

# New materials for energy management at BASF

**Dr. Joachim Rösch**

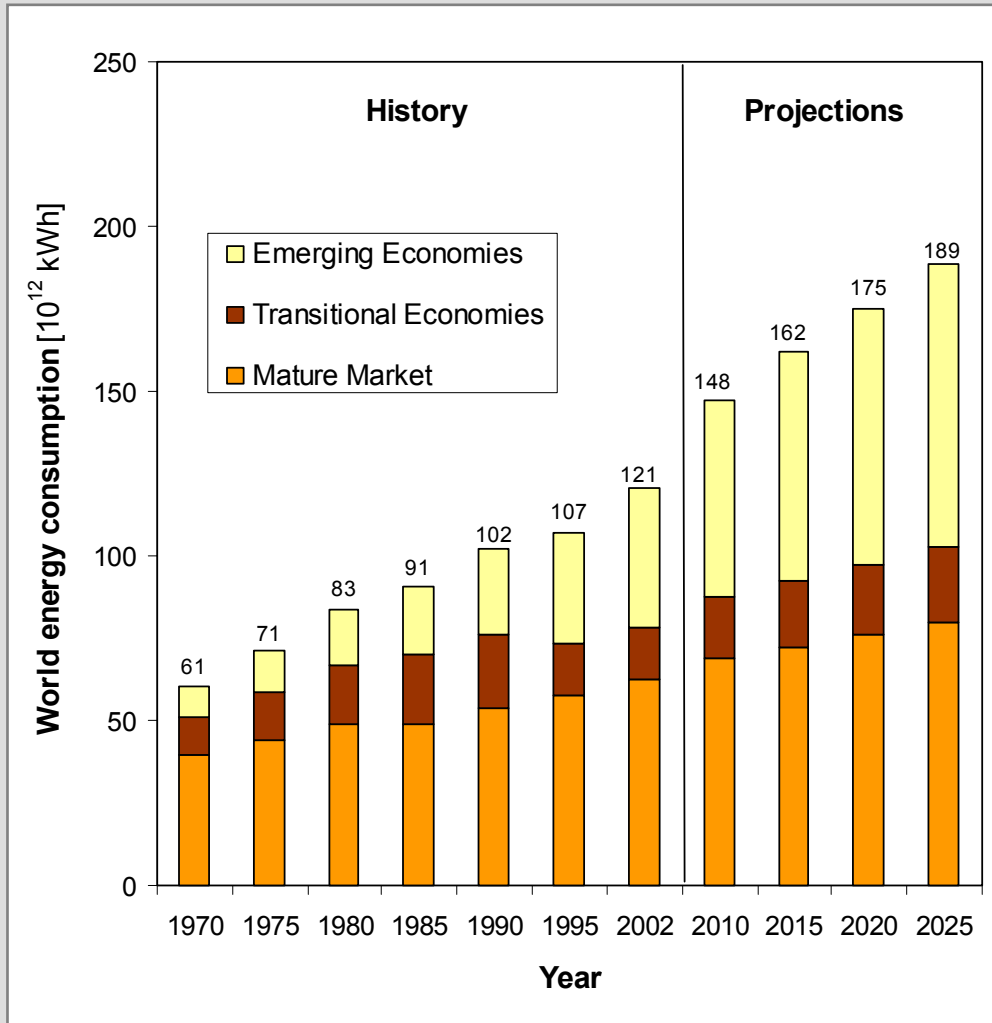
BASF Future Business GmbH

**BASF**

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# The world's energy consumption is projected to increase by 2% p.a.

Oil, coal and gas remain the main energy sources



## Trends in emerging economies

- Energy demand grows faster in **emerging economies** (3.2%)
- Energy demand is largely driven by China and India
- **Fossil fuels** continue to supply the major share of energy consumption
- The challenge is to build infrastructure (e.g., coal-fired power plants)

## Trends in mature markets

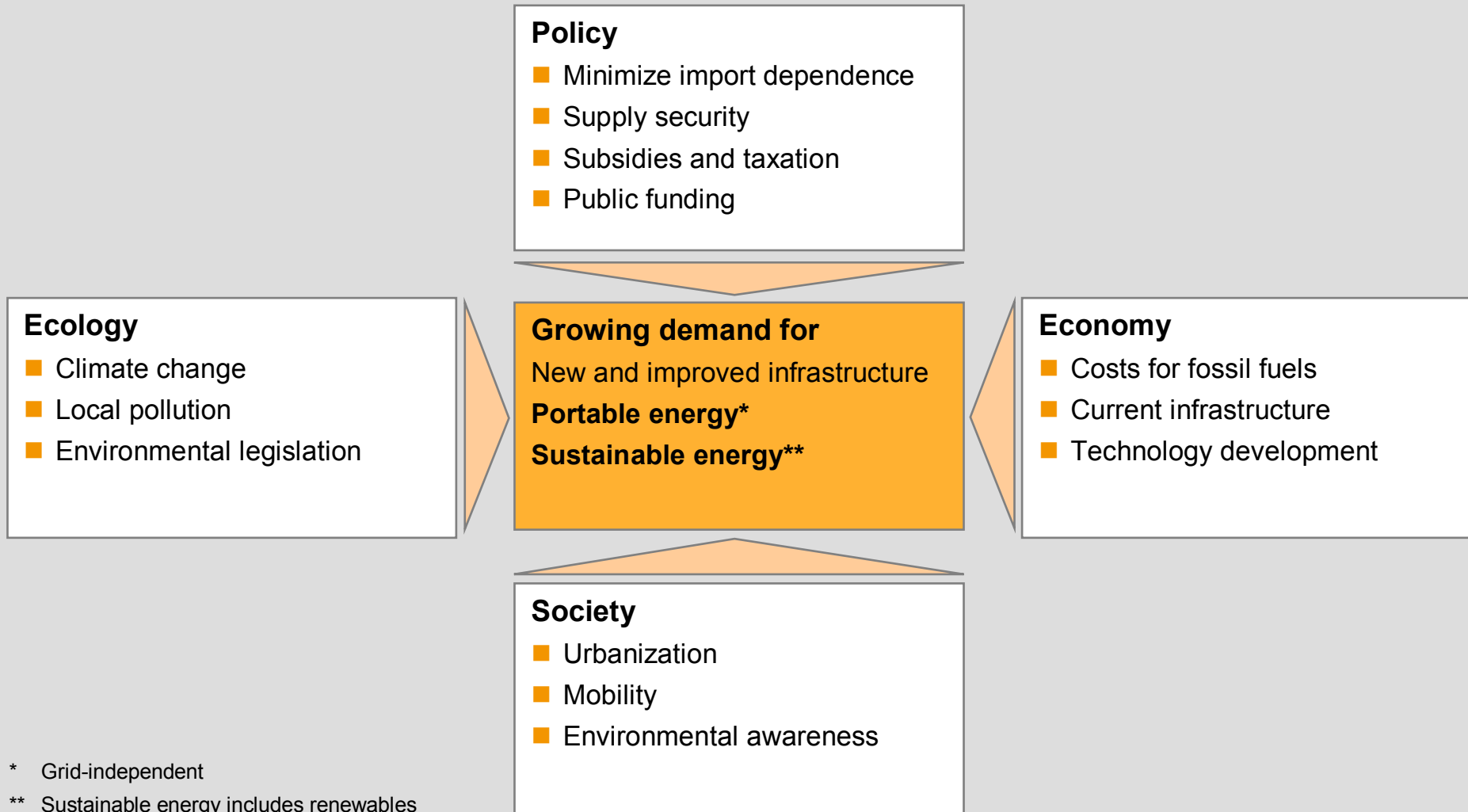
- Energy demand grows slowly in **mature market economies** (1.1%) due to a shift from energy-intensive industries to service-oriented industries
- Energy demand is driven by USA, Japan, Korea
- Fastest growth is predicted for the commercial sector (**portable energy**)
- Challenges are energy saving and promotion of renewable energy (**sustainable energy**)

# Energy relevant sectors at BASF

Technology	Tomorrow	<ul style="list-style-type: none"> <li>■ Nano foams</li> </ul>	<ul style="list-style-type: none"> <li>■ Fuel cells</li> <li>■ OLED lighting</li> <li>■ Thermoelectrics</li> <li>■ Photovoltaics</li> <li>■ Li-batteries</li> <li>■ Capacitors</li> <li>■ Gas storage</li> </ul>
	Today	<ul style="list-style-type: none"> <li>■ Oil and gas (Wintershall)</li> <li>■ Insulation (Neopor...)</li> <li>■ 3-liter-house (LUWOG)</li> <li>■ Fuel additives</li> <li>■ Biodiesel (catalysts)</li> <li>■ Gas scrubbing (CZ)</li> </ul>	<ul style="list-style-type: none"> <li>■ Geothermal energy (Wintershall study)</li> <li>■ Biofuels (Plant Science)</li> <li>■ Oil field chemicals</li> <li>■ Phase change materials</li> </ul>
		Today	Tomorrow

**Growth Cluster**  
**Energy Management**  
Portable energy  
Sustainable energy

# The future energy markets are influenced by four key drivers



\* Grid-independent

\*\* Sustainable energy includes renewables and energy saving (efficiency)

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## Energy Management



### Fuel Cells

- Direct methanol fuel cell MEAs
- High temperature membranes



### Batteries

- High-power lithium batteries
- Cathode materials



### OLED Lighting

- Phosphorescent emitters
- Organic semiconductors



### Gas-Storage

- Natural gas storage for cars
- Methane hydrates



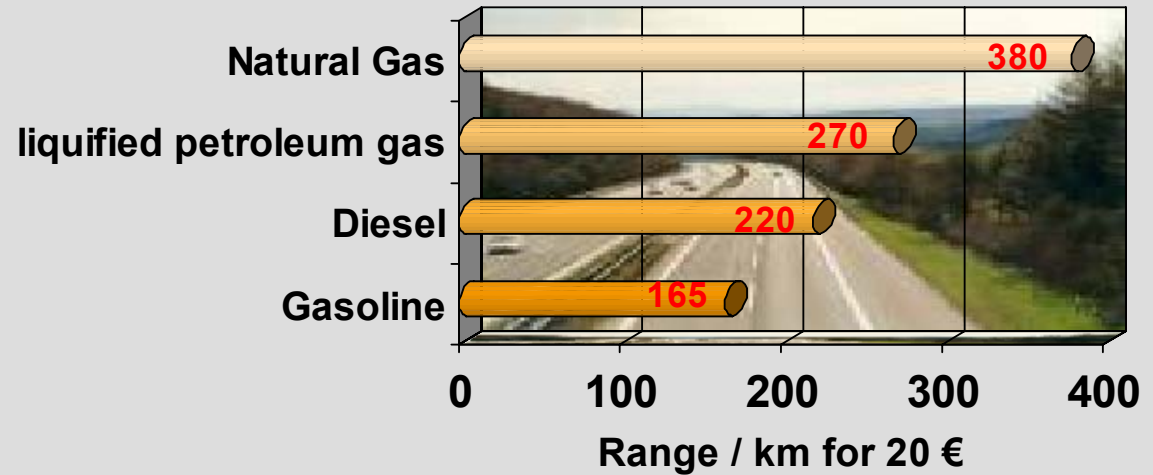
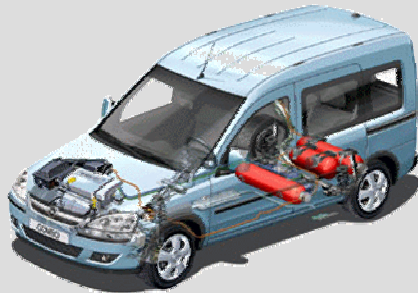
### Photovoltaics

- Excitonic solar cells
- Dye sensitized solar cells

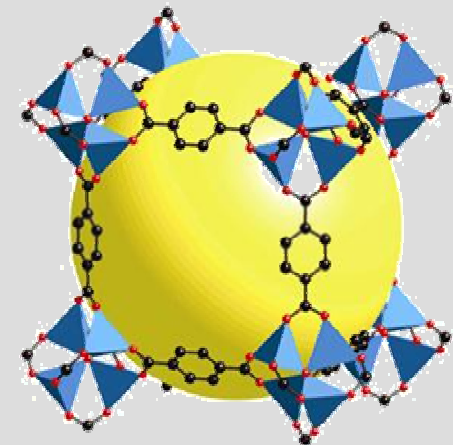


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# Increase today's limited driving range with improved storage in nanocubes



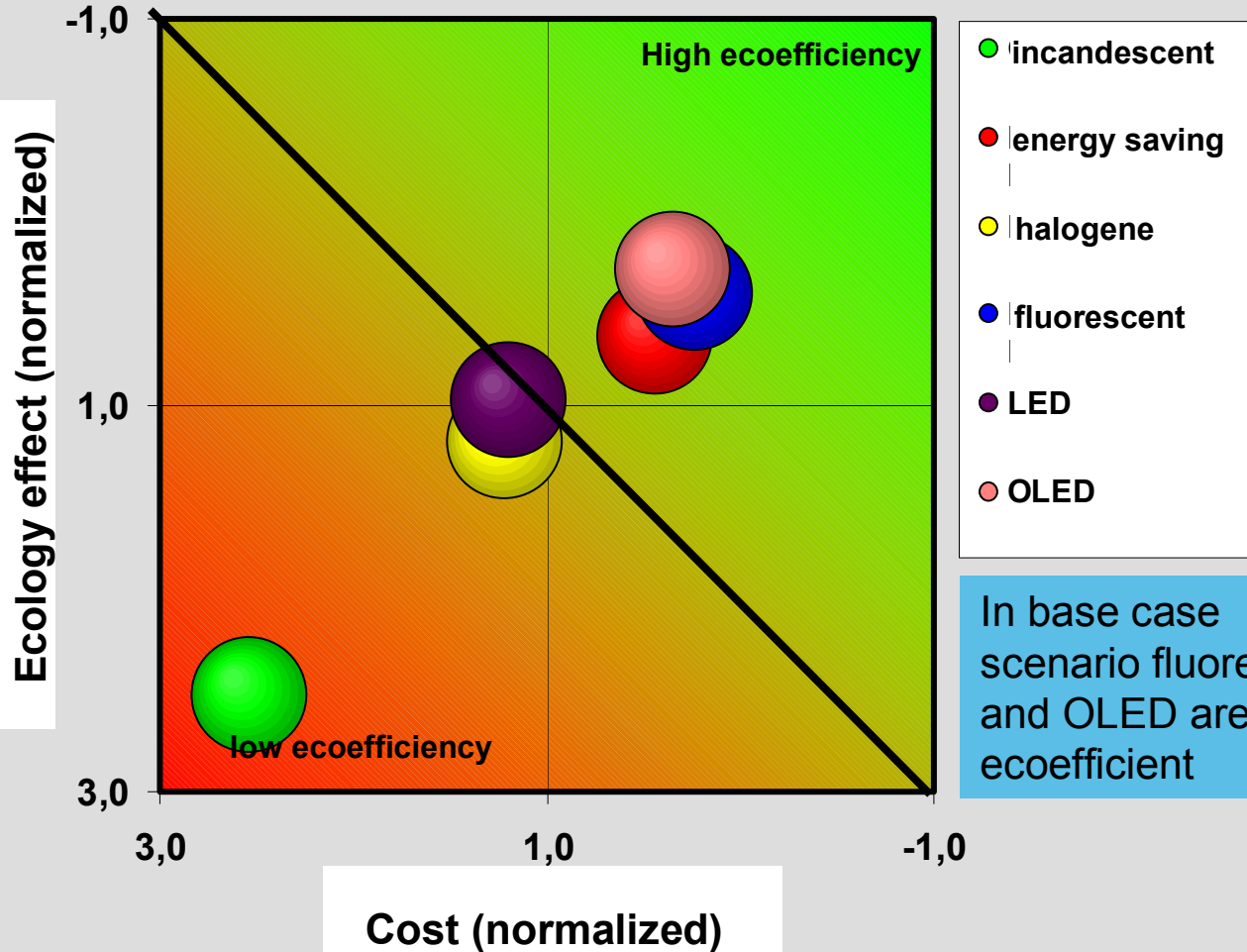
- Cost and environmental benefits from natural gas cars already today
- However, driving range is limited to 400km
- > Solution: Increase storage density with high performance adsorbents (nanocubes)



# Base case: Portfolio of alternative technologies

Customized usage:

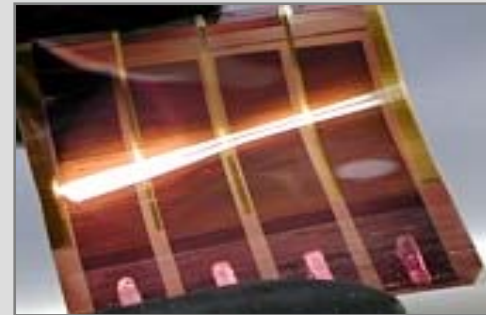
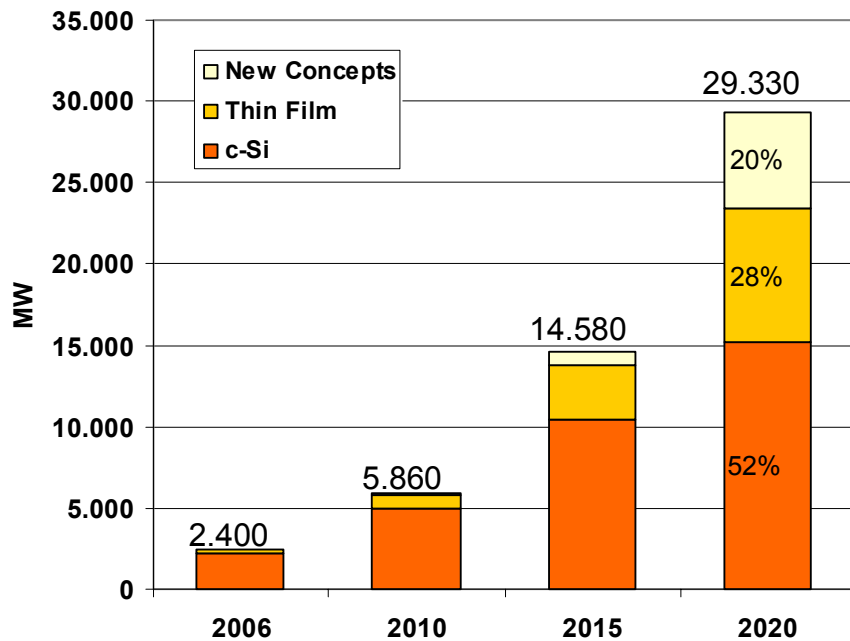
Lighting with 300 Lux white Light of a conference room with dimensions 15m x 8m x 3,4m for 20.000 hrs



# Organic Photovoltaics

## Market by Technology 2006 - 2020 (systems)

CAGR 2006 - 2020: 20%



**dyes**  
instead of  
**silicon**

**low cost**  
**printed**

and  
**flexible**

# Energy storage economics and renewables

## Why not utility scale batteries?

### Not all renewables are volatile

- **PV: synchronous with daily demand – moderate storage needs**
- **Wind: Linked to weather pattern – need partial storage and improved prediction**
- **Biomass: already stored energy**

**Cost for electricity storage in batteries adds at least 10 cent/kWh**

### Many cheaper competing solutions

- **Hydrostorage lakes**
- **Compressed air storage**
- **Transnational grid extension and integration**
- **Smart grid / smart appliances / smart metering**
- **Optimized integration of all energy technologies**

# Distance reached with 1 ha of energy crop/ PV ground mounted system

**Biodiesel\***



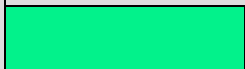
21.500 km

**Bioethanol\*\***



22.500 km

**Biomass to liquid\***



60.000 km

**Biogas (from corn)\***



67.000 km

**Electricity (PV\*\*\*\* to plug-in hybrid or EV)\*\*\***



3.250.000 km

**1ha =  
100\*100 m**



**0,75 ha**

\* 6,5 l/100 km fuel equiv.

\*\* 7,4l/100 km fuel equiv.

\*\*\* 16 KWh/100 km

\*\*\*\* 520.000 kWh/ha\*y (Germany)

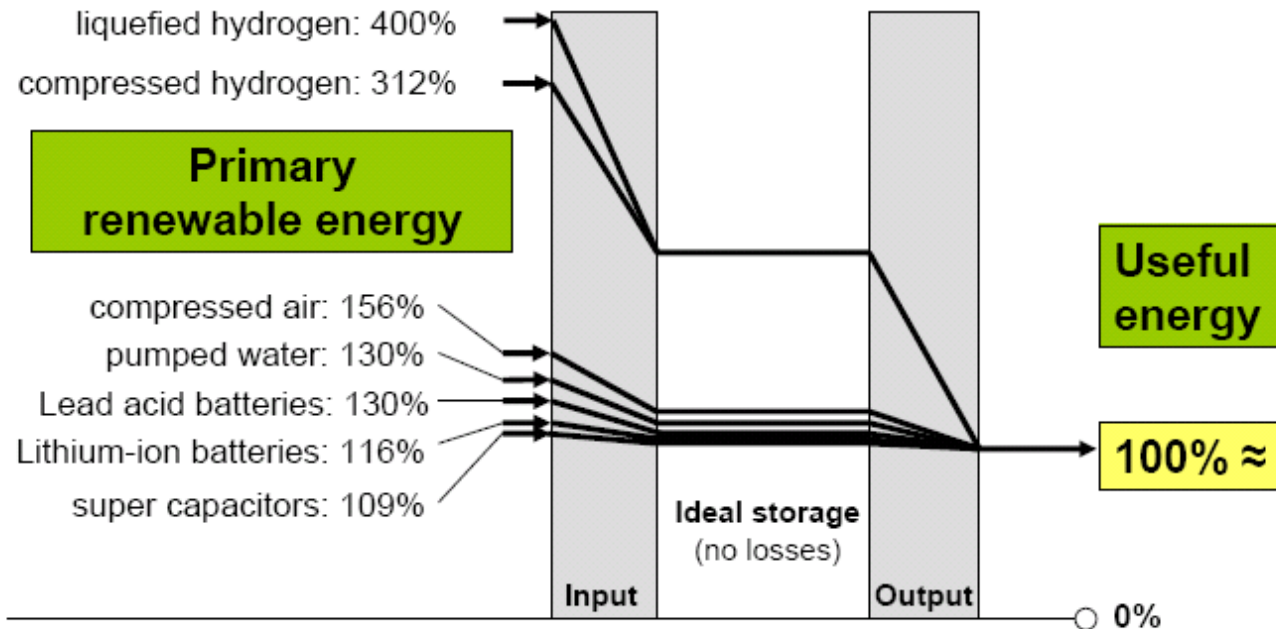


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# Energy storage economics and renewables

## Poor efficiency adds additional cost

### Renewable Energy Demand to Cover Storage Transfer Losses

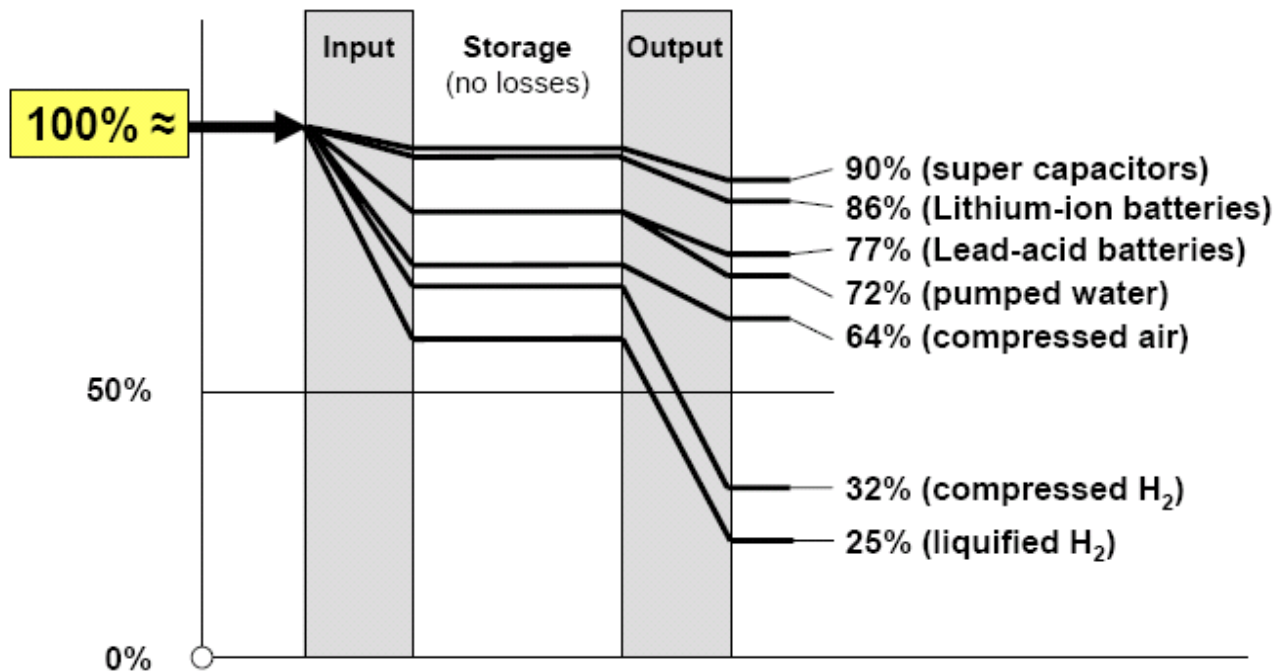


**Storage transfer efficiency essential for economic use of renewable energy**

# Energy storage economics and renewables

## Poor efficiency adds additional cost

### Energy Storage Transfer Losses



**Only 1/3 of the original energy for hydrogen storage**