Cluster 7/Module 1 (C7/M1): Energy Efficiency Issues.

This presentation is one of the support materials prepared for the capacity building program **Building Leaders in Urban Transport Planning (LUTP).**

Support for LUTP was provided by:

- The World Bank
- Australian Agency for International Development Aid
- The Energy Sector Management Assistance Program (ESMAP), and
- Public-Private Infrastructure Advisory Facility (PPIAF).

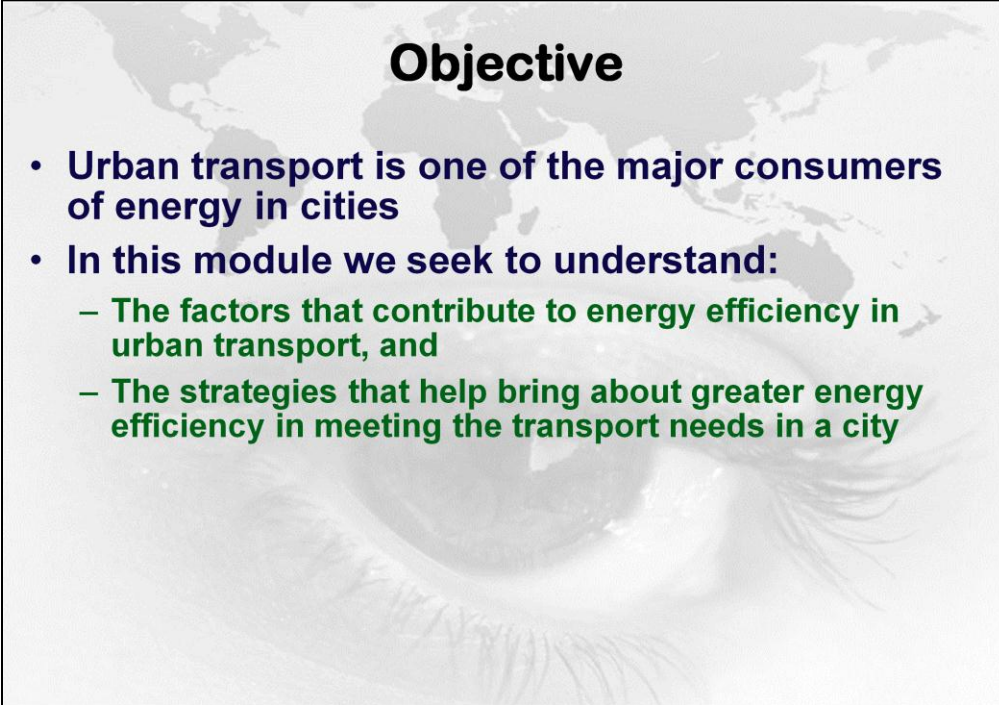Urban transport is rapidly becoming one of the world's most significant consumers of energy. The main sources of this energy are non-renewable petroleum based fuels.

The purpose of this module is to understand:

-What factors impact the energy efficiency of urban transport?

-What strategies can be adopted to make urban transport less energy intensive?

Opening Exercise
Travel Demand and Energy Consumption

- **Demand management strategies can positively affect energy consumption**
- **What kind of measures could you adopt in your city to make people travel less? List 3 such measures**

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This exercise is designed to get you to start thinking about strategies for making urban transport less energy intensive. Common solutions are to improve the energy efficiency of transport vehicles and to reduce congestion and needless vehicle idling.

However, in recent years, cities also have been thinking about demand management strategies that reduce travel demand. The logic is that if demand is less, than so will be energy consumption.

What kind of measures could you adopt in your city to make people travel less? List 3 such measures.

Take about 5 minutes to do this exercise.

Let's start by looking at 2 cities – Atlanta and Barcelona. They both have a population of about 5.3 million. Yet in meeting their transport needs, residents of Atlanta emit about 10 times as much carbon dioxide annually when compared to the residents of Barcelona. This implies that Atlanta consumes about 10 times as much energy. Why does this happen?

Let's keep this example in mind as we go through this module.

World Energy Consumption by Sector

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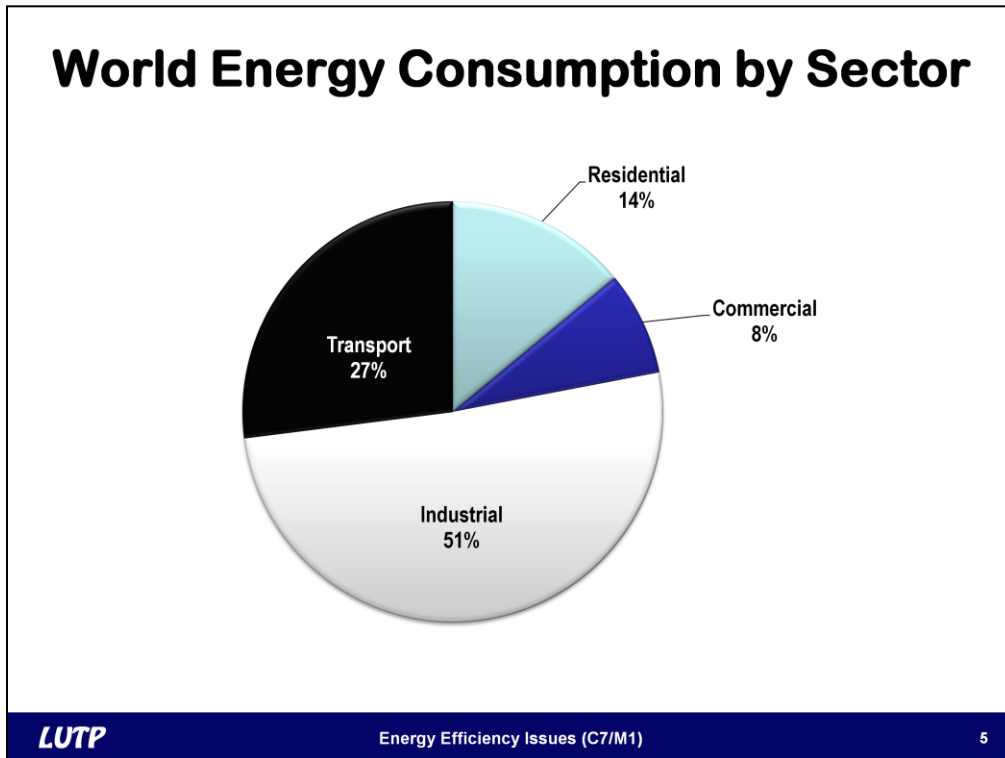
This graph illustrates energy consumption by sector. The transport sector consumes 27% of the world's energy--second only to the industrial sector which consumes 51%.

Some Important Characteristics

- **Major fuel is petroleum**
- **The transport sector consumed 45% of world oil production in 1973**
  - **This increased to 61% in 2007**
- **Road transportation accounts for 81% of thisconsumption**
  - **51% for passenger transportation**
  - **30% for freight**

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Global petroleum consumption for the transport sector increased from 45% in 1973 to 61% in 2007.

Within the transport sector itself, road transport accounts for 81% of the petroleum fuel consumed, 51% being for passenger transport and 30% going for freight transport.

These figures help us to understand how some of our energy efficiency initiatives need to be targeted for the most impact.

Energy Consumption Scenario

- **Transport related oil demand projected to grow at 2.1% annually from 1827 MToE in 2002 to 3273 MToE in 2030**
- **Projected to expand much faster in Asia, at 4.3% annually**
- **Despite high growth rate, per capita demand for transport oil will still be lower that in OECD and the US**

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The global transport related oil demand is projected to grow at a rate of 2.1% per year. In Asia, however, the growth is projected to be much higher, at 4.3%. Despite the high growth rate, the per capita oil consumption in Asia is projected to be much less than in the OECD countries and in the US.

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Outlook in Cities

- Transport is a significant consumer of energy in cities
- Large increases projected due to projections of high growth in urban population
- Effective counter measures are necessary
- Improving the efficiency of the urban transport system has the potential for significantly reducing the energy consumed

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A significant part of this energy is consumed by meeting the mobility needs of people and goods in cities. As urbanization continues, this share will continue to grow. The growth will be the fastest in the developing world due to the relatively low levels of urbanization that currently exist.

Effective counter measures need to be taken to make urban transport more energy efficient without compromising the needs of access and mobility.

There are three main factors that affect energy consumption in city transport. These factors are spatial pattern, income levels, and the nature of the vehicle fleet. As seen in the example of Atlanta and Barcelona, the spatial pattern of a city and its population density are important factors. Atlanta is far less dense than Barcelona and therefore, consumes much more energy.
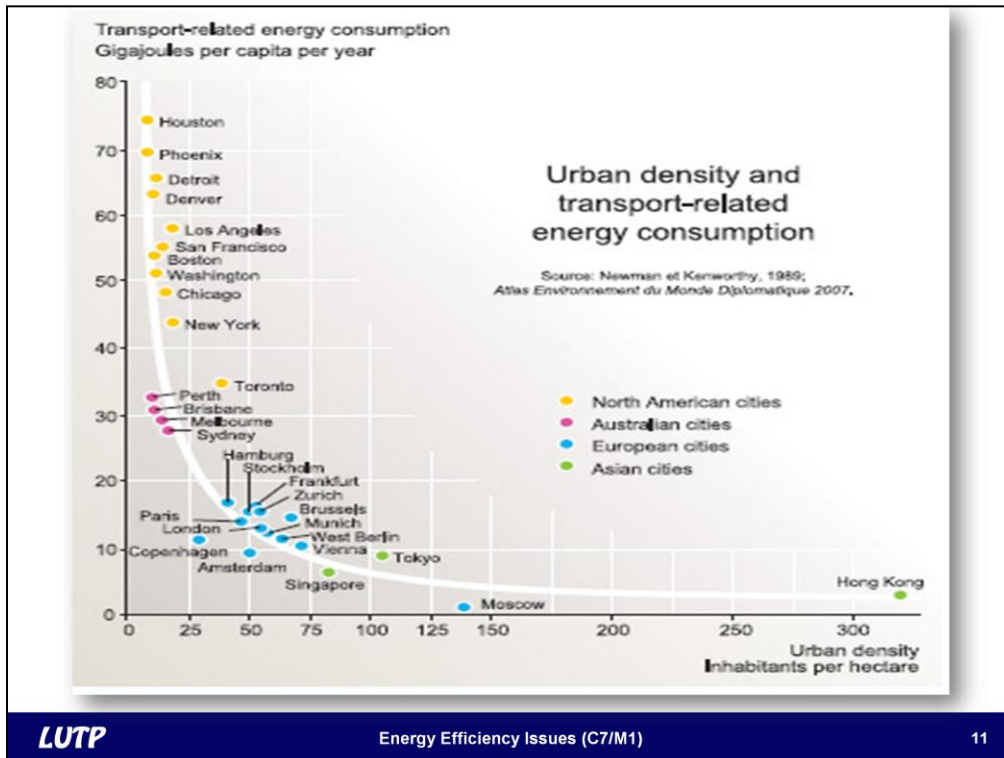
The income level of a city is another factor that influences the energy consumed. In high income cities, people tend to use personal vehicles and often high energy consuming cars which leads to high energy consumption. In low income cities, however, most people cannot afford personal vehicles so they use public transport, walk, or cycle. These are examples of energy efficient modes of travel.

The nature of the vehicle fleet in a city also influences the amount of energy consumed. Cities with poor regulations and old vehicles that may be poorly maintained tend to consume more energy compared to those that have a strong regulatory environment that requires vehicles to be relatively new and well maintained.
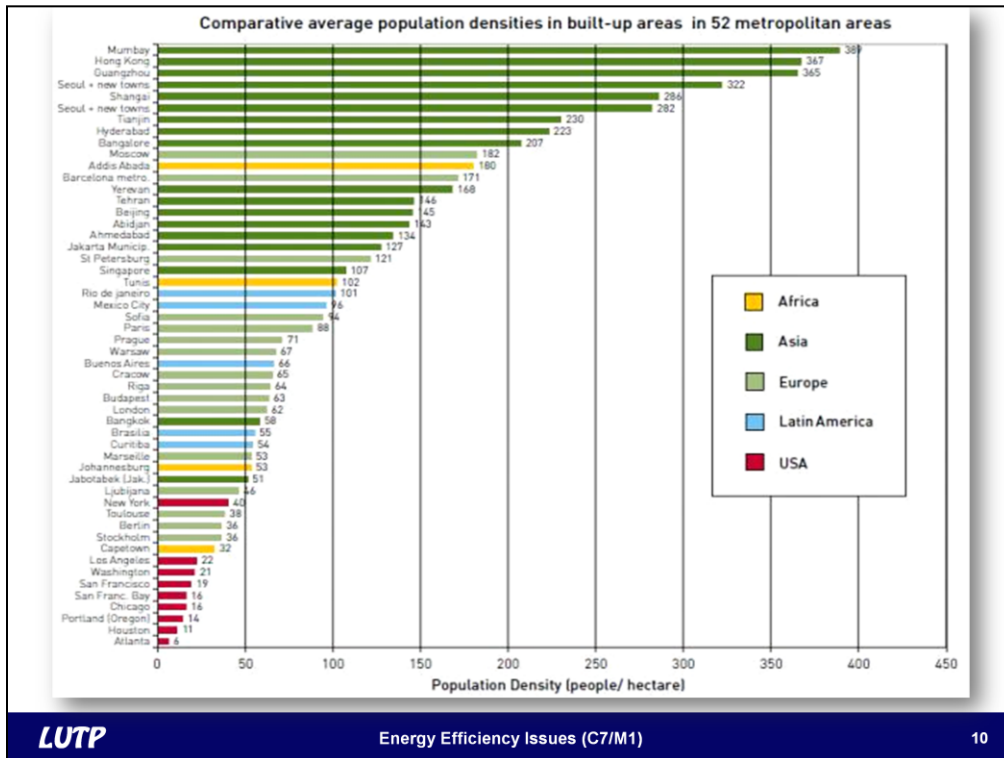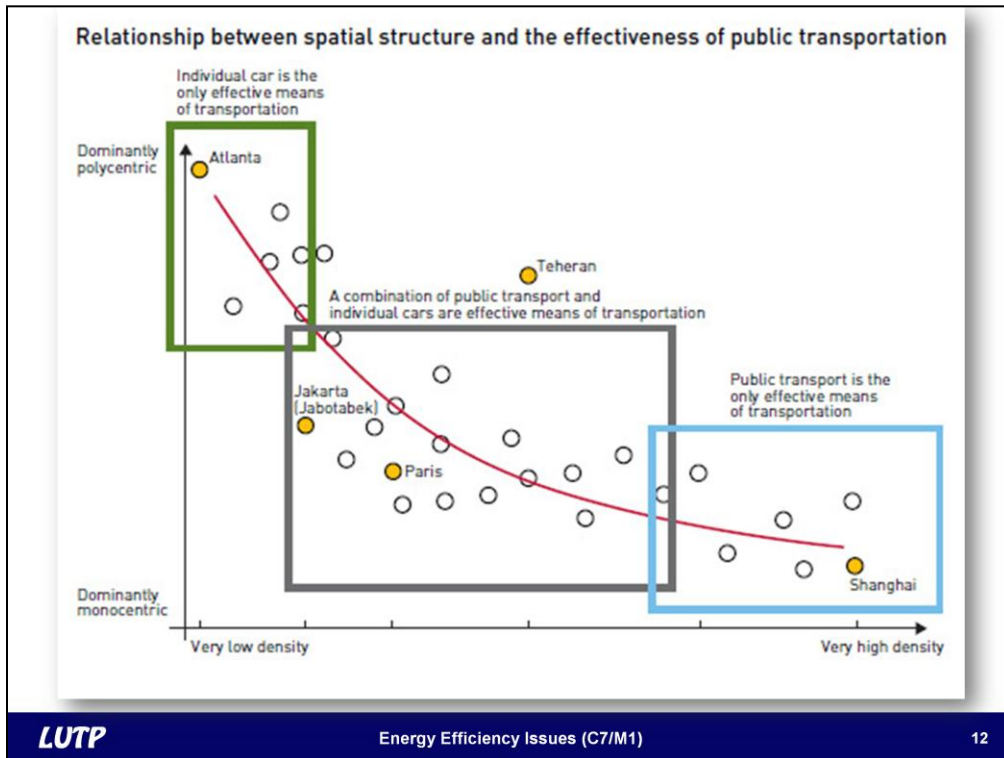
Let's look at the spatial patterns of cities. We find that there is a wide variation. A study of 52 metropolitan areas across all continents showed that Asian cities tend to be the densest and those in North America are the least dense. Cities in Europe and Africa fall in the intermediate range.

Transport-related energy consumption
Gigajoules per capita per year

Urban density and
transport-related
energy consumption

Source: Newman et Kenworthy, 1989;
Atlas Environnement du Monde Diplomatique 2007.

● North American cities
● Australian cities
● European cities
● Asian cities

Urban density
Inhabitants per hectare

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This graph shows the kind of relationship that exists between density and energy consumption. On a per capita basis, low density cities like Atlanta tend to consume significantly more energy than highly dense cities like Mumbai.

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Relationship between spatial structure and the effectiveness of public transportation

Here we see the effectiveness of public transport in cities at different density levels. In highly dense cities public transport is very effective, whereas in low density cities, it is ineffective. At intermediate densities, a mix of public and private modes of transport is the appropriate strategy.

City Typology Based on Urban Density and Transport

Density		Low (25 /ha)	Medium (50-100/ha)	High (>250/ha)
Typical regions		North America and Australia	Europe	Asia
Modal split	Motorized Private	80%	50%	25%
	Public Transport	10%	25%	50%
	Non - motorized	10%	25%	25%
Automobile use (Km/pers/yr)		>10,000		<5,000
Public transport use (trips/pers/yr)		<50		>250
Petrol consumption for transport (MJ/pers/yr)		>55,000	20,000 – 35,000	<15,000

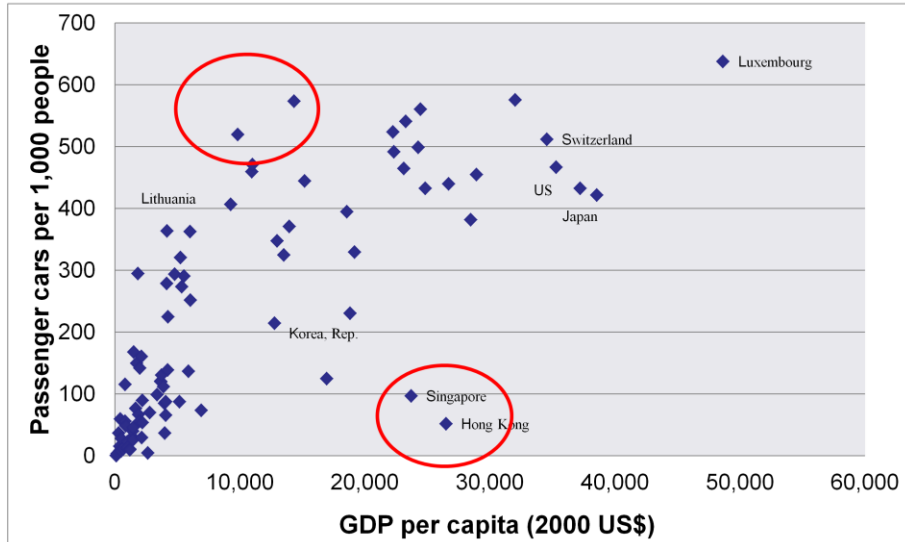*LUTP* — Energy Efficiency Issues (C7/M1) — 13

The table here shows this more effectively. We see that fuel consumption in low density cities is very high when compared to fuel consumption in high density cities.

Transport Energy Consumption and Income
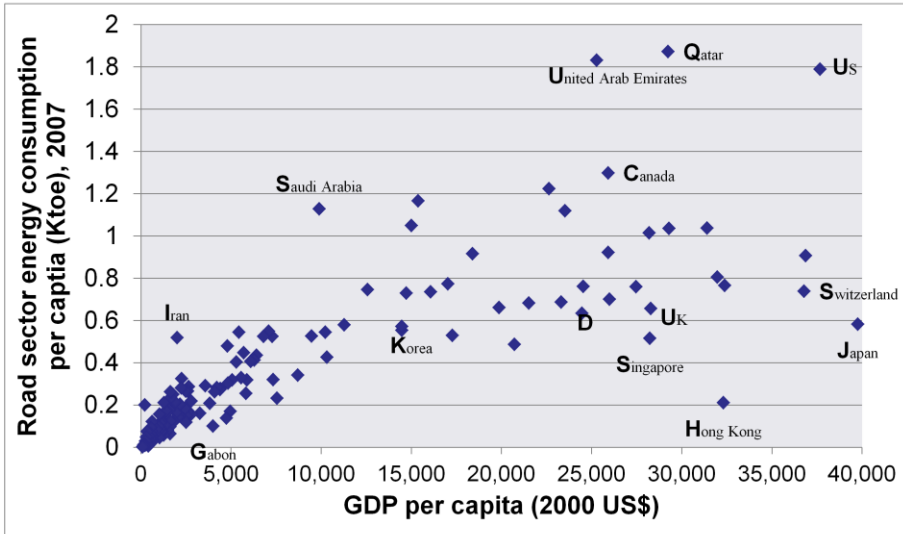
This graph shows that energy consumption tends to increase with income. However, some countries like Singapore, Japan, and the UK have managed to keep their energy consumption levels low, despite higher incomes. Others like Iran, Saudi Arabia, and the US are at very high energy consumption levels.

Passenger Car Density and Income, 2003

This slide shows the passenger car density in different countries having different income levels. We see that countries like Singapore and Korea as well as the city of Hong Kong have managed to keep car ownership levels extremely low despite their high income. Yet there are countries that have very high ownership levels despite lower incomes.

An interesting fact to be noted from this slide and the previous one is that even though passenger car density in Japan is high, the energy consumption levels in transport are low. What could be the reason for this?
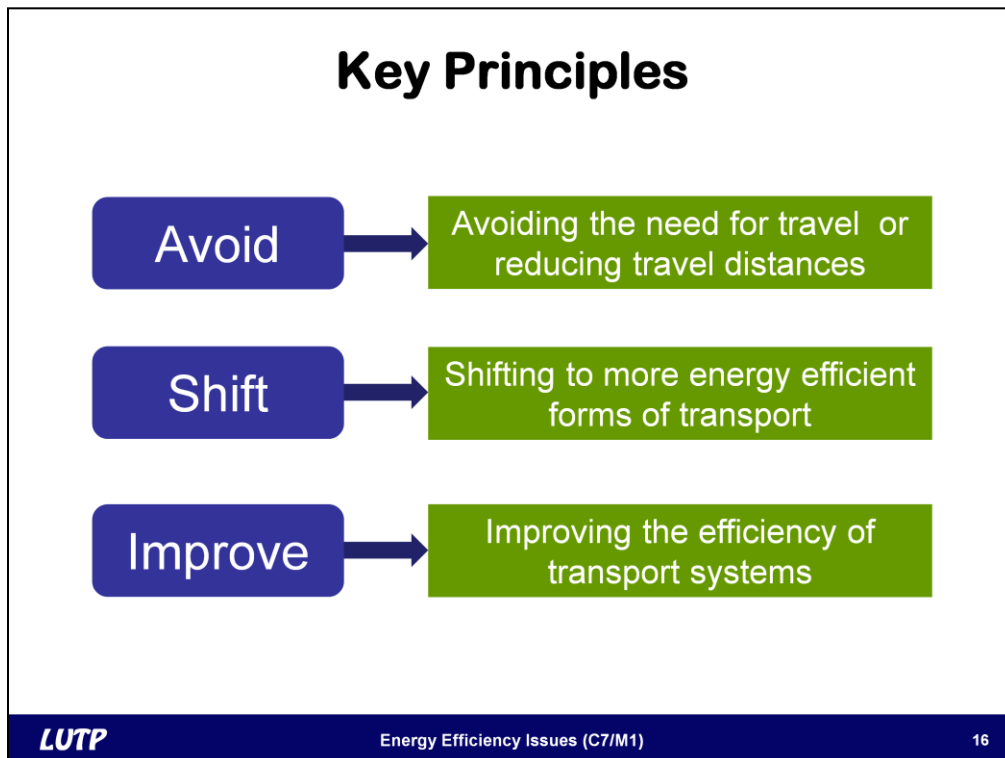
Let us now look at what can be done to reduce the extent of energy consumed in meeting the transport needs in a city. The strategies used are better known as the Avoid – Shift – Improve strategies, wherein:

- **Avoid** refers to initiatives that work towards reducing the need to travel
- **Shift** refers to initiatives that encourage people to shift to more energy efficient forms of transport, such as public transport and non-motorized modes, and
- **Improve** refers to enhancing the efficiency of transport systems in terms of the energy they consume, the quantum of emissions they emit or the noise they cause, etc

Options for Improving Energy Efficiency

- **Management options**
  - Densification
  - Mixed land use
  - Telecommuting
  - Reduce vehicle kms of travel
  - Improve traffic flow
  - Discourage use of energy intensive vehicles
- **Technology options**
  - Fuel efficient engines

There are two clusters of actions that can be taken to improve the energy efficiency of urban transport systems. These are "Management actions" and "Technological actions".

Management actions include:

- Measures that reduce travel distance through making cities more compact and dense so that distances between places comes down
- Measures that attract people towards public transport
- Measures that improve traffic flow and thereby reduce the extent of energy consumed – in idling or stop – start movement
- Measures that require greater attention to vehicle maintenance.

Technological actions include telecommuting (to reduce travel demand) and the introduction of fuel-efficient technologies.

Summary

- **Most actions that work well for reducing congestion and air quality also work well for improving energy efficiency in meeting the urban travel demand**

- **Reducing the extent of sprawl, moving to energy efficient modes of travel and improving the energy efficiency of motor vehicles are the key areas to focus on**

In short, most actions that need to be taken for reducing congestion or improving the air quality also contribute towards energy efficiency in urban transport. The key areas on which to focus include:

- Reducing the extent of sprawl by making cities more compact and dense
- Moving toward energy efficient modes of travel such as public transport and non-motorized modes
- Improving the energy efficiency of motor vehicles through improved technologies

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