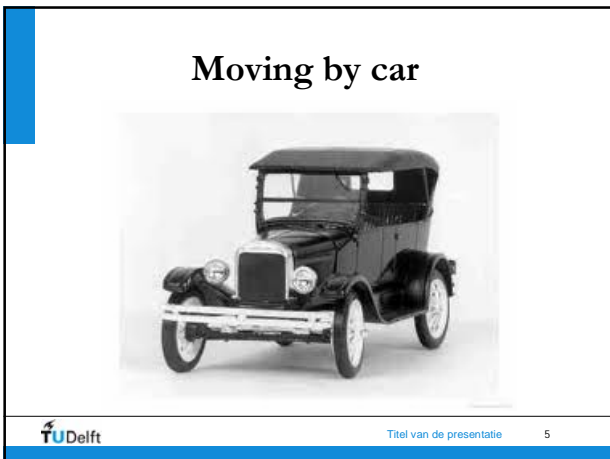


### There is no energy crisis

- Energy efficiency world wide is about 2%
- The sun gives us in one hour more energy than the world consumes in a year
- Renewable energy is everywhere but dispersed

TU Delft Titel van de presentatie 2

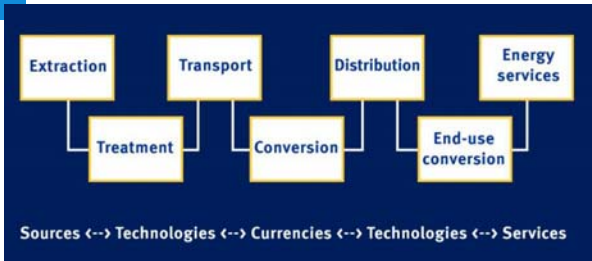


### Flows of solar energy

Solar radiation intercepted by the earth	5.450.000 EJ/yr
Solar radiation reflected by the earth	1.640.000 EJ/yr
Solar energy involved in direct heating	2.550.000 EJ/yr
Solar energy involved in evaporation	1.260.000 EJ/yr
Solar energy utilized in photosynthesis	3.150 EJ/yr
World wide energy use 2007	500 EJ/yr

TU Delft Titel van de presentatie 6

## Traditional energy chain: from source to service



## The energy revolution

- Energy buildings
- LED light
- All electric, DC smart
- Mobile power plants

## Energy buildings

- Energy use for heating and cooling our buildings is roughly 25% of all energy.
- But why do we use energy in our buildings?
  - In winter time it is too cold and we have to heat our buildings
  - In summer time it is too hot and we have to cool our buildings
- It is not an energy problem it is a storage problem

## The Closed Greenhouse

Total control of temperature, humidity and CO<sub>2</sub> levels in a greenhouse

Advantages:

- Produce, not consume, energy
- re-use of irrigation water 90%
- reduced use of pesticides 90%
- increased crop production 25%
- improved process control



## The Energy Wall



## The Energy Wall



## The Harp



## LED light

- LED is efficient and will change the lighting systems;
  - Very small light source
  - Less heat production
  - Integration in walls, floors, ceilings,
  - Integration in products, furniture, clothes
  - Interactive
  - Multi functional
  - Adaptive

## LED light in the kitchen



## LED light in greenhouses

LED light plants

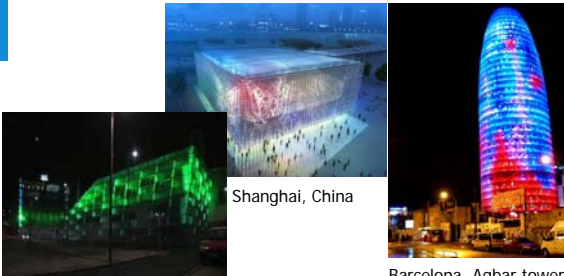


LED light roses



LED light; higher yield, lower energy consumption

## LED lighted Buildings



Linz, Austria.

The window color changes with the broadcasted music

Shanghai, China

Barcelona, Agbar tower

## Interactive LED art, Maastunnel Rotterdam



<http://www.studioroosegaarde.net/project/dune-4-1/>

## All electric

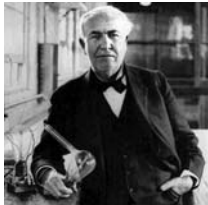
- In a future energy supply, households and companies can be both energy consumers and producers
- Electricity could be produced by solar systems, small wind turbines, piezo-electricity, biogas and biomass
- Fuel cell cars can produce electricity and deliver it to the grid as well
- Electric cars can store electricity in their battery system, which can be used to feed in the grid in order to balance supply and demand
- The new energy infrastructure will therefore link electricity generation, heating / cooling and transport.

## All electric, DC smart

- Smart Grids
  - Combination energy and information technology
  - Optimal control on demand, supply and storage
  - Two way grid
  - Smart metering with information about demand, supply and price
  - Intelligent agents for trading locally
- DC
  - Easy (no reactive power)
  - Less losses
  - Almost all appliances use DC
  - No unnecessary conversion losses from local production (solar, wind) to demand and storage (batteries)

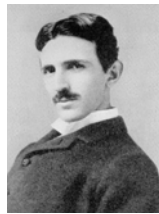
## Tesla versus Edison

### The AC - DC battle



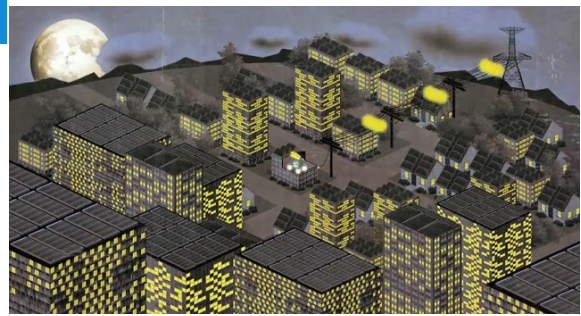
Thomas Edison  
11 february 1847, West Orange  
DC distribution

VS



Nikola Tesla  
10 July 1856, New York  
AC distribution

## AC versus DC



## Mobile power plant

- 7 million cars in the Netherlands times 50 kW is 350.000 MW, which is over 20 times present capacity
- Cars are in operation 7% of their time
- 0.5 million new cars per year in the Netherlands. Times 80 kW is 40.000 MW new capacity per year. More than 2 times present installed capacity
- 0.5 million new cars per year times 25 kWh storage capacity in an electric car, means 12.5 GWh storage capacity.
- In one year we can completely change our electricity system



## Mobile power plant



How to boil an egg?

Think different