



Workshop on Business Models for Renewable Energy Aggregators - Session II

"RES aggregators as providers of flexible and competitive electricity supply"

"The Needs of the Industrial Electricity Consumers"

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Questions to be answered:

Is using higher share of increasing share of electricity from renewable distributed generation in industrial process a target?

Can industrial processes be adapted to intermittency?

Is helping the congestion management a target?

Target is to produce industrial products such as Copper or Industrial Gases, in a sustainable and competitive manner in a predictable way.

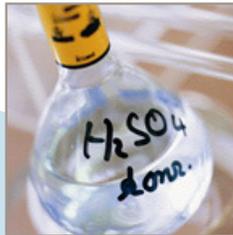
To the extent Renewable Electricity and Demand Aggregation bring down the electricity system cost and thus help Industry to remain sustainable and competitive, industry will be looking forward to engage itself and when it has the capacity, to react flexibly to the market directly or through intermediaries.

Aurubis, an integrated copper producer



CONCENTRATES

BU Primary Copper



SULFURIC ACID



Iron silicate

BU Recycling / Precious Metals



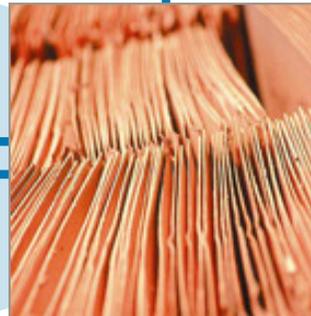
RECYCLING MATERIALS



EDEL-METALLE

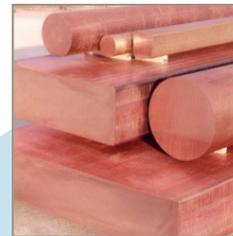


Other metals



CATHODES

BU Copper Products



SHAPES



Flat rolled products



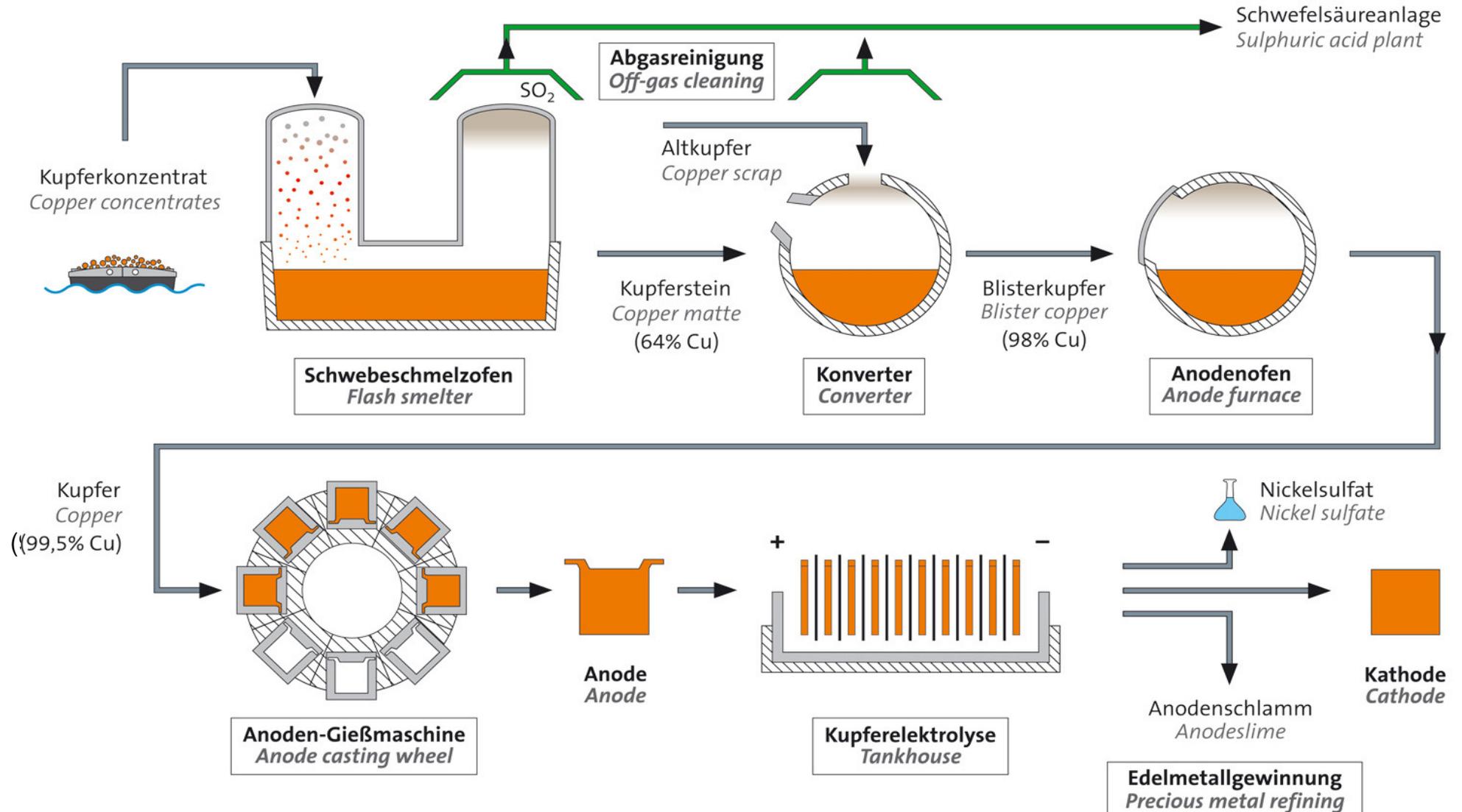
WIRE ROD



Other semi-finished products



Primary copper production process



Aurubis recycling turns secondary raw materials into first-class products

Copper scrap



E-scrap



Shredder materials



Printed circuit boards



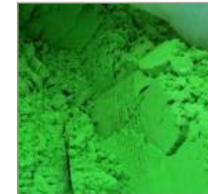
Slimes, industrial residues



Best available technologies



Grade A copper cathode



Nickel sulfate



SnPb alloy



Anode slime (precious metals)



Zinc-bearing KRS oxide



Iron silicate sand

Demand Flexibility opportunities must be balanced with other company objectives required by Sustainability, Energy Efficiency and Emissions Efficiency.

- » Modulating demand in a flexible manner will be possible only for a part of a the total plant consumption.
- » Ancillaries are flexible, but a small portion of the total consumption. Moreover, not all industrial processes can respond to market or TSO signals close to real-time.
- » A deep analysis of demand flexibility potential, by professionals who understand the industrial sector, per installation, is necessary to establish the business cases.
- » Such an analysis would result in a list of potential investments (e.g. for storage of products/energy) and to increase demand flexibility.
- » The investment to install equipment to make the demand flexible must be planned long in advance, to coincide with the planned major shutdowns.
- » The “flexibility” enhancing investment solutions should not undermine continuity or safety of operation.
- » Encouragement for demand-flexibility should be financially attractive to overcome the possible loss of objectives towards sustainability.

- » Aurubis is not the only organisation interested to deliver Demand side services;
- » Industrial gases company, Linde is an active DSR player in several countries and has made a number of contributions to the debate in this area, which you can find on the Commission Smart Grids Task Force and UK National Grid Demand Responsive sites, amongst other places.
- » Chris Webb, Linde's Head of Energy Management for EMEA summarised their view as follows :

Demand Side Response

One view from an industrial consumer


THE LINDE GROUP

DSR is not
“negative
generation”

- Linde's number one focus is on safe and efficient delivery of industrial gases to our customers - DSR is a secondary activity which disrupts that, so there has to be an **economic incentive** to take part.

Predictability

- **Participation in DSR may require investment** in storage, control systems, or process equipment . The capex required is easiest to justify if some element of the DSR revenue is fixed, and the **Regulatory landscape is predictable**.

One size does
not fit all !

- **DSR schemes must be flexible**; in duration, in lead time, in contract term, in baselining and in frequency, or potential players will be excluded.

Efficient or
Economic

- Most DSR makes production less energy efficient at the point of use, but takes OSGTs or Diesel Generators out of the stack - so reduces the carbon intensity of the overall electricity system - the '**greenest**' solution.

CONFIDENTIAL

EEFIG Report 2015

EU Industry leads in EE, yet Substantial Savings Available...



EU Industry:

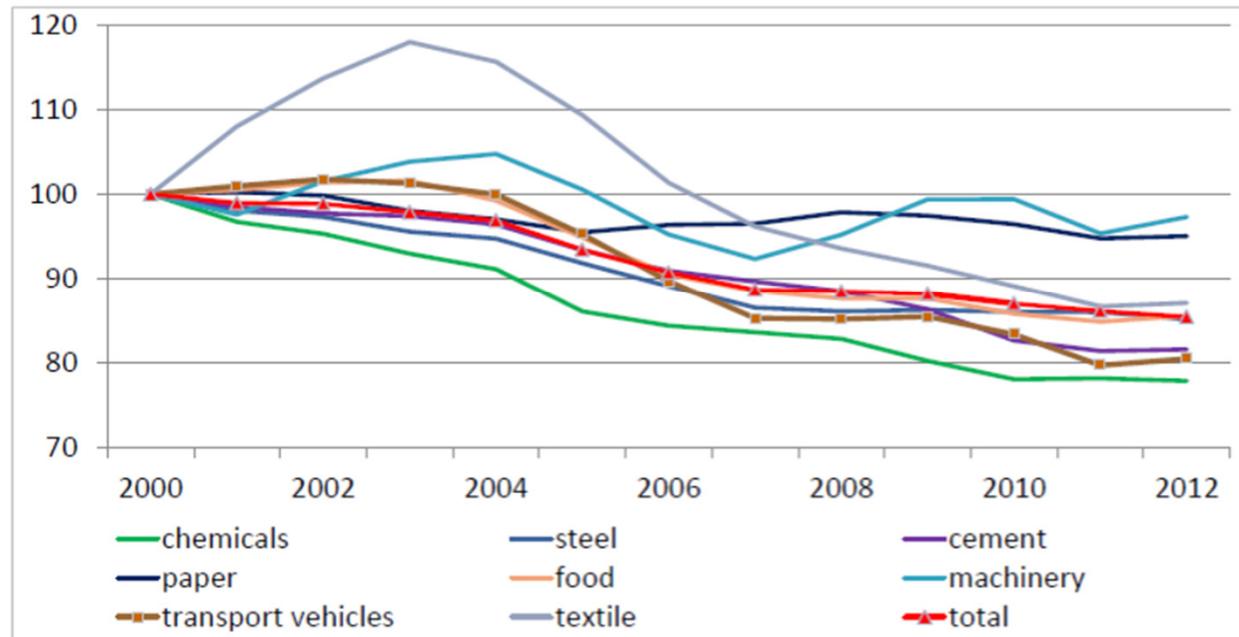
- Responsible for (26%) of European final energy consumption
- World leader in EE

EU Industrial Energy Efficiency:

- Improved on average by 1.3% per annum over the last 15 years
- Speed of progress has been reduced since the financial crisis

Yet Potential additional savings with a 2030-2050 horizon are substantial

Energy Efficiency Index (ODEX) in EU Manufacturing Industries calculated by ODYSSEE-MURE project and published November 2014, using industry data rebased from year 2000.



Demand Flexibility must be balanced with Energy Efficiency targets

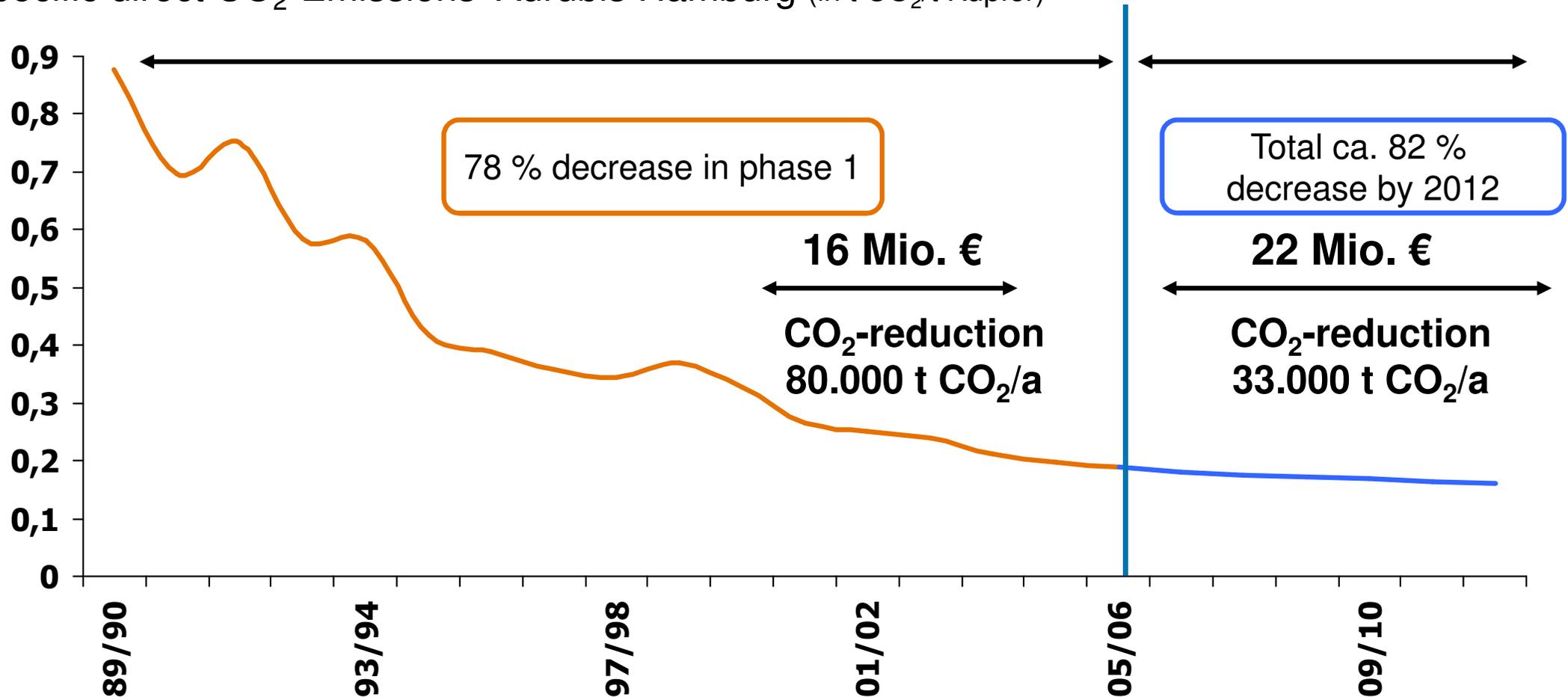
- » Modulating demand in a flexible manner results in loss of energy efficiency.
 - » e.g. Furnaces in stand-by due to cutting of electricity load
 - » Shutting off a part of the electrolysis-plant

- » Demand flexibility should be voluntary. Unpredicted shut down's result in huge financial losses and safety incidents.

- » There should be encouragement for demand-flexibility while overcoming the threat of under-achieving the energy efficiency improvement targets.

CO₂-Savings potential is close to technological and physical limits

Specific direct CO₂-Emissions Aurubis Hamburg (in t CO₂/t Kupfer)



Aurubis committed to decrease by 2018 further 12.000 t CO₂/a in Hamburg site.

Demand Flexibility must be balanced with EU-ETS Targets

- » Modulating demand in a flexible manner may result in increase of CO₂ emissions.
 - » E.g. standby operations need to keep furnaces warm, however no Copper is produced. This results in increase of CO₂/ton of copper produced.
 - » Effects on other emissions, fine particle generation etc. needs to be studied.

- » There should be encouragement for demand-flexibility while overcoming penalties related to emission efficiency decrease.

Elements of a compelling Business Case for Demand Flexibility Program

- » Raise awareness of the entire site about the Demand flexibility & RE use involving all the employees, suppliers, customers etc.
- » Construct a Demand Flexibility program from several small projects.
- » Incorporate Demand Flexibility projects as a part of periodic technical upgrades.
- » Report monthly measurement of Energy units and costs and revenues due to demand flexibility and project a revenue for the future 5 years, after subtracting the cost of CO2 energy efficiency loss etc.
- » Get attention for “demand flexibility program” on the Board agenda based on cost and revenue forecasts.
- » Make demand flexibility and RE injection actions as a part of programs on “sustainability”, “circular economy”, “innovation”.
- » Indicate potential gain of goodwill at the government by being the “best” or as contributing to the EU goals of electricity supply security.
- » Implement the project along with an excellent technical partner, by “first time right” implementation philosophy. A failure in a project may jeopardize the bigger program.
- » Continue reporting the energy revenues expressed by the benefits from the demand flexibility projects.

Summary

- » Aurubis is among one of the best performers in the Energy Intensive Industries in the world.
- » Energy is a core-cost, innovation for sustainability is a must to remain competitive, and the Board underlines this.
- » Demand Flexibility improvements or RE injection, require high investments and are not economical with current technologies at current electricity market conditions.
- » An excellent technical partner with knowledge of demand-flexibility technologies in copper manufacturing needs to be developed.
- » Demand Flexibility and RE injection must be put in perspective with competitiveness, materials extraction efficiency and sustainability.





THANK YOU.

Aurubis AG

The Leading Integrated Copper Producer,

Aurubis is a member of various national Associations of energy intensive users, which are members of IFIEC Europe.

- ♀ Copper (Venus)
- ☉ Gold (sun)
- ☾ Silver (moon)
- ♁ Platinum (Uranus)
- ♄ Lead (Saturn)
- ♃ Tin (Jupiter)
- ♁ Nickel
- ♂ Zinc
- ♁ Sulfur

Back-up Slides



Annex 1: Company profile

- » Founded in 1866 as Norddeutsche Affinerie AG in Hamburg
- » IPO in 1998
- » Renamed in 2009 after the acquisition of Cumerio

Aurum + Rubrum = the red gold = Aurubis

- » Production sites in European countries and North America with about 6,500 employees
- » Third largest producer of copper cathodes in the world with an annual output of about 1.1 million t of copper cathodes
- » No. 1 copper recycler in the world
- » Largest rod producer in the world
- » One of the world's leading copper foil and flat rolled product manufacturers
- » Production capacities for approx. 1.3 million t of different copper products
- » Global leader in environmental protection