# City and Energy Towards a sustainable development



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The National Council of Engineers (CNI) is the national and institutional representation of the relevant interests of engineers.

The CNI plays a major role in promoting, developing and enhancing the role of the engineer in order to:

- increase its impact in the society;
- > pursue growth of the profession in service of the community;
- promote the essential role of the engineer in processes of evolution and change of the community.



# THE Energy Workgroup

The Energy workgroup is an advisory body of the CNI to support the strategies and actions to be taken in the energy sector.

It consists of 10 energy experts from all over Italy coordinated by ing. Gaetano Fede (member of the National Board of Engineers).

#### **Activities:**

- > link between the local councils and CNI on the correct application of the national regulations;
- contacts with Ministries for all initiatives concerning the respect for and the protection of the rights of engineers in the field of energy and environment;
- memorandum of understanding with other associations and Standardization Organizations ;
- providing news and information in the field of energy

## World consumption:

World energy consumption 2010: 12 Gtoe

World energy consumption in the history: - 300 Gtoe from non-renewable energy source - 100 Gtoe from renewable energy source



= 6 Lake GARDA 370 km2 49 km3

**QUESTIONS:** 

- How many Lake Garda are still available?

- How many lake Garda may be burnt without causing irreversible damage to the environment?





With over half the worlds population living in cities and the vast majority of economic activity occurring in cities, it is clear that if we are to successfully create a *sustainable* future we have to focus on cities.

The global effort for sustainability will be won, or lost, in the world's cities, where urban design may influence over 70 percent of people's *Ecological Footprint*.

(Wackernagel - President of Global Footprint Network)



### **Energy Concerns in Urban Development**

- Cities occupy 3% of the Earth's land surface, and house 75% of the human population
- Most production, trade and transportation activities usually are located in these areas. [80% of Asia's GDP is produced by Asian cities]
- Cities account for a considerable portion of a country's energy consumption. [2/3 of worldwide energy usage and GHG emissions]



Per capita carbon emission of selected cities (World Bank, 2010)

# The City as a System

To help understand how cities can be designed in a more sustainable way we can use a systems approach.



### Natural ecosystem

"the complex of a community and its environment functioning as an ecological unit in nature."

#### Large city

- the cycle of matter is open. During the transformation of raw materials into goods, in the production and consumption of the goods there is waste generation that only partly can be recycled
- the energy flow is based mainly on non-renewable sources with a high energy content, that can be concentrated and stocked
- energy dissipation and entropy increase is higher than the natural entropy process, precisely because of the high concentration of urban structure, services and production

## THIS MEANS THAT CITIES ARE NOT ECOSYSTEMS

# **Unsustainable Linear Urban Metabolism**



A) 'Linear metabolism' cities (consume and pollute at a high rate)

# **Sustainable Circular Urban Metabolism**



B) 'Circular metabolism' cities (minimise new inputs and maximise recycling)



## **Unsustainable City**

High level of inputs. Not satisfying our needs (e.g. congestion,poor air quality). Producing large amounts of waste and pollution.

## Sustainable City

Reduced level of inputs. Satisfying our needs (good quality of life). Reduced levels of waste and pollution.





- Urban Systems Infrastructures; resource intensive (energy, water, materials and land); Difficult and costly to modify.
- Traffic congestion Inadequate road & transport infrastructures
  cost can be as high as 10% of the city's GDP.
- Typical buildings non-energy efficient can account for 40% of a city's total energy consumption and 30% of GHG emissions.
- Expansion of infrastructures (rapid urbanization; fast economic growth; increased competitiveness etc.).

#### THE WAY A CITY IS PLANNED, DESIGNED, OPERATED AND MAINTAINED WILL INFLUENCE ITS FUTURE ENERGY USAGE AND EMISSIONS (GHG & POLLUTANTS)

Source: Manuel L. Soriano





# **CHALLENGES TO OVERCOME**

## **Institutional Challenges**

e.g., Divided responsibilities and split incentives of relevant stakeholders; energy and climate change are not mainstreamed in urban development planning processes

## **Energy Use and Energy Policy Challenges**

e.g., Energy planning not responsibility of cities; existing laws, regulations not supportive of energy efficiency and renewable energy initiatives; restrictive regulations and default controls

## **Political Challenges**

 e.g., Local authorities support missing; changes in administration often translate to change in policies; lack of awareness & information about the economic, environmental (and also political) benefits of sustainable development

## **Social/Community Challenges**

e.g., Local communities not aware and resistant to proposed changes lifestyles and attitudes

## **Capacity & Financial Challenges**

e.g., City planners & engineers not skilled/knowledgeable of the opportunities of funds development; Lack of local financing for sustainable development initiatives







# A CHANGE OF GEAR

#### Integrating Energy & Environment Concerns & Impacts in: Land Use and Transport Planning

Contiguous development patterns; parking plans and siting; street design and layout; traffic rules; trip reduction measures; citizens participation, etc.

## **Site Planning and Building Design**

Building efficiency; orientation; landscaping; building services design and operations; pedestrian facilities; transit facilities, etc.

#### **Infrastructure Efficiency**

Water supply and use; wastewater collection and storm drainage; solid waste collection & recycling facilities; heat & power recovery; joint infrastructure planning & delivery.

### **Energy Supply**

Electricity supply & distribution; district heating & cooling; waste heat utilization; cogeneration systems; waste-to-energy systems; renewable energy utilization, etc.

# Some ideas to develop a Sustainable City

Protect natural ecosystems, biodiversity, wildlife

More attractive, more frequent and more reliable public transport

More economic public transport with more balanced loadings

More dedicated public transport routes; light rail or bus only

More tree planting on watersheds, field boundaries and urban areas

Community forests to increase biomass



Increased production and use of renewable energy, solar gain, CHP

Upgrade energy efficiency of existing buildings

Enforce regional ceilings for emission pollutants

Reduce pollution and waste by closed-cycle processes, recycling More compact mixed-use new settlements to take urban growth

Road pricing and parking charges to retain private car use

Restrictions on new car-based development More attractive cycling and walking routes and pedestrian areas

> Reduced consumption of water and finite natural resources

> > Increased densities in suburbs and small towns, at public transport nodes

Reduce commuting by better balance of homes and jobs

More mixed development and home working

Reduce urban spread by greening and decongesting inner cities







# **Sustainable and Energy Efficient Cities**

### **Benefits of Sustainable Development of Cities**

- · GHG Emission Reduction (climate change mitigation)
- Energy Use and Energy Cost Reduction
- Preservation of Natural Environment
- · Pollution Reduction (air, land, water)
- · Improved Public Health (reduction of the high costs)
- Empowered Communities
- Enhanced Quality of Life in Cities (safety, welfare and wellbeing)
- Improved Economy and Competitiveness







Most electricity flows outward from remote generating plants fueled by oil, coal or natural gas. Typical plants use less than 40 percent of the energy in their fuel.

**Transmission Grid:** The voltage coming from the plant must be very high—up to 765,000 volts—to cover the long distances between where the power is made and where it is used.

Fossil-Fuel

**Power Plants** 

**Cars:** Today they run on oil because it's a portable high-energy fuel, but in the future they'll become part of the grid, too.

Transformer

**Consumers:** Transformers reduce the superhigh voltage of the transmission grid, and the power goes to homes and businesses via a lowvoltage distribution grid. The users are clients of the plant and make no power of their own.

#### TOMORROW

The future grid won't rely solely on distant power plants. Instead, consumers will become producers, using microgeneration technologies that harness the sun, wind, hydrogen and fossil fuels to feed the grid with surplus power.

Key: Power from the grid:

Wind Farms: Most fossil-fuel power plants will be gone, but clusters of wind generators will supplement the grid, especially when solar power is hindered by night or clouds.

Industrial Generation: Factories with solar panels could sell survius power back into the grid.

Information Technology: New information systems will turn the grid into a data network as well. The improved power - monitoring capability will make twoway power transmission possible.

Hydrogen: Some of the power generated by solar panels will be used by electrolyzers to make hydrogen from water. The hydrogen will run fuel cells in cars and houses.

#### Solar Panels

PV Power: During the sunniest part of the day, roof-mounted photovoltaic (PV) panels will produce more power than a home needs. The surplus could flow back out to the grid.

#### **Opting Out:**

Microgeneration systems may enable some people to go off the grid entirely.

Microturbines:

Driven by wind or fossil fuels, these systems provide another way for homes and businesses to lessen their reliance on the grid—or make power to sell back to power companies. Fonte: Newsweek

# **Conclusions**

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- How urban areas expand in the future has big implications on the GHG emissions that are generated in cities.
- Urban development planning should consider energy as one important component of sustainable development.
- Energy and Climate Change should be mainstreamed into the urban development planning processes
- Policies formulated for various concerns in city development plans should be in accord with the preservation of man's environment and the provision of energy for sustaining growth and development.
- \* The capacity of local governments should be improved to better identify the optimum mix of regulatory and public financing instruments to attract catalytic financial flows toward lowemissions climate-resilient development.

#### THE SUCCESS OF AN ENERGY INTEGRATED CITY DEVELOPMENT PLAN CAN ONLY BE ENSURED IF THERE IS POLITICAL SUPPORT. WITHOUT IT, ANY PLANNING APPROACH WILL FAIL.