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Urban Responses to Climate Change: Lessons from Japanese Cities



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Background and Previous Work

- Urban planning... Currently teaches in City and Regional Planning Department of the Middle East Technical University (METU)
- Postdoc researcher in Japan; 2009 – 2012
 - UNU-IAS, Sustainable Urban Futures Programme
 - Involved in academic and policy-oriented research
- Research interest: links between urban development and climate change; how to mitigate and adapt to climate change in and through cities
- In Japan, my research focused on achievements in local actions to address climate change, particularly on urban regeneration and urban buildings
 - not directly on mobility issues... but mobility-related conclusions and lessons have been derived from the case studies
- Today: differences between metropolitan and mid-size Japanese cities in urban sustainability agenda based on research conducted in Tokyo, Yokohama, Kanazawa and Toyama

The Japan Context

- Japan is aging and depopulating since 2005
 - The nation's population will decline by 12.5 million by 2030 and by 25 million by 2050 (Onishi & Kobayashi, 2011)
- Urban population is aging and declining too but not all cities are affected from this trend in the same way
- Problem is less serious for **big cities**, where population and economy is still vibrant
- On the other hand, mid-size or **regional cities** are seriously affected
 - Decline in economic and urban living conditions
 - Industrial decentralization deepened the decline and decay in regional cities
- This economic and demographic change has shifted the focus of urban planning in Japan from **urban growth** to **urban reorganization** (Murayama, 2005)
- **Urban reorganization** aims to create sustainable cities with high quality of life and low atmospheric emissions by two specific objectives (Balaban & Puppim de Oliveira, 2014)
 - Addressing key urban problems inherited from previous periods of rapid urbanization and economic growth
 - Tackling of global environmental problems, especially the climate change

The Japan Context

- Primary targets and focus of **urban reorganization** differ among metropolitan and mid-size cities as with their problems and priorities
- Mid-size cities inherited significant problems from rapid urbanization period, i.e. urban sprawl, suburbanization, city-center decline, high motorization, increasing GHG emissions
- Big cities are economically and infrastructurally strong, but responsible for high energy use and GHGs... They, thus, prioritize renewal or retrofitting of existing urban quarters and buildings that have higher environmental and carbon footprints
- Two contemporary terms of urban development match with the differentiation of agenda for urban reorganization and sustainability in big and regional Japanese cities:

Compact City & Smart City

- Regional cities are in search of policies and projects to achieve a compact urban form
- Metropolitan cities aim to implement policies and projects that will make them smarter in several respects



Agenda for Sustainable Urban Reorganization in Big Japanese Cities

The Case of Metropolitan Cities

- Smart City concept is a new direction to future of cities
 - *the city where the state-of-the-art information and communication technologies (ICTs) are applied to design and provision of major urban services so as to make the city more sustainable and livable*
- There are **broad** and **narrow** definitions
 - Narrow definition centers on **hard and technical** issues such as buildings, infrastructure and services (see Fukuchi, 2011)
 - Broad one covers **also soft** issues like governance, people and living (see Giffinger et al., 2007)
- In Japan, mainstream approach is to follow the narrow definition (Kono et al., 2016). Most smart city initiatives target the following:
A) *buildings* B) *infrastructure* C) *transportation* D) *urban services*

The Case of Metropolitan Cities

- Smart City concept makes sense for big Japanese cities
 - Energy use in Tokyo Metropolitan Area (TMA) is equal to that of Nordic countries
 - Energy need will continue... domestic sources are limited and nuclear is not safe
 - City systems should be reorganized in order to increase energy efficiency and diversify energy sources
- Numerous initiatives for smart city development in TMA
 - *Some are individual or stand-alone actions in particular sectors*
 - *There are also district-level initiatives to apply a combination of actions in city quarters*
- Turning former regeneration sites into smart communities/districts is an emergent response
- Minato Mirai 21, the CBD of Yokohama, is such a case
 - Yokohama City's showcase of environmental technology
 - One of the three focus areas of the Yokohama Smart City Project (YSCP - 2009)
 - Also one of my research areas in Japan

Minato Mirai 21

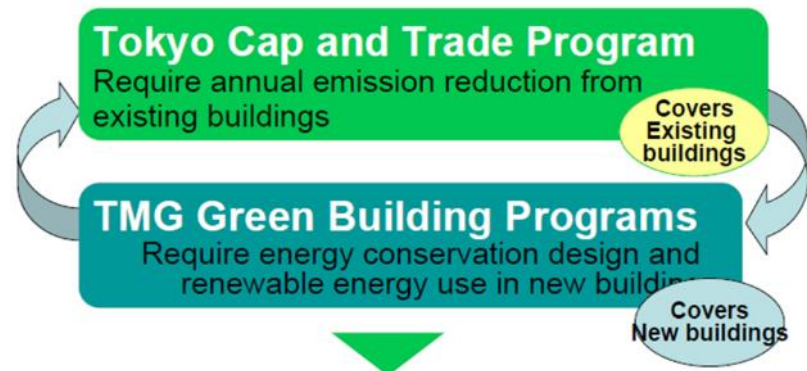


- Located in central Yokohama
- Long history of development, started in 1980s and still ongoing
- 186 hectares of brownfields and reclaimed lands
- Contributes to Yokohama's self-sufficiency by strengthening its CBD
- Currently a mixed-use district with offices, malls, residences, hotels, cultural centers, hospital and parks
- Major focuses of SC development
 - Buildings
 - Transport

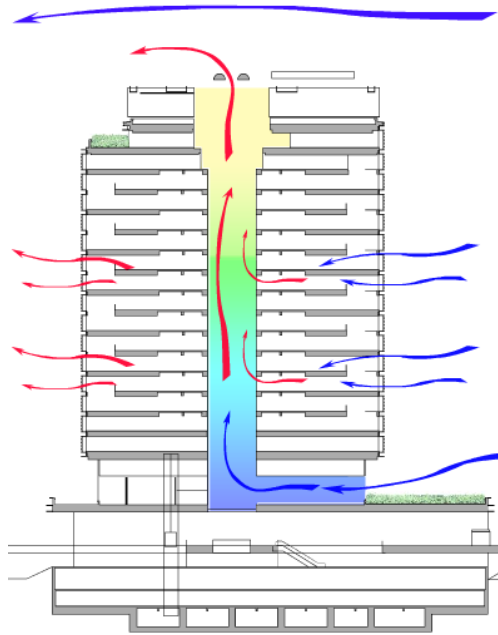
Smart Buildings in TMA



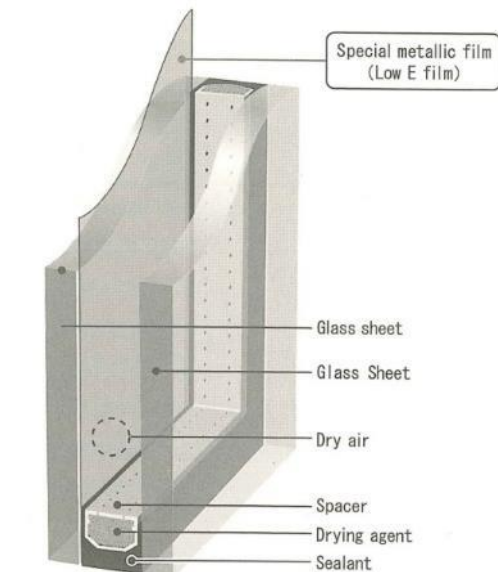
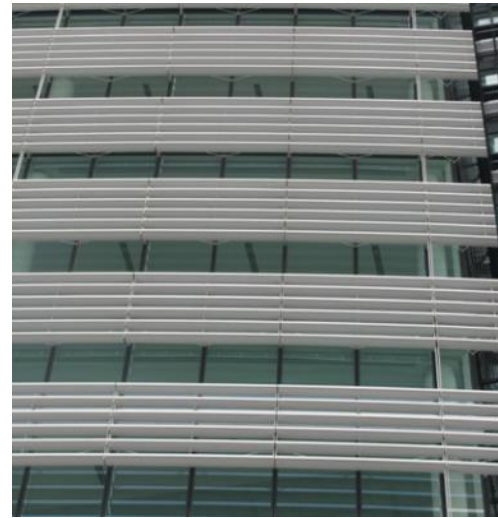
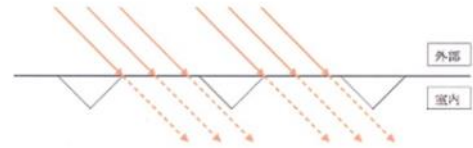
- Buildings are a major source of GHGs in Japan
 - In 2008, 63 million t-CO₂ were emitted in Tokyo, half of it is from residential and commercial buildings (TMG, 2011)
- TMG leads the smart buildings agenda in Japan (Balaban & Puppim de Oliveira, 2016)
 - Tokyo Cap and Trade Program (CTP) – existing buildings
 - Tokyo Green Building Program (GBP) – new buildings
- Japan has its own GB Certification System – The CASBEE
- Yokohama City introduced the *CASBEE Yokohama* to promote smart and low-carbon buildings (Balaban & Puppim de Oliveira, 2016)
 - MM21 is a major area of application of the CASBEE Yokohama
 - MM21 is home to several CASBEE buildings with lower energy use and CO₂ emissions due to various green design technologies



Smart Buildings in TMA



- Smart Building initiatives are based on application of computer technologies to building design & management
- Innovative active and passive design strategies that improve energy efficiency are in use
- BEMS, DHCS, ECO-VOID with sun tracking, Special Façade designs, External Louvers, Low Emissivity double-glazed windows are common
- Some concrete outputs (Balaban & Puppim de Oliveira, 2016)
 - louvre system of a building in MM21 reduced 115,400 kg CO₂ in 2009
 - Eco-void in another building in MM21 reduced electricity use by 15%



Smart Buildings in TMA



Office Bld. w/ Public Gallery
92.000 m² Owner-Occupied



Office Bld. w/ Commercial Fac.
95.220 m² Tenant-Occupied



Office Bld. w/ Shopping Mall
114.539 m² Not in use



Office Building
25.331 m² Tenant-Occupied

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O. Balaban, J.A. Puppim de Oliveira / Journal of Cleaner Production xxx (2016) 1–11

Table 3

Results of the analysis of the case study buildings.

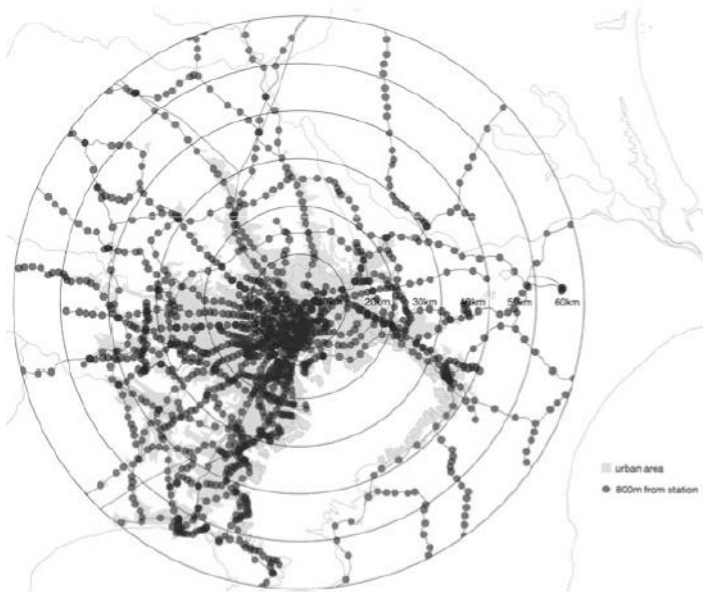
Building name	Rank	Environmental benefits						Economic benefits	Health benefits
		Energy consumption reduction			CO ₂ emissions reduction				
		Total annual energy use (Thousand MJ/yr)	Energy use intensity (MJ/m ² /yr)	Reduction rate*	Total CO ₂ emissions (tons/yr)	CO ₂ emissions intensity (kg/m ² /yr)	Reduction rate*		
Building A	1	141,379	1537	33.4%	5680	61.7	38.0%	183 million	++++
Building B	2	161,615	1697	26.4%	6478	68.0	31.7%	145 million	++++
Building C	3	217,595	1900	17.6%	8730	76.2	23.5%	118 million	+++
Building F	4	161,008	1949	15.5%	6448	78.1	21.6%	73 million	++
Building D	5	182,542	2025	12.2%	7289	80.9	18.8%	60 million	+++
Building E	6	No Data	No Data	No Data	No Data	103.1	0%	No Saving	++
Building G	7	79,877	3153	0%	3204	126.5	0%	No Saving	+
Average values	Av.	157,336	2043	11.4%	6305	85.0	14.6%	116 million	Not applicable

*Reduction rate as compared to benchmark values determined by TMG and JSBC for the years 2011 and 2012. Benchmark values are 2306 MJ/m²/yr for energy use intensity and 99.6 kg/m²/yr for CO₂ emissions intensity.

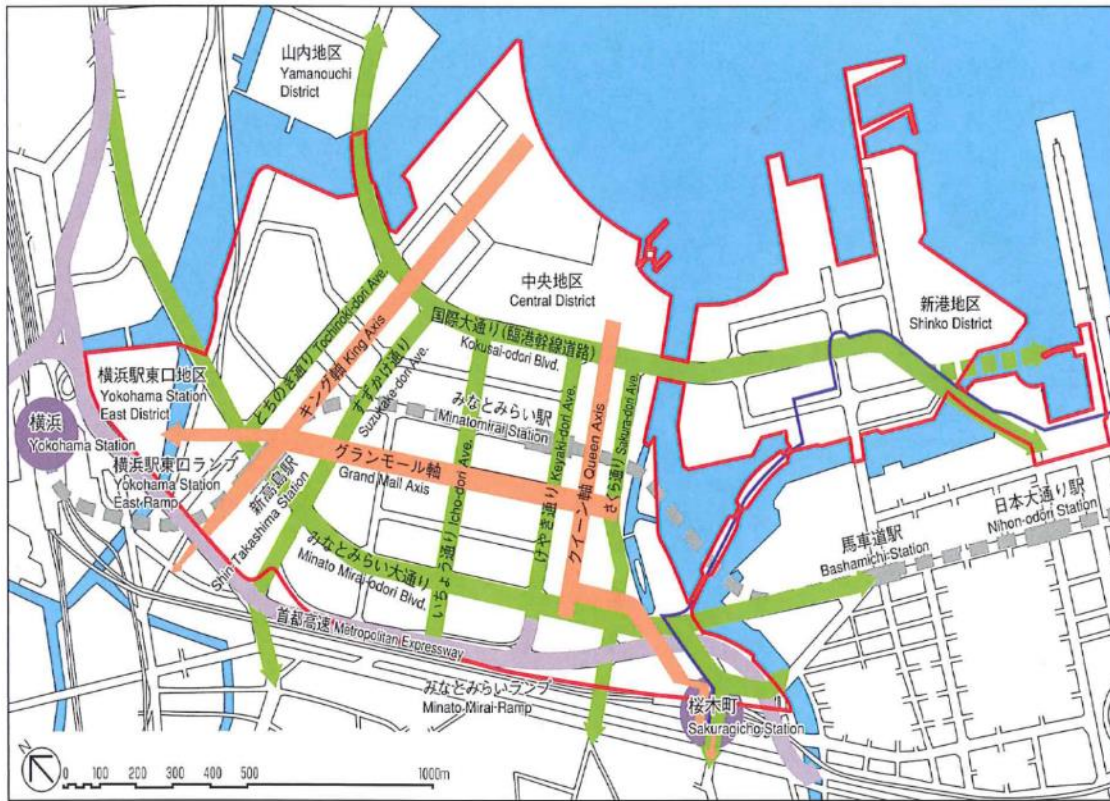
Smart Mobility in TMA



- Smart Mobility applies to both public and private modes
 - Supply of an extensive network of public modes supported with smart management applications i.e. smart ticketing and timetables, multi-modal integration, etc.
 - For private modes, the focus is on technological improvements in manufacturing of vehicles that run on new and cleaner fuels
- Japanese metropolitan cities are already successful and smart in provision, coverage and use of public transport systems
- Tokyo is the leading example with an extensive railway network comprising high-speed rail, commuter rails, subways, monorails, private lines, etc.
 - Around 136 individual rail lines, and 1,000 to 1,200 railway stations, most designed for heavy use
 - Major stations can accommodate several thousands of passengers at any given time
 - Tokyo Station has underground connections that span 4 km
 - Use of PT systems is high, 50% share by rail systems in modal split



Smart Mobility in MM21



- MM21 project was designed in a way to integrate rail and road-based systems
- Pedestrian network provides access to all functions including two railway lines and stations
- Key facilities in MM21 are located within a 500 meter distance from the MM station
- Parking spaces in residential and commercial facilities are not rich and encouraging
- Majority of trips to and from MM21 are made by public transportation and walking (Balaban & Puppim de Oliveira, 2014)
 - 76% of work trips and 48% of leisure trips are made by rail transport
 - 32% of leisure trips are made by walking

Smart Mobility in TMA



- Focus of smart mobility in is on private modes
- Car-based smart mobility makes sense in Japan
 - old age citizens
 - rural communities and mid-size cities



- Car manufacturers' R&D efforts:
 - Wireless transfer of energy
 - Fuel cell EVs with longer distance or time
 - Hydrogen-powered cars
 - Full or partial auto-drive vehicles



- City-based initiatives aim to encourage the use of EVs by
 - the necessary urban infrastructure that facilitates the use of EV
 - raising awareness of urban residents



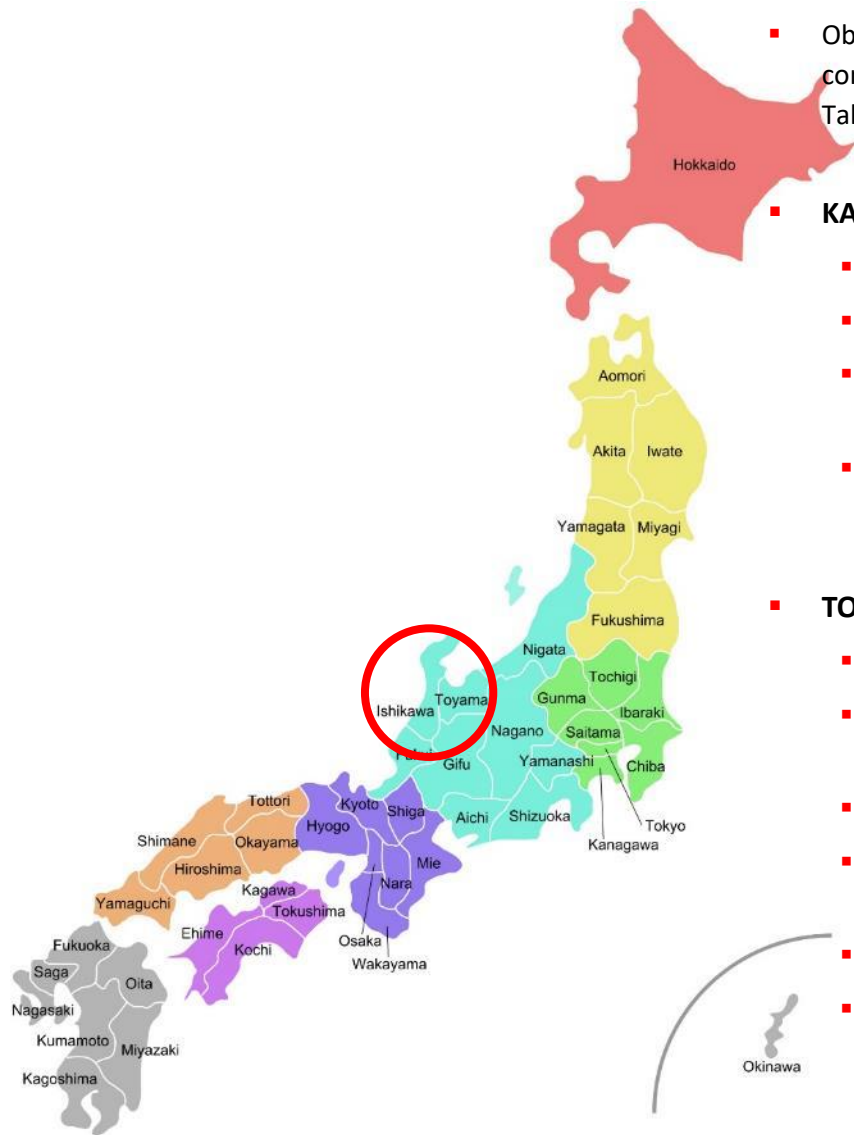


Agenda for Sustainable Urban Reorganization in Regional Cities in Japan

The Case of Regional Cities

- Compact city concept has attracted global attention in the recent years
- In Japan, regional cities aim for compact urban development in response to adverse impacts of suburbanization, industrial decentralization and high motorization
- City center revitalization has been added to the goals of compact city planning and has become one of the major means to achieve compact urban form
 - projects and initiatives aim for making the central quarters of regional cities more attractive places to live, work and invest
- There is national guidance for city center revitalization (Kidokoro, 2008)
 - City Center Revitalization Law was enacted in 1998 and amended with the City Planning Act in 2006 to promote compact urban development through the revitalization of downtown areas
 - CCR plans that are approved by the central government are rewarded with subsidies
- Kanazawa & Toyama are frontrunners of DR and CUD in Japan (Kidokoro, 2008; Takami & Hatoyama, 2008)
- Kanazawa is less successful than Toyama due in large part to weaknesses in transport planning and organization for downtown revitalization

The Case of Regional Cities



- Obvious reasons for Kanazawa and Toyama to focus on city center revitalization and compact urban development (Kidokoro, 2008; Takami & Hatoyama, 2008; Onishi & Takahashi, 2011)

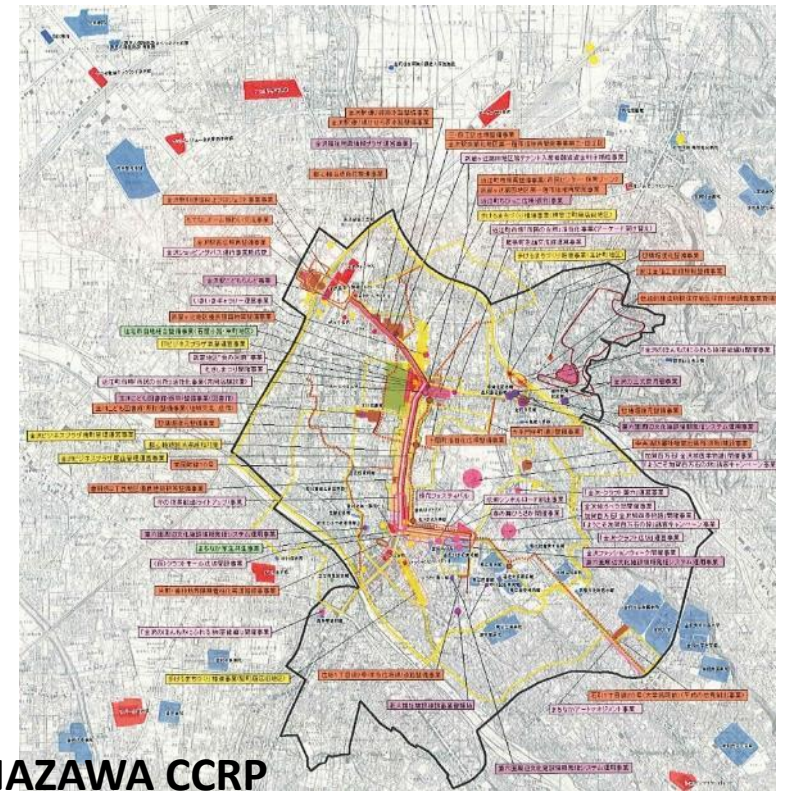
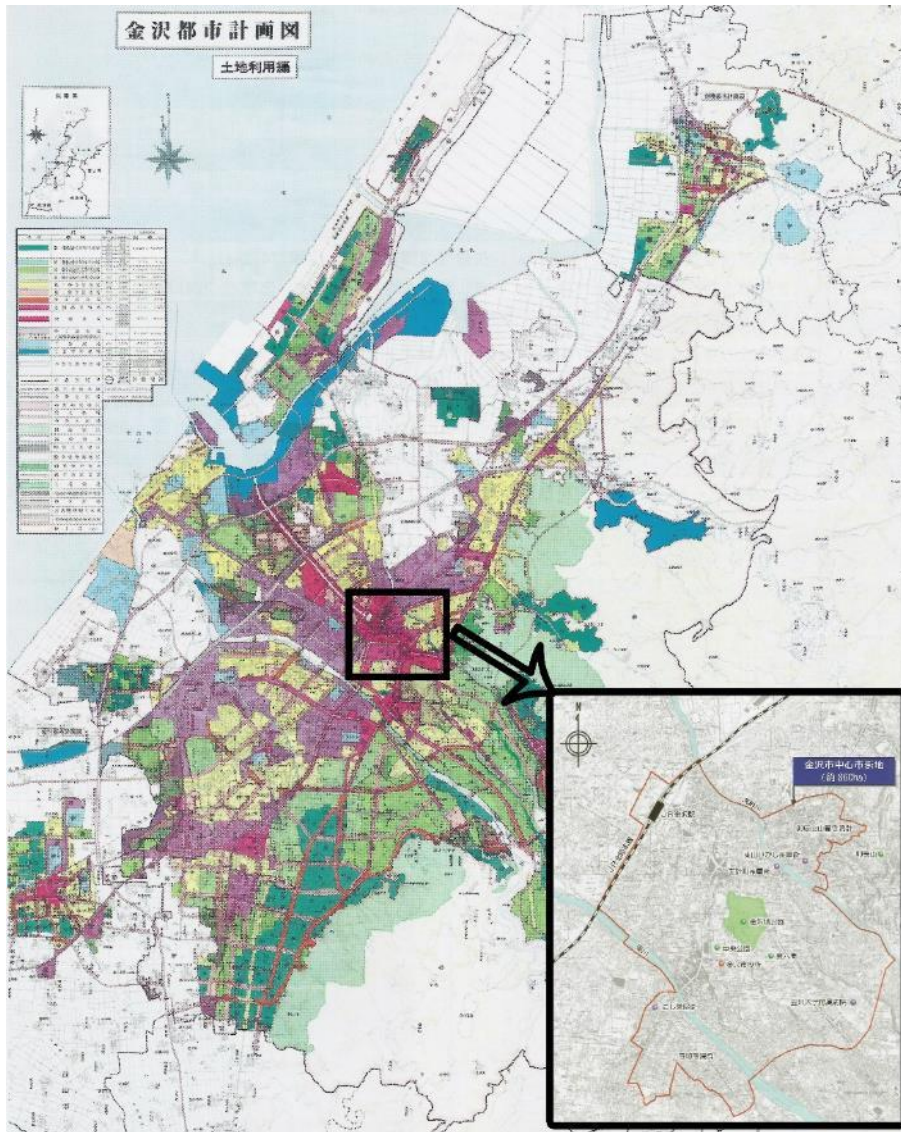
▪ KANAZAWA CASE

- Population was 456,000 people in 2005
- From 1960 to 1990, land area tripled despite the 1.6-fold increase in population
- City center population fell from 22% in 1960 to 6% in 2000 with a density decline from 200 to 77 persons/ha
- From 1995 to 2007, share of all trips in a private car increased from 59% to 67% and share of commuting trips in cars increased from 72% to 78%

▪ TOYAMA CASE

- Population was 420,000 people in 2005
- From 1995 to 2007, city center population decreased by more than 10% with the lowest DID density among all prefectural capitals in Japan; 40 persons/ha in 2005
- 40% decrease in retail turnover in downtown from 1994 to 2004
- In 1999, 72% of all trips and 84% of commuting trips were found to be made by automobiles
- Bus ridership dropped to one-third from 1989 to 2004
- Toyama's per capita gasoline consumption was 1.4 times higher than the national average

The Case of Kanazawa



KANAZAWA CCRP

- Covers 860 ha area in city center
- Suggests various actions to enhance environmental, spatial and living quality of the center
- Three main objectives:
 - best use of existing built-up area and building stock in city center
 - create a compact city by increasing the attractiveness of city center
 - promote the use of public transportation and encourage walking and cycling in the city center

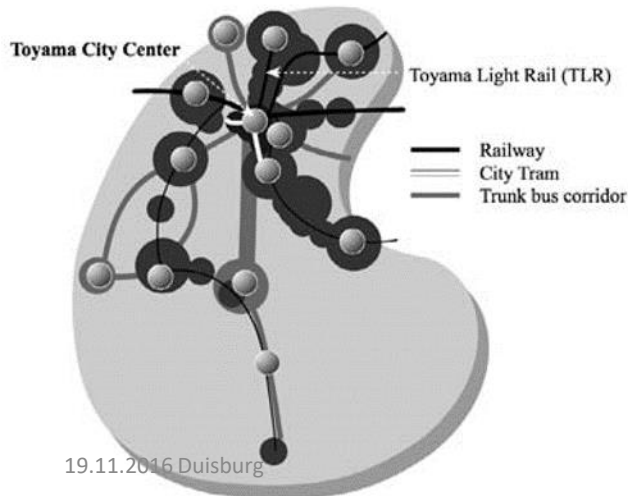
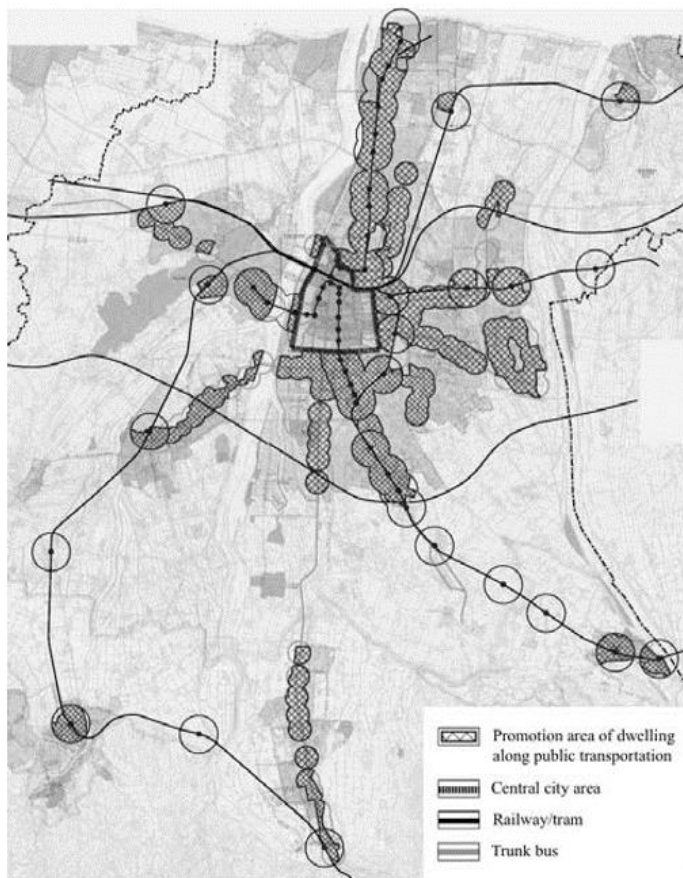
The Case of Kanazawa

- A selection of specific actions and projects of the CCRP Kanazawa are as follows (Balaban & Puppim de Oliveira, 2014):
 - Encourage new shopping malls on vacant lots in city center rather than suburbs
 - Uncover Kanazawa's 50 water canals, which were covered over to make parking lots, and reorganize them as landscape elements of public routes and walkways
 - Soft measures as subsidies to citizens who construct/purchase house in center
 - Opening of the Kanazawa 21st Century Contemporary Museum of Art in 2004
 - Retrofit/Reuse the former HQ building of the prefecture as a cultural complex
 - Improve the convenience and coverage of the bus system
 - few new bus routes were designated "100 Yen Bus" routes to increase ridership via lower fares
 - shopping buses to run between Kanazawa station the city center on Saturdays and holidays
 - Improve pedestrian and bicycle mobility in city center by opening new walkways and bicycle paths and by renewing the existing ones

The Case of Kanazawa

- Major drawbacks and shortcomings (Balaban & Puppim de Oliveira, 2014):
 - The progress has been very limited... no significant population increase in city center... bus riders continued to decrease
 - The plan was unable to introduce structural measures for transport due to the inability of the city to introduce structural measures in urban transport sector
 - The bus service in Kanazawa is largely run by the private sector
 - The city was reluctant and unable to make significant changes to the system
 - Structural measures have not been developed to increase the convenience and coverage of the system as well as encourage the use of it
 - The city introduced only soft measures, such as awareness-raising campaigns and the 100 Yen Buses
 - Soft measures have fallen short of overcoming the structural deficiencies in Kanazawa's public transportation system

The Case of Toyama



- Compact city planning in Toyama has been coordinated with the city center revitalization policy
- Toyama's CCRP sets three objectives:
 - making public transportation more convenient
 - promoting residence in the central area
 - creating a lively city core
- Parallels drawn between compact city & revitalized city center targets via improved public transport & better land use-transport integration
- Unlike the Kanazawa case, in Toyama, interventions into the transport sector were not limited to soft measures
- CCRP actions and transport policies were coordinated through “**sticks and dumplings**” approach (Takami & Hatoyama, 2008)
 - The **sticks** are public transportation routes with high service levels,
 - The **dumplings** are homes and facilities within walking distance of rail stations and other public transportation stops
- All railway and tram lines and selected bus lines among city center, district centers, and important facilities are designated as public transportation corridors, *the Sticks* (Takami & Hatoyama, 2008)



The Case of Toyama

Most of *the Sticks* were not available but created by the City via following actions (Onishi & Takahashi, 2011):

- Former JR Toyamako Line was turned into Japan's first Light Rail Transit system with new vehicles and improved service in April 2006
- Frequency of JR Takayama Line increased
- Existing streetcar system was extended to create a circular route to connect all rail lines
- Bus corridors with frequent service were provided with subsidies for vehicle and bus stop upgrades
- Dumplings were also encouraged via guidance on land use and financial support (Takami & Hatoyama, 2008)
 - subsidize the construction, acquisition and rental of homes within central city and public transport corridors
 - support elderly households to move to the central area, i.e. by mediating the exchange of suburban houses between elderly and young families



The Case of Toyama

- There are other actions and policies of compact city planning and downtown revitalization in Toyama
- Outputs have been significant since the mid-2000s (Takami & Hatoyama, 2008; Onishi & Takahashi, 2011)
 - Target is to increase the current 30% of city's population that live in dumplings to 40% by 2025
 - LRT ridership doubled on weekdays, tripled or quadrupled on holidays
 - 10% of LRT users confirmed to have switched from their cars
 - More than 80% of inhabitants in any district of the city, as well as in the district along TLR highly appreciate LRT
- Two important differences between Kanazawa and Toyama are
 - Kanazawa's actions for CCP and CCR were developed in isolation from each other, whereas in Toyama, they were coordinated via transport-land use integration
 - Public sector involvement in Toyama was quite decisive and intense, especially in transport planning and management

Future of Mobility Agenda

- **BIG CITIES:** the already developed and highly used transit systems should be sustained and improved
- Priority should be given to smartization of private modes via EV cars and buses, micro-mobility options, etc., and to the use of smart private modes where car dependency is difficult to change
- **REGIONAL CITIES:** priority to establishment of a transit oriented urban spatial structure, not necessarily rail, BRT systems may also be considered
- Cities should do more than soft measures for transport-land use integration and citizens to locate along transit corridors
- Governance-related barriers to be overcome...

Lessons for Governance of Urban Planning

- Need for Smart Governance or Smartization of Governance
 - Departmental approach and limited coordination between administrations
 - Urban planning restrictions
 - More government involvement in some sectors like transport
- Need for Compact Policy Frameworks
 - Policy documents are fragmented and in some cases too complicated...
difficult to understand and follow
 - Competing policy agendas... limited capacity should be dedicated to realistic targets

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THANK YOU
for your attention

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