Firing, 2. Process, 3. Recovery, 4. Process Innovation, 5. System



Ⅲ-4. Performance Tracking & Evaluation System

❑ No Measure, No Improvement

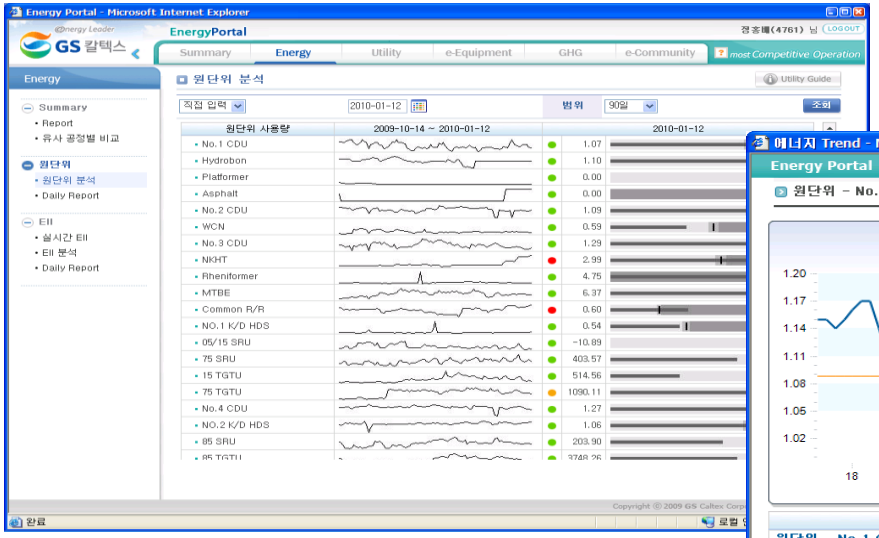
▷ Measuring energy efficiency or energy loss per category

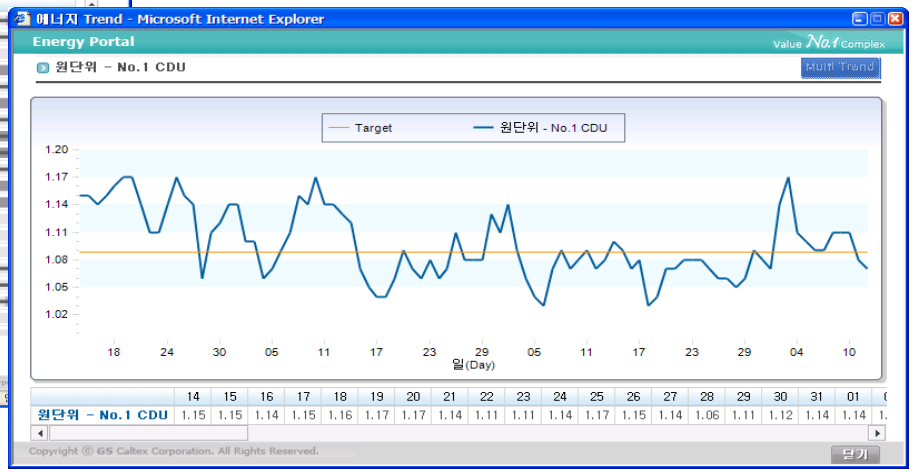
- provide with rationale of energy efficiency projects
- track and monitor its performance in a sustainable way

▷ Set energy saving performance as one of team key performance indices (KPI)

- better to have 'aggressive target' - *"5% is not possible, but 20% is possible"*

Example : Energy Portal





- ✓ *% Fuel Tracking*
- ✓ *Tracking per energy source*

IV. Conclusion

- Unpredictable market environment and the advent of new policies and fuel standard drive refiners to prepare new green growth strategy

- GS Caltex keeps moving towards green growth through upgrading & greening of current working site, developing new green businesses, and consolidating energy efficiency of Yeosu Complex

- To establish energy efficient refinery, performance measuring & evaluation system and consistent implementation based on strong commitment, surpassing any obstacles, are required.

- We believe that diverse collaborative activities such as co-research program and personal exchange among energy companies from the three countries will provide all of us with win-win synergy.

감사합니다

非常感谢

ありがとうございます

GS Caltex

Ye-ul Maru (Venues & Eco-Park located in Yeosu)

Ye-ul Maru, 100 million USD worth CSR project donated by GS Caltex will be the most eco-friendly landmark in Yeosu where GS Caltex is running world scale refining & petrochemical complex.
Ye-ul Maru will be equipped with spacious venues, exhibition halls, eco-park, etc, and it is schedule to open by the first half of 2012 when the Yeosu Expo is held