Energy Savings Calculations for selected end use technologies and existing evaluation practices in the Republic of Korea

A report produced for the IEA DSM Agreement, Task 21
Harmonisation of Energy Savings Calculations

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4 October 2012

In the IEA DSM Agreement, Task 21 Harmonisation of Energy Savings Calculations, the following countries are participating:

France,
Republic of Korea
Netherlands
Norway
Spain
Switzerland
USA

Each country prepared a report on the Energy Savings Calculations for selected end use technologies and existing evaluation practices. These reports are available at www.ieadsm.org

The report holds information on selected case applications. These cases are selected with a view to present information on the energy savings calculations that are or could be done for the selected end use technologies. The case applications are not selected as best practice examples, but are good examples for common practise.

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1. CASE APPLICATION

1.1 Introduction

The country experts discussed during the project how an overview could be created for the methods that are used for calculating or estimating (ex-post) energy savings. It was decided to use case applications in selected technology areas and energy end-users. For this project the selection of case applications is to illustrate what is or could be used for estimating energy savings from programme or project implementations. The case applications show the practise in a participating country, without suggesting that these are ‘best practises’. They are a snapshot and sometimes also one of the applications that are in use in a country, but they clearly illustrate what key elements in the energy savings calculations are, how problems in data collections are handled and how default or standard values are used.

The case applications are selected for the following technologies and energy end-users:

a. Industry; Variable Speed Drive and High Efficient motor
b. Commercial Buildings; Heating system
c. Commercial Buildings; Integrated Air conditioning system
d. Households; Retrofit wall insulation
e. Households; Lighting

For the Republic of Korea the following case applications are selected:

- 32W florescent lamps
- Variable speed drives

These case applications are presented from section 1.2 onwards.

Each of the case applications presents the information in a common format, a template. There are four groups:

1. Summary of the program
2. Formula for calculation of annual energy savings
3. Input data and calculations of energy savings
4. Greenhouse gas savings

Additional information is provided in references, one or more annex and on definitions

The template was improved during the project, based on experiences to present the information for case applications and discussions during the experts meetings. A workshop was held in April 2011 in Korea to get feed back on the final draft of the template. During the workshop three different case applications were presented to illustrate the use of the template and to discuss future application.
In Appendix A the final version of the template with instructions is enclosed.

1.2 32W fluorescent lamps

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

The purpose of the program is to facilitate the distribution of ballasts for 32W fluorescent lamps certificated as high efficient equipment by KEMCO.

The subsidy program of high efficient ballasts for 32W fluorescent lamps was operated from 1994 to 2010 as a one of electric power demand management programs, and 12.1% (31,614MWh) of the performance of 2009 electric power demand management programs was obtained through high efficient ballasts for 32W fluorescent lamps.

1.1.2 Type of instrument(s) used

The government offered subsidies, tax deductions, and low interest loans to corporations or private individuals who installed high efficient ballasts for 32W fluorescent lamps. Related laws for subsidies, tax deductions and loans are as follow

Subsidies:	ELECTRICITY BUSINESS ACT
Tax deductions:	SPECIAL TAX TREATMENT CONTROL ACT
Loans:	ENERGY USE RATIONALIZATION ACT

1.2 General and specific user category

The program did not limit the target of subsidy and users are categorized as residential, commercial, industrial sector

1.3 Technologie(s) involved

Ballasts for 26mm 32W fluorescent lamps (FLR), Ballasts for 16mm 32W fluorescent lamps (T-5), Ballasts for 32W U-shape fluorescent lamps (FPL).

1.4 Status of the evaluation and energy savings calculations

Electric power infrastructure centre, committed the management of the electric power industry basis fund from the Ministry of Knowledge Economy, puts together the performance of energy savings at electric power demand management business and writes a report on the performance of electric power demand management business and economic feasibility evaluation (hereafter referred as the performance report) [1], but this report is not published formally.

Electric power infrastructure centre updates the parameter used to calculate the energy savings through irregular survey, and the calculated energy savings is determined as business performance after centre's review of subsidy program result.

1.5 Relevant as a Demand Response measure

No

2 Formula for calculation of Annual Energy Savings

Energy savings obtained by subsidy program of high efficient ballasts for 32W fluorescent lamps is calculated in the unit of kWh, and the power savings per unit is specified in the electric power demand management business instruction (hereafter referred as the instruction)[2].

2.1 Formula used for the calculation of annual energy savings

The formula for the annual energy savings is specified in the performance report, as follows.

$E_{saved} = P_{saved} \times H_{annual} \times N_s$

2.2 Specification of the parameters in the calculation

E_{saved} = Energy savings (kWh)
P_{saved} = Power savings per unit (kW/unit)
H_{annual} = annual running hours (h)
N_s = the number of subsidized units (unit)

2.3 Specification of the unit for the calculation

The unit for the calculation is ballast for 32W fluorescent lamps.

2.4 Baseline issues

The power savings (kW) of high efficient ballast for 32W fluorescent lamps is the power difference between the existing 40W fluorescent lamp fixture and new 32W fluorescent fixture and it is specified in the instruction [2], as follows.

Table 1. Power savings of high efficient ballast for 32W fluorescent lamps

Classification	Power savings(W/unit)
A ballast for one 32W lamp	18
A ballast for two 32W lamps	36

Baseline is assumed to be the magnetic ballast for 40W fluorescent lamps and the sum of electric power for a fixture (a fluorescent lamp and ballast) is assumed to be 50W, and this is not specified in the instruction.

Because the magnetic ballast which was mostly used in the design stage of subsidy program is assumed to be baseline, baseline is a stock average and it does not change during the business period.

It is assumed that running hours before and after the replacement would not change [1].

Table 2. Average annual running hours of ballast for 32W fluorescent lamps

Average annual running hours(h)		
Residential	Commercial	Industrial
2,771	3,528	3,027

2.5 Normalisation

No normalisation has been applied for the energy savings.

2.6 Energy savings corrections

No corrections have been made for the energy savings.

3 Input data and calculations

3.1 Parameter operationalisation

Energy savings parameters are P_{saved} (unit power savings), H_{annual} (annual running hours), N_s (the number of subsidized units). Energy savings per unit (P_{saved} x H_{annual}) is stipulated during business period. Each parameter is determined as follows.

P_{saved} (Power savings) & H_{annual} (Annual running hours): Before a program is launched, P_{saved} & H_{annual} is determined by expert's opinion and survey. P_{saved} is specified in the instruction, and does not change during the business period. H_{annual} is updated irregularly by electric power infrastructure centre through survey

N_s (the number of subsidized units): The supervision institution (usually KEPCO, KEMCO etc) which implemented the electric power demand management business reports N_s (the number of subsidized units) to the electric power infrastructure centre

3.2 Calculation of the annual savings as applied

$E_{saved} = P_{saved} \times H_{annual} \times N_s$

E_{saved} (Ballasts for one 32W lamp, Residential use) in 2009 business performance
= 0.018kW/unit x 2,771h x 117,778units = 5,874,531kWh

Same calculation formula could be applied to other cases with appropriate P_{saved}, H_{annual}, and Ns

Table 3. Performance of ballasts for 32W fluorescent lamps subsidy program in 2009

Classification		P_{saved} (kW)	Number of subsidized units (unit)				Energy savings (kWh)			
			Residence	Business	Industry	Total	Residence	Business	Industry	Total
Ballast for one 32W lamp	FLR	0.018	12,825	40,748	3,737	57,310	639,685	2,587,661	203,614	3,430,961
	FPL	0.018	89,857	45,203	3,845	138,905	4,481,887	2,870,571	209,499	7,561,957
	T5	0.018	15,096	97,892	2,916	115,904	752,958	6,216,534	158,881	7,128,373
Subtotal			117,778	183,843	10,498	312,119	5,874,531	11,674,766	571,994	18,121,291
Ballast for two 32W lamps	FLR	0.036	5,542	7,516	2,642	15,700	552,848	954,592	287,904	1,795,344
	FPL	0.036	68,737	15,197	2,052	85,986	6,856,928	1,930,141	223,611	9,010,679
	T5	0.036	21,450	4,306	-	25,756	2,139,766	546,896	-	2,686,663
Subtotal			95,729	27,019	4,694	127,442	9,549,542	3,431,629	511,515	13,492,686
Total			213,507	210,862	15,192	439,561	15,424,073	15,106,395	1,083,509	31,613,977

3.3 Total savings over lifetime

3.3.1 Savings lifetime of the measure or technique selected

Economic lifetime of ballast for the 32W fluorescent lamp is 7 years, and this is specified in the performance report [1].

3.3.2 Lifetime savings calculation of the measure or technique

Although the lifetime savings of the ballast for 32W fluorescent lamps is not specified in the performance report, lifetime savings is used for evaluating the economic feasibility and is calculated multiplying E_{saved} (annual energy savings) by lifetime. It is assumed that physical function deterioration would not happen during lifetime period and same E_{saved} (annual energy savings) would be created.

$E_{saved, lifetime} = T_{life} \times P_{saved} \times H_{annual} \times N_s$

$E_{saved, lifetime}$ = Lifetime savings (kWh)
T_{life} = Lifetime (year)
P_{saved} = Power savings per unit (kW/unit)
H_{annual} = annual running hours (h/year)
N_s = the number of subsidized units (unit)

$E_{saved, lifetime}$ (Ballasts for one 32W lamp, Residence) in 2009 business performance
= 7years x 0.018kW/unit x 2,771h/year x 117,778units = 41,121,718kWh

Same calculation formula could be applied to other cases with appropriate T_{life}, P_{saved}, H_{annual}, N_s

4 GHG savings

4.1 Annual GHG-savings

4.1.1 Emission factor for energy source

GHG emission factor applied in the performance report in 2009 electric power demand management business was 445g/kWh and that was the emission factor of 2007[1]

KPX (Korea Power Exchange) has been publishing the report on the GHG emission factor for power generation, and GHG emission factor up to date is as follows[3].

Table 4. GHG emission factor in power generation in Korea

(unit: tCO_2e/MWh)

Classification	2005	2006	2007	2008	2009
CO_2e	0.4167	0.4243	0.4447	0.4503	0.4524
CO_2	0.4157	0.4234	0.4438	0.4494	0.4515
CH_4	0.00513	0.00514	0.00537	0.00494	0.00503
N_2O	0.00260	0.00257	0.00258	0.00249	0.00244

4.1.2 Annual GHG-savings calculation as applied

In 2009, the annual energy savings obtained by subsidy program of ballasts for 32W fluorescent lamps was 31,614MWh, and this was converted into GHG, as follows.

Annual GHG savings (CO2e) = annual energy savings (kWh) x GHG emission factor of electric energy (g/kWh)

Annual GHG savings (CO2e) = 31,614MWh x 445g/kWh = 14,068,230kg = 14,068 ton.

4.2 GHG lifetime savings

GHG lifetime savings = lifetime x annual energy savings (kWh) x GHG emission factor of electric energy (g/kWh)

4.2.1 Emission factor

The same GHG emission factor is used for the lifetime

4.2.2 GHG lifetime savings as applied

GHG lifetime savings = lifetime x annual energy savings (kWh) x GHG emission factor of electric energy (g/kWh)

= 7 x 31,614MWh x 445g/kWh

= 98,477,610kg = 98,477 ton

References

[1] The electric power demand management business performance and economic feasibility evaluation report in 2009, Electric power infrastructure centre, 2010.

[2] Electric power demand management business instruction, Electric power infrastructure centre, 2009.
http://www.etep.re.kr/home/client_cont/p_form/pRFormList.jsp?SCH_CATE1=0004&SCH_CATE2=0003&SCH_CATE3=0002

[3] GHG emission factor calculation in the power generation in 2009, Korea Power Exchange, 2010.

Annex

None

Definitions

None

1.3 Variable Speed Drive (VSD)

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

The purpose of the program is to facilitate the distribution of variable speed drives certificated as high efficient equipment by KEMCO. A variable speed drive is usually called as an inverter in Korea.

The subsidy program of high efficient inverters is being operated from 1994 to 2010 as one of electric power demand management programs, and 52.5% (137,550MWh) of the performance of 2009 electric power demand management programs was obtained through high efficient inverters.

1.1.2 Type of instrument(s) used

The government offered subsidies, tax deductions, and low interest loans to corporations or private individuals who installed high efficient inverters. Related laws for subsidies, tax deductions and loans are as follow

Subsidies:	ELECTRICITY BUSINESS ACT
Tax deductions:	SPECIAL TAX TREATMENT CONTROL ACT
Loans:	ENERGY USE RATIONALIZATION ACT

1.2 General and specific user category

The program targets commercial, industrial users

1.3 Technologie(s) involved

Inverters whose capacity ranges from 3.7kW to 220kW. It should be installed in variable torque load, and be equipped with the reactor, noise filter, and control panel at the same time.

The word efficient as in “a high efficient inverter” does not mean inverter’s efficiency is higher than average inverters; rather it means the inverter has been qualified for KEMCO certification standards.

1.4 Status of the evaluation and energy savings calculations

Electric power infrastructure centre, committed the management of the electric power industry basis fund from the Ministry of Knowledge Economy, puts together the performance of energy savings at electric power demand management program and writes a report on the performance of electric power demand management programs and economic feasibility evaluation (hereafter referred as the performance report) [1], but this report is not published formally.

Electric power infrastructure centre updates the parameter used to calculate the energy savings through irregular survey, and the calculated energy savings is determined as the performance of the program after centre's review of the subsidy program result.

1.5 Relevant as a Demand Response measure

No

2 Formula for calculation of Annual Energy Savings

Energy savings obtained by the subsidy program of high efficient inverters is calculated in the unit of kWh, and the power savings per unit is specified in the electric power demand management program instruction(hereafter referred as the instruction)[2].

2.1 Formula used for the calculation of annual energy savings

The formula for the annual energy savings is specified in the performance report, as follows.

$E_{saved} = P_{saved} \times H_{annual} \times N_s$

2.2 Specification of the parameters in the calculation

E_{saved} = Energy savings (kWh)
P_{saved} = Power savings per unit (kW/unit)
H_{annual} = annual running hours (h)
N_s = the number of subsidized units (unit)

2.3 Specification of the unit for the calculation

The unit for the calculation is a high efficient inverter

2.4 Baseline issues

The power savings (kW/unit) of a high efficient inverter is the power difference between before and after installing the inverter, and it is specified in the instruction [2], and included in Table 1.

Table 1. Power savings of a high efficient inverter by capacity in 2009

Inverter capacity(kW)	Power savings(kW/unit)	
	Maximum output frequency	
	50Hz	55Hz
3.7	1.37	0.74
5.5	2.04	1.10
7.5	2.78	1.50
11	4.07	2.20
15	5.55	3.00
18.5	6.85	3.70
22	8.14	4.40
30	11.10	6.00
37	13.69	7.40
45	16.65	9.00
55	20.35	11.00
75	27.75	15.00
90	33.30	18.00
110	40.70	22.00
132	48.84	26.40
160	59.20	32.00
200	74.00	40.00
220	81.40	44.00

Baseline is assumed to be the case that the rotation number is not controlled (60Hz) by an inverter.

Table 2. Power savings rate of a high efficient inverter by maximum output frequency*

Maximum output frequency	Power savings rate
50Hz	37%
55Hz	20%

* Limiting the maximum output frequency is discontinued since the 2010 inverter subsidy program.

The reason why maximum output frequency is fixed: Calculation of power savings for subsidy payment is difficult because the electric power changes by load form, operation time. But in case fixing the maximum output frequency, minimum power savings can be calculated in spite of changing load condition, and most electric motors can be operated despite the fixed maximum output frequency because of spare capacity(20~50%)

Because electric motor without a high efficient inverter which is most common is assumed to be the baseline, baseline is a stock average and it does not change during the program period It is assumed that running hours before and after the replacement would not change [1].

Table 3. Average annual running hours of an inverter

Average annual running hours(h)	
Commercial	Industrial
3,747	4,189

2.5 Normalisation

No normalisation has been applied for the energy savings.

2.6 Energy savings corrections

No corrections have been made for the energy savings.

3 Input data and calculations

3.1 Parameter operationalisation

Energy savings parameters are P_{saved} (unit power savings), H_{annual} (annual running hours), and Ns (the number of subsidized units). Energy savings per unit (P_{saved} x H_{annual}) is stipulated during program period. Each parameter is determined as follows.

P_{saved} (Power savings) & H_{annual} (Annual running hours): Before a program is launched, P_{saved} & H_{annual} is determined by expert's opinion and survey. P_{saved} is specified in the instruction, and does not change during the program period. H_{annual} is updated irregularly by electric power infrastructure centre through survey

N_s (the number of subsidized units): The supervision institution (usually KEPCO, KEMCO etc) which implemented the electric power demand management program reports N_s (the number of subsidized units) to the electric power infrastructure centre

3.2 Calculation of the annual savings as applied

$E_{saved} = P_{saved} \text{ x } H_{annual} \text{ x } N_s$

E_{saved} (Capacity 3.7kW, 50Hz, commercial) in 2009 program performance
= 1.37kW/unit x 3,747h x 10units = 51333.9kWh = 51.3MWh

Same calculation formula could be applied to other cases with appropriate P_{saved}, H_{annual}, and Ns

Table 4. The energy savings of high efficient inverters in 2009

(50Hz)

Classification		P_{saved} (kW/unit)	Number of subsidized units(unit)			Energy savings(MWh)		
Frequency	Capacity		Commercial	Industrial	Total	Commercial	Industrial	Total
50Hz	3.7	1.37	10	14	24	51	80	132
	5.5	2.04	12	91	103	92	776	867
	7.5	2.78	28	65	93	291	756	1,047
	11	4.07	40	118	158	610	2,012	2,622
	15	5.55	77	236	313	1,601	5,487	7,088
	18.5	6.85	87	112	199	2,231	3,211	5,443
	22	8.14	44	108	152	1,342	3,683	5,025
	30	11.10	153	199	352	6,364	9,253	15,617
	37	13.69	53	125	178	2,719	7,168	9,887
	45	16.65	14	141	155	873	9,834	10,708
	55	20.35	3	127	130	229	10,826	11,055
	75	27.75	22	217	239	2,288	25,225	27,513
	90	33.30	0	23	23	0	3,208	3,208
	110	40.70	4	55	59	610	9,377	9,987
	132	48.84	0	12	12	0	2,455	2,455
	160	59.20	2	59	61	444	14,631	15,075
	220	81.40	0	16	16	0	5,456	5,456
	Subtotal		549	1,718	2,267	19,744	113,439	133,183

(55Hz)

Classification		P_{saved} (kW/unit)	Number of subsidized units(unit)			Energy savings(MWh)		
Frequency	Capacity		Commercial	Industrial	Total	Commercial	Industrial	Total
55Hz	3.7	0.74	0	0	0	0	0	0
	5.5	1.10	0	0	0	0	0	0
	7.5	1.50	0	3	3	0	19	19
	11	2.20	12	0	12	99	0	99
	15	3.00	24	11	35	270	138	408
	18.5	3.70	10	3	13	139	46	185
	22	4.40	3	20	23	49	369	418
	30	6.00	0	14	14	0	352	352
	37	7.40	0	12	12	0	372	372
	45	9.00	0	12	12	0	452	452
	55	11.00	0	4	4	0	184	184
	75	15.00	0	6	6	0	377	377
	90	18.00	0	6	6	0	452	452
	110	22.00	0	1	1	0	92	92
	132	26.40	0	5	5	0	553	553
	160	32.00	0	3	3	0	402	402
	220	44.00	0	0	0	0	0	0
	Subtotal		49	100	149	557	3,809	4,366

3.3 Total savings over lifetime

3.3.1 Savings lifetime of the measure or technique selected

Economic lifetime of a high efficient inverter is 15 years, and this is specified in the performance report [1].

3.3.2 Lifetime savings calculation of the measure or technique

Although the lifetime savings of the inverter is not specified in the performance report, lifetime savings is used for evaluating the economic feasibility and is calculated multiplying E_{saved} (annual energy savings) by lifetime. It is assumed that physical function deterioration would not happen during lifetime period and same E_{saved} (annual energy savings) would be created.

$E_{saved, lifetime} = T_{life} \times P_{saved} \times H_{annual} \times N_s$

$E_{saved, lifetime}$ = Lifetime savings (kWh)
T_{life} = Lifetime (year)
P_{saved} = Power savings per unit (kW/unit)
H_{annual} = annual running hours (h/year)
N_s = the number of subsidized units (unit)

$E_{saved, lifetime}$ (Capacity 3.7kW, 50Hz, commercial) in 2009 program performance
= 15years x 1.37kW/unit x 3,747h x 10units = 770008.5kWh = 770MWh

Same calculation formula could be applied to other cases with appropriate T_{life}, P_{saved}, H_{annual}, N_s

4 GHG savings

4.1 Annual GHG-savings

4.1.1 Emission factor for energy source

GHG emission factor applied in the performance report in 2009 electric power demand management program was 445g/kWh and that was the emission factor of 2007[1]

KPX (Korea Power Exchange) has been publishing the report on the GHG emission factor for power generation, and GHG emission factor up to date is as follows[3].

Table 5. GHG emission factor in power generation in Korea

(Unit: tCO_2e/MWh)

Classification	2005	2006	2007	2008	2009
CO_2e	0.4167	0.4243	0.4447	0.4503	0.4524
CO_2	0.4157	0.4234	0.4438	0.4494	0.4515
CH_4	0.00513	0.00514	0.00537	0.00494	0.00503
N_2O	0.00260	0.00257	0.00258	0.00249	0.00244

4.1.2 Annual GHG-savings calculation as applied

In 2009, the annual energy savings obtained by the subsidy program of inverters was 137,550MWh, and this was converted into GHG, as follows.

Annual GHG savings (CO2e) = annual energy savings (kWh) x GHG emission factor of electric energy (g/kWh)

Annual GHG savings (CO2e) = 137,550MWh x 445g/kWh = 61,209,750kg = 61,210ton.

4.2 GHG lifetime savings

GHG lifetime savings = lifetime x annual energy savings (kWh) x GHG emission factor of electric energy (g/kWh)

4.2.1 Emission factor

The same GHG emission factor is used for the lifetime

4.2.2 GHG lifetime savings as applied

GHG lifetime savings = lifetime x annual energy savings (kWh) x GHG emission factor of electric energy (g/kWh)
= 15 x 137,550MWh x 445g/kWh = 918,146,250kg = 918,146 ton

References

[1] The electric power demand management program performance and economic feasibility evaluation report in 2009, Electric power infrastructure centre, 2010.

[2] Electric power demand management program instruction, Electric power infrastructure centre, 2009.
http://www.etep.re.kr/home/client_cont/p_form/pRFormList.jsp?SCH_CATE1=0004&SCH_CATE2=0003&SCH_CATE3=0002

[3] GHG emission factor calculation in the power generation in 2009, Korea Power Exchange, 2010.

Annex

None

Definitions

None

2. EVALUATION PRACTISE

2.1 Introduction

In Korea evaluation of energy savings programmes and policies and measures are developing. Korean organisations participated in several projects within the IEA DSM Agreement to improve the monitoring and evaluation practise. In recent years the use of evaluation experiences in the USA, e.g. the IPMVP, for the Korean situation is researching. Korea also participates in IPEEC and in the APEC.

2.2 National Evaluation guidelines, guidances and selected reports on evaluations and energy savings calculations

2.2.1 List of guidelines

There are (yet) non national guidelines.

2.2.2 List of guidance

Korea is developing national guidance on energy suppliers investment on DSM. According to Energy Suppliers Demand Side Management Investment Regulation, a monitoring report of DSM activities of energy suppliers should be submitted to administering organization (KEMCO) with an investment result since 2011. Regarding ESCO business which is subsidized by government, ESCO should submit a detailed audit report on contract, and post-management plan(including MRV plan). And Post-management plan is required to hold information regarding performance assurance of energy conservation facilities and performance indicators of performance maintenance. ESCOs are encouraged to specify monitoring equipments for comparing before and after business performance, monitoring system, sampling plan and energy savings calculation method in MRV plan of post-management plan.

2.2.3 Selected reports

In the early 2000s the expert Jong-Duck Kim from the Korean Energy Economics Institute participated in the IEA DSM Agreement Task 1 dealing with evaluating energy efficiency policy measures & DSM programmes. The report Volume II, country reports and case examples holds information on four programmes:

- energy audits in industry;
- energy audits in buildings;
- financial incentives for DSM;
- voluntary agreements.

At that time evaluation efforts concerted on output indicators and expected energy saving http://www.ieadsm.org/ViewTask.aspx?ID=17&Task=99&Sort=1#ancPublications3

In 2007 the results of a study for assessing the energy conservation technology project in the period 1992-2000 was published in the Energy Sources, Part B, Volume 3, issue 1, 2007 (Evaluation of the energy saving technology development project in Korea, W. Bae and Y. Cho).

2.3 Use of international guidelines and guidance

2.3.1 List of guidelines

There are no international guidelines in use.

2.3.2 List of guidance

Korea participates in IPEEC. This International Partnership for Energy Efficiency Cooperation is cooperation among 14 countries: the G8 (USA, UK, France, Germany, Italy, Canada, Japan, and Russia) and China, India, Brazil, South Africa, Mexico and Korea. One of the topics is international Measuring & Verifying EE Improvements.

Korea is one of the 21 member countries of Asia-Pacific Economic Cooperation (APEC) APEC holds an Expert Group on Energy Efficiency and Conservation; currently international energy efficiency projects are focused on improvements of energy efficiency of appliances and equipment. Its well known project is APEC ESIS (Energy Standard Information System). APEC ESIS provides information on member countries' MEPS, energy labels, policy regulators, and international harmonization efforts. Web site: www.egeec.apec.org

In November 2010 and April 2011 an Eco-efficient and Sustainable Infrastructure International Training Course, was held in South Korea. It introduces IPMVP to the attendees and how it can be used to prove the energy savings as well as the reason to apply measurement and verification in context of Eco-efficient Urban Infrastructure.

2.3.3 Selected reports

In 2012 the results of an economic evaluation applying the California Standard Practice Test and reviewing energy efficiency programs using a levelized cost evaluation methodology, were published in the Journal of International Council on Electrical Engineering Vol. 2, No. 2, pp. 219~224, 2012 (An Economic Evaluation of the Energy Efficiency Programs in Korea, Woo-Nam Lee, Hyeong-Jung Kim, Jong-Bae Park, Jae-Hyung Roh and Ki-Seon Cho). The paper presents additional to the two case application in chapter 1 (32W fluorescent lamps and VSD) and additional a programme on transformers

3. STANDARDS RELATED TO ENERGY SAVINGS CALCULATIONS

3.1 Introduction

Korea introduced in 1992 the Energy Efficiency Label and Standard Programme for appliances. It continues it efforts in this programme that provides consumers with information on energy efficiency.

Korea also has national energy management standards and participates in the ISO work in this field resulting in the new ISO 50001 standard on energy management. This standard is also supported by the APEC in 2011.

3.2 National standards

There is no national standard on energy savings calculations.

3.3 Developments on standards

Korea continues to improve its EE Label and standard programme for appliances:
http://www.kemco.or.kr/nd_file/kemco_eng/KoreaEnergyStandards&Labeling.pdf

3.3.1 Ongoing and expected developments

Korea has been participating in joint ISO TC 242 – TC 257 working group to develop international standards on "Measurement and verification of organizational energy performance-General principles and guidelines".

3.3.2 Comments on (draft) international standards

Korea has a TC 242 mirror committee to make comments on international standards.

3.4 Relevant organisations

The Korean Agency for Technology and Standards (KATS) is a government agency involved in leading national and international standards in the Republic of Korea and is an active member of ISO.

APPENDIX A: TEMPLATE ENERGY SAVINGS CALCULATION, WITH INSTRUCTIONS, FOR CASE EXAMPLES IN IEA-DSM TASK XXI

Frontpage:
Case application: [Name, including technology and user category]
Country: [Name]
Author(s): [Name]
Date and version: [day month year] [only full numbers of version]

Page 1

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

[Also include the period the program was running or when it started.]

1.1.2 Type of instrument(s) used

[Please indicate the type of instrument used. E.g. financial support, subsidize, label and standard, agreements, tax reduction]

1.2 General and specific user category

[Please by a specific as possible. Make a clear distinction between households, industry, services (commercial and non-commercial. If more users are targeted, please give some specification, especially if formulas would be different for different user categories.]

1.3 Technologie(s) involved

[Present the technology or technologies; please clarify in case a not well-known technology is used]

1.4 Status of the evaluation and energy savings calculations

[Provide information whether the energy savings calculations are used in an evaluation report. Include references and source in the Annex]

[Provide information whether the energy savings calculations itself have been evaluated. Include references and source in the Annex]

[Use one of the following options to qualify the status: 1. Legal; 2. Official stamped; 3. Semi official; 4. Use in practice; 5. Under development; 6. Under research)

1.5 Relevant as a Demand Response measure

[Indicate when the case is relevant for DR; if so refer to the separate DR case application description]

2 Formula for calculation of Annual Energy Savings

2.1 Formula used for the calculation of annual energy savings

[Short introduction and provide information on the origin of the formula; please use one of the three options:

- an existing formula (give reference; also in reference list in Annex the traceable source), or
- an adapted version of an existing formula; please describe adaptations in short and give reference for the original formula (also in reference list in Annex the traceable source), or
- self developed (short description; present additional documentation in Annex)]

[Present the formula]

2.2 Specification of the parameters in the calculation

[Provide information on the parameters and the reasoning of selecting those parameters]

2.3 Specification of the unit for the calculation

[The most common units are: an object of assessment; an action or an energy end-user]

2.4 Baseline issues

[Brief description which type of baseline is used in the energy savings calculations. The most commonly used types are:

a. before situation; evaluate the measure against the technique used before
b. stock average; evaluate the measure against the average stock technique
c. market average; evaluate the measure against the average technique on the market
d. common practice; evaluate the measure against the most commonly used technique]

[Describe whether a static or a dynamic baseline is used.
The before situation is always a static baseline. The other methods can be either static (using the values of a base-year or base period) or dynamic (changing over time, for example reflecting the change in most commonly used techniques)]
[Specify if a combination of approaches is used]

[Describe the important assumptions and the reasoning of the choice]

2.5 Normalization

[Normalization is a way to adjust the data in line with a normal situation; most common this is normalization for degree heating or cooling days.]
[Please describe briefly and give sources / references for the normal situation].

2.6 Energy savings corrections

2.6.1 Gross-net corrections

[Specify which (gross to net) corrections have been applied and how these are calculated. Please be clear in the corrections taken into consideration and used to correct.
[The most common categories are: a) double counting; b) free riders; c) technical interactions; d) spill over effects and e) rebound effect]

2.6.2 Corrections due to data collection problem

[Specify which corrections have been applied to handle imperfect data collections e.g. using sales data as a proxy for installation data, using a secondary data source for a bigger region than the region a programme is implemented]

3 Input data and calculations

3.1 Parameter operationalisation

[Describe how the calculation parameters are obtained; both for actual and reference situation.]

[Please also clearly indicate what type of values is used:

a) deemed (rough approximations, expert opinions, etc.)
b) calculated (for example using survey data)
c) measured (for example real measurements taken, billing information, etc.)
d) combination]

3.2 Calculation of the annual savings as applied

[Present the calculation with the values used. Please provide the data is several steps as this improves transparency and understanding]

3.3 Total savings over lifetime

3.3.1 Savings lifetime of the measure or technique selected

[Present information on the lifetime used. Also indicated whether this is an economical lifetime or not.]
[Present the number of years and the source for this value; include the reference in the Annex]

3.3.2 Lifetime savings calculation of the measure or technique

[Present the formula and the conducted calculation. In most cases this will be the outcome of 3.3.1 multiplied with the lifetime years. Please clarify if the energy savings calculated are not the same in all years. Explain if this is the case.]

4 GHG savings

4.1 Annual GHG-savings

4.1.1 Emission factor for energy source

[Present the emission factor used and give reference; included the source in the appendix.]

[Please specify what GHG emissions are included in the calculation: CO_2; CH_4 or N_2O]

4.1.2 Annual GHG-savings calculation as applied

[Present the formula as well as the calculation]

4.2 GHG lifetime savings

4.2.1 Emission factor

[Present the emission factors used when not the same factor is used for the lifetime, and give reference; included the source in the appendix. Otherwise include: The same GHG emission factor(s) are used for the lifetime.]

4.2.2 GHG lifetime savings as applied

[Present the formula as well as the calculation]
[The lifetime should be the same as for the energy savings; if not please clarify]

References

[Please use: Report title, Author, year and if applicable the website]

Annex

[Present in the Annex additional information on methods, data sources etc. to elaborate the data, formulas etc]
[If no or no clear energy savings calculations is used in the case application, but a method could be used, please describe this in an Annex]

Definitions

[Provide definitions used for the target group, unit of saving etc.]