Think Green Energy in Urban, National & Citizen Perspective

11 April 2019, University of Seoul

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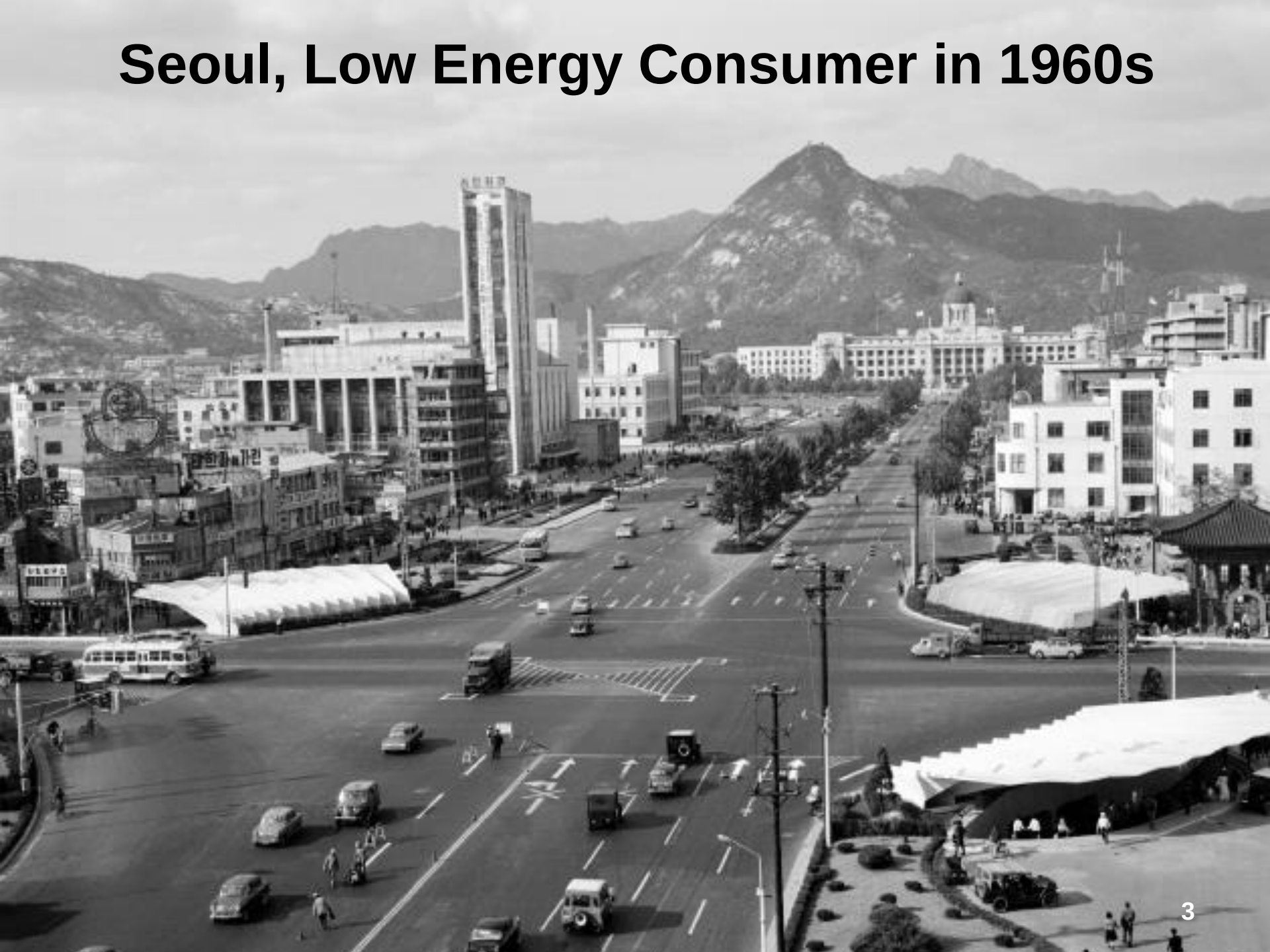
I. Urban Perspective : Program

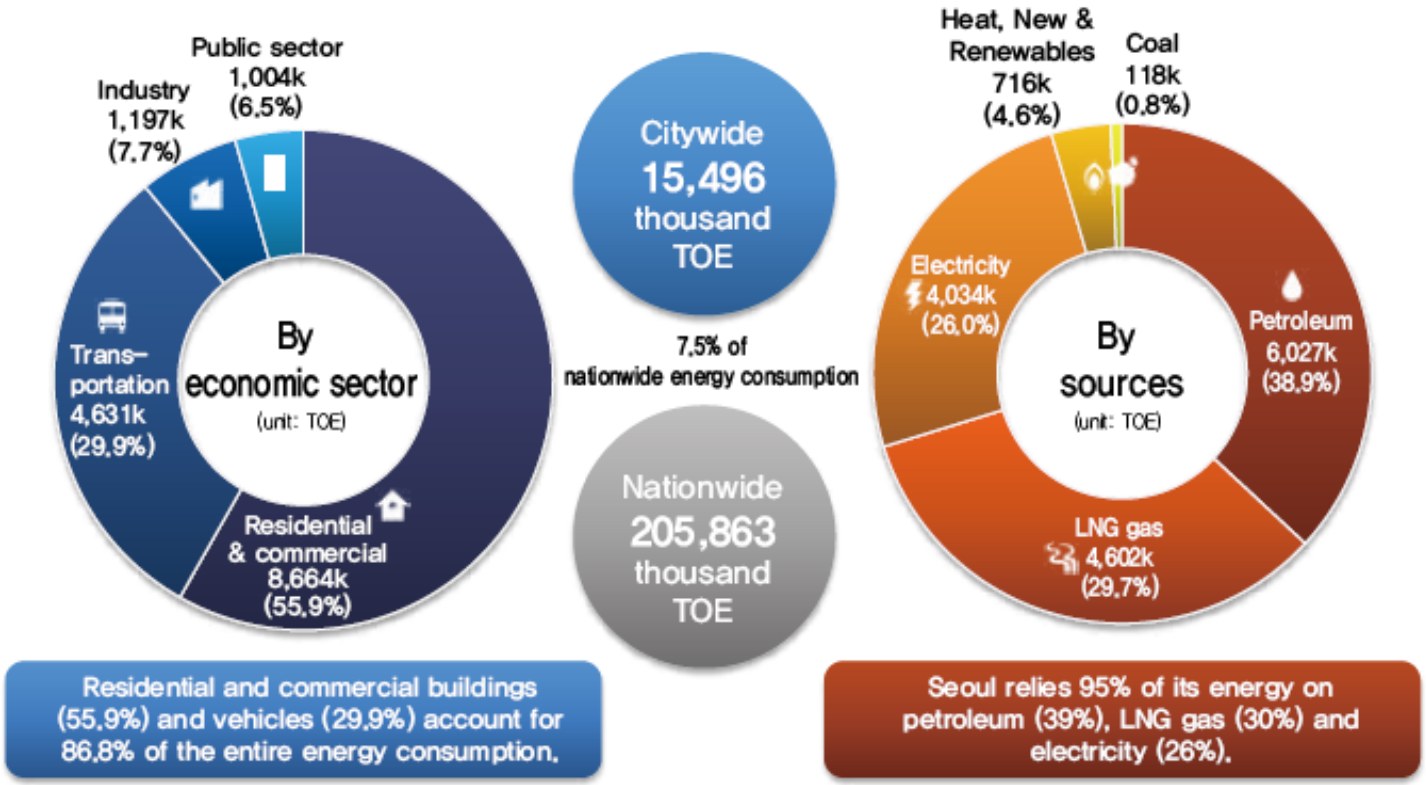
1. Seoul's Energy Consumption
2. OLNPP 1st Phase
3. OLNPP 2nd Phase

Seoul, Low Energy Consumer in 1960s



1. Seoul's Energy Consumption

- Seoul consumed 15,496 thousand TOE, 7.5% of national total('11)
  - Residential & Commercial: 56%
  - Highly dependent on fossil fuels: Oil (38.9%) & LNG (29.7%)



2. OLNPP Phase 1

Black-out in Seoul on 15 September 2011
(Reserve Margin Fell to 5% and Caused Overload)

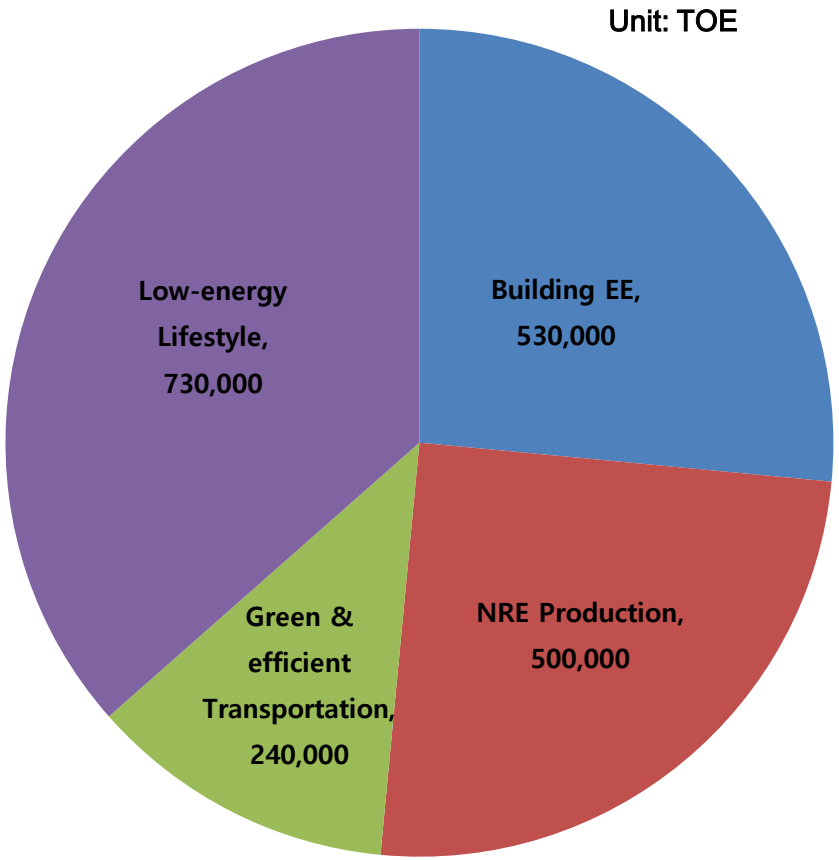
2. OLNPP Phase 1

One Less Nuclear Power Plant: Seoul's Energy Program

- **Announced on April 26, 2012 after the black-out in 2011**
- **Save 2 million TOE equivalent to one nuclear power plant**

2. OLNPP Phase 1: Goal & Effects

Goal: Save 2 million TOE by 2014



Expected Effects

-GHG reduction: **6.06 mil. tCO2e**

-Economic benefits: **1.73 tril. KRW**

-Job creation: **34,000 jobs**

-Power self-sufficiency: **8% by 2014**

2. OLNPP Phase 1: Achievements

Unit: thousand TOE

	Target	Achievement			
		'12	'13	'14	Total
Energy Production	410	35	78	147	260
Energy Efficiency	1,110	145	328	396	869
Energy Conservation	480	151	515	245	911
Total	2,000	331	921	788	2,040

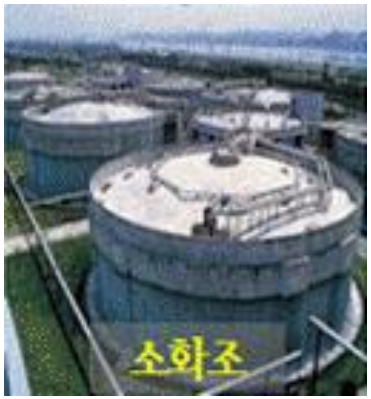
2. OLNPP Phase 1: Achievements

Unit: TOE

Energy Production	
Power Generation (PV, Fuel Cell, etc.)	57,403
Waste Heat (Sewage Heat, Incineration Heat, etc.) Geothermal Power, Regeneration Power	119,218
Environmental Impact Assessment	82,912
Total	259,533

Amsa Arisu Water Purification Center(5MW)

SH District Energy Site Sanggye area(2.8MW)

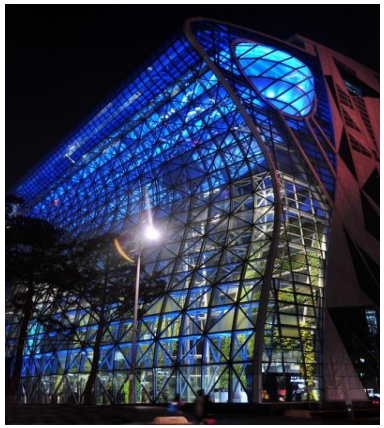


Cogeneration (Sewage Center)

2. OLNPP Phase 1: Achievements

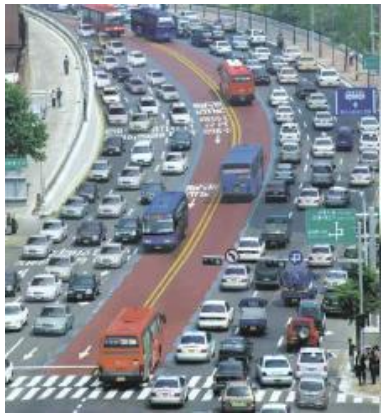
Unit: TOE

Energy Efficiency	
Cap on Energy Consumption	352,098
BRP (Building Retrofit Project)	192,304
LED	201,252
Transportation	123,370
Total	869,024



LED(Seoul City Hall)

BRP(Seoul Plaza Hotel)



BRT

2. OLNPP Phase 1: Achievements

Unit: TOE

Energy Conservation		
Waste	Eco-mileage Limit on Building Temperature	777,376
Public Sector	Energy Conservation in the Public Sector	55,302
Citizen Participation	Waste Recycling	77,607
Total		910,285

Eco-mileage

Green Card

Energy Guardian Angels

2. OLNPP Phase 1: Achievements

Power Consumption(2011-2014): Nationwide 4.9%↑ ↔ Seoul: 4.0%↓
Seoul accounted for 9.4% of national power consumption in 2014

	2011 (GWh)	2014 (GWh)	Change (2014-2011)
National	455,070	477,592	4.9%
Seoul	**46,903**	**45,019**	**- 4.0%**
Daegu	14,822	14,859	0.2%
Gwangju	8,047	8,197	1.9%
Daejeon	9,060	9,103	0.5%

3. OLNPP Phase 2

Seoul Sustainable Energy Action Plan: Phase 2 of OLNPP

3. OLNPP Phase 2: Overview

Vision	"Seoul, an Energy Self-Reliant City" where citizens produce energy and consume it efficiently				
Values	Energy Self-reliance	+	Energy Sharing	+	Energy Participation
Policy Goals	1. A city pursuing distributed energy production 2. Social structure based on efficient, low energy consumption 3. Creation of quality jobs through innovations 4. Promotion of energy-sharing, warm communities				
Core Indicators	20% Self-reliance in Power by 2020 - 4 million TOE saving with RE Production & Energy Saving - 10 million ton reduction in GHG emissions				

3. OLNPP Phase 2: Tasks & Projects

23 Tasks 88 Projects(10 Core Projects) under 4 Goals

Distributed Energy Production	Low Energy Consumption	Creation of Good Jobs	Energy-sharing Warm Communities
5 Tasks 19 Projects	9 Tasks 34 Projects	4 Tasks 17 Projects	5 Tasks 18 Projects
1.“Solar City Seoul” **- 40,000 micro PV** **- Citizens Fund(100 bil. KRW)** **- Seoul FIT** **2.Expansion of Distributed Power (RE, Cogeneration)** **- 12% → 20%**	**1.Building Energy Consumption Disclosure** **2.LED Replacement** **- Security Light(’16)** **Public Institution(’17)** **Street Lamps(’18)** **3.Driving Mileage (1.18 million Cars by ’18)** **- Basis: No. of Days → Distance Traveled**	**1. Job Creation (25 Energy Hub Centers)** **- Comprehensive Energy Service (incl. Energy Consultation)** **2.New Energy Industry** **- Smart Grid, BEMS, Specialized Clusters** **3.Jobs for Elderly** **- 9,100 Recycling Stations** **- Recycling Ratio↑ (45% →66%)**	**1.EE Projects for Energy Poor Groups** **- BRP for 150 Welfare Facilities** **- LED for 120,000 Low-income Households** **2.Seoul Energy Governance** **- Implementation Council for ONLPP** **- Green Citizen Council**

2. OLNPP Phase 2: What's Going On

2. OLNPP Phase 2: What's Going On

Solar City Seoul (November 2017)

Install 1 GW PV annually over 5 years

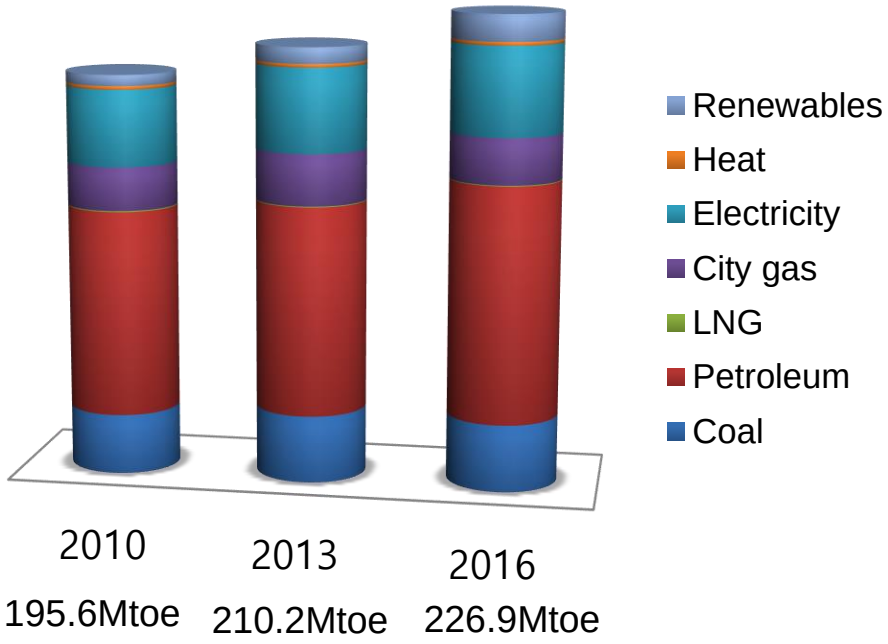
II. National Perspective : Policy

1. National Energy Consumption
2. Energy Policy of New Govt.
3. EE Policies by Sector
4. RE Promotion Policies

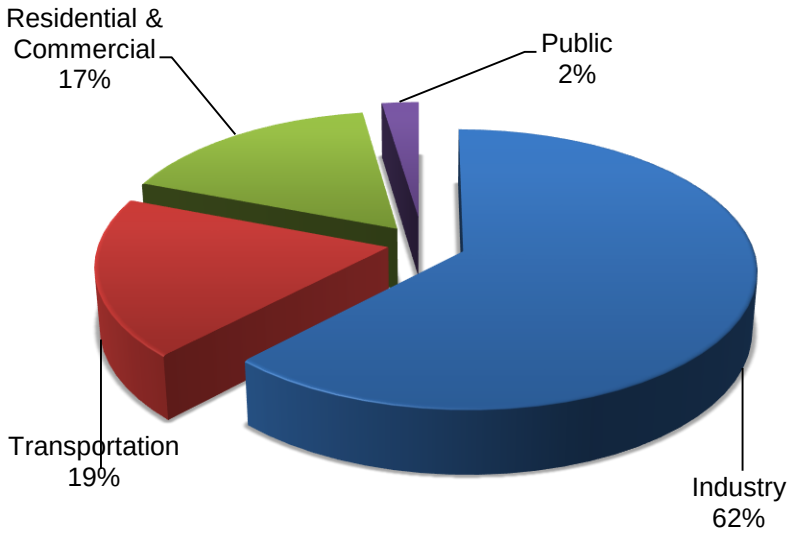
1. National Energy Consumption

- **High dependency on imported energy : 94.2% in 2017**
- **Cost of energy import: 98 billion in 2017**
  - **20.6% of total import**

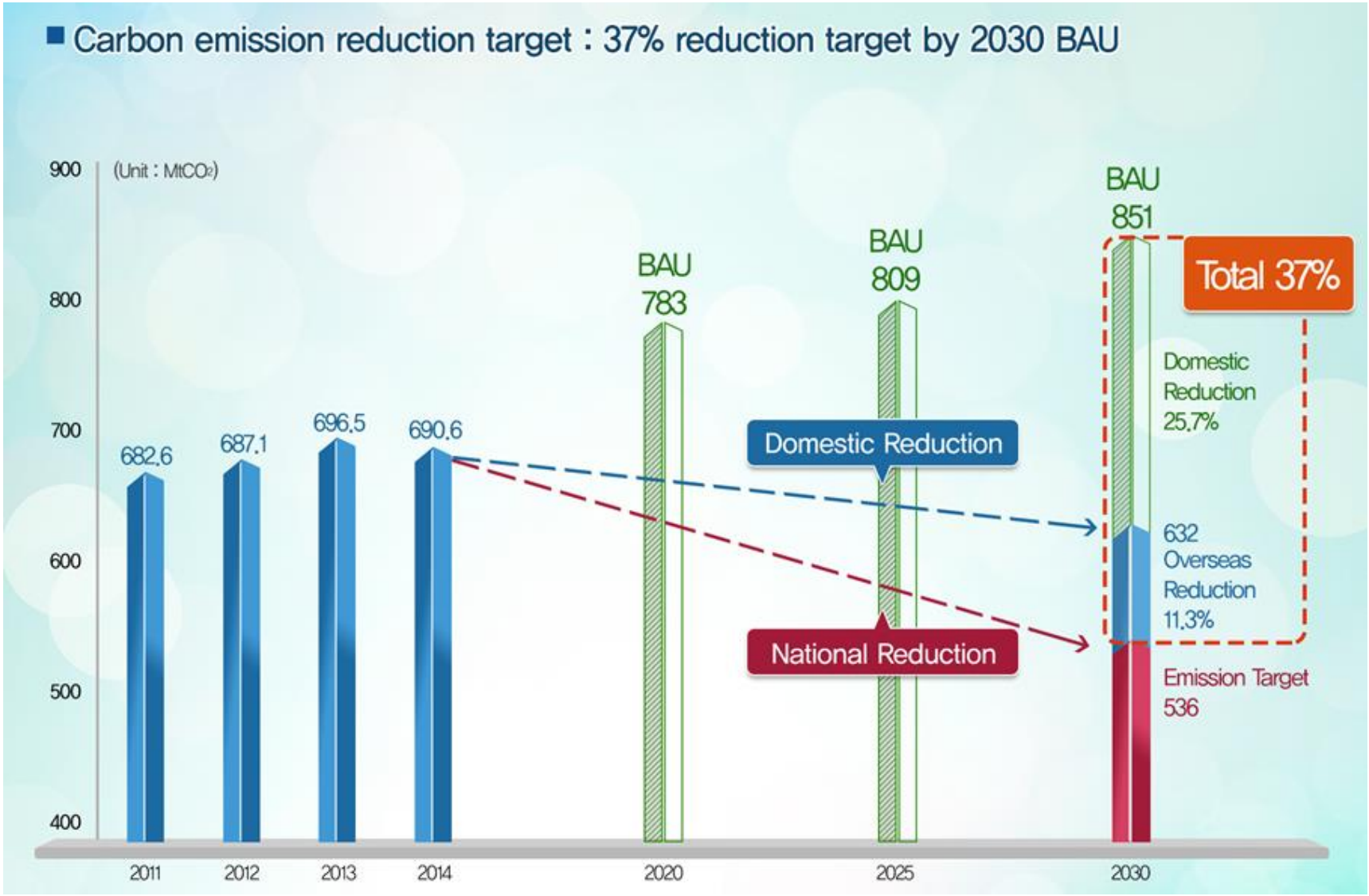
Composition of Final Energy Consumption



Final Energy Consumption by Sector in 2016



2. Energy Policy of New Government



2. Energy Policy of New Government

■ Energy Policy of New Government

1. Economy & energy supply-oriented
   ➡ Eco-friendly & safety energy policy priority

2. Increasing target of RE power generation rate up to 20% by 2030

3. 4th industrial revolution technologies + energy convergence
   ➡ Energy New Biz

4. RE + Energy New Biz + R&D + financing ➡ Job creation

3. EE Policies by Sector

3-1 Improving Industrial EE

3-2 Enhancing Appliance EE

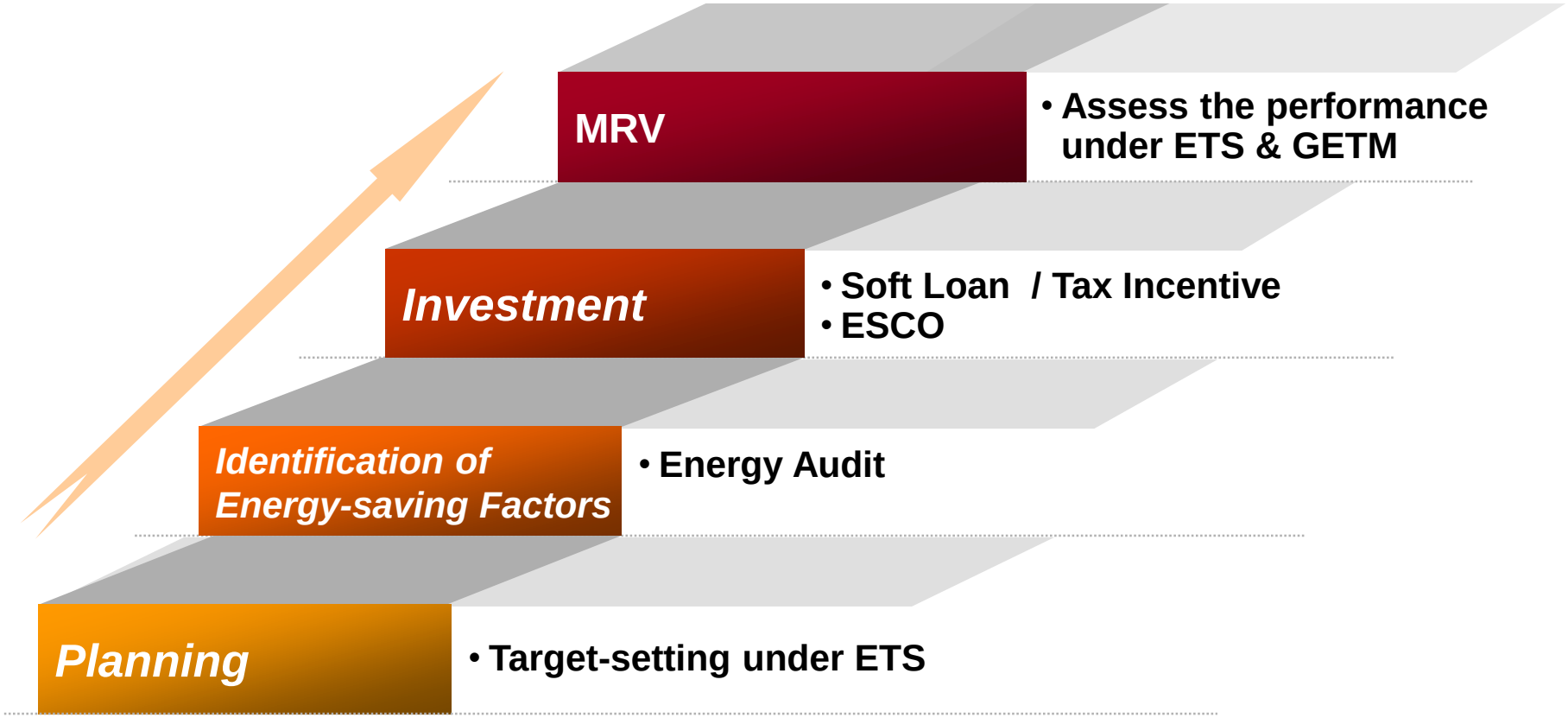
3-3 Promoting EE in Building

3-4 Promoting EE in Transport

3-5 Cross-sectoral Programs

3-1. Industrial EE

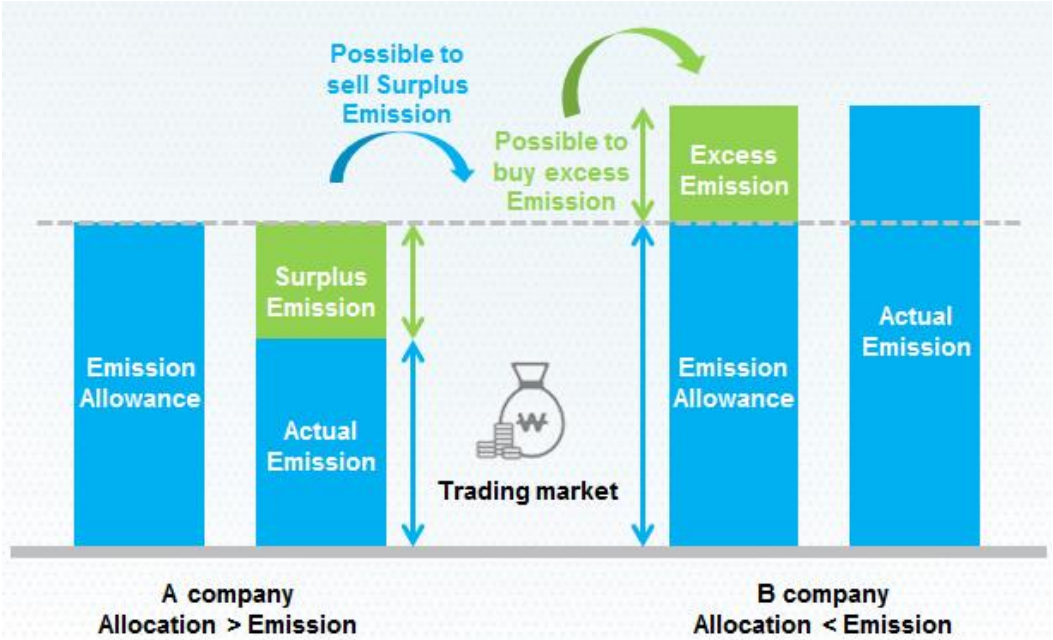
Industrial EE Scheme (Target: Energy-intensive companies)



3-1. Industrial EE

ETS(Emission Trading Scheme)

- **ETS: Government-mandated, market-based approach to controlling pollution by providing economic incentives for achieving reductions in the emissions of pollutants. Target entities are the biggest emitters(over 25,000 tCO2/yr).**

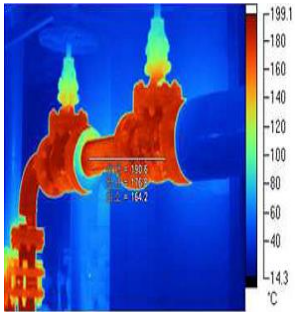


- **Introduced in 2015, the ETS will play an essential role in meeting Korea's 2030 NDC target of 37% relative to BAU emissions**

3-1. Industrial EE

Energy Audit

- Survey & analyze on-site Energy Management
- Identify Energy Loss Factors & Propose Improvement Measures



- Train Energy Auditors in Private Sector & Enhancing Audit Quality

3-1. Industrial EE

Soft Loan & Tax Incentive

- **Soft Loan is provided to support Energy Efficiency Investment**
  - **Interest rate is far lower than market rate, currently 1.5~1.75%**

	%	Grace Period/ Repayment (yr)	2018 Budget (mil. USD)
ESCO	1.50 (2.75, fixed)	3 / 7	63.6
Energy-saving Facilities	1.5(SME) 1.75(non-SME)	3 / 5	209.1
Total			272.7

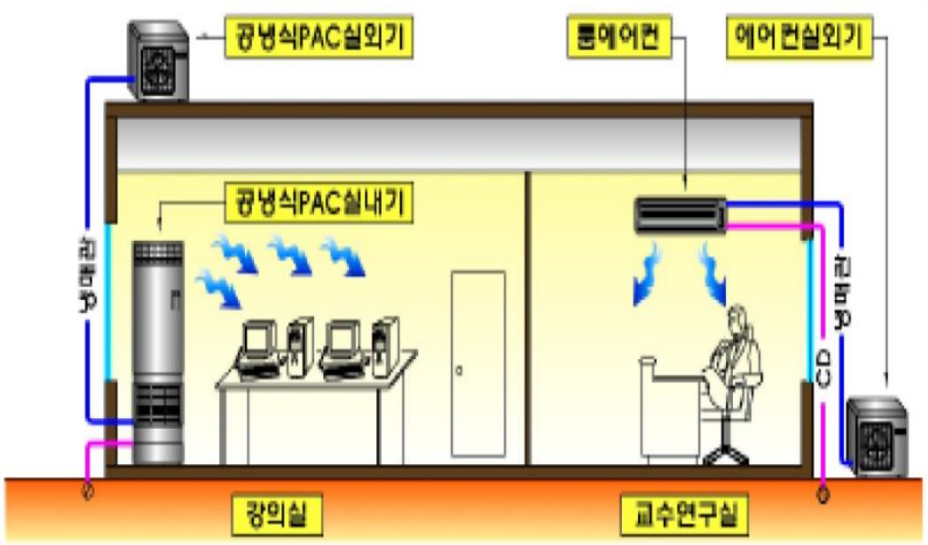
- **Tax Credit (1%, for SME 3-6%)is given to Energy Efficiency Investment**

3-1. Industrial EE

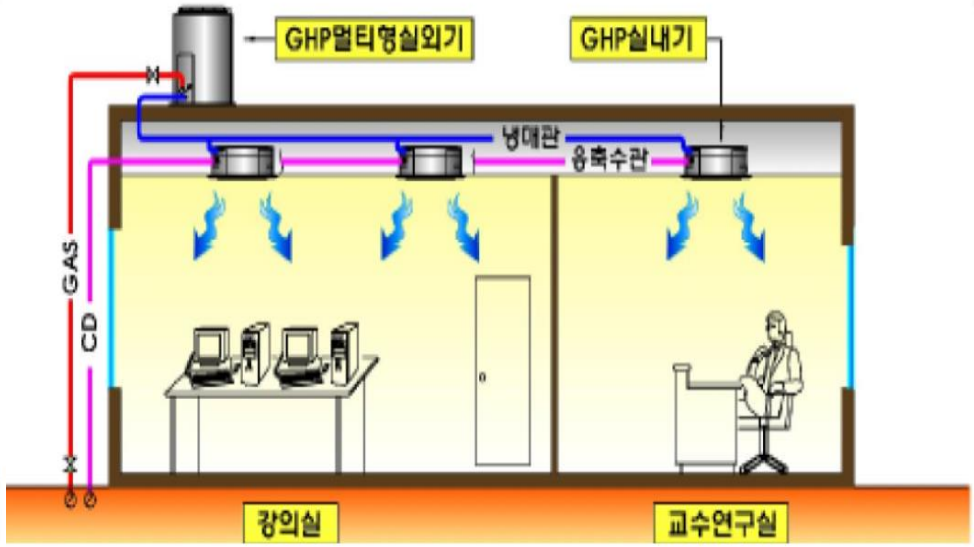
Promoting ESCO Activities

- **No. of ESCOs has been increased from 4 in 1993 to 334 in 2018**

Before(individual A/C)



After(Gas Heat Pump)



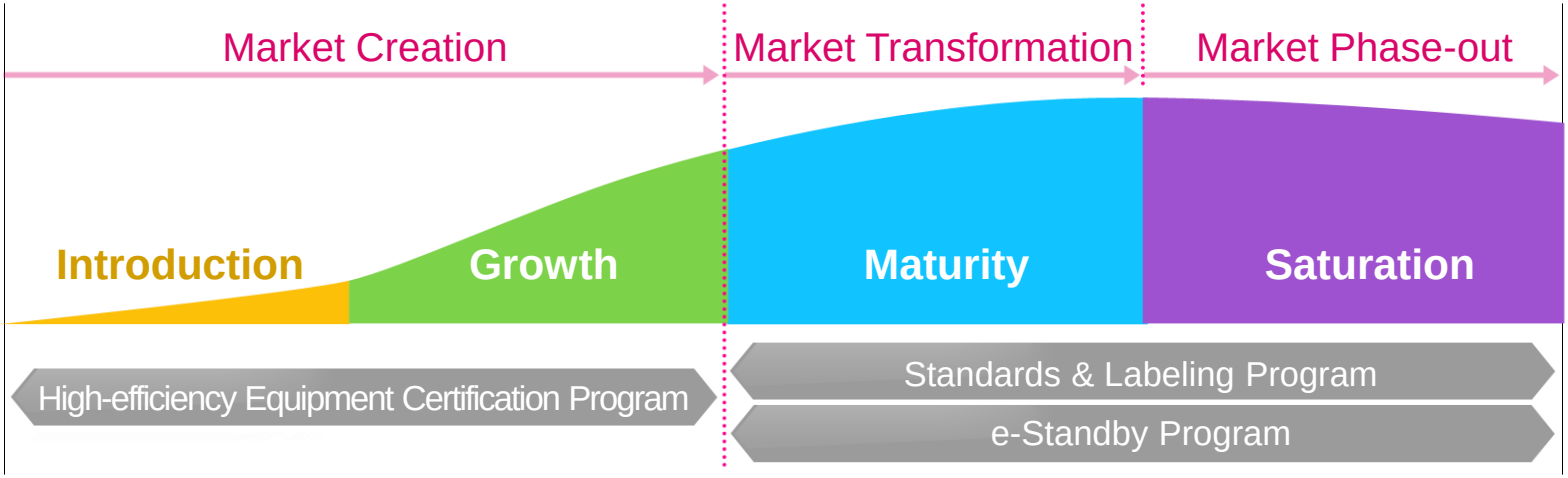
< ESCO project in Seoul National Univ.>

- **KEA's soft loan to ESCOs has been contributed to significant increase of ESCO activities**
- **USD 2.64 billion has been invested during 1993-2017**
  - **Average investment was around USD 0.7 mil.**

3-2. Appliance EE

Strategy for Appliance EE Programs

- Market Transformation to promote high energy efficient products by combining the mandatory and voluntary programs



3 Appliance EE Programs

Energy efficiency labeling program

- Implementation(’92)
- 27 items including refrigerator, washing machine etc

High efficiency certification program

- Implementation(’96)
- 48 items including LED, pump, etc

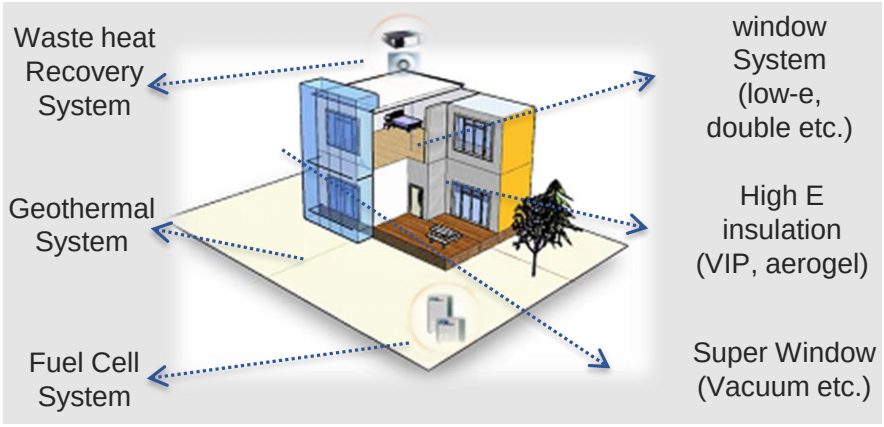
e-standby program

- Implementation(’99)
- 21 items including PC, copier, set-top box

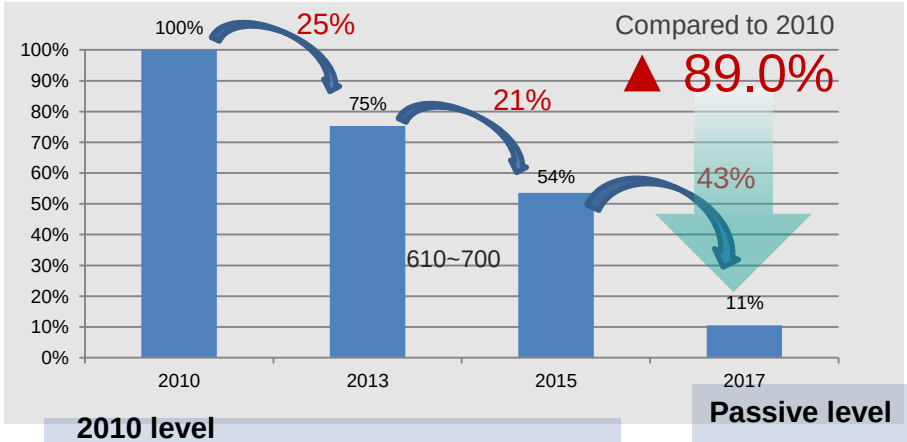
3-3. Building EE

Building Energy Code

■ Building EE(Passive & Active & NRE)



Enhance criteria in energy saving design codes(500㎡ ↑)



2010 level

Wall : 0.47W/m²K Roof : 0.29W/m²K
floor : 0.35W/m²K window : 3.0W/m²K

Passive level

Wall : 0.15W/m²K
Roof : 0.12W/m²K
floor : 0.15W/m²K
window : 0.8W/m²K

■ **Introducing code to restrict total energy consumption in building**

ESDC (energy saving design code)
- EP (Envelope, Equipment, NRE) : > 65 (Public 74)

→ Energy Performance Simulation →

Restrict TEC (total energy consumption)
- TEC ≤ Legal Standards(kWh/m² year)

■ Criteria & Schedule

Division	2011. 7	2013	2016. 7	2017	2018
Size	10,000㎡ ↑	3,000㎡ ↑	(Private) 3,000㎡ ↑, (Public) 500㎡ ↑		
Code	ESDC			ESDC + TEC	TEC

3-3. Building EE

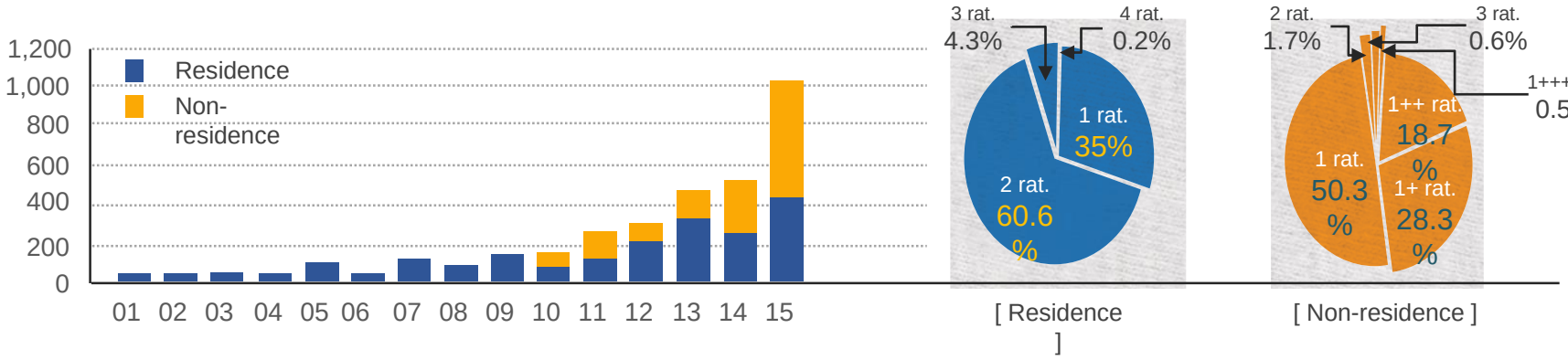
Building EE Certification

- Target : **New & existing buildings (3,000m2↑)**
- Criteria for certification

Primary energy consumption (heating, cooling, lighting, ventilation and wate										
Rating	1+++	1++	1+	1	2	3	4	5	6	7
Residence	~ 60	60~90	90~120	120~150	150~190	190~230	230~270	270~320	320~370	370~420
Non-residence	~ 80	80~140	140~200	200~260	260~320	320~380	380~450	450~520	520~610	610~700

- Criteria for certification

Class	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	Total
Residence	1	5	6	8	28	14	68	63	127	83	141	212	360	267	456	1,836
Non-residence	No regulation									68	132	92	101	239	558	1,190



3-4. Transport EE

Fuel Efficiency Labeling

- **Mandatory regulation: Automakers and importers have to indicate Vehicle FE & Grades to Vehicle and Advertisement**

Passenger car	Van	Truck
		

Fuel Economy

- **Mileage(km) per Liter(fuel)**
- **Indicate : City FE, Highway FE, Combined FE**

Carbon dioxide emission (CO_2)

- **Carbon dioxide(g) per Mileage(km)**

Energy Efficiency Grade

- **According to FE, 1~5 grades classification**

Grade	1	2	3	4	5
Combined FE(km/L)	16.0 and higher	15.9~13.8	13.7~11.6	11.5~9.4	9.3 and lower

3-4. Transport EE

Tire EE Labeling

- **Summary**

  - Purpose: To induce consumers to purchase high efficiency Tire

  - Subject : Passenger Car Tire(PCR), Light-duty Vehicle Tire(LTR)

  - Efficiency criteria : Rolling Resistance(RR), Wet grip(WG)

- **Energy saving effect**

  - 10% improvements of Rolling Resistance brings Into 1.74% improvement of Fuel Efficiency

- **The Way Forward**

  - Expanded to Heavy-duty Vehicle Tire

3-5. Cross-sectoral: Awareness, Education

Energy[-], Love[+]

Energy conservation and social service

Optimal heating in wintertime

Optimal indoor heating and lifestyle

Tire-Up, Energy-Down

Proper tire pressure and Eco-driving culture

Goodbye! Standby Power

Reduction of standby power of electronics

Green Sports / Green Market

Various consumer friendly campaign

SESE NARA

Save Energy Save Earth

- **Practical Early Education Program for energy conservation**
  - * Elementary school : 546 groups,
  - * Middle school : 299 groups,
  - * High school : 232 groups
  - * Others : 731 groups

Total : 1,808 groups

4. RE Promotion Policies

3-1 RE 3020 Target

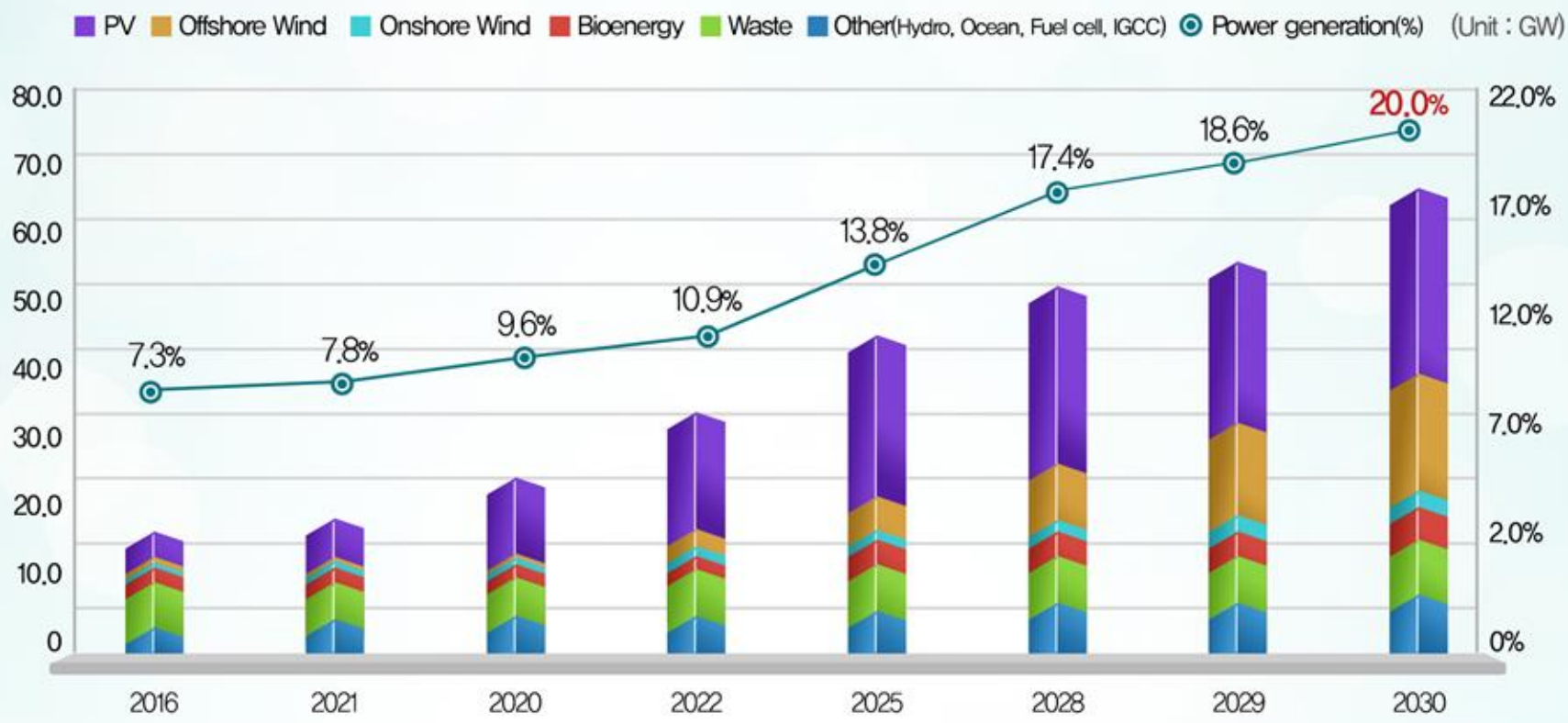
3-2 RE Deployment Programs

3-3 Energy New Business Promotion

4-1. RE 3020 Target

■ New Government : Set target of RE power generation as 20% by 2030

– RE deployment 68GW by 2030(53GW new addition is needed compared to 2016(15GW), KEA analysis)



4-2. RE Deployment Programs

■ RE Deployment Programs

1. Feed in Tariffs(FIT, 2001–2011) ➡ Renewable Portfolio Standard(RPS, 2012~)
   * RPS goal : ('12) 2.0% ➡('16) 3.5% ➡('17) 4.0% ➡('18) 5.0% ➡('20) 6.0% ➡('23~) 10.0%

RPS('12~'16)	FIT('02~'11)	Rate of change
7,555MW (Solar PV 3,289MW)	1,030MW (Solar PV 497MW)	633.5%↑ (Solar PV 561.8% ↑)

2. RE mandatory programs : RE use for public buildings(30% by 2020), RFS
   * RFS goal : ('15~'17) BD 2.5 ➡('18~'20) BD 3.0

3. Subsidy programs : Home / building / regional / combined support
   * 0.7 mil households by 2020(target)

4. PV rental program / agricultural solar villages program
   * PV rental goal : 0.4 mil households by 2030

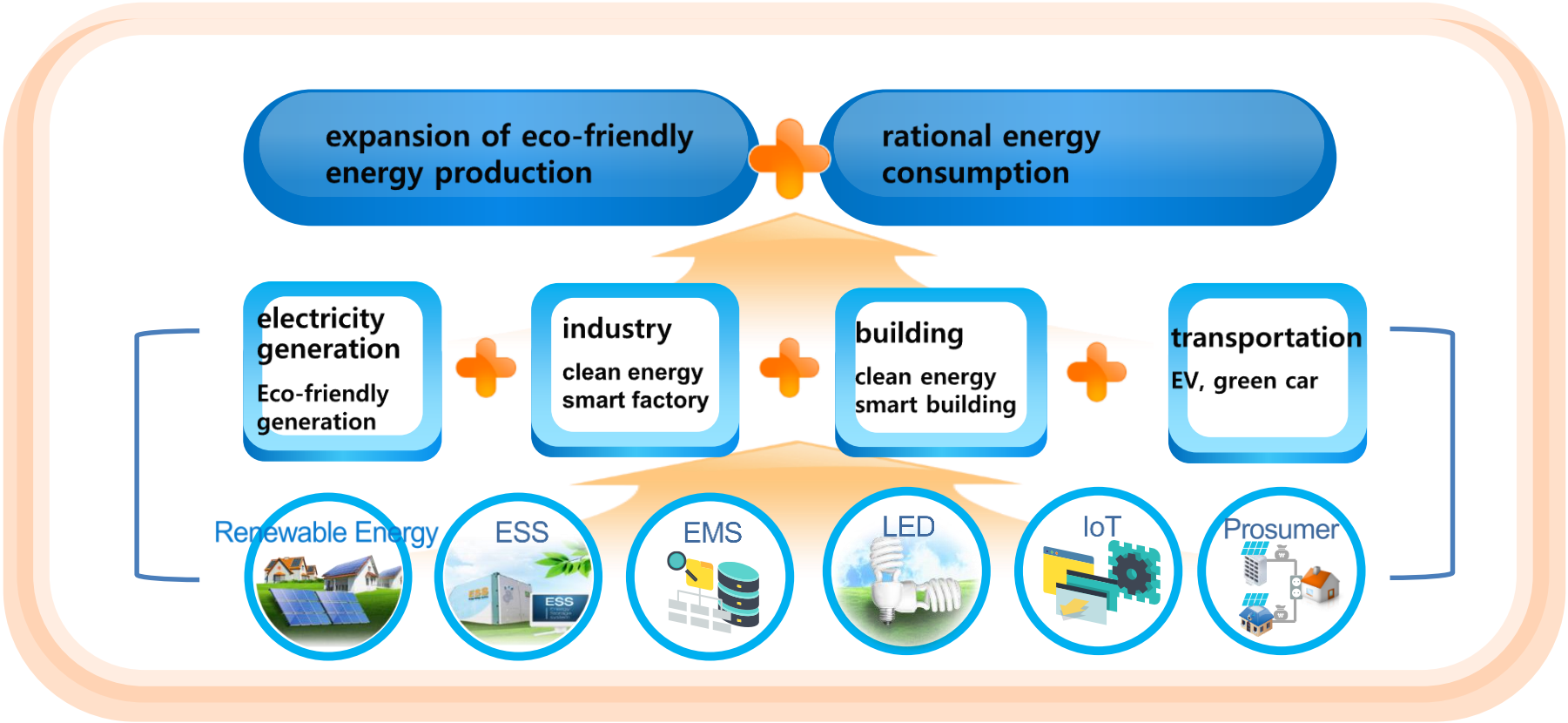
4-3. Energy New Business Promotion

- **Korean Smart Solution** to achieve NDC in Paris Agreement

  * NDC : Nationally Determined Contribution

- **4th Industrial Revolution** in Energy sector

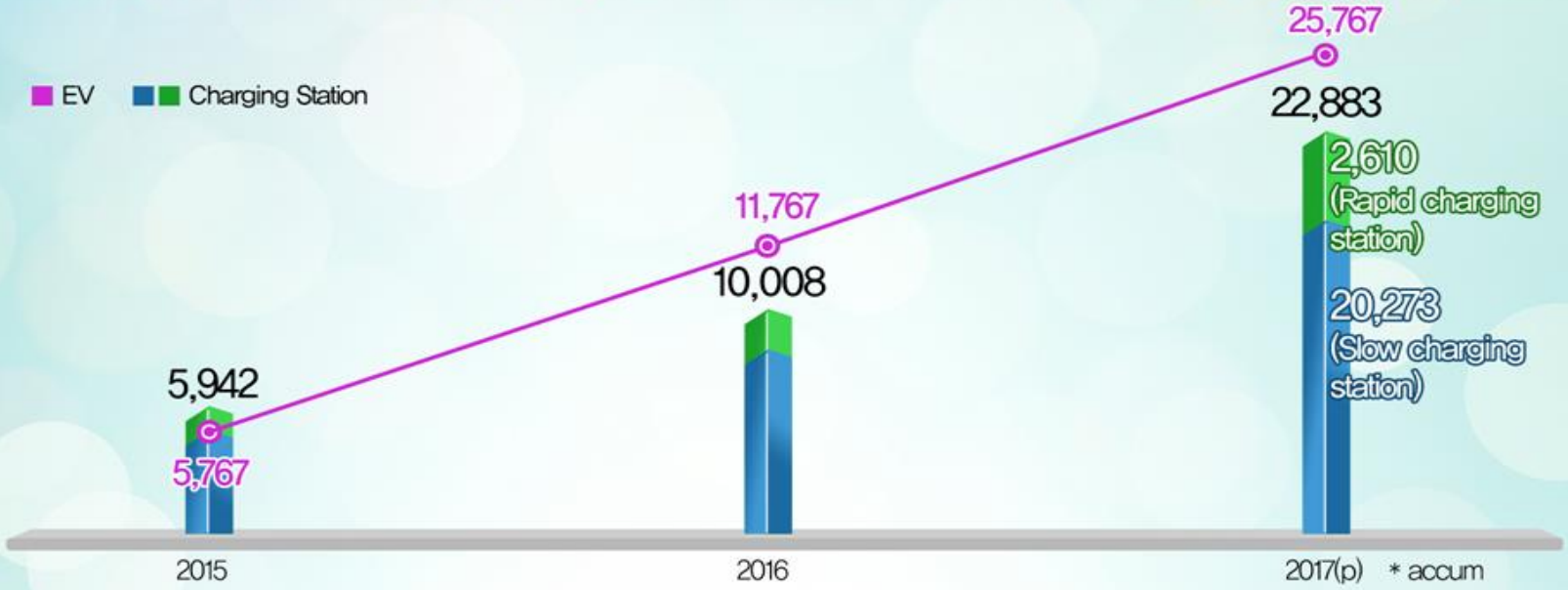
  - Promotion of EE & RE through new tech.



4-3. Energy New Business Promotion

02 Electric Vehicle(EV)

■ Deployed 11,767 units(2016) / Target 250thou. Units & 3,000 Rapid charging stations by 2020



Subsidy

- EV : $12.72 thou/unit
- Charging station: 50% of installation

Tax Deduction

- Education tax, Consumption tax, Acquisition tax, etc

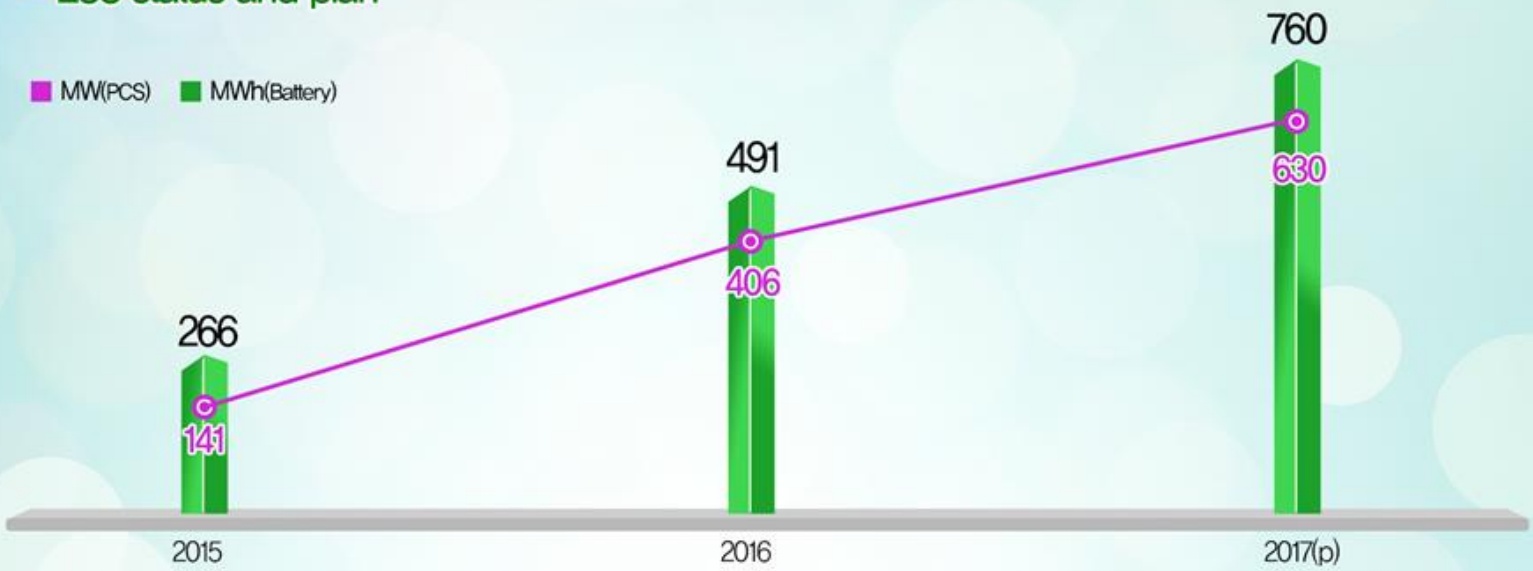
Electricity Fee

- Discount rapid charging fee $0.285 ➡ $0.158/KWh

4-3. Energy New Business Promotion

03 Energy Storage System(ESS)

■ ESS status and plan

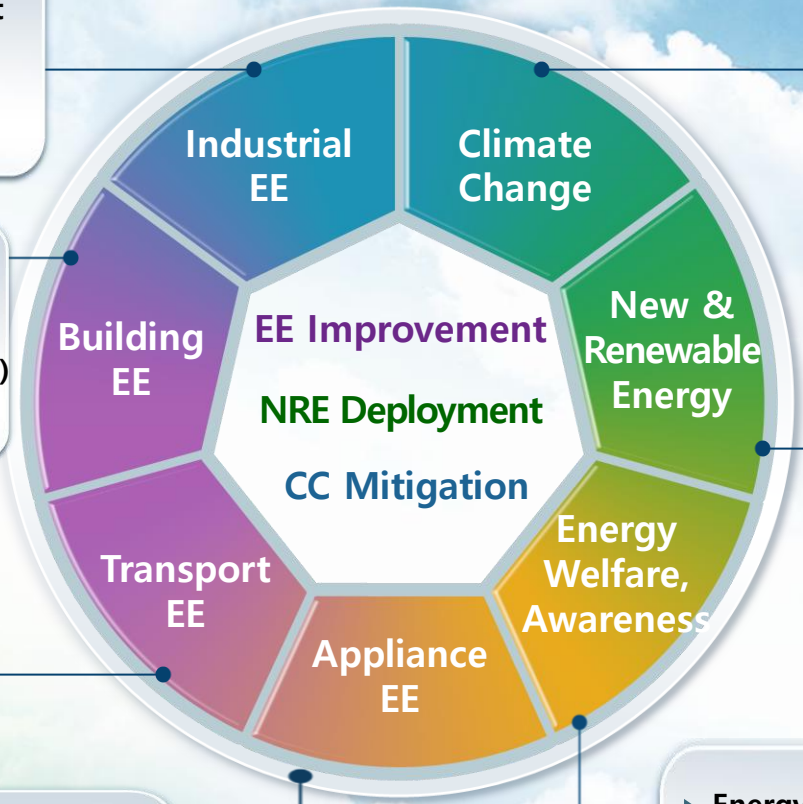


Mandatory	Subsidy & financial support	Special electricity fee
⊙ ESS installation mandatory for public building	⊙ Subsidy for installation ⊙ Long-term & low interest rate preferential finance support	⊙ Providing special discount on electricity fee for ESS

KEA: Department Store of Energy P&M

- ETS & GHG-Energy Target management
- Energy New Business Promotion
- Soft Loan for EE Investment
- Energy Management Systems

- Carbon Neutral
- GHG DB Management
- Registration of GHG Reductions
- CDM Validation/Verification



- Building EE Certification
- Building Energy Codes
- Target Management(Cap and No-Trade)
- Energy Saving in Public Building

- 1mil. Green Homes Project
- Subsidy for NRE Deployment
- Soft Loan for NRE Deployment
- Feed-in Tariff
- Renewable Portfolio Standard
- Certification of NRE Equipment
- Subsidy to Local Govt.'s NRE Deployment

- Average Fuel Economy
- Fuel Efficiency Labeling
- Tire Efficiency Labeling
- Deployment of Green Car

- Energy Efficiency Label & Standard
- High-Efficiency Equipment Certification
- E-Standby
- Energy Welfare

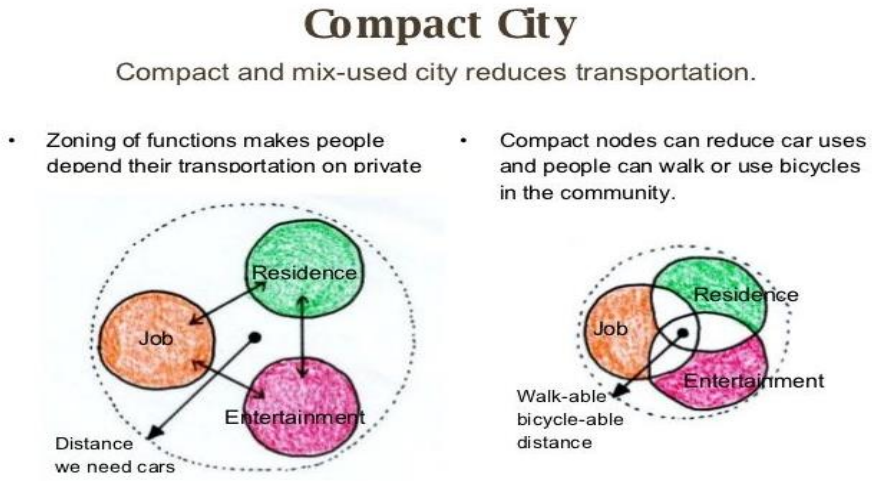
- Energy Voucher
- Korea Green Energy Show
- Early Education
- Training for Technical Engineer
- International Cooperation

III. Citizen Perspective : Behavior

1. Compact City
2. Candlelight Energy Saving
3. Compact Energy Consumption

1.Compact City(1)

❖ **Compact Cities** try to restrict sprawling, raise population density and improve the efficiency of municipal functions by concentrating urban services and facilities on city center

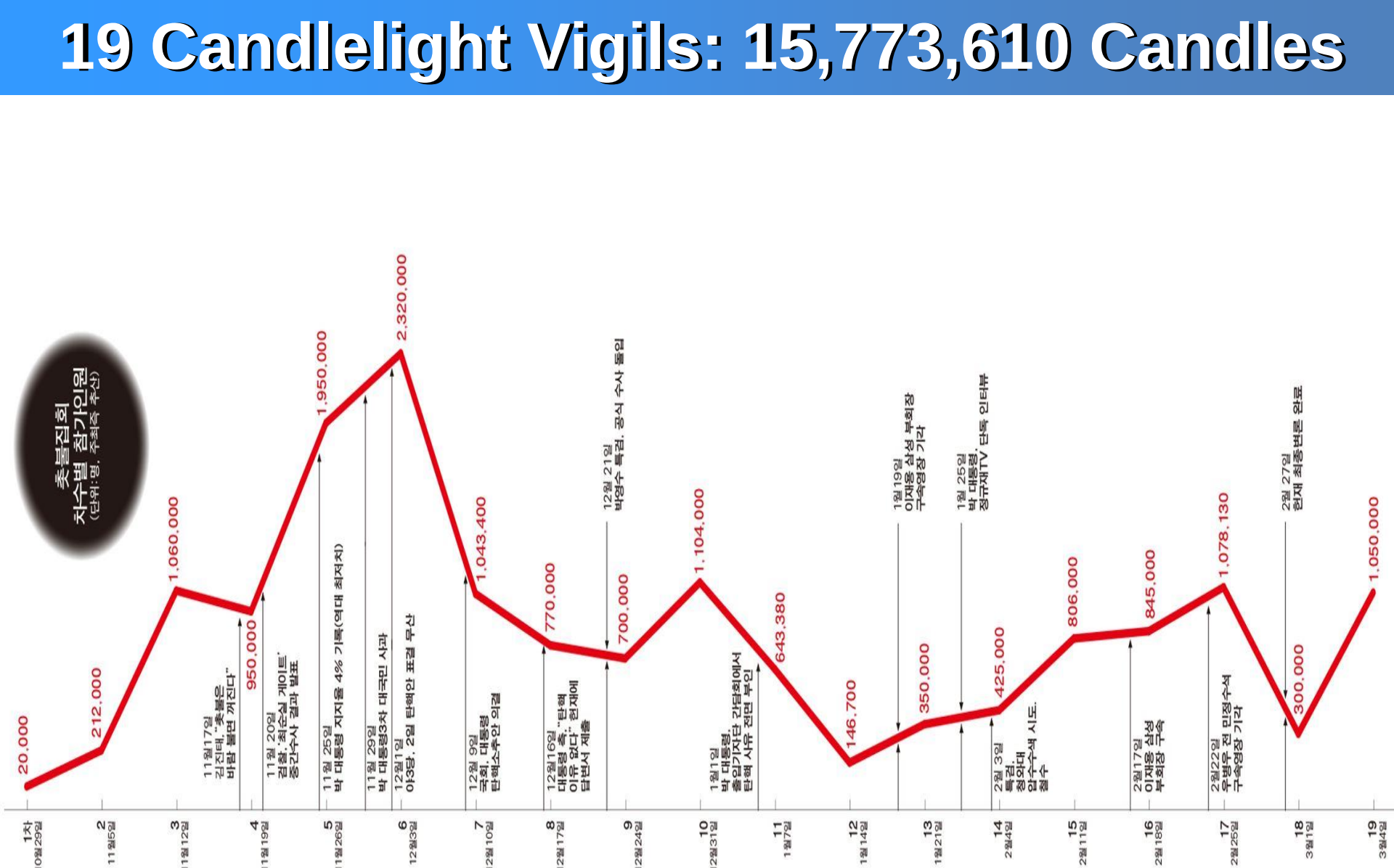


Concept of Compact City (Rogers, Richard, and Philip Gumuchdjim)

❖ **Effects:** Shorten transport distance, reduce vehicle dependency, reduce energy consumption, improve land use efficiency, create new business model, enhance investment efficiency on infrastructure and save municipal maintenance cost

People's Power Changed Power in 2016-2017

19 Candlelight Vigils: 15,773,610 Candles



2.Candlelight Energy Saving(1)

A Korean newspaper estimated that 19 candle light vigils produced energy of 1,261MW, equivalent of two nuclear reactors in Gori.

*** 15,773,610 candles x 80W**
= 1,261,888,800W
= 1,261MW
= 2 Gori Reactors(587MW)

Accumulated participants of 15,773,610 lit candles during their 19 Saturday candle light vigils from October 29, 2016 to March 4, 2017.

Is it energy production?
It can be energy saving.
Vigils were made on the street at Saturday nights when most of people stay at home and watch TVs.

2.Candlelight Energy Saving(2)

◆ **2016-2017 candle light vigils in Seoul can be estimated to save 12.1GWh of energy**

- **85.17kWh/m[1)] x 3m(Nov-Jan) x 4Sat/30d x 937,456[2)]/2.64[3)] = 12,097,444kWh = 12.1GWh**

1) 85.17kWh/m: power consumption during night-time(6-9pm) in Seoul during Dec - 413.43kWh/m[4)] x 20.6%[5)] = 85.17kWh/m

2) 937,456: average vigil participants during Nov 2016-Jan 2017

3) 2.64: average number of residents per HH in Seoul in 2015

4) 413.43kWh/m: average monthly power consumption per HH in Seoul(Nov-Jan)

5) 20.6%: night-time(6-9pm) power consumption(4,943)/daily power consumption (24,001) in Seoul during Dec 2016

→ Unintentional Energy Saving by Intentional Demonstrators

2.Candlelight Energy Saving(3)

Especially the vigils coincided with Saturday night mega hit soap opera, Goblin(도깨비), aired 2 Dec 2016 to 21 Jan 2017.
The vigil participants saved energy by not consuming residential energy at home and collectively being on the street instead .

3.Compact Energy Consumption

◆ **3W of Energy Consumption: When, Where, with Whom**

(Day) Power consumption at office with colleagues or
Oil/power consumption on the road alone/together or
Power/gas consumption at home(school) alone/together

(Night) Power/gas consumption at home with family or
Power consumption at office alone or

- **Energy can be saved by change of 3W behavior**

(w/d night) individual consumption at different place(work/home)
→ group consumption at the same place(home)
"To Home (Getting in Together)"

(w/e day) energy consumption inside home
→ less(no) consumption outside(nearby square, park)
"To Square (Getting out Together)"

Case (1): Share House

❖ Share House

- New type of housing in which multiple non-family residents live in separate rooms and share common facilities of living room, kitchen and bathroom in a house
- Meet both needs of sharing cost/chores and building human relationship
- Increased demand among singles in 20s and 30s

Case (2): WoLiBal

◆ Work-Life Balance

- **Work-Life Balance is being pursued in Korea**

WoLiBal can beget unintentional co-benefit: Energy Saving

- **Energy Saving might be better pursued as co-benefit of urban planning or policies**

Seoul has built many parks and public spaces for its citizen's quality of life. And these parks and plazas might help save energy.

Food for Thought : Green Energy Restaurant

- Needs a professional chef
  - A dedicated organization is needed : KEA, Seoul Energy Corp.
- Needs money to hire good staff and prepare fresh ingredients
  - Secure dedicated fund such as levy on fuels: Energy Special Account
- Chef cannot cook bare hands. Needs cooking tools
  - Empowered with a systematic mix of carrots & sticks : Soft Loan/ Tax Incentive, GETM/Appliance S&L/Building Code/CAFE
- Keep all ears to VOC: Network → Communication!!! → Trust
  - Establish regular network with stakeholders and change to the changes by getting feedback : ESP, Energy Managers
  - Implementation is successful when trust is built in the market
  - Market trusts the authority when it gets right signals of strong punishment and attractive incentives and it develops right sensors

Thought to Chew: Green Energy Puzzle

- There is no silver bullet in Green Energy
  - Situation keeps changing : Electrification of Energy, Urbanization, EV, China dominance, Connected device
  - Responding to changing market, continuous all-out effort in every sector is needed

  "Ten spoons of rice makes one bowl of rice"

- The answer to your question is on your mind
  - Pieces of Green Energy are scattered in every nook and corner. Use your mindful spoons to collect them like…

The Boy Who Harnessed the Wind

You can enjoy the beautiful picture when you put together the pieces of jigsaw puzzle with your mindful spoons just like…

Seoul, High Energy Consumer in 2010s


Thank you