A New Energy Paradigm for the City of Riyadh

Brian Efird, Ph.D.

Team: Anvita Arora, Abdelrahman Muhsen, Nourah Al Hosain

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THE CITY OF RIYADH

• Total surface area of approximately 1800 km² (700 miles²)
• 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

GDP per capita vs. Modal Share of Motorized Private Mode

Many paths to choose from!

Source: UITP 2006, cited by Dalkmann and Sakamoto 2011
Avoid

Shift

Improve

TRAVEL DOES NOT TAKE PLACE
Need/desire to travel has been reduced

NON-MOTORIZED TRANSPORT
Walking and cycling

PUBLIC MOTORIZED TRANSPORT
Public Transport: Bus, rail

INDIVIDUAL MOTORIZED TRANSPORT
Car, motorcycles, taxi

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

Low carbon transport

THE ENERGY EFFICIENCY PATH IN TRANSPORT
With similar GDP, the energy use of Atlanta for private transport is more than 5 times that of Stockholm or Singapore.
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

Sources: Atlanta ANIS database, Barcelona Regional Planning Office
WHAT ARE RESIDENTIAL DENSITIES IN RIYADH?

Al Maseef District

<table>
<thead>
<tr>
<th>Total Area</th>
<th>420 hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of dwellings</td>
<td>8267</td>
</tr>
<tr>
<td>Number of villas</td>
<td>2421</td>
</tr>
<tr>
<td>Residential Density</td>
<td>5.76</td>
</tr>
</tbody>
</table>

According to most guidelines, 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 Railway Journal, Zaha Hadid Architects
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 (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
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
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