KAPSARC
مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

A New Energy Paradigm for the City of Riyadh

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7th IAEE Asia-Oceania Conference, 14 February 2020, Auckland, New Zealand

THE CITY OF RIYADH

- Total surface area of approximately 1800 km^2 (700 miles^2)
- Population of ~7 million people in 2019
- 110,000 residents in 1950
- Estimated 30% of residents are expatriate
- Perhaps 1/3 of Riyadh residents live in poverty

CHALLENGES FOR RIYADH

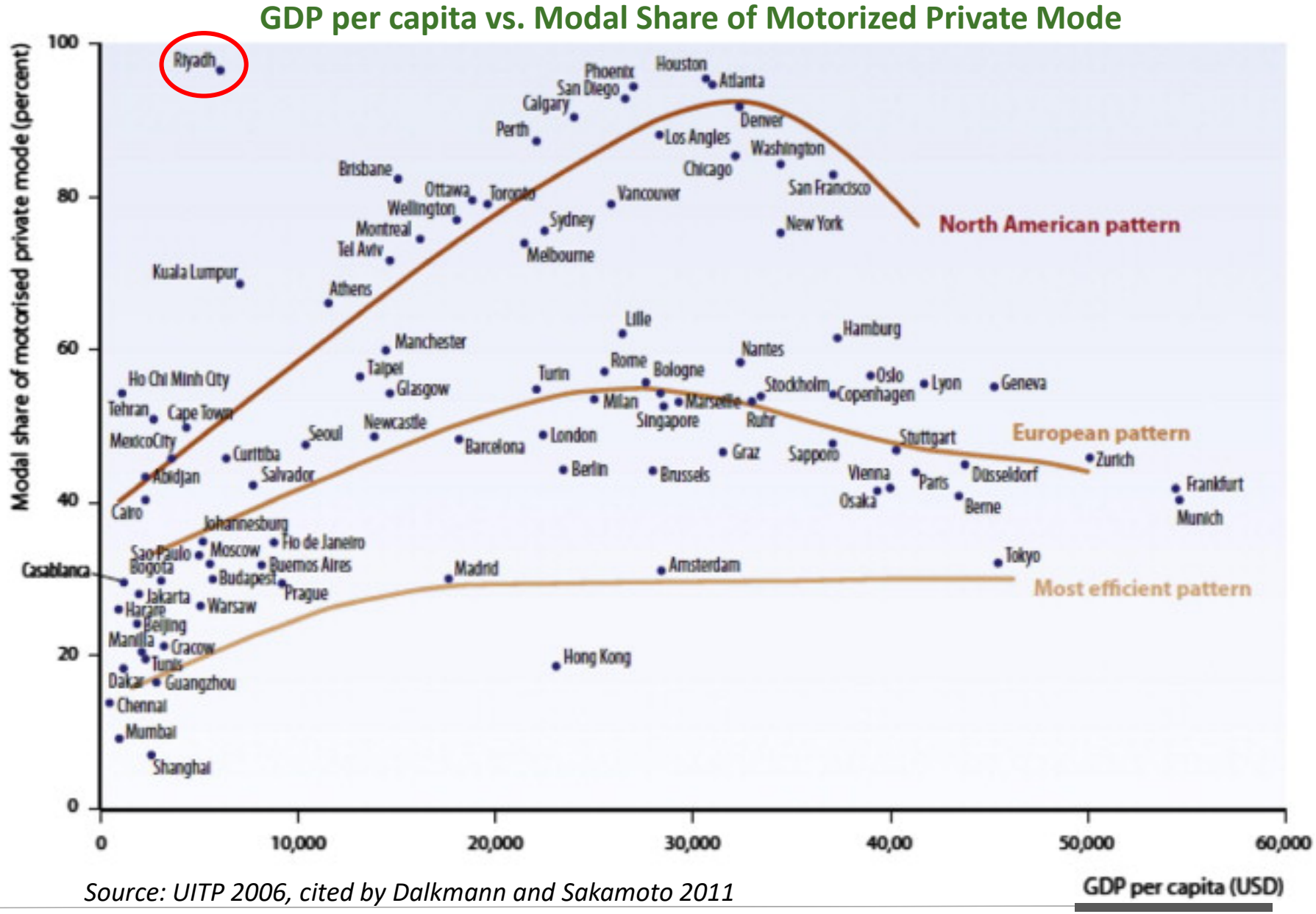
- The growth rate for annual energy consumption is twice the growth rate of GDP
- Urbanization expected to increase up to 97.6% by 2030
- Riyadh expected to reach a population of 8.5 million in 2030 (adding 22 people per day)
- Annual energy subsidies now measure USD $13 billion a year, representing 9% of total government expenditure
- Should Saudi Arabia continue on this trajectory it could find itself a net oil importer in 2040

Urban Planning Challenge

- Urban sprawl
- High per capita energy consumption
- Heavy traffic
- Low quality of livability
- Lack of affordable housing

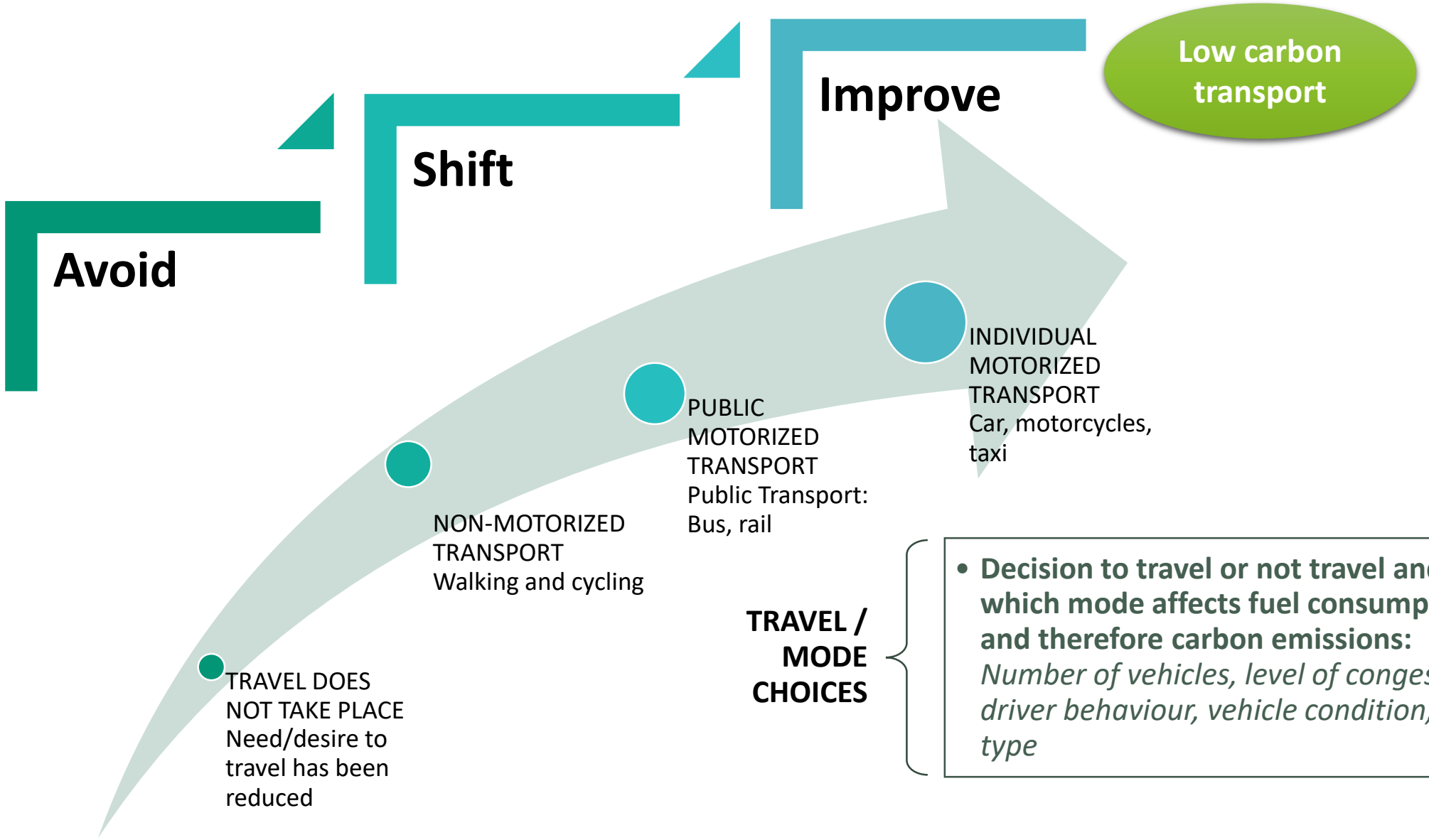
ECONOMIC GROWTH VERSUS MOTORIZATION

Many paths to choose from!



Source: UITP 2006, cited by Dalkmann and Sakamoto 2011

THE ENERGY EFFICIENCY PATH IN TRANSPORT



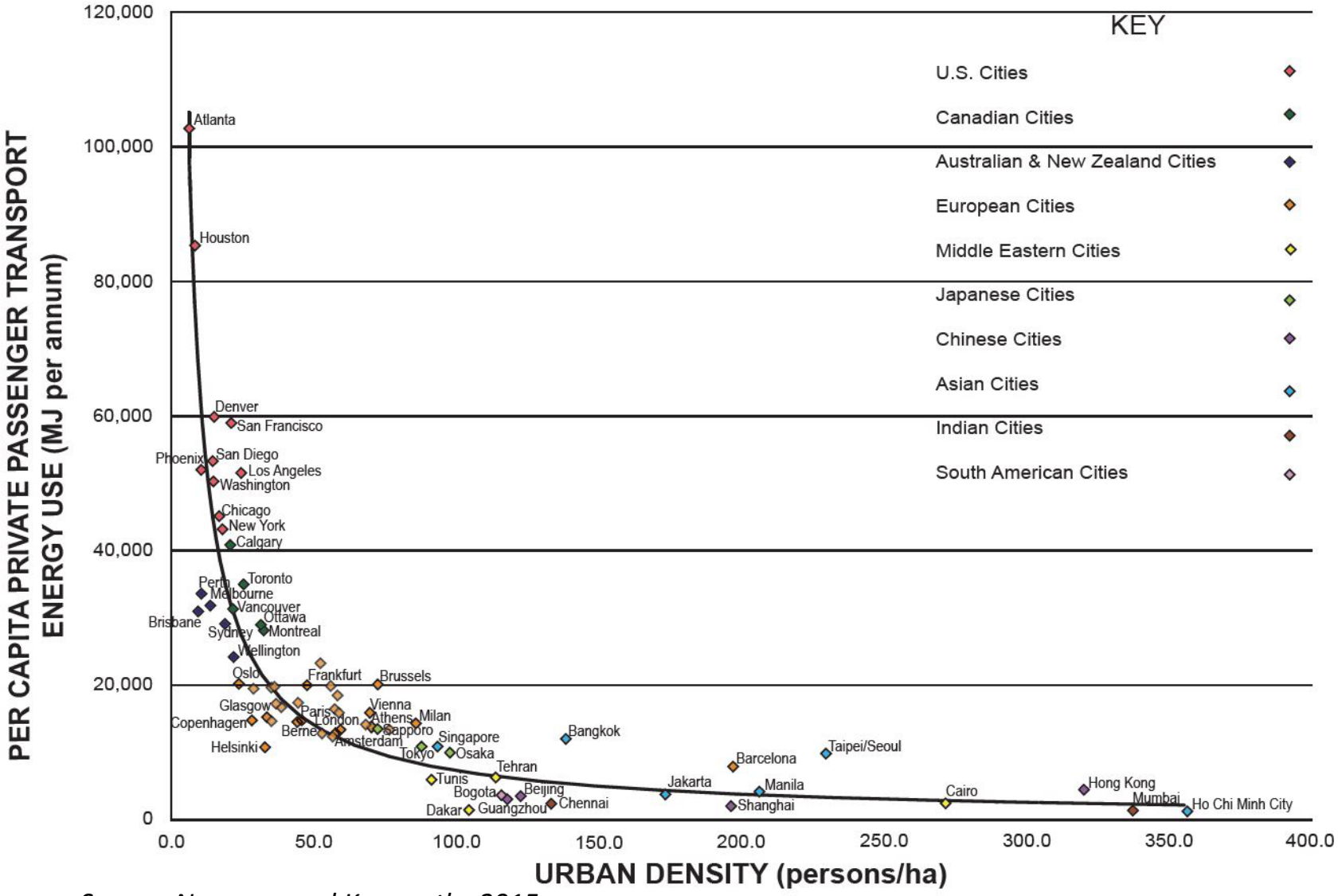
TRAVEL / MODE CHOICES

- **Decision to travel or not travel and by which mode affects fuel consumption, and therefore carbon emissions:** *Number of vehicles, level of congestion, driver behaviour, vehicle condition, fuel type*

URBAN DENSITY AND ENERGY USE – The Game Changer

With similar GDP, the energy use of Atlanta for private transport is more than 5 times that of Stockholm or Singapore

Population Density and Transport Energy User per capita for Selected Cities

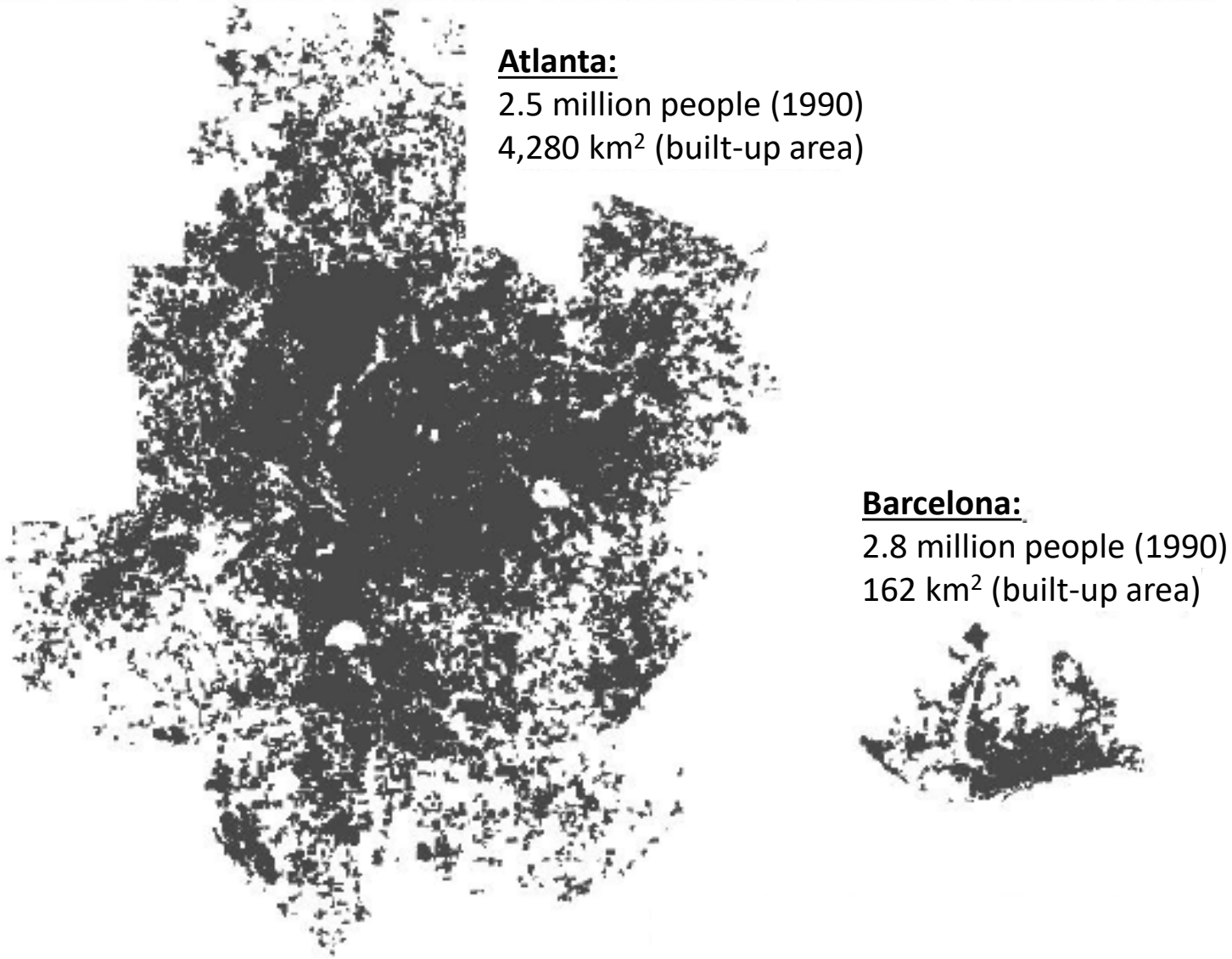


Source: Newman and Kenworthy 2015

DENSITY IS IMPORTANT

- In 1990, Atlanta and Barcelona had about the same population (2.8 million)
- 60% of the population of Barcelona is within 600m of a subway line (99km of line with 136 stations)
- To provide the same accessibility, Atlanta would have to build 3400km of metro line with 2800 new stations

The Built-up Area of Atlanta and Barcelona Represented at the Same Scale



Sources: Atlanta ANIS database, Barcelona Regional Planning Office

WHAT ARE RESIDENTIAL DENSITIES IN RIYADH?

Al Maseef District

Total Area	420 hectares
Number of dwellings	8267
Number of villas	2421
Residential Density	5.76 dwellings per hectare

According to most guidelinesm the most efficient density to serve a metro line is 40-75 dwelling units per hectare

THE FISCAL COST OF SPRAWL

Comparative average annual cost of services
(police, fire, roadways, sewer)

US urban location: USD $88.67 per new household

US sprawl location: USD $1222.39 per new household

RIYADH

- **Fastest de-densifying city in the world**
- **Rate of sprawl > rate of economic growth**

THE RIYADH METRO

- Construction began in April 2014 on a 176km six-line fully-automated metro with 85 stations
- Complimentary 1900km bus network with 300 stops
- First public transportation in Riyadh
- Expected completion in second half of this year

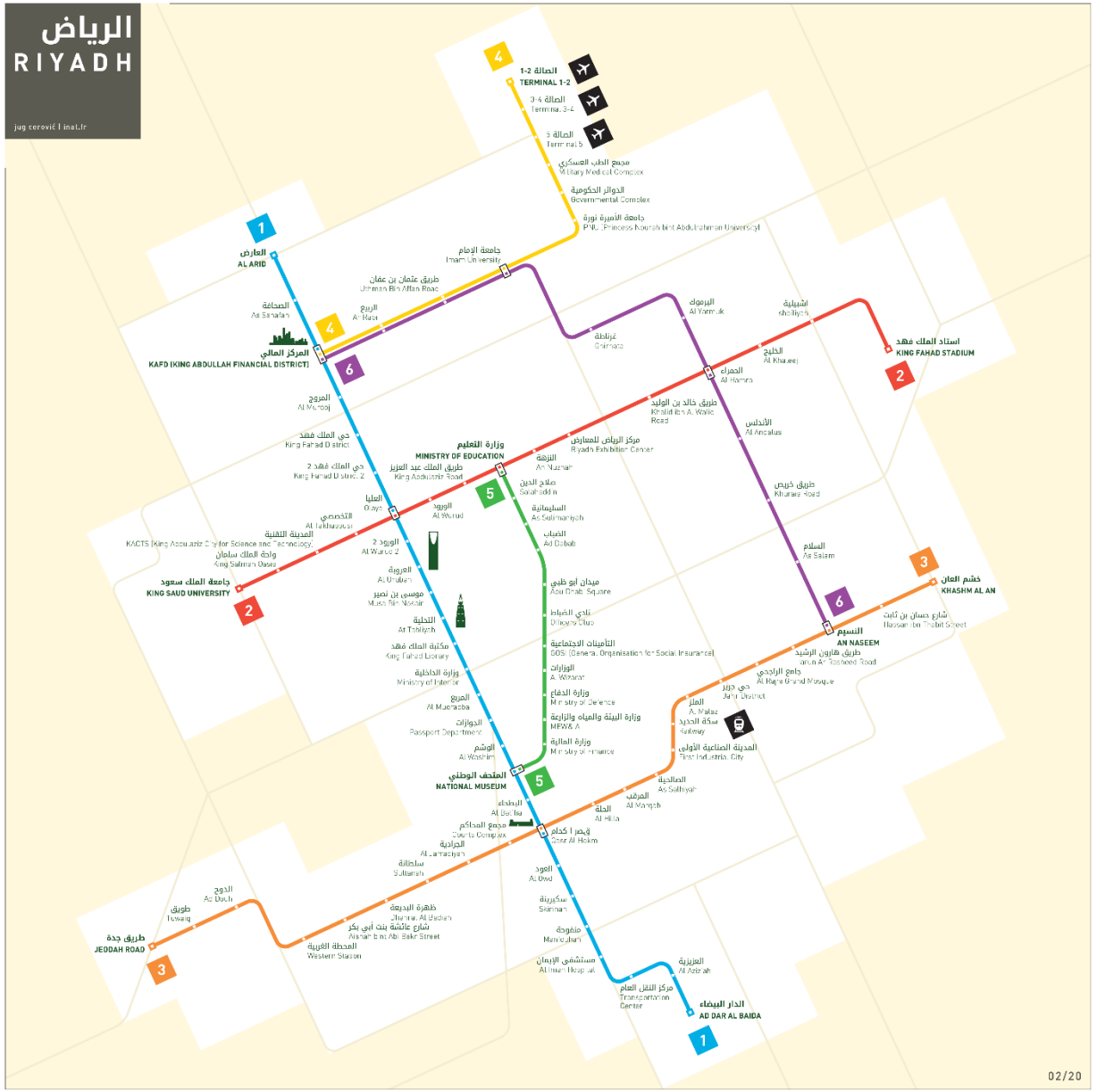
Sources: International Raliway Journal, Zaha Hadid Architects

THE OPPORTUNITY AND A COMMITMENT – RIYADH METRO

The Saudi Nationally Determined Contribution (NDC) for the Paris Agreement

- Introducing energy efficient measures in buildings and transportation
- Development of Riyadh Metro (along with planned metros for Jeddah and Dammam) as urban planning initiatives

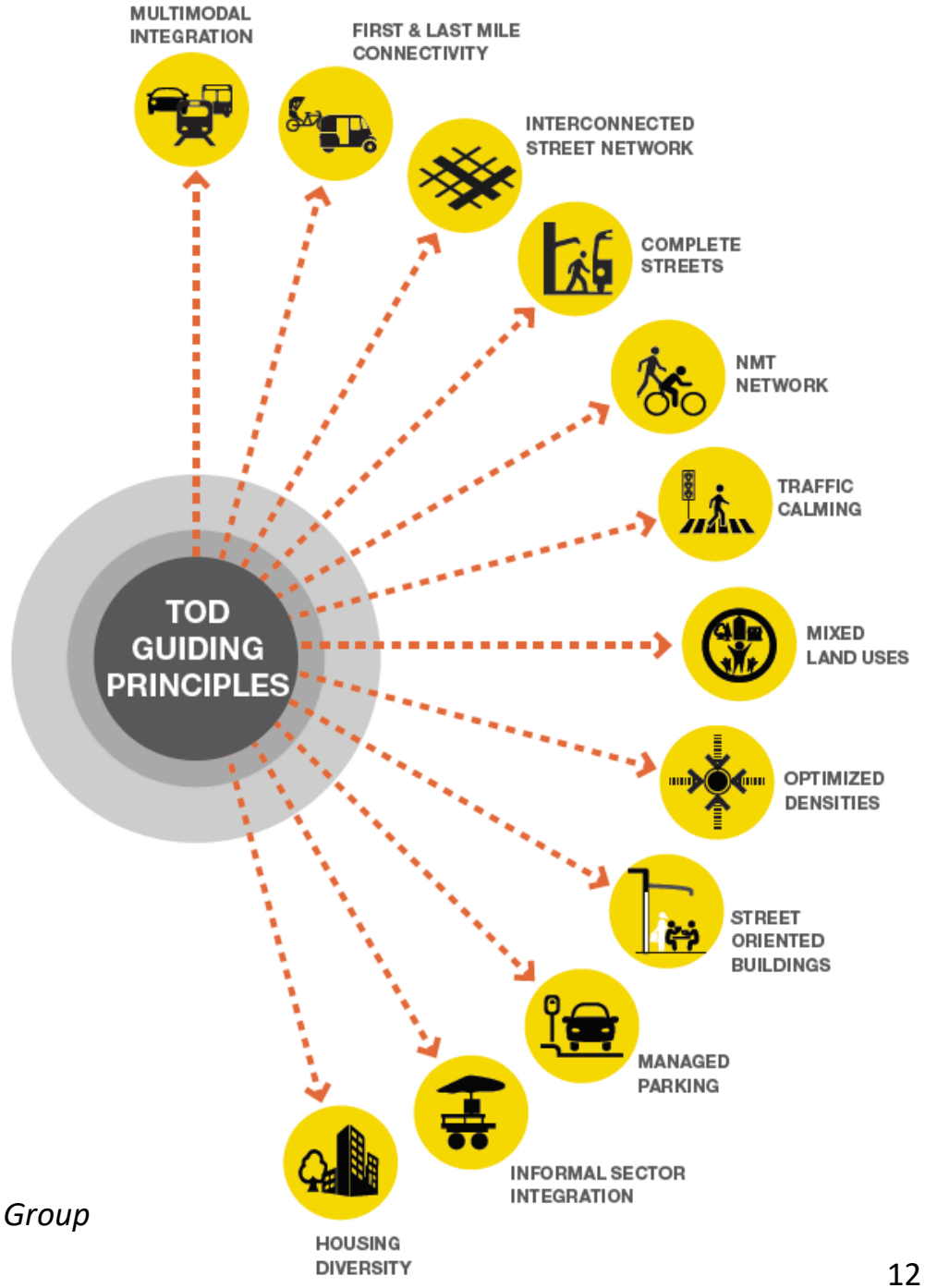
The Opportunity: Transit Oriented Development with Riyadh Metro



TRANSIT ORIENTED DEVELOPMENT
A Theoretical Framework for Smarter Cities

- Transit Oriented Development (TOD) involves creating concentrated nodes of moderate-to-high density developments supporting a balanced mix of land uses around transit stations.

- TOD encourages:
  - Compact/dense growth within a 5-10 minute walk from quick and efficient public transit
  - Promotes ‘live, work, play, shop and learn’ in a pedestrian-friendly environment
  - Without the need for a car



Source: TOD Guidelines, IBI Group

TOD AS AN ENABLER FOR ENERGY EFFICIENCY

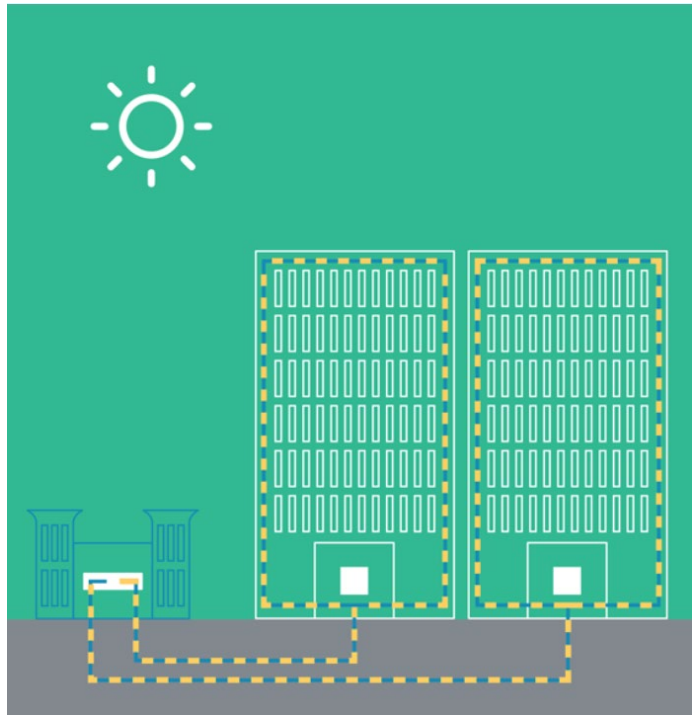
Once density has been achieved, other energy efficiency measures are possible:

- District cooling
- Water recycling
- Waste-to-energy
- Urban agriculture

Potential energy savings from district cooling:

- 70% of electricity in the GCC goes to air conditioning
- Energy savings of 50%
- Plants last for 30 years

Urban Agriculture



District Cooling

Water Recycling Model

Waste-to-energy

The KEMCity-Riyadh Model

KAPSARC is developing a spatial urban-energy model for the city of Riyadh:

- Land use and transport data
- Building energy consumption and transport energy consumption
- Residential, demographic, economic, and business data

Simulation model for Riyadh:

- Test TOD-compatible densification proposals around different metro stations
- Assess impact on energy consumption in the buildings and transportation sector

- Review state-of the art technologies used to improve efficiency in high density neighborhoods
- Demonstrate if any additional gains can be realized with these interventions