Renewable Energies for Manufacturing Industries

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Electricity can power sustainable growth

**2011**

- Primary energy use: 550 EJ
  - Power: 38%
  - Other: 62%

- CO₂ emissions: 33.8 Gt
  - Power: 39%
  - Other: 61%

**2050 2DS**

- Primary energy use: 695 EJ
  - Power: 52%
  - Other: 48%

- CO₂ emissions: 15.0 Gt
  - Power: 5%
  - Other: 95%
Electricity Generation: a share reversal

- Generation today:
  - Fossil fuels: 68%
  - Renewables: 20%

- Generation 2DS 2050:
  - Renewables: 65 - 79%
  - Fossil fuels: 20 - 12%
Direct "end-use" CO2 emissions

Industry and transport dominate non power sectors

- Industry: 27%
- Power: 37%
- Transport: 21%
- Other transformation: 6%
- Residential: 6%
- Services: 2%
- Agriculture/Other non-specified: 1%
Fossil fuels dominate industrial energy use

Final industrial energy supply by sources:
- Heat: 4%
- Biomass and waste: 6%
- Oil: 12%
- Electricity: 24%
- Coal: 36%
- Natural gas: 18%

Final energy demand by sub-sectors:
- Iron and steel: 25%
- Others: 40%
- Non-metallic minerals: 12%
- Chemical and petrochemical: 13%
- Non-ferrous metals: 4%
- Pulp and paper: 6%
Renewables for manufacturing industries – the rationale

- 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**

**Global industrial energy use**

![Graph showing global industrial energy use from 2000 to 2011. The graph includes categories such as United States, European Union, Other OECD, China, India, and Other non-OECD. The y-axis represents energy use in gigajoules, ranging from 0 to 180, and the x-axis represents years from 2000 to 2011.]
Current electrification trends

- Ferrous metal recycling
  - Energy-efficient
- Advanced manufacturing
  - Smart sensors
  - Further automation
  - Robotics & cobotics
- Additive manufacturing
  - 3-D printing save feedstock

Source: Energy Energy Transitions for Industry (IEA, 2009)
But process heating is the big fish (e.g. in the US)

Process Energy = 10 350 TBtu
88%

Process Heating Energy = 7 204 TBtu
61%

Non Process Energy = 1 434 TBtu
12%

Markets: industry

- 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

- Solar water heaters in a service area (Austria)
  Source: AEE INTEC.

- Cooking with Scheffler dishes (India)
  Source: Deepak Gadhia

- Experimental industrial solar oven (France)
  Source: Four Solaire Développement

- Solar air drying of coffee beans (Columbia)
  Source: SolarWall.
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)
Industries electrification will result in the growth of electricity demand which brings opportunities for RE grid integration.

- Growth of industrial electricity provides a large market for RE;
- Increase of the share of industrial load changes the load profile and decreases the peak-valley ratio (peak-valley difference/total load) of load.

**Graphs:**
- Peak-valley ratio: 31.70%
- Peak-valley ratio: 20.13%

**Graph Descriptions:**
- Residential load growth
- Industrial load growth
- Peak-valley ratio decrease
Battery Cost: 3500$/10kWh (Tesla announcement)

Cost for a 1MW/1MWh Battery:

350k$

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

35k$

Store Energy in existing consumers is 10 times cheaper than the cheapest battery!!
A sustainable electricity system is a smarter, multidirectional and integrated energy system that requires long-term planning for services delivery.
Useful links

  - [https://www.iea.org/workshops/renewable-energies-for-manufacturing-industries.html](https://www.iea.org/workshops/renewable-energies-for-manufacturing-industries.html)

- **Energy Technology Perspectives 2014 – Harnessing Electricity’s Potential**

- **The Power of Transformation – Wind, Sund and the Economics of Flexible Power Systems**

- **Solar Energy Perspectives (2011)**
  - [http://goo.gl/uIU0N6](http://goo.gl/uIU0N6)