

STUDY ON DEVELOPMENT OF AN EVALUATION METHOD FOR CITY ENERGY RESILIENCE IN JAPAN



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Contents

1. What is the energy resilience of a city?
2. Evaluation of the energy resilience measures
3. Proposal of policy model for energy resilience

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What is resilience?

Resilience:

The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Source: IPCC WGII AR5 Summary for Policymakers

What is energy resilience?

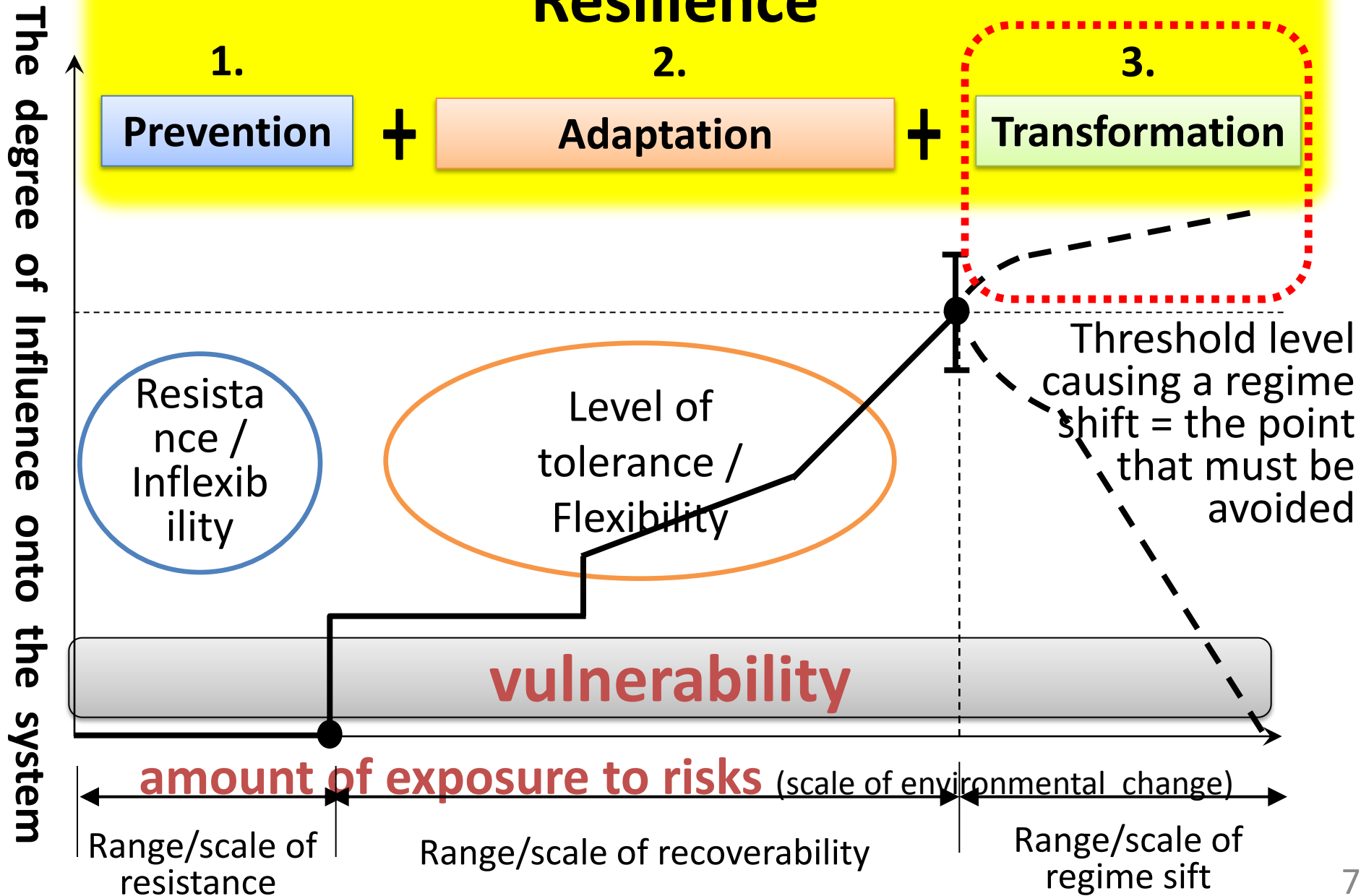
- Ability of the city's energy system to respond to systemic risks caused by natural disasters and climate change.
- Energy resilience measure: a measure that increases the ability to respond to the systemic risks in the energy sector.

Energy resilience measures

Energy resilience measures are divided into 3 categories:

1. Prevention	strengthening energy networks, etc.
2. Adaptation	early restoration of damaged facilities, etc.
3. Transformation	transition to distributed energy system, etc.

The 3 types of energy resilience measures



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Energy resilience indicators

Set up energy resilience indicators to evaluate energy resilience measures by region.

e.g. Estimating the cost to reduce the number of days without power, calculated using the costs of planned outages as a metric.

Resilience value	The cost which could avert damages of systematic risks by resilience measures.
CO ₂ emission reductions	Amount of CO ₂ reduction emissions by resilience measures.
Amount of capital investment	Amount of capital investment for resilience measures.

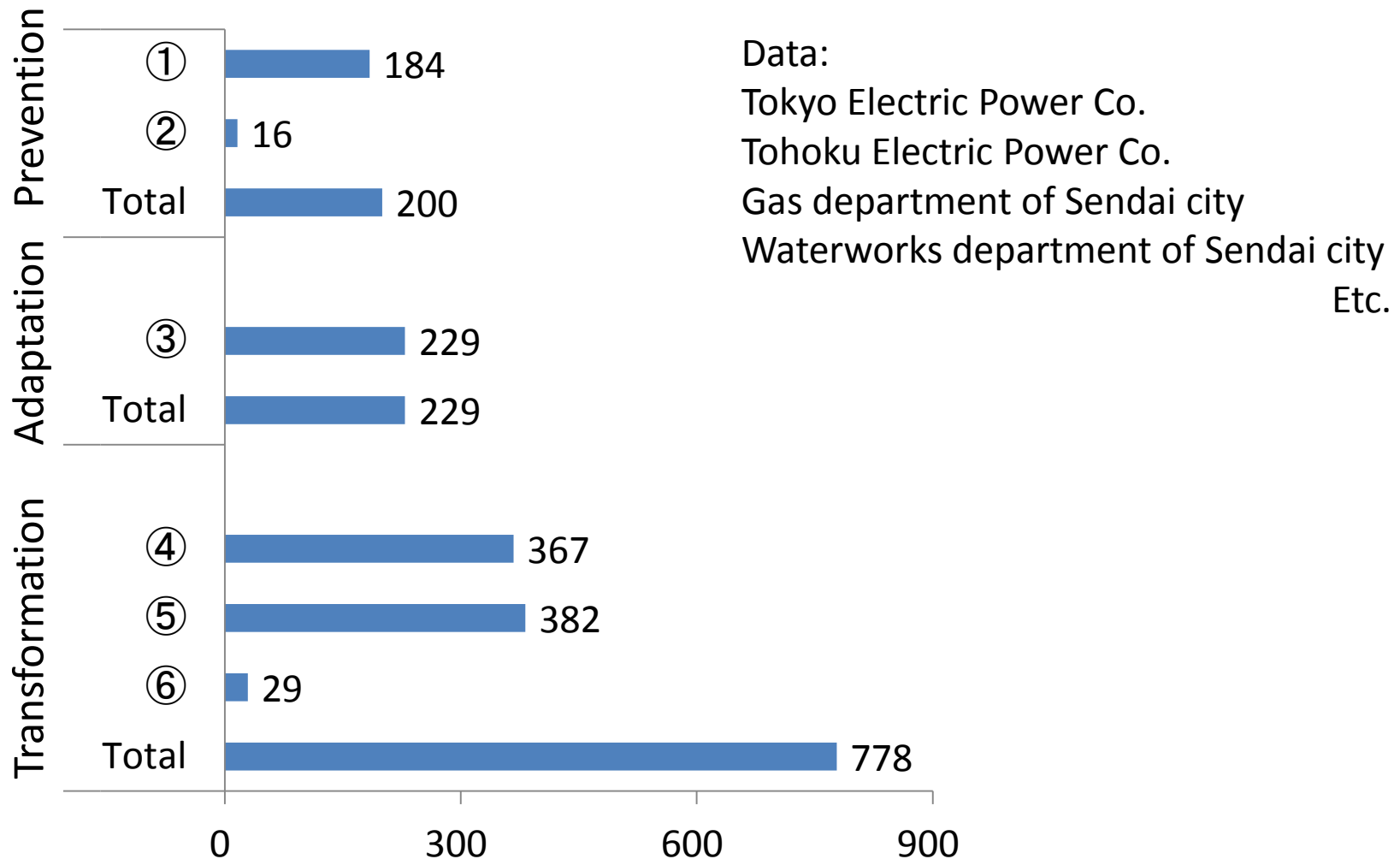
Evaluation for energy resilience measures

Estimate each resilience measure (Prevention, Adaptation, Transformation) by 3 energy resilience indicators using the data from The Great East Japan Earthquake. Intended for Nagoya city.

Prevention	Shorten the period of blackout to recover 90% of users by multiplexing the energy network (5days → 4days)
	Shorten the outage time of city gas by introducing the polyethylene pipe, etc. (25 days → 20 days)
Adaptation	Shorten the post-disaster non-operating period of thermal power plant (127 days → 90 days).
Transformation	Supply 40% of power by distributed energy system (CHP, private power generation, PV, etc.) . Then shorten the outage time of electricity (5 days → 3 days).
	Different / various energy supplies to residential and commercial sector. Then shorten the outage time of electricity (10 hours → 5 hours)
	Supplying thermal energy from co-generation plants, factories, waste incineration plants, etc. through the water system to households and businesses (except for a 14-day period without water).

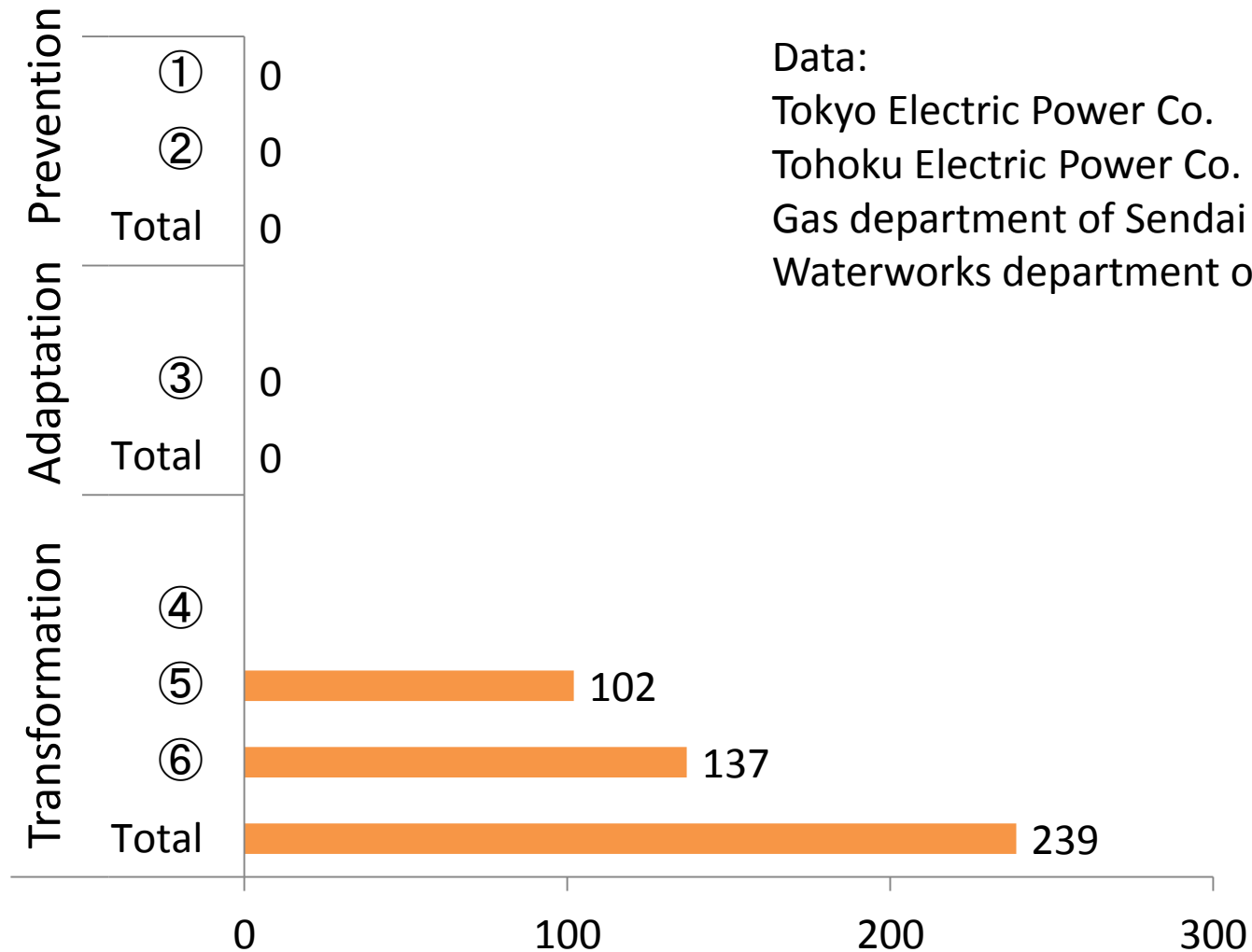
Evaluation for energy resilience measures

■ Resilience value: costs avoided (million yen)



Evaluation for energy resilience measures

■ CO2 Emission reduction
(10 thousand tons)



Data:

Tokyo Electric Power Co.

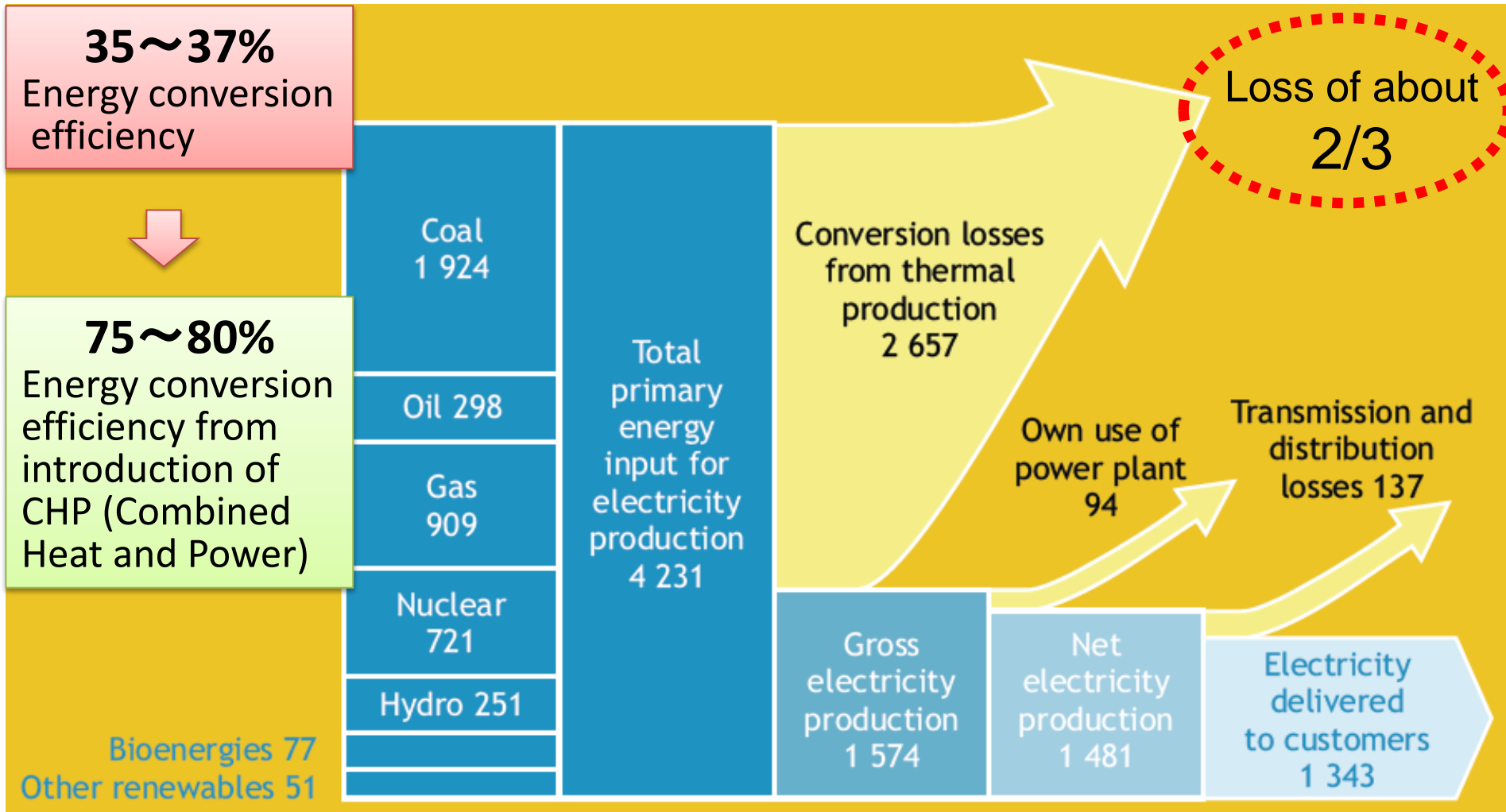
Tohoku Electric Power Co.

Gas department of Sendai city

Waterworks department of Sendai city

Etc.

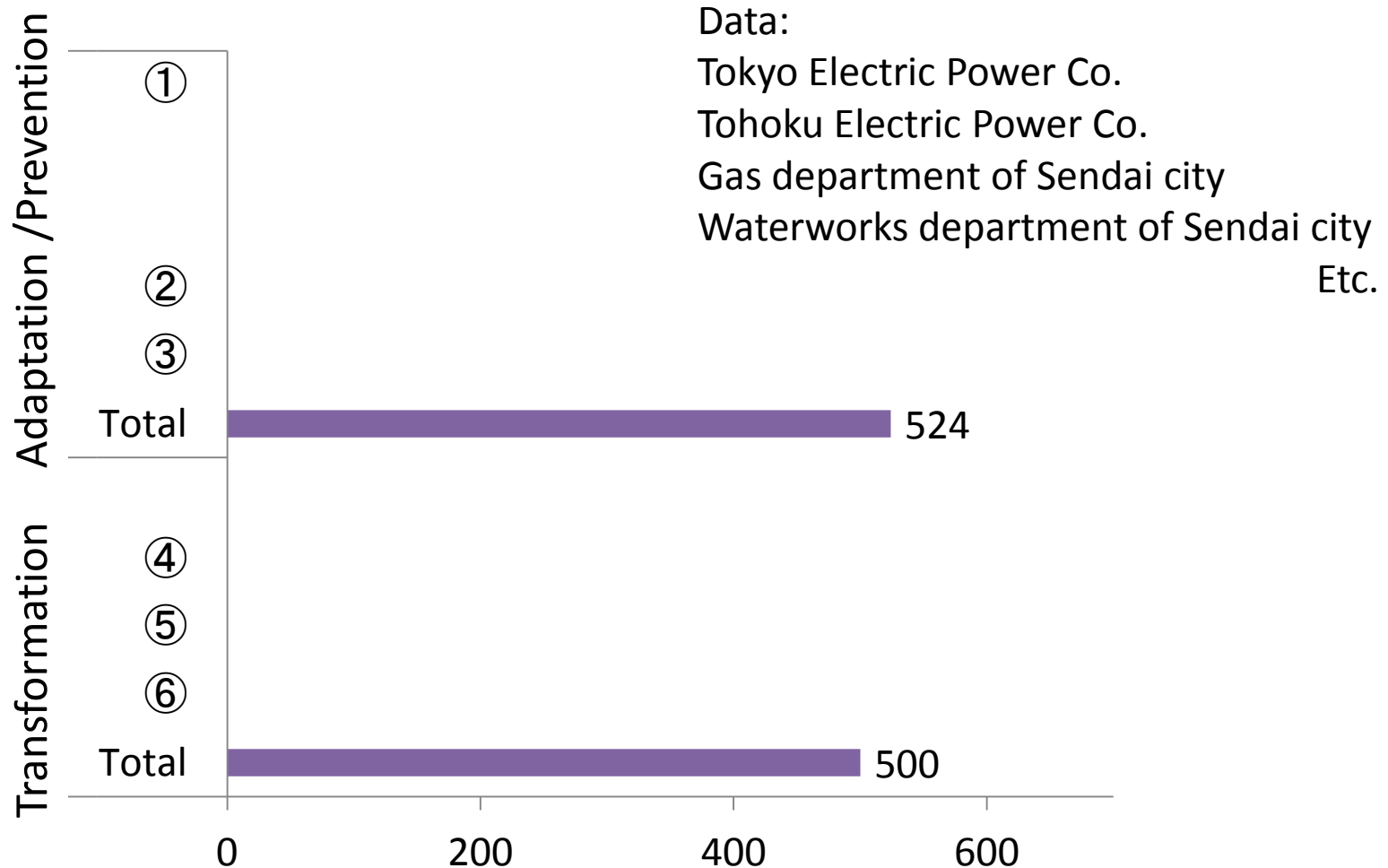
Energy flow in the global electricity system



(unit: Mtoe)

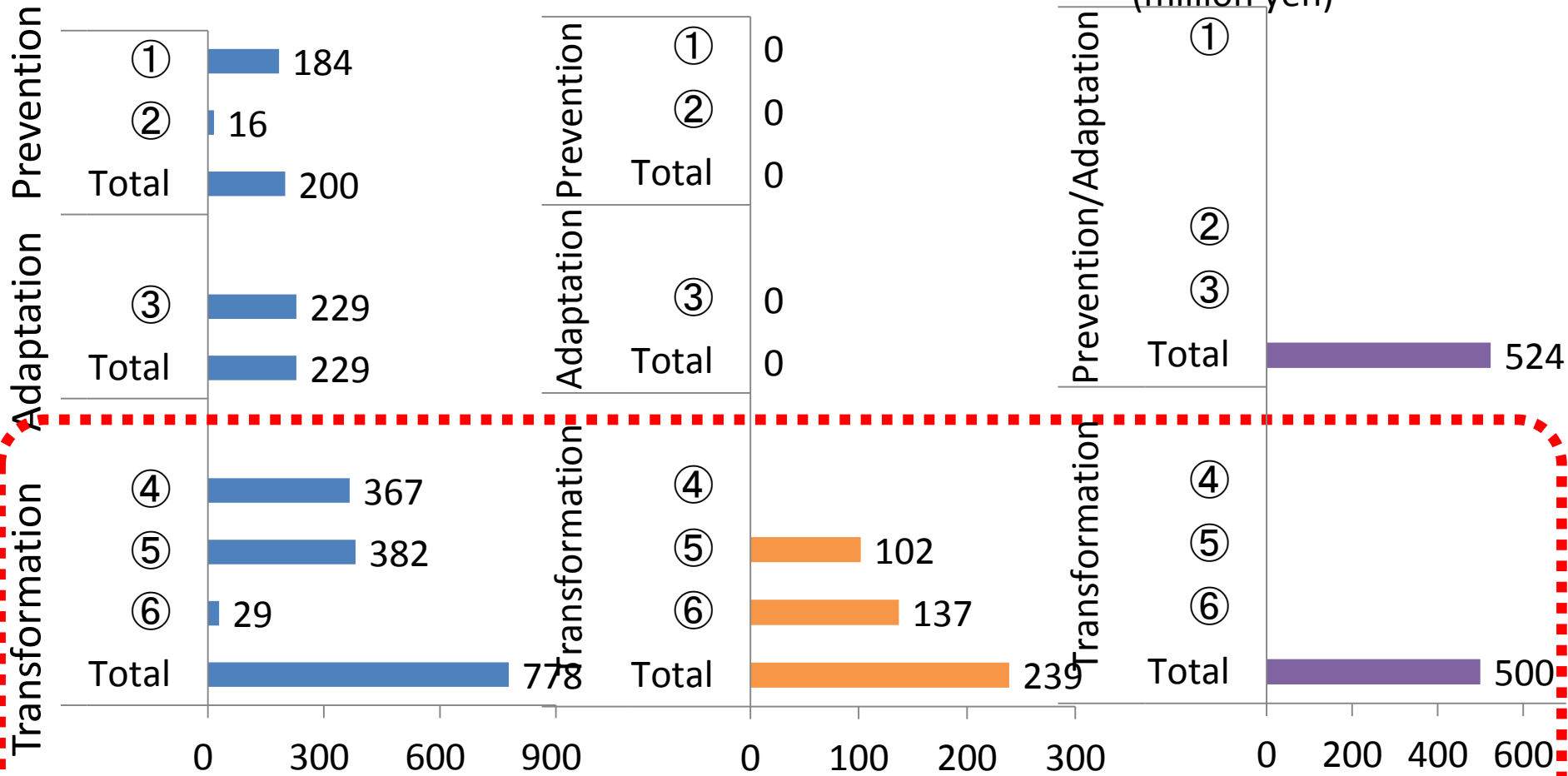
Evaluation for energy resilience measures

■ Amount of capital investment for resilience (million yen)



Evaluation for energy resilience measures

■ Resilience value: costs avoided (million yen)
 ■ CO2 Emission reduction (10 thousand tons)
 ■ Amount of capital investment for resilience (million yen)



More so than Adaptation and Prevention, Transformation results in a lower cost along with greater emission reductions.

Positioning of distributed energy system

Mitigation for climate change

Biomass + CCS, etc.

Rising energy efficiency, etc.

Climate Resilience Pathway IPCC, AR5

Climate-resilient pathways are sustainable-development trajectories that combine adaptation and mitigation to reduce climate change and its impacts.

CCS: Carbon capture and storage

Adaptation for climate change

Transformation to distributed energy system

Transformation

Early restoration of damaged facilities, etc.

Adaptation

Strengthening energy network, etc.

Prevention

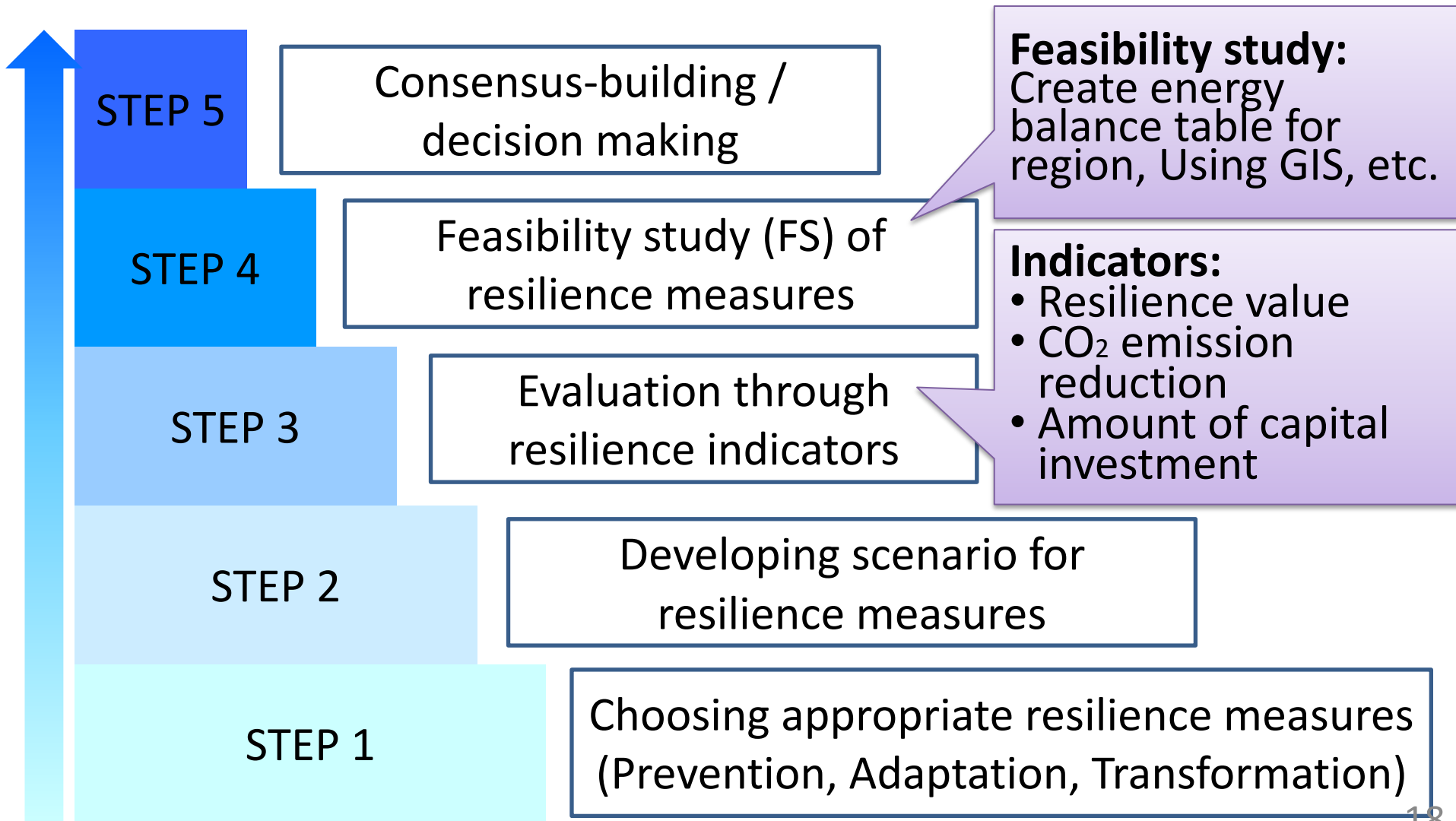
Measures for building Japanese national resilience (in the energy sector)

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Energy resilience policy skill enhancement program

Show the STEPs for planning, implementing and promoting the energy resilience of a city and coming true the sustainable low carbon city.



Conclusion

1. Energy resilience measures:
 - 1) Prevention, 2) Adaptation, 3) Transformation
2. Evaluation of the energy resilience measures indicators: 1) Resilience value, 2) CO₂ emission reductions, 3) Amount of capital investment
3. The “Transformation” measures has tri-benefit with energy resilience.

➤ Acknowledgment

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Thank you for your attention!