

OUTLINE OF  
THE POLICY FRAMEWORK TO REDUCE  
URBAN HEAT ISLAND EFFECTS

Decided in March 2004

By Inter-Ministry Coordination Committee  
to Mitigate Urban Heat Island

(tentative translation)

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## 1. Background

The air temperature at the city center is higher than that of the surrounding non-urban areas so that it looks like an island and this phenomenon is so called “urban heat island”. In those days, it attracts attention as an environmental problem unique to urban areas.

The Ministries and local governments have taken several measures which contribute to mitigate urban heat island effects. In order to further promote measures appropriately, it is necessary to strengthen coordination between various measures and implement them systematically. Recognizing these situations, the Revised Three Year Program to Promote Regulatory Reform, decided by the Cabinet in March 2002, stipulated that ① to set up an institutional arrangement including the establishment of the Inter-Ministry Coordination Committee, ② to consider and conclude on the drawing up of the policy framework to reduce urban heat island effect.

Based on the Revised Three Year Program to Promote Regulatory Reform, the Inter-Ministry Coordination Committee to mitigate urban heat island effects was established in September 2002, and it started considering the drawing up of a policy framework.

Further, the Re-revised Three Year Program to Promote Regulatory Reform was decided by the Cabinet in March 2003, and it stipulated that a policy framework should be drawn up until March 2004.

In order to promote counter-measures on urban heat island effects, by the Central Government, local Governments, business and residents, this Policy Framework sets up basic policies and systematically stipulates concrete measures to be implemented.

## 2. Current Situation of Urban Heat Island Phenomenon

### 1. Current Situation of Urban Heat Island Phenomenon

#### (1) Long-term Trend of the Mean Temperature

In the twentieth century, the mean temperature in six large cities in Japan, including Tokyo and Nagoya, risen 2 – 3 °C, while the globally averaged temperature risen 0.6 °C. The trend of urban heat island phenomena in those large cities in Japan is significant even compared with the trend of the global climate change.

#### (2) The rise of the temperature in day-time and night-time

In recent years, it is observed that the hours and areas with temperature above 30 °C has been

extended, and nights which minimum temperature is above 25 °C have been growing. It is supposed that residents have been exposed to high temperature during longer hours than before.

## 2. Causes of urban heat island phenomenon

Causes of urban heat island phenomenon are ①anthropogenic heat emission by human activities of air-conditioning, electrical appliance, burning equipment, automobile and so on, ②expansion of hard surface such as reduce of green land and water and increase of buildings and road surface.

## 3. Effects of urban heat island phenomenon

### (1) Effects in summer

Discomfort has been growing due to the increase of nights which minimum temperature is above 25 °C and higher temperature in daytime. It is reported that there is correlation between number of death and number of days which maximum temperature is above 30 °C and nights which minimum temperature above is 25 °C.

The rise of temperature increases the demand for air conditioning and energy use. It is a vicious circle that increase of anthropogenic heat emission causes additional rise of temperature.

It is also reported that urban heat island phenomena increase photochemical oxidants, and UHI is correlated to frequency of heavy rainstorm.

### (2) Effect in winter

It is reported that up-current of air by urban higher temperature is blocked by an inversion layer and then formulates a dust dome.

## 4. Basic Policies

In order to mitigate urban heat island (UHI) phenomenon, it is important to carry out comprehensive and effective measures while monitoring urban thermal environment, analyzing factors and cost-benefit.

Urban heat island phenomenon is deeply embedded with urbanization which has been built up for a long period, so it inevitably needs long term programs. In order to carry out long-term programs, it is reasonable to strengthen counter-measures step by step in revising them flexibly. For this purpose, monitoring of UHI situation and review on state of the art scientific knowledge and technologies shall be carried out.

There have been three pillars of counter-measures against UHI, ①reduction of anthropogenic heat

emission, ②improvement of urban surface and ③improvement of urban structure. However, UHI phenomenon also reflects residents' life style. So the improvement of lifestyle shall be the forth pillar of countermeasures. Countermeasures against UHI shall be carried out in getting understanding and support by residents.

In order to further promote counter-measures against UHI, analysis on causal relationship and mechanism and research on the assessment of impacts shall be further carried out. In addition, the methodology on the comprehensive evaluation of the effects of the various countermeasures shall be considered.

UHI phenomena vary according to their locality. So it is necessary to collaborate with local governments in implementing measures. UHI phenomenon reflects wide range of social and economic activities. Therefore partnership between the central government, local governments, business and residents is important in implementing measures. Also, linkage with policies on global warming, urban, traffic and energy and so on shall be promoted.

Especially in the large cities such as Tokyo and Osaka, concentrated measures shall be carried out , in collaboration with local governments, research institutions and business, in the areas where it seems possible to take measures effectively and efficiently.

#### 4. Promotion of the Policies against UHI

##### 1. Reduction of Anthropogenic Heat Emission

In order to reduce anthropogenic heat emission from such as air conditioning, electric equipments and automobiles, following measures shall be carried out;

- Facilitation to improve efficiency of energy consuming equipments by subsidizing new technology development and installation of its outcome.
- Facilitation to diffuse high energy efficient houses and buildings by policy-based finance, model projects developing environment friendly houses and urban areas and utilization of “Energy Service Company (ESCO)”
- Facilitation of the technology development and the diffusion of low emission vehicles
- Traffic control measures, facilitation of rationalization of the distribution and encouraging use of public transportation
- Encouragement of the use of new energy

##### 2. Improvement of Urban Surface

In order to mitigate decrease of evapo-transpiration and the high temperature rise of the ground,

which were caused by reduction of green space and water and expansion of impervious surface such as buildings and asphalt, the following measures for the improvement of urban surface shall be carried out;

- Facilitation of tree-planting in private houses, buildings and their sites
- Promotion of tree-planting in public facilities such as government buildings
- Construction of urban parks and promotion of tree-planting in public spaces such as ports, airports and sewage plants

### 3. Improvement of urban structure

In order to ensure wind flow through green spaces and water, following measures for the improvement of urban structure shall be carried out;

- Development of network with green and water in the region across the prefectures by construction of large green spaces and making up the linkage between parks, rivers and roads
- Feasibility study on the urban heat emission treatment system which carry heat from the very densely build-up area to rivers and sea through under-ground pipes with circulating water
- Facilitation to utilize the city planning system to develop “less environmental burden cities”.

### 4. Improvement of Life-style

UHI phenomenon is closely linked to socio-economic activities in the city. Therefore, following measures shall be promoted to improve life-style;

- Promotion of actions taken by business and families to utilize new energy and to save energy such as utilizing sunshine and air heat energy and to collect and utilize rainwater
- Promotion of light clothes in summer
- Facilitation of summer vacation to reduce anthropogenic heat emission in the cities
- Facilitation of efficient use of cars by eco-driving and so on

## **5. Strengthening Monitoring and Promoting Research**

### 1. Observation and Monitoring

Observation/Monitoring system to grasp actual condition of UHI shall be strengthened as basis for the evaluation of measures. Until now, research and study by the central government have been carried out mainly concerning the Tokyo metropolitan area. From now, they shall be promoted also concerning other large cities' areas such as Kyoto-Osaka-Kobe area, in collaboration with local governments. Actual measurement shall be reinforced in carrying out study and research.

### 2. Research and Study on Cause, Mechanism and Impact

Research and study shall be further promoted concerning linkage between various causes, mechanism and evaluation of impact.

### 3. Research and Study for the Systematic Promotion of Measures

The methods shall be further improved to make maps concerning thermal environment in accumulating and evaluating data. The method should be developed to make comprehensive evaluation on counter-measures. A design guideline shall be developed for the parties concerning construction to make voluntary efforts to reduce UHI phenomenon. A simplified calculation system shall be further developed for local governments to easily grasp effect of counter-measures.

### 4. Others

It shall be promoted to exchange information with other countries where UHI phenomenon supposedly will become to be clear.

## **6. Follow up and Review**

UHI phenomenon has close linkage with wide-range socio-economic activities. So it is necessary for each party such as the central government, local governments, business and residents to take various measures. The central government shall effectively promote this Policy Framework keeping close collaboration through the Inter-Minister Coordination Committee. UHI phenomenon is an issue which has clear locality. Therefore, adequate collaboration with concerned local governments shall be kept and they shall be supported to draw up a plan and to implement measures. Every year, the progress of counter-measures shall be monitored. The review of this Policy Framework shall be carried out flexibly in accordance with necessity, taking account of the progress of research on mechanism of UHI and development of technologies and counter-measures.

Data

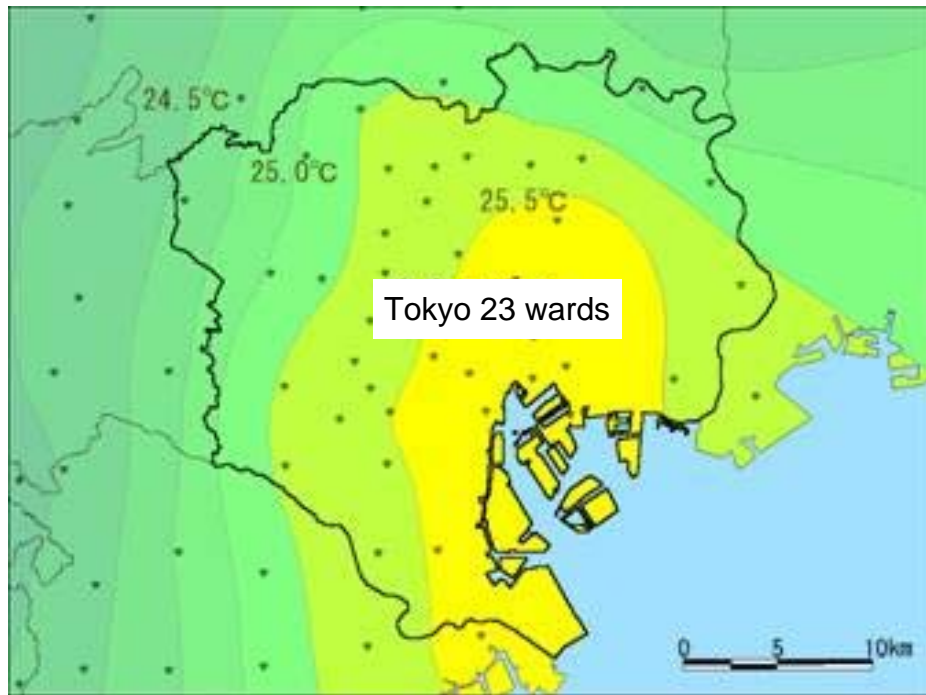


Fig.1 Distribution of Average Daily Minimum Temperature (Tokyo) August in 1998, 1999  
(From Mikami Lab. In Tokyo Metropolitan University (2000))

Table 1 Average Temperature in Japanese Big Cities  
(From Meteorological Agency)

| City                               | Rise by 100 years (°C) |         |        |
|------------------------------------|------------------------|---------|--------|
|                                    | Average Temperature    |         |        |
|                                    | Annual                 | January | August |
| Sapporo                            | + 2. 3                 | + 3. 0  | + 1. 5 |
| Sendai                             | + 2. 3                 | + 3. 5  | + 0. 6 |
| Tokyo                              | + 3. 0                 | + 3. 8  | + 2. 6 |
| Nagoya                             | + 2. 6                 | + 3. 6  | + 1. 9 |
| Kyoto                              | + 2. 5                 | + 3. 2  | + 2. 3 |
| Fukuoka                            | + 2. 5                 | + 1. 9  | + 2. 1 |
| Average of Big Cities              | + 2. 5                 | + 3. 2  | + 1. 8 |
| Average of Middle and Small Cities | + 1. 0                 | + 1. 0  | + 1. 0 |

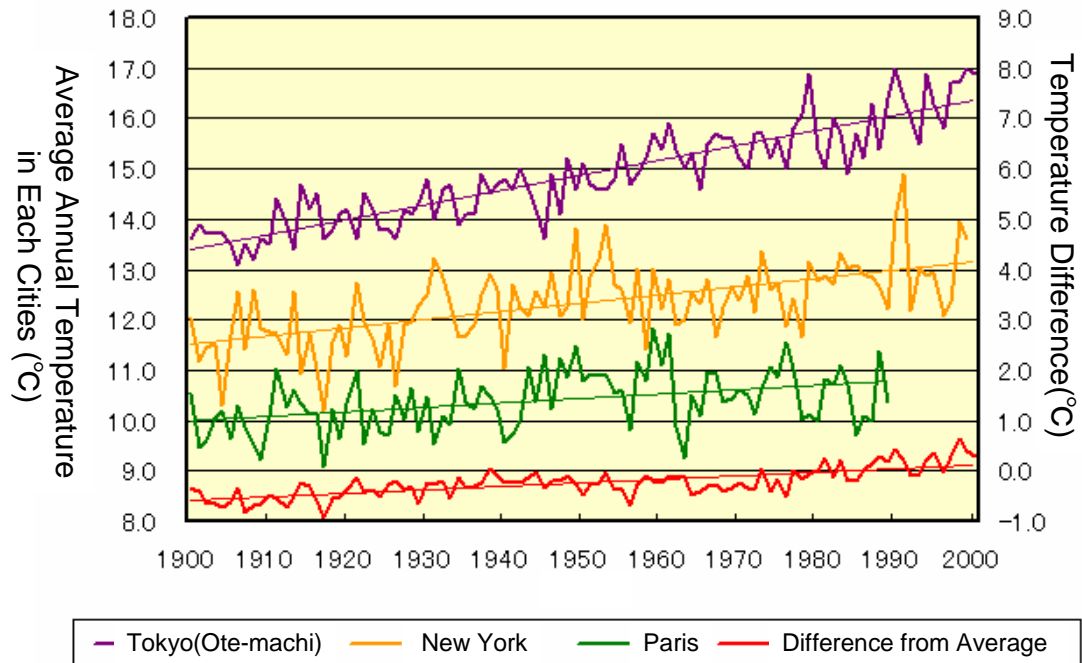


Fig.2 Comparison of Temperature Difference in World Big Cities (From Meteorological Agency)

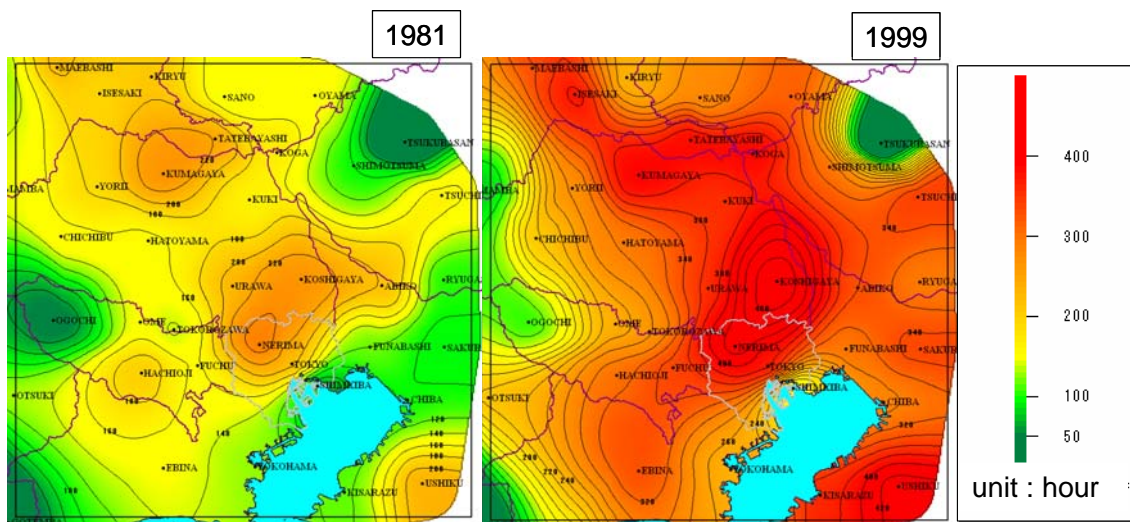


Fig.3 Comparison of Distribution of Cumulative Hours Exceeded 30°C in Tokyo At 1981 and 1999 (From Ministry of the Environment)



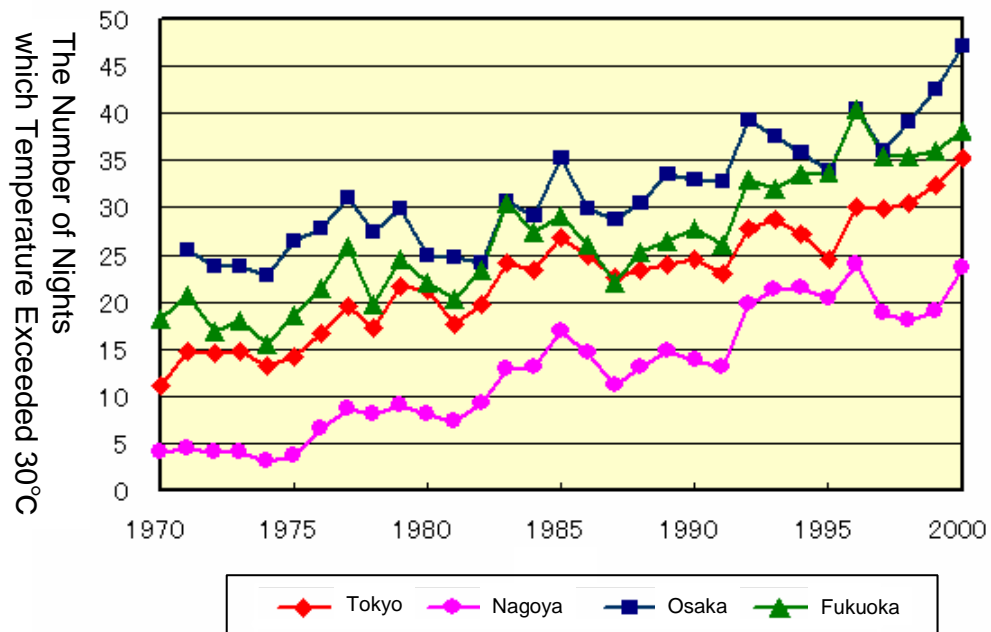


Fig.4 The Number of Nights which Temperature Exceeded 30°C (From Meteorological Agency)

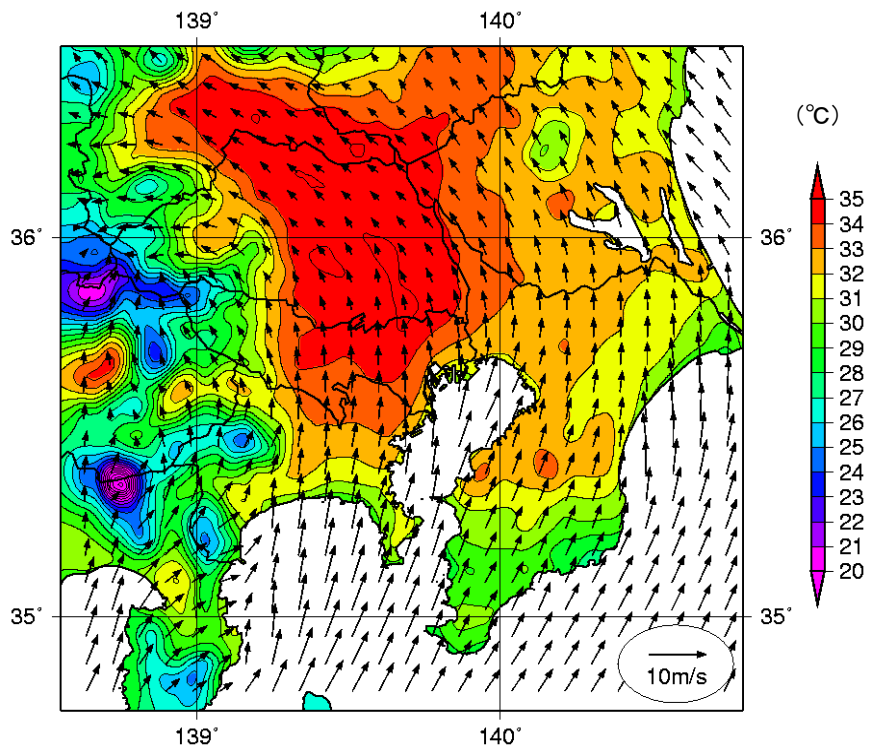


Fig.5 Analysis on UHI in Summer in Tokyo Metropolitan Area Distribution of Temperature and Wind at 2pm. Average of 23 cases (Weak Wind, Fine) in 2001 to 2003. (From Meteorological Agency)

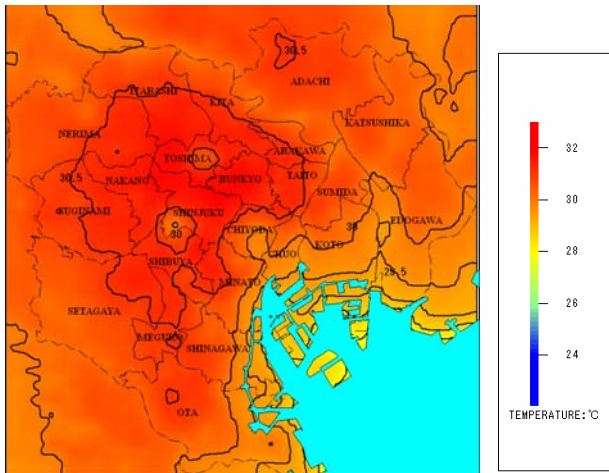


Fig.6 Distribution of Temperature in Tokyo  
(14pm)

(From Ministry of the Environment)

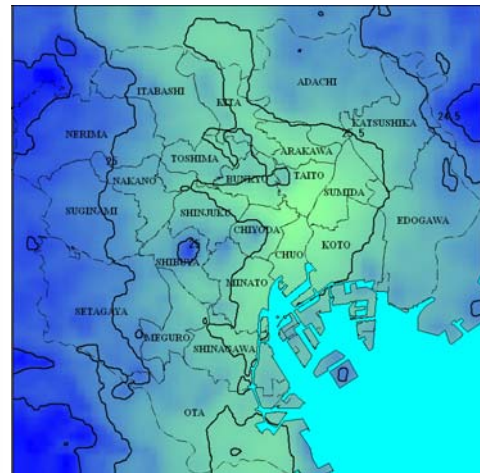


Fig.7 Distribution of Temperature in Tokyo  
(6am)

(From Ministry of the Environment)

Simulation based on data of the days when it was fine and wind was weak.

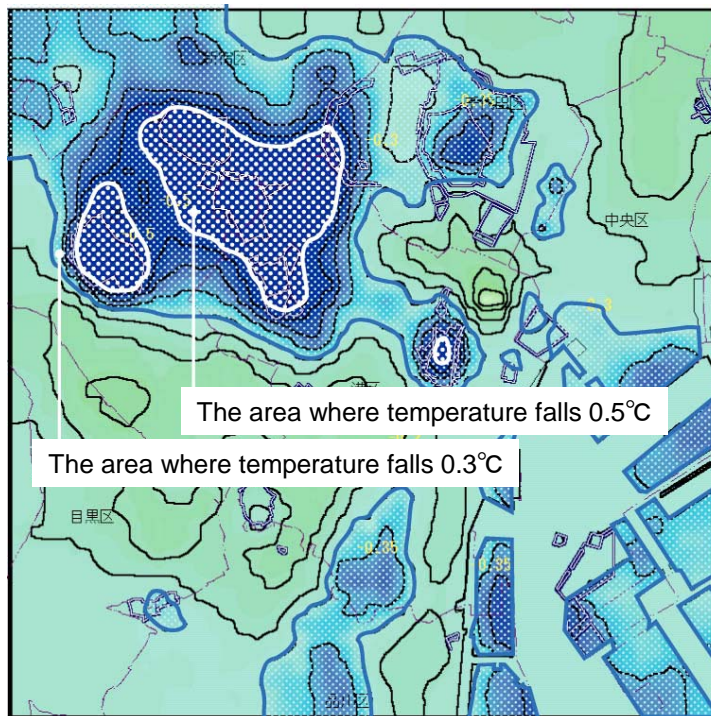


Fig.8 Simulation on Temperature Difference Between Present and the Case with Expansion of Green Spaces (at13:00)

(From Ministry of Land, Infrastructure and Transport)

A simulation shows that if the ratio of green spaces increases from 27.3% (present) to 39.5% , the daily temperature (average, maximum, minimum) falls 0.3°C in average in the central Tokyo (10kmX10km).