

JICA Training

Measures against Offensive Odors

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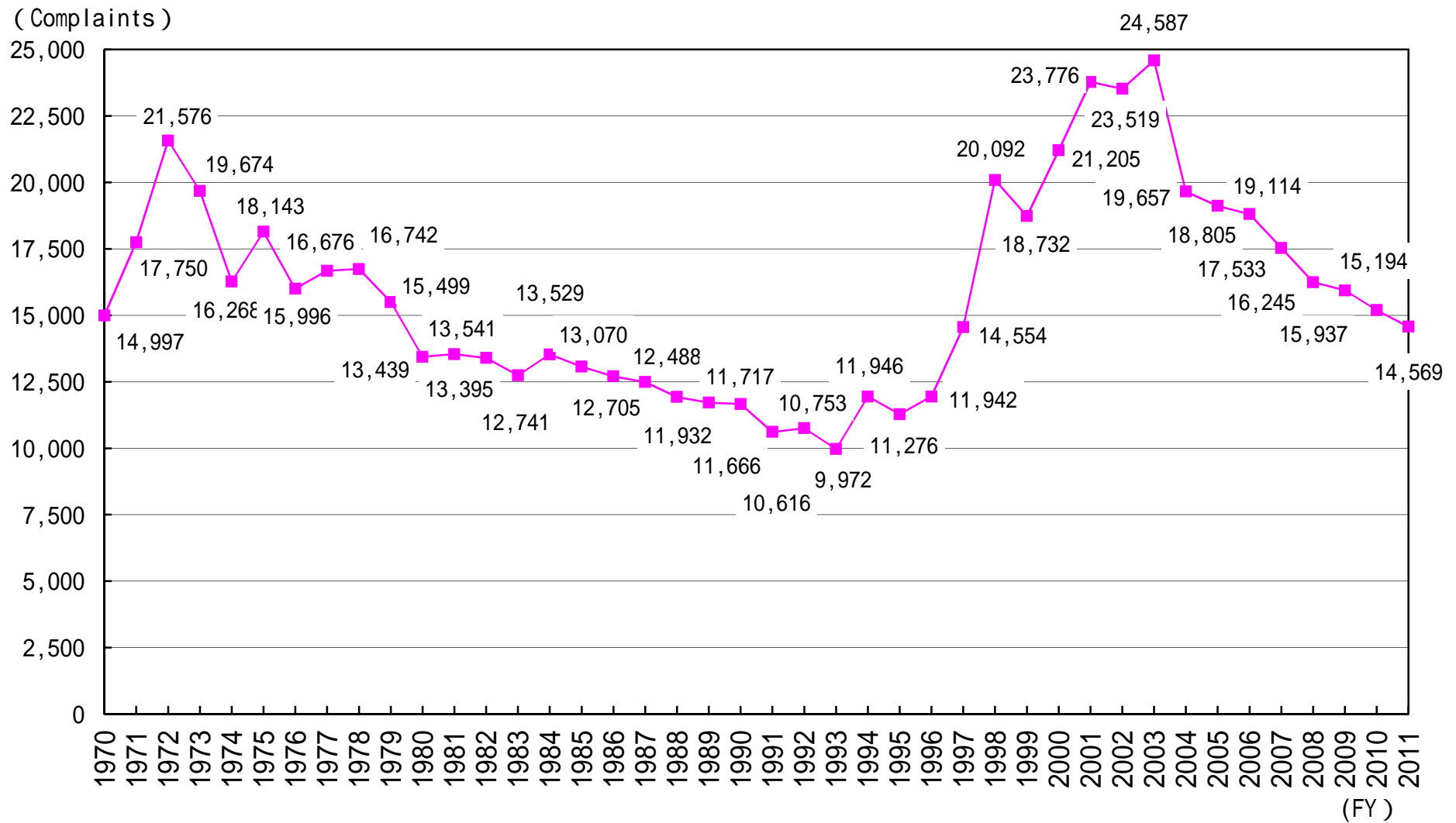
Introduction

- What are offensive odor problems?
 - Sensory pollution (related to human comfort/discomfort, recognized immediately through one's sense of smell)
 - Closely related to people's lives
- Measures against offensive odors that are currently in need
 - Efforts for problems that exist in urban life or in people's spheres of activity
 - (←Offensive odor problems arising from large chemical plants or livestock agriculture)
 - Efforts to improve offensive odor problems
 - + Urban development focused on the “aroma” perspective

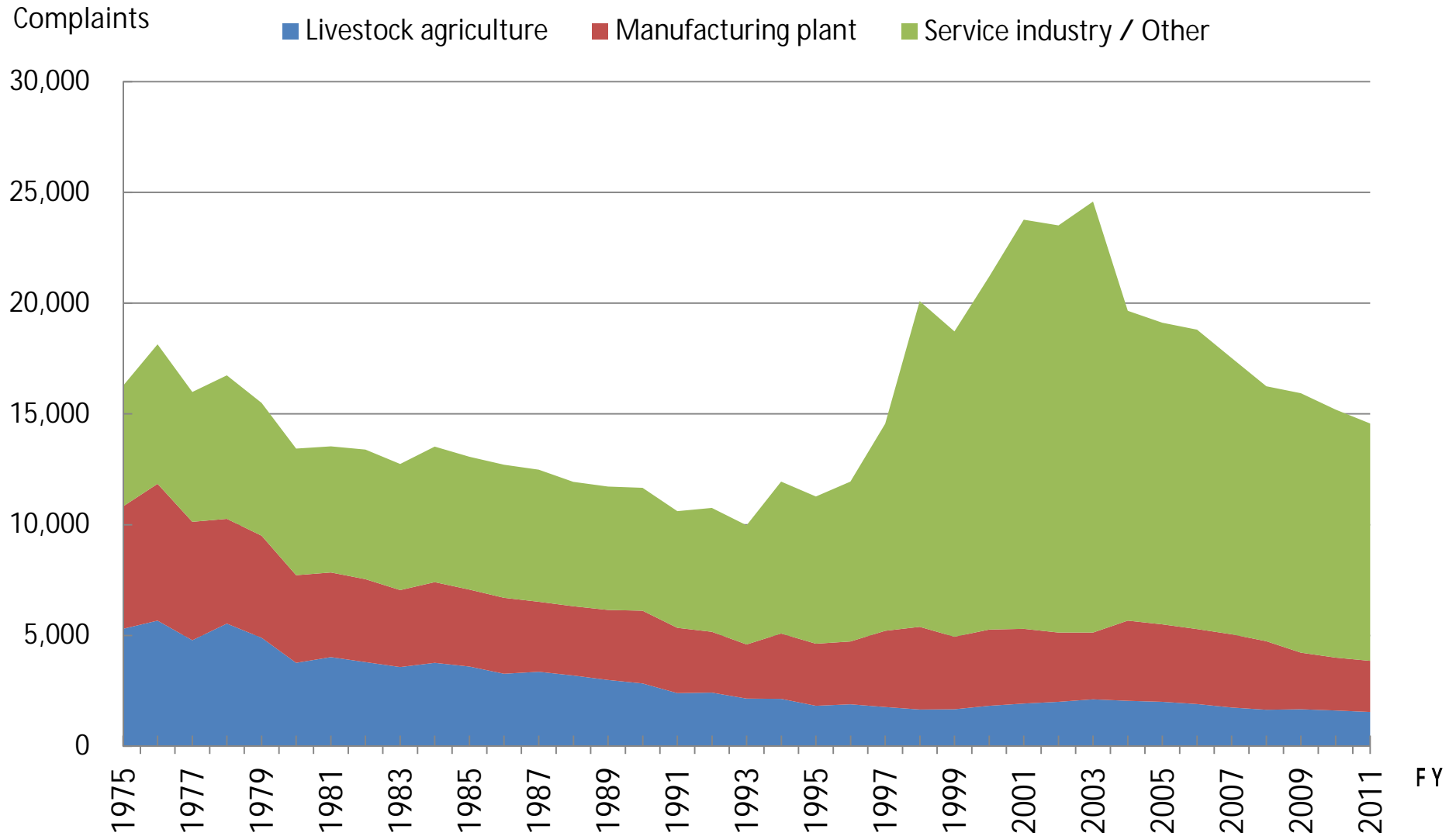


- A better living environment

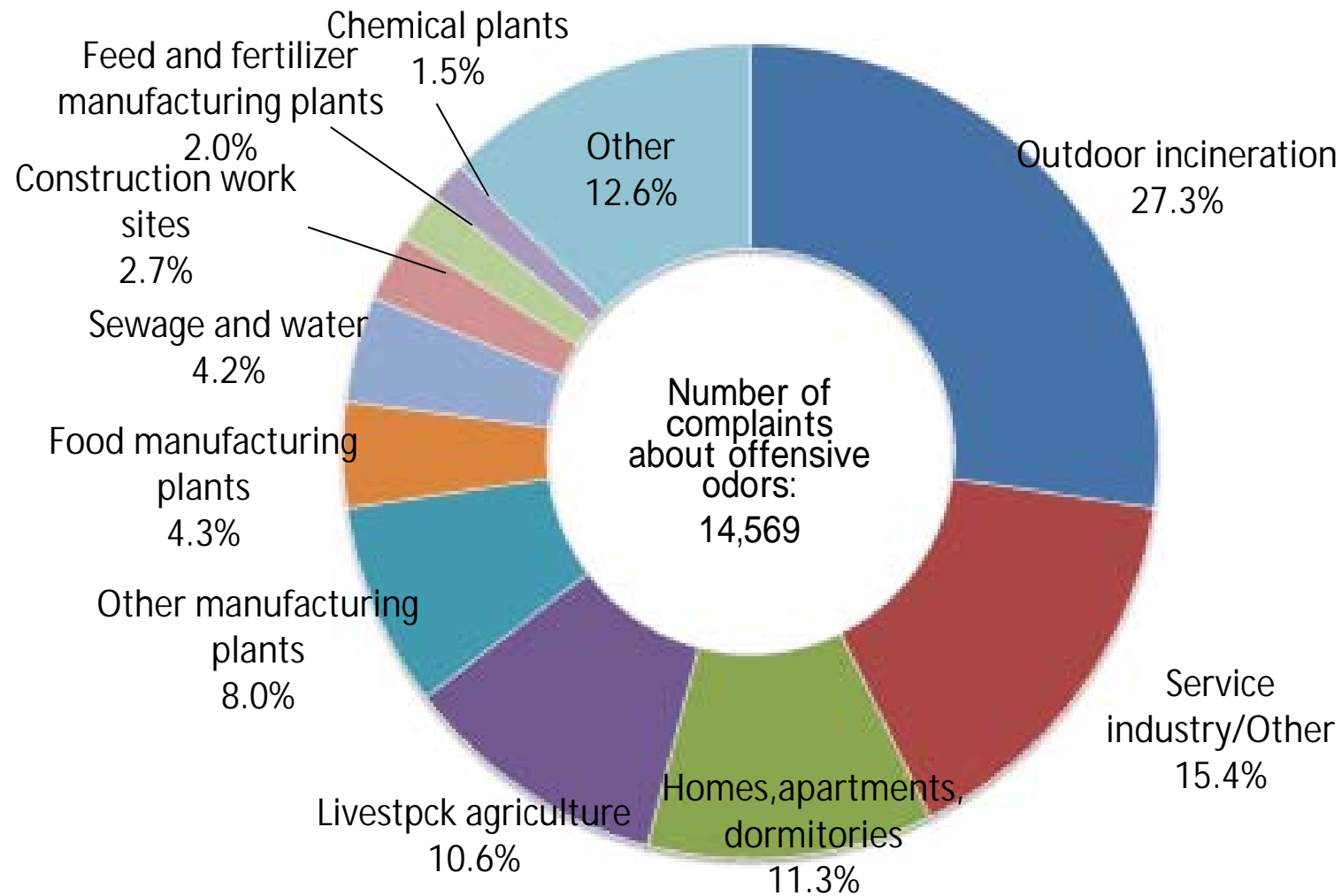
Number of complaints pertaining to offensive odors



Number of complaints by source



Breakdown of complaints about offensive odors, FY2011



Background to the regulation of offensive odors



Formulation of the Basic Law for Environmental Pollution Control in 1967

“Offensive odor” was stipulated as one of the typical types of pollution, and it was prescribed that appropriate measures should be taken for offensive odor problems.

* Other typical types of pollution: air pollution, water pollution, soil pollution, noise, vibration, land subsidence



However...



**Prior to the formulation of the Offensive Odor Control Law (June 1971),
there had not been any unified regulation based on national law.**

Passing of the Offensive Odor Control Law



1969

Of the 7 types of typical pollution, the number of complaints/petitions brought to local public bodies about offensive odors ranked 2nd behind noise/vibration



Promulgation of the Offensive Odor Control Law, June 1971

(Use of instrumental analysis techniques)

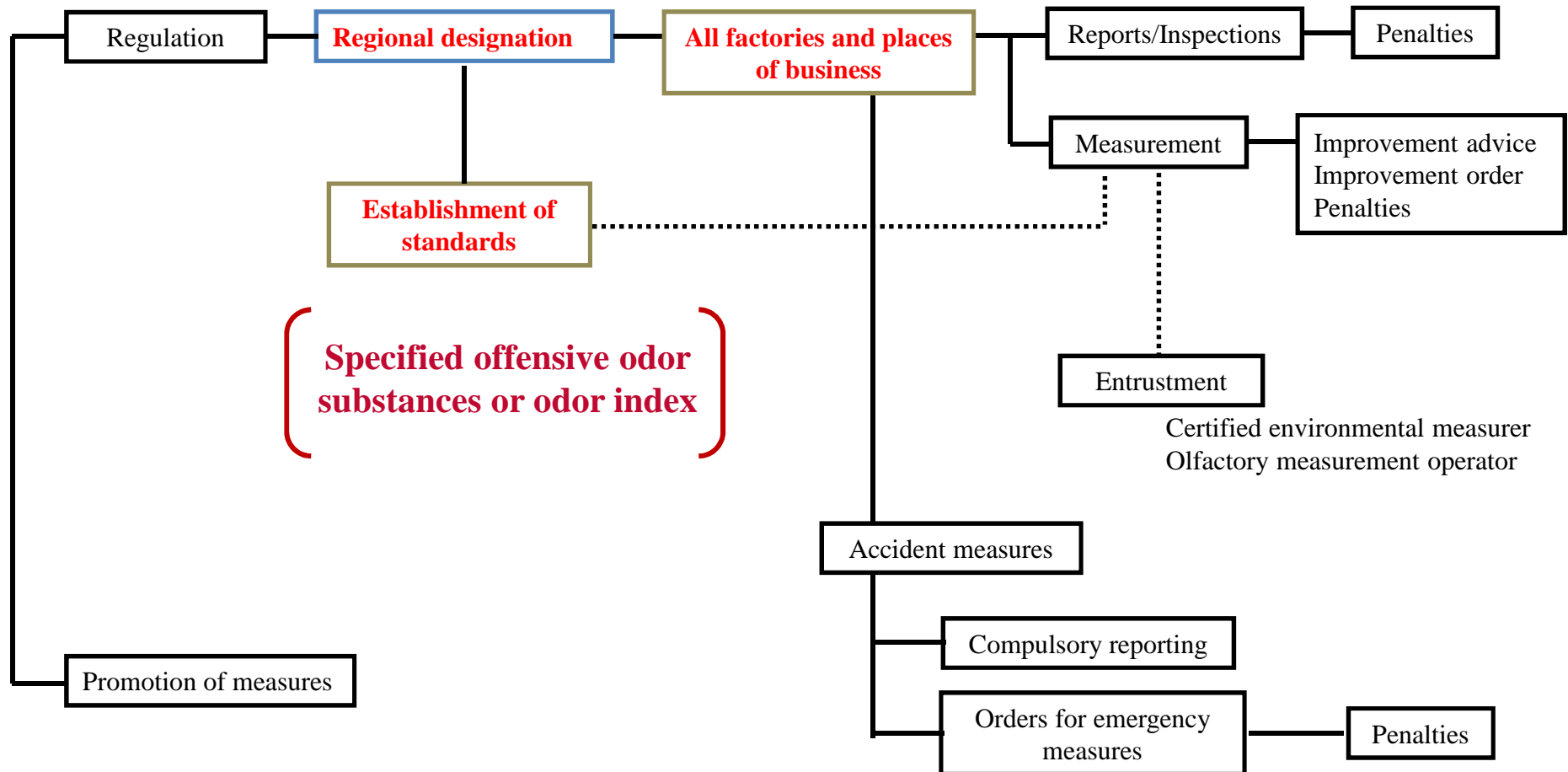
Up to 1994, 22 substances had been designated as “specified offensive odor substances”

Offensive Odor Control Law

Purpose (Article 1 of the Law)

- This law is enacted for the purpose of preserving living environment and contributing to protection of the people's health by carrying out necessary regulations and by promoting other countermeasures to control offensive odors generated in the course of business activities at factories or at other places of business.

Structure of the Offensive Odor Control Law



Basic terminology related to the Offensive Odor Control Law

- Specified offensive odor substance
Defined in Article 2 of the Law: One of the 22 substances prescribed by cabinet order, such as ammonia
- Odor index
Odor index = $10 \times \log$ (odor concentration)
- Odor concentration
Dilution rate at which the offensive odor can no longer be sensed
- Odor intensity
Six-point scale indicating the strength of the odor

System for representing odor intensity on a 6-point scale

Odor intensity	Description
0	No odor
1	Odor that can only just be sensed (detection threshold concentration)
2	Slight odor by which the odor can be identified (recognition threshold concentration)
3	Odor that can easily be sensed 1
4	Strong odor
5	Intense odor

Specified offensive odor substances (22 substances)

– Part 1

Specified offensive odor substance	Characteristics of the odor	Main locations
Ammonia	Smells like raw sewage	Livestock facilities, rendering plants, sewage treatment plants
Methyl mercaptan	Smells like rotten onions	Pulp mills, chemical plants, sewage treatment plants
Hydrogen sulfide	Smells like rotten eggs	Livestock facilities, pulp mills, sewage treatment plants
Methyl sulfide Methyl disulfide	Smells like rotten cabbage	Pulp mills, rendering plants, sewage treatment plants
Trimethylamine	Smells like rotten fish	Livestock facilities, rendering plants, marine product canneries
Acetaldehyde	Has an irritating smell of raw vegetation	Chemical plants, fishmeal processing plants, tobacco manufacturing plants

Specified offensive odor substances (22 substances)

– Part 2

Specified offensive odor substance	Characteristics of the odor	Main locations
Propionaldehyde n-Butyraldehyde Isobutyraldehyde	Has an irritating, bittersweet burnt smell	Workplaces that have a baking-finish process
n-Valeraldehyde Isovaleraldehyde	Has a stifling, bittersweet burnt smell	
Isobutanol	Has an irritating fermented smell	Workplaces that have a painting process
Ethyl acetate Methyl isobutyl ketone	Has an irritating smell like thinner	Workplaces that have a painting process or printing process
Toluene	Smells like gasoline	

Specified offensive odor substances (22 substances)

– Part 3

Specified offensive odor substance	Characteristics of the odor	Main locations
Styrene	Smells like city gas	Chemical plants, FRP product manufacturing plants
Xylene	Smells like gasoline	Workplaces that have a painting process or printing process
Propionic acid	Has an irritating sour smell	Fatty acid manufacturing plants, dyeing and weaving factories
n-Butyric acid	Smells of sweat	Livestock facilities, rendering plants, starch factories
n-Valeric acid	Smells like musty socks	
Isovaleric acid		

Regulation areas and regulation standards based on the Offensive Odor Control Law

- **Regulation areas**

- Designated by prefectures, etc.
- Densely populated areas where the prevention of offensive odors is deemed necessary in order to preserve the living environment
- 1,278 municipalities (73.4%) (2011)

- **Regulation standards**

- Designated by prefectures, etc.
- Given the natural and social conditions, select either regulation based on the concentration of specified offensive odor substances, or regulation based on the odor index

Regulation areas (Article 3 of the Law)

- Regulation areas can be designated by a prefectural governor or the head of a ordinance-designated city, core city, specially designated city or special ward

As of the end of FY2011

	Number of municipalities	Number of municipalities with regulation areas	
Cities	787	737	(93.6%)
Wards	23	23	(100.0%)
Towns	748	463	(61.9%)
Villages	184	55	(29.9%)
Total	1,742	1,278	(73.4%)

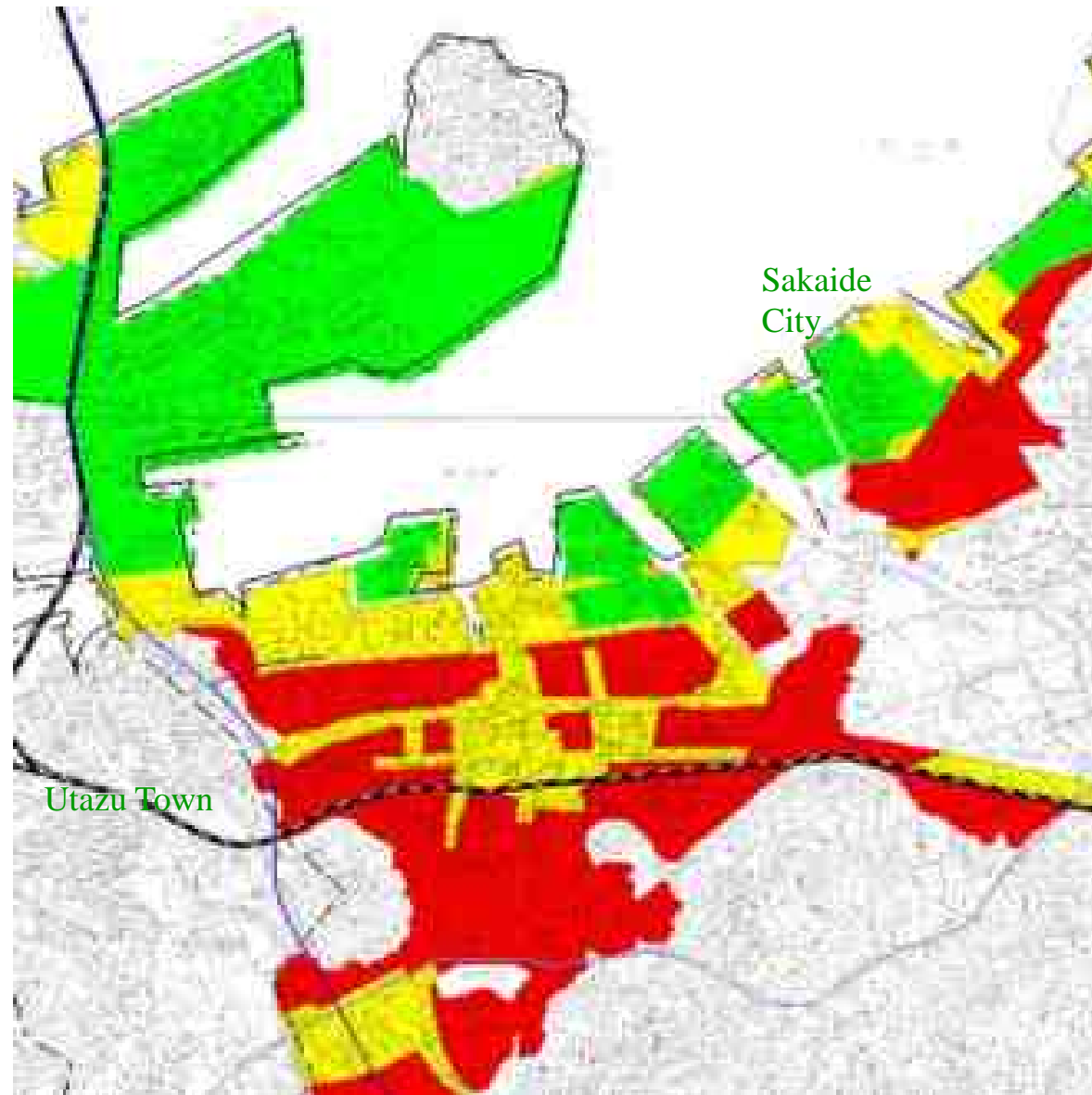
Regulation areas

[Classification of regulation areas]

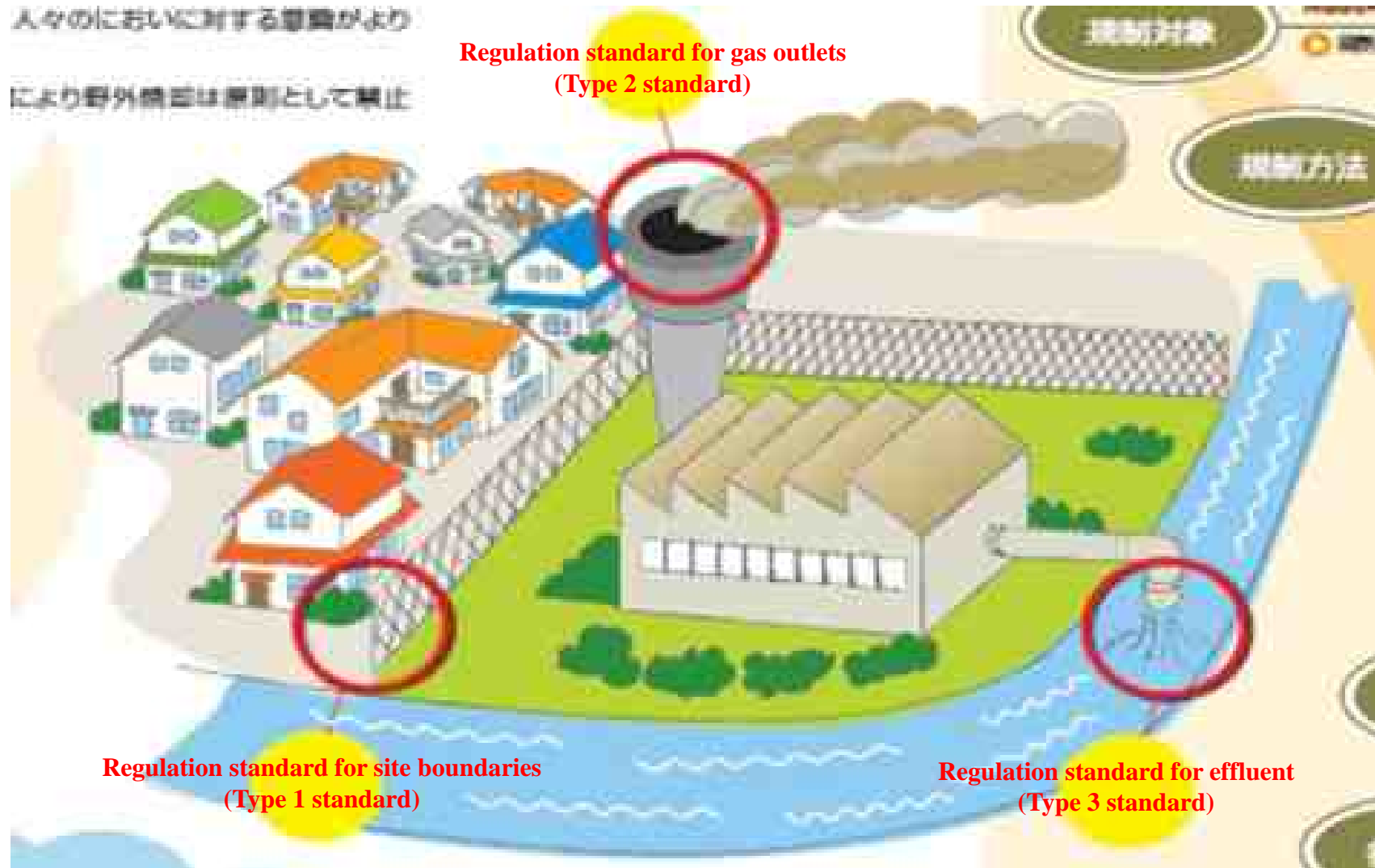
In designated areas, Zone A – Zone C classifications have been established, taking into account such factors as specific-use zones under the City Planning Law.

Classification	Specific-use zones under the City Planning Law	Classification indicators
Zone A	Exclusive residential areas Residential areas	Areas where there is particular need to prevent offensive odors in order to maintain a good residential environment
Zone B	Commercial areas Quasi-industrial areas	Areas that are used for both residential and commercial/industrial purposes, and where there is a need to preserve the living environment of local residents.
Zone C	Industrial areas Exclusive industrial areas	Areas that are primarily used for industrial purposes, and where there is a need to prevent the generation of any notably offensive odors in order to avoid damaging the living environment of local residents

Example of a designated regulation area



Regulation standards (Articles 4 to 7 of the Law)



Regulated specified offensive odor substances

Specified offensive odor substance	Type 1	Type 2	Type 3		Specified offensive odor substance	Type 1	Type 2	Type 3
Ammonia	○	○			Isovaleraldehyde	○	○	
Methyl mercaptan	○		○		Isobutanol	○	○	
Hydrogen sulfide	○	○	○		Ethyl acetate	○	○	
Methyl sulfide	○		○		Methyl isobutyl ketone	○	○	
Methyl disulfide	○		○		Toluene	○	○	
Trimethylamine	○	○			Styrene	○		
Acetaldehyde	○				Xylene	○	○	
Propionaldehyde	○	○			Propionic acid	○		
n-Butyraldehyde	○	○			n-Butyric acid	○		
Isobutyraldehyde	○	○			n-Valeric acid	○		
n-Valeraldehyde	○	○			Isovaleric acid	○		

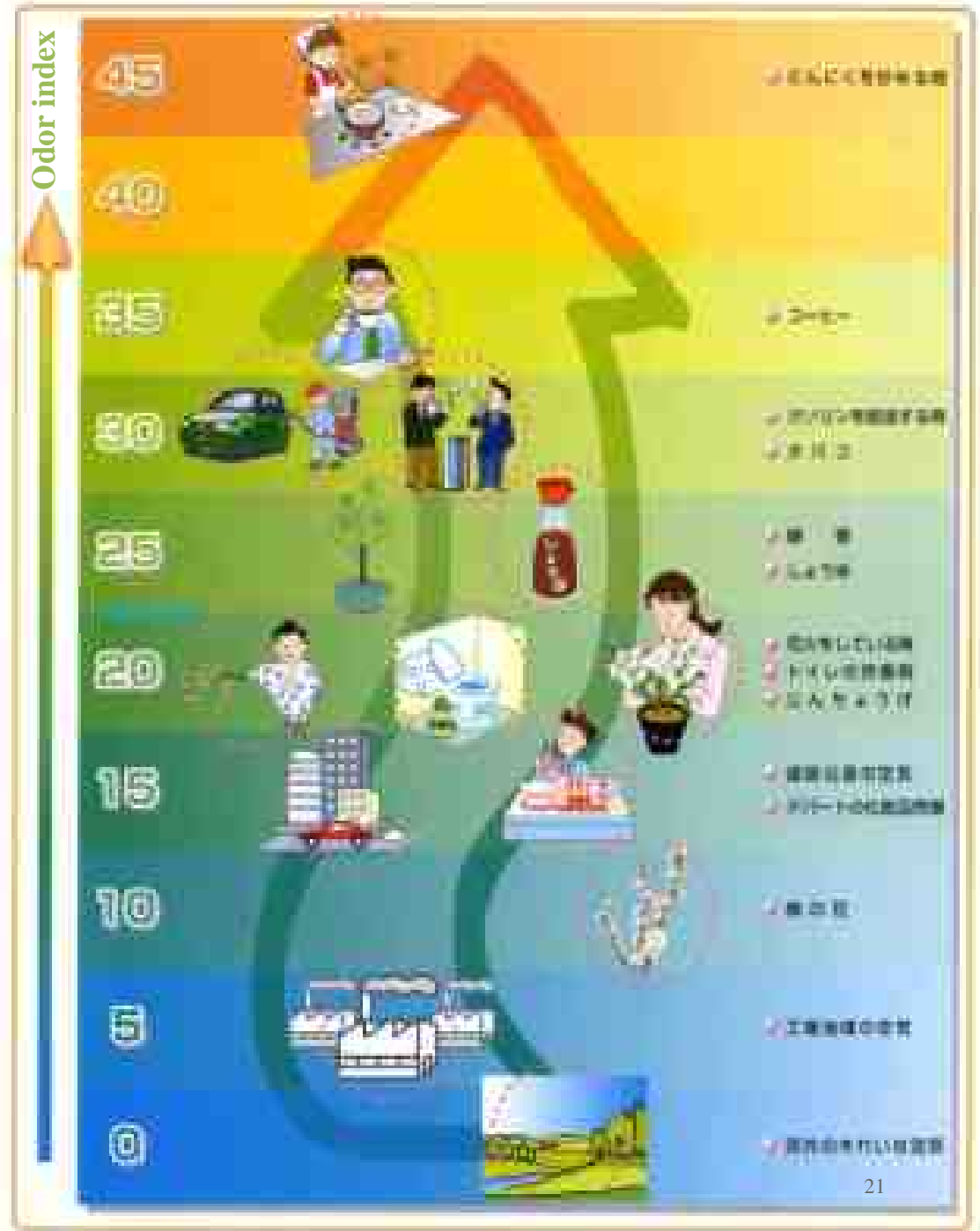
Regulation standards for specified offensive odor substances (Type 1 (site boundaries))

(Units: ppm)

Specified offensive odor substance	Range	Specified offensive odor substance	Range
Ammonia	1 - 5	Isovaleraldehyde	0.003 - 0.01
Methyl mercaptan	0.002 - 0.01	Isobutanol	0.9 - 20
Hydrogen sulfide	0.02 - 0.2	Ethyl acetate	3 - 20
Methyl sulfide	0.01 - 0.2	Methyl isobutyl ketone	1 - 6
Mmethyl disulfide	0.009 - 0.1	Toluene	10 - 60
Trimethylamine	0.005 - 0.07	Styrene	0.4 - 2
Acetaldehyde	0.05 - 0.5	Xylene	1 - 5
Propionaldehyde	0.05 - 0.5	Propionic acid	0.03 - 0.2
n-Butyraldehyde	0.009 - 0.08	n-Butyric acid	0.001 - 0.006
Isobutyraldehyde	0.02 - 0.2	n-Valeric acid	0.0009 - 0.004
n-Valeraldehyde	0.009 - 0.05	Isovaleric acid	0.001 - 0.01

Odor index regulation

- The odor index is a numerical expression for the degree of odor using the human sense of smell.
- The index is calculated by finding the dilution rate (odor concentration) at the point when the original odor has been diluted with odorless air to the extent that it can no longer be sensed by humans, and by multiplying this common logarithm by a factor of 10.



Triangular Odor Bag Method



- The triangular odor bag method is a method of olfactory measurement used to judge odor concentration.
- Three odor bags are prepared, one containing the sample and two containing odorless air. A panel then judges whether each bag contains an offensive odor.
- Odor concentration is measured by diluting the sample until most panel members can no longer identify which bag has the odor and which have the air.

Six-point scale for odor intensity and the regulation standards

Odor intensity	Description	Specified offensive odor substance (in the case of Ammonia)	Odor index
0	No odor		
1	Can only just be sensed (detection threshold)	0.1 ppm	-
2	Weak odor by which the odor can be identified (recognition threshold)	0.6 ppm	-
2.5		1 ppm (Zone A)	10 – 15
3	Odor that can easily be sensed	2 ppm (Zone B)	12 – 18
3.5		5 ppm (Zone C)	14 - 21
4	Strong odor	10 ppm	-
5	Intense odor	40 ppm	-

Method for calculating the odor index

Type 1 standard (regulation standard for site boundaries)

- In principle, make the initial dilution rate 10.
- Have a panel of six members repeat the test at the same dilution rate three times.
- Give “correct” responses a score of 1.00, “incorrect” responses a score of 0.00 and “indeterminable” responses a score of 0.33, and calculate the average ratio of correct responses.
- If the average ratio of correct responses is at least 0.58, increase the dilution rate by a factor of 10, and repeat the test.
- If the average ratio of correct responses is less than 0.58, stop the test, and calculate the odor index (odor indexes are integral numbers (rounded)).

$$Y = 10 \log \left(M \times 10^{\frac{r1 - 0.58}{r1 - r0}} \right)$$

Method for calculating the odor index

Type 1 standard (regulation standard for site boundaries)

Dilution rate 10		100					
Selection test number		1st	2nd	3rd	1st	2nd	3rd
Panel	A	Correct	Correct	Incorrect	Incorrect	Incorrect	Correct
	B	Correct	Correct	Correct	Incorrect	Incorrect	Correct
	C	Correct	Unsure	Correct	Correct	Correct	Correct
	D	Correct	Correct	Correct	Incorrect	Correct	Incorrect
	E	Incorrect	Correct	Incorrect	Correct	Incorrect	Incorrect
	F	Correct	Correct	Correct	Incorrect	Correct	Incorrect
Correct (1.0 points)		1.0 x 14 = 14			1.0 x 7 = 7		
Unsure (0.33 points)		0.33 x 1 = 0.33			0.33 x 0 = 0		
Incorrect (0 points)		0 x 3 = 0			0 x 11 = 0		
Total		14.33			7.00		
Average ratio of correct responses:		$r1 = 14.33/18 = 0.80$			$r0 = 7.00/18 = 0.39$		

[Calculation of odor index]

$$Y = 10 \log \left(M \times 10^{\frac{r1 - 0.58}{r1 - r0}} \right) = 10 \log \left(10 \times 10^{\frac{0.80 - 0.58}{0.80 - 0.39}} \right) = 15.4$$

The odor index is 15

Measurement of offensive odors

Entrustment of measurement

(Articles 11 and 12 of the Law)

- **Measurement of offensive odors**

The mayor of a municipality **shall be required to make necessary measurements** with regard to the concentration of specified offensive odor substances or the odor index within regulation areas in order to preserve the living environment of the residents.

- **Entrustment of measurement for the purpose of recommendations and orders for improvement as well as orders for accident measures**

- When entrusting the measurement of specified offensive odor substances...

- Certified environmental measurer pursuant to the Measurement Law**

- When entrusting the measurement of odor indexes, etc...

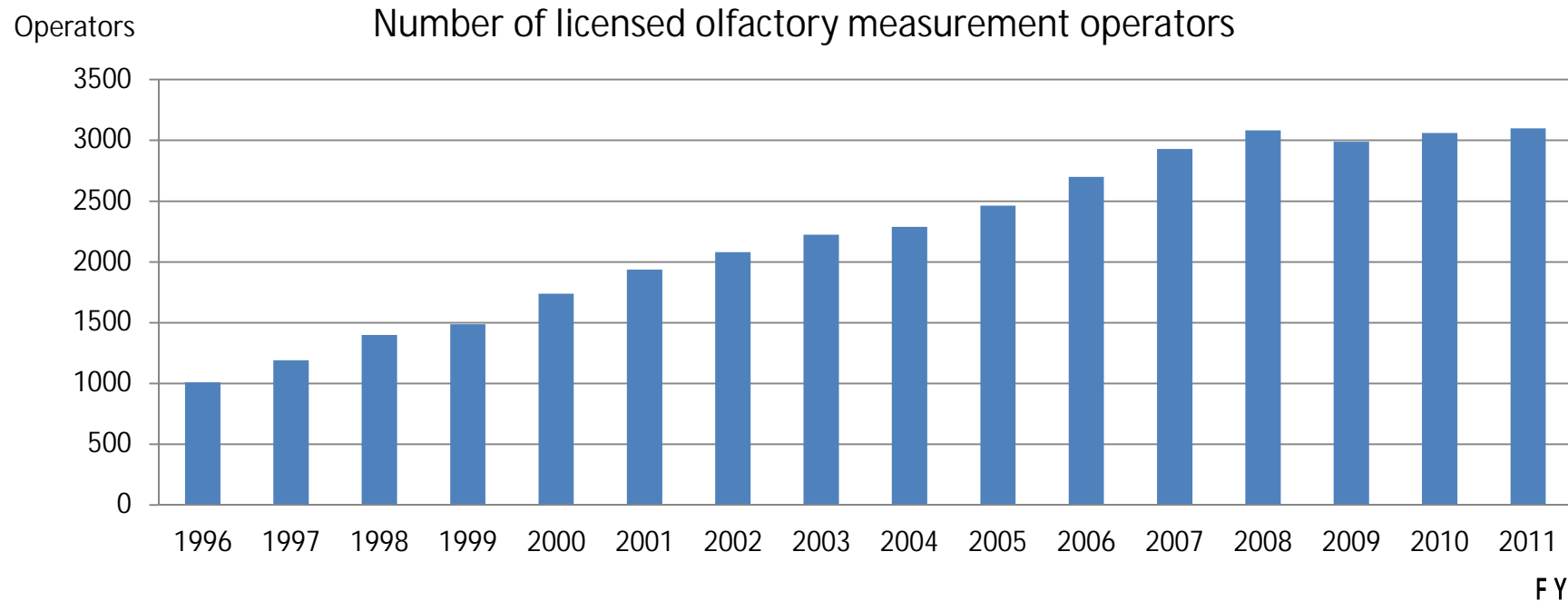
- Olfactory measurement operators pursuant to the Offensive Odor Control Law (Article 13)**

Duties of olfactory measurement operators

- Panel selection
 - Selection of people with normal senses of smell
- Sample collection
- Sensory testing
 - Consideration of the psychological influences of panel members and olfactory fatigue
- Summary of results
 - Calculation of measured values in accordance with promulgated methods

Examination for olfactory measurement operators (Article 13 of the Law)

- Number of licensed olfactory measurement operators: 3,099 (as of March 31, 2012)
- Number of people who successfully passed the olfactory measurement operator examination in FY2012: 148 (pass rate: 25.8%)



Recommendations for improvement

Orders for improvement

(Articles 8 of the Law)

- Recommendations for improvement

In cases where the emission of a substance causing an offensive odor **does not conform to regulation standards**, and where it is recognized that the **living environment of residents is being harmed**:

→The owner is set a reasonable period of time, and to the extent necessary to remove the situation:

- Improvement of facility operations
- Improvement of emission prevention equipment
- Other measures to reduce the emission of substances causing offensive odors

- Orders for improvement

In cases where a recommendation for improvement is not followed

Action is instigated by the mayors of municipalities and special wards

Measures, etc. Pursuant to the Offensive Odor Control Law

Administrative action, etc. (Number of complaints)	FY2010 (6,062 cases)	FY2011 (5,903 cases)
Onsite inspections	2,043	1,794
Collection of reports	410	329
Measurements	86	67
(Standards exceeded)	38	29
Recommendations for improvement	8	4
Orders for improvement	0	0
Administrative guidance	1,570	1,358

- ★ In dealing with complaints, there are few onsite inspections and collections of reports.
- ★ There are few measurement cases. The ratio of standards exceeded is high.

Limits of regulations based on specified offensive odor substances

- There are more than 400,000 types of substances that produce odors
- Additive / multiplier effect of odors
- Some substances smell even if their level of concentration is below the standard value

By themselves, regulations on the concentration of substances have limits



Introduction of the odor index regulation (2005 revision of the Law)

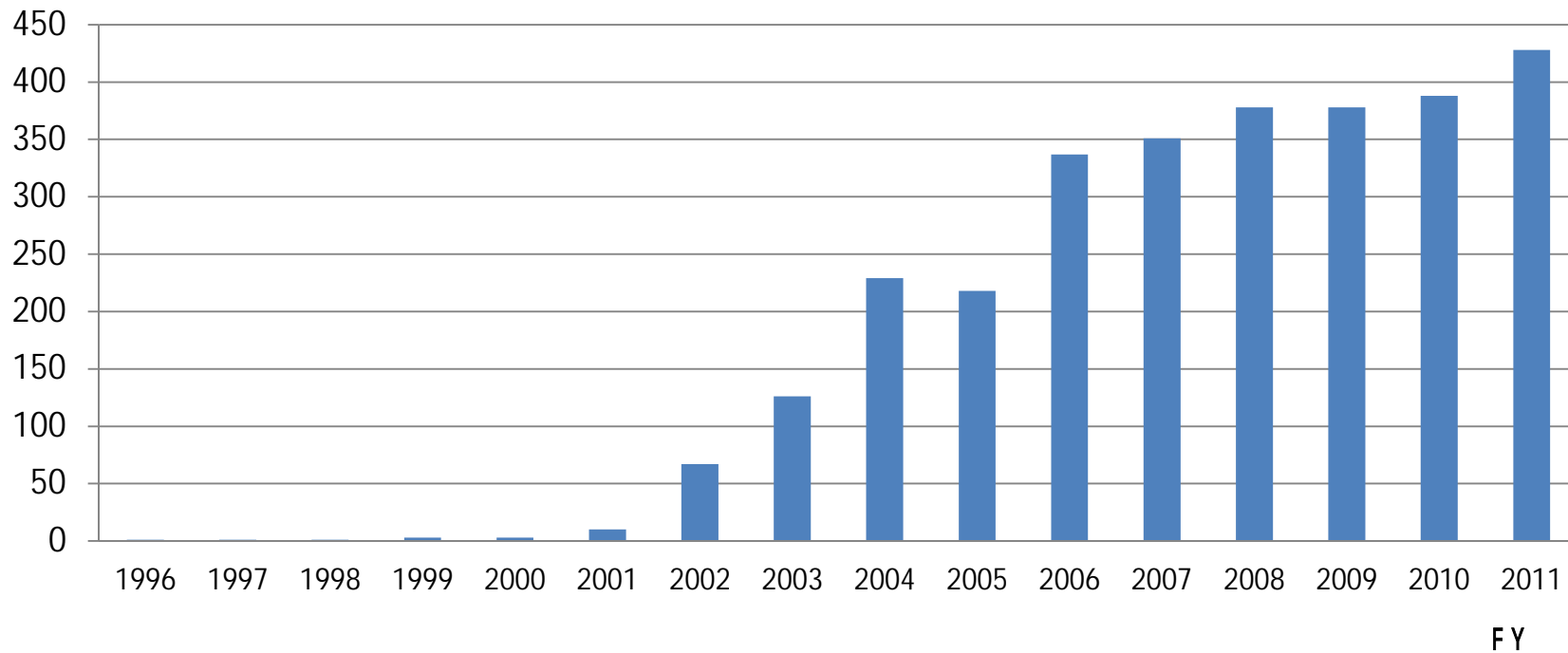
The value obtained by multiplying the logarithmic value of the dilution rate (odor concentration), when a sample is diluted with odorless air to the point that the offensive odor can no longer be sensed, by a factor of 10.

Odor index = 10 x Log(odor concentration)

Adoption of odor index regulations

- 428 municipalities (33.5% of regulation areas) (end of FY2011)

Number of local governments



Adoption of odor index regulations (as of the end of FY2011)

(1) Number of municipalities		(2) Number of municipalities with regulation areas (as a percentage of (1))		(3) Number of municipalities that have adopted odor index regulations (as a percentage of (2))	
Cities	787	737	(93.6%)	267	(36.2%)
Wards	23	23	(100.0%)	23	(100.0%)
Towns	748	463	(61.9%)	121	(26.1%)
Villages	184	55	(29.9%)	17	(30.9%)
Total	1,742	1,278	(73.4%)	428	(33.5%)

Adoption of odor index regulations

★ The introduction of odor index regulations has not progressed.

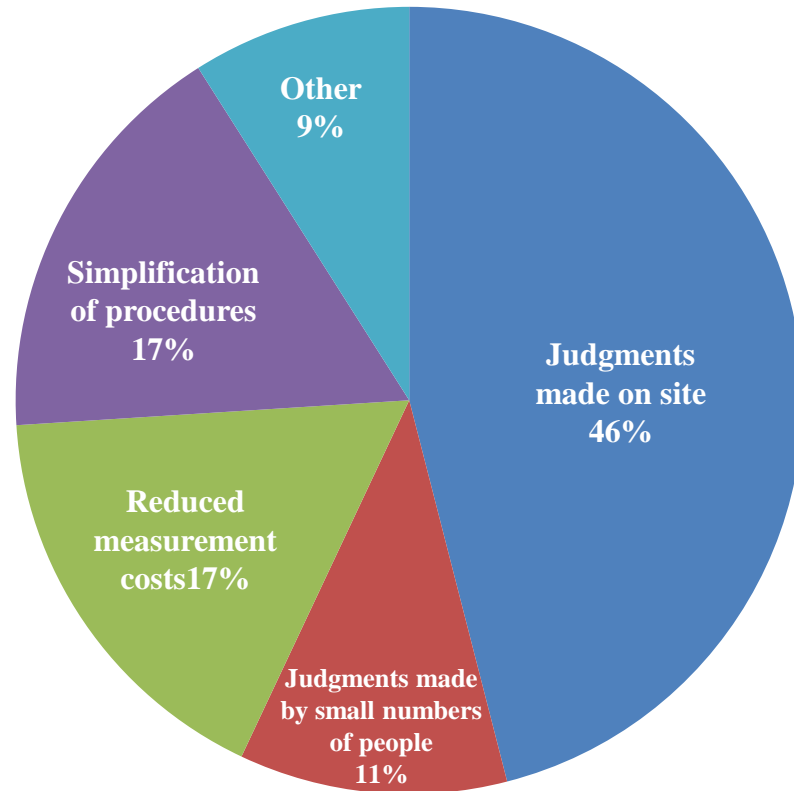
- Seminars for local public bodies
(training in olfactory measurement, etc.)
- Production of pamphlets
- Creation of odor simulators
(software for calculating/assessing type 2 standards)



Requirements of simplified olfactory measurement

◆ Opinions on olfactory measurement

- The cost of entrustment is high, and cannot be measured easily.
- Securing panels is difficult (fewer staff members).
- The people making the complaint want to know the results then and there.
- Methods are needed which are easy to use.



Development of simplified olfactory measurement

☆ The official method lacks flexibility and is expensive.

	Official method (Environment Law)	Simplified olfactory measurement
Application	Determine conformity with regulation standards (guidance, recommendations for improvement, orders for improvement, etc.)	Local government staff easily determine odor index when complaints are raised, etc.
Features	The initial dilution rate is judged three times, and if the average ratio of correct responses by six panel members is 58% or higher, the dilution rate is increased by a factor of 10, and judged again. The odor index is calculated based on the average ratio of correct responses for the initial dilution rate and the subsequent increased dilution rate.	Each dilution rate is judged twice, and regarded as a correct response if judged correctly both times. (Depending on the degree of confidence and the results of the intensity judgment, could be abbreviated to a single measurement.)
Measurement time	20 – 40 minutes	10 – 20 minutes in the case of a 2-person exclusive panel
Required measurement personnel	Minimum of 8 people	2 – 5 people
Testing room	There are provisions for a testing laboratory and a sample preparation room	Able to be performed in a meeting room, etc. at a public office
Number of odor bags per sample	108 bags (3 bags x 3 times x 2 stages x 6)	2-person panel : 26 bags 3-person panel : 39 bags (per person : 2 bags x 4 stages x 1.5 + 1 bag)
Number of odor bags distributed	Triangular test (1 bag with odor, 2 bags without odor)	Paired test (1 bag with odor, 1 bag without odor; plus 1 bag with “Odorless Air” written on it)

“Manual of Measures against Offensive Odors” targeted at business operators in the restaurant business



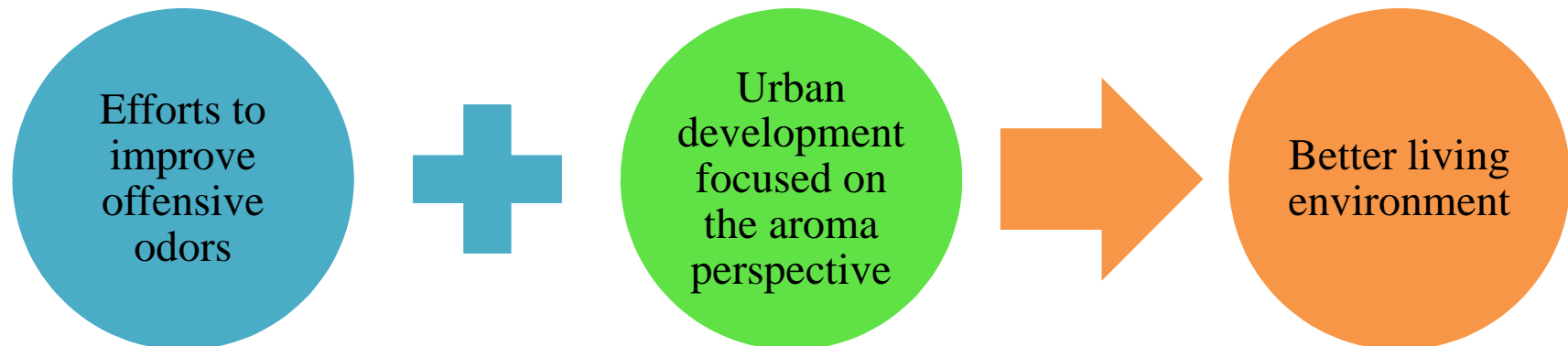
As a step against offensive odors in the restaurant business, the manual contains a collection of reference cases. It is sorted according to types of measures, and introduces a menu of measures.

Towns with an aromatic environment

- Increase in complaints about offensive odors that are outside the scope of legal regulation
- Importance of efforts to prevent offensive odors before they occur



- Improvement of the odor environment as an element of comfort in the living environment, and creation/preservation of an aromatic environment



Definition and scope of “aroma design”

“Aroma design”:

A part of “urban development” in which a number of details are designed in order to take full advantage of the aromatic environment, such as ways of selecting, arranging and installing aromatic elements.

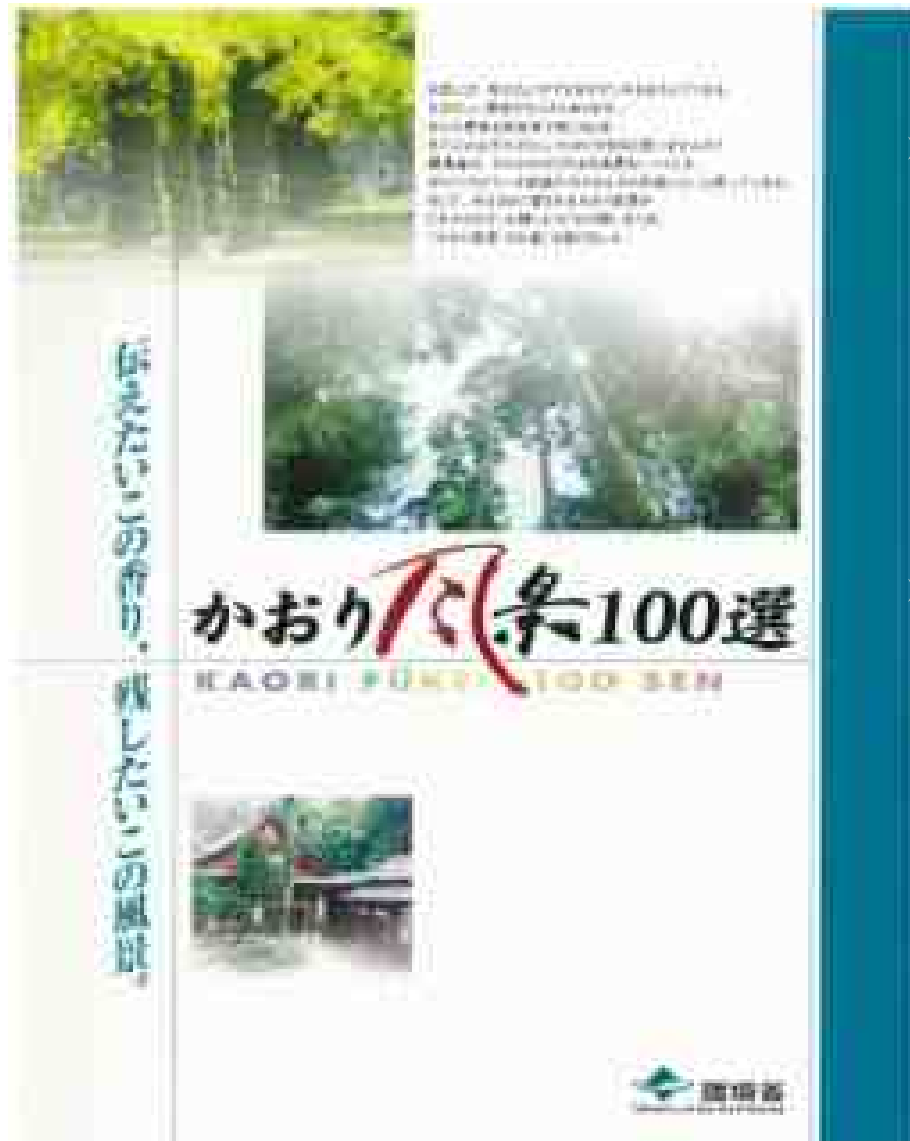
Target spaces: Primarily outdoor spaces, excluding indoor spaces

Aromatic elements: Natural aromas (trees and flowers, sea breezes, earth, etc.)
Traditional aromas (hot springs, black ink, incense, etc.)

Aromatic elements that can be used in “aroma design”

- **Shape the individuality of a community**
- **Feel time**
- **Feel the seasons**
- **Feel history**
- **Feel culture**
- **The effect of tranquility**
- **The effect of alleviating stress and fatigue**
- **The effect of improving arousal and work efficiency**

Past efforts of the Ministry of the Environment <100 Best Fragrant Scenes of Japan (2001) >



➤ The aim of this collection is to bring together Japan's rich fragrances and the nature, culture and lifestyles from which they originate, and to preserve them for future generations.

➤ (Rediscover familiar pleasant fragrances, become aware of a variety of scents around you by taking more notice of fragrances, and work to ameliorate unpleasant odors in the community as a whole.)

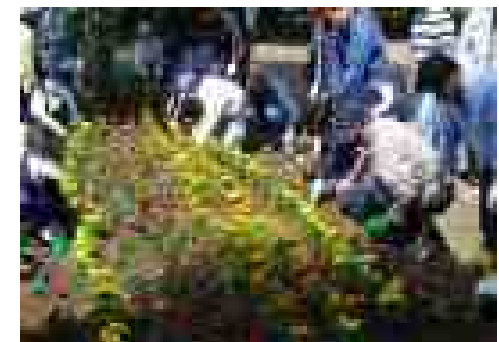
<“Community Designs that Smell of Green” Contest (from 2006)>



Open to local governments, private-sector businesses, school corporations, neighborhood store associations, resident associations and other resident group NPOs, etc.

Awards

- 1 x Minister of the Environment Award
 - ・・・ Supplementary prize: all of the trees, seedlings, etc. used in the design
 - 2 x Association Award
 - ・・・ Supplementary prize: some of the trees, seedlings, etc. used in the design
 - Up to 5 Prizes
 - ・・・ Supplementary prize: some of the trees, seedlings, etc. used in the design
- Closing date: Wednesday October 31, 2012



FY2012 Minister of the Environment Award



Thank you for your attention