서울시 기후에너지정책 성과 분석을 위한 기초정보 조사

조향문 김인희, 김민경, 고준호, 김민제
서울시
기후에너지정책
성과 분석을 위한
기초정보 조사
\ 연구책임

조항문 안전환경연구실 연구위원
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고준호 교통시스템연구실 연구위원

\ 연구진

김민재 안전환경연구실 연구원

이 보고서의 내용은 연구진의 견해로서
서울특별시의 정책과는 다를 수도 있습니다.
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Energy Consumption and Energy Environment in SEOUL


\연구책임
조항로 안전환경연구실 연구위원
김인희 기획조정본부 연구조정실장
김민경 안전환경연구실 연구위원
고준호 교통시스템연구실 연구위원

\연구진
김인제 안전환경연구실 연구원
01 Introduction
Background and Aim of the Study

Background of the Study

• Lately, a proposal was suggested to apply an environmental policy performance evaluation tool made by a global enterprise. Seoul Metropolitan Government has decided to apply the tool.

Aim of the Study

• Collection, Analysis and Provision of Basic Information and Data
  That is needed to evaluate the performance of the urban environment policy using the tool.

• Compilation and Provision of the Data Base
  The DB contains energy consumption statistics and the basic information affecting energy consumption.
# Scope and Main Contents of the Study

## 연구의 범위 및 주요 내용

### Scope of the Study

- **Zone**: Seoul Metropolitan (by district)
- **Year**: 2005 ~ 2014

### Main Contents of the Data

- **Human Social Environment**: population, household, etc./by gender & age/by zone/by year
- **Economic Indicator**: number of workers & business, etc./by gender & industry/gu/2005~2014
- **Weather Condition**: temperature, CDD, HDD, humidity, etc./monthly & daily/1976~2015
- **Building Condition**: total floor area, etc./by use/by gu/by year(2005~2014)
- **Energy Consumption**: electricity, city water, town gas, district heating/gu & dong/2005~2014
02 Energy Consumption in SEOUL
### Annual Energy Consumption in SEOUL by Energy Source

<table>
<thead>
<tr>
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<tbody>
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<td>2,209</td>
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<td>2,250</td>
<td>2,446</td>
<td>2,700</td>
<td>2,866</td>
<td>3,000</td>
<td>3,110</td>
<td>3,286</td>
<td>3,485</td>
<td>3,597</td>
<td>3,696</td>
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<td>7,657</td>
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<td>6,531</td>
<td>6,578</td>
<td>6,038</td>
<td>6,329</td>
<td>6,487</td>
<td>6,321</td>
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<td>5,800</td>
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<td>5,863</td>
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<td>Others</td>
<td>692</td>
<td>605</td>
<td>573</td>
<td>529</td>
<td>587</td>
<td>612</td>
<td>627</td>
<td>639</td>
<td>630</td>
<td>632</td>
<td>747</td>
<td>683</td>
<td>715</td>
<td>701</td>
<td>697</td>
<td>724</td>
<td>834</td>
<td>850</td>
<td>744</td>
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Annual Energy Consumption in SEOUL by Use

서울시 연간 부문별 에너지 소비량

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential &amp; Commercial</td>
<td>7,789</td>
<td>8,100</td>
<td>8,744</td>
<td>7,482</td>
<td>8,277</td>
<td>8,241</td>
<td>8,114</td>
<td>8,263</td>
<td>8,350</td>
<td>8,385</td>
<td>8,777</td>
<td>8,847</td>
<td>8,829</td>
<td>8,493</td>
<td>8,380</td>
<td>9,153</td>
<td>8,664</td>
<td>8,844</td>
<td>8,728</td>
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<tr>
<td>Transportation</td>
<td>5,317</td>
<td>5,667</td>
<td>7,185</td>
<td>6,113</td>
<td>6,134</td>
<td>5,734</td>
<td>4,547</td>
<td>4,802</td>
<td>4,612</td>
<td>4,625</td>
<td>4,292</td>
<td>4,674</td>
<td>4,870</td>
<td>4,942</td>
<td>4,857</td>
<td>4,846</td>
<td>4,631</td>
<td>4,576</td>
<td>4,517</td>
</tr>
<tr>
<td>Industry</td>
<td>2,930</td>
<td>3,178</td>
<td>2,950</td>
<td>2,381</td>
<td>2,000</td>
<td>1,791</td>
<td>2,283</td>
<td>1,467</td>
<td>1,366</td>
<td>1,586</td>
<td>1,527</td>
<td>1,512</td>
<td>1,551</td>
<td>1,380</td>
<td>1,044</td>
<td>1,023</td>
<td>1,197</td>
<td>1,133</td>
<td>1,382</td>
</tr>
<tr>
<td>Public &amp; Others</td>
<td>796</td>
<td>860</td>
<td>835</td>
<td>758</td>
<td>672</td>
<td>684</td>
<td>457</td>
<td>472</td>
<td>448</td>
<td>466</td>
<td>587</td>
<td>552</td>
<td>758</td>
<td>666</td>
<td>747</td>
<td>696</td>
<td>1,004</td>
<td>1,014</td>
<td>771</td>
</tr>
</tbody>
</table>
### Annual Energy Consumption in SEOUL

서울시 연간 에너지 소비량

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity (GWh)</th>
<th>City Water (million m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>35,617</td>
<td>1,266</td>
</tr>
<tr>
<td>2006</td>
<td>37,250</td>
<td>1,261</td>
</tr>
<tr>
<td>2007</td>
<td>39,363</td>
<td>1,237</td>
</tr>
<tr>
<td>2008</td>
<td>40,395</td>
<td>1,230</td>
</tr>
<tr>
<td>2009</td>
<td>40,208</td>
<td>1,172</td>
</tr>
<tr>
<td>2010</td>
<td>42,583</td>
<td>1,196</td>
</tr>
<tr>
<td>2011</td>
<td>42,260</td>
<td>1,180</td>
</tr>
<tr>
<td>2012</td>
<td>42,690</td>
<td>1,176</td>
</tr>
<tr>
<td>2013</td>
<td>41,939</td>
<td>1,174</td>
</tr>
<tr>
<td>2014</td>
<td>40,346</td>
<td>1,164</td>
</tr>
</tbody>
</table>

- Energy consumption of electricity is on the decrease since 2012 and consumption of city water is on the decrease generally.
### Annual Energy Consumption in SEOUL

서울시 연간 에너지 소비량

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Town Gas (million Nm³)</td>
<td>4,054</td>
<td>4,443</td>
<td>4,054</td>
<td>4,175</td>
<td>4,879</td>
<td>5,156</td>
<td>4,731</td>
<td>4,562</td>
<td>4,573</td>
<td>4,013</td>
</tr>
<tr>
<td>District Heating (1,000Gcal)</td>
<td>4,522</td>
<td>4,129</td>
<td>4,403</td>
<td>4,586</td>
<td>4,720</td>
<td>5,100</td>
<td>5,023</td>
<td>5,138</td>
<td>4,955</td>
<td>4,448</td>
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</tbody>
</table>

- Energy consumption of town gas and district heating changes depending on weather condition.
Annual Energy Consumption in SEOUL
서울시 연간 에너지 소비량

- Town Gas + District Heating (1,000 Gcal)

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>46,805</td>
<td>50,469</td>
<td>46,686</td>
<td>48,131</td>
<td>55,608</td>
<td>58,877</td>
<td>54,367</td>
<td>52,720</td>
<td>52,651</td>
<td>46,304</td>
</tr>
</tbody>
</table>

Graph and pie charts showing energy consumption trends from 2005 to 2014, with notable years 2007, 2010, and 2014.
2014 Energy Consumption in SEOUL

Electricity

MAX
Gangnam-gu (강남구)
4,338.55 GWh

MIN
Gangbuk-gu (강북구)
849.30 GWh

City Water

MAX
Gangnam-gu (강남구)
89.42 million m³

MIN
Yongsan-gu (용산구)
29.63 million m³

MAX
Seocho-gu Seocho-dong (서초구 서초동)
1,119.33 GWh

MAX
Gwanak-gu Sillim-dong (관악구 신림동)
32,771,000 m³
2014 Energy Consumption in SEOUL
2014년 서울시 에너지 소비량

**Town Gas**
- MAX: Gangnam-gu (강남구) 341.18 million m³
- MIN: Geumcheon-gu (금천구) 99.26 million m³
- MAX: Yangchun-gu Mok-dong (양천구 목동) 132.33 million m³

**District Heating**
- MAX: Gangnam-gu (강남구) 872,000 Gcal
- MAX: Yangchun-gu Sinjeong-dong (양천구 신정동) 273,000 Gcal
03 Temperature and Energy
Temperature and Energy Consumption in SEOUL

서울시 기온과 에너지 소비량

The Highest Temperature
Annual Average Temperature
The Lowest Temperature

HDD

2005: 2,483.2
2006: 2,967.7
2007: 2,967.7
2008: 2,967.7
2009: 2,967.7
2010: 2,967.7
2011: 2,967.7
2012: 2,967.7
2013: 2,967.7
2014: 2,967.7

Gas Use

2005: 5,165.52 million st
2006: 5,165.52 million st
2007: 5,165.52 million st
2008: 5,165.52 million st
2009: 5,165.52 million st
2010: 5,165.52 million st
2011: 5,165.52 million st
2012: 5,165.52 million st
2013: 5,165.52 million st
2014: 5,165.52 million st

CDD

2005: 194.8
2006: 194.8
2007: 194.8
2008: 194.8
2009: 194.8
2010: 194.8
2011: 194.8
2012: 194.8
2013: 194.8
2014: 194.8

Electricity Use

2005: 42,668.81 GWh
2006: 42,668.81 GWh
2007: 42,668.81 GWh
2008: 42,668.81 GWh
2009: 42,668.81 GWh
2010: 42,668.81 GWh
2011: 42,668.81 GWh
2012: 42,668.81 GWh
2013: 42,668.81 GWh
2014: 42,668.81 GWh
2014 Temperature and Energy Consumption in SEOUL

- **HDD (Heating Degree-Day)**: Sum of daily mean temperature and temperature difference between 18°C about the day that the daily mean temperature is under 18°C
- **CDD (Cooling Degree-Day)**: Sum of daily mean temperature and temperature difference between 24°C about the day that the daily mean temperature is over 24°C
04 Population and Energy
The Population of Seoul has decreased since 2010 (10.58 million).
2014 Population • Households • Density by District of SEOUL

2014年 서울시 구별 인구 • 가구 • 인구밀도
Energy Consumption per Household of SEOUL

Electricity

City Water

Town Gas

District Heating

- The data of district heating will be updated and offered.
05 Workers · Business and Energy
Number of Workers and Business

서울시 종사자 · 사업체 현황

Workers

- 2014 MAX
  - Gangnam-gu (강남구)
  - 275,755 persons

- 2014 MIN
  - Dobong-gu (도봉구)
  - 31,072 persons

Businesses

- 2014 MAX
  - Gangnam-gu (강남구)
  - 70,262 businesses

- 2014 MIN
  - Dobong-gu (도봉구)
  - 8,584 businesses
The data of district heating will be updated and offered.
06 Building and Energy
Total Floor Area of Building by Use in SEOUL

서울시 용도별 건축물 연면적(m²)

- Detached House
- Apartment House
- Commercial Building
- Educational and Community Building
- Industry Building
- Others

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2008</th>
<th>2011</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>House</td>
<td>44%</td>
<td>51%</td>
<td>46%</td>
<td>45%</td>
</tr>
<tr>
<td>Others</td>
<td>56%</td>
<td>49%</td>
<td>54%</td>
<td>55%</td>
</tr>
</tbody>
</table>

2005

2008

2011

2014
Energy Consumption per Total Floor Area (m²)

서울시 건축물 연면적 1m²당 에너지 소비량

Electricity

City Water

Town Gas

District Heating

2014 MAX

Jung-gu 723.69 kWh

Gwanak-gu 2.95 m³

Yangcheon-gu 10.57 m³

Yangcheon-gu 28.78 Gcal
SI has recorded and possesses the DB of SEOUL.
We are prepared to open the DB to the public.

- Weather (Temperature) Data by Month and Year (1976~2015)
- Population Data by District (gu & dong), Age, Gender and Year (2005~2014)
- Building Data by District (gu & dong), Use and Year (2005~2014)
- The Number of Workers and Business Data by District (gu), Type and Year (2005~2014)
- Detailed Energy Data (2005~2014)

Raw data can be found on

### Appendix

#### A1. Description on Data

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<thead>
<tr>
<th>No.</th>
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<td>household</td>
<td>yearly</td>
<td>gu, dong</td>
<td>2005~2014</td>
<td>동별 인구_05_14.xls</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>density(gender, age)</td>
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<td>No.</td>
<td>yearly</td>
<td>gu</td>
<td>2005~2014</td>
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<tr>
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<td>city</td>
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<td></td>
<td></td>
<td>registered cars</td>
<td>No.</td>
<td>monthly</td>
<td>city</td>
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<td>US $</td>
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<td></td>
<td></td>
<td>minimum temperature</td>
<td>°C</td>
<td>monthly &amp; daily</td>
<td>city</td>
<td>1976~2015</td>
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<td></td>
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<td>the average temperature</td>
<td>°C</td>
<td>monthly &amp; daily</td>
<td>city</td>
<td>1976~2015</td>
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<tr>
<td></td>
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<td>heating degree-day</td>
<td>deg. day</td>
<td>monthly &amp; daily</td>
<td>city</td>
<td>1976~2015</td>
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<td></td>
<td></td>
<td>cooling degree-day</td>
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<td>1976~2015</td>
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<td></td>
<td></td>
<td>humidity</td>
<td>%</td>
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<td>4</td>
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<td>total floor area</td>
<td>m²</td>
<td>yearly</td>
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<td>2005~2014</td>
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<td>taxed buildings</td>
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<td>registered buildings</td>
<td>No.</td>
<td>yearly</td>
<td>gu</td>
<td>2005~2014</td>
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<td>5</td>
<td>Energy Consumption</td>
<td>electricity</td>
<td>GWh(KWh)</td>
<td>yearly &amp; monthly</td>
<td>gu, dong</td>
<td>2005~2014</td>
<td>에너지소비량</td>
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<td></td>
<td></td>
<td>city water</td>
<td>m³</td>
<td>yearly &amp; monthly</td>
<td>gu, dong</td>
<td>2005~2014</td>
<td>에너지소비량(DFB, xml, shp, etc.)</td>
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<td>town gas(m³)</td>
<td>m³</td>
<td>yearly &amp; monthly</td>
<td>gu, dong</td>
<td>2005~2014</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>district heating</td>
<td>Gcal (Mcal)</td>
<td>yearly &amp; monthly</td>
<td>gu, dong</td>
<td>2005~2014</td>
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<td>6</td>
<td>Energy Consumption by sector</td>
<td>electricity by sector</td>
<td>MWh</td>
<td>monthly</td>
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<td>district heat</td>
<td>Gcal</td>
<td>monthly</td>
<td>city</td>
<td>1999~2014</td>
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* The data collected in the years 2005~2008 and 2009~2014 are based on the Dong(administrative division) of the year 2005 and 2009, respectively.*
A2. Relationship between GRDP and Annual Retail Sales Index

A3. Effect of GRDP on the Power Consumption

A4. Effect of HDD on the Coefficient of Power Consumption Variation
A5. Effect of CDD on the Coefficient of Power Consumption Variation

![CDD vs coefficient of power consumption variation (commercial)](image)

\[ R^2 = 0.500136 \]

![CDD vs coefficient of power consumption variation (residential)](image)

\[ R^2 = 0.381509 \]

A6. Effect of HDD and CDD on Town Gas Consumption

![Town Gas Consumption (winter)](image)

\[ R^2 = 0.8551 \]

\[ R^2 = 0.9399 \]

![Town Gas Consumption (summer)](image)

\[ R^2 = 0.6614 \]

\[ R^2 = 0.4369 \]
A7. Temporal Variation of Power Consumption by Sector

A8. Temporal Variation of Town Gas Consumption by Sector
A9. Temporal Variation of District Heat Consumption by Sector

A10. Temporal Variation of Energy Consumption by Source
서울연 2015-BR-15

서울시 기후에너지정책 성과 분석을 위한 기초정보 조사

발행인  _ 김수현
발행일  _ 2016년 4월 30일
발행처  _ 서울연구원

비때문

06756 서울특별시 서울구 남부순환로 340길 57

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