A Support Tool for Ranking Energy-Saving Activities in Office Buildings

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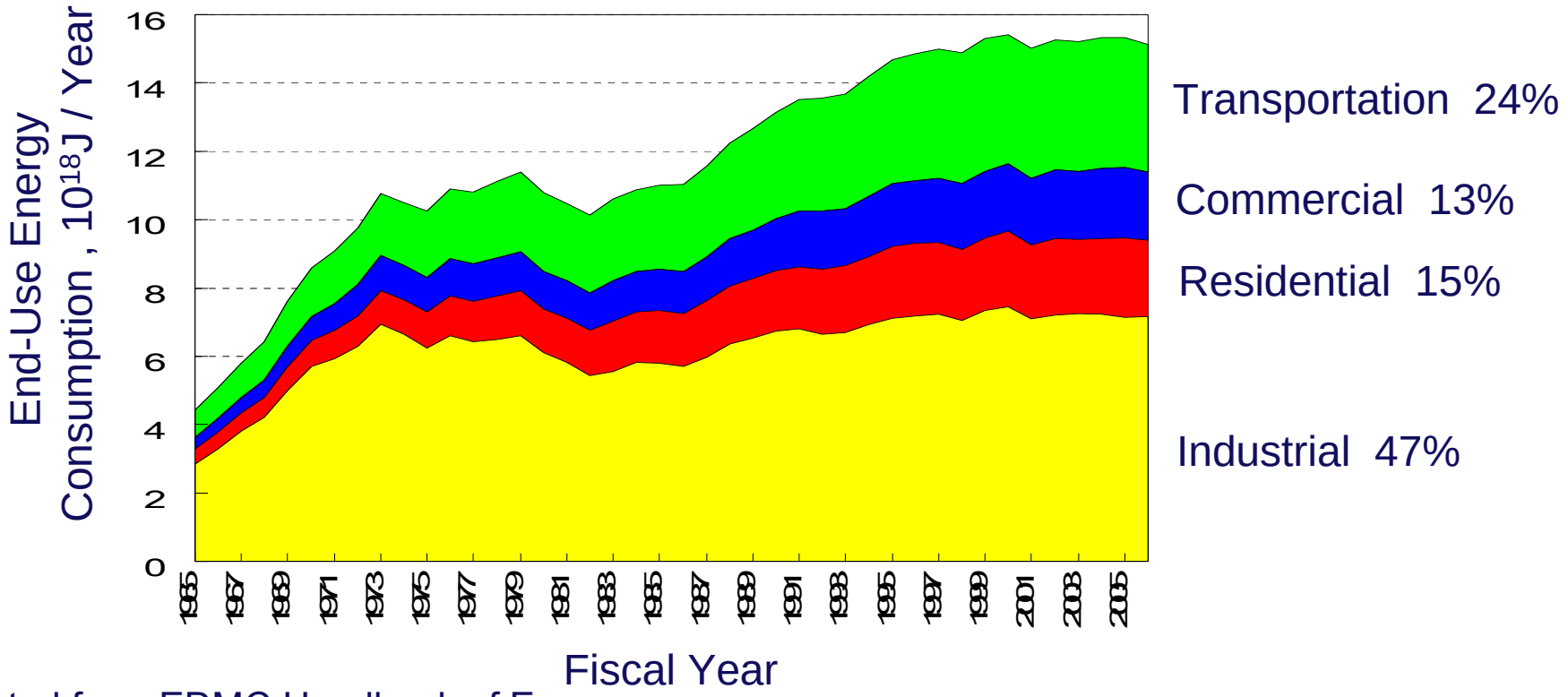
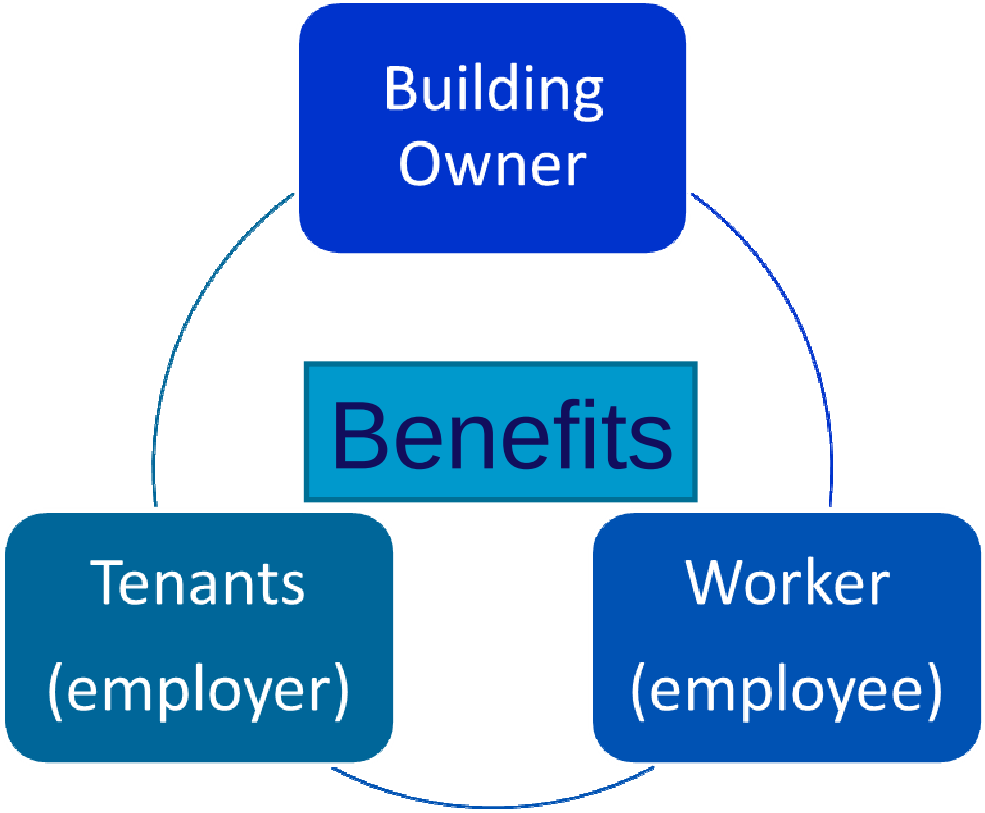
Introduction

- Increasing energy consumption in the commercial sectors



Adapted from EDMC Handbook of Energy & Economic Statistics in Japan, 2008.

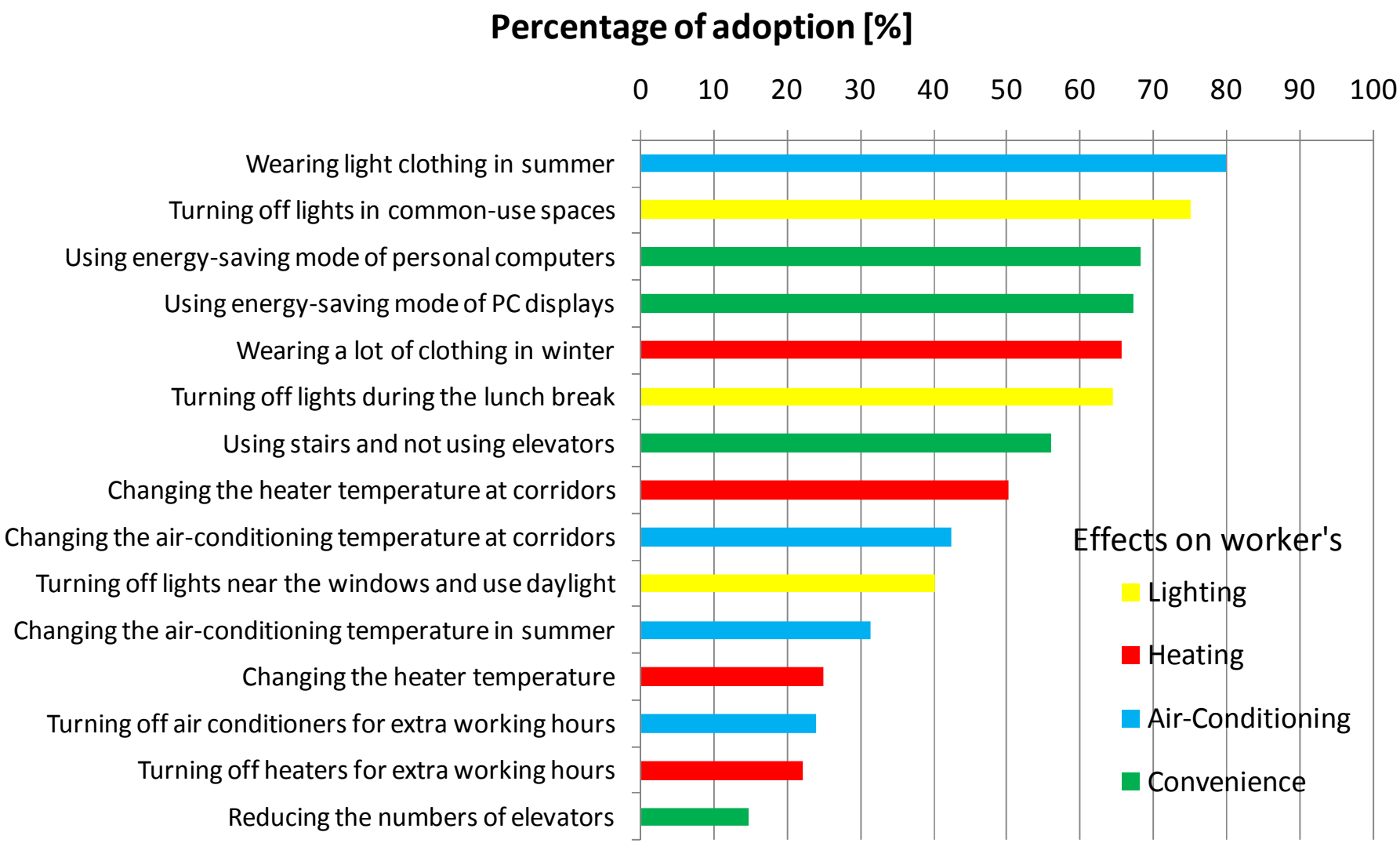
Introduction



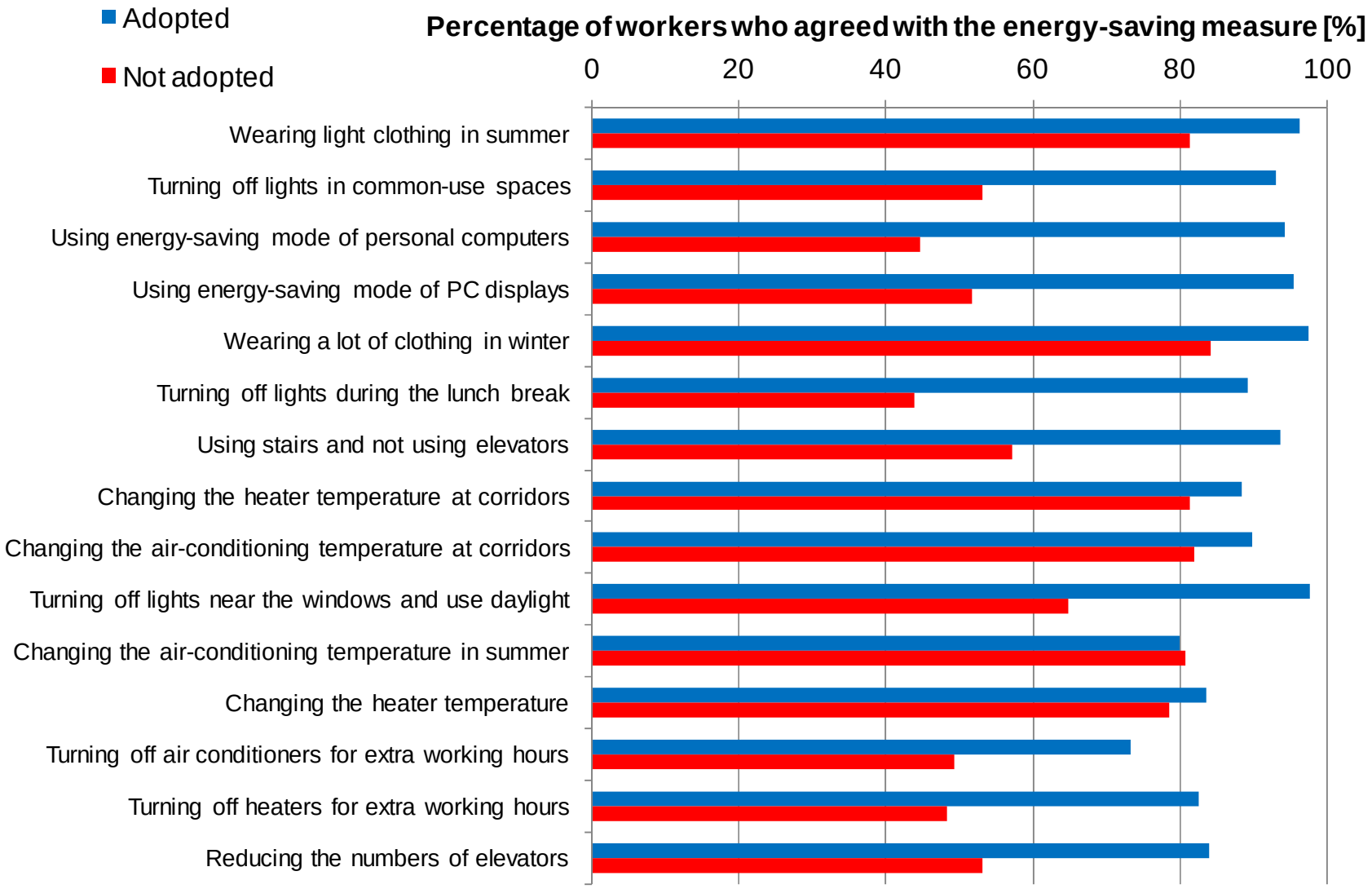
Questionnaire-based survey

Survey method	Web survey
Candidate for survey	Office workers throughout Japan. Registrant of web questionnaire survey by research organization
Surbey period	March, 2010 (Be careful that the date is before Earthquake of 3.11,2011)
The number of effective replies	2,512
Survey item	Attribute of respondent such as gender, ages, position, etc.
	Attribute of office where respondent works such as region, building scale, etc.
	Adoption of each energy-saving measure, approval/disapproval of each energy-saving measure, etc.

Percentages of adoption of energy-saving measures



Percentages of worker agreement to energy-saving measures



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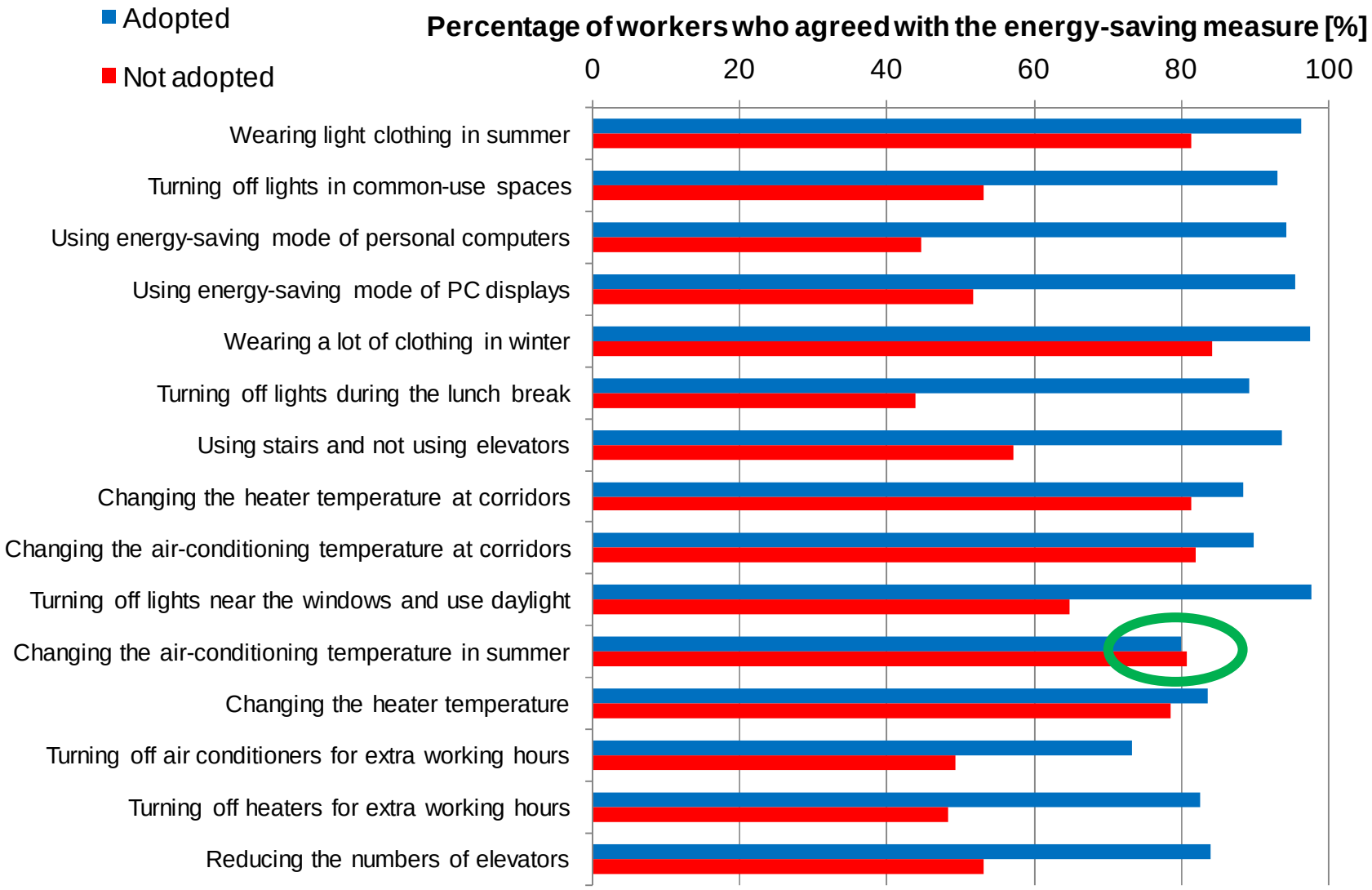
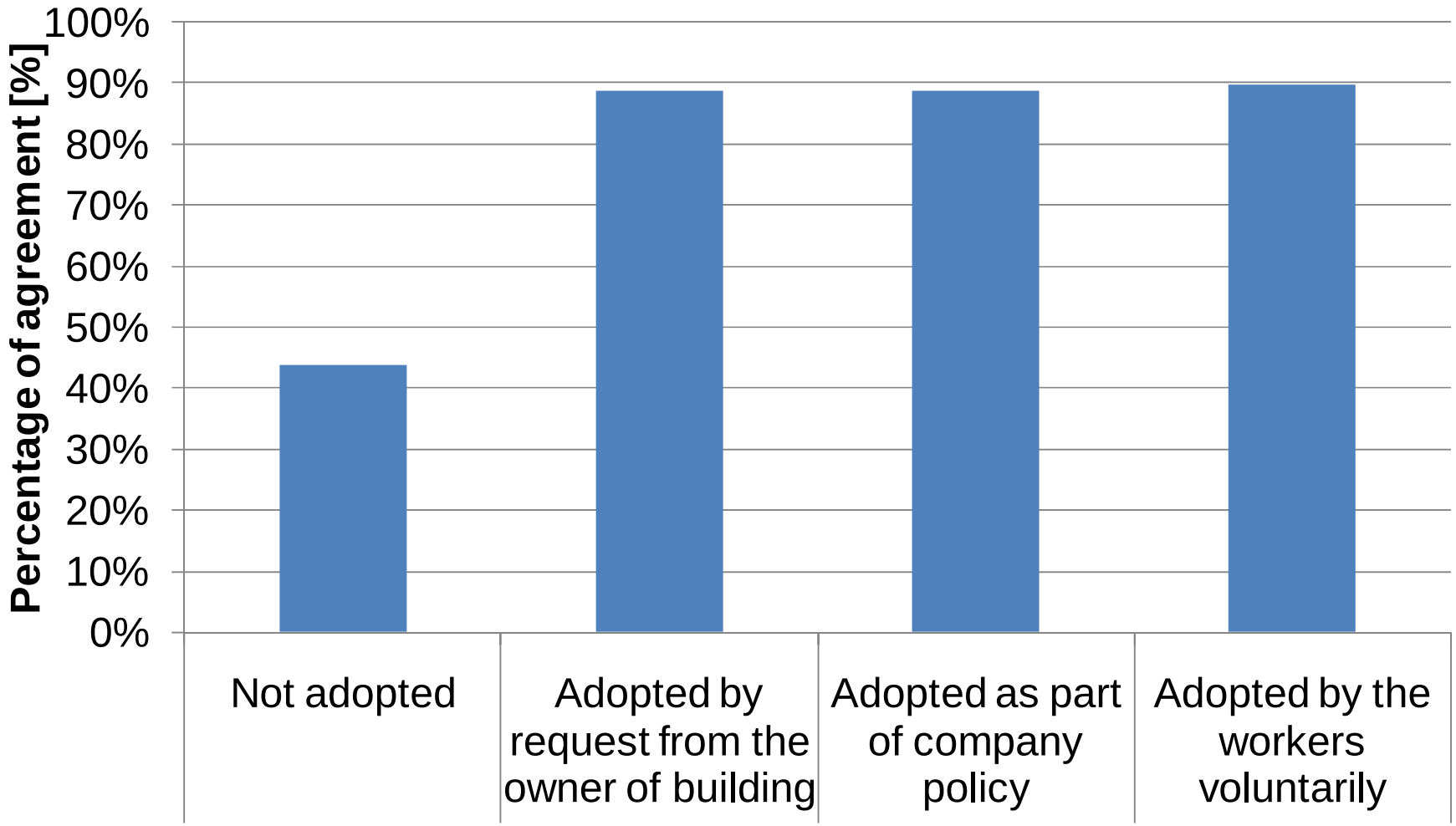


Percentages of worker agreement to the measure of turning off room lights during the lunch break for different decision makers



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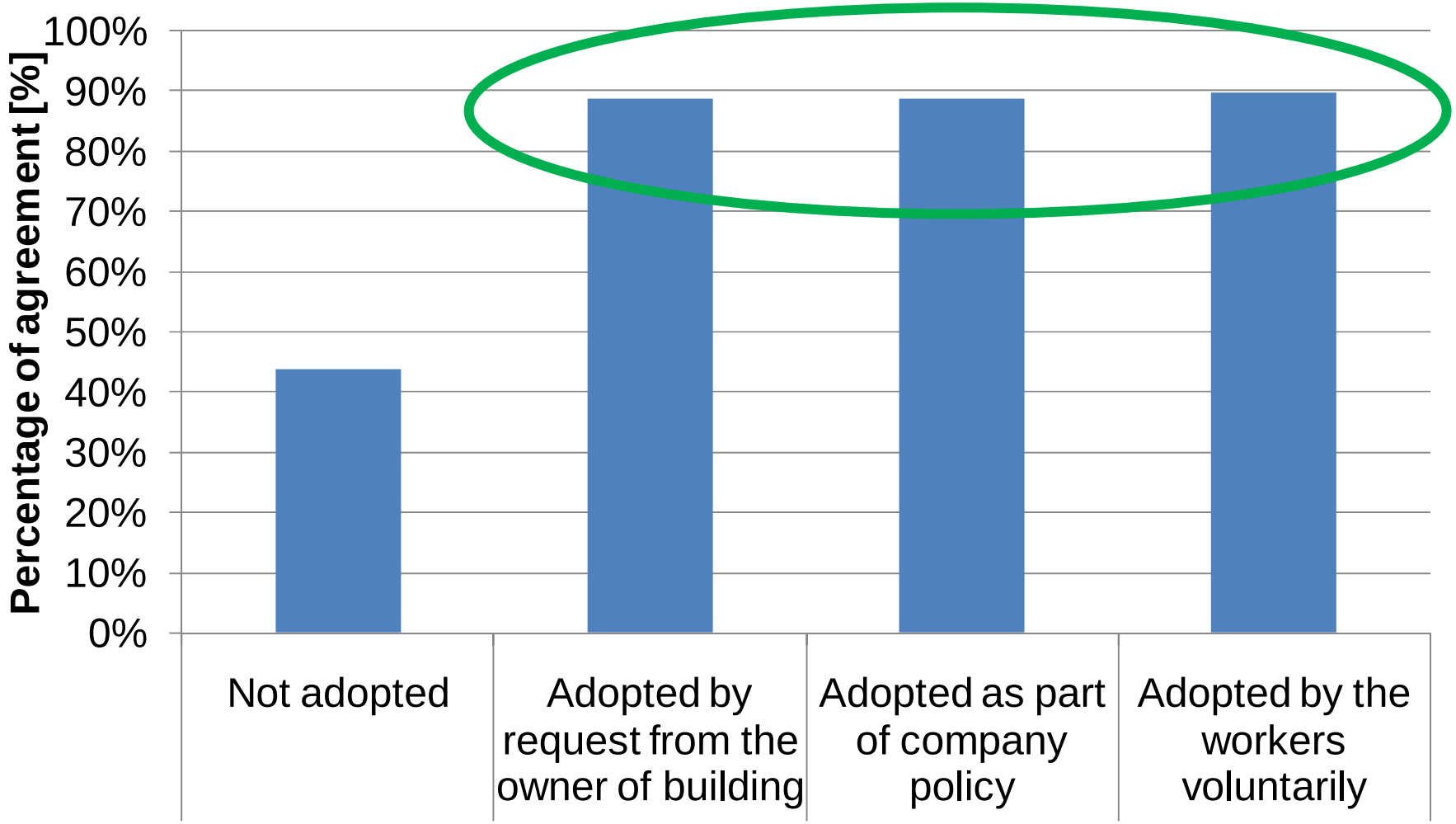


A Hypothesis to energy-saving

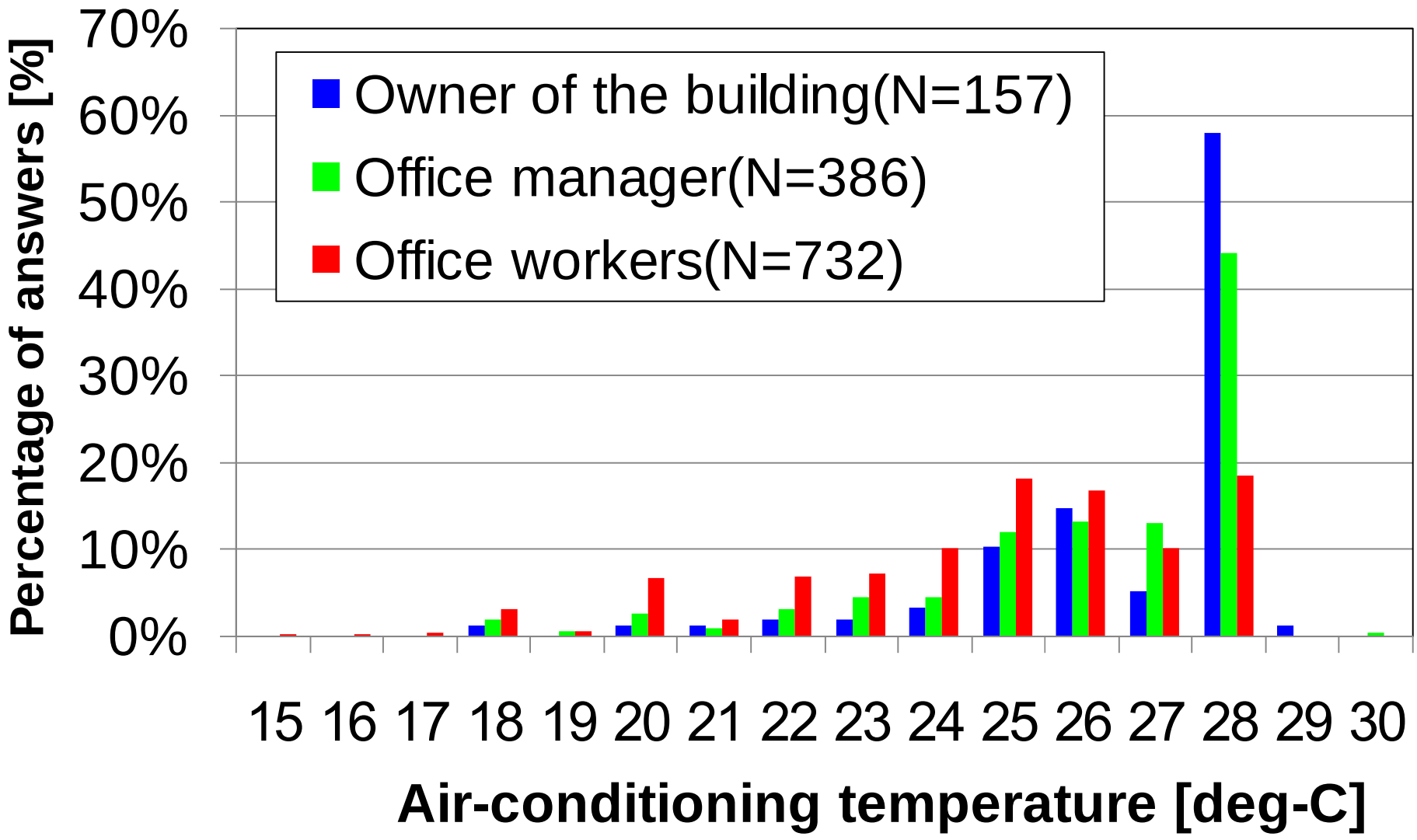
- The percentage of agreement was high even though the owner of the building request the measure

- Providing opportunity to experience energy-saving effect

- Understanding of workers of the effect of the measures can be enhanced

- Promotion of energy-saving measures

Frequency distribution of actual air-conditioning temperature set in offices for each type of decision maker



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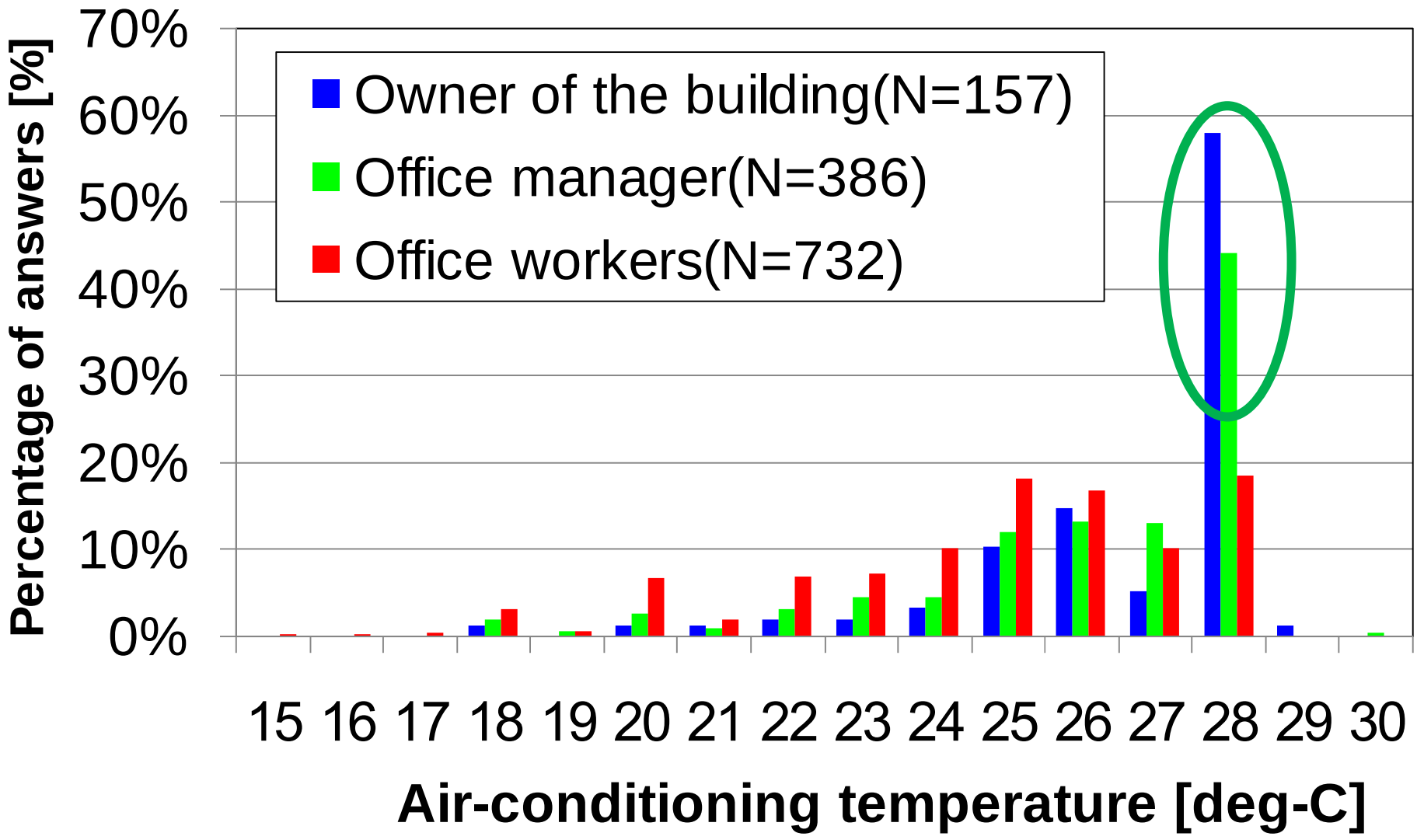

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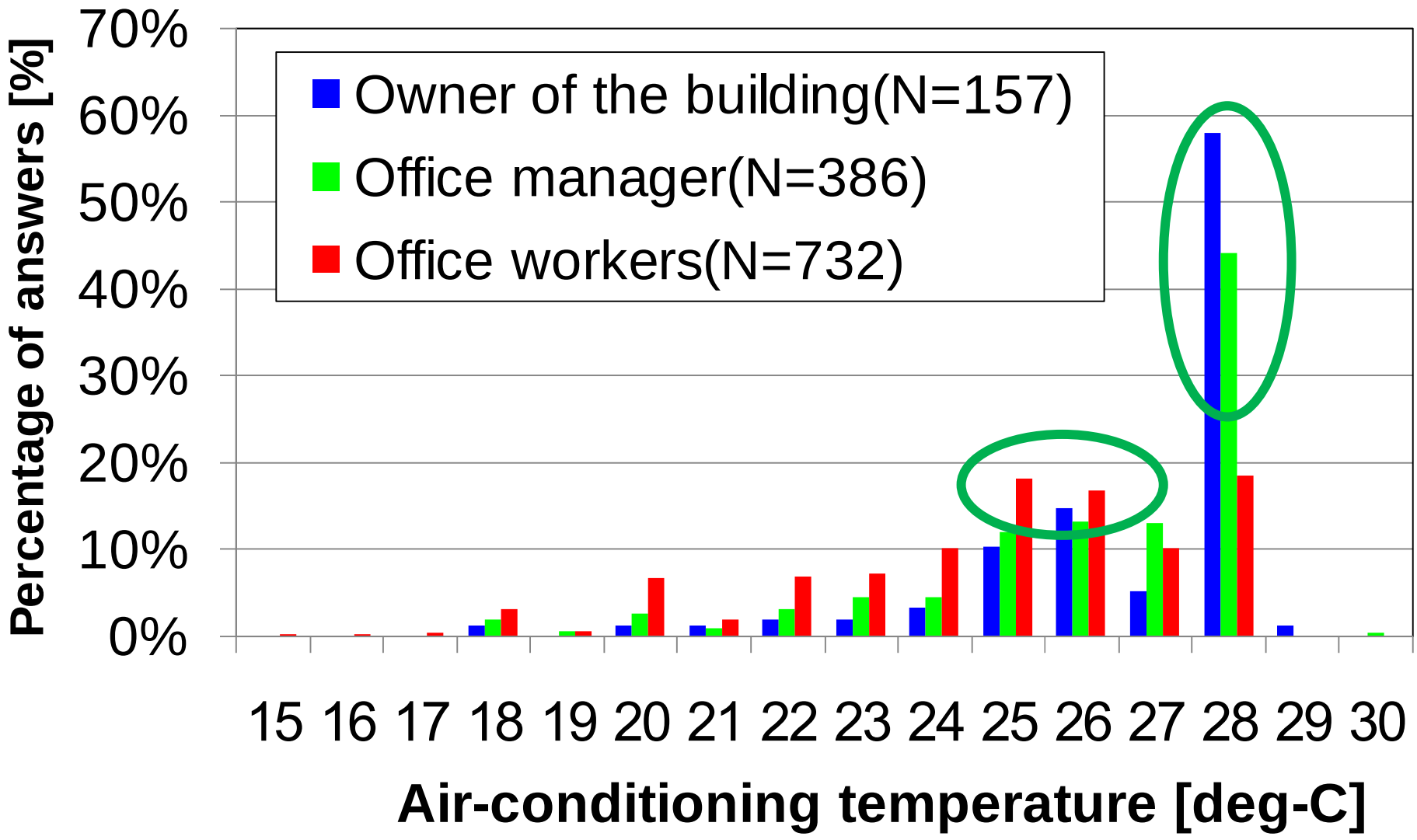
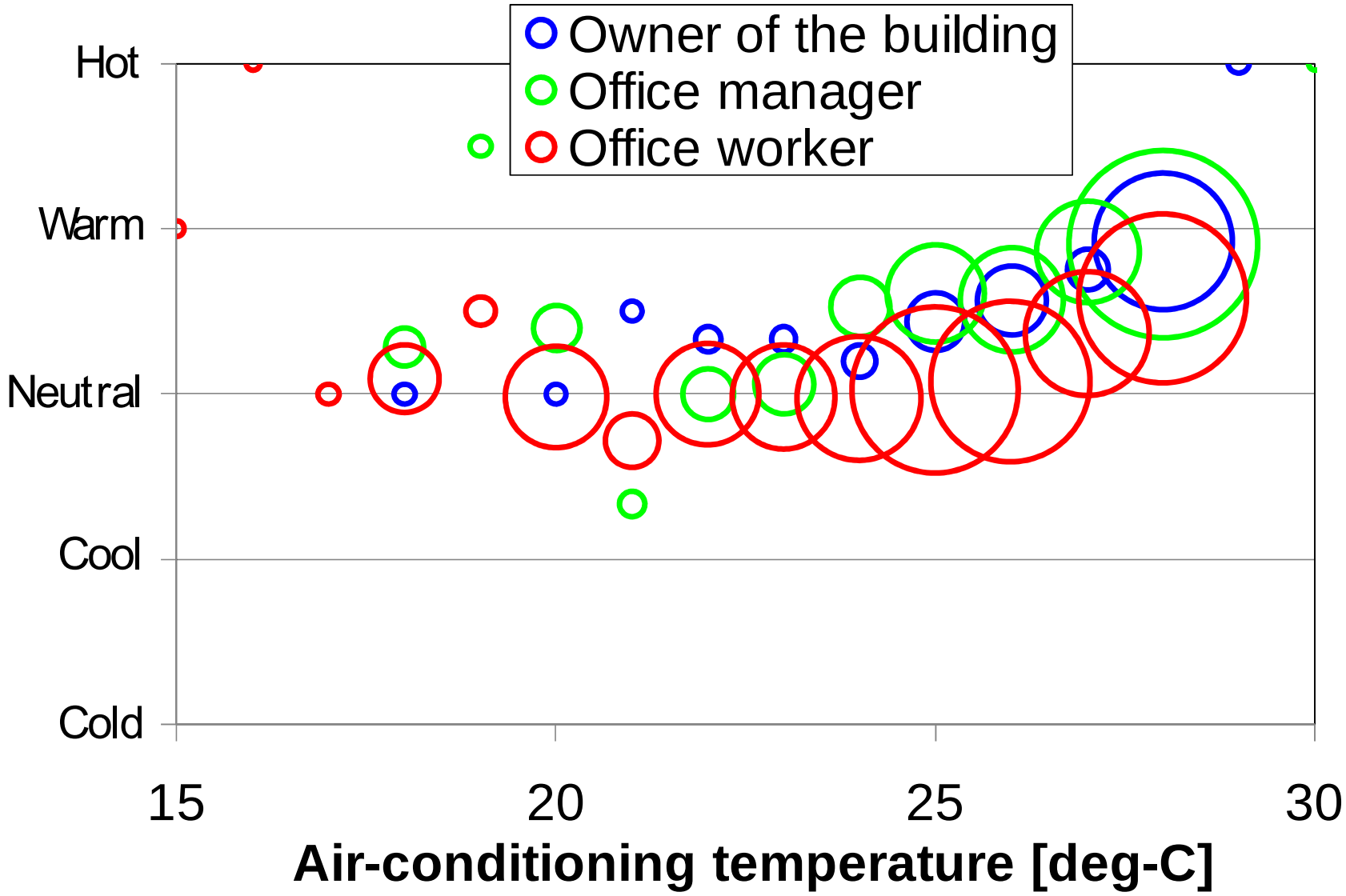
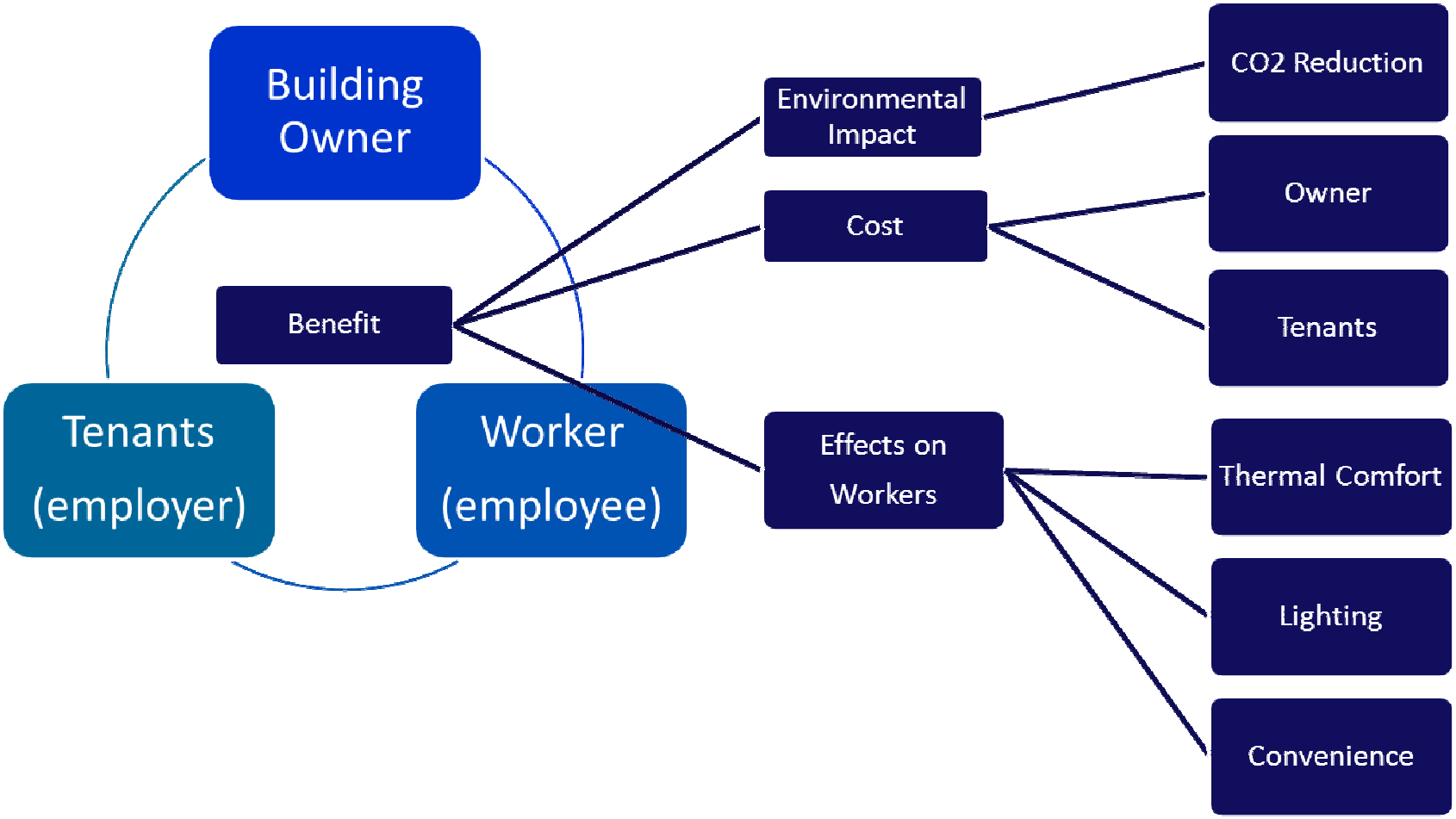


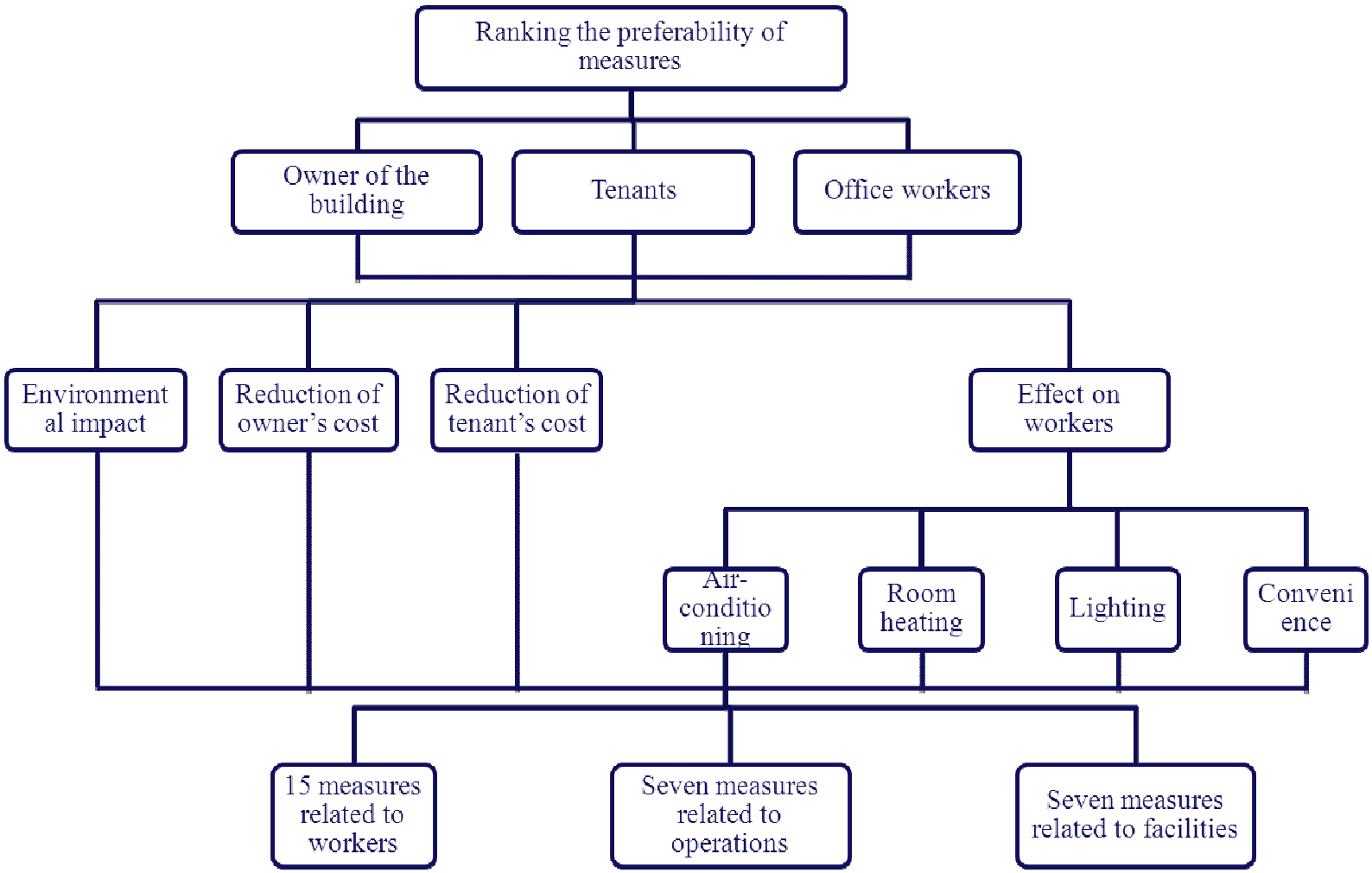
Relationship between air-conditioning temperature and worker comfort



Purpose of the Tool

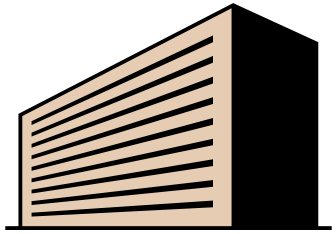


AHP hierarchy diagram

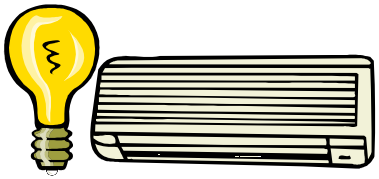


Calculate Evaluation Criteria

Model Building



Energy Consumption
/ Saving Energy



CO2 Reduction

Cost Reduction

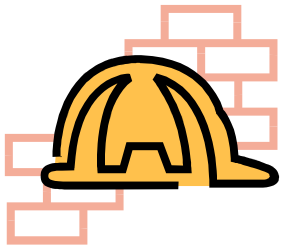
Questionnaire
Workers benefit

Satisfaction
= 100%

Satisfaction
= ??%

- Turning Lights Off
- Changing the air-conditioning Temp. Etc.

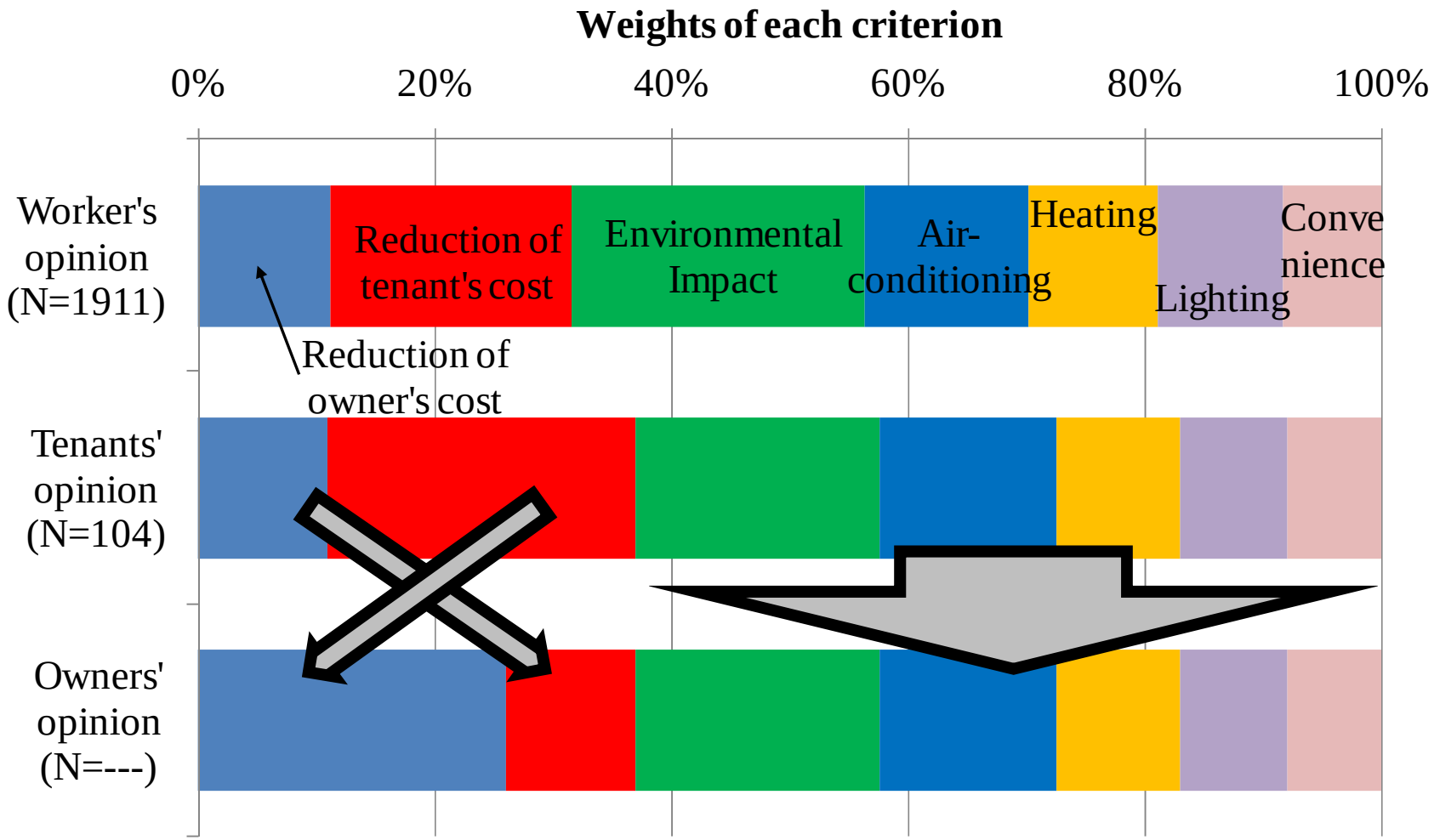
Cost of Installing Facilities,
Maintenance cost



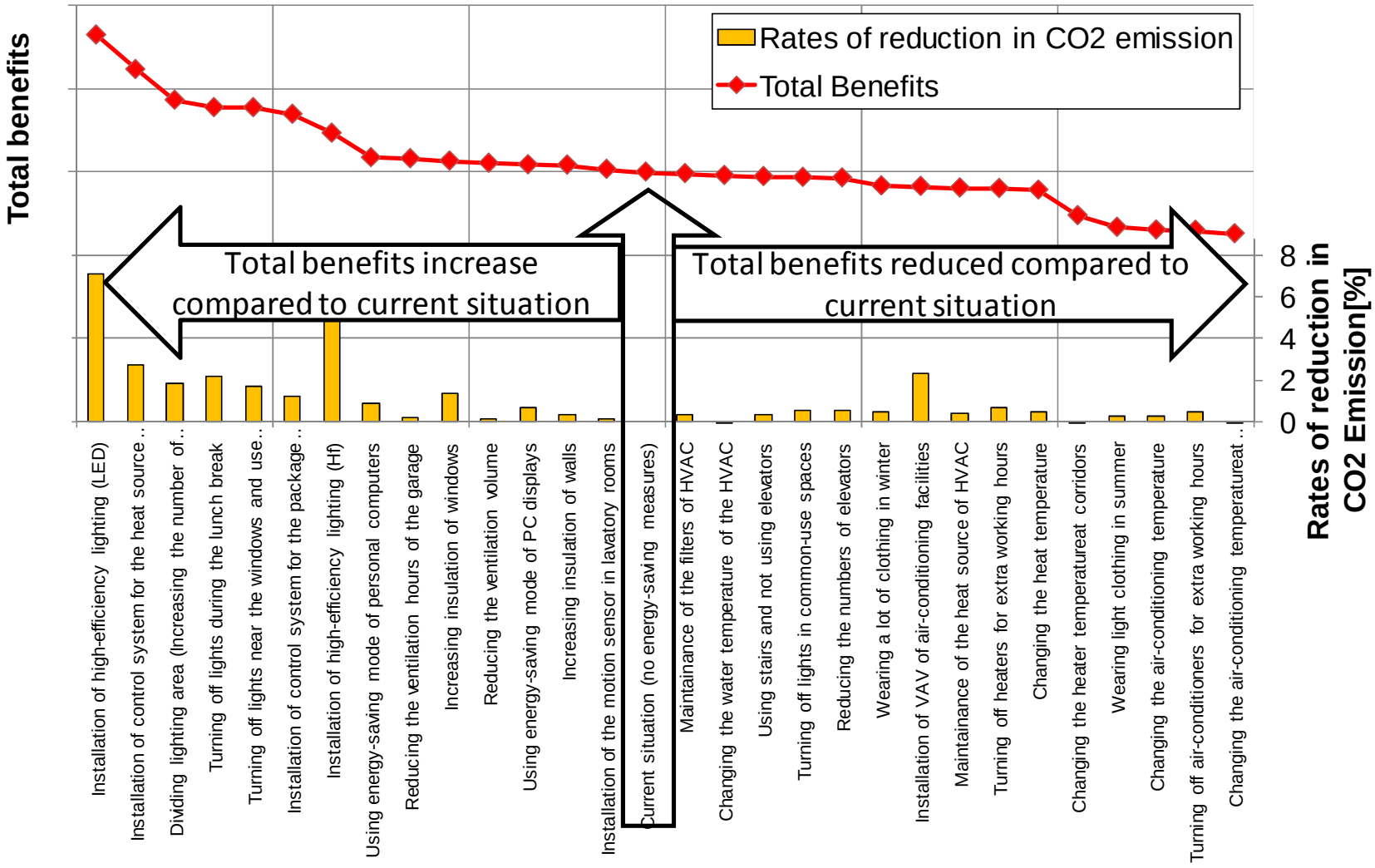
Summary of specifications of six model buildings

Large building	Small building
Rented building (used as office)	
Ten stories above ground, one story beneath ground level	Eight stories above ground
Total floor area: 12,000 m^2	Total floor area: 2,000 m^2
Story height: 3.8m	
Ceiling height: 2.7m	
Number of elevator: three	Number of elevator: two

Weights for evaluation criteria for different decision makers



Calculation results of total benefits (average for six model office buildings)



Conclusion

- Carried out a large-scale Internet-based questionnaire of office workers, tenants and owners on the current status of adoption of energy-saving measures and their agreement and disagreement to promote energy-saving measures for office buildings.

- Proposed a tool to support the decision-making procedure related to the selection of energy-saving measures using the analytic hierarchy process.