Current Status and Implications of Energy Efficiency Programs in Korea

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Sangsoo Ahn

KEMCO

Background of evaluation

- Programs analyzed in the paper
  - The energy efficiency subsidy program has been implemented as a part of the investment program of energy suppliers for demand side management by Rational Energy Utilization Act

- Implementation of program
  - Started in 1993 with high efficient fluorescent light ballasts
  - Includes transformers, variable speed drives, energy welfare program in 2010
  - Conducted by KEPCO (Korea Electric Power Company), Evaluated by KEMCO (Korea Energy Management Corporation)

Programs conducted by KEPCO

- **High efficient equipment subsides program**
  - To provide electricity to users with a reasonable price by implementing high efficient equipments subsides program
  - Analysis of appropriate amount of subsidies for high efficient equipments to be adopted in the market is needed
  - New installations, Replacements of high efficient equipments are subsidized in Korea for dissemination.

- **Energy Welfare program**
  - Has stared in 2004, targets low level income families and social welfare facilities with free of charge

# California Standard Practice Test (CSPT) methodology

- CSPT has been established to evaluate the economic feasibility and quantitative aspects of the demand side management programs from various perspectives

- CSPT has been widely used in Korea to analyze the economic performance of energy efficiency programs since early 2000s

- CSPT has advantages of providing costs and benefits by stakeholders (program administrator, participant, rate-payer, and total resource)

Energy Savings by Programs

- Energy savings : $\sum$ (subsidized units * unit savings * operation hours)
  - Savings per one year is being reported as a performance of a program
  - Savings during lifetime of equipment is taken into account when evaluating cost effectiveness
  - Local offices of KEPCO (electric utility) are responsible for inspection of installation of subsidized units and reporting of the number of subsidized units to head office of KEPCO
  - All savings value is gross savings because free rider effect, spill over effect are not considered in Korea
- Energy savings of 2010 energy efficiency program
  - 338.4GWh/year which accounts for 0.08% of electricity consumption (434,160GWh) in 2010 in Korea

Entities related to energy efficiency programs

- Regulator : Ministry of Knowledge Economy (MKE)
- Budget : Electric Power Public Tasks Evaluation & Planning Center
- Program Evaluation : Korea Energy Management Corporation (KEMCO)
- Implementation : Korea Electric Power Company (KEPCO)

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Ministry of Knowledge
Economy (MKE)
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Electric Power      Project Director of
Public Tasks         DSM
Evaluation &
Planning Center
    |         |          |
  Budget      |     Program Design
    |         |          |
    +---- Korea Energy Management ----+
         Corporation
              |
        Program Evaluation
              |
        Korea Electric Power     Implementation
        Company
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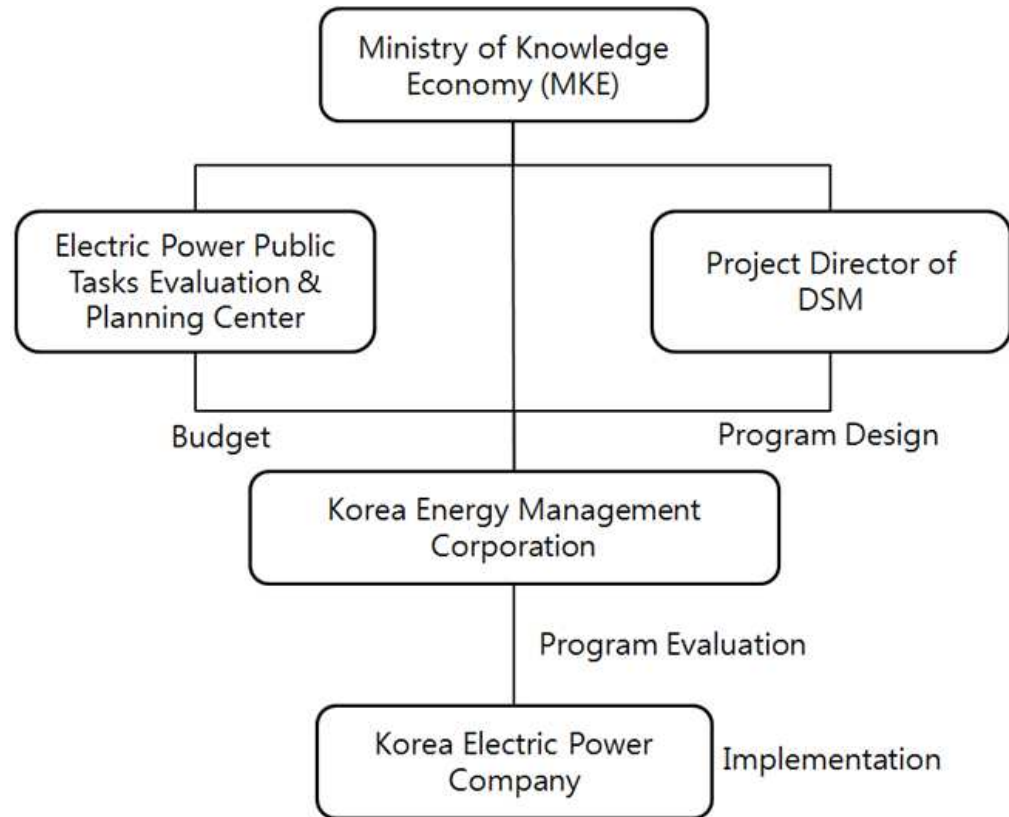
Economic feasibilities test procedure

- Calculate Installation Costs, Incentives, Annual Energy(kWh) and Peak Demand(kW) savings using the number of measures, annual operating hours and coincident factor

- All savings are deemed savings without the onsite M&V
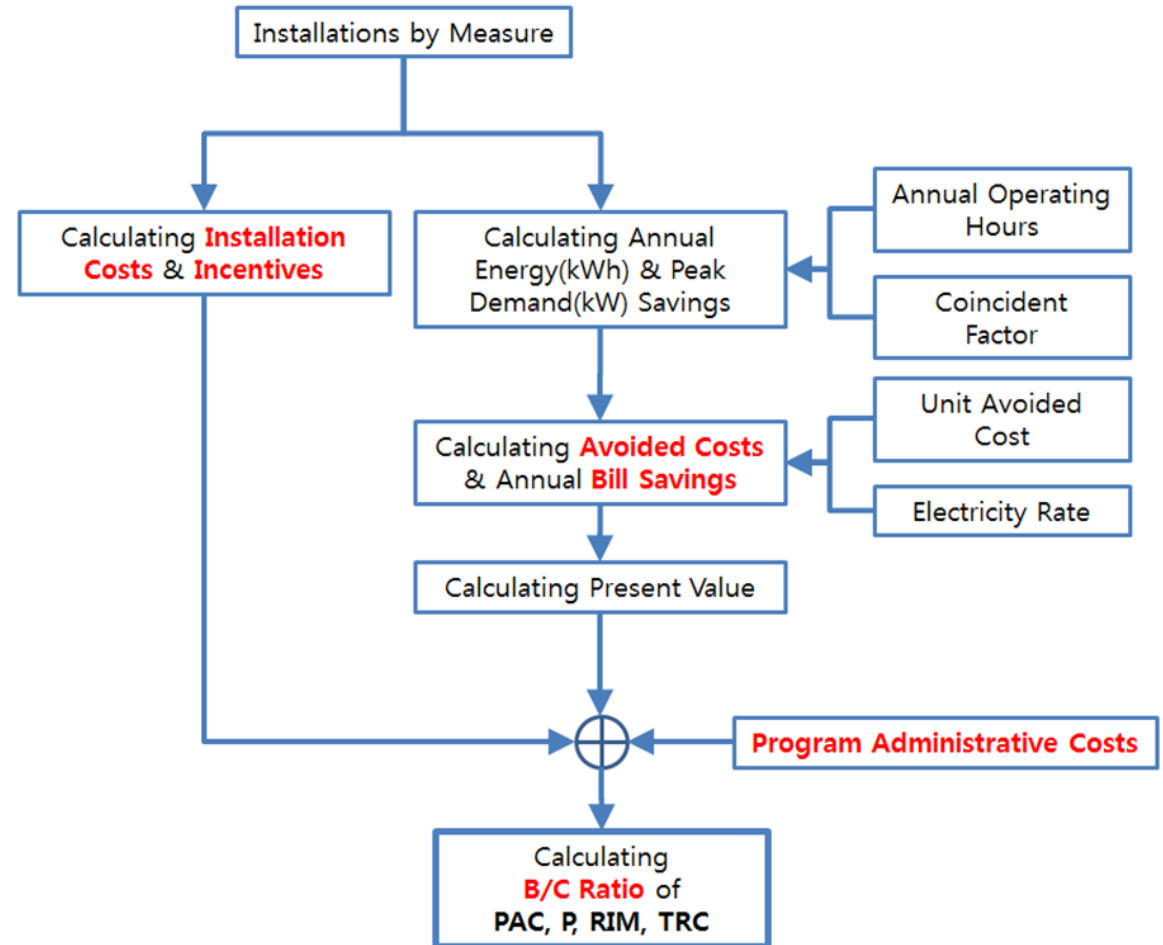
Indices of feasibilities test

Cost	PAC	P	RIM	TRC
Avoided Cost	+		+	+
Installation Cost		-		-
Administrative Cost	-		-	-
Subsidy	-	+	-	
Bill reductions		+	-	

1) Program Administration Cost Test: Will utility bills increase?
2) Participant Cost Test : Will the participants benefit from the measure?
3) Ratepayer Impact Measurement : Will utility rates be increased?
4) Total Resources Cost Test : Will the total costs of energy in the utility service territory decrease?

Elements in economic evaluation

Category	Name of Program	Index	Benefits/Costs	
			Benefits	**Costs**
Efficiency Improvement	All	TRC	· Avoided facilities costs [1] · Avoided energy costs · Avoided environmental costs	· Administration costs[2] · Equipment costs
Load Management	Equipment	TRC	· Avoided facilities costs	· Administration costs · Equipment costs
	Demand Control	RIM	· Avoided facilities costs	· Administration costs · Subsidies

1) Avoided facilities costs include avoided utility facilities, transmission, distribution costs
2) Administration costs include program management, advertisement, employment costs

Avoided costs

Organization	Avoided facilities	Avoided facilities costs (EUR/kW)				Avoided energy costs (EUR/MWh)	Avoided environmental costs[1] (EUR/MWh)	Remarks
		Gen.	Trans.	Dist.	Sum			
Korea Electrotechnology Research Institute (2011. 3)	LNG Combined Cycle	92	41	25	159	74.7	7.1	-
	Soft coal	129	41	25	195	29.2	16.3	Transformers

1) Avoided environmental costs are obtained by averaging prices of EUA, CER at EU-ETS

Calculation Result of Evaluation Factor by Program

Program		Energy Savings (MWh)	Peak Savings (MW)	Avoided Costs (kEUR)	Installation Costs (kEUR)	Incentives (kEUR)	Administrative Costs (kEUR)	Bill Reductions (kEUR)
Lighting	Electrical Ballast	89,493.60	17.7	57,739	6,119	1,486	493	38,846
	LED	73,641.30	21.2	54,309	18,637	6,035	279	28,069
VSD		130,178.50	19.8	136,781	14,099	689	337	71,208
Transformer		30,995.50	3.5	20,802	5,280	974	332	19,287
Energy welfare		14,051	2.6	7,819	-	8,619	517	5,665
Total		338,360.00	64.8	277,451	44,134	17,803	1,957	163,075

Evaluation Results

Program		PACT	PCT	RIM	TRC
Lighting	Electrical ballast	29.17	6.59	1.41	8.73
	LED	8.6	1.83	1.58	2.87
VSD		133.31	5.1	1.89	9.48
Transformer		15.93	3.84	1.01	3.71
Energy welfare		0.86	∞	0.53	0.86
Total		14.04	4.1	1.52	6.02
Total (except welfare)		25.38	3.77	1.6	5.92

Conclusion

- Electric ballast for fluorescent lamp shows the most highest B/C ratio in lighting category

- LED lamp is less cost effective due to high installation cost despite high unit savings

- Variable Speed drive has the most highest B/C ratio among all programs

- Energy Welfare program has the lowest B/C ratio due to the installation costs program administrator should pay

Conclusion (cont)

- TRC is the most important index for korean policy maker to compare among programs because TRC shows economic values from nationwide

- All programs except energy welfare program seem to be cost effective and overall energy efficiency programs' B/C ratios is 6.02

- For a accurate cost effective test, M&V should be accompanied

- As of 2011 energy suppliers (electric, gas, heat) should need to evaluate their performance of programs, and the results should be verified by 3rd party