

Renewable Energies for Manufacturing Industries

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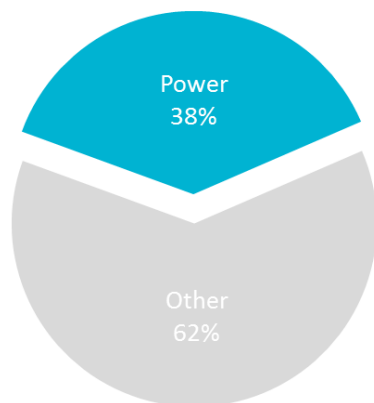
*RE-energising the Future, RE Industry workshop
Paris, 4 December 2015*

www.iea.org

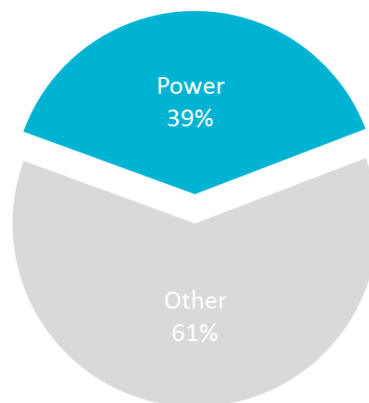
Electricity can power sustainable growth

2011

Primary energy use 550 EJ

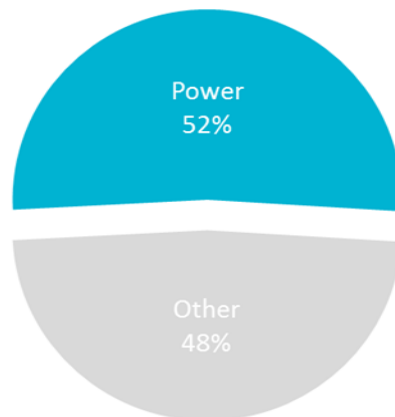


CO₂ emissions 33.8 Gt

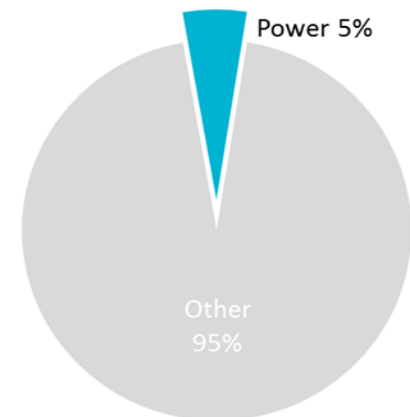


2050 2DS

Primary energy use 695 EJ

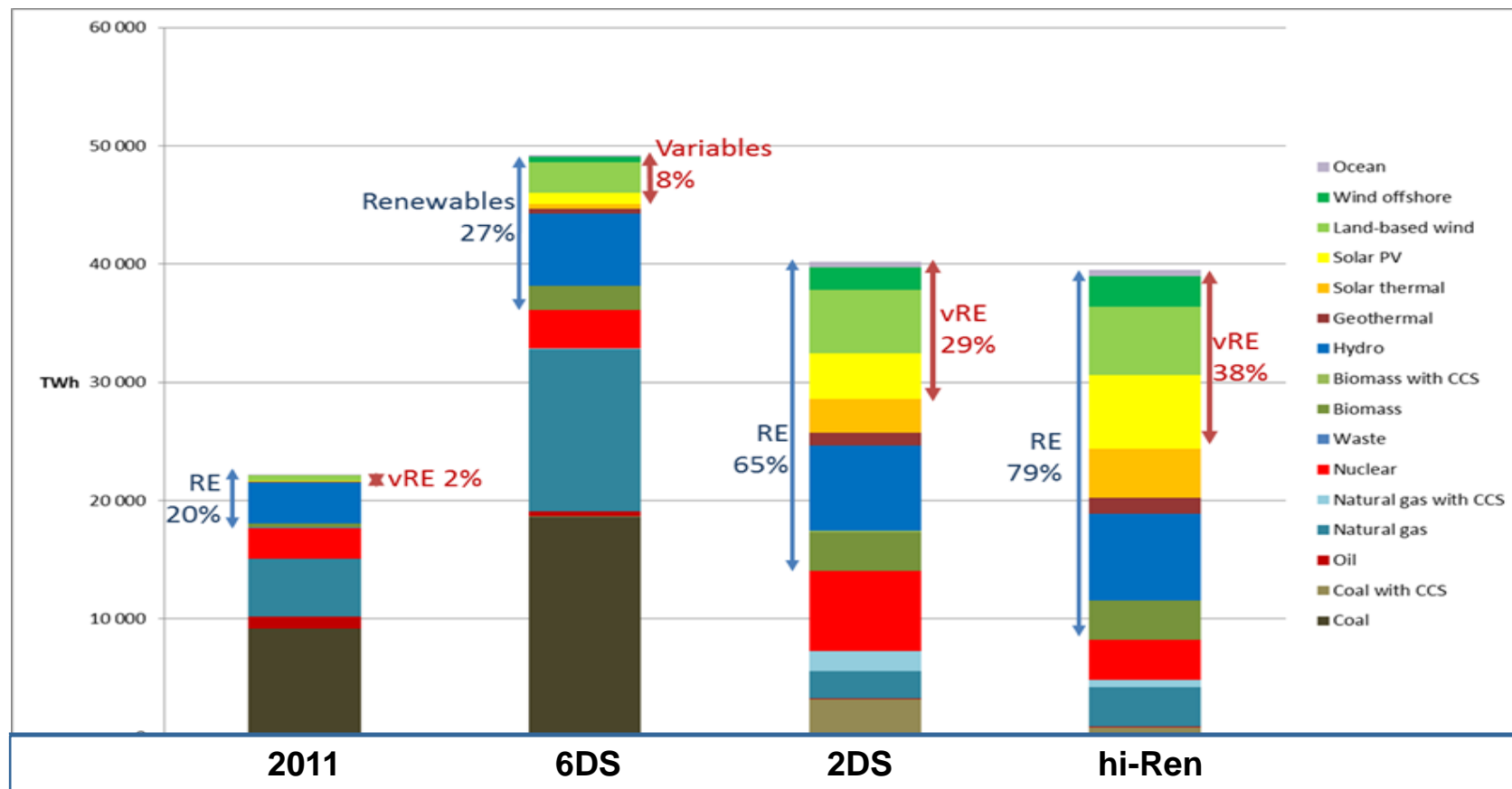


CO₂ emissions 15.0 Gt



Electricity Generation: a share reversal

ETP
2014



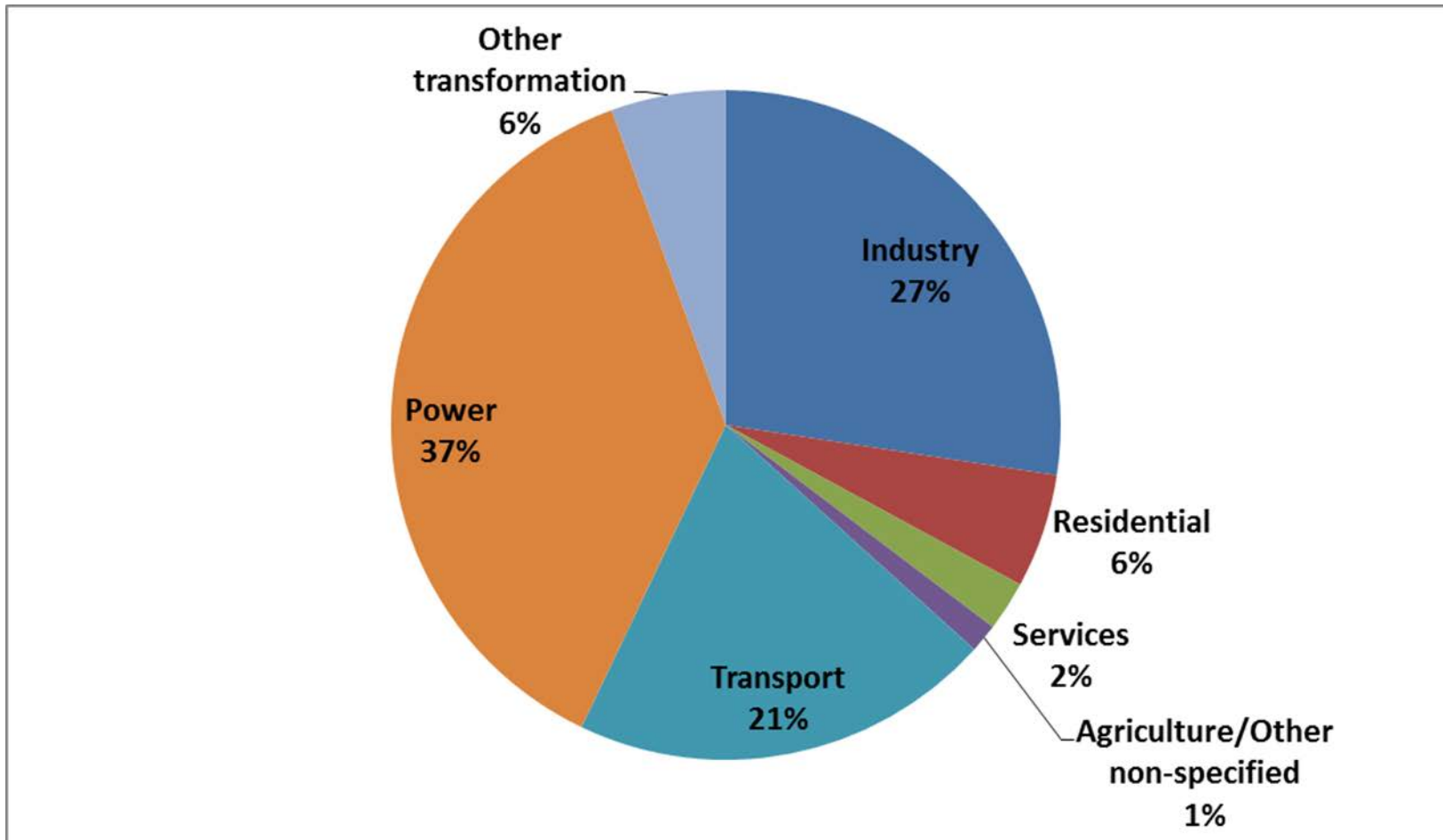
■ Generation today:

- Fossil fuels: 68%
- Renewables: 20%

■ Generation 2DS 2050:

- Renewables: 65 - 79%
- Fossil fuels: 20 - 12%

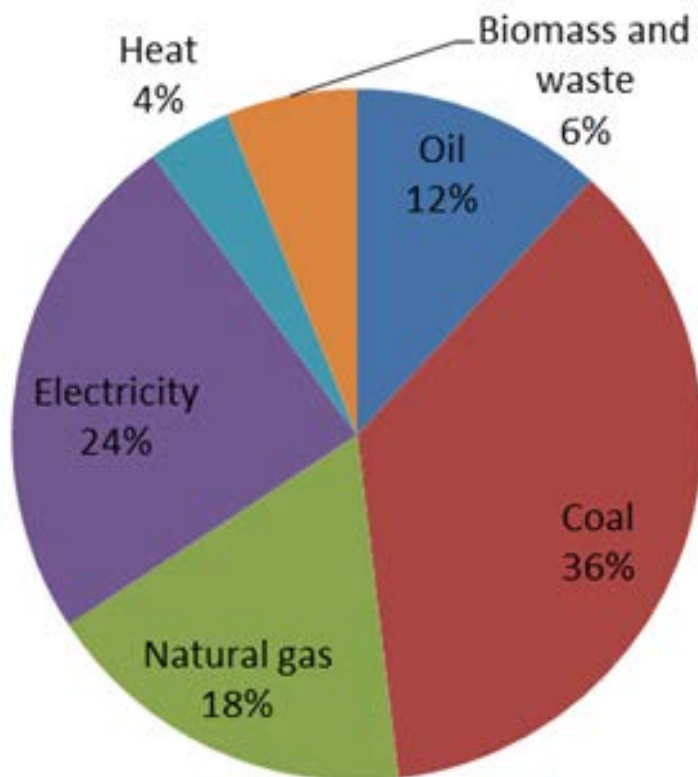
Industry and transport dominate non power sectors



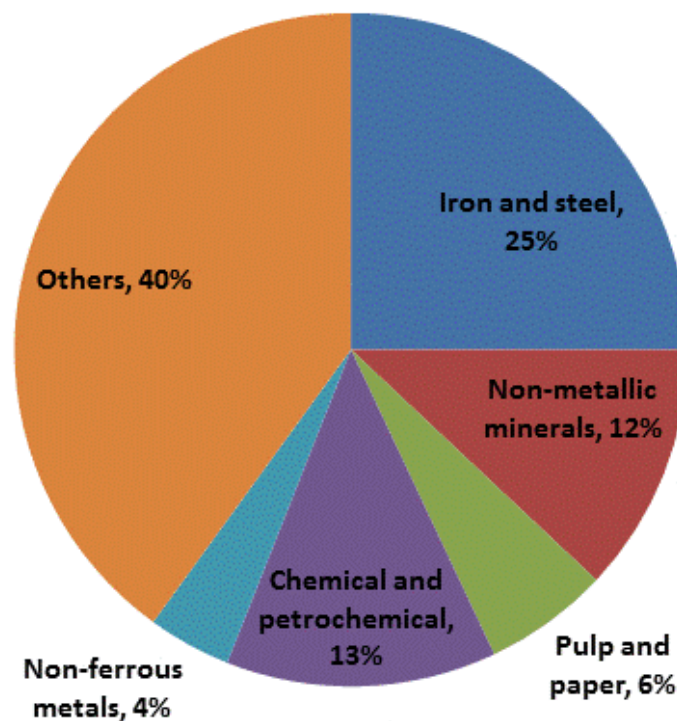
Fossil fuels dominate industrial energy use

ETP
2014

Final industrial energy supply by sources



Final energy demand by sub-sectors



Renewables for manufacturing industries – the rationale



International
Energy Agency
Secure
Sustainable
Together



- **Manufacturing industries use ~ 30% of global energy**
 - 40% including feedstock, blast furnace and coke oven
- **Demand would grow until 2050**
 - by 83% in the 6DS scenario (ETP 2014)
 - By 40% in the 2DS scenario
- **Some substitution would occur**
 - Biomass would grow from 6% to day to 13% in 2050 (2DS)
 - Electricity would grow from 24% today to 32% in 2050 (2DS)

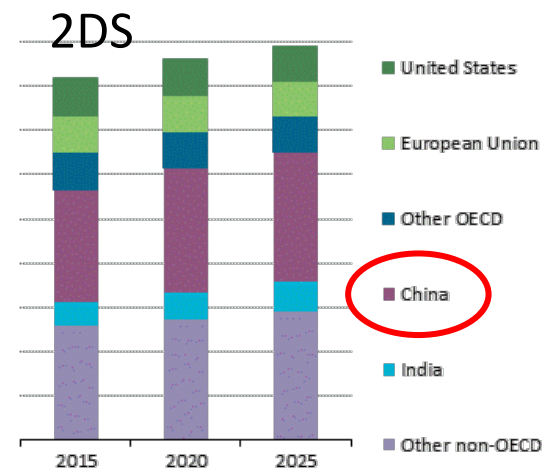
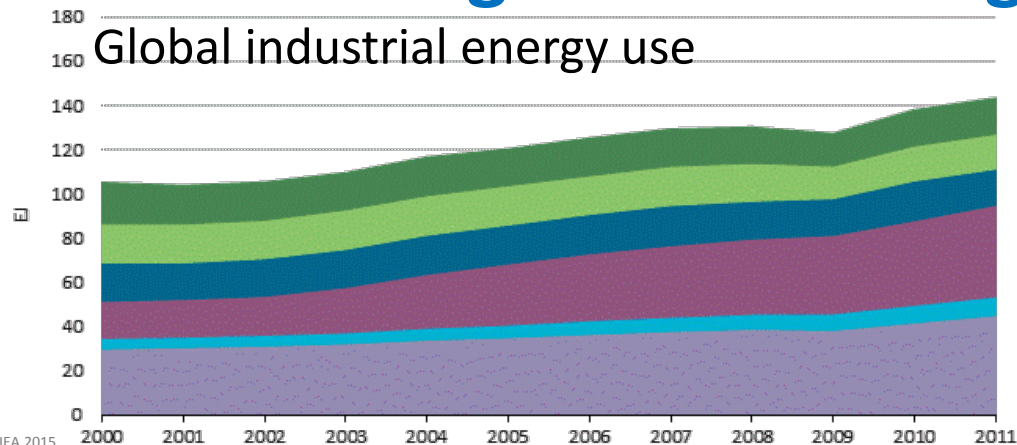
How to increase the use of RE in manufacturing industries?

- **How to increase the use of RE as in 2DS or beyond?**
 - For energy, feedstock, process agents...
 - Using biomass, solar heat, geothermal...
 - Hydrogen from renewables
 - (mostly) Renewable power, self-generated or from the grid
 - Electrification of industry help integrate more variable RE



A three-year effort

- **2015: Inception meeting at IEA Headquarters (May)**
 - Fact-finding and literature review
- **2016: Workshops and case studies**
 - China with SGCC, end of March
 - Possibly USA with EPRI, H2
- **2017: drafting and reviewing**



Current electrification trends

■ Ferrous metal recycling

- Energy-efficient

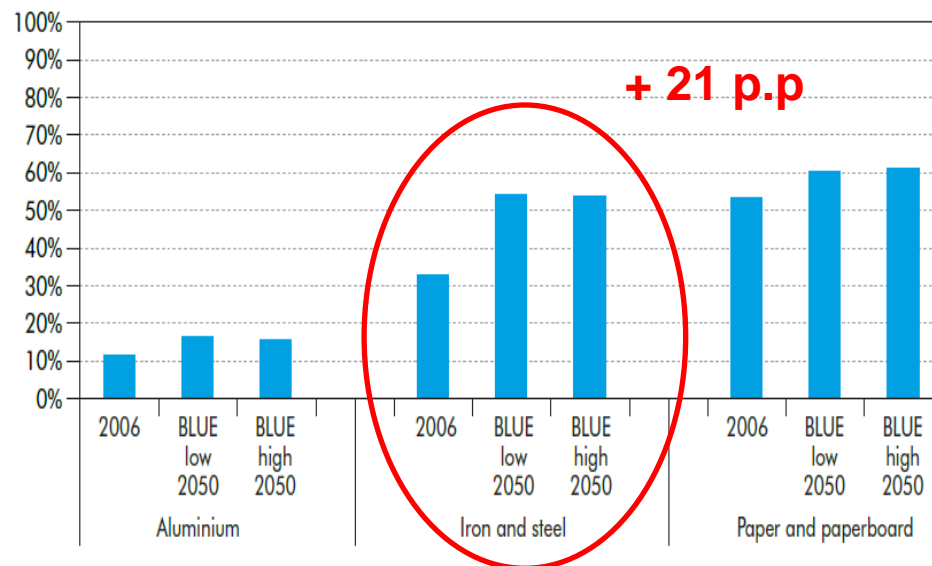
■ Advanced manufacturing

- Smart sensors
- Further automation
- Robotics & cobotics

■ Additive manufacturing

- 3-D printing save feedstock

Figure 7.12 ▶ Share of recycled materials by industry

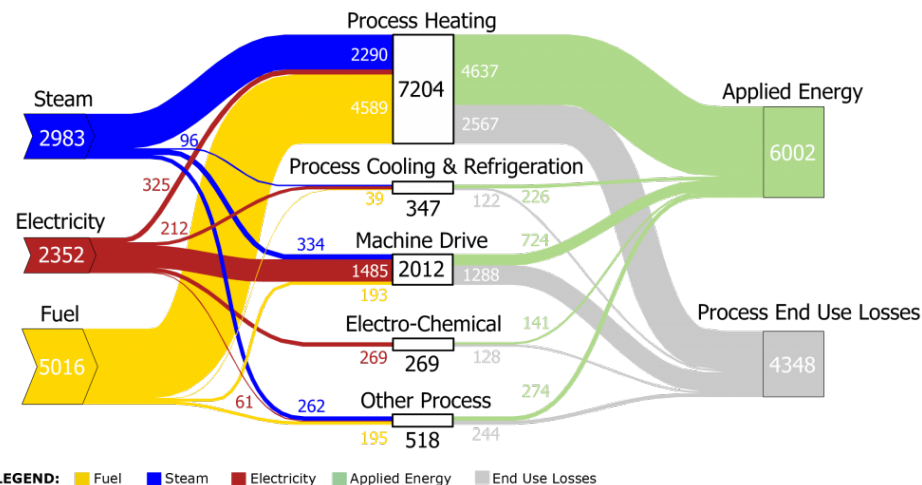


Source: IEA analysis.

Source : Energy Energy Transitions for Industry (IEA, 2009)

But process heating is the big fish (e.g. in the US)

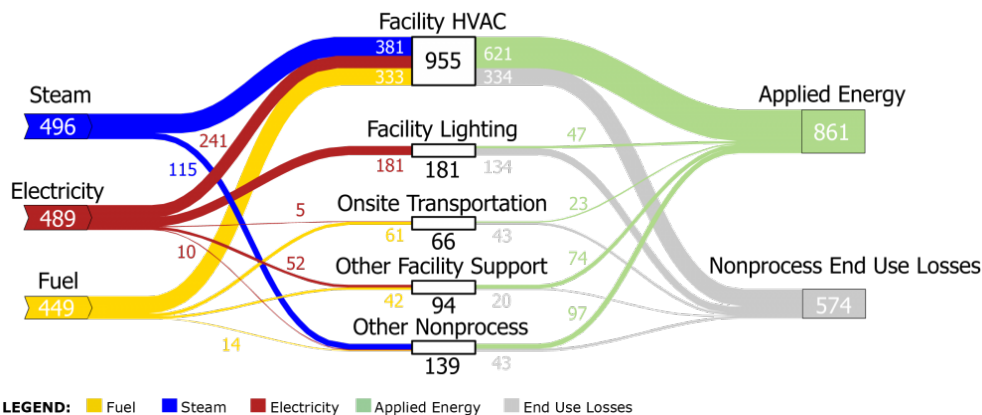
Process Energy (TBtu), 2010



Process Energy = 10 350 TBtu
88 %

Process Heating Energy = 7 204 TBtu
61 %

Nonprocess Energy (TBtu), 2010

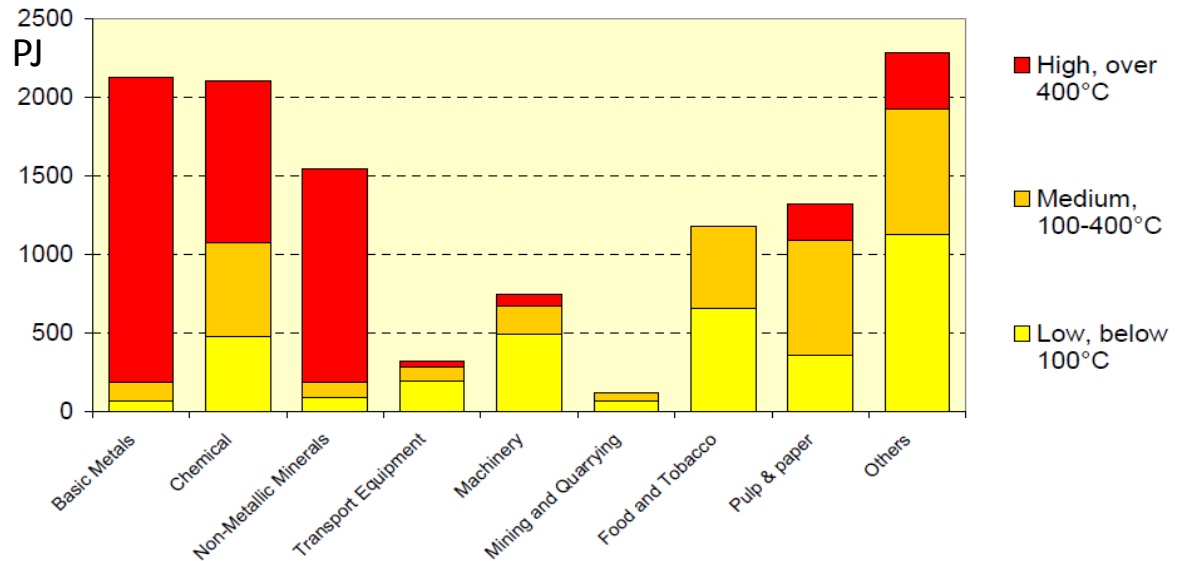


Non Process Energy = 1 434 TBtu
12 %

Source : D.O.E., Office of Energy Efficiency & Renewable Energy (from MECS 2010)

Markets: industry

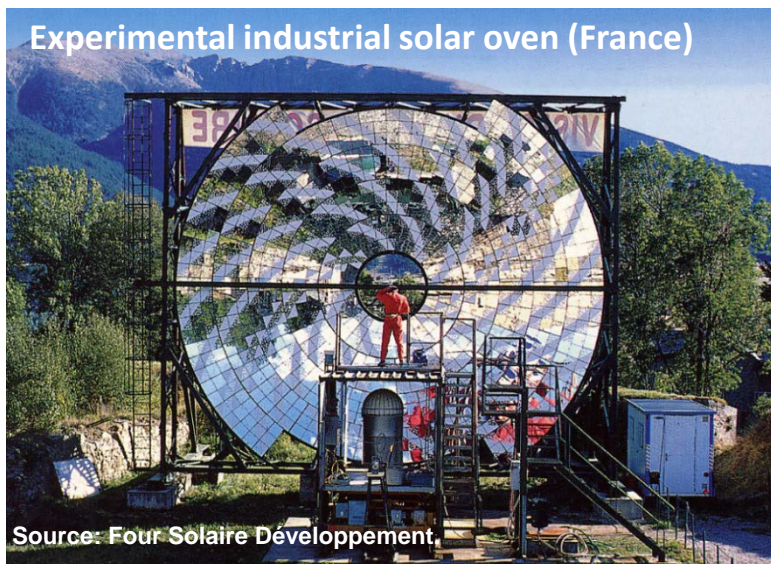
Estimated industrial heat demand by temperature range in Europe, 2003



Source: Werner, 2005-2006

- Large heat needs at various temperature levels in industry and services;
- Low-temp. solar heat available everywhere, demand all year round
- High-temp. solar heat under hot and dry climates

Solar heat industrial use



Mirrah, Oman, forthcoming

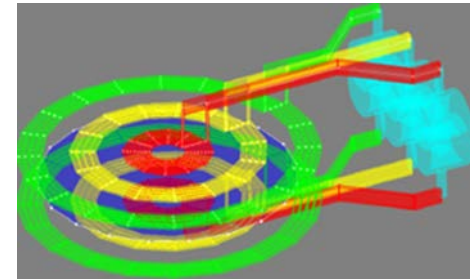
Parabolic troughs protected from winds & soiling in greenhouse (*Glasspoint*)



... for enhanced oil recovery operations

Efficient electric heating technologies

- **Industrial heat pumps**
 - Commercially available to 100°C output
 - Reaching 140°C output would double potential
- **Induction heating and smelting**
- **Microwaves (food, rubber, plastics)...**



Electrowinning

Electrowinning cell demonstrator
(ULCOwin, 2011)



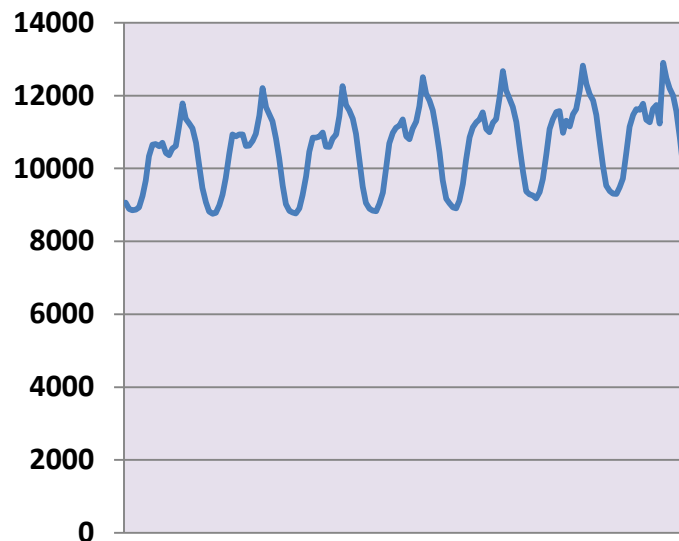
Opportunities Brought by Industries Electrification



国家电网
STATE GRID

- ◆ Industries electrification will result in the growth of electricity demand which brings opportunities for RE grid integration.
 - ◆ Growth of industrial electricity provide a large **market for RE**;
 - ◆ Increase of the share of industrial load **changes the load profile** and **decrease the peak-valley ratio (peak-valley difference/ total load)** of load.

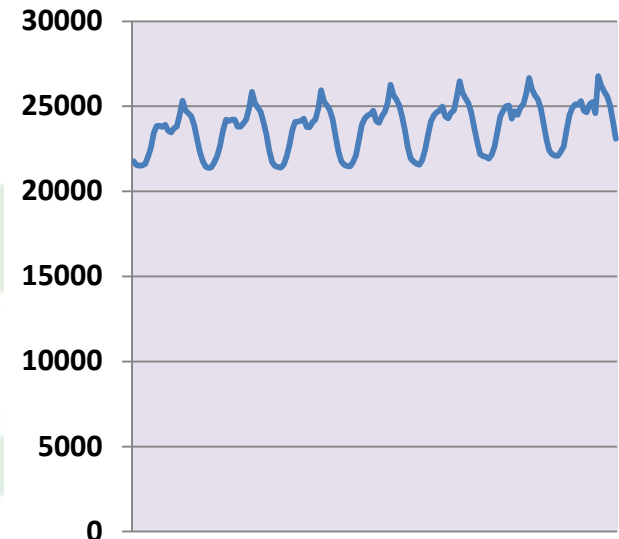
peak-valley ratio: 31.70%



Residential load grow
Industrial load grow

Peak-valley ratio decrease

peak-valley ratio: 20.13%



Some Economics

Comparison Battery/ Consumers

Battery



Battery Cost: 3500\$/10kWh (Tesla announcement)

Cost for a 1MW/1MWh Battery:

350k\$

Water Supply
Distribution System



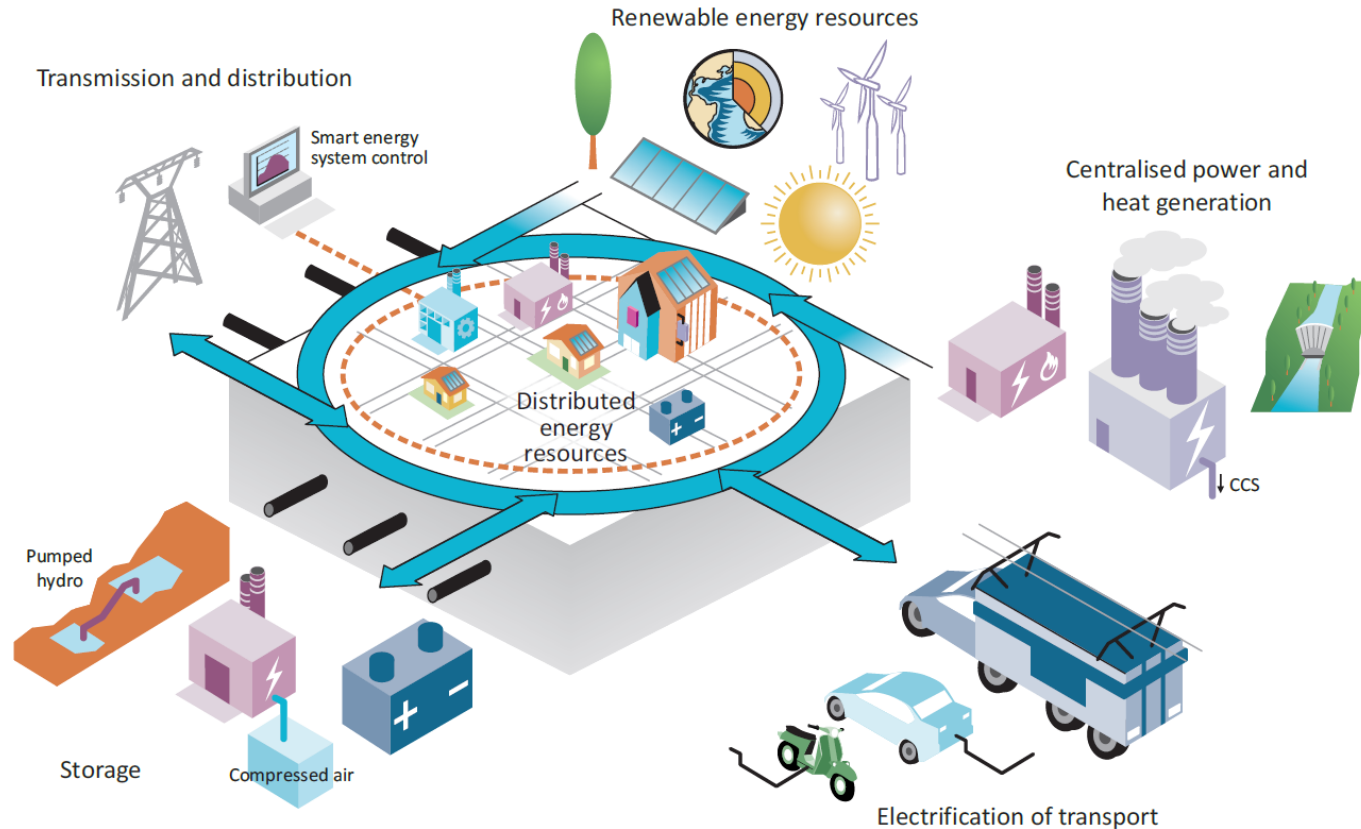
Instrumentation cost for a 1MW Flexibility at
the consumer side:

35k\$

**Store Energy in existing
consumers is 10 times cheaper
than the cheapest battery!!**

Systems thinking and integration

ETP
2014



A sustainable electricity system is a smarter, multidirectional and integrated energy system that requires long-term planning for services delivery

- **Renewable energies and manufacturing industries – first workshop, Paris, May 2015**
 - <https://www.iea.org/workshops/renewable-energies-for-manufacturing-industries.html>
- ***Energy Technology Perspectives 2014 – Harnessing Electricity’s Potential***
 - <http://www.iea.org/bookshop/472-Energy Technology Perspectives 2014>
- ***The Power of Transformation – Wind, Sund and the Economics of Flexible Power Systems***
 - <http://www.iea.org/bookshop/465-The Power of Transformation>
- ***Solar Energy Perspectives (2011)***
 - <http://goo.gl/uIUON6>