



TOKAI
UNIVERSITY

工学部
材料学科
第9研究室

Energy efficient urban rail transport at Hot-spot Tokyo

ブンダリッヒ・ビルフリド

Prof.Dr. Wilfried Wunderlich,

Tokai University, Fac.Engr., Dept. Material Science,
Hiratsuka-shi, 259-1292 Japan

E-mail: wunderli@keyaki.cc.u-tokai.ac.jp

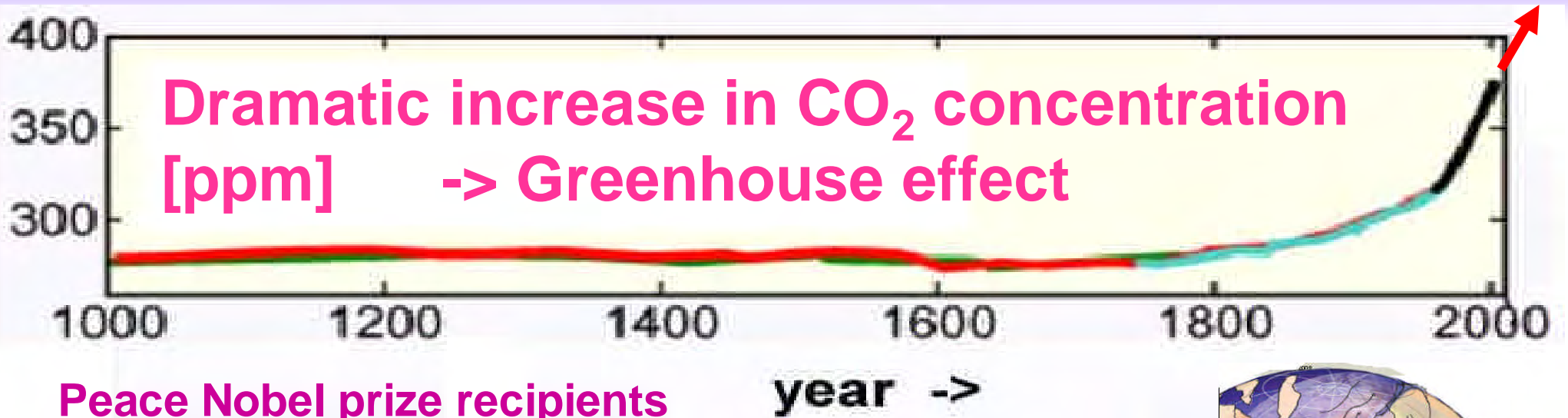
This lecture

Greenhouse gases reduction

Tokyo as example for a world metropolis -> Expo 2010

History of public transport in Tokyo

New railway technology reduces energy consumption



Peace Nobel prize recipients



We must

We can



2005

2006

2009

M. el-Baradei

Al Gore

B. Obama

- > **Plants grow faster**
- > **Insects and Virus are increasing**
- > **Climate phenomena -> larger energy**
- > **Water draughts -> Eco-system damage**

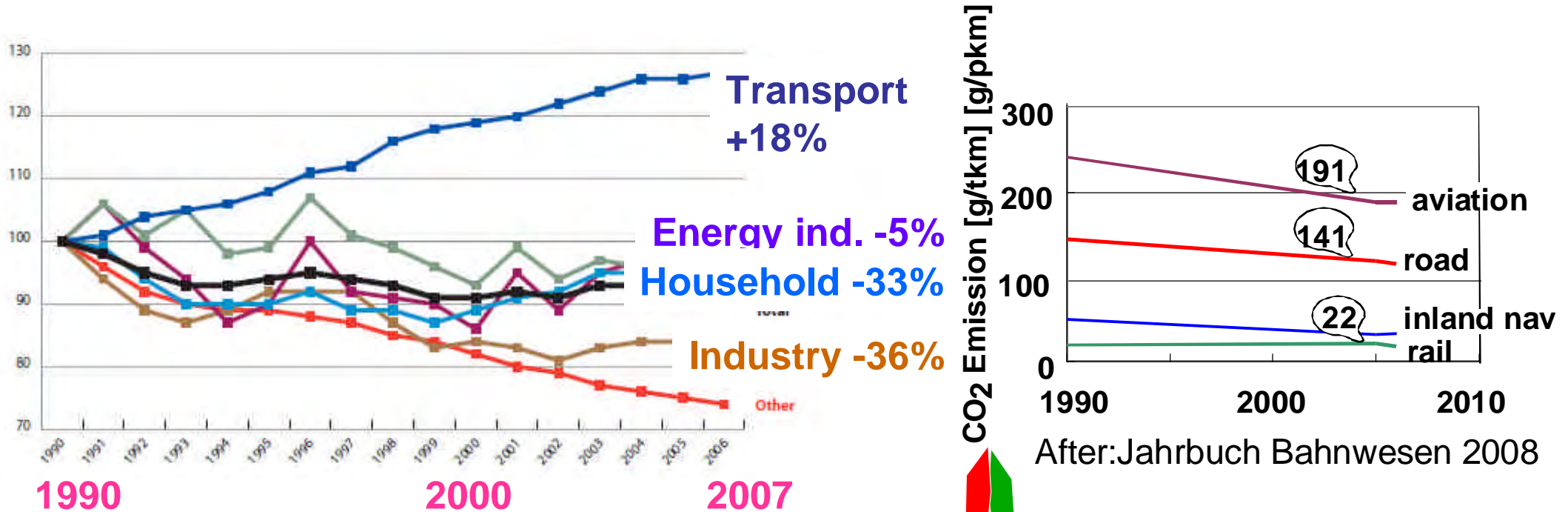
EPI IEA : ...

only 20 years left

-> EU wants to maintain 450 ppm in 2020

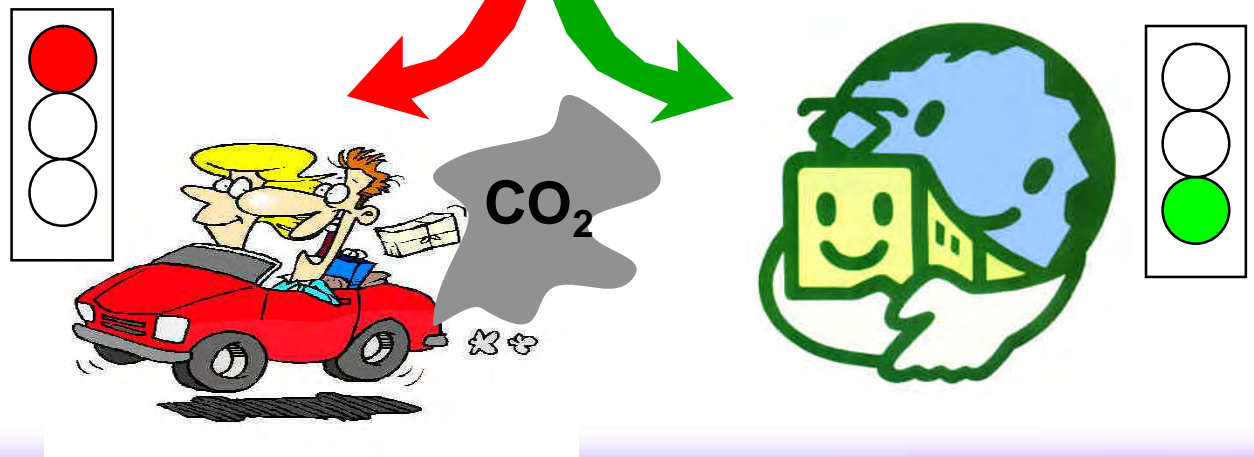
Reduction in greenhouse gas Emissions.....

.... but not yet in the transport sector in Europe

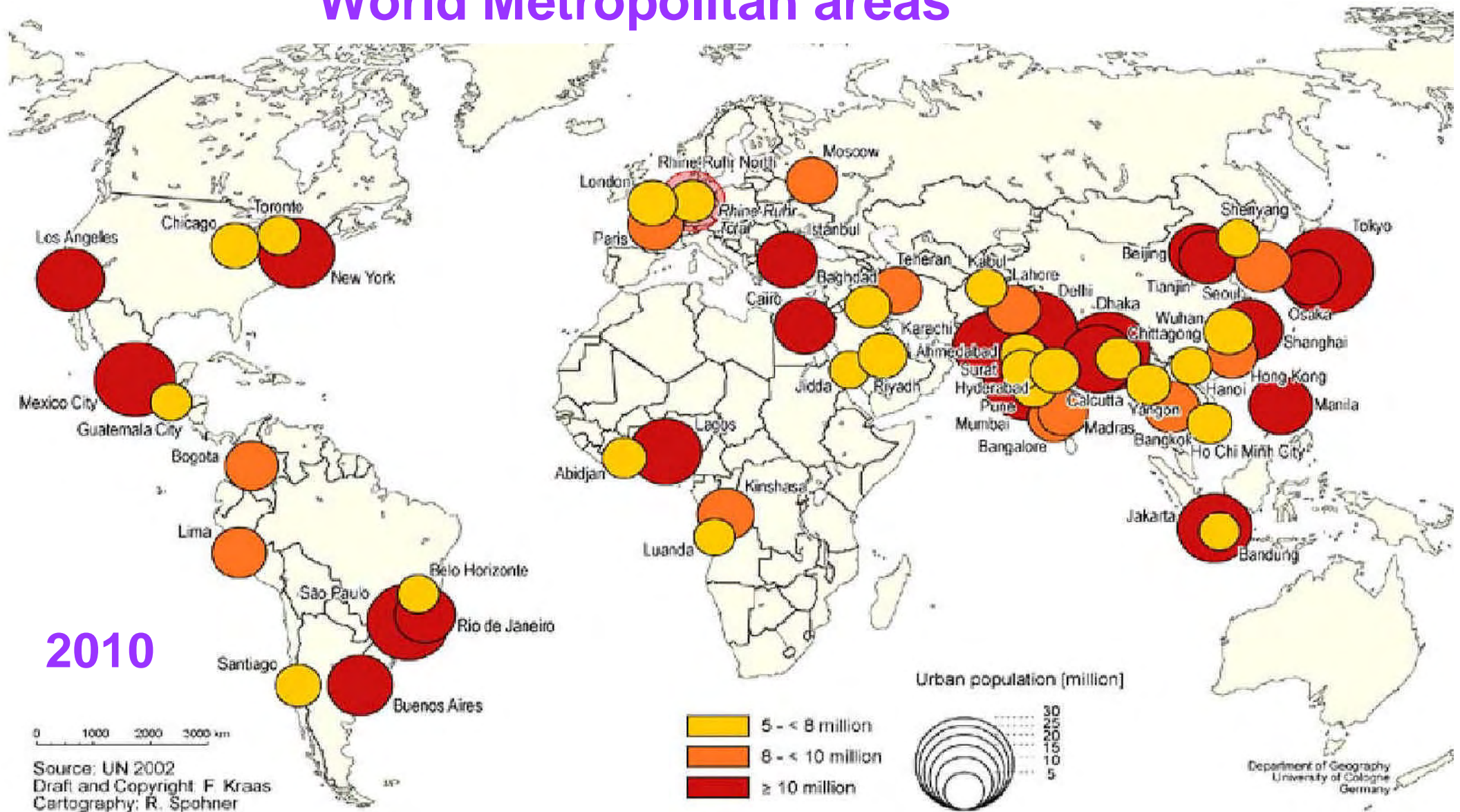


Antonio Tajani, "Future of Transport",
EU Study 2008

To avoid restrictions,
rail transport must
become more attractive –
fast, easy,...



World Metropolitan areas



Every Decade Megacities grow and new are arising
2010 75% of people live in cities, 2050 84% expected

Why do people want to live in cities?

“Better cities = Better life” –
theme of Expo 2010 in Shanghai

● **Good transport network means good social network**

● **Less travel time to work,**

● **Easy access to transport, hospital, shopping, culture...**

● **Job condition, income,**

● **Housing cost, access**

● **Number of square meter for living**

● **Number of city events**

-> Quality of life improves when living in cities

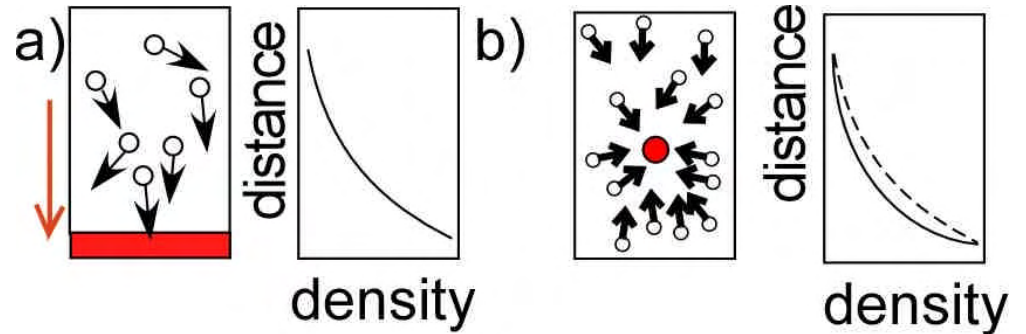


Hot-Spots are areas of vital Activity and Energy

Physics tells us:

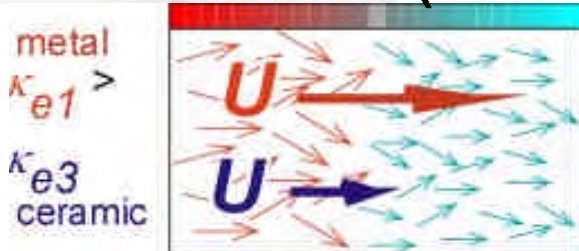
Driving force leads to gradient.

When migrating particles gather,
a singular hot spot is formed.



Particle – car, train or pedestrian
Energy – activeness of pedestrians
Temperature – progress of passenger flow
Force – attraction or motivation to go somewhere.

Ludwig Boltzmann
(1844 - 1906 Wien)



-> Simulation of traffic flow uses particle physics

W.Wunderlich et.al., http://bulletin.soe.u-tokai.ac.jp/english_vol34/5-10.pdf

Purpose of using train



40% Work



Entertainment



Shopping



School



Events



Culture



Art

Hiking



Sports

-> 97% of all journeys are less than 100 km

Urbanization in greater Tokyo area



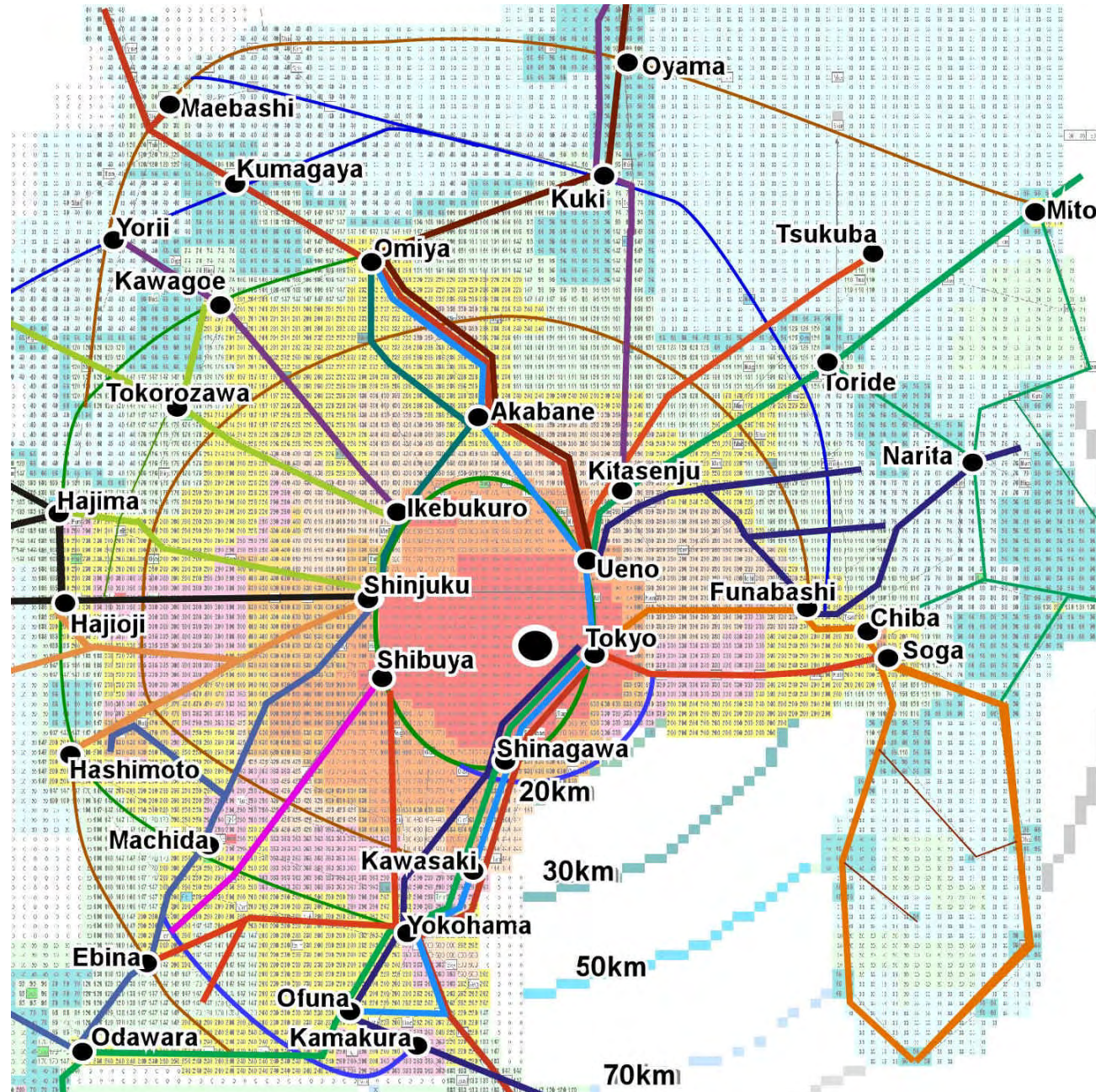
< 15km
Center city

15 – 45 km
-> suburb

> 45 km
-> rural

Concerns about “too convenient” traffic: Urban sprawl, that means landscape consumption due to urbanization

Map of real estate prices in Tokyo area



> 1000 Tsd Y / sqm
1000-700
500-300
300-200
200-70
< 70

Data:
Yomiuri Shinbun
2008-03-25

Why is public transport in Tokyo a success?

Network started, when rail was the only transport
-> continuous optimization started Olympia 1964

Station- based culture: shops, pubs, real-estate

Narrow and slow roads, very high parking costs

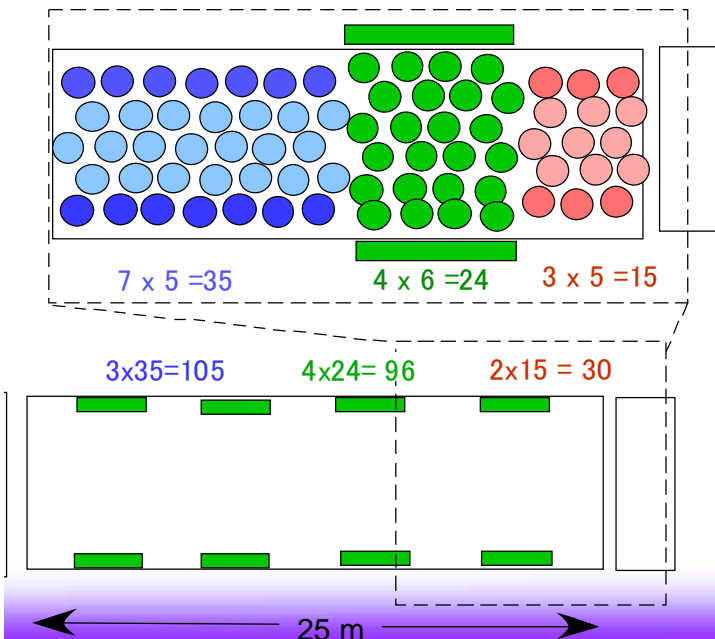
Easy and convenient, IC-tickets (Pasmo, Suica)

1964 ~ 1985



> 2000

Capacity of a commuter train



15 coaches per train

240 passengers per coach

$240 \times 15 = 3600$ passengers per train





Mass transport

Akihabara

14:12h

14:17h

14:22h

14:27h

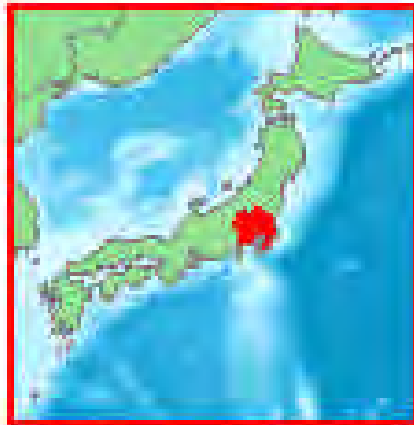
14:32h

....

Each time
about 400
people are
boarding

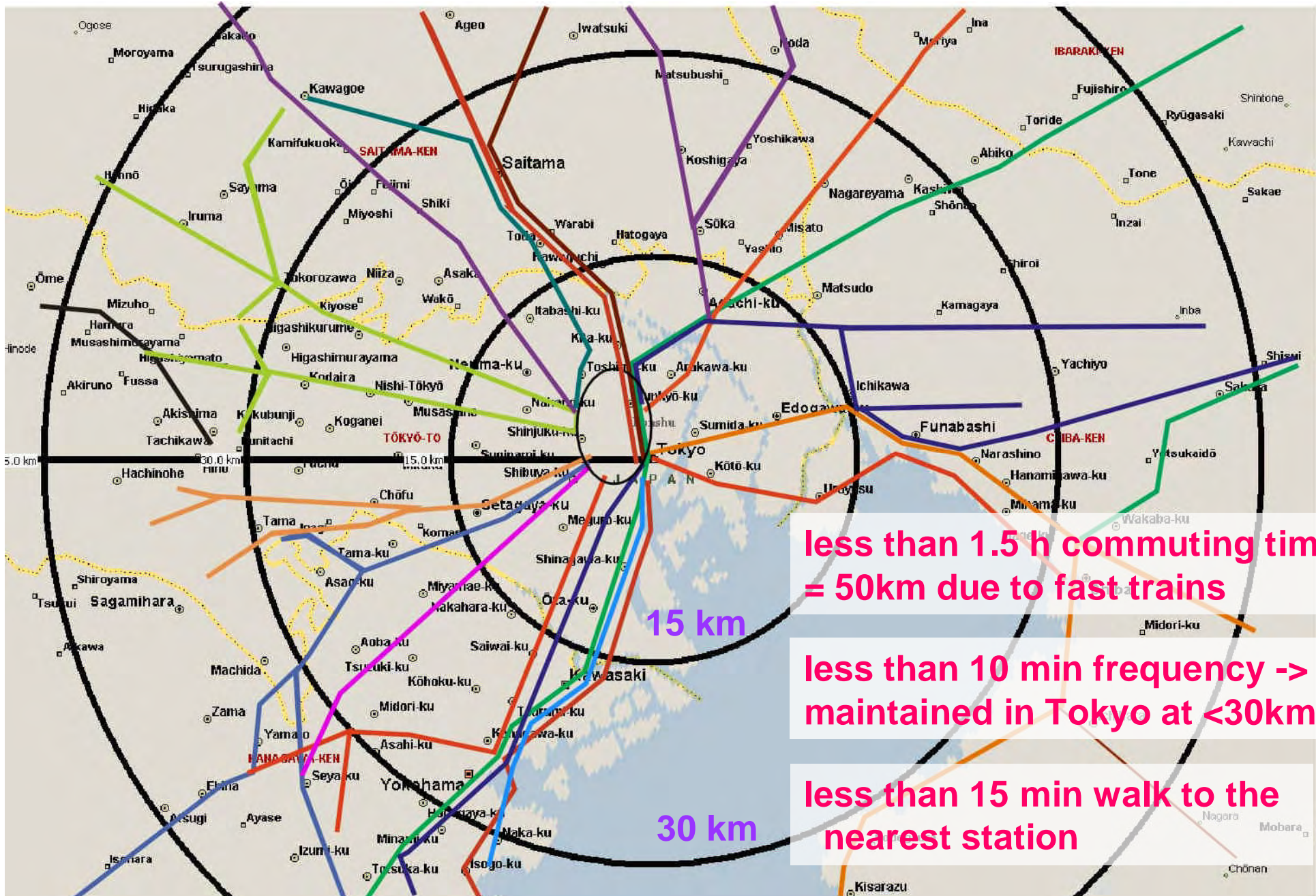
MAP OF
KANTŌ

関東地方



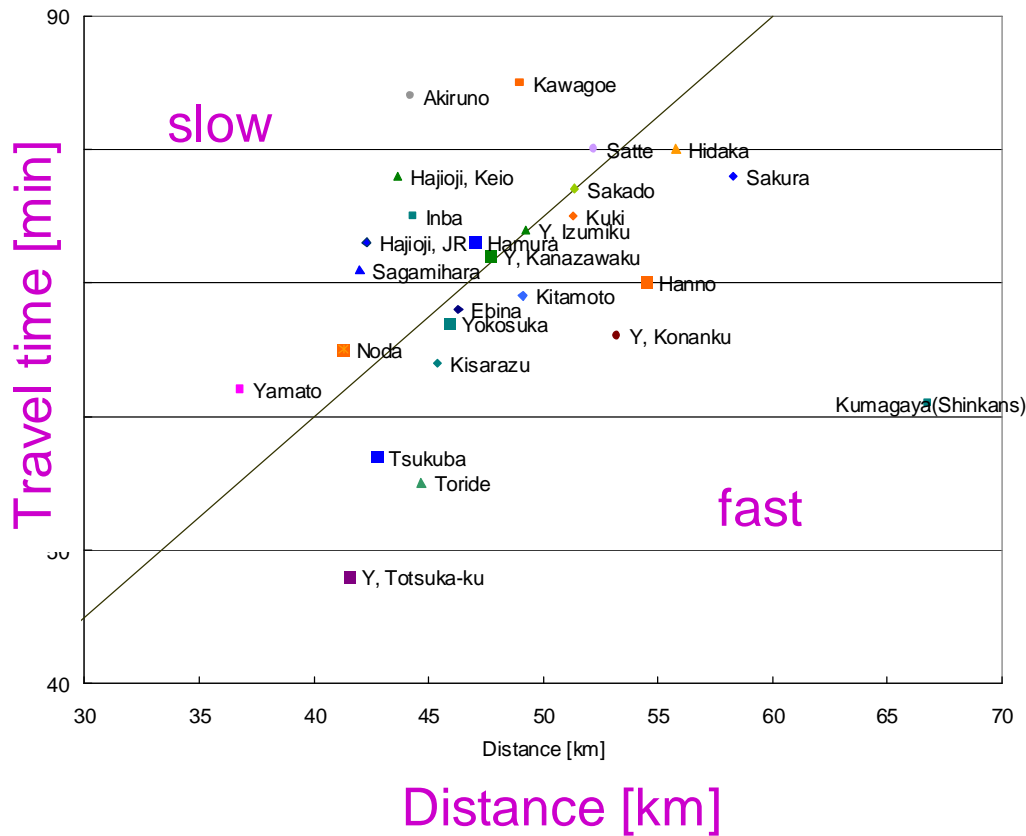
100 km

Human-being's needs related to public transport system

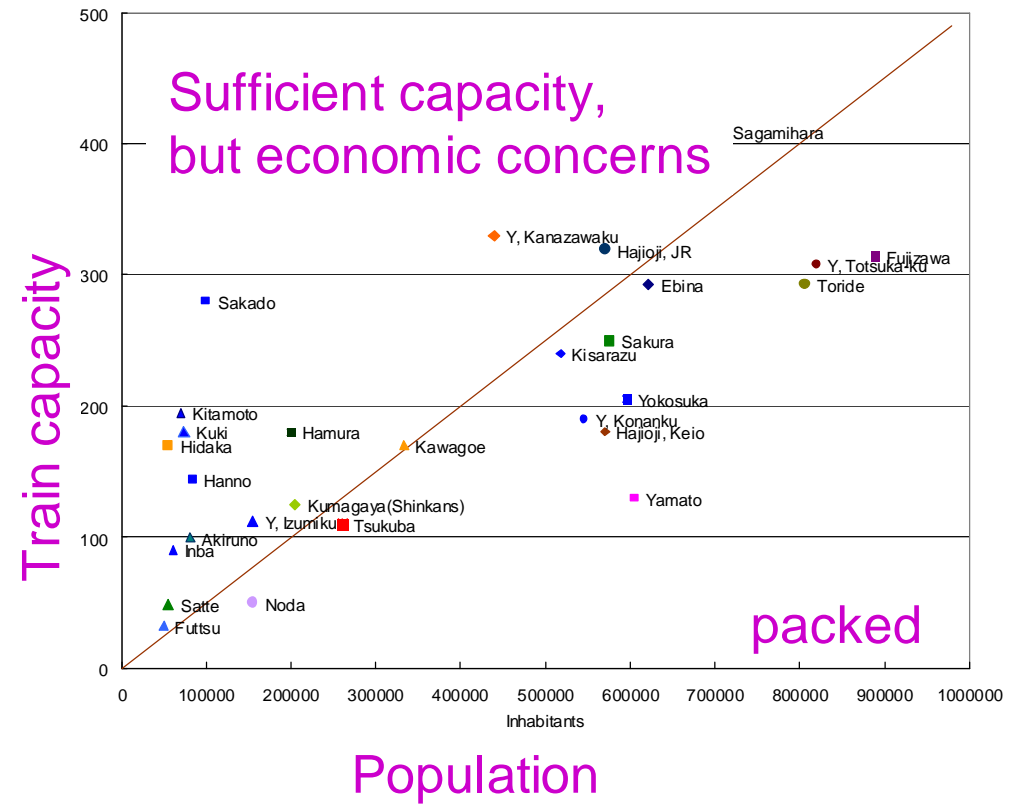


Criteria for evaluation of public transport

Travel time versus distance



Train capacity versus population



For details see this paper:

W.Wunderlich et.al., http://bulletin.soe.u-tokai.ac.jp/english_vol34/5-10.pdf