# Energy savings potential in the commercial sector

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Center for Low Carbon Society Strategy

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- Estimation of the load curve of the commercial sector for a summer day
- Sensitivity analysis : Variation in demand with outdoor temperature and air conditioning COP
- Evaluation of effects from measures

# Estimation of electricity demand

- Estimation of daily load curve for the commercial sector in TEPCO service area
  - Include Tokyo, Kanagawa, Saitama, Chiba, Ibaraki, Tochigi, Gunma, Yamanashi, parts of Shizuoka
  - Average hourly electricity demand in July, August and September
  - Industries considered
    - Schools
      - K-12 schools, Universities
    - Hotels
      - “City hotels” and “business hotels”
      - Exclude “ryokan” hotels
    - Hospitals and elderly care facilities
      - Exclude clinics and dentists
    - Food and services
      - “Family restaurants”, fast food, “soba” and “udon”, Japanese and Chinese restaurants
      - Fitness clubs, karaoke houses
- Air conditioning settings
  - COP of electric air conditioning ：2.5
  - Ratio of gas air conditioning ：25%

# Base data for estimation

- Number of offices
  - By industry, by prefecture
  - Source : Economy census[1]
- Floor area per office
  - By industry
  - Source: investigated a sample of few ten offices per industry
- Air conditioning and general electricity demand
  - By industry
  - Source: investigated a sample of few ten offices per industry
- Demand by month, by hour in one day
  - By industry
  - Source : The society of heating, air conditioning and sanitary engineers of Japan[2], Ojima research group[3], Agency for Natural Resources and Energy [4], measured data[5]

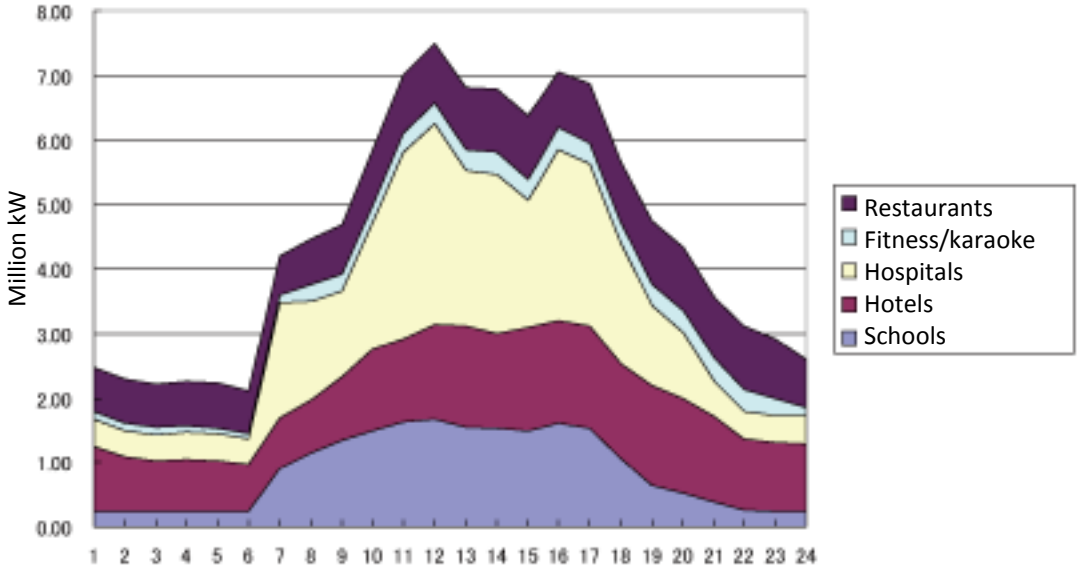
# Consistency check

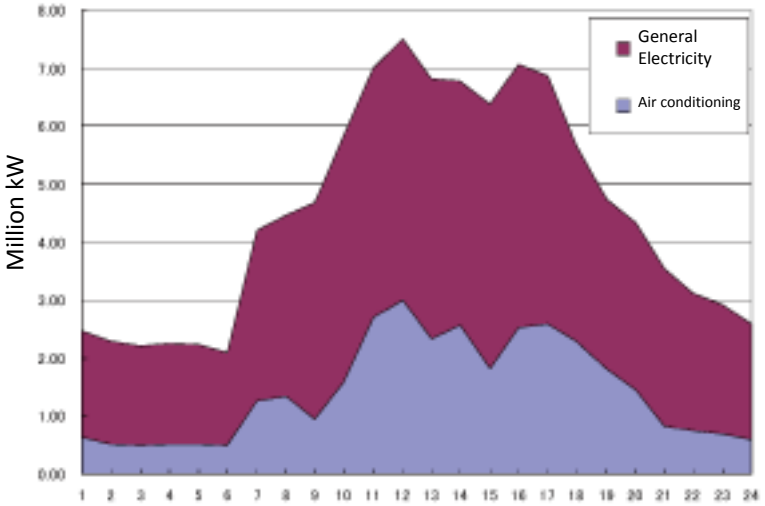
| | 2pm demand（10,000kW） | | Gloss floor area（10,000m$^2$） | |
|---|---|---|---|---|
| | This estimate | ANRE | This estimate | ANRE |
| Hospitals | 207 | 160 | 3028 | 3000 |
| Hotels | 165 | 120 | 3129 | 2250 |
| Restaurants | 99※1 | 190※1 | 1033 | 2300 |
| Schoos※2 | 86 | 130 | 11520 | 9060 |

※1　8pm demand

※2　Elementary, middle, and high schools only

# Total demand

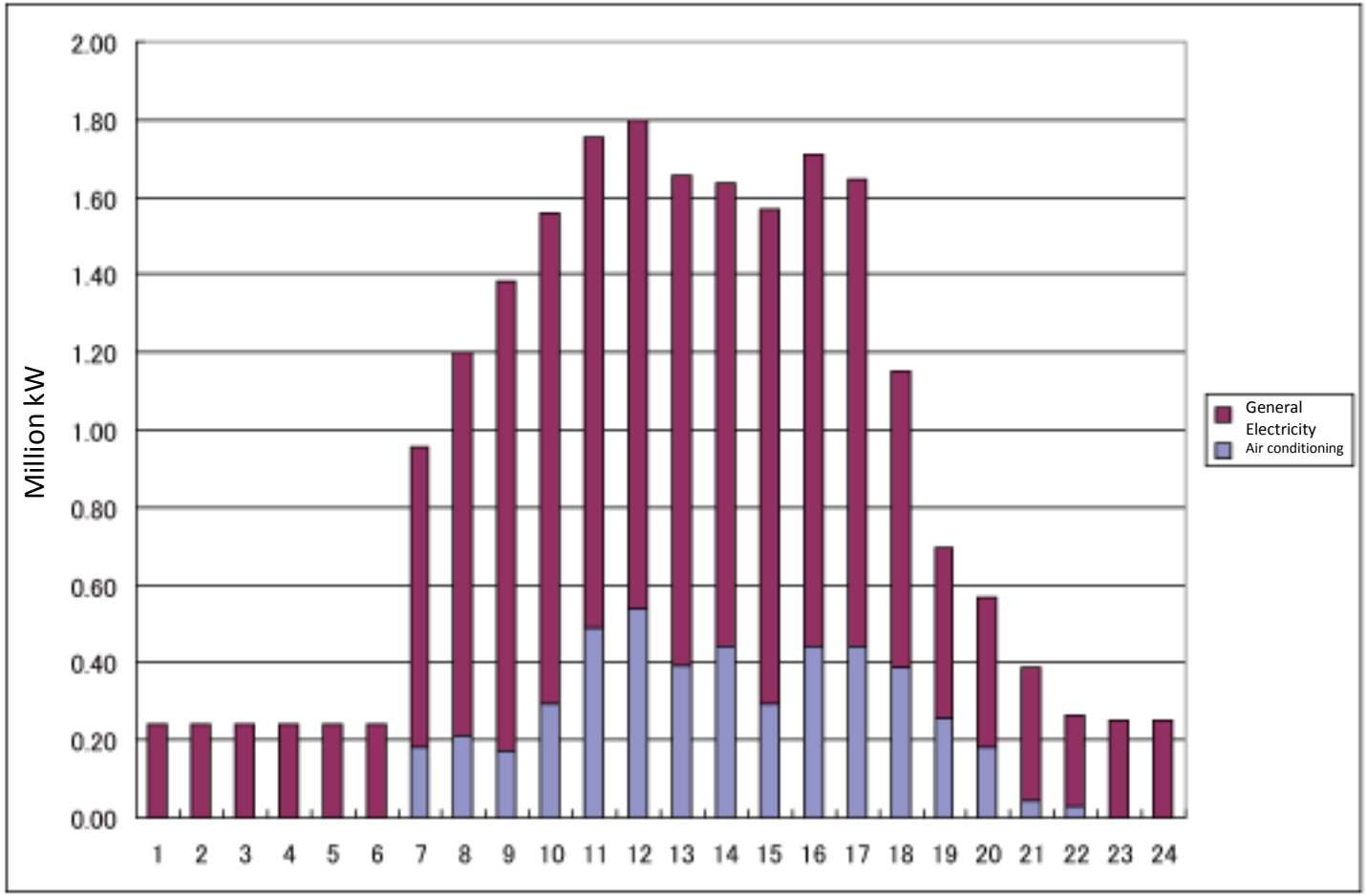


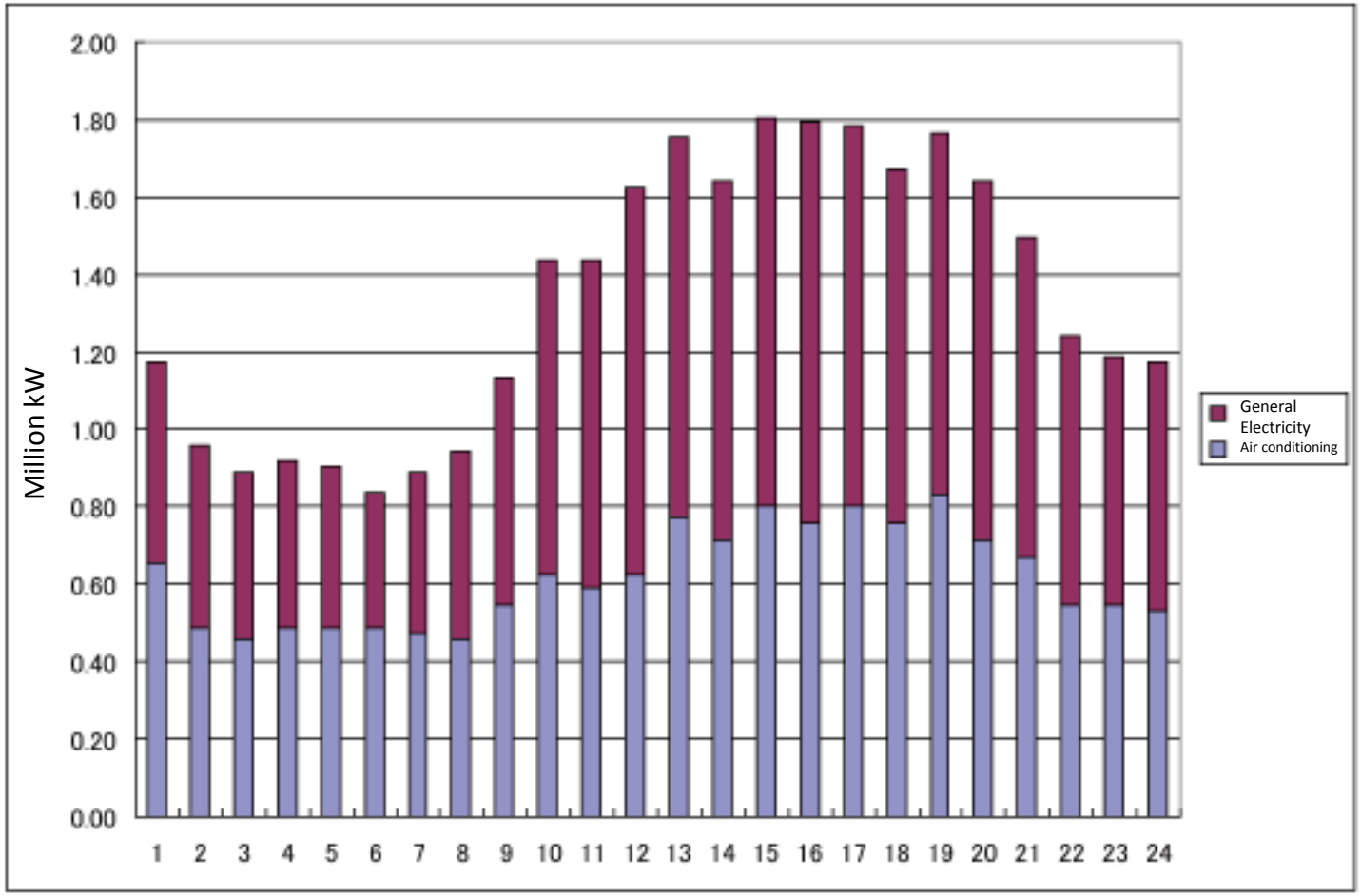

Peak demand : 7.5 million kW

Covers about 1/3 of peak demand in the commercial sector (25 million kW)

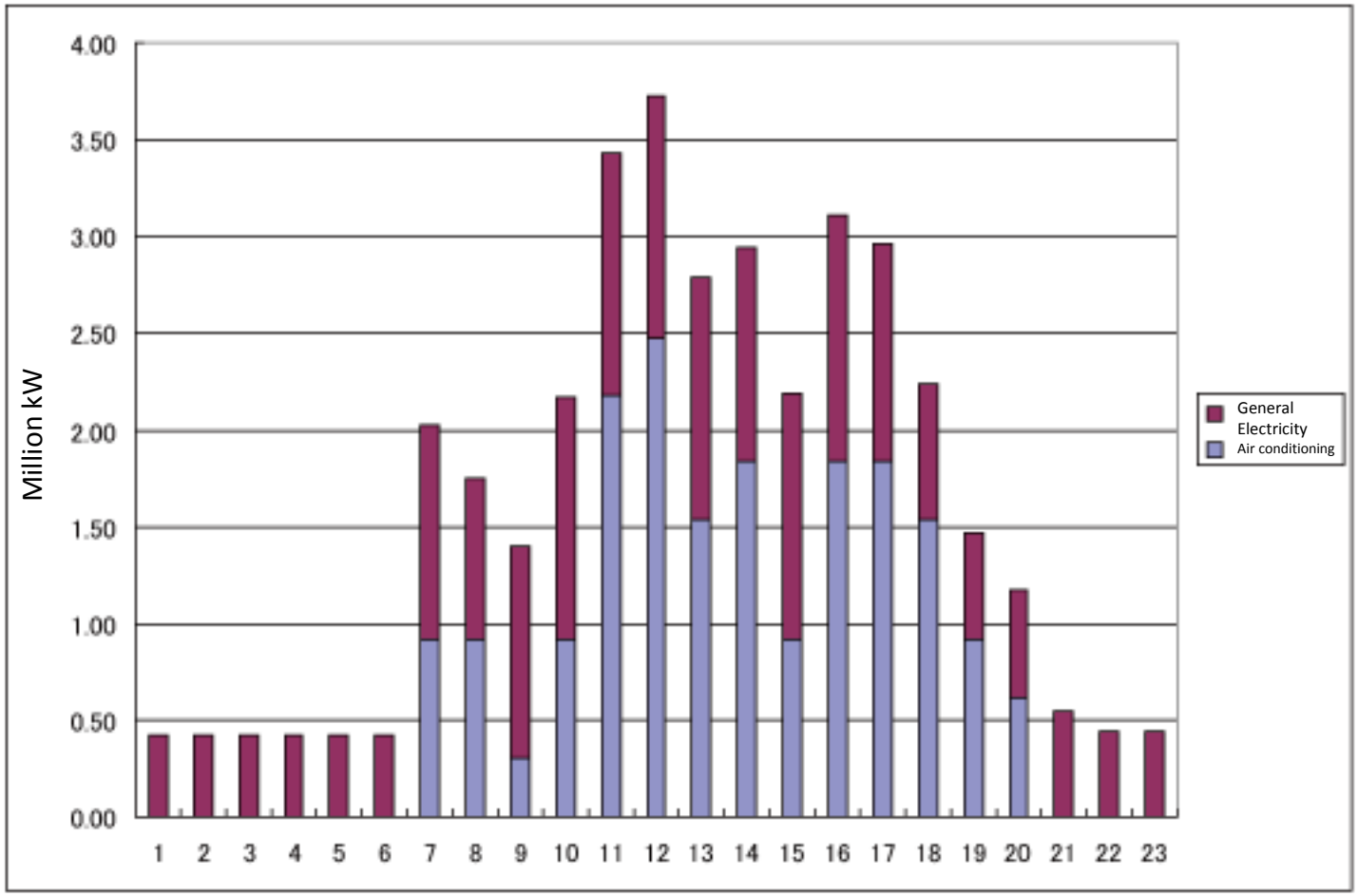
# By industry (schools)



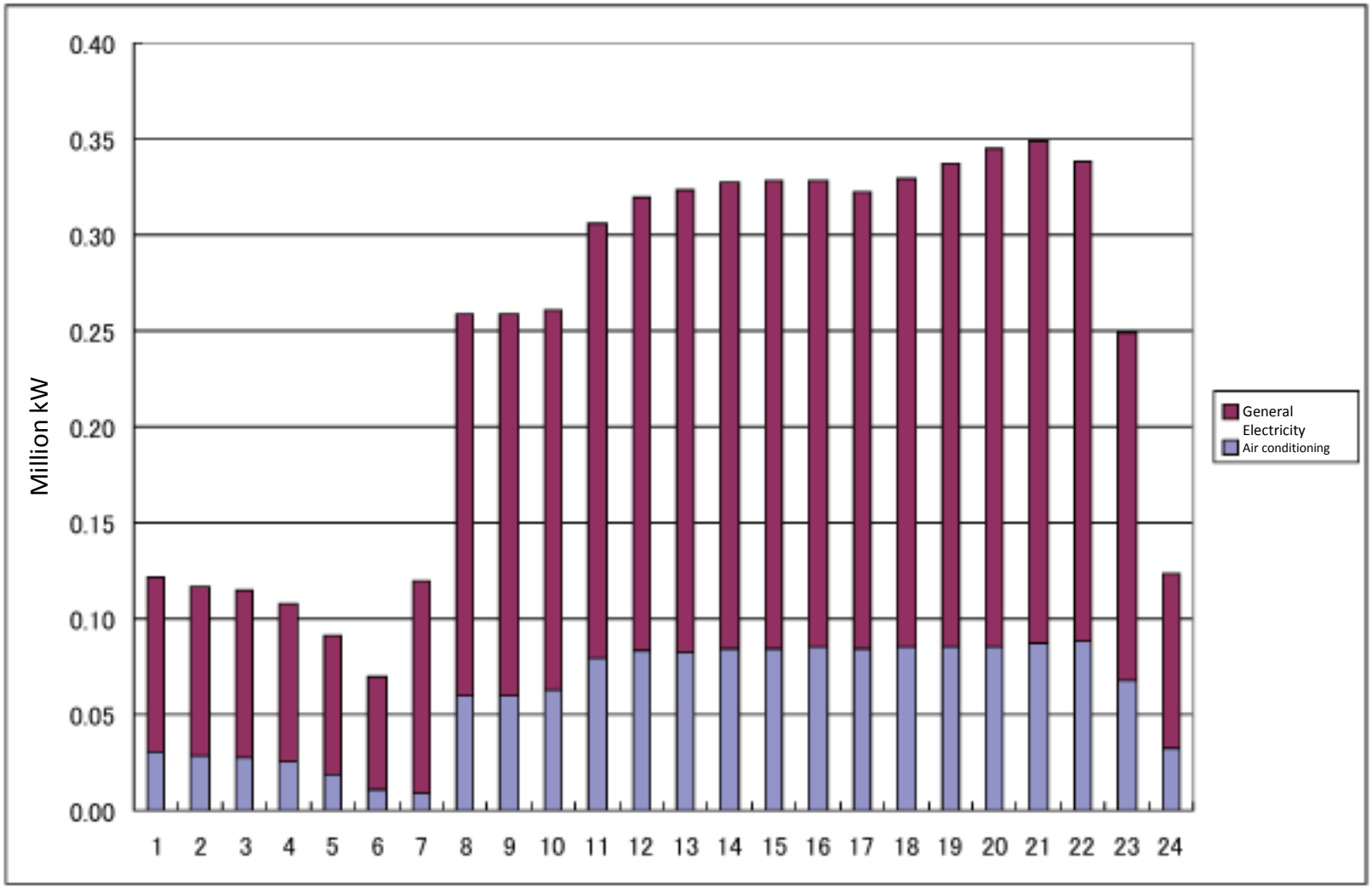
# By industry (hotels)



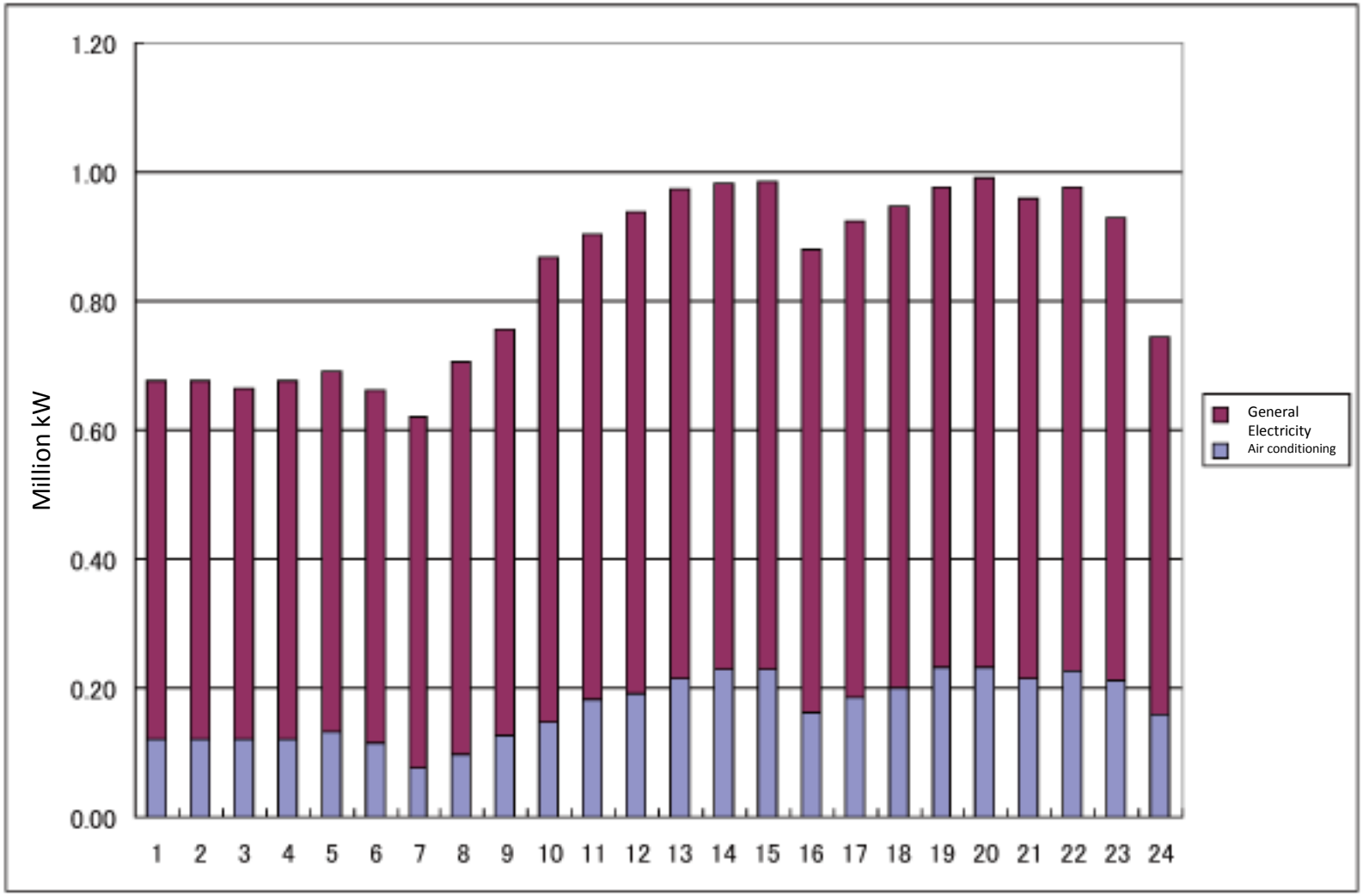
# By industry (hospitals)



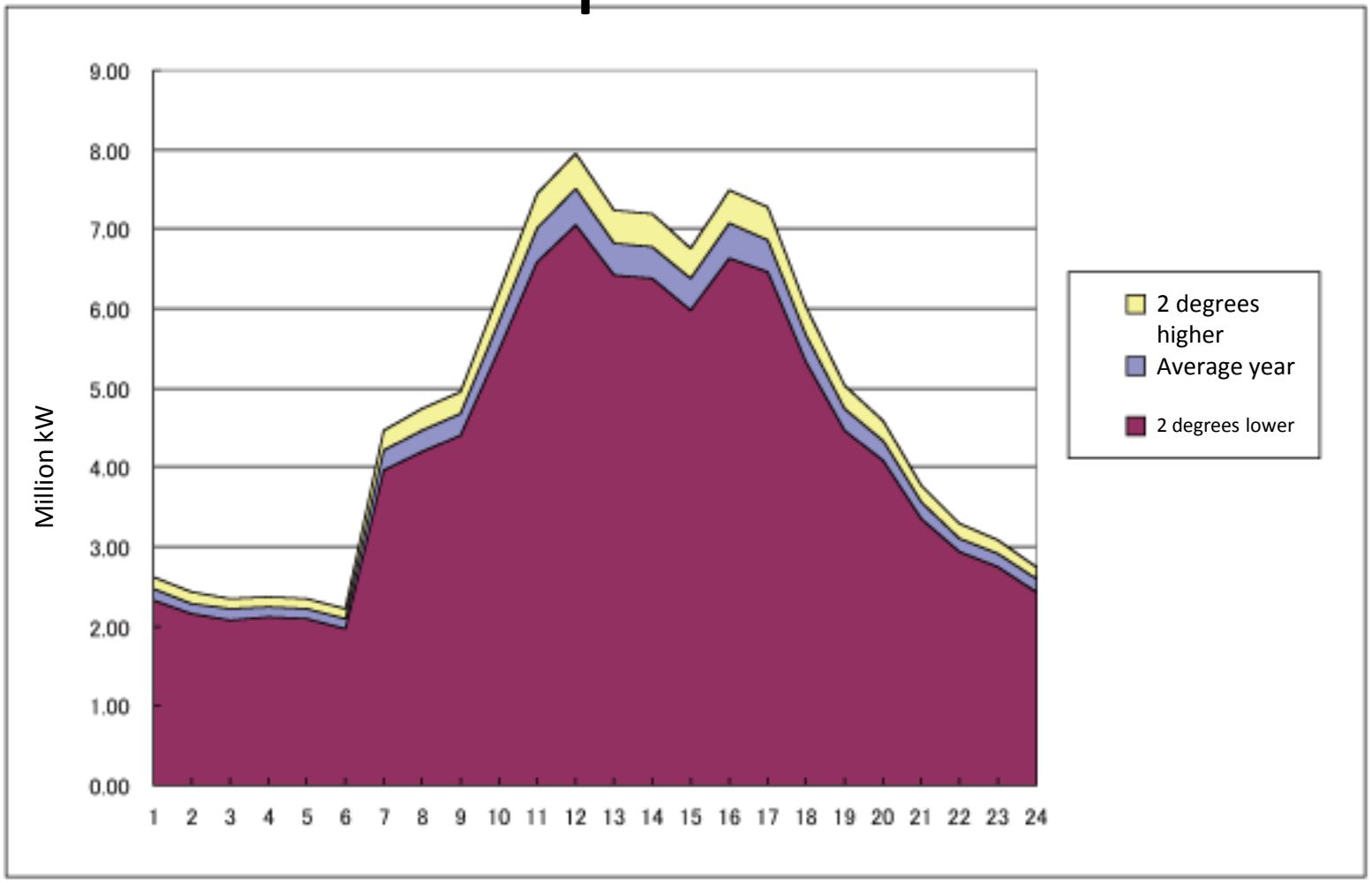
# By industry (fitness/karaoke)



# By industry (restaurants)

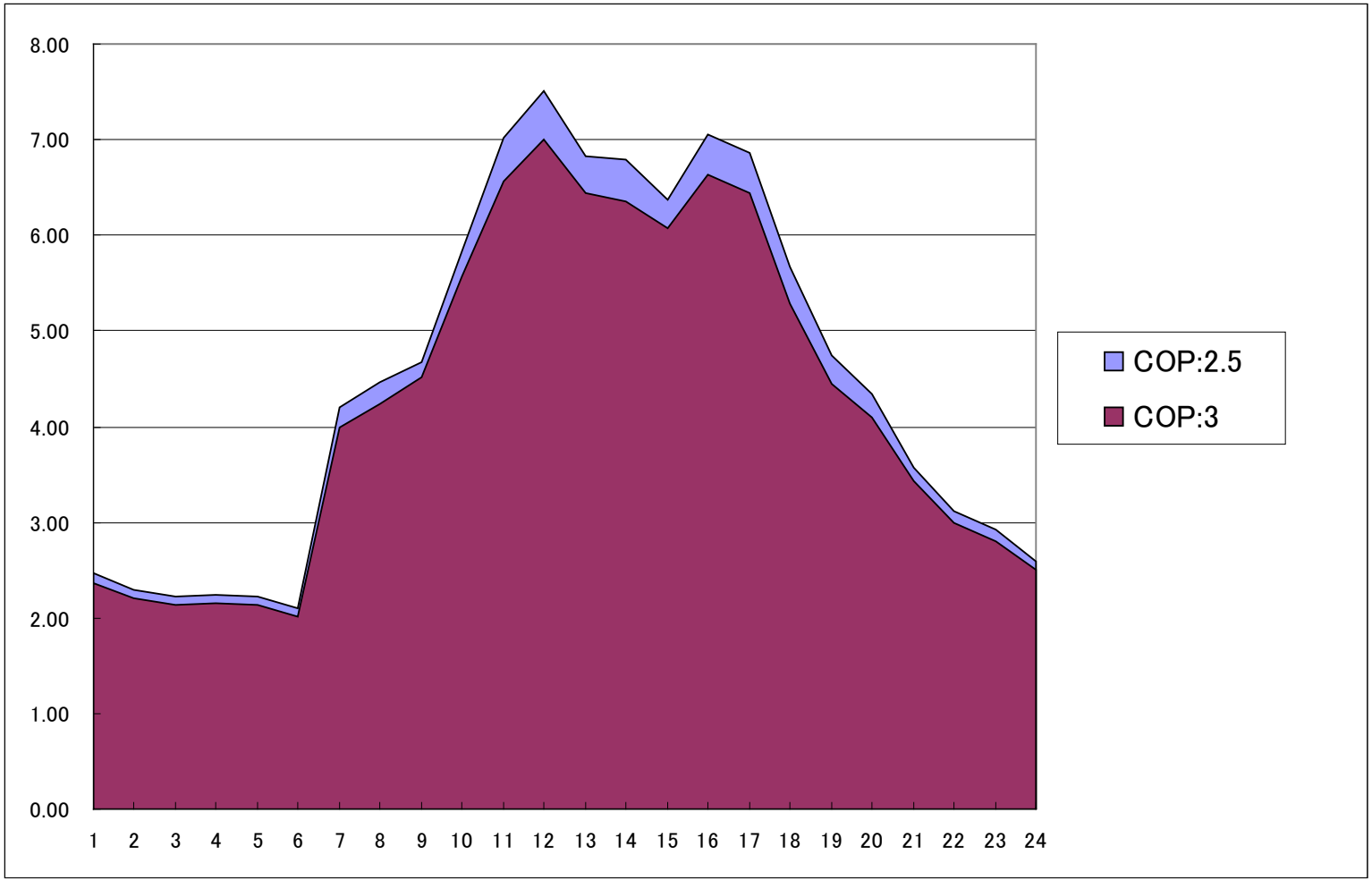


# Variation of demand with temperature




About 3% change with change of 1℃ → Increase air conditioning setting temperature by 1℃ reduces electricity demand by 3%

# Variation of demand with COP

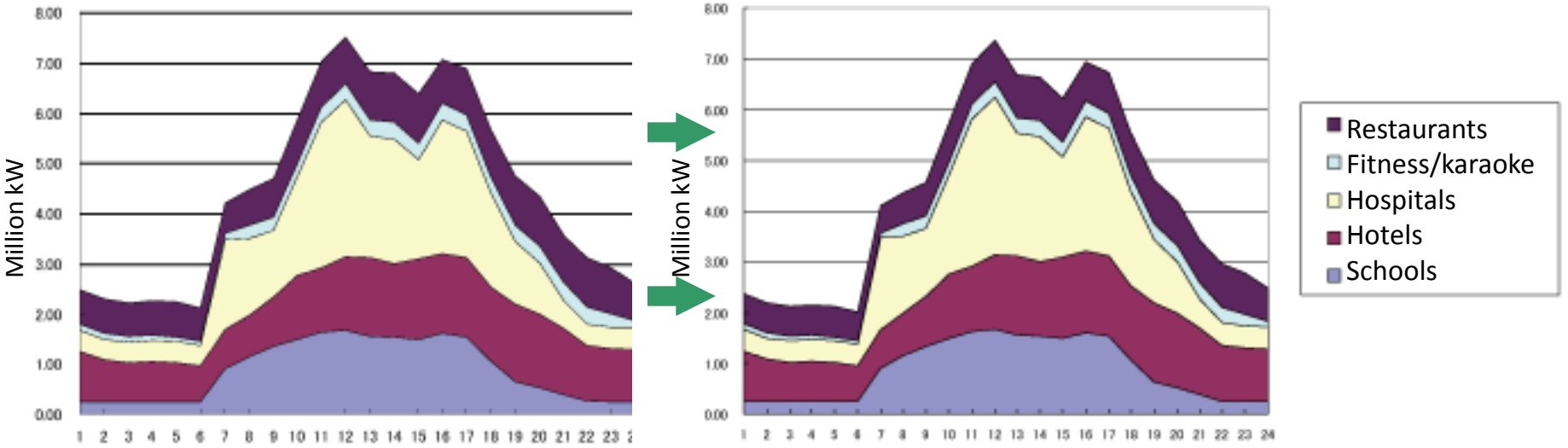


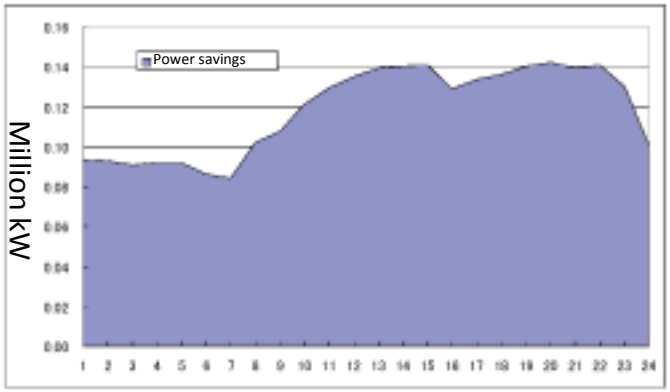

Improvement from COP2.5 to 3.0 reduces demand by about 5%

# Measures taken

| | Restaurants | Sports clubs | Karaoke houses |
|---|---|---|---|
| Lighting | ・Turn off backyard lighting when no one is using<br>・Revise lighting on/off rules for billboards, outside lighting, parking lots<br>・Revise lighting on/off rules for customer seats during stand-by before opening | ・Revise lighting on/off rules during cleaning<br>・Reduction of lights based on brightness<br>・Turn off backyard lighting when no one is using<br>・Revise lighting on/off rules for outside lighting<br>・Replacement of conventional light bulbs with LED lighting | ・Turn off backyard lighting when no one is using<br>・Revise lighting on/off rules for billboards, outside lighting, parking lots<br>・Revise lighting on/off rules for customer seats during stand-by before opening<br>・Reduction of lights based on brightness<br>・Replacement of conventional light bulbs with LED lighting |
| Air conditioning | ・Revise on/off rules for air conditioners<br>・Change temperature settings by area<br>・Change temperature settings by time (by number of guests and external temperature)<br>・Use external air in mornings and evenings to reduce air conditioning load | ・Revise on/off rules during operating hours<br>・Revise on/off rules outside operating hours<br>・Change temperature settings<br>・Revise backyard air conditioning usage rules | ・Revise on/off rules for air conditioners by area<br>・Change temperature settings by area<br>・Revise on/off rules for air conditioners during stand-by and closing |
| | Periodically clean filters (about once every two weeks) | Periodically clean filters (about once every two weeks) | Periodically clean filters (about once every two weeks) |
| | Use window shades, heat shield film, hoods, screens | | |
| Kitchen appliances | ・Do not leave refrigerator and fridge door open<br>・Quickly store or remove food | | ・Do not leave refrigerator and fridge door open<br>・Quickly store or remove food |
| | ・Revise temperature settings of kitchen appliances<br>・Revise on/off rules<br>・Adjust number of operating appliances based on number of guests | | ・Revise temperature settings of kitchen appliances<br>・Revise on/off rules<br>・Adjust number of operating appliances based on number of guests |
| | ・Do not leave refrigerator and fridge door open while storing or removing food<br>・Turn off internal lighting unless while storing or removing food<br>・Quickly store or remove food | | |
| Power outlets | | ・During closing, remove power cables of electric appliances that will not be used | |
| Others | | ・Revise on/off rules of hot water related pumps<br>・Reduce operating air supply and exhaust system equipment | |

# Evaluation of implemented measures




## Scope of measures

- Restaurants : 10～15%
- Fitness clubs : 3～9%
- Karaoke houses : 10%

## Measures taken

Measures were limited to those already taken in the past that can be implemented easily and in a short time (e.g. air conditioning)

⇒ Total power savings of about 90,000kW～140,000kW

# Summary

- Estimated load curve for about 1/3 of demand out of the total 25 million kW of the commercial sector
- Implementing easy to implement measures in half of the stores in three industries (restaurants, fitness clubs, karaoke houses) results in at least 140,000kW of power savings
  - This power savings corresponds in all users of the 25 million kW commercial sector
    - Increasing the air conditioning temperature setting by about 0.5～1℃
    - Improving the COP by about 0.1～0.2

      （Corresponds to changing to air conditioning equipment that consumes 4% to 7% less electricity）
- Hospitals, hotels, schools
  - If 3% of power savings is possible, the combined 6 industries have the potential for power savings of about 320,000kW

# References


1. Ministry of Internal Affairs and Communications: 2009 Economic Census – Basic Survey
2. The Society of Heating, Air-Conditioning and Sanitary Engineering of Japan : Standard load data
3. Ojima Group (Waseda University) : “Basic units of light, heating and water utilities in buildings”
4. Agency for Natural Resources and Energy : “Estimated electricity demand structure for a peak summer day peak (TEPCO service area) http://www.meti.go.jp/setsuden/20110513taisaku/16.pdf
5. Data from PICO ADA Co.,Ltd.