

LECTURE 18:
JUNE 10, 2014

URBAN ENVIRONMENTAL MANAGEMENT

SUSTAINABLE URBAN DEVELOPMENT I & II

Text Reference: Dearden and Mitchell (2012), Ch. 13, pp. 459-465

Outline

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□ Upcoming:

- June 11 (Wed, Map Quiz)
- June 12 (Thurs, Presentations)
- June 12 (**Papers Due – change!**)
- June 13 (Fri, Last Class)
- June 16 (Mon, Final Exam)
 - 9 am to noon, in RC 2003
 - Covers post-midterm material and related field trips;

□ Today:

□ (lecture)

- Part 1: Sustainable Development I: State of Cities; Key Terms; Broad Goals of Urban Sustainability
- Break:
- Part 2: Sustainable Development II: 4 factors needing our attention to meet the challenges of SUD



Source: Dearden and Mitchell (2012)

Part 1: Sustainable Development I

- State of cities and urbanization trends
- Definitions:
 - Urban forms (urban, suburban, exurban, rural)
 - Housing types (single family, multi-family)
 - Sustainability (broadly, goals of a sustainable community)

Big Cities at the Beginning of the Century

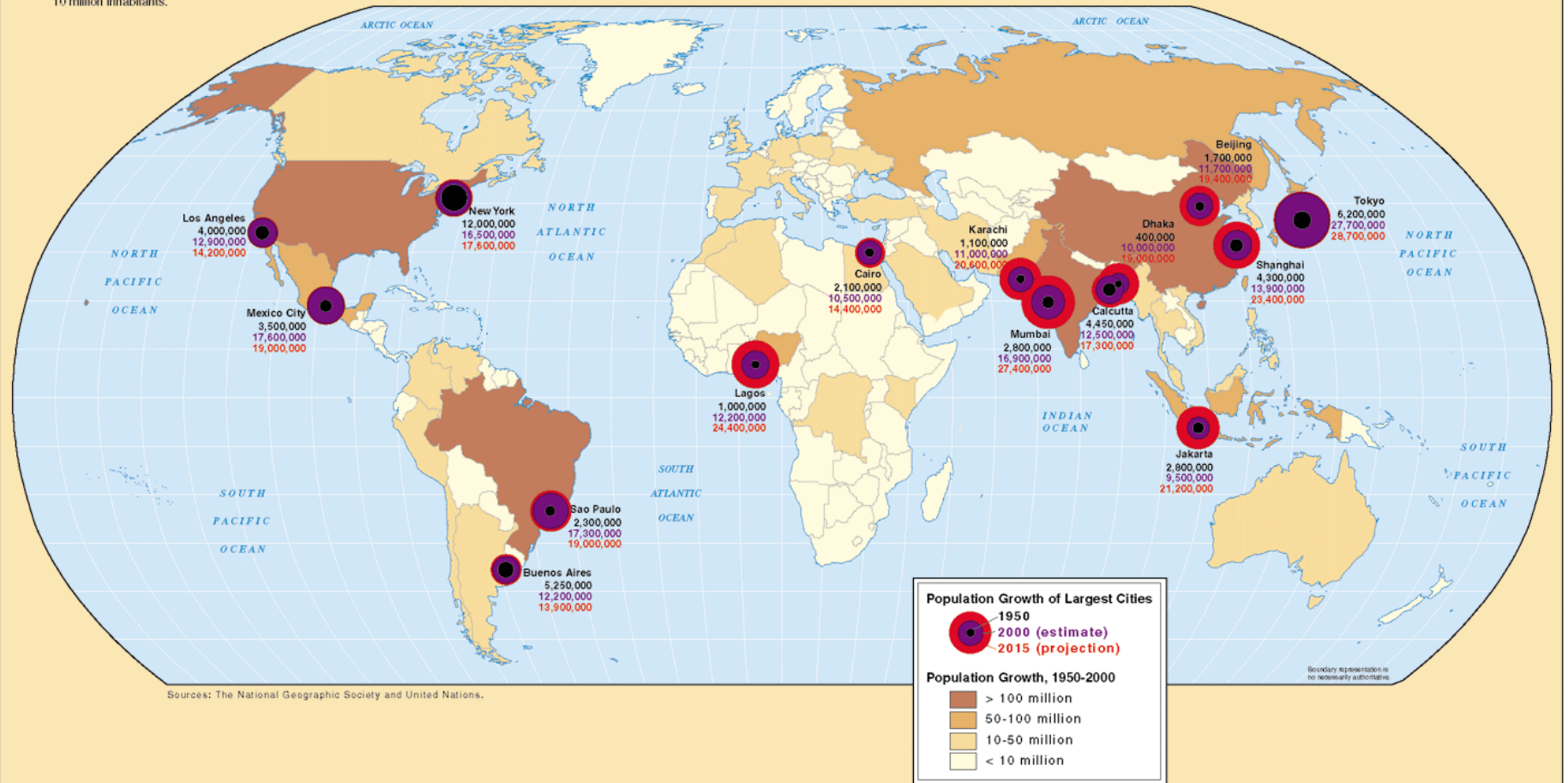


Big Cities at the End of the Century



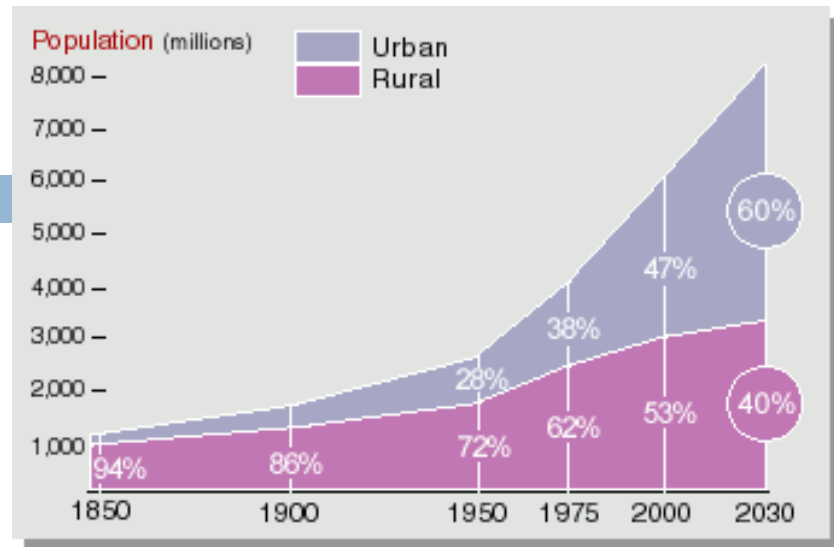
Growth in Megacities^a

^aCities containing more than 10 million inhabitants.



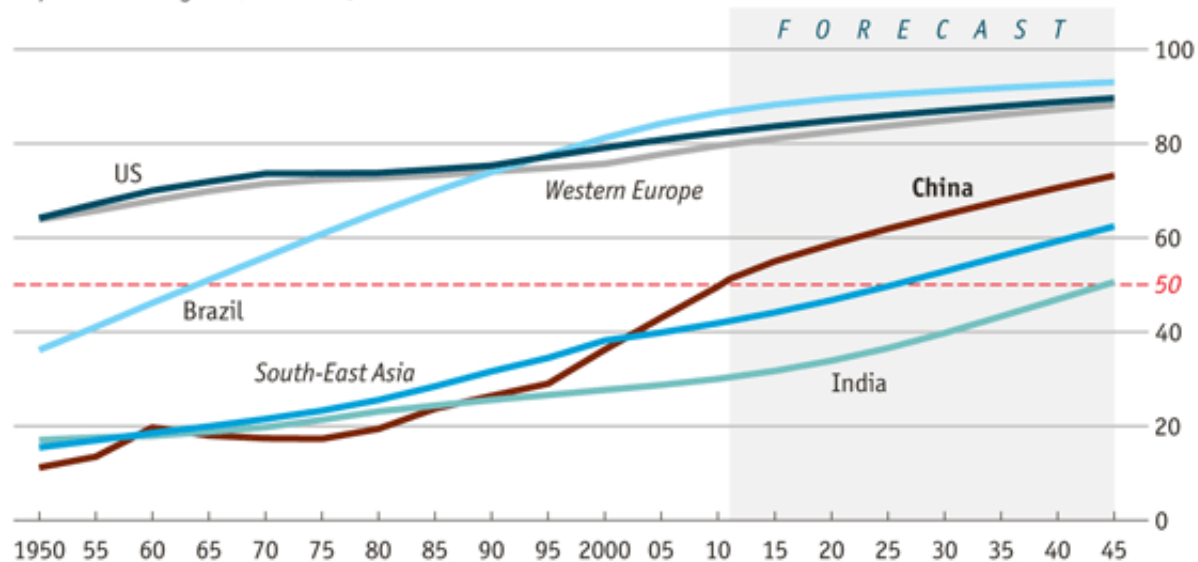
Forecast: Urbanization Trends

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Urbanisation

Population living in urban areas, % of total

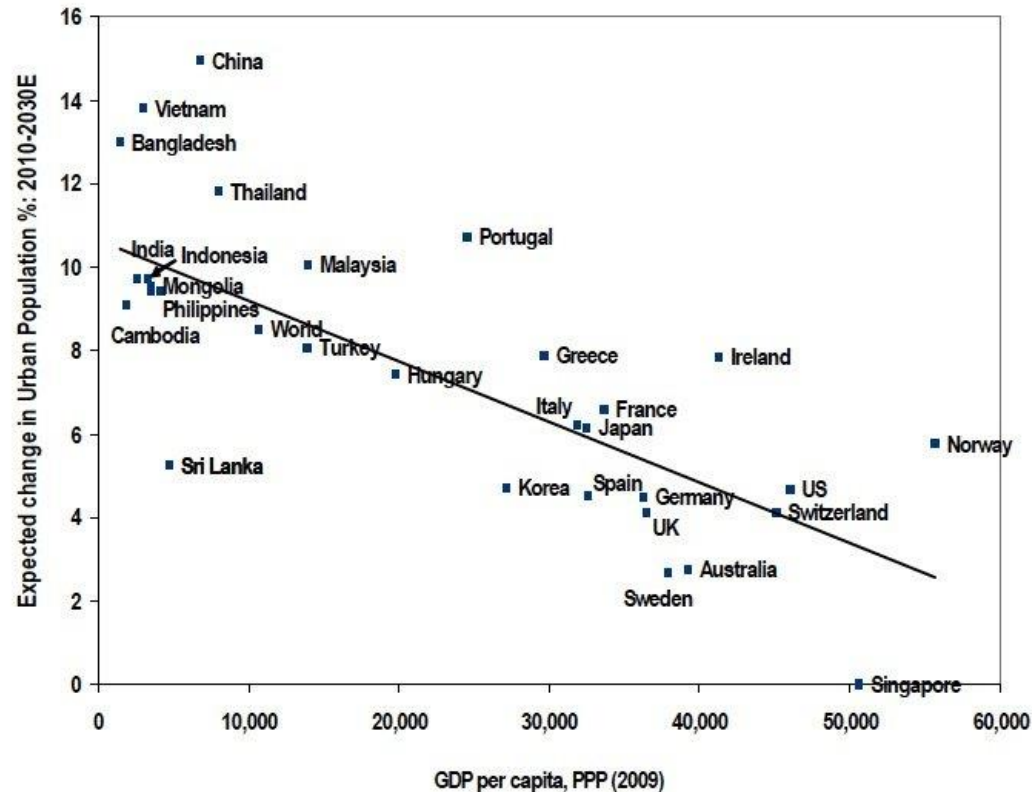


Sources: CEIC; UN Population Division; *The Economist*

With urbanization also comes economic prosperity ... or at least that has been the historical trend

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Chart 2: Per capita wealth and urbanization trends



Source: World Urbanization Prospects 2009 revision, World Bank

Urbanization boosts growth and equity market returns.... China, Vietnam and Bangladesh will lead the wave of urbanization ...

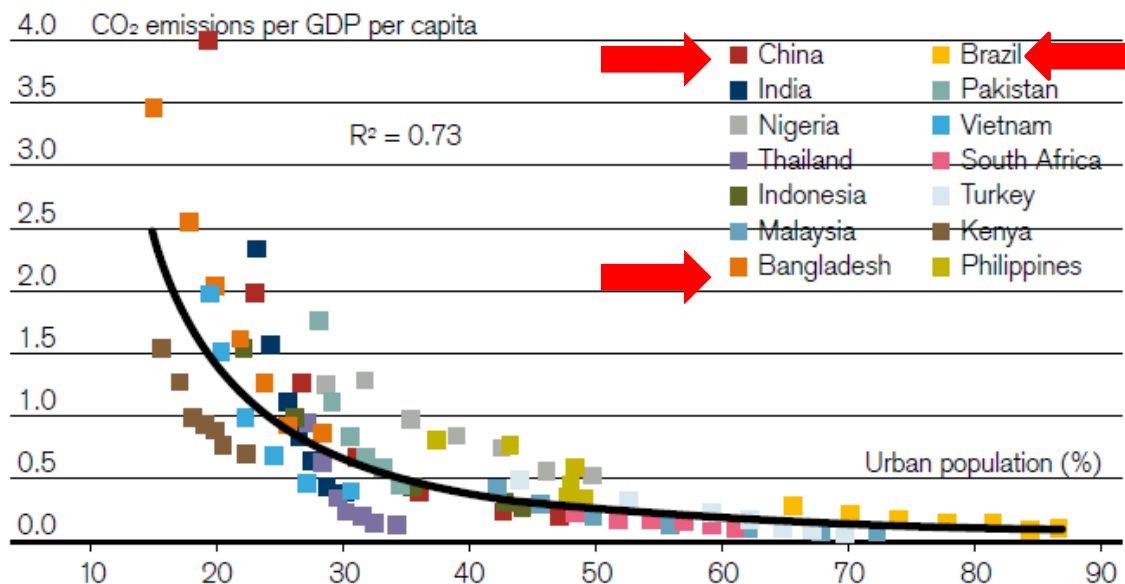
<http://www.businessinsider.com/asian-demographic-trends-2011-2?op=1#ixzz2vfhT2EOB>

Why is urbanization “environmentally friendly”?

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Total CO2 emissions versus urban population rate in emerging markets (1980–2010, 5-year intervals)

Source: World Bank Development Indicators, Population Division of Department of the Economic and Social Affairs of the United Nations Secretariat, Credit Suisse



CO₂ emissions per capita versus % urbanization ...

Two graphics from the recent [Credit Suisse report](#) on global urbanization trends shows how urbanization dramatically lowers carbon emissions from transportation. The above graphic shows trends from across the emerging world...

What characteristics make urbanization “environmentally friendly”?

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1. Urban form
 - ▣ Density; Land use mix; Housing mix
2. Transportation choices
3. Per capita consumption of {land, energy, consumer goods}
4. Social mix
5. Others?

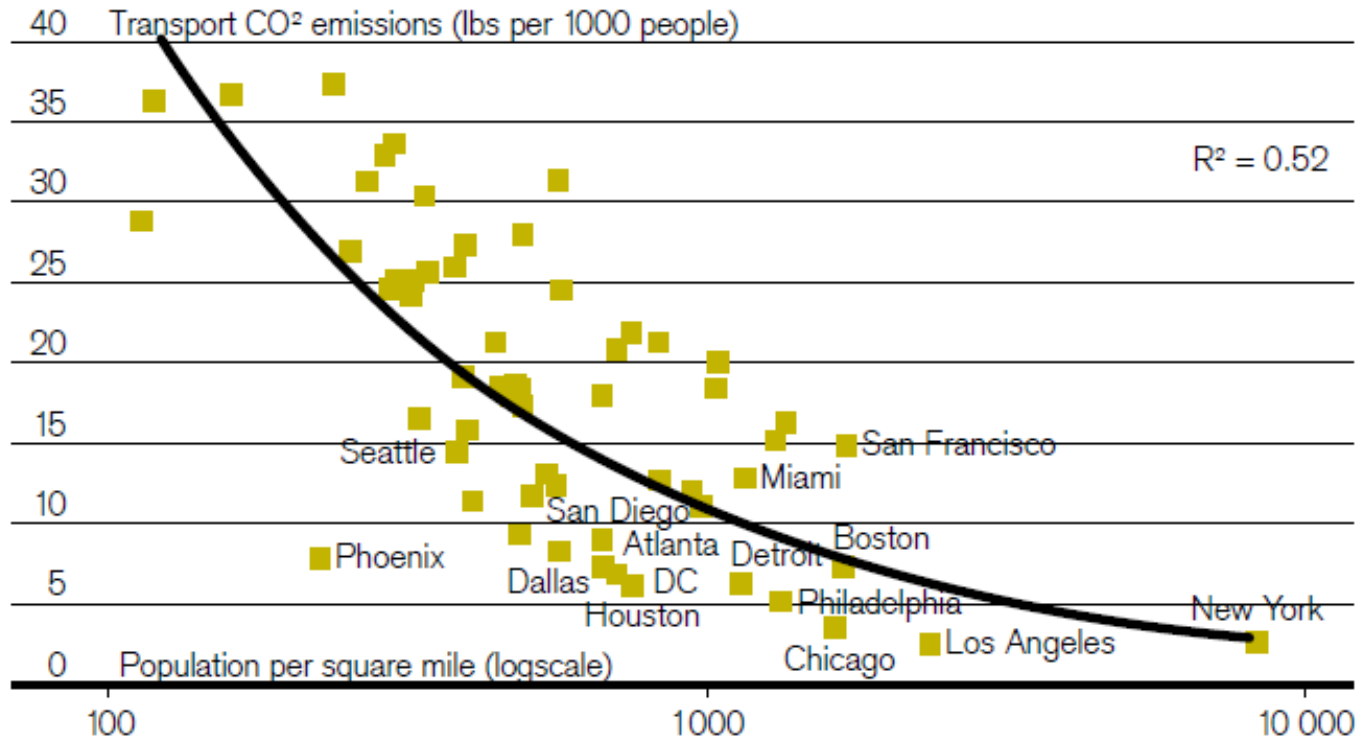


photo credits: TR, Nov 2011



Emissions from transportation (public and private) versus population density for US metropolitan statistical areas

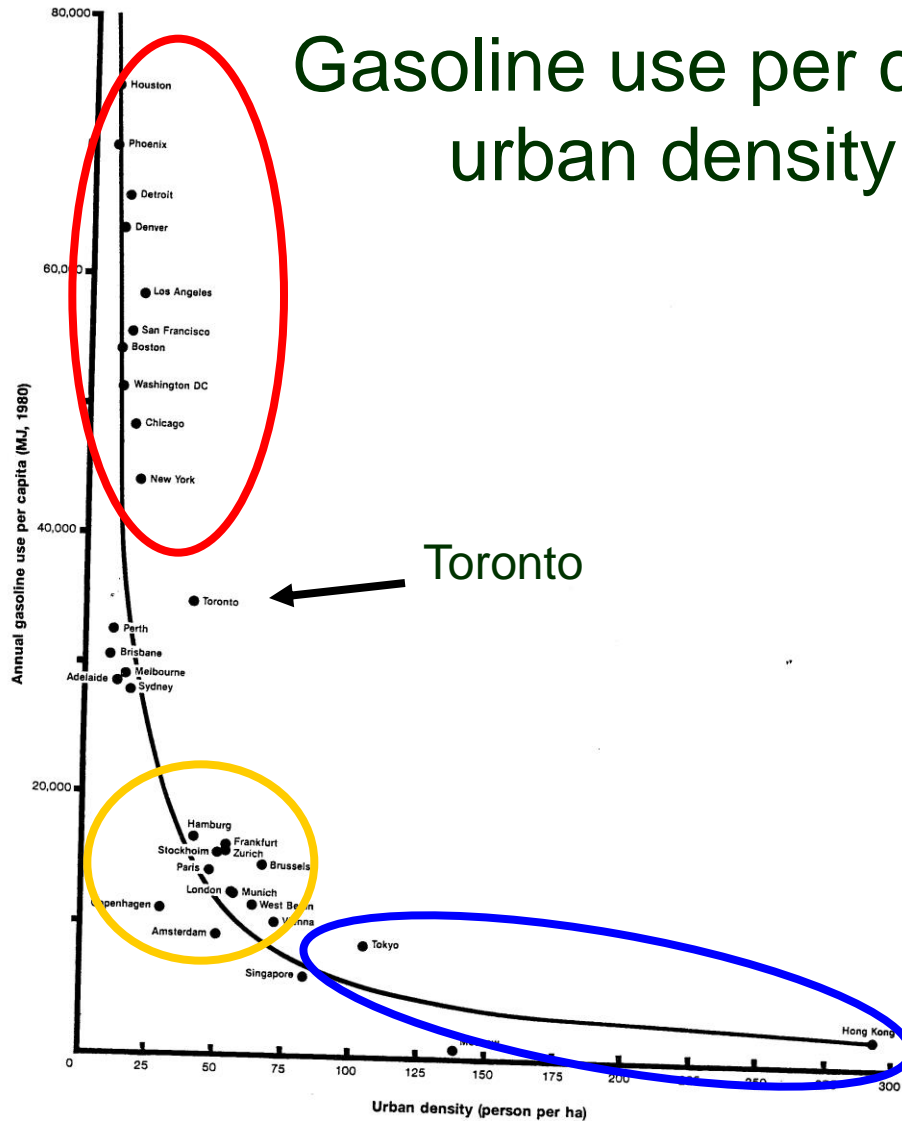
Source: US Census Bureau 2000 Census, Credit Suisse



... similar trend among US metropolitan areas (to emerging cities shown earlier).

- How do US (and North American) cities compare with Global Cities?

Gasoline use per capita versus urban density in 1980



- US (low density)
- European (medium density)
- Asian (high density)
- Canadian (**limited sample**)

Figure 3.1 Gasoline use per capita versus urban density (1980).

Source: Newman and Kenworthy (1989)

Gasoline use per capita versus urban density in 1990

$$(R^2 = 0.8594)$$

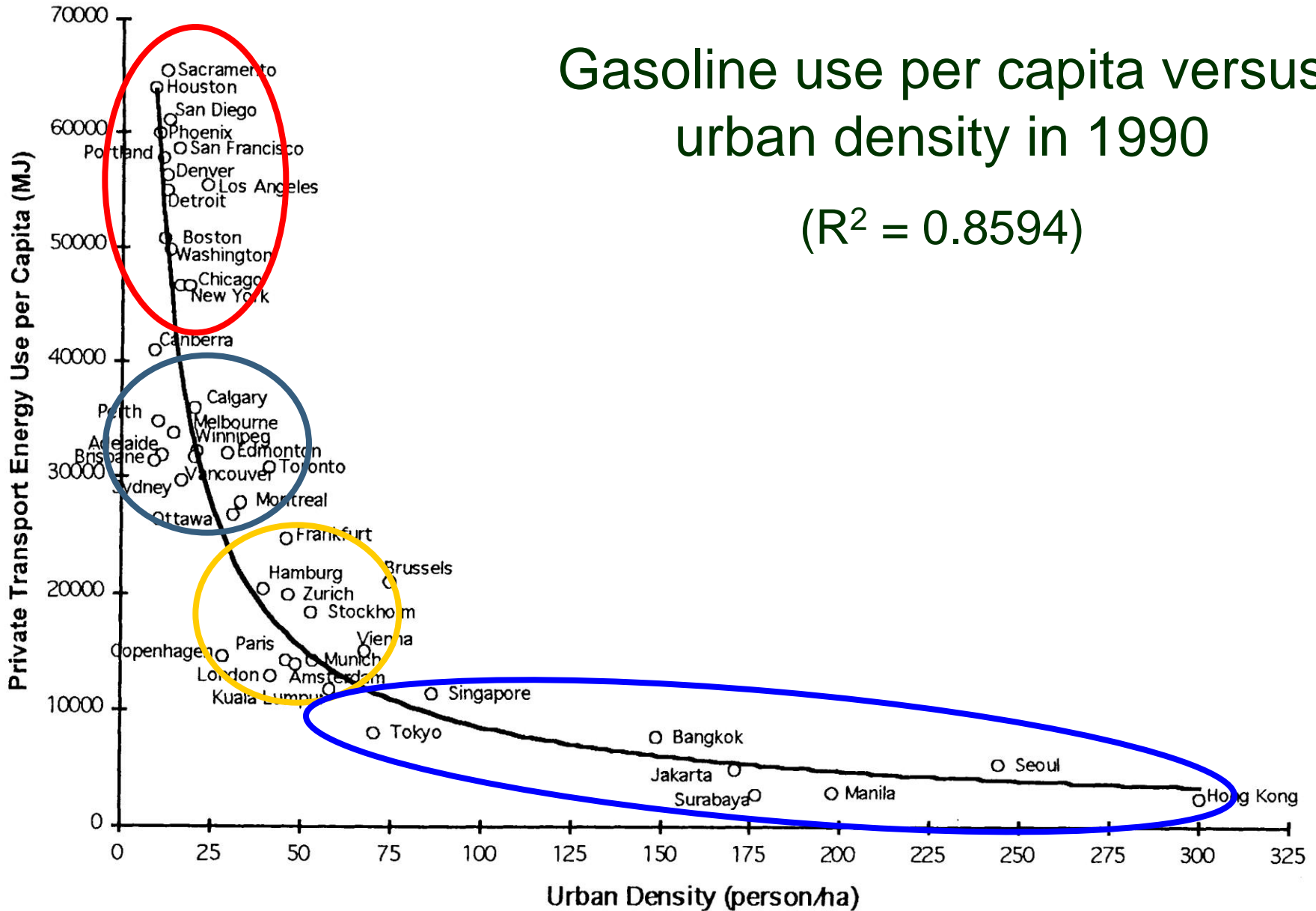


Figure 3.2. Energy use per capita in private passenger travel versus urban density in global cities, 1990.

Source: Newman and Kenworthy (1999)

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Urban Forms

Urban

Suburban

Exurban

Rural

S. Ontario's "Greater Golden Horseshoe"

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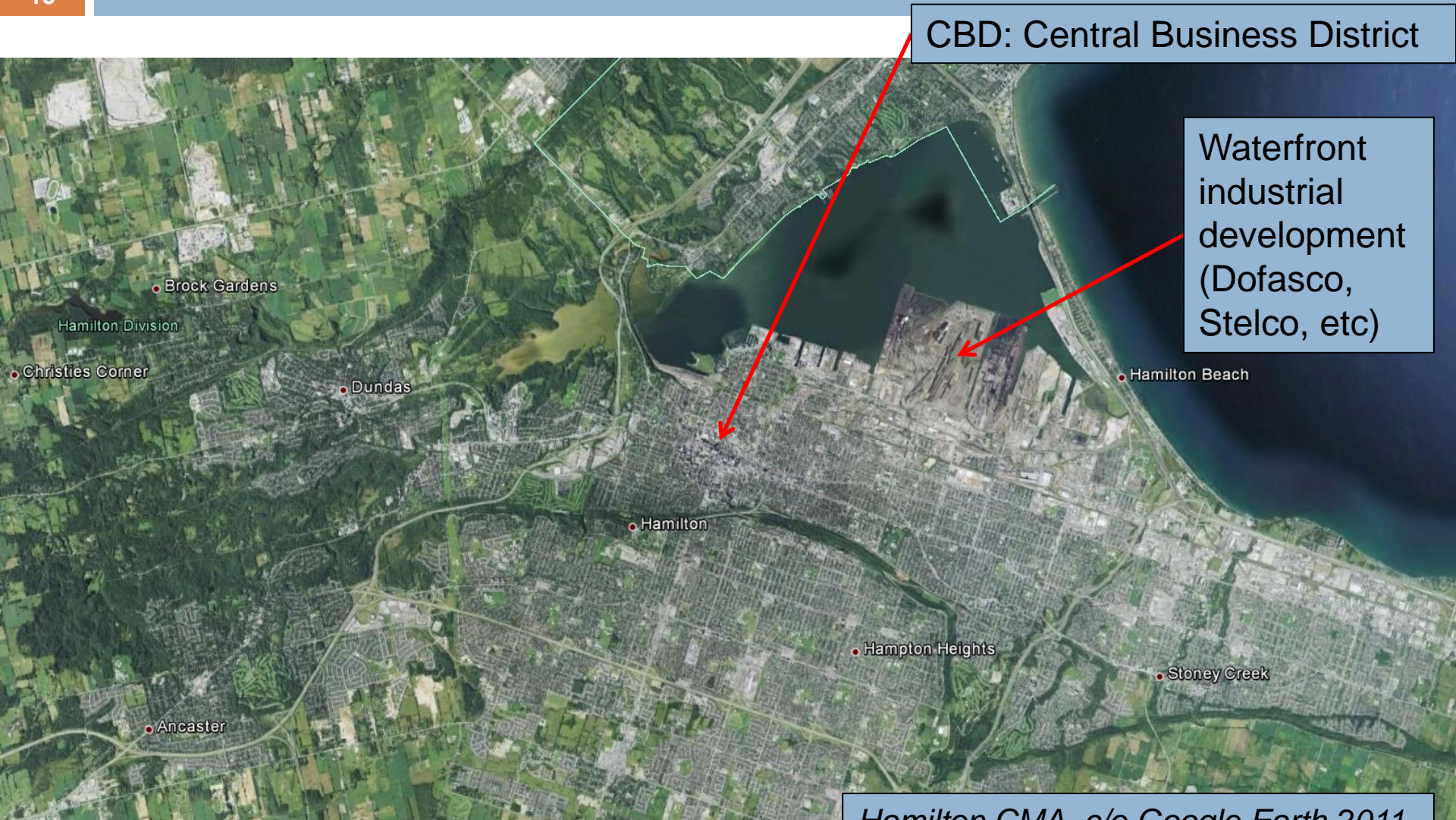
- Transect from 'urban core' to rural communities;
- 20th Century trend of 'urbanization'



Image c/o Google Earth 2011

Traditional urbanism (early 20th Century, pre-auto, ped-scaled urbanism)

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CBD: Central Business District

Waterfront industrial development (Dofasco, Stelco, etc)

Hamilton CMA, c/o Google Earth 2011



Horsecar along Simpson Street (Ft. William, ON)
– *circa early 20th Century*

Street Railway Network – Pt. Arthur (northward Thunder Bay, 1892-1914)

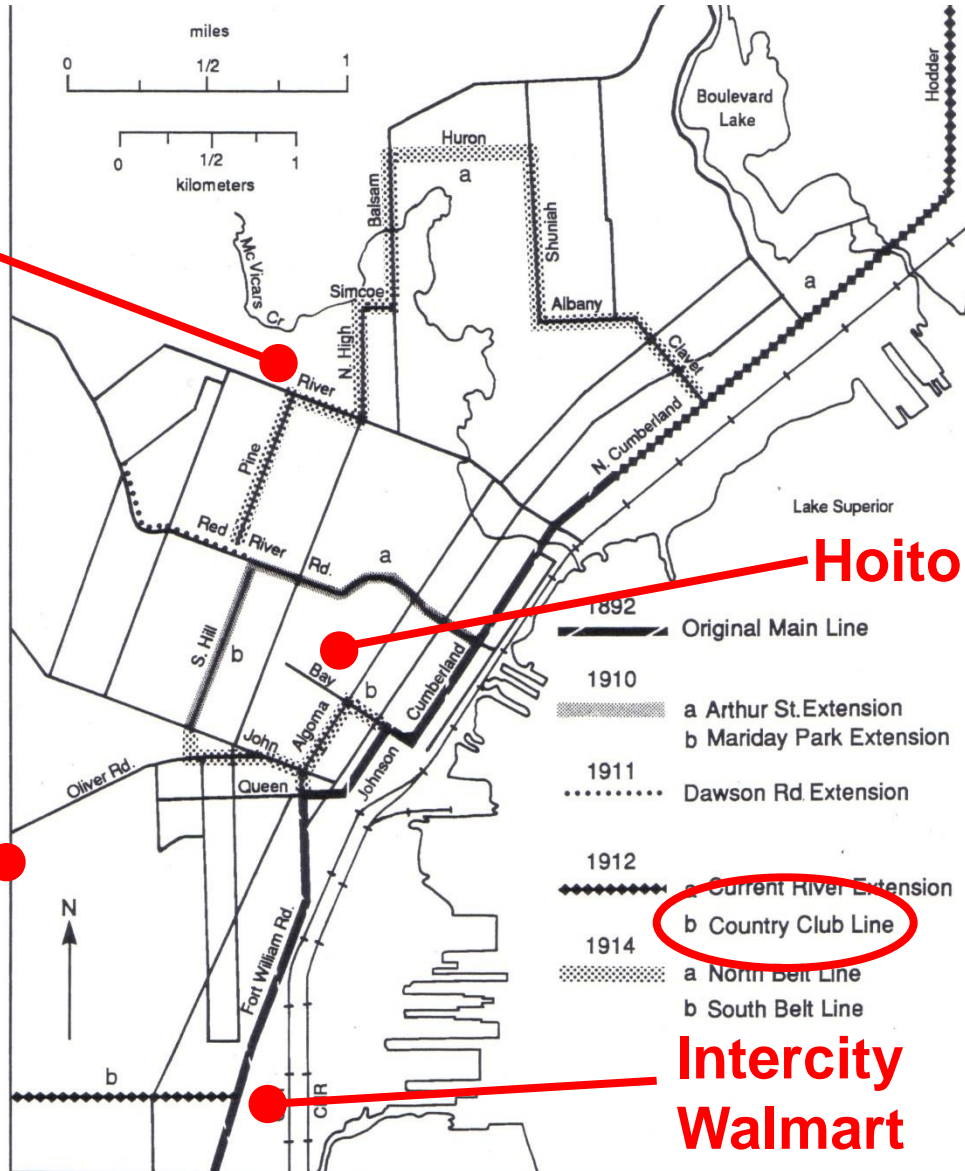
17

**Grandview
Metro**

LU

Hoito

**Intercity
Walmart**



Source: Lorch and Jordan (1995)



- traditional urbanism:**
 a concentrated urban form, typical of older patterns found in European cities.





□ Madrid and Granada





Traditional Urbanism: front porches (enclosed due to climate), garages added later (where space permitted)

Photo from Thunder Bay

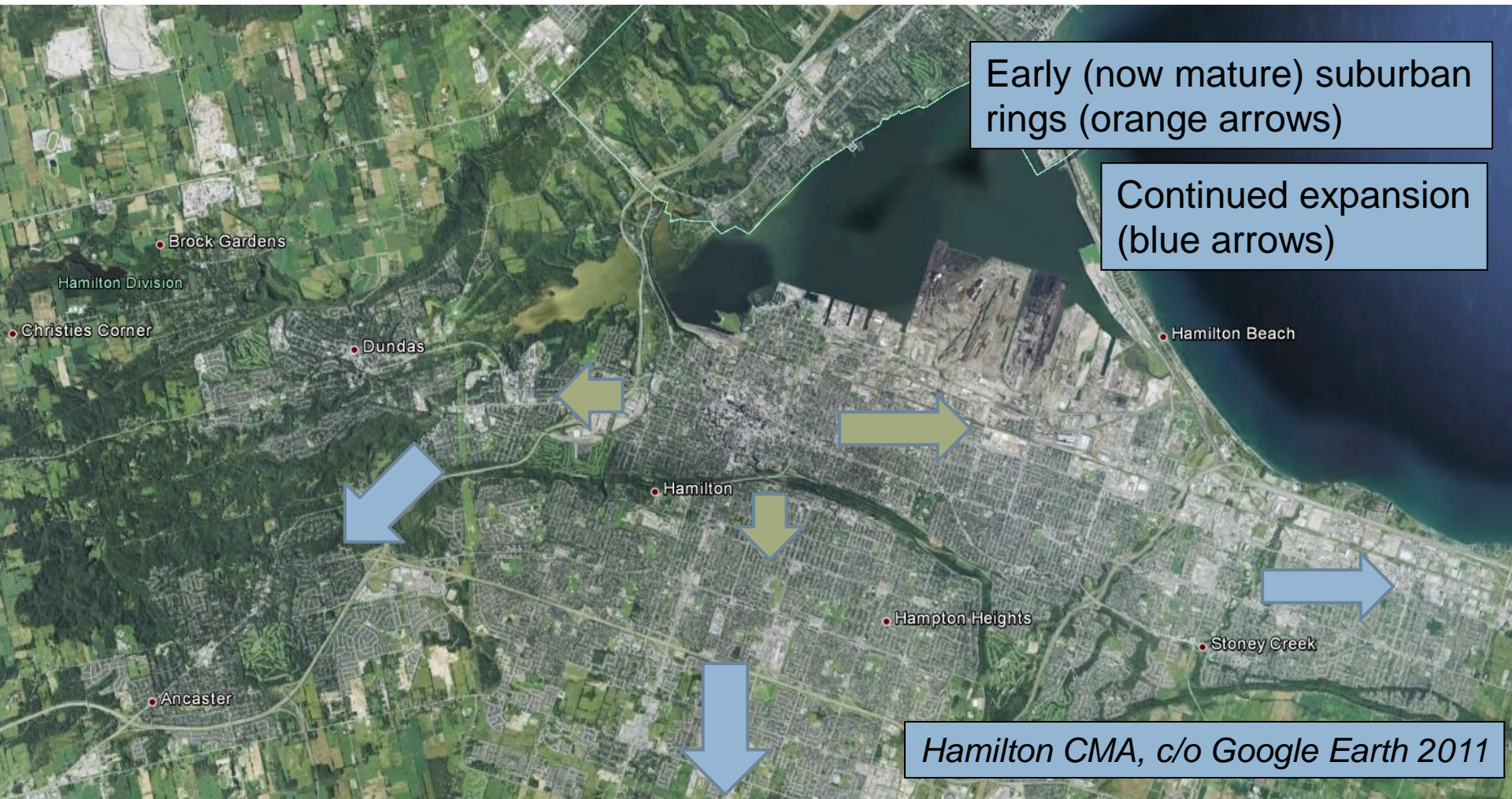


Traditional Urbanism: Modest-scaled apartment buildings (3-4 story walk-ups), attention to architectural details

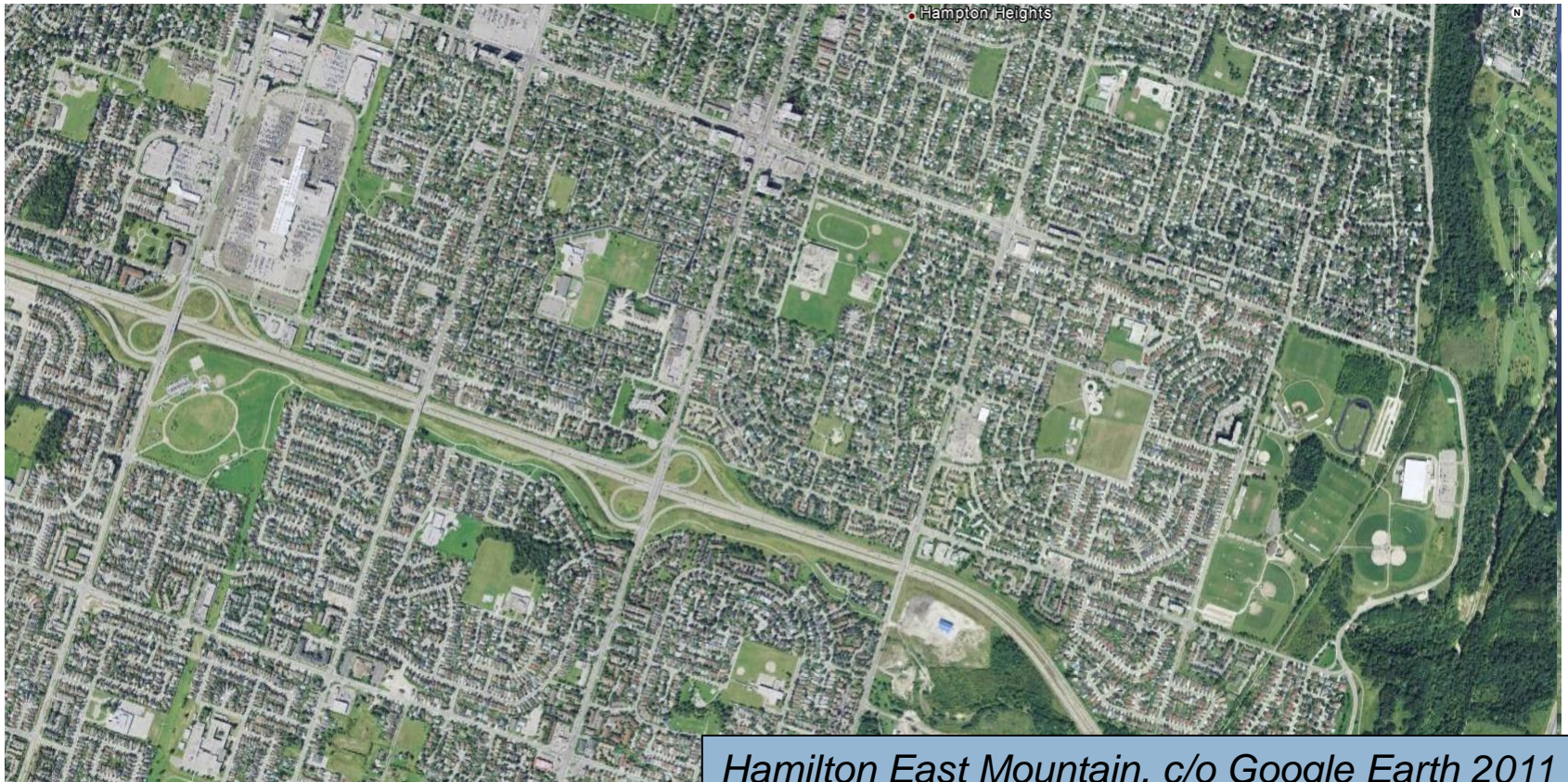
Conventional Suburban Development / Postwar Sprawl

22

(post-1940's; rise of the automobile; segregation of land uses; land consumption)



- **Auto-centric infrastructure** (freeways, parking lots, double garages)
- Low density housing forms (neighbourhood centre); higher density forms, transit routes and non-residential functions (neighbourhood periphery)



Hamilton East Mountain, c/o Google Earth 2011



- **Postwar sprawl:**
car-oriented, segregated land use,
suburban sprawl around many cities

(Photo: sprawl in Colorado)

- non-farmers/non-loggers/non-fishers living in rural settings;

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larger-lots – often estate-sized lots;

increased commuting distance – more distal bedroom communities

Exurban Development



Cadallic Circle near Thunder Bay (~ 10 km from LU), c/o Google Earth 2011



← *Near Winnipeg, photo credit: T.Randall*

Suburbanization of rural Ontario

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New subdivisions to small agriculture cross-roads, since 2005 (blue arrows)



Binbrook SE of Hamilton, c/o Google Earth 2011

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Housing Types

Single family

Multi-family

Single Family Housed (detached)

28



K



Duplex (semi-detached)

29



Multi-family housing (rowhouse/townhouse)

30



Multi-family housing (apartment/cond

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Sustainable Urban Development

- Definition of SUD, Sustainability ...
- Required attention to at least 4 factors to achieve it ... (**next class**)

Definition of Sustainable Development



“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p.8)

- Evolution / broadening of term during the 1990s to “sustainability”

Table 5.1 The Eco-Footprints and Biocapacities of Selected Nations

Country	Per Capita Eco-Footprint (global ha)	Per Capita Domestic Biocapacity (gha)	Overshoot Factor
World	2.7	2.1	1.3
United States	9.4	4.9	1.9
Australia	7.8	15.4	0.5
Canada	7.1	20.0	0.4
Greece	5.9	1.7	3.5
United Kingdom	5.3	1.6	3.3
France	4.9	3.0	1.6
Japan	4.9	0.6	8.2
Germany	4.2	1.9	2.2
Netherlands	4.0	1.1	3.6
Hungary	3.5	2.8	1.3
Mexico	3.4	3.3	1.0
Malaysia	2.4	2.7	0.9
Brazil	2.4	7.3	
China	2.1	0.9	
Thailand	2.1	0.8	
Peru	1.6	4.0	
Ethiopia	1.4	1.0	1.4
Nigeria	1.3	1.0	1.3
Indonesia	0.9	1.4	0.6
India	0.9	0.4	2.3
Bangladesh	0.6	0.3	2.0
Malawi	0.5	0.5	1.0

Source: WWF (2008).



Wackernagel and Rees (1996)

Ecological Footprint:
a measure of sustainability

Source: Rees (2010)

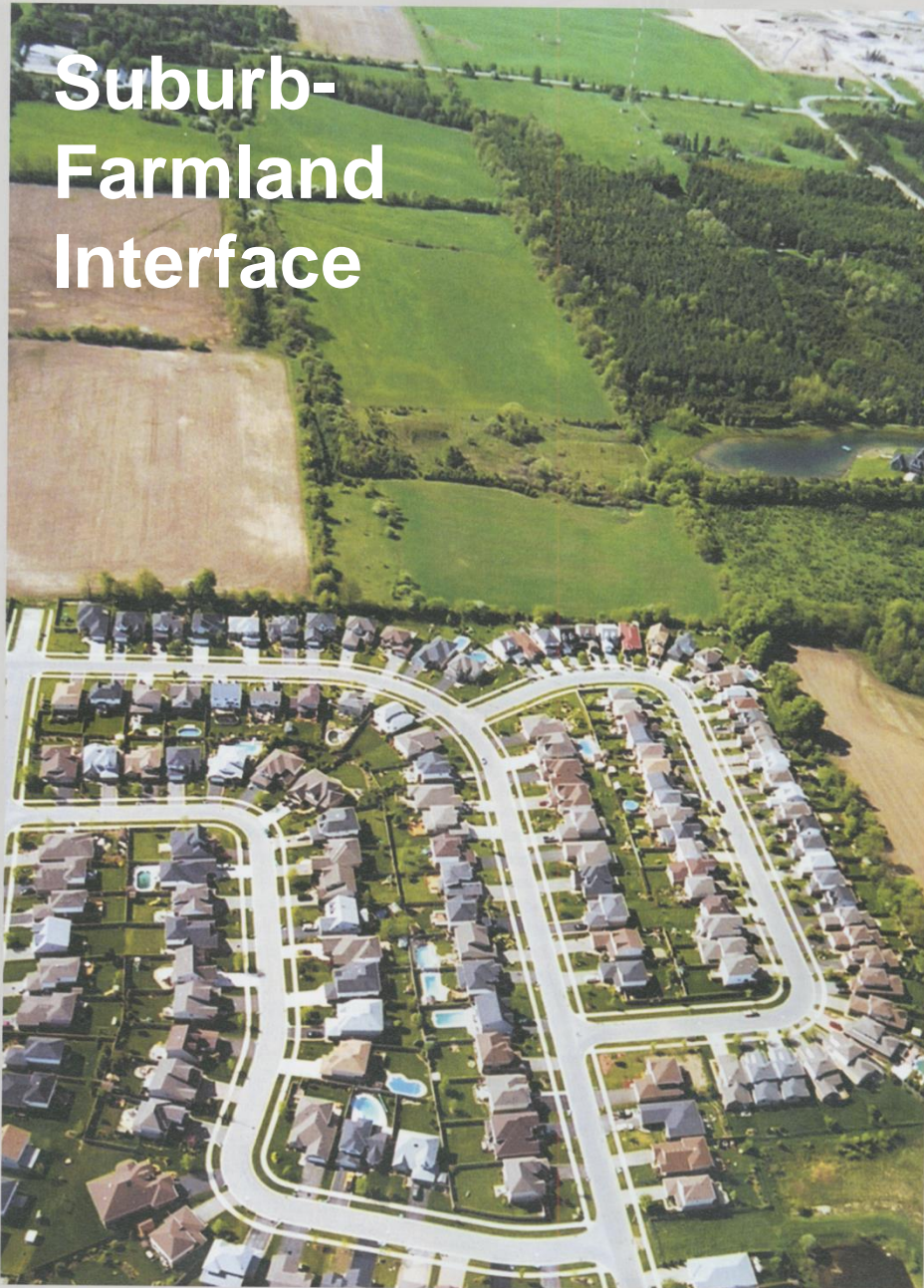
Sustainability

- Like an ecosystem, the planet has a finite **carrying capacity**;
- As stewards of the planet, we are responsible to **strike a balance** between our activities and environmental preservation
- Sustainability is viewed as this balance between the **Environment**, the **Economy** and **Societal Well-Being**
- Reduced consumption of **energy**, **raw materials** and **land**;
- Achieved in the 'built environment' via:
 - ▣ Use of Renewable Forms of Energy
 - ▣ Use of Recycled (rather than Virgin) Material
 - ▣ Re-Use of Urban Land (rather than Continue Expansion onto Greenfields)



Image credit: Government of Manitoba

Suburb- Farmland Interface



University of Guelph

1954



1963



1976



2008

South Richmond, BC

Photo credits: *Alternatives Journal* Vol. 34 Issue 3, 2008

References

- Dearden, P and Mitchell, B. 2012. Environmental Change and Challenge, Fourth Edition, Don Mills, Ontario: Oxford University Press {Chapter 13: 'Urban Environmental Management'}
- https://infocus.credit-suisse.com/data/_product_documents/_shop/344677/opportunities_in_an_urbanizing_world.pdf . Two graphs used sourced to Credit Suisse (March 2014), although this link did not work (noted by TR).
- Newman P. and Kenworthy J. 1989. Gasoline consumption in cities: a comparison of US cities with a global survey, *Journal of American Planning Association*. 55: 24-37

One-Mile Walk in a Compact Neighborhood



A one-mile walk in [Seattle's Phinney Ridge](#) takes you through a grid-like street network with a mix of residences and businesses.

One-Mile Walk in a Sprawling Suburb



A one-mile walk in [Bellevue, WA](#) with cul-de-sacs and winding streets has few shops and services within walking distance.

Maps courtesy of [Lawrence Frank & Co.](#) and the [Sightline Institute](#).

Part 2: Sustainable Development II

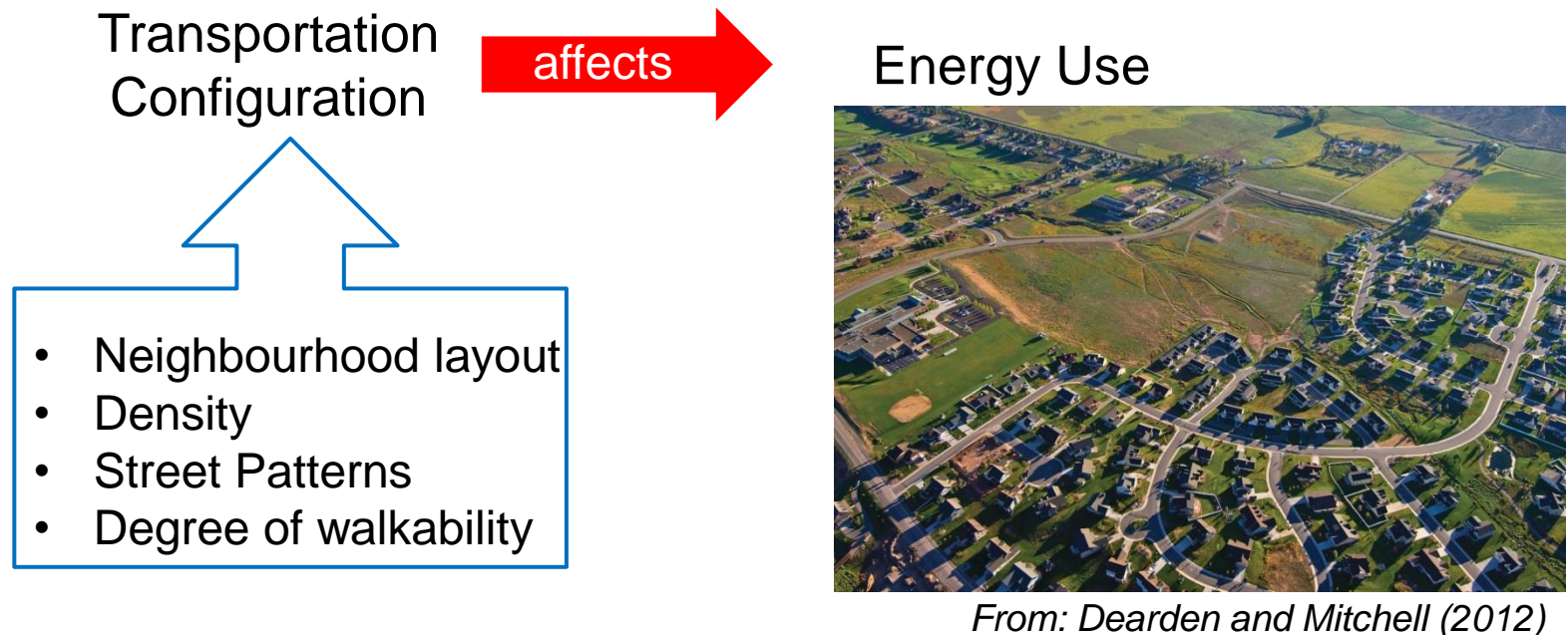
- 4 factors needing attention to meet the challenges of **sustainable urban development**:
 1. Urban Form;
 2. Transportation
 3. Energy Use
 4. Waste Management

Urban Form (1)

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- **Urban form**

- the type and distribution of infrastructure in cities;
- a key factor influencing environmental quality
- Examples: urban vs suburban vs exurban vs ‘unserved’

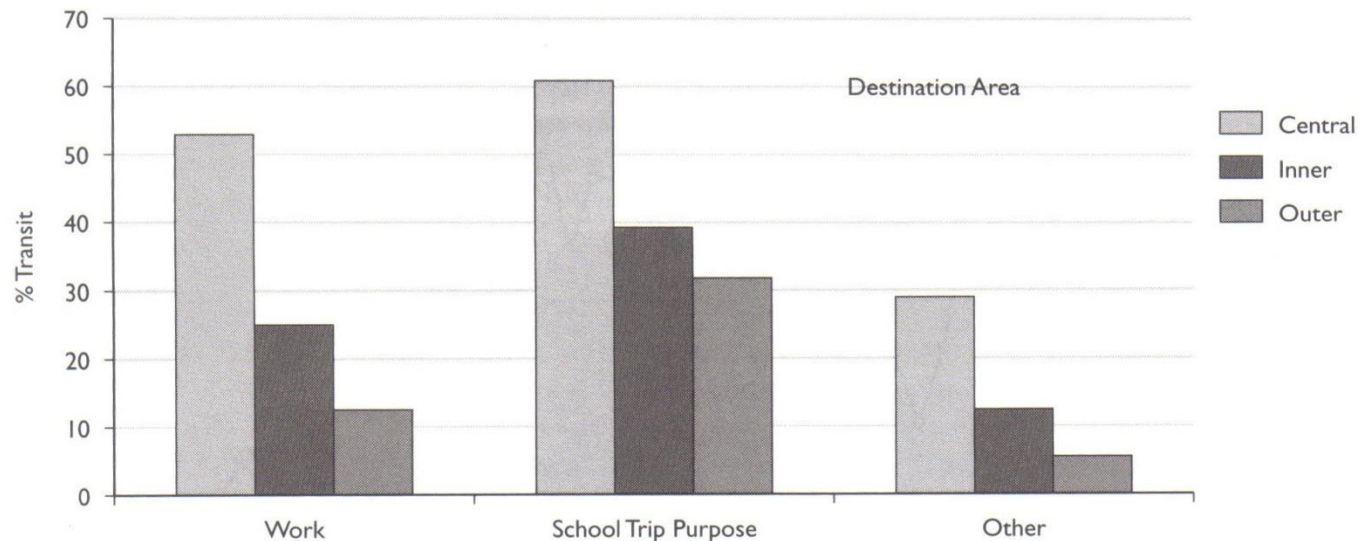


Urban Form (2)

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- Influence on choice of travel mode in central Toronto versus “inner” and “outer” ring of suburbs
- Greater transit choice made in central city for trips to work and school;

Figure 8.5 Transit Mode Splits by Destination and Trip Purpose, Toronto, 1996



Source: 1996 Transportation Tomorrow Survey, Toronto: University of Toronto Joint Program in Transportation.

From: Miller, E. 2000

Urban Form (3)

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Building Design

affects

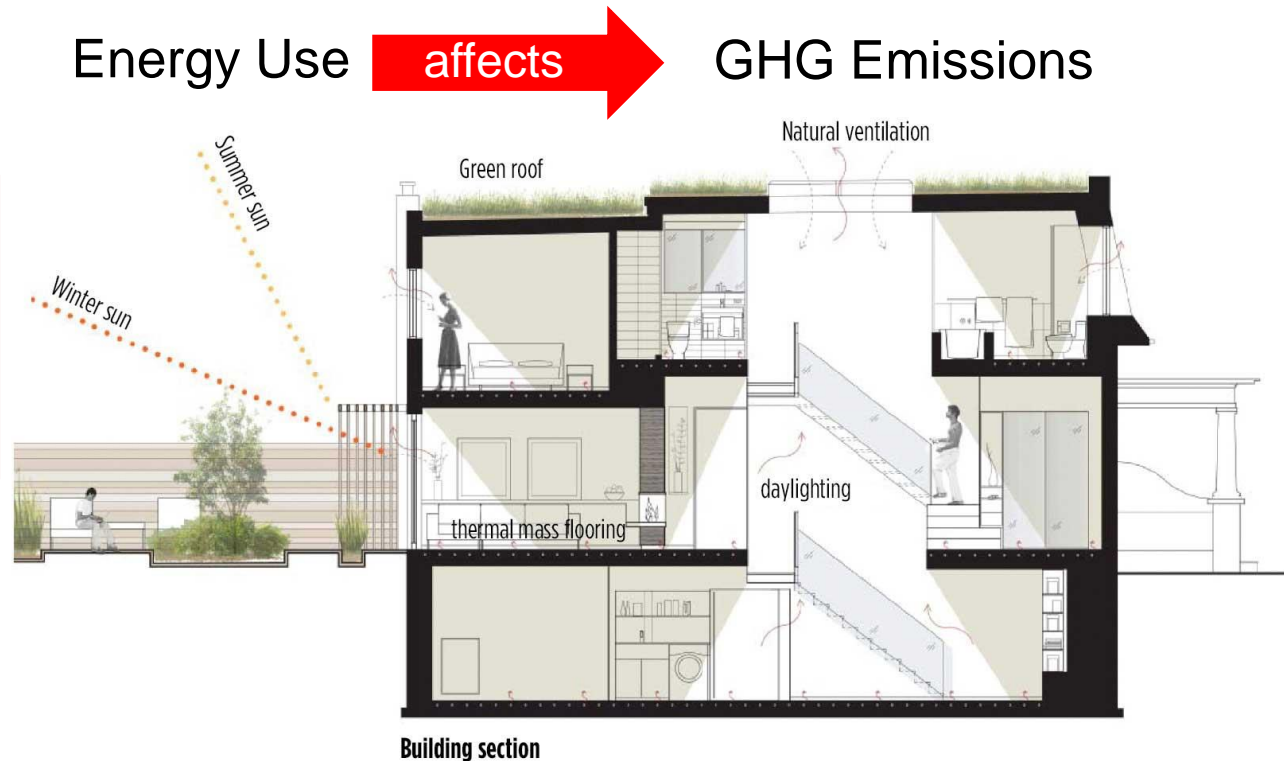
Energy Efficiency

Energy Use

affects

GHG Emissions

- Building materials
- Insulation
- Size
- Structure orientation (solar potential?)



<http://www.sabmagazine.com/blog/2013/06/25/eco-house-3-through-house-2013-canada-green-building-award-residential-winning-project/>



Eco-extraordinaire Simon Dale went into the woods one day and built a **sustainable, eco-friendly, and above all functional hobbit house** for him and his family to live in whilst they worked on an ecological woodland management project. (in Wales)

From: <http://www.nerdlikeyou.com/man-builds-fully-functional-hobbit-house-in-wales/olympus-digital-camera-5/>

Toronto “Healthy House” Key Features

44

1. Off-grid – completely self-sufficient with respect to: water, energy, wastewater;
2. All concrete was 78% recycled natural materials;
3. 1700 sq. foot semi-detached home;
4. Built in 1997
5. Infill location, on a laneway in urban Toronto



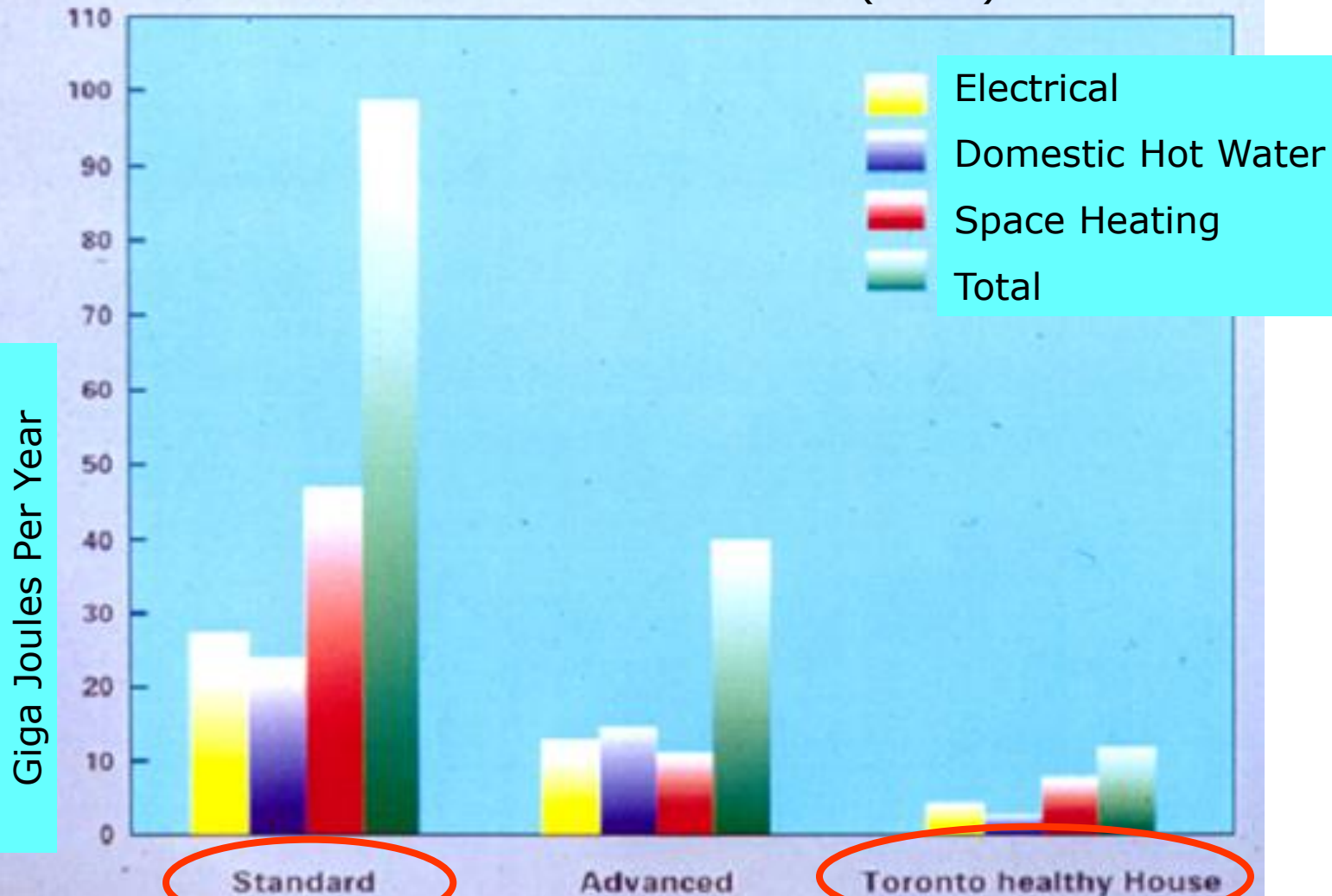
Photo credit:

www.fims.uwo.ca/newmedia/newmedia2004/energy

Annual Energy Consumption

Annual energy consumption⁴⁵
for three design approaches

Source: Breathe Architects
(2007)



Giga Joules Per Year

Benefits of the Toronto Healthy House

46

- Annual Thermal Energy Cost:
 - \$80 versus \$800 (1996 dollars)
- Annual Water Use:
 - 120 L per day versus 1050 L per day (family of 3)
- Total Operating Cost:
 - Under \$300 annually
 - TR's House (Thunder Bay)
 - Heat via natural gas (\$1500)
 - City Water (\$500)
 - Electricity (\$1000)

At least \$3000 annually



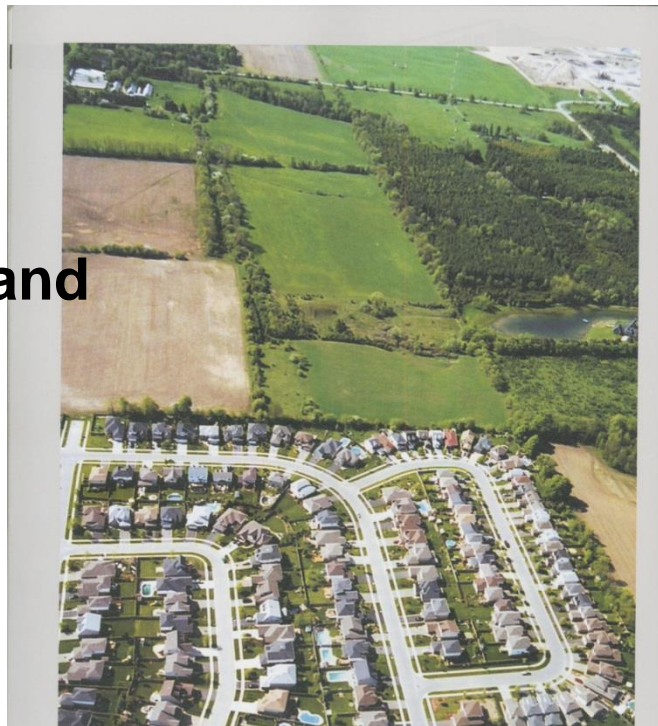
www.fims.uwo.ca/newmedia/newmedia2004/energy

Urban Form (4)

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- **Urban sprawl** contributes to loss, disruption, or degradation of adjacent agricultural land, environmentally sensitive areas, natural habitats, and water and air quality

Suburb-Farmland Interface



South Richmond, BC

Photo credits: *Alternatives Journal* Vol. 34 Issue 3, 2008

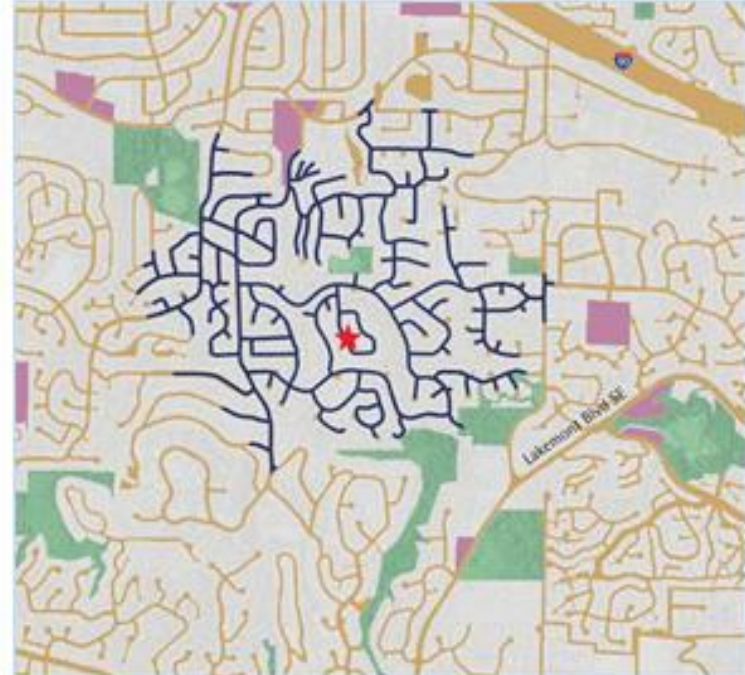
- ▣ A compact urban form is most environmentally desirable

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Urban Form (5)

- The External Advisory Committee on Cities and Communities reported in 2006 that:
 - ▣ The average Canadian home is farther from a city centre than a decade ago
 - ▣ Commuting times and traffic congestion have increased
 - ▣ The proportion of low-rise, low density homes is increasing
 - ▣ House sizes have increased but people per house decreased
 - ▣ Sprawl causes higher infrastructure and service costs and less effective public transit, displaces habitat and prime agricultural land, and degrades water quality

From this same report...

“the principal land use challenge” for the immediate and foreseeable future is to reduce our sprawl...”

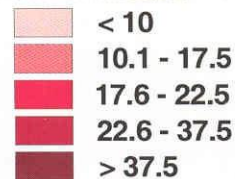
Transportation (1)

50

- Urban areas with **high population density in their cores** lead to more efficient and effective land use;
- They are also much more likely to be able to provide **effective** (and economically viable) **public transit**



City Density
(du/ha)



Level of Transit Service (Pushkarev & Zupan, 1982)
[based on Net Residential Density]

No Viable Transit Service
Minimal Bus Service
Intermediate Bus Service
Intermediate Bus or Light Rail Service
Frequent Bus or Light Rail Service

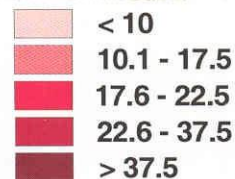
Transportation (1)

51

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[based on Net Residential Density]

No Viable Transit Service
Minimal Bus Service
Intermediate Bus Service
Intermediate Bus or Light Rail Service
Frequent Bus or Light Rail Service



Densities to support
economically viable transit
service (based on Puskarev
and Zupan, 1982)

Transportation (2)

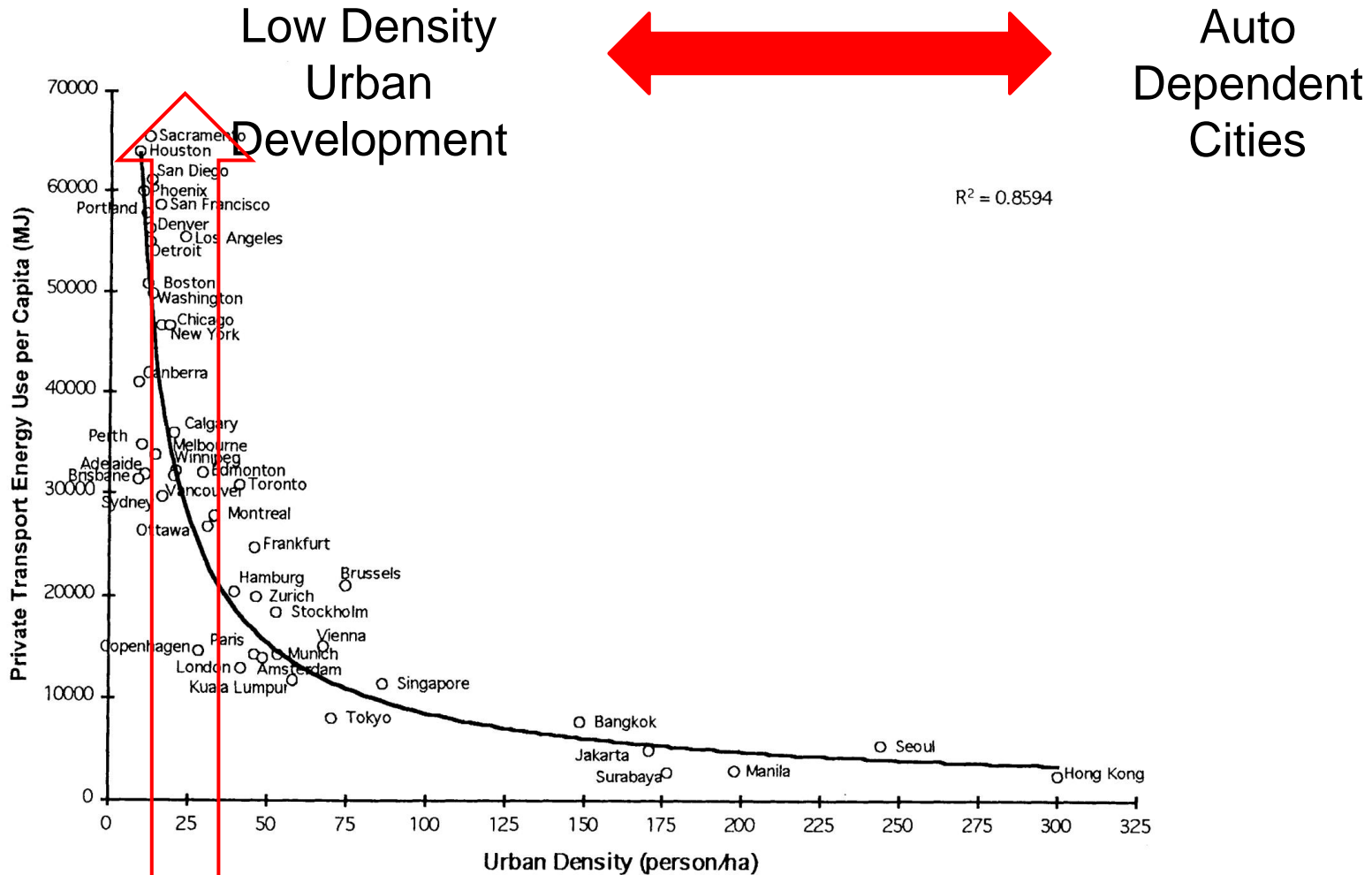


Figure 3.2. Energy use per capita in private passenger travel ve 1990.

Source: Newman and Kenworthy (1999)

Gasoline use per capita versus urban density in 1990

($R^2 = 0.8594$)

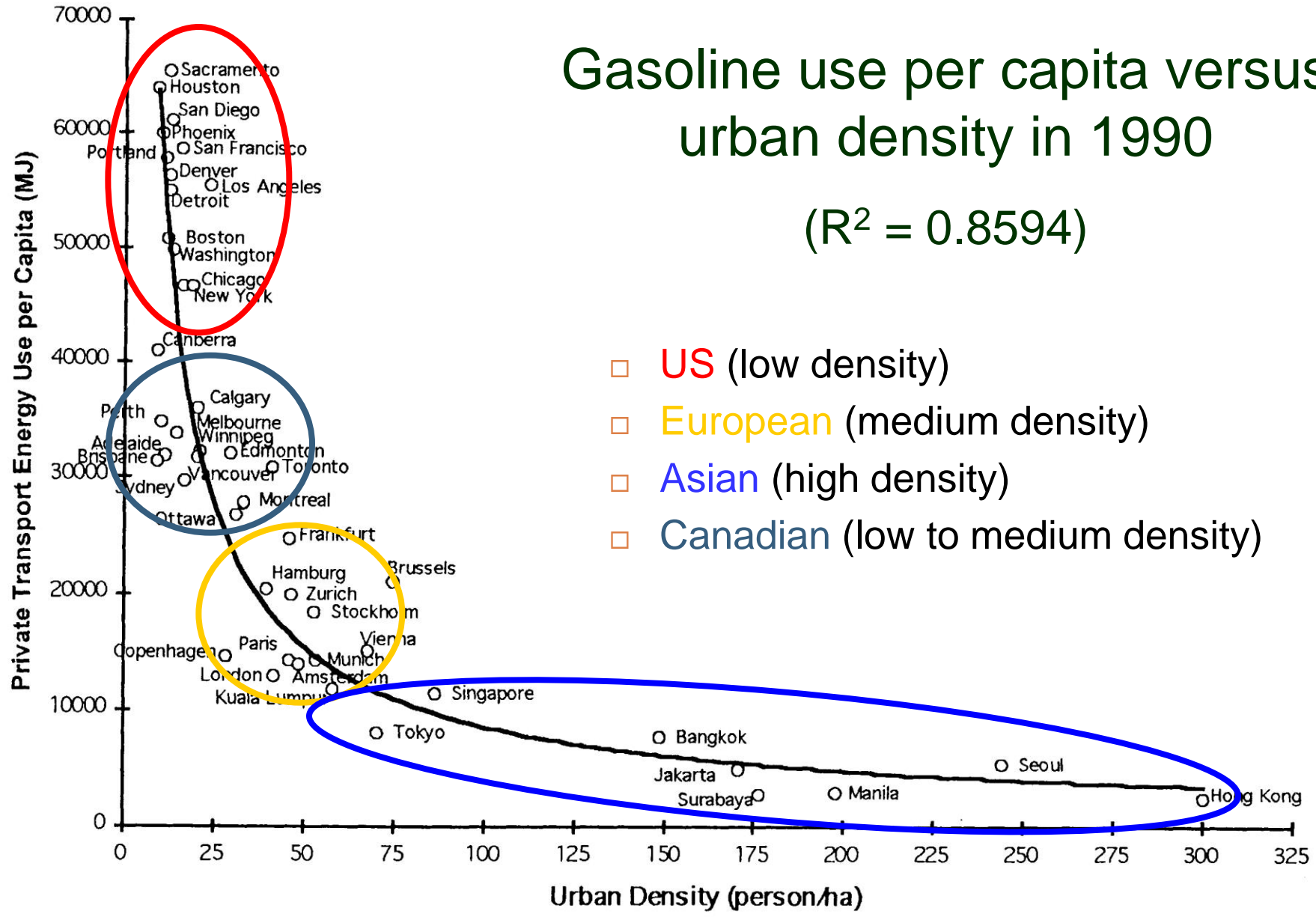


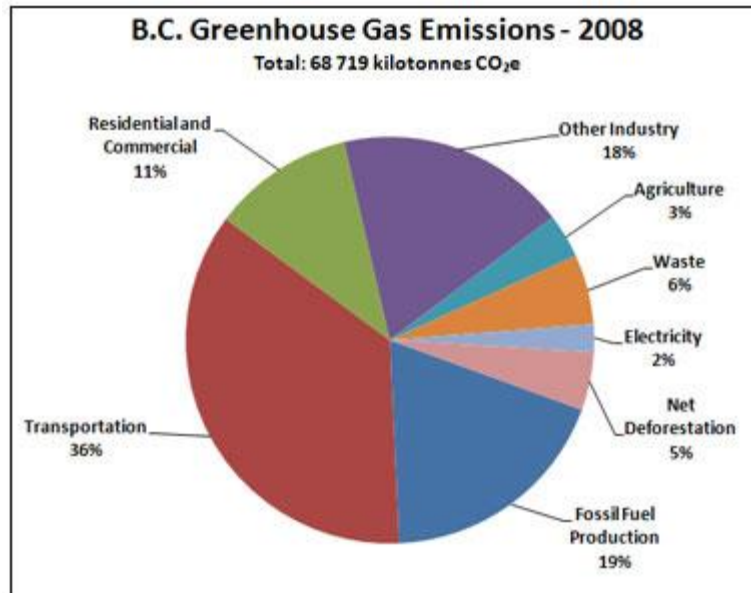
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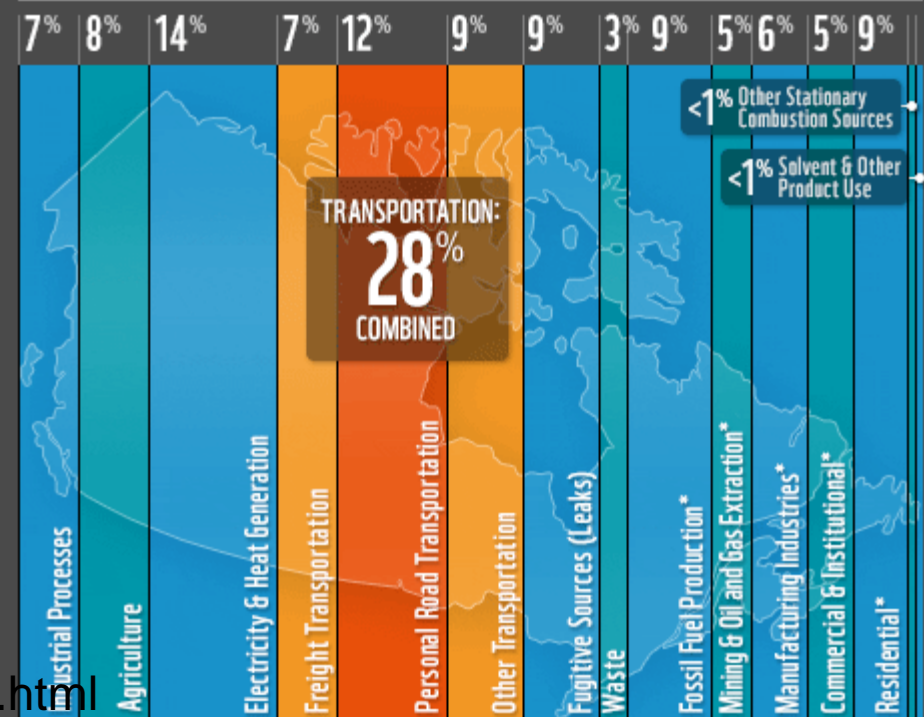
Transportation (2)

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- Transportation is a major contributor to GHG emissions because most vehicles are powered by fossil fuels
- Energy used for heating, cooling and lighting buildings are often from cleaner sources such as hydroelectricity



Breakdown of GHG emissions in Canada



<http://www.livesmartbc.ca/learn/emissions.html>

Energy Use (1)

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- Buildings in Canada (residential, commercial, industrial) account for >60% of Greenhouse Gas Emissions;
- **Energy use in residential buildings** a function of:
 - Construction materials
 - Shape of and orientation of the building
 - Internal temperature settings (i.e., operation)
 - Internal use
 - Climatic conditions
 - !!! Housing type and urban form (sfh vs duplex vs apartment/condo)
- Many opportunities to improve energy efficiency in both existing and new construction.
 - E.g., new LEED-certified buildings at the Lakehead Orillia Campus.

Waste Management (1)

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- Waste generation a function of:
 - ▣ Demographic characteristics (household size; age structure; annual income)
 - ▣ Type of dwelling (e.g., single family home vs apartment)
 - ▣ Geographic location (e.g., close to market for 'recyclables') (e.g., recycled newsprint requirement for California newspapers ... effect on Mackenzie papers mills in northern BC)
 - ▣ Time of year

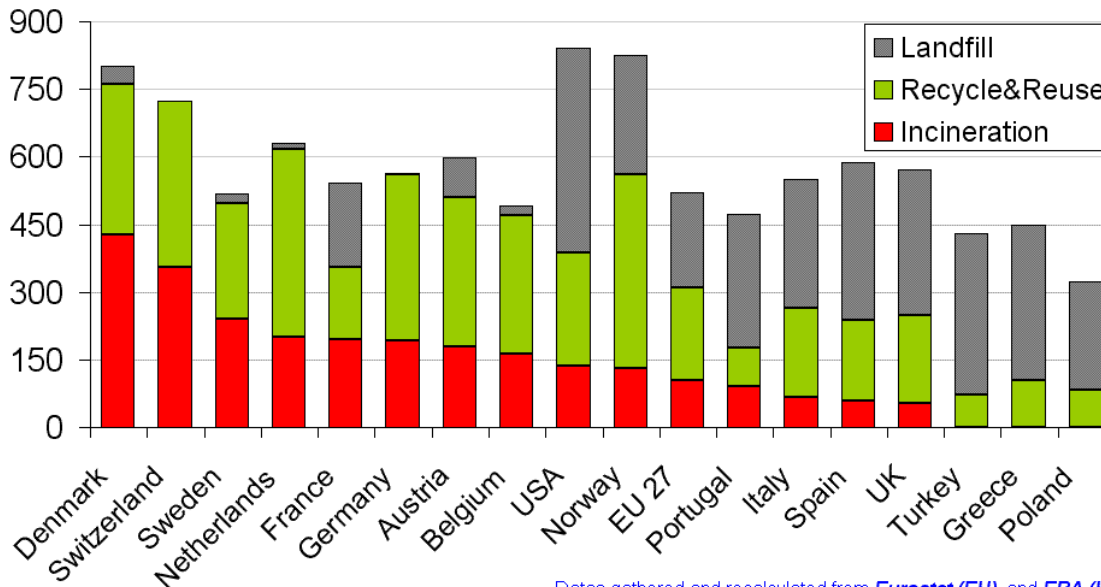


Waste Management (2)

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- Integrated approaches to Municipal Waste Management:
 - → divert from landfill, via
 - Source reduction
 - Reuse and Recycling Programs
 - Thermal treatment (i.e. incineration with energy recovery)

Waste Treatment (kg) per Capita
in Selected Countries (2007)



Datas gathered and recalculated from [Eurostat \(EU\)](#) and [EPA \(USA\)](#)



SWARU incinerator
(Hamilton), demolished in
2002.

Waste Management (3)

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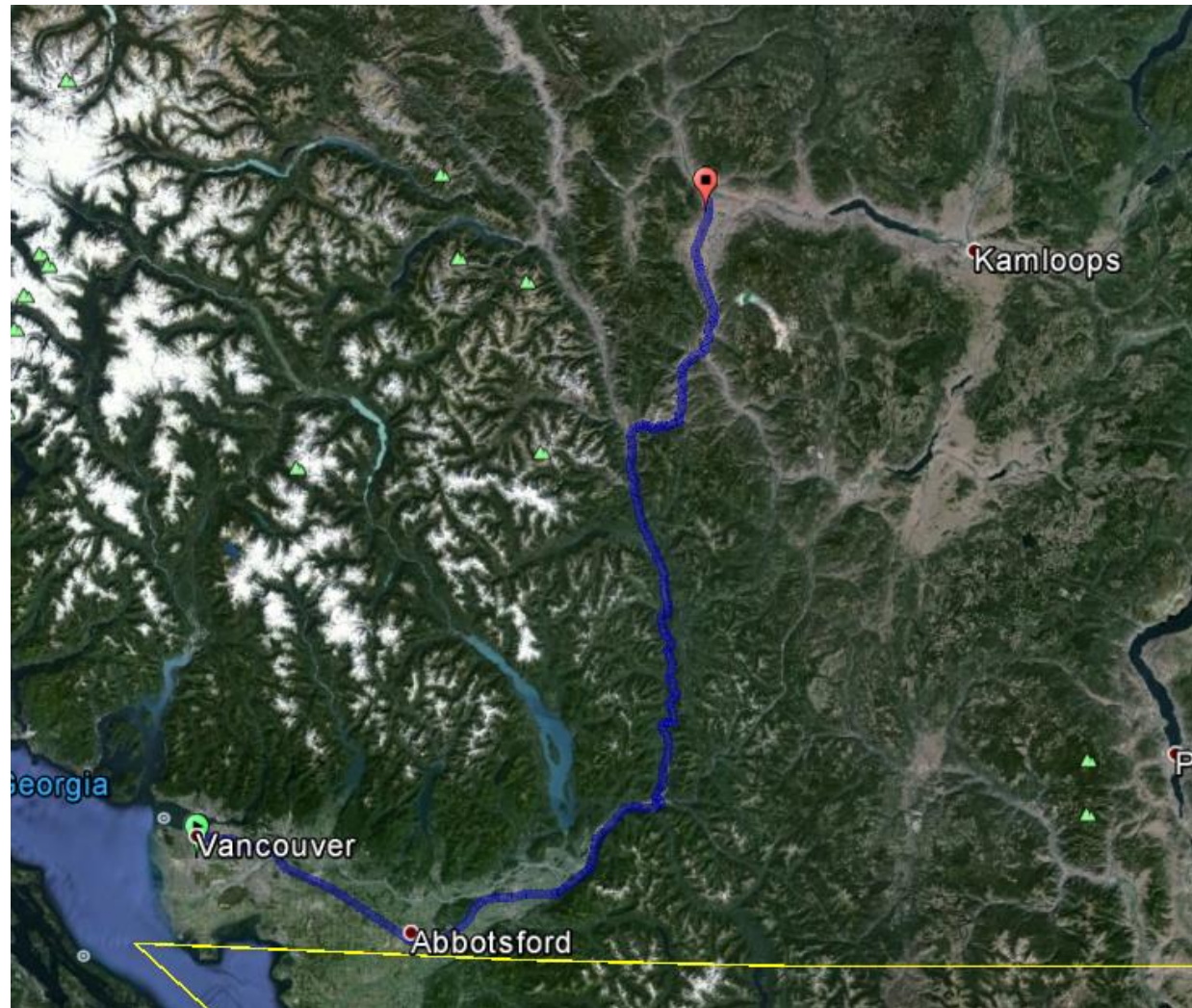
- Waste Exports
 - ▣ International (Metro Toronto to Michigan)
 - ▣ Domestic (Greater Vancouver to Cache Creek, BC)



Cache Creek (or “Trash” Creek?)

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- In 1989, Cache Creek became a landfill site for garbage shipped by truck from BC's Lower Mainland.
- permitted to receive up to 500,000 tonnes of municipal solid waste annually.
- 343 km trip (one way)



References

- Dearden, P and Mitchell, B. 2012. Environmental Change and Challenge, Fourth Edition, Don Mills, Ontario: Oxford University Press {Chapter 13: 'Urban Environmental Management'}

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