ESCO Business in Korean Energy market:
The Current Issues and Possible Solutions

Developing Financial Intermediation Mechanisms
For Energy Efficiency Projects
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Introduction

How is ESCO (Energy Service Company) in Korea?

- In Korea, for the purpose of intentional promotion of energy savings investment, government is supporting ESCO business by providing relatively lower interest rate funds.

- Basic form of energy savings contract between ESCO and user is shared savings contract. For example, the energy savings benefit will be that of ESCO's for the project period, while it will be user's when the contract is over.

- Most of the ESCO businesses, however, are small & medium size and have serious problems in finance due to low credit ratings.

- ESCO generally acts as project developer for a wide range of diagnosis of energy savings and following facility installments. But it also assumes the technical and performance risk associated with the project.* To earn investment revenue, ESCO bears the investment risk.

- With limited resource of government funding, it needs a new way to finance the project through the market.

* [http://www.naesco.org/meminfo.htm#WhatisESCO](http://www.naesco.org/meminfo.htm#WhatisESCO)
Objectives of the Study

The Present Status of the ESCO Business in Korea

- Debt ratio is increased proportionally as ESCO projects increase for a company.

- For the loaner, BIS (Bank for international settlements) will be worsened, too.

The Purpose of the Study

- Analysis of the past ESCO business lesson gives the idea and suggest possible solutions.

- Once the profitability of ESCO business can be empirically validated, we will be able to find a to mobilize market mechanism of financing to guarantee the sustainable growth of ESCO industry.
# Overview of the Korean ESCO

## The Basic Legislations on Korean ESCO

<table>
<thead>
<tr>
<th></th>
<th>Basis Clause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rational Energy Utilization Act (Amended 1991)</td>
<td>Article 22 (Support to Energy Service Company)</td>
</tr>
</tbody>
</table>
| Enforcement Ordinance for the Rational Energy Utilization Act | Article 20 (Project for Energy Conservation)  
Article 21 (Registration of Energy Service Company, etc.) |
| Enforcement Regulation for the Rational Energy Utilization Act | Article 10 (Application of Registration of Energy Service Company) |

## The Registry Requirements for the Korean ESCO

<table>
<thead>
<tr>
<th></th>
<th>Type One (Industrial Sector)</th>
<th>Type Two (Building Sector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>Public capital Over 500 million Won</td>
<td>Over 300 million Won</td>
</tr>
<tr>
<td></td>
<td>Private capital Over 600 million Won</td>
<td>Over 400 million Won</td>
</tr>
</tbody>
</table>
| Technical manpower       | Technology master : more than one person  
(facility sector such as instrument, chemistry etc.)  
Technician : more than two person  
Technical assistant : more than one person | Technology master : more than one person  
(building sector)  
Technician : more than two person  
Technical assistant : more than one person |
| Equipment                | Gas analyzer etc.            |                             |

Source: Kim, Chan-ho, ‘The present condition of the Korean ESCO’, Korea Energy Management Corporation
Overview of the Korean ESCO

### Procedure of the ESCO Investment in Korean

1. **ESCO & Client**
   - Preliminary Examination & Counseling

2. **ESCO**
   - Simple Proposition

3. **Client**
   - Continue the Project? **NO**
     - **Project Canceled**
   - **Yes**
     - Feasibility Study and Project Proposal (Energy conservation, pay-back period)
     - Auditing Fee

4. **ESCO**
   - Implement the Project? **NO**

5. **Client**
   - **Yes**
     - Energy Savings Performance Contracting (Reduced Amount Estimation, Allocation etc)
       - Loan
       - Loan request (ESCO)
     - Installation of equipment and facilities
     - Operation & Maintenance, Measure, Monitor, and Verify the project's Energy savings
       - Reduced Cost

6. **ESCO & Client**
   - Contract Expiration, Ownership Transfer

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Source: Kim, Chan-ho, Overview Korean ESCO, KEMCO
Overview of the Korean ESCO

Flow Chart of ESCO Decision Making

- **Existing Process**
- **New Process**

1. **Energy industry**
   - **ESCO Project?**
     - **Yes**
       - **ESCO Project**
       - **Consider the firm's financial condition**
         - **Private Funds**
           - **Over 10 billion won**
             - **Yes**
               - **The Application of the Project Financing**
             - **No**
               - **The Application of the Lease**
         - **No**
           - **Loaning Funds**
       - **ESCO Loaning**
   - **Non ESCO Project**
     - **Abandon the Project**

2. **Government Funds (KEMCO)**
   - **Consider the firm's financial condition**
     - **Over 10 billion won**
       - **Yes**
         - **The Application of the Project Financing**
     - **No**
       - **The Application of the Lease**
Overview of the Korean ESCO

A Flow Chart of the Korean ESCO Project

Source: Choi, Sang-ho, 'ESCO Benefit Analysis', LG Honeywell
Overview of the Korean ESCO

Recent Trends of the Korean ESCO Registry

Source: Korean ESCO Association, 2004
Overview of the Korean ESCO

Trends of ESCO Business in Korea

Overview of the Korean ESCO

Shared Savings Contracts

(Current ESCO business form)

Guarantor

Energy User

ESCO

Finance

Shared Savings Contracts

Financing
Overview of the Korean ESCO

Guaranteed Savings Contracts

(Not Known to Actual Business)

ESCO

Energy User

Finance

Guarantor

Diagnosis and Guarantees the Energy Savings

Financing
Overview of the Korean ESCO

**Direction of Government Policies**

- Promoting the creation of Energy savings system
- Improvement and strengthening of Institution/policy in energy savings
- Auditing/monitoring energy savings of subordinate institutions

- ESCO Business targets since 1993: industrial, building (commercial, public, Apartment, Hotel, hospital, school, telephone office, institute, department, others)

- Project types: light, co-generation, boiler, process improvement, heat recovery steam generators, air cooler and heating system, power, kiln & furnace, operating funds, etc.
Current Issues and Problems in Korean ESCO

Issues of the Korean ESCO

- Investment on energy savings has not been considered economically feasible projects due to low energy prices controlled by government in Korea.
- Accuracy of diagnosis technology is dependent on its cost.
- Therefore, small ESCO business lacks diagnostic expertise and provide unreliable measurement of resulting energy savings.
- It in return will results in an unclear contract agreement on sharing the energy savings between client and ESCO.
- This will make the situation worse since the potential ESCO clients already lacks the perception of energy savings.
- Lack of access to financing and credit; ESCO has limited capital. The more ESCO projects performed, the higher the debt ratio for ESCO.
- This poses the problem of hedging the risk on loan and investment.
ESCO Supporting System by Low Interest Rate Public Funds

Interest Rates Policies for Energy Savings Facilities Investment

<table>
<thead>
<tr>
<th>Interest rate</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floating</td>
<td></td>
<td></td>
<td>4.75</td>
</tr>
<tr>
<td>Fixed</td>
<td>5.25</td>
<td>5.25</td>
<td>5.25</td>
</tr>
<tr>
<td>Difference</td>
<td>0.50</td>
<td>0.25</td>
<td>0.50</td>
</tr>
</tbody>
</table>

- Once the feasibility study and project proposal is done, and the user agrees, the project will be implemented via ‘Energy Savings Performance Contract’ between ESCO and user.
- A Loan Request to KEMCO for it’s Recommendation.
- The only one institute (KDB Capital) in Korea handles the loan of public low interest rate fund.
- If the ESCO needs money after the project investment is done but before the whole contract expires, it asks KDB capital for ‘factoring’ the debenture based on the contract.

Refer to Page 5 of this ppt file
Types of Facility Financing for Rational Energy Utilization by KEMCO and Yearly Trends of Fund Size Withdrawn

<table>
<thead>
<tr>
<th>Establish energy savings facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry, building, co-generation business</td>
</tr>
<tr>
<td>Establish high efficient product and Production facilities</td>
</tr>
<tr>
<td>Project of ESCO investment</td>
</tr>
<tr>
<td>Company investment project on voluntary agreement (VA)</td>
</tr>
<tr>
<td>Supporting establishment of small and medium enterprises</td>
</tr>
<tr>
<td>Developing local energy project</td>
</tr>
<tr>
<td>Establishing energy saving project</td>
</tr>
<tr>
<td>Investment project on demand management</td>
</tr>
<tr>
<td>Improving housing insulation</td>
</tr>
<tr>
<td>Supporting project of a building efficiency of a class certification</td>
</tr>
</tbody>
</table>

Withdrawing of Government Supported Funds During the Past Three Years

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first half of the year</td>
<td>14,174(19%)</td>
<td>47,338(34%)</td>
<td>15,363(16%)</td>
<td>21,760</td>
</tr>
<tr>
<td>The second half of the year</td>
<td>60,964(81%)</td>
<td>92,632(66%)</td>
<td>84,398(84%)</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>75,138</td>
<td>139,970</td>
<td>99,761</td>
<td>21,760</td>
</tr>
</tbody>
</table>

Data Availability for the Analysis of Korean ESCO’s Profitability

- KEMCO (Korea Energy Management Corporation) is a public institute funded by government to facilitate and promote energy savings projects.
- Guided by the Rational Energy Utilization Act, they play the role of the company which guarantees the ESCO performance and provide the public, low interest rate funds to the ESCO for the investment in shared savings contracts on certain conditions.
- The institute is almost the unique source for the past historical data of Korean ESCO.
- Variables such as:
  - Total project length, facility installation length
  - The size of total investment, energy savings in quantity and monetary term
  - 11 Project types, 11 categories for building and industry, and regional category and year are accumulated, although many of the items not complete.
- Right-hand side is the summary of the observations meaningful for the proper analysis up to date.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>1</td>
</tr>
<tr>
<td>1997</td>
<td>6</td>
</tr>
<tr>
<td>1998</td>
<td>111</td>
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<tr>
<td>1999</td>
<td>126</td>
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<tr>
<td>2000</td>
<td>420</td>
</tr>
<tr>
<td>2001</td>
<td>470</td>
</tr>
<tr>
<td>2002</td>
<td>333</td>
</tr>
<tr>
<td>2003</td>
<td>126</td>
</tr>
<tr>
<td>2004</td>
<td>80</td>
</tr>
</tbody>
</table>

Total of 1673 observations
The Model for the Analysis of ESCO Profitability

Estimation of the Investment Length for Facility Installations

1. To overcome the limitation of actual data of investment length for facility installation, we used 472 sample observations from the year 2002, 2003, 2004. Therefore, the following regression equations are used to find the statistically significant values for the investment length for facility installation.

**Population Regression Equation**

\[ y_i = \alpha_0 + \alpha_1 X_{1i} + \sum_{i \in B} \beta_i D_i X_{1i} + \sum_{i \in C} \gamma_i D_i X_{2i} + \alpha_2 U_{23i} + \varepsilon_i \]

**Estimation of Unconstrained Regression Equation**

\[ y_i = a_0 + a_1 X_{1i} + \sum_{i \in B} b_i D_i X_{1i} + \sum_{i \in C} c_i D_i X_{2i} + a_2 U_{23i} + e_i \]

**Test of Hypothesis Using Constrained Regression Equation.**

\[ H_0 : \beta_2 = \beta_{10} = \gamma_2 = \gamma_3 = \gamma_6 = \gamma_{10} = 0 \]
The Model

\[ X_{1i} : \text{Total Project Length} \]
\[ X_{2i} : \text{Energy Savings} \]
\[ D_i : \text{Dummy Variables for the Project Types} \]
\[ U_{23i} : \text{Hotel (Usage Category)} \]

\[ B = \{1, 2, 3, 4, 5, 6, 7, 10\}, \quad C = \{1, 2, 3, 4, 5, 6, 7, 10\} \]

Project Types:

Light=1, co-generation=2, boiler=3, process improvement=4, recovery steam generations=5, air cooler & heating system=6, power=7, others=10, substitutes=11

F-Test Result: Cannot reject the Null Hypothesis.

\[ F_{(q, n-k)} = \frac{(RSS^* - RSS) / q}{RSS / (n - k)} = \frac{(2649.906 - 2625.155) / 6}{2625.155 / 453} = 0.712 \]
## Estimation Results

### Unconstrained Regression Results

<table>
<thead>
<tr>
<th>Coef.</th>
<th>STD</th>
<th>T- value</th>
<th>P- Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_0$</td>
<td>1.525</td>
<td>0.298</td>
<td>5.109</td>
</tr>
<tr>
<td>$a_1$</td>
<td>0.085</td>
<td>0.020</td>
<td>4.322</td>
</tr>
<tr>
<td>$b_2$</td>
<td>-0.080</td>
<td>0.020</td>
<td>-4.030</td>
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<tr>
<td>$b_3$</td>
<td>-0.079</td>
<td>0.021</td>
<td>-3.791</td>
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<tr>
<td>$b_4$</td>
<td>-0.045</td>
<td>0.021</td>
<td>-2.144</td>
</tr>
<tr>
<td>$b_5$</td>
<td>-0.053</td>
<td>0.021</td>
<td>-2.538</td>
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<tr>
<td>$b_6$</td>
<td>-0.038</td>
<td>0.020</td>
<td>-1.896</td>
</tr>
<tr>
<td>$b_7$</td>
<td>-0.053</td>
<td>0.021</td>
<td>-2.560</td>
</tr>
<tr>
<td>$b_{10}$</td>
<td>-0.086</td>
<td>0.100</td>
<td>-0.854</td>
</tr>
<tr>
<td>$c_1$</td>
<td>0.002</td>
<td>0.001</td>
<td>2.587</td>
</tr>
<tr>
<td>$c_2$</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.086</td>
</tr>
<tr>
<td>$c_3$</td>
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<td>0.001</td>
<td>1.482</td>
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<td>0.001</td>
<td>0.000</td>
<td>4.417</td>
</tr>
<tr>
<td>$c_6$</td>
<td>0.000</td>
<td>0.001</td>
<td>-0.049</td>
</tr>
<tr>
<td>$c_7$</td>
<td>0.001</td>
<td>0.001</td>
<td>1.941</td>
</tr>
<tr>
<td>$c_{10}$</td>
<td>0.014</td>
<td>0.025</td>
<td>0.554</td>
</tr>
</tbody>
</table>

### Constrained Regression Results

<table>
<thead>
<tr>
<th>Coef.</th>
<th>STD</th>
<th>T- value</th>
<th>P- Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_0$</td>
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<td>5.427</td>
</tr>
<tr>
<td>$a_1$</td>
<td>0.060</td>
<td>0.006</td>
<td>9.721</td>
</tr>
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<td>$b_2$</td>
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</tr>
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<td>0.008</td>
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<td>0.001</td>
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<tr>
<td>$c_{10}$</td>
<td>0.014</td>
<td>0.025</td>
<td>0.554</td>
</tr>
</tbody>
</table>

**RSS** = 2625.155  
**number of variables** = 19  
**number of samples** = 472

**RSS* = 2649.906  
**number of variables** = 13  
**number of samples** = 472
The Model for the Analysis of ESCO Profitability

Net Present Value of the ESCO Project

\[ NPV = \sum_{i=t_1+1}^{t_2} \frac{B_i}{(1+r)^i} - \sum_{i=1}^{t_1} \frac{C_i}{(1+r)^i} \]

To get the internal rate of return (IRR), we set

\[ NPV = 0 \]

and used grid search method in GAUSS program to get IRR. We summarized the results in various ways for better understanding of Korean ESCO’s profitability.

- Trends of IRR by Project Types
- the Size of Investment and IRR
- Total Project Length and IRR
- Profitability (or IRR) of Each Project Types
- ESCO Projects’ Profitability (or IRR) by Year
- ESCO Project Length and the Size of Investment
- the Size of Investment and Energy Savings
## Empirical Results (Trends of IRR by Project Types)

<table>
<thead>
<tr>
<th></th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tbody>
<tr>
<td>1</td>
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<td>0.096</td>
<td>0.143</td>
<td>0.149</td>
<td>0.239</td>
<td>0.189</td>
<td>0.073</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.006)</td>
<td>(0.123)</td>
<td>(0.026)</td>
<td>(0.000)</td>
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<td>2</td>
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<tr>
<td></td>
<td>(0.000)</td>
<td>(0.577)</td>
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<td>(0.044)</td>
<td>(0.092)</td>
<td>(0.073)</td>
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<tr>
<td>3</td>
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<td>(0.094)</td>
<td>(0.045)</td>
<td>(0.154)</td>
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<td>(0.000)</td>
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<td>(0.326)</td>
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<td>(0.114)</td>
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<td>(0.067)</td>
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<td>(0.293)</td>
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<td>6</td>
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<td>0.073</td>
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<td>(0.037)</td>
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<td>0.293</td>
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<td>(0.000)</td>
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<td>(0.000)</td>
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</tbody>
</table>

Note: The numbers in ( ) represents $\sqrt{n}$, other numbers are mean values of IRR (which represents the profitability of each project types): Light=1, co-generation=2, boiler=3, process improvement=4, recovery steam generations=5, air cooler & heating system=6, power=7, others=10, substitutes=11
The Size of Investment and IRR
Total Project Length and IRR
Profitability (or IRR) of Each Project Types
ESCO Projects’ Profitability (or IRR) by Year
ESCO Project Length and the Size of Investment
the Size of Investment and Energy Savings
Advanced Financing for ESCO

New Supporting System for ESCO

Companies which Guarantees the ESCO Performance

Energy User

ESCO

Investment (Private or Public Investor)

Financing

An Investment Company
ABS: Asset-Backed Securities

Basic Structure of ABS

Original Debtor → Originator:
- Lending Securities
- Cash
- Provide the Principal

Asset-Backed Transfer:
- Issue Subordinate Securities

SPC (Special Purpose Company):
- Issue Senior Securities
- Asset Backed Trust
- Provide the Principal

Trustee:
- Asset-Backed Management

Servicer:
- Instruct asset operating

Investors:
- Provide the Principal

Source: Securities Research Center, [The Process of ABS] 2003, p.72
Expected Effects

- Private fund should be mobilized promoted to ESCO investment (At the present Korean ESCO relies on government funds)
- Sustainable development of ESCO industry by market mechanism
- Activation in Korean ESCO market by promoting sound ESCO
- Expanding energy savings facility investment and promoting low energy intensity industry.
- ESCO could be a very practical and useful way to prepare the kyoto Mechanisms -Kyoto Protocol has came into effect in February 2005
- It is also economically and environmentally useful way to counterbalance the high crude oil prices.
Thank you