

Improving energy savings in the Korean apartment housing sector



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I Korean apartment housings

II Green housing policy

III Green certification



Seoul Mapo

1962

- The first sample estate in Korea
- Supply for a middle class by government
- Applying a tower in the park



Seoul Sanggea

1986

- The first high-rise apartment
- Central heating system



Ilсан

1995

- Large scale new city development



Pusan Dangam 1998

- Terrace house using a nature ground
- The beginning of a sustainable environment estate



Seoul Nangok

2007

- Redeveloped area
- The last poor village in Seoul



Start Green housing

2009~

● Solar heating apartment house

Site	Osan ('10)
houses	1,179
Collector area	1700m ²
Storage tank	47ton
Cost	\$1,220,000
Energy saving	About 15% of DHW
Payback	\$5.5/month/house



● PV cell apartment house

Item	House Net area	'17	'21
PV cell Capacity [kW]	36m ² (1 house)	0.058	0.15
	84m ² (1 house)	0.14	0.34



The latitude and longitude of main cities

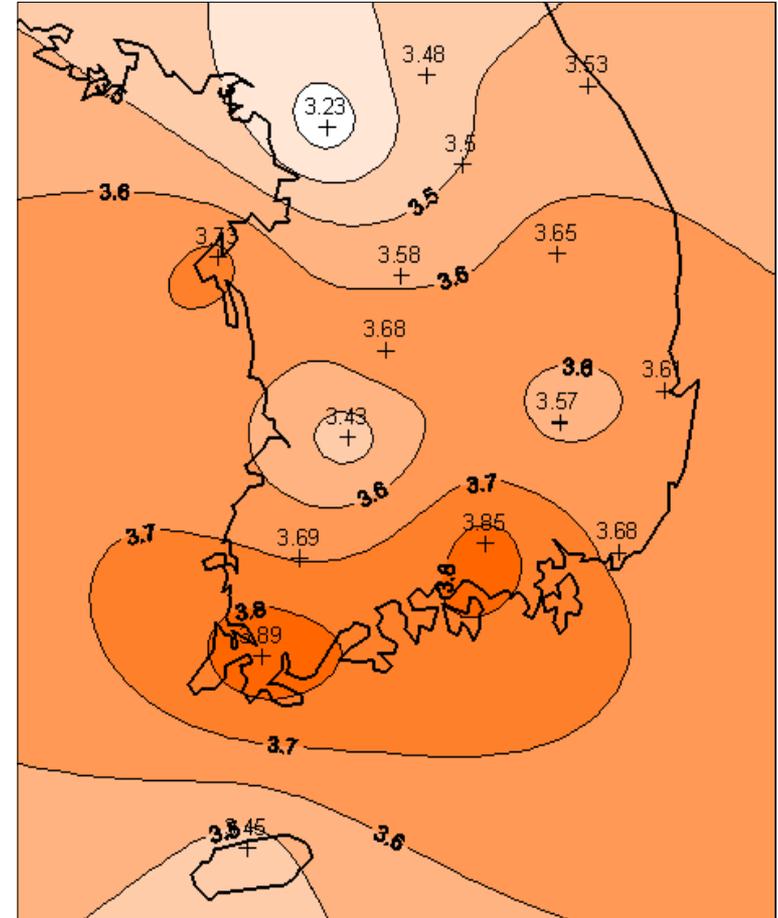
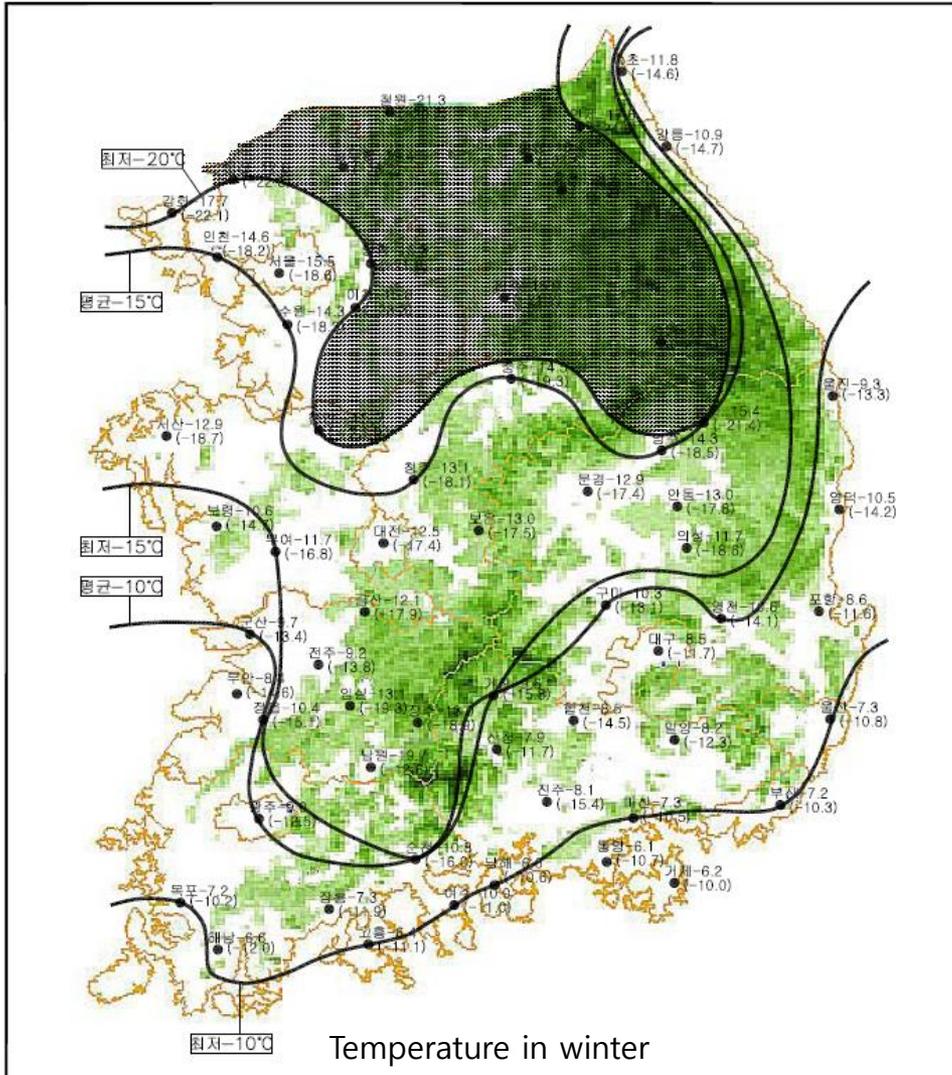


Cities	latitude	longitude
Seoul (Middle 2)	37.7	127
Chun Cheon (Middle 1)	38	127.6
Tae Gu (Southern)	35.5	128
Jeju	33.1	126

Design temperature for heating

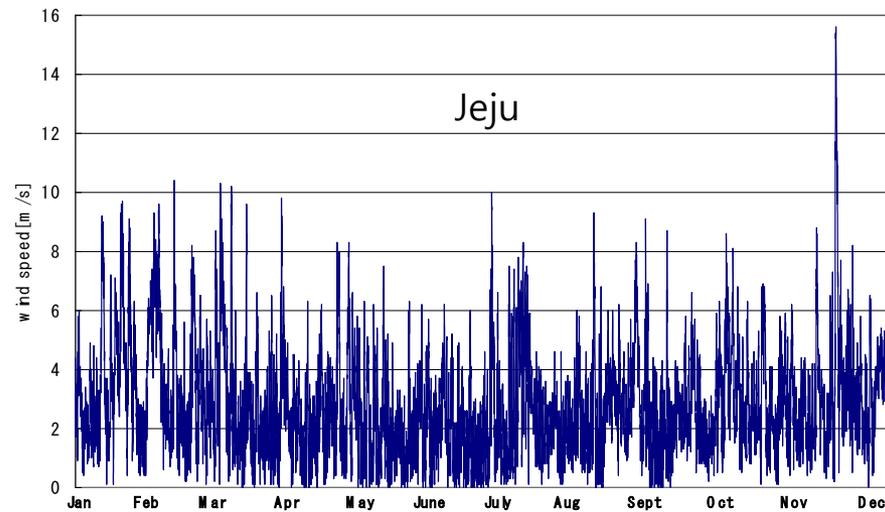
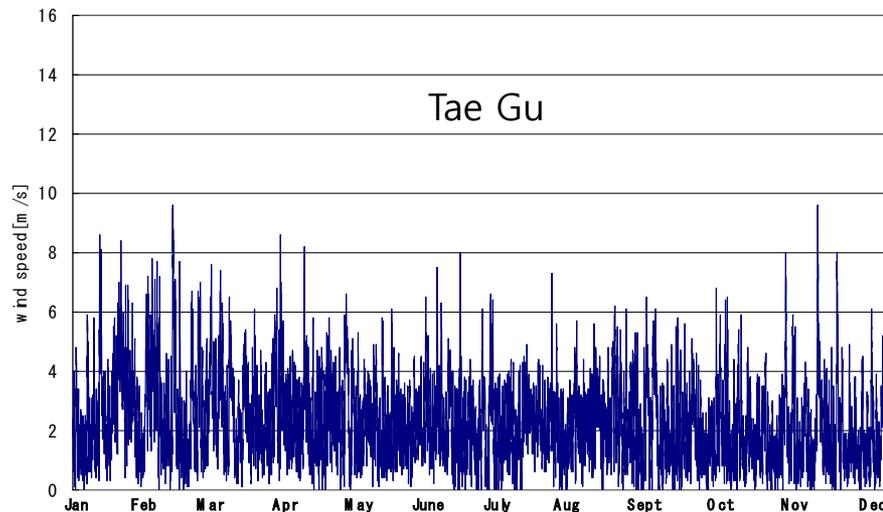
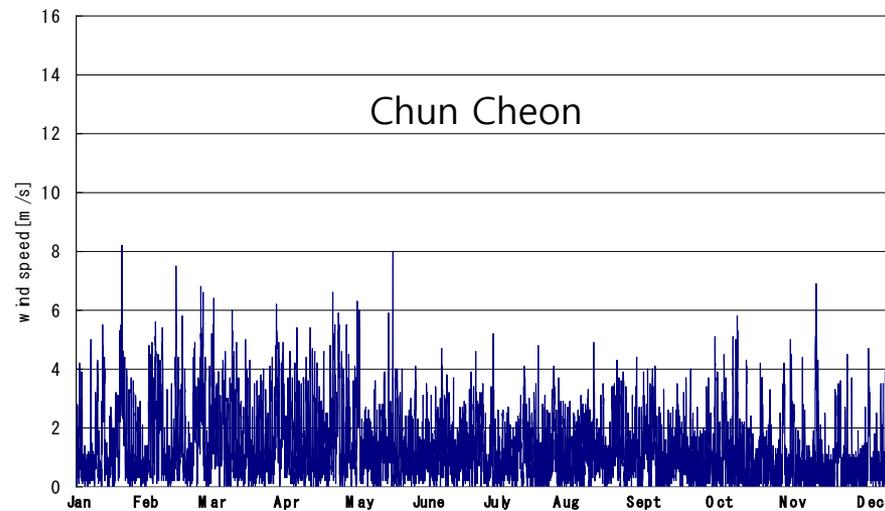
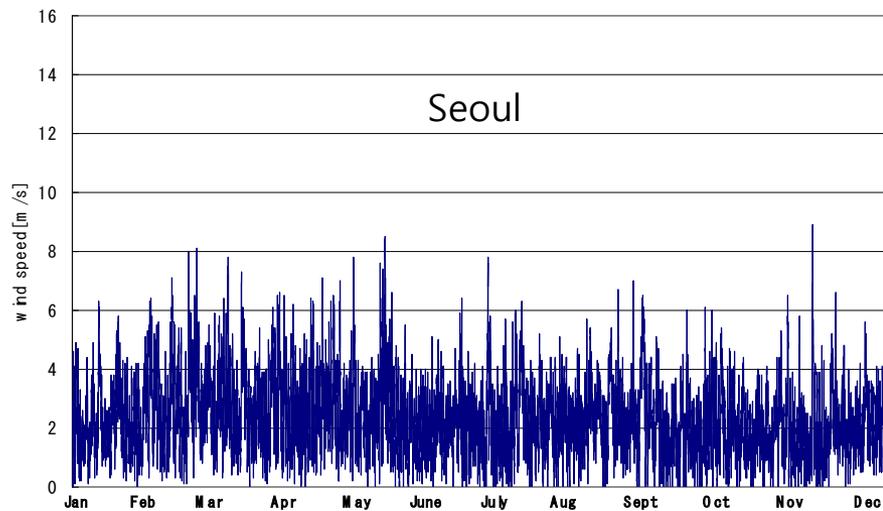
- Seoul : -11.3 °C
- Chun Cheon : -14.7 °C
- Tae Gu : -7.6 °C
- Jeju : 0.1 °C

● Temperature and solar radiation



Average global horizontal solar radiation (kWh/m²/day)

Wind speed



1 | Start Green Housing

● Energy saving goal

- '08. 8.15 The government had published 'Low Carbon and Green Growth'
- '09. 9.19 a Ministry had planned to build 1 million 'Green housing' by 2018
- '09. 11.5 with Six ministries reported the energy saving plan in housing sector to the President
 - ☞ energy saving roadmap for green housing 30% in 2012, 60% in 2017, zero-energy housing by 2025

● Establish of the regulations

- '09. 6 Amendment of the Regulations on housing construction standards
 - ☞ Obligation to design green(eco-friendly) housing for apartment housings with 30 or more housing
- '09.12 Notice『Green housing construction standards and performance』 enforcement
 - ☞ Start to 10~15% energy savings (10% for below floor area 60m², 15% over the area 60m²)
- the Notice amendment '10(15~20%),'12(25~30%), '15(30~40%), '17(50~60%),'19(60%)
'23(zero energy grade 5 for public Institution, '24(nearly zero energy for private)

● Revise the roadmap

- In December 2017 : All apartment housings designed zero energy house in '25 → All apartment housings designed zero energy level 5 in '25

2 | Green Housing Regulations

● Regulation of Housing Construction Standard

- Regulations on housing construction standard Article 64 (Standards for Construction of Energy-saving green Housing)
 - ① In the case of constructing an apartment house that has obtained approval for a construction plan pursuant to Article 15 of the Housing Law, it must be constructed as an energy-saving green house that can reduce total energy consumption and carbon dioxide emissions using any one or more of the following technologies
 1. Low-energy building construction technology such as high insulation and high-functional outer shell structure, airtight design, using sunlight and green materials
 2. Energy-efficient equipment technology such as high-efficiency heat source equipment, control equipment and high-efficiency ventilation equipment
 3. Technology using new and renewable energy such as solar heat, solar power, geothermal heat and wind power
 4. External environment creation technology to secure ecological circulation functions such as preservation of natural ground, securing ecological area ratio and circulation of rainwater
 5. Building energy information technology, automatic control device, and technology to maximize energy use efficiency, such as intelligent power grid

2 | Green Housing Regulations

● Notice in charge Ministry of Land, Infrastructure and Transport

● Construction standards for Green housing

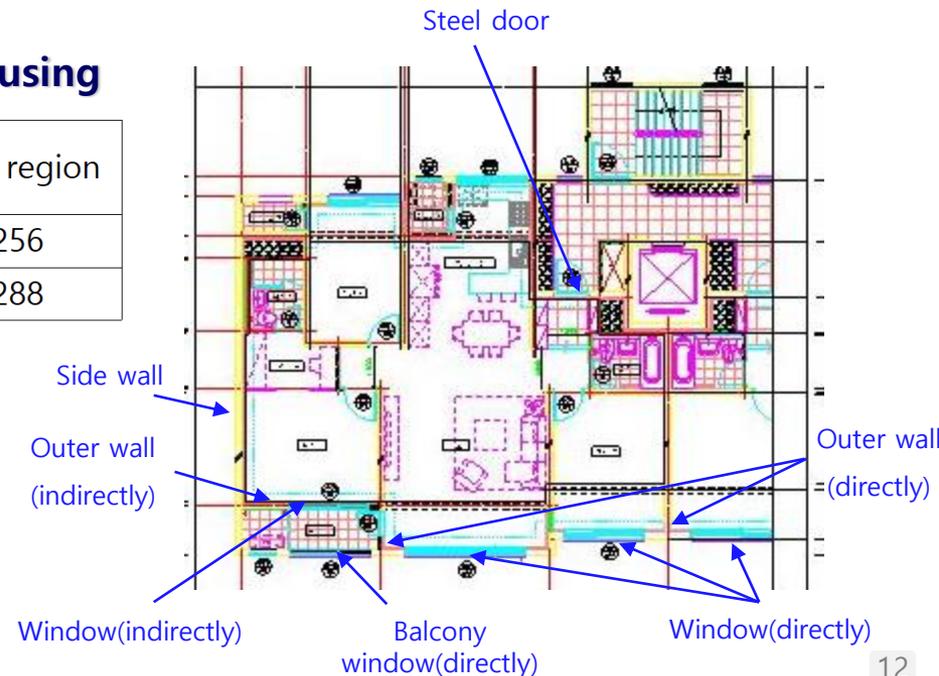
(Article 6) Design recommendations about Preservation of the land, Development density, Ecological function, Sunlight, Renewable energy, Wind ways, Waste recycling, Rainwater recycling.

(Article 7) Green housing must meet one of the following conditions.

- ① Green housing should be designed with a primary energy consumption of less than 120 kWh/m².yr per unit area of the housing in accordance with the evaluation method presented in Article 14.
- ② Green housing must meet all of the following design standards.

● Primary Energy consumption of the criteria housing

Division	Middle 1 Region	Middle 2 Region	Southern region	Jeju region
No Cooling	352	320	288	256
With Cooling	384	352	320	288



2 | Green Housing Regulations

● Raising the green housing design standard ('09~'15)

Items			Energy Savings	0%(’08)	10~15%(Oct. ’09)	25~30%(Nov. ’12)	30~40%(Mar. ’15)
Overall heat transfer coefficient U-value	Window [W/m²K]	cold area	outside air directly	Below 3.0	Below 1.8	Below 1.2	Below 1.0
			outside air indirectly	Below 4.3	Below 2.8	Below 2.8	Below 1.9
		Southern area	outside air directly	Below 3.3	Below 2.1	Below 1.5	Below 1.2
			outside air indirectly	Below 4.7	Below 3.1	Below 2.3	Below 2.1
		Jeju island	outside air directly	Below 4.2	Below 2.8	Below 1.8	Below 1.6
			outside air indirectly	Below 6.0	Below 3.7	Below 2.8	Below 2.5
	Outer wall [W/m²K]	cold area	outside air directly	Below 0.47	Below 0.36	Below 0.25	Below 0.21
			outside air indirectly	Below 0.64	Below 0.49	Below 0.32	Below 0.28
		Southern area	outside air directly	Below 0.58	Below 0.45	Below 0.32	Below 0.28
			outside air indirectly	Below 0.81	Below 0.63	Below 0.47	Below 0.43
		Jeju island	outside air directly	Below 0.76	Below 0.58	Below 0.50	Below 0.46
			outside air indirectly	Below 1.10	Below 0.85	Below 0.62	Below 0.58
	Side wall [W/m²K]	cold area		Below 0.35	Below 0.27	Below 0.20	Below 0.17
		Southern area		Below 0.47	Below 0.36	Below 0.28	Below 0.25
		Jeju island		Below 0.58	Below 0.45	Below 0.35	Below 0.32
	Boiler(heating system)			Above 84% efficiency	Above 87% efficiency	Above 87% efficiency	Above 91% efficiency
	Steel door	outside air directly		-	-	Below U-value 1.4W/m²K Below airtight Level 1	Below U-value 1.4W/m²K Below airtight Level 1
		outside air indirectly		-	-	Below U-value 1.8W/m²K Below airtight Level 2	U-value, Below 1.8W/m²K Below airtight Level 2
Airtight performance((outside air directly)			-	Below airtight Level 2	Below airtight Level 2	Below airtight Level 1	
Window area ratio to walls and windows[%]			-	-	-	(0.0689×Bay + 0.1044)×100	
Balcony window(outside air directly) U value			-	-	-	Below 2.8W/m²K	
Boiler, Transformer, Electric motor			High-efficiency equip.	High-efficiency equipment	High-efficiency equipment	High-efficiency equipment	
Pumps(heating, DHW, Water)			1.12 times of KS efficiency	1.12 times of KS efficiency	1.12 times of KS efficiency	1.12 times of KS efficiency	
Standby power cut-off device			-	Above 1 each in living room, bedroom, and kitchen	Above 1 each in living room, bedroom, and kitchen	Above 1 each in living room, bedroom, and kitchen	
Batch off switch			-	In-house installation	In-house installation	In-house installation	
Household lighting			High-efficiency lighting	High-efficiency lighting	High-efficiency lighting, or LED	High-efficiency lighting, or LED	
Common toilet lighting			-	Automatic flashing switch	Automatic flashing switch	Automatic flashing switch	
Room temperature control device			-	1 for each room	1 for each room	1 for each room	

2 | Green Housing Regulations

● Raising the green housing design standard ('17~'21, Now)

Items			Energy Savings	50~60%(Dec. '17)	60%(July. '21)	
Overall heat transfer coefficient	Window [W/m ² K]	cold area 1	outside air directly	Below 0.9	Below 0.9	
			outside air indirectly	Below 1.3	Below 1.2	
		cold area 2	outside air directly	Below 1.0	Below 0.9	
			outside air indirectly	Below 1.5	Below 1.5	
		Southern area	outside air directly	Below 1.2	Below 1.0	
			outside air indirectly	Below 1.7	Below 1.7	
	Jeju island	outside air directly	Below 1.6	Below 1.5		
		outside air indirectly	Below 2.0	Below 1.7		
	U-value	Outer wall (including side wall) [W/m ² K]	cold area 1	outside air directly	Below 0.15	Below 0.15
				outside air indirectly	Below 0.21	Below 0.21
			cold area 2	outside air directly	Below 0.17	Below 0.17
				outside air indirectly	Below 0.24	Below 0.24
		Southern area	outside air directly	Below 0.22	Below 0.22	
			outside air indirectly	Below 0.31	Below 0.31	
Jeju island		outside air directly	Below 0.29	Below 0.29		
		outside air indirectly	Below 0.41	Below 0.35		
Boiler(heating system)			Above 91% efficiency	Above 92% efficiency		
Steel door	outside air directly		Below U-value 1.4W/m ² K, Below airtight Level 1	Below U-value 1.4W/m ² K Below airtight Level 1		
	outside air indirectly		U-value, Below 1.8W/m ² K, Below airtight Level 2	U-value, Below 1.8W/m ² K, Below airtight Level 2		
Airtight performance(outside air directly)			Below airtight Level 1	Below airtight Level 1		
Window area ratio to walls and windows[%]			(0.0689×Bay + 0.1044)×100	(0.0689×Bay + 0.1044)×100		
Balcony window(outside air directly) U value			Below 2.4W/m ² K	Below 2.4W/m ² K		
Boiler, Transformer, Electric motor			High-efficiency equip.	High-efficiency equip.		
Pumps(heating, DHW, Water)			1.12 times of KS efficiency	1.12 times of KS efficiency		
Standby power cut-off device			Above 1 each in living room, bedroom, and kitchen 30% or more of the total number of outlets	Above 1 each in living room, bedroom, and kitchen 30% or more of the total number of outlets		
Batch off switch			In-house installation	In-house installation		
Illumination density			10W/m ²	8W/m ² 또는 전면 LED		
Renewable energy system, outside insulation system			10 points	25 points		
Household lighting			High-efficiency lighting	High-efficiency lighting		
Common toilet lighting			Automatic flashing switch	Automatic flashing switch		
Room temperature control device			1 for each room	1 for each room		

2 | Green Housing Regulations

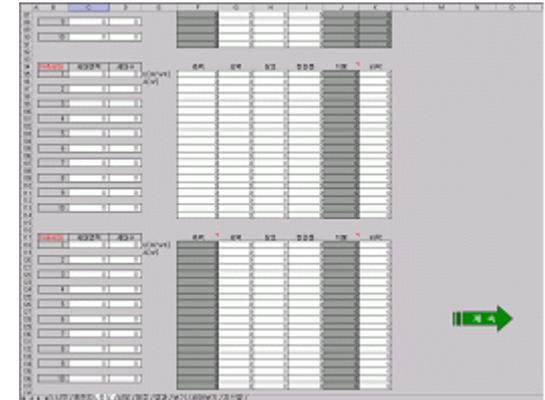
Energy saving calculation software (before December 2017)



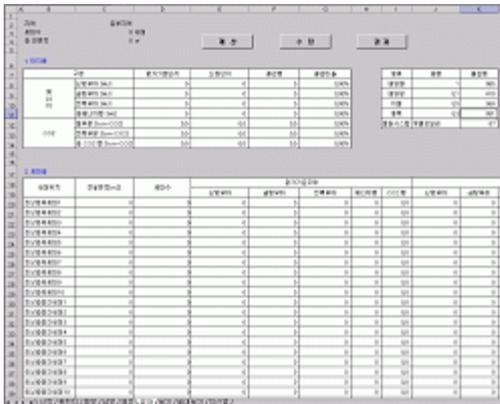
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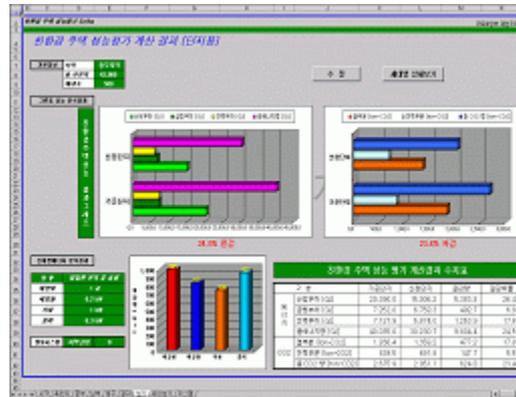
Input data



Thermal insulation data



Calculation



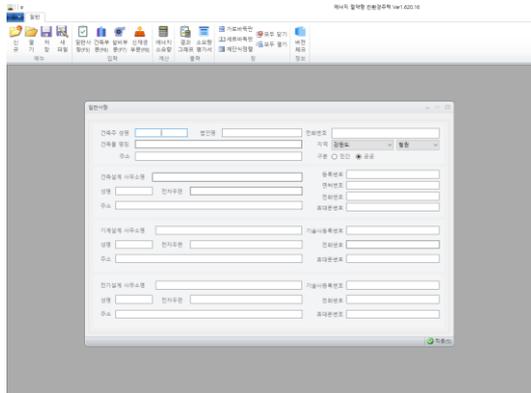
Results (for estate)



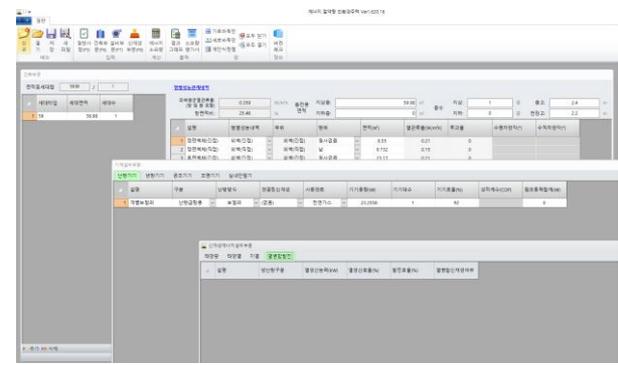
Results (for houses)

2 | Green Housing Regulations

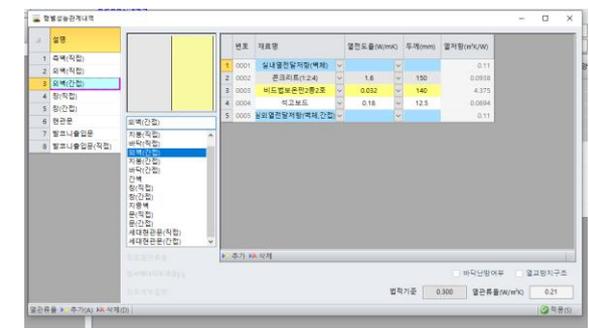
Energy saving calculation software (after December 2017 ~ Now)



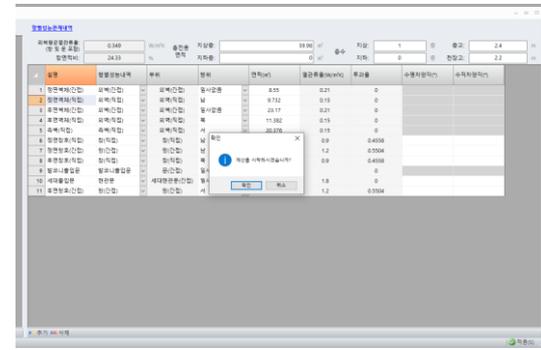
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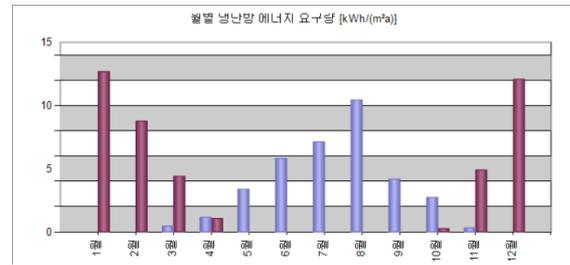
Input data



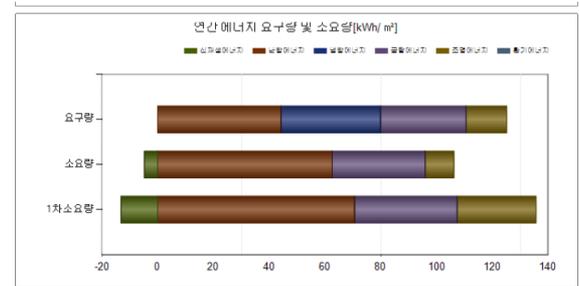
Thermal insulation data



Calculation



Results



	신재생에너지	냉방에너지	냉방에너지	급탕에너지	조명에너지	환기에너지	합계
요구량	0.0	44.2	35.7	30.7	14.6	0.0	125.1
소요량	-4.8	62.6	0.0	33.4	10.3	0.0	106.2
1차소요량	-13.1	70.6	0.0	36.8	28.3	0.0	135.7

2 | Green Housing Regulations

● Additional construction cost

- Additional construction cost criteria according to the energy saving rate is in the Notice, Green housing construction standard
- The additional cost is calculated by multiplying the floor area for each energy saving rate per unit area, and this value is added to the basic construction cost

< Additional cost per unit area by energy saving (Unit : KRW/m²) >

Area \ Energy saving	25%	30%	40%	50%	55%	60%
Middle 1, 2	5,940	11,879	23,758	35,637	41,577	47,516
Southern, Jeju island	4,134	8,269	16,537	24,806	28,940	33,074

- If the energy saving rate exceeds 60%, use the correlations for green housing addition cost

Energy savings[%]	Middle 1	Middle 2	Southern, Jeju island
60~65	$y = 1,794.3X - 107,666$	$y = 1,794.3X - 107,666$	$y = 24.33*(X-60)^{2.93}$
65~70	$y = 1,714.3X - 108,248$	$y = 1,554.3X - 100,372$	$y = 24.33*(X-60)^{2.93}$
70~75	$y = 3,294.3x$	$y = 2,994.8x$	$y = 1,385.8x - 95,944$
Over 75	$y = 3,294.3x$	$y = 2,994.8x$	$y = 2,695.4x$

2 | Green Housing Regulations

● Tables of the additional construction cost (Middle region 2, KRW/m²)

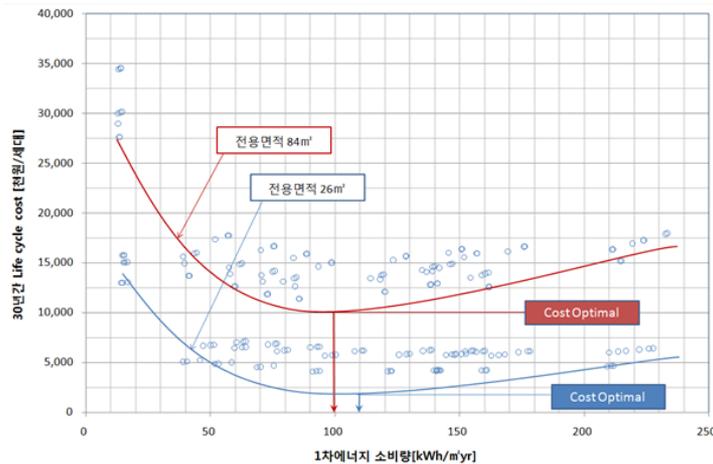
Energy savings[%]	5th floor and below	6th to 10th floor	11th to 15th floor	16th to 20th floor	21th to 25th floor	26th to 30th floor	30 floors and above
20				0			
21				1,188			
22				2,376			
23				3,564			
24				4,752			
25				5,940			
26				7,127			
27				8,315			
28				9,503			
29				10,691			
30				11,879			
31				13,067			
32				14,255			
33				15,443			
34				16,631			
35				17,819			
36				19,006			
37				20,194			
38				21,382			
39				22,570			
40				23,758			
41				24,946			
42				26,134			
43				27,322			
44				28,510			
45				29,698			
46				30,885			
47				32,073			
48				33,261			
49				34,449			
50				35,637			
51				36,825			
52				38,013			
53				39,201			
54				40,389			
55				41,577			
56				42,764			
57				43,952			
58				45,140			
59				46,328			
60				47,516			
61				49,442			
62				51,757			
63				54,504			
64				57,685			
65				61,300			
66				62,759			

Energy savings[%]	5th floor and below	6th to 10th floor	11th to 15th floor	16th to 20th floor	21th to 25th floor	26th to 30th floor	30 floors and above
67				64,880			
68				67,000			
69				69,119			
70				71,240			
71				73,360			75,324
72				75,480		77,445	79,409
73				77,599	79,565	81,529	83,495
74				79,720	83,650	85,614	87,580
75				81,840	87,735	89,699	91,665
76				83,960	85,925	91,819	93,785
77				86,081	90,010	95,904	97,870
78				88,200	90,164	94,094	99,989
79				90,320	94,250	98,179	101,954
80				92,441	98,335	102,265	104,075
81				94,561	102,420	108,160	110,124
82				96,680	106,505	110,124	112,089
83				98,800	110,589	114,519	
84				100,921	114,674	118,604	
85	103,041	105,008	118,759	122,689			
86	105,160	109,090	122,845	126,774			
87	107,281	113,175	126,930	130,859			
88	109,401	117,260	131,014	134,943			
89	111,521	121,346	135,099	139,028			
90	113,642	125,431	139,184	143,114			
91	115,761						
92	117,881						
93	120,001						
94	122,122						
95	124,241						
96	126,361						
97	128,482						
98	130,602						
99	132,721						
100	134,842						

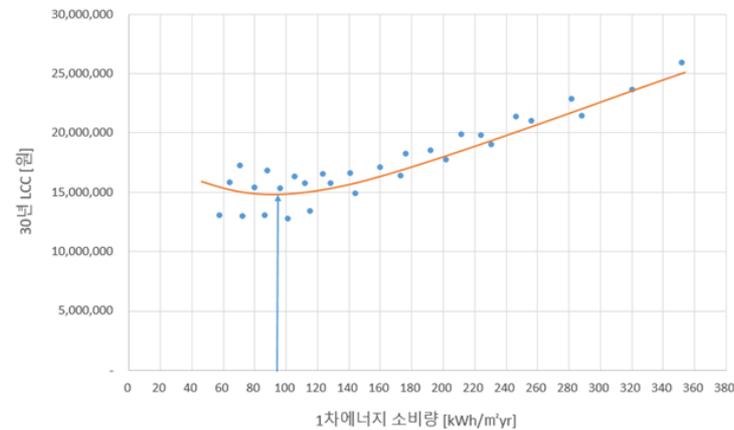
3 | Energy Saving Roadmap

● Cost Optimal Level

- Net present value (NPV) calculation for 30 years of housing use by considering investment cost, energy cost, maintenance cost, and real financial discount rate
- After applying the current level of passive technology first, cost analysis according to the primary energy consumption according to the scenario where the solar system and the external insulation system are applied later
- In 2017, the cost optimization point was about 110 kWh/m²yr for the floor area of 26m², and about 100 kWh/m²yr for 84m² of the primary energy consumption of heating, hot water, and lighting
- In 2020, the cost optimization point was about 90~100kWh/m²for the area of 60m² or more which is lower than in '17 evaluated



(a) Dec. 2017



(b) March 2020

Analysis of cost optimization level according to primary energy consumption(heating, hot water, lighting)

3 | Energy Saving Roadmap

● Energy saving roadmap (Before Dec. '21)

- 2022 : Energy efficiency level 1++ (only 60m² or more, zero energy grade 5, Cost Optimal Level)
- 2025 : Zero Energy Level 5 (all apartment housings)

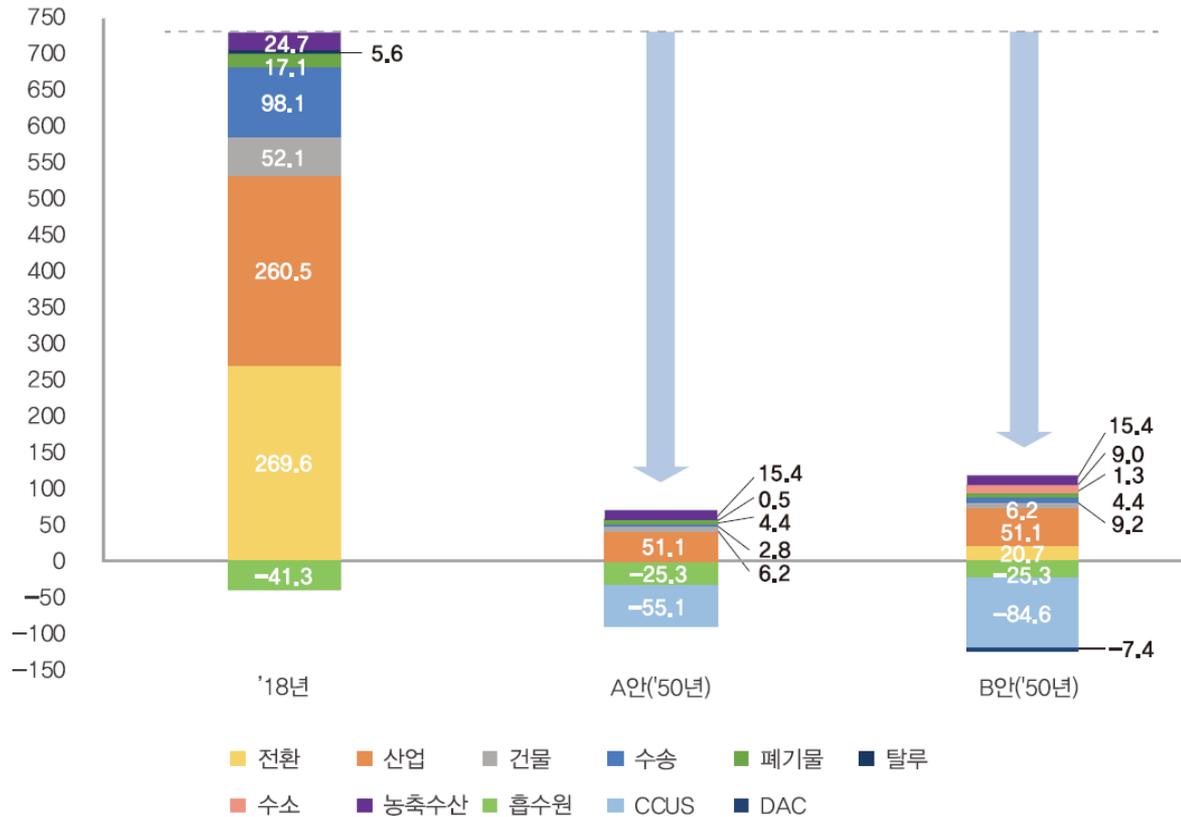
Division	2018 year	2020 year	2022 year	2025 year
Energy efficiency level	1+	1+	1++	1++
Primary energy [kWh/m ² yr]	Below 120	Below 100	Below 90	Below 80
Qualitative indicator	Passive house	Renewable energy installation	Zero energy level 5 for over 60m ²	Zero energy level 5 for all apartment houses
Energy savings	60%	65%	70%	75%

3 | Energy Saving Roadmap

2050 Carbon neutral scenario

Two scenarios for net zero green house gas emission in 2050 (727.6 million tons in '18)

- Plan A : to reduce emissions as much as possible, such as out of use of thermal power generation
- Plan B : to utilize CO₂ removal technologies such as CCUS instead of fossil power generation remaining



Transformation (Electricity)

Items	Plan A		Plan B	
	Value	Percentage	Value	Percentage
Nuclear	76.9	6.10%	86.9	7.20%
Coal	0	0%	0	0%
LNG	0	0%	61	5.00%
Renewable E	889.8	70.80%	736	60.90%
Fuel cell	17.1	1.40%	121.4	10.10%
Asia Grid	0	0%	33.1	2.70%
Gas Turbine	270	21.50%	166.5	13.80%
BPG	3.9	0.30%	3.9	0.30%
Total	1257.7	100%	1257.7	100%
CO2 Emission [million ton]	0		20.7	

3 | Energy Saving Roadmap

● 2030 NDC

- Setting the Green House Gas emissions in the 「Carbon Neutral Framework Law」

* GHG emission in '30 should be reduced by 35% or more compared to '18 (Article 8, Paragraph 1)

- GHG 26.3% reduction compared to '18 (727.6 million tons) → 40% reduction ('30, 436.5 million tons)

Items	Sectors	Base year('18)	NDC(before '21.10)	NDC(now)
Total Carbon Emissions		727.6 million tons	536.1 million tons (△191.6, △26.3%)	436.6 million tons (△291.0, △40.0%)
Emissions	Transformation(Elec.)	269.6	192.7 (△28.5%)	149.9 (△44.4%)
	Industry	260.5	243.8 (△6.4%)	222.6 (△14%)
	Building	52.1	41.9 (△19.5%)	35.0 (△32.8)
	Transportation	98.1	70.6 (△28.1%)	61.0 (△37.8%)
	Agriculture, Livestock Fisheries	24.7	19.4 (△21.6%)	18.0 (△27.1%)
	Waste	17.1	11.0 (△35.6%)	9.1 (△46.8%)
	Hydrogen	-	-	7.6
	Etc.	5.6	5.2	3.9
Absorption and Removal	Absorption resource	-41.3	-22.1	-26.7
	CCUS	-	-10.3	-10.3
	Overseas reduction	-	-16.2	-33.5

3 | Energy Saving Roadmap

● Energy saving roadmap changes

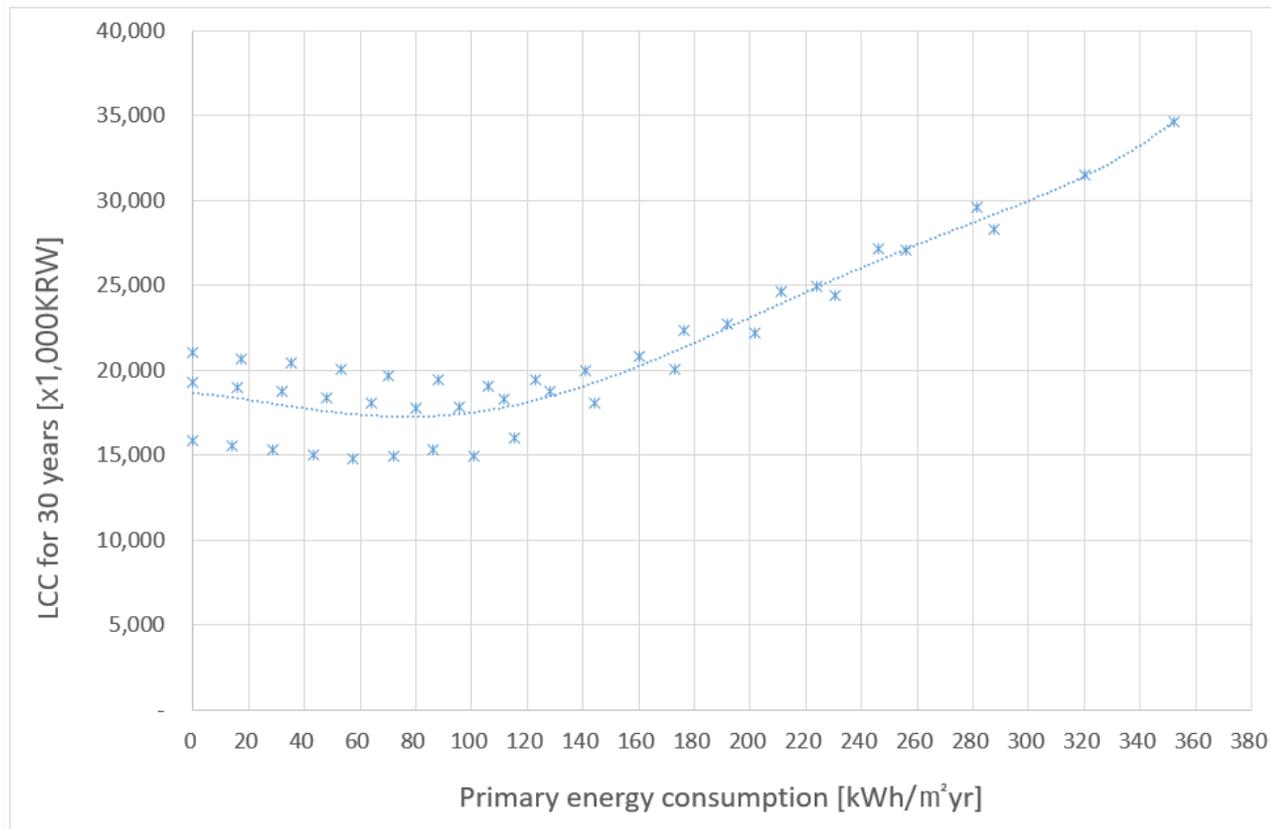
- Change of the Land, Infrastructure and Transport Carbon Neutral Roadmap (Dec. 2021)
- Early implementation of the Zero-energy building for apartment housings according to revised 2030 NDC (public : '23 ZEB 5, Private : '24 nearly ZEB 5)

	'20	'23	'24	'25	'30
Public	Floor area 1,000m ² over building (ZEB 5 Grade)	Floor area 500m ² over building, Over 30 houses in apartment complex (ZEB 5 Grade)	-	nearly ZEB 4	nearly ZEB 3
Private	-	-	Over 30 houses in apartment complex (nearly ZEB 5)	Floor area 1,000m ² over building (nearly ZEB 5)	Floor area 500m ² over building (nearly ZEB 5)

3 | Energy Saving Roadmap

● Energy saving roadmap proposal

- Middle 1 region : 100, Middle 2 region : 80~90kWh/m²·yr
- Southern and Jeju Island : 60kWh/m²·yr, Considering the entire region : 85kWh/m²·yr
- Primary Energy is 60kWh/m²·yr in the zero energy grade 4, so it is difficult to achieve zero energy grade 4 in the public sector in 25 years. It is proposed to achieve zero energy level 5 in both public and private sectors in 2025, and raise to the zero energy grade 4 in 2030.



1 | Green and Energy Regulations

● Green Building Certification and Energy Saving Regulations

Items	Green Building Certification	Building energy efficiency grade certification and zero energy grade	Energy saving design standards for buildings	(Energy saving) Green housing Construction standards
Related Laws	Article 16 of the 「Green Building Construction Support Act」	Article 17 of the 「Green Building Construction Support Act」	Article 17 of the 「Green Building Construction Support Act」	Article 64 「Regulations on housing construction standards」
Ministry in charge	Ministry of Land, Infrastructure and Transport, Ministry of Environment	Ministry of Land, Infrastructure and Transport, Ministry of Trade, Industry and Energy	Ministry of Land, Infrastructure and Transport, Ministry of Trade, Industry and Energy	Ministry of Land, Infrastructure and Transport
Purpose	Induce resource-saving, nature-friendly buildings	Supply of energy-saving buildings and housings	Supply of energy-saving buildings and housings	Supply of energy-saving and green houses
Target Buildings	Apartment houses, office, schools, retail, accommodation, etc.	Detached house, apartment house, school, office, etc.	All buildings except apartment housings	Apartment housings
Evaluation items	25~51 items depending on the buildings	Energy consumption per unit area	EPI(Energy performance index) points	1. Energy consumption per unit area 2. 16 Design obligations, insulation, boiler, lighting, renewable system. etc
Obligation or not	Voluntary certification (Obligation for public buildings)	Voluntary certification (Obligation for public buildings, and Apartment housings(30 more) in '23)	Obligation for buildings with floor area 500m ² or more	Obligation for apartment housing with over 30 houses
When to apply	1st certification : after construction approval 2nd certification : after approval for use	Same as left	Upon approval of construction project	Same as left
Incentive	Acquisition tax reduction, floor area ratio easing, bidding point	Acquisition tax reduction, floor raise the floor area ratio, bidding point	Acquisition tax reduction, raise the floor area ratio	Acquisition tax reduction, and add to the sale price
Grades	the Best, excellent, very good, good	Energy efficiency grade 1+++ ~ 7 (10 grades) Zero energy 5~1 grades (energy efficiency grade 1++ & Produced energy by renewable energy system 20~100%)	Public : 74 points Private : 65 points	Primary energy consumption, and energy saving rate
Evaluating Agency	10 institutions	9 institutions	6 institutions	10 institutions

2 | Zero Energy Building Certification

▶ Overview of the zero energy building certification

- ☑ Definition : Green building that minimizes the heating and cooling load required by the building, and minimizes energy consumption by applying renewable energy
- ☑ Relevant Laws : (1) Green building construction support law
(2) Building energy efficiency rating and zero energy building certification standards
- ☑ Government department : Ministry of Land, Infrastructure and Transport,
Ministry of Trade, Industry and Energy
- ☑ Operations, and certification body : Korean Energy Agency

▶ Obligatory buildings

- ☑ New construction, reconstruction, and expansion with a total floor area of 1,000m² or more, Apartment housing for over 30 households

▶ Minimum requirement for certification

- ☑ Primary energy consumption 90kWh/m²yr or less, and higher than 20% energy production by renewable energy systems

$$\text{Energy independence rate (\%)} = \frac{\text{Primary energy production per unit area by renewable energy}}{\text{Primary energy consumption per unit area}} \times 100$$

* Primary energy is calculated by ISO 13790(2008)
Energy performance of buildings - Calculation of energy use for space heating and cooling)

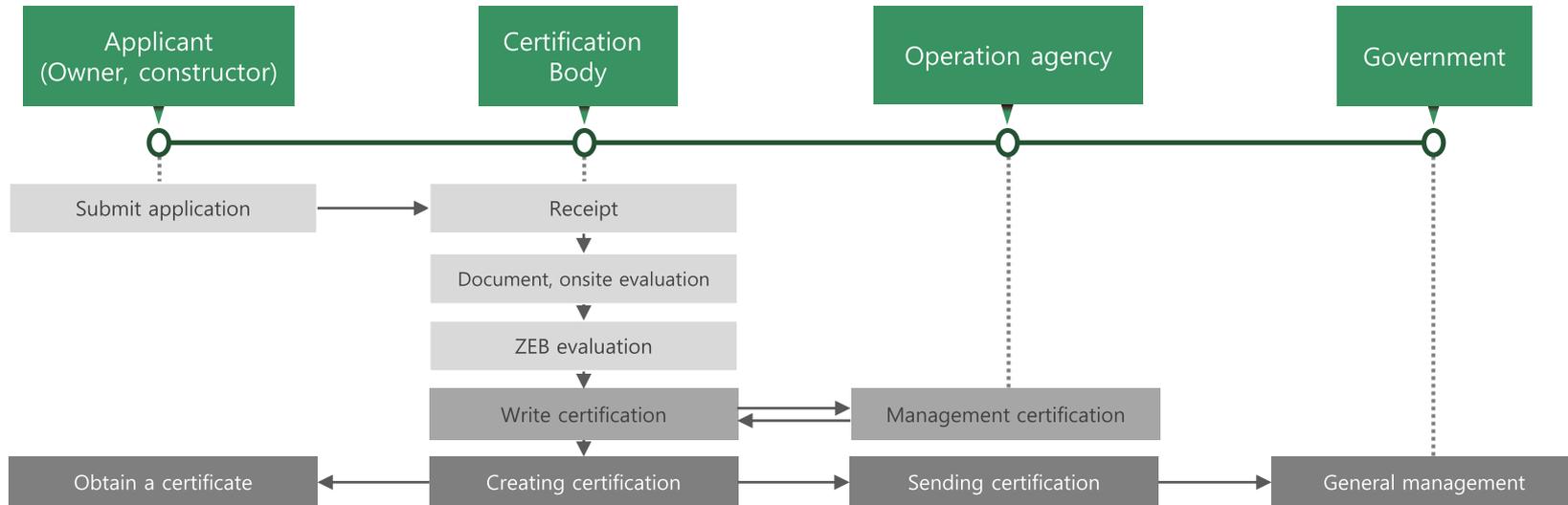
- ☑ Installation of a building management system or an electronic remote measurement system

2 | Zero Energy Building Certificaiton

▶ Grades

the Grades	Energy independence rate
ZEB 1	More than 100%
ZEB 2	80% more ~ 100% under
ZEB 3	60% more ~ 80% under
ZEB 4	40% more ~ 60% under
ZEB 5	20% more ~ 40% under

▶ Process



2 | Zero Energy Building Certificaiton

▶ Incentives

Items	Details												
Relaxation of Standard	<p>☑ Permission of a relaxation ratio according to the certification grade to the limited floor area ratio (Ratio of the total floor area of the building to the total site area) and maximum height of the building specified in laws and ordinances</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr style="background-color: #c6e0b4;"> <th>Certification grades</th> <th>ZEB 1</th> <th>ZEB 2</th> <th>ZEB 3</th> <th>ZEB 4</th> <th>ZEB 5</th> </tr> </thead> <tbody> <tr> <td>Max. relaxation ratio</td> <td>15%</td> <td>14%</td> <td>13%</td> <td>12%</td> <td>11%</td> </tr> </tbody> </table>	Certification grades	ZEB 1	ZEB 2	ZEB 3	ZEB 4	ZEB 5	Max. relaxation ratio	15%	14%	13%	12%	11%
	Certification grades	ZEB 1	ZEB 2	ZEB 3	ZEB 4	ZEB 5							
	Max. relaxation ratio	15%	14%	13%	12%	11%							
Priority support for renewable energy installation subsidies	<p>☑ 30~50% subsidy is provided according to the support amount in the renewable energy installation subsidy notice, and subsidy is paid when the building is completed and the renewable system installation is confirmed</p>												
Increase the loan limit of the housing and urban Fund	<p>☑ Housing and Urban Fund loan limit increased by 20% for public rental housing and pre-sale housing certified as zero-energy buildings</p>												
Reducing the burden of donating infrastructure	<p>☑ Maximum 15% reduction is applied to the infrastructure donation burden level, that is 8% of the construction site area</p>												
Tax reduction	<p>☑ 15~20% reduction of the acquisition tax</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr style="background-color: #c6e0b4;"> <th>Grades</th> <th>ZEB 1</th> <th>ZEB 2</th> <th>ZEB 3</th> <th>ZEB 4</th> <th>ZEB 5</th> </tr> </thead> <tbody> <tr> <td>Reduciton rate</td> <td></td> <td>20%</td> <td></td> <td>18%</td> <td>15%</td> </tr> </tbody> </table>	Grades	ZEB 1	ZEB 2	ZEB 3	ZEB 4	ZEB 5	Reduciton rate		20%		18%	15%
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	Reduciton rate		20%		18%	15%							
Support for installation of energy saving facilities	<p>☑ 20 million won to 15 billion won according to the guideliens (3-year grace period, 5 year repayment, variable interest)</p>												
Certification fee reduction	<p>☑ Certification fee reduction for private buildings</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr style="background-color: #c6e0b4;"> <th>Grades</th> <th>ZEB 1</th> <th>ZEB 2</th> <th>ZEB 3</th> <th>ZEB 4</th> <th>ZEB 5</th> </tr> </thead> <tbody> <tr> <td>Reduciton rate</td> <td></td> <td>100%</td> <td></td> <td>50%</td> <td>30%</td> </tr> </tbody> </table>	Grades	ZEB 1	ZEB 2	ZEB 3	ZEB 4	ZEB 5	Reduciton rate		100%		50%	30%
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	Reduciton rate		100%		50%	30%							

2 | Zero Energy Building Certificaiton

▶ Integrated plan for building energy efficiency rating and zero energy building certification

- ✔ Certification grade reorganization from the ZEB 5 grade system to a ZEB 6 expanded to "Zeb plus"
- ✔ Energy independence rates and primary energy consumptions will be applied as a certification standard

Present				
"Primary energy" and "Energy independent" evaluation				
Energy efficiency grades			ZEB grades	
Grades	Primary energy (kWh/m ² ·yr)		Grades	Energy independence
	residential	Non-resid.		
			ZEB 1	100%
			ZEB 2	80%
			ZEB 3	60%
1+++	Under 60	Under 80	ZEB 4	40%
1++	Under 90	Under 140	ZEB 5	20%
1+	Under 120	Under 200		
1	Under 150	Under 260		
2	Under 190	Under 320		
3	Under 230	Under 380		
4	Under 270	Under 450		
5	Under 320	Under 520		
6	Under 370	Under 610		
7	Under 420	Under 700		

Reorganization plan('25)					
Basic "Energy independent", Supplementary "Primary energy"					
Grades	independence	Primary energy (kWh/m ² ·yr)		Energy saving system	Note
		Residential	Non residen.		
ZEB Plus	120% more	Under -10	Under -70	Installation or not	Independent is same Primary energy is newly (Supplementary)
ZEB 1	100% more	-10 ~ 10	-70 ~ -30		
ZEB 2	80% more	10 ~ 30	-30 ~ 10		
ZEB 3	60% more	30 ~ 50	10 ~ 50		
ZEB 4	40% more	50 ~ 70	50 ~ 90		
ZEB 5	20% more	70 ~ 90	90 ~ 130		
	Basic	Supplementary			

2 | Zero Energy Building Certificaiton

▶ Pilot estates for zero energy certification

Division		In-Cheon AA10-2	Gwa-Cheon S-3	Guri-Galme A-2	Guri-Galme A-3	Guri-Galme A-5
Total floor area		88,196.55㎡	76,115.01㎡	34,080.33㎡	28,482.27㎡	33,730.55㎡
Building-to-land ratio /Floor area ratio		21.17/173.79%	20.92/216.28%	20.16/199.28%	21.66/194.3%	24.27/192.5%
Floors		4~25 Floors	37 Floors	8~15 Floors	12~15 Floors	15 Floors
Housings/ Floor area		26~46㎡ 1,188 housings	55~59㎡ 547 housings	37~42㎡ 386 housings	26~36㎡ 477 housings	26~36㎡ 566 housings
Construction cost		1,742.0KR₩/㎡	2,174KR₩/㎡	-	-	-
Passive	Wall	0.133 W㎡·K	0.133 W㎡·K	0.144 W㎡·K	0.144 W㎡·K	0.145 W㎡·K
	Wall(indirect)	0.211 W㎡·K	0.209 W㎡·K	0.227 W㎡·K	0.227 W㎡·K	0.230 W㎡·K
	Roof	0.133 W㎡·K	0.149 W㎡·K	0.149 W㎡·K	0.149 W㎡·K	0.149 W㎡·K
	Floor	0.230 W㎡·K	0.236 W㎡·K	0.236 W㎡·K	0.232 W㎡·K	0.238 W㎡·K
	Window	1.189 W㎡·K	0.936 W㎡·K	1.171 W㎡·K	1.178 W㎡·K	0.769 W㎡·K
	ETICS	Not installed	Not installed	Not installed	Not installed	Not installed
Infiltration		6 vol./h	6 vol./h	6 vol./h	6 vol./h	6 vol./h
Active	Heating	DHW	DHW	DHW	DHW	DHW
	Hot water	DHW	DHW	DHW	DHW	DHW
	Cooling	Package aircond.	-	-	-	-
	Ventilation effic. (heating/cooling)	Not installed	75% / 67%	74% / 70%	70% / 50%	81.7% / 69.3%
	Light density	-	5.37W/㎡	4.73W/㎡	4.34W/㎡	4.39W/㎡
Renewable	Photo Voltaic (Power)	2,272㎡ (0.32kW)	272.22kW (0.50kW)	145.04kW (0.38kW)	87.80kW (0.39kW)	191.52kW (0.34kW)
	Geo-thermal	Not installed	Not installed	Not installed	Not installed	Not installed
Primary energy (kWh/㎡·yr)		120.04	108.50	103.7	109.9	114.7
Energy productions (kWh/㎡·yr)		35.74	23.54	25.8	25.0	27.9
Primary energy for grades (kWh/㎡·yr)		84.3	85.0	77.9	84.9	86.8
Energy independence		29.78%	21.69%	24.88%	22.75%	24.32%
ZEB Level		5 Grade	5 Grade	5 Grade	5 Grade	5 Grade



3 | Green Building Certification

▶ Green Building Certification overview

☑ Obligatory buildings

- Public buildings with a total floor area of 3000m² or more built by public institutions
- Apartment housings with more than 500 houses
- Seoul City green building design standards : green grade 4 ~ green grade 1

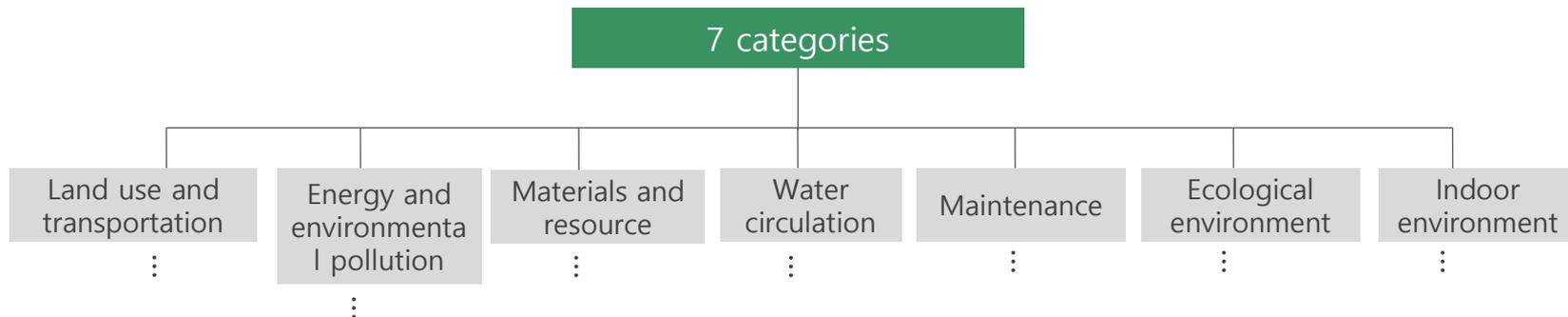
☑ Buildings subject to certification

- They are divided into new buildings and existing buildings, and are classified into residential buildings and non-residential buildings
 - * Residential : Ordinary house (i.g. row housing), apartment housings
 - * Non-residential : Ordinary building, office building, School, Accommodation, Retail

☑ Buildings subject to certification exclusion

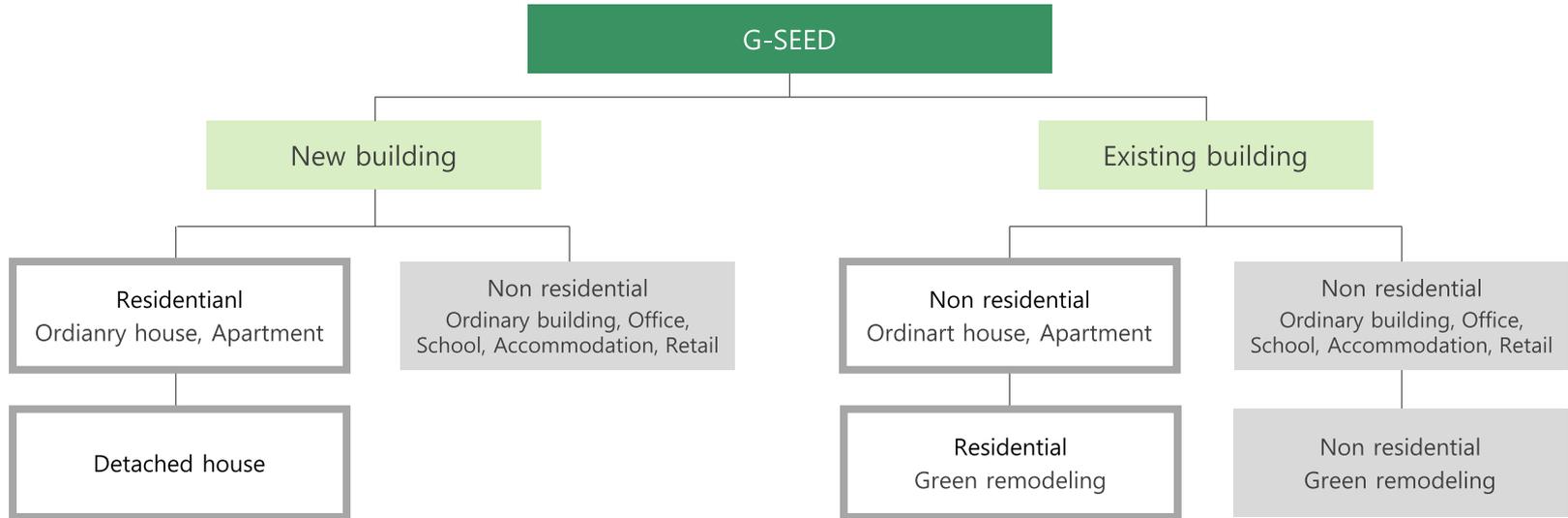
- National defense military facilities within military bases

☑ Certification evaluation items



3 | Green Building Certification

▶ Buildings subject to certification



▶ Number of evaluation items by building types

✔ Residential building



✔ Non residential building



3 | Green Building Certification

▶ Score criteria for certification level

✔ New Building

Certification level	Scores			Note
	Residential	Detached house	Non residential	
The Best (Green 1)	74 points or more	74 points or more	80 points or more	100 points perfect
Excellent (Green 2)	66 points or more	66 points or more	70 points or more	
Very good (Green 3)	58 points or more	58 points or more	60 points or more	
Good (Green 4)	50 points or more	50 points or more	50 points or more	

✔ Existing Building

Certification level	Scores		Note
	Residential	Non residential	
The Best (Green 1)	69 points or more	75 points or more	100 points perfect
Excellent (Green 2)	61 points or more	65 points or more	
Very good (Green 3)	53 points or more	55 points or more	
Good (Green 4)	45 points or more	45 points or more	

✔ Green Remodeling Building

Certification level	Non residential		Note
	Residential	Non residential	
The Best (Green 1)	69 points or more	75 points or more	100 points perfect
Excellent (Green 2)	61 points or more	65 points or more	
Very good (Green 3)	53 points or more	55 points or more	
Good (Green 4)	45 points or more	45 points or more	

3 | Green Building Certification

▶ Evaluation items by building types

Sectors	Ordinary house	Apartment housings	Detachend house	Ordinary building	Office building	School	Retail	Accommodation	
Land use and transportation	Ecological value before land development								
	Avoid excessive underground development		-	Avoid excessive underground development					
	minimize the amount of cut soil		-	minimize the amount of cut soil					
	Validity of measures to prevent sunlight access								
	-	Pedestrian-only road connection within estate		-	-	Layout plan for sunlight		-	-
	Proximity to public transportation								
	Suitability of bicycle parking lots and bicycle paths		Bicycle storage area and its path connection	Installation of bicycle parking lot					
Accessibility of amenities				-	-	-	-	-	
Energy and environmental pollution	Energy saving performance(9.6 points more for Green 1, 7.2 for the Green 2)		Energy saving performance	Energy saving performance (9.6 points more for the Green 1 and the Green 2)					
	-	-	-	TAB(Test, adjustment, implementation, Balancing) implementation					
	Energy monitoring and management system			-	Energy monitoring and management system				
	-	-	-	-	Lighting energy saving				
	renewable energy use								
	Application of low-carbon energy source technology(domestic heating etc.)								
	Protecting the ozone layer and reducing global warming(refrigerant, EPS insulation etc.)								
-	-	-	-	solar radiation control to save cooling energy			-	-	
Material and resource	Use of EPD(Environmental Product Declaration)								
	Use of low carbon materials								
	Use of resource recycling material								
	Harmful substance reduction materials			-	Harmful substance reduction materials				
	Application rate of green building materials			-	Application rate of green building materials				
	Installation of storage facilities for recyclable materials			-	Installation of storage facilities for recyclable materials				

3 | Green Building Certification

▶ Evaluation items by building types

Sectors	Ordinary house	Apartment housings	Detachend house	Ordinary building	Office building	School	Retail	Accommodation
Water circulation management	Rainwater management		-	Rainwater management				
	Use rainwater and runoff underground water							
	Use Water saving devices							
Maintenance	Water usage monitoring		-	Water usage monitoring				
	Management plan for construction site		-	Management plan for construction site				
	Provision of operation maintenance documents and manuals		-	Provision of operation maintenance documents and manuals				
	Provision of user manuals		Have user manuals	-	-	Playground dust prevention	-	-
Ecological environment	Provision of green building certification information		-	Provision of green building certification information				
	-	Creation of a green strip	-	-	-	Creation of a green strip	-	-
	Green area rate on a natural ground		-	Green area rate on a natural ground				
	Ecological area rate(Rooftop greening, permeable pavement, grass, trees, etc)							
Indoor environment	Creating biotope		-	Creating biotope				
	-	-	-	-	-	Creation of an ecological learning center	-	-
	Use of low emission indoor pollutant products							
	Natural ventilation performance							
Indoor environment	Ventilation performance		-	Outdoor air supply and exhaust design				
	-	-	-	-	-	-	CO ₂ monitoring system operation	-
	Room temperature control device performance							
	-	-	Building placement for sunlight	-	Indoor air quality control	-	-	-
	Reduction of light impact sound		-	-	-	-	-	-
	Reduction of heavy impact sound		-	-	-	-	-	-
	Sound insulation of boundary walls between households		-	-	-	Shading device of direct beam solar radiation	-	Sound insulation of boundary walls between guest room
	Prevent traffic noise		-	Prevent traffic noise				
Toilet water and drainage noise		-	Establish an area just for rest					

Thank you.