SMART ENERGY
Anforderungen der Anwender - Lösungswege

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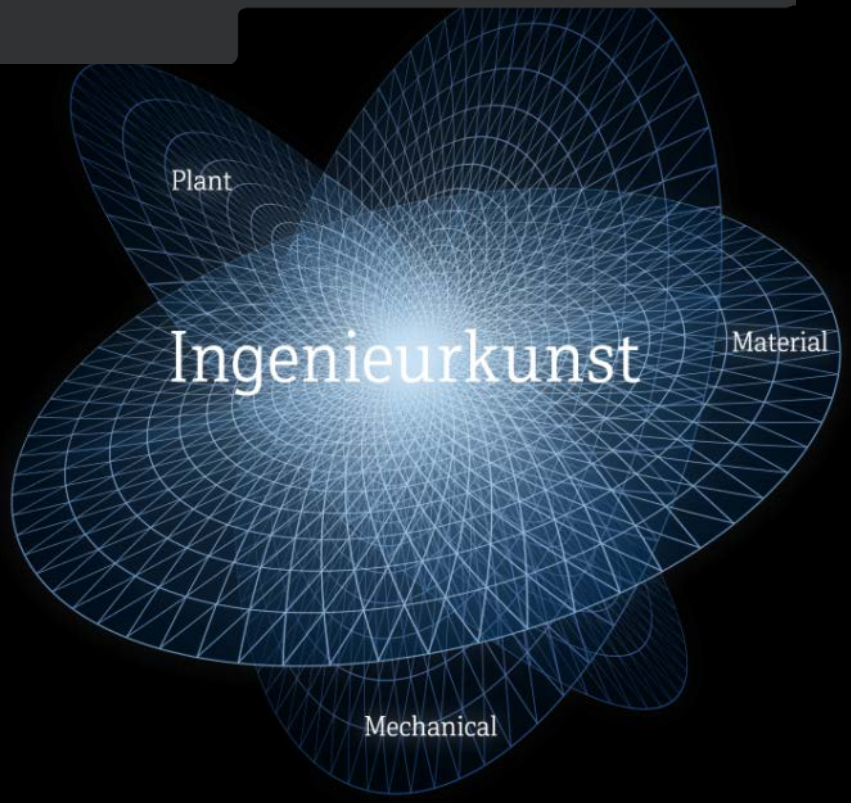
München, 14. Mai 2014



Wir entwickeln die Zukunft für Sie.

ThyssenKrupp

Leading engineering expertise supports global sustainable progress

Drivers	Demand ("more")	Business opportunities	Demand ("better")	Limitations
Demography 	More consumer and capital goods	Resources	Reduction of CO_2 emissions; Renewable energies	Climate change 
Urbanization 	More infrastructure and buildings	ThyssenKrupp Leading engineering competence in Material Mechanical Plant	Efficient infrastructure and methods/ processes	Limited resources 
Globalization 	More consumption of resources and energy	Infrastructure	Efficient use of resources and energy; Alter-native energies	Political framework 

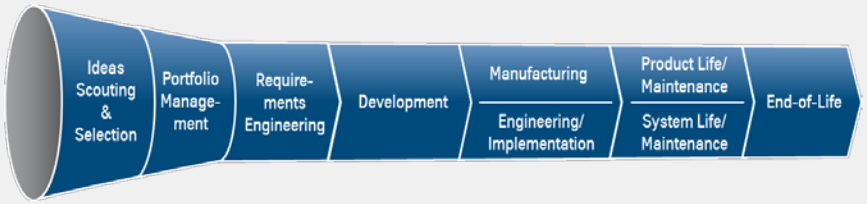
Business opportunities for ThyssenKrupp:
Positioning in growth areas

Business opportunities for ThyssenKrupp:
Differentiation with solutions

Sustainable Innovation Strategy

- We strive for leading edge technology
- Create sustainable products and solutions for our customers …
  … and produce them in a sustainable manner.
- Have a system optimum in mind (versus local optima).
- Differentiation:

Resource efficiency
- Energy
- Materials
- Etc.



Product Lifecycle

Sustainable includes economical, social and environmental aspects.

Transition of the Energy System (Energiewende)

The increasing use of renewable energy creates a paradigm shift!

Paradigm shift

From … **Power generation follows consumption**

To … **Consumption follows generation**

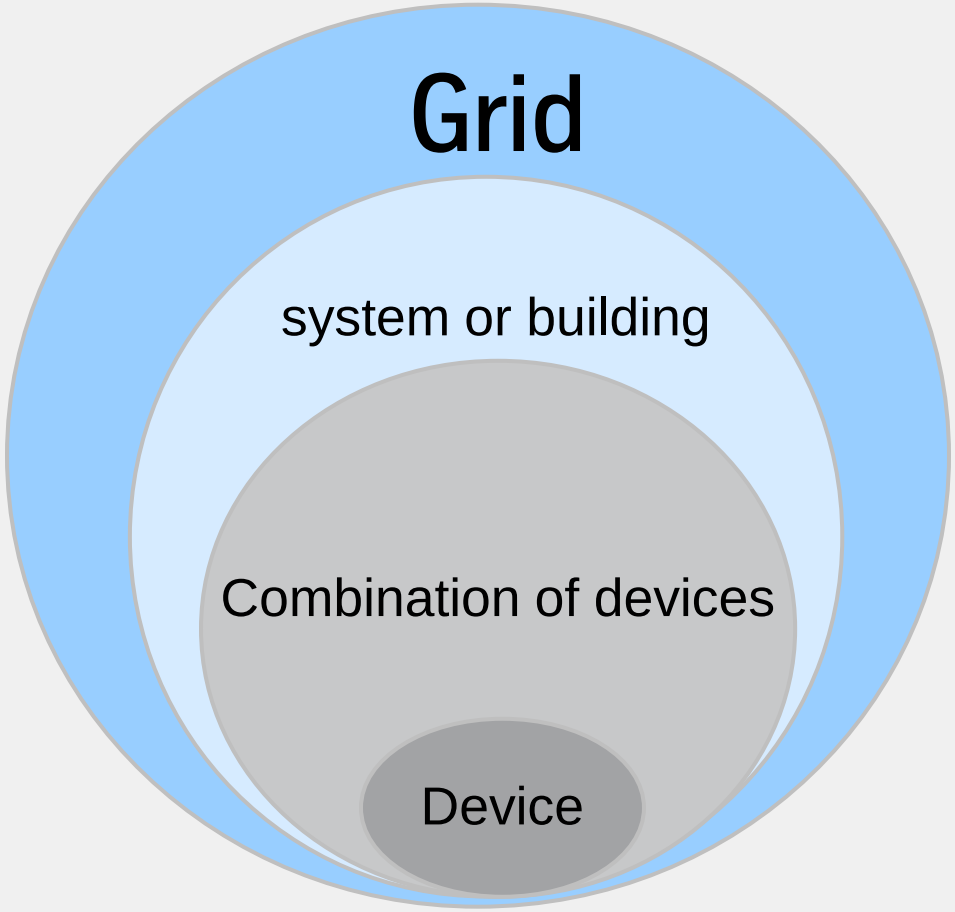
→ The generation of power from renewable resources can not be controlled.
→ The consumption of power is following generation as close as possible.
→ Consequence: We need flexible consumer/user!

Future Energy System
Requirements of Energy Consumers (Prosumers)

A solution should be:

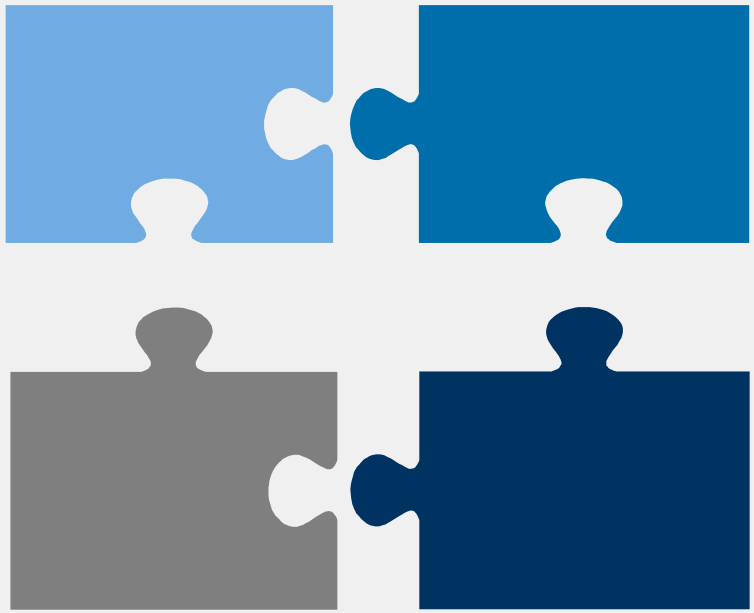
- Competitive
- Economically viable
- Environment friendly
- Accepted by society
- Secure energy supply

Optimization Opportunities on All Levels



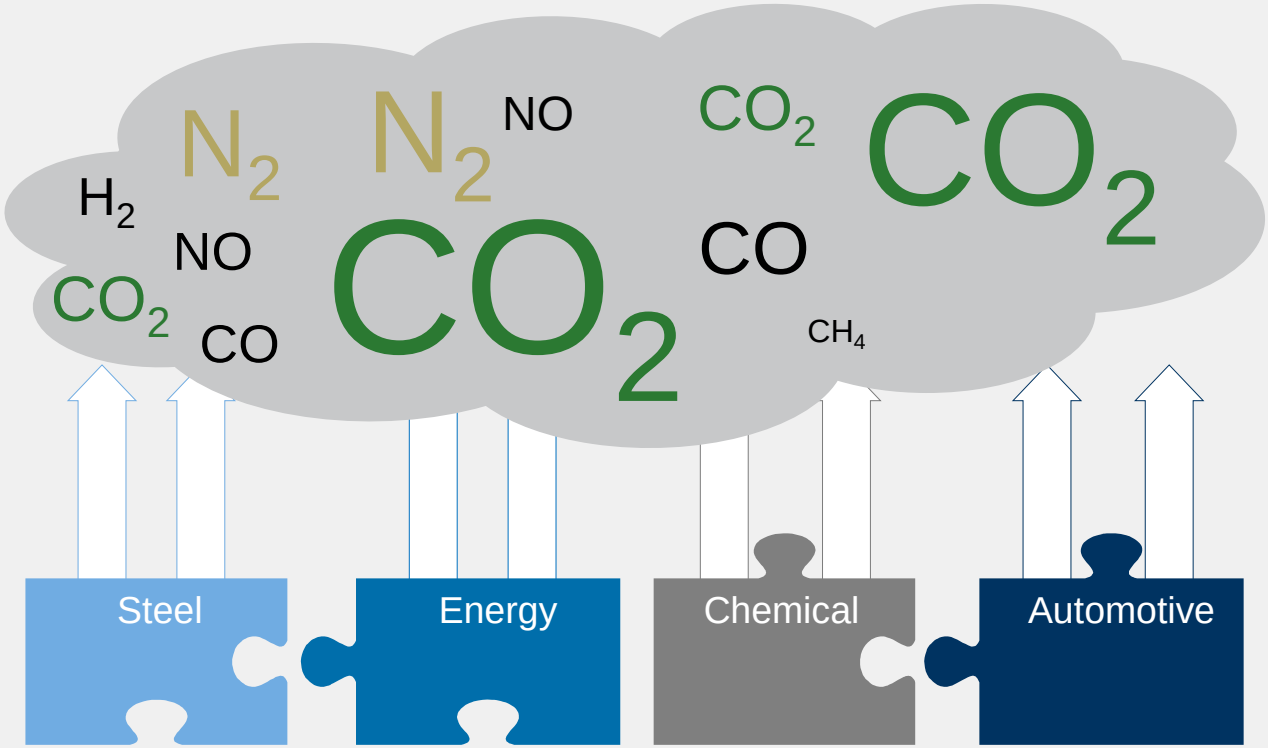
To meet the requirements of energy users and producers
we need to use optimization opportunities on all levels!

Future Energy System



- Energy Solutions of the Future will consist of connectable modules with well defined interfaces
- Software is the glue
- Examples:
  - Hydrogen electrolysis,
  - Redox flow storage

Optimization Opportunities
Cross Industrial Network



System optimum vs. local optima!

Future Energy System

From power generation follows consumption to consumption follows generation

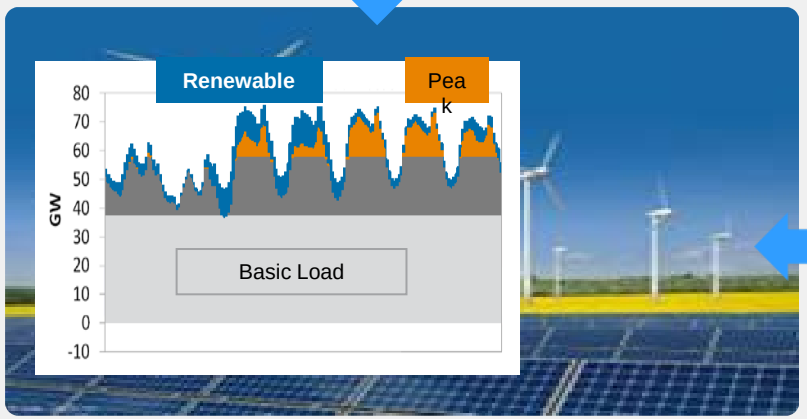
CEM

Prediction

Simulation - System

Simulation - Control System

Energy



Industrial System

(Energy intensive processes)

Volatile Generation

Flexible User

Future Energy System: Example Steel Production

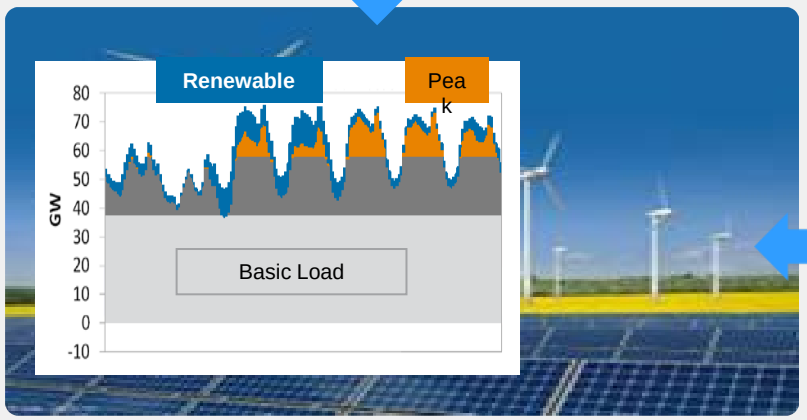
CEM

Prediction

Simulation - System

Simulation - Control System

Energy



Volatile Generation

Chemical Use of Top Gas

Blast Furnace

Converter

Coking Plant

Top Gas

X %

Y %

Z %

Power Plant

Chemical Plant

Steel Mill

Flexible Steel Production

Energy consumption …

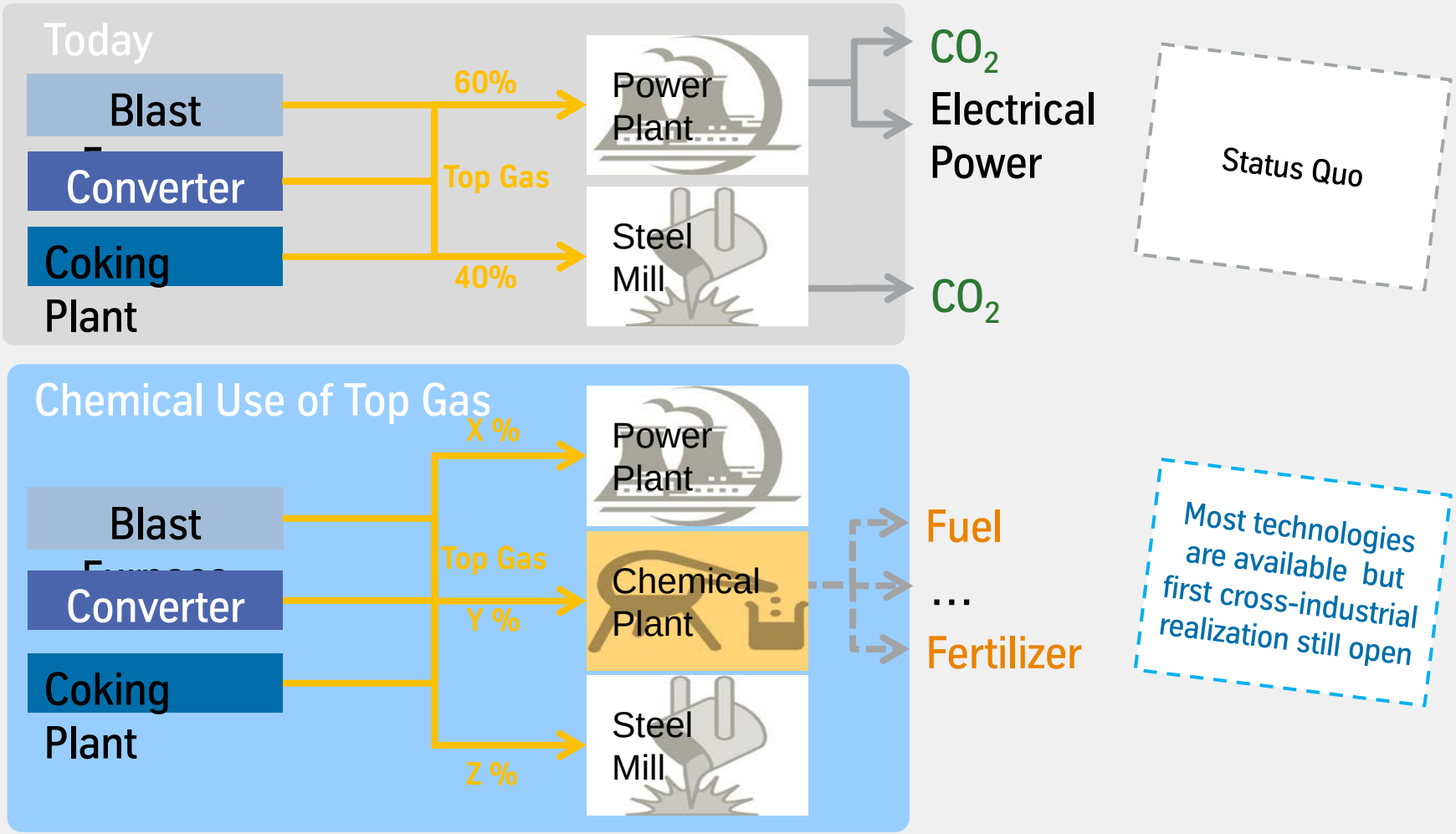
One Steel Mill…

≈

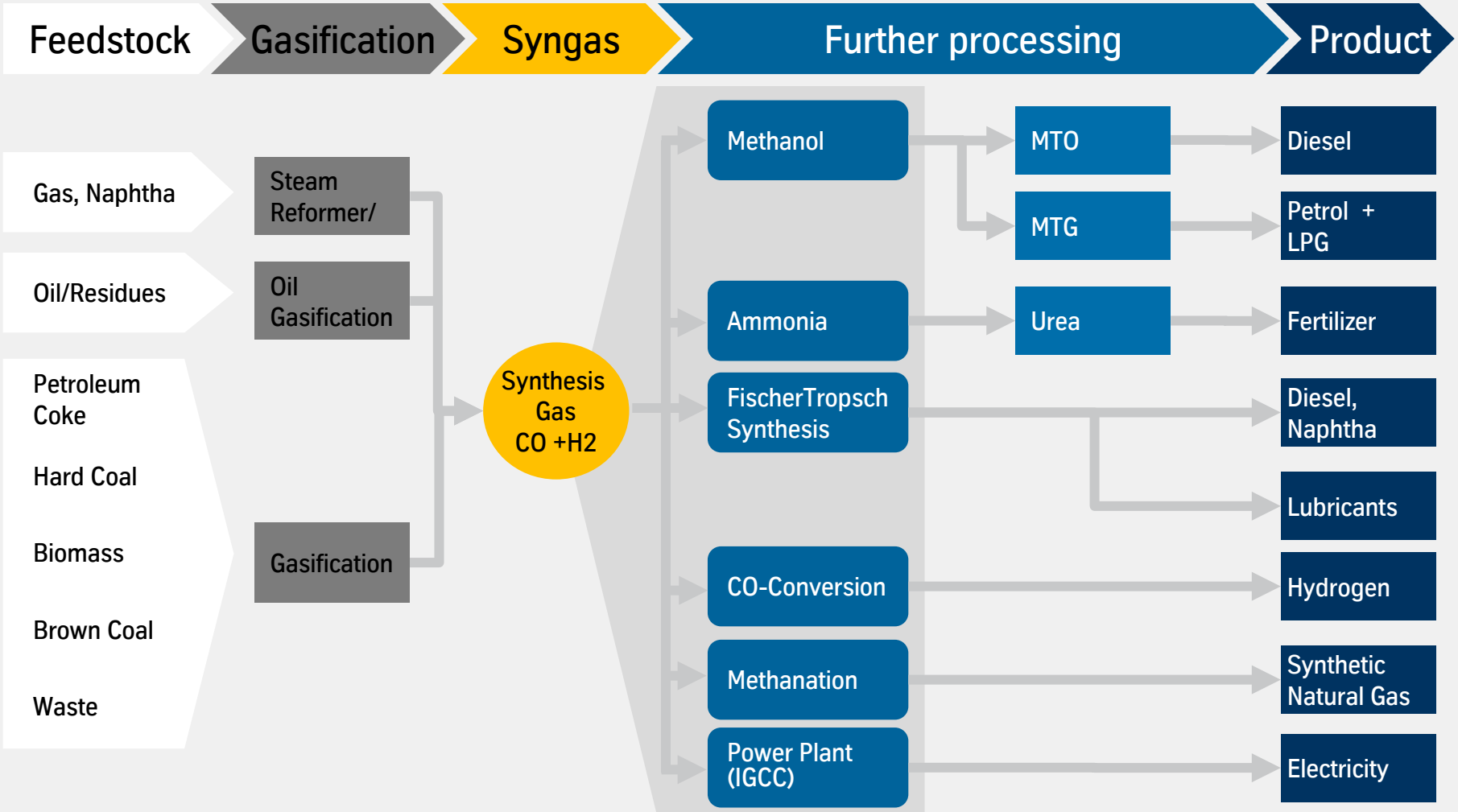
… City Berlin

Statistik Berlin Brandenburg (2010), Haushalte, Gewerbe. Handel Dienstl. Endenergieverbrauch
Stahlwerk: mit Reduktionsmitteln

Chemical Use of Top Gases from Steel Mills



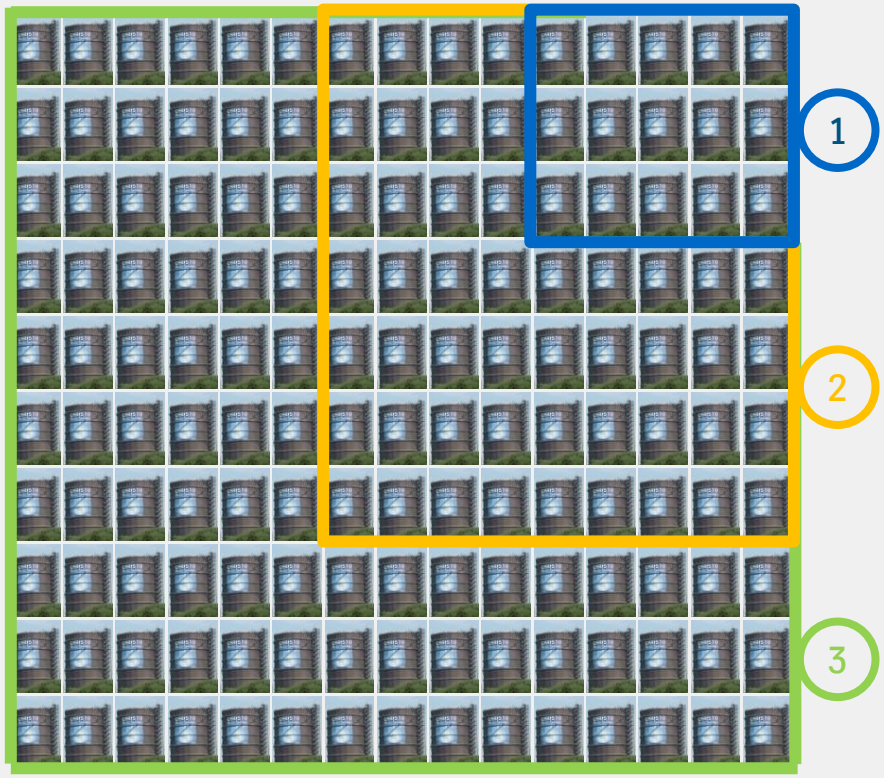
Synthesis Gas and Hydrogen: A Central Part in Chemical Value Chain



Source: TK Uhde proprietary gasification technology

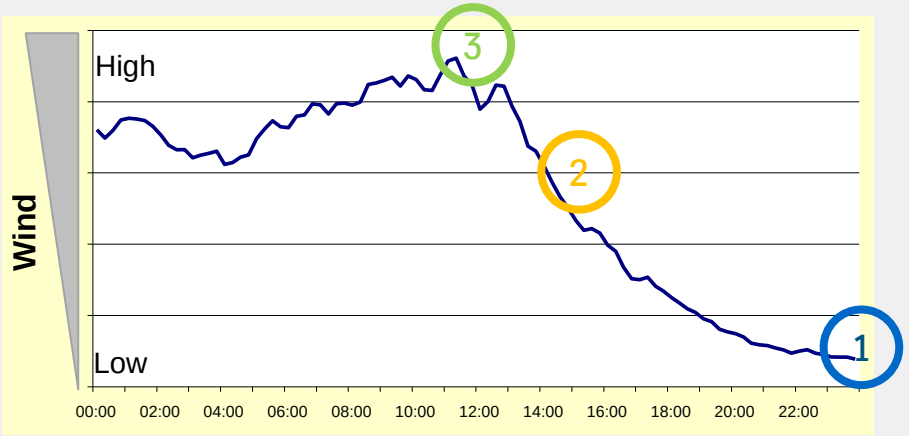
Today: Ammonia / Urea and Methanol Plant feasible!

Amount of top gas with sufficient Hydrogen



For use of all top gases for chemical products approx. 50*10⁶ Nm³/day additional Hydrogen are necessary!!

Illustrative: Energy fluctuation wind



1 No renewable energy for H_2 production available

2 Medium amounts of renewable energy for H_2 production available

3 High amounts of renewable energy for H_2 production available

From Idea to Implementation

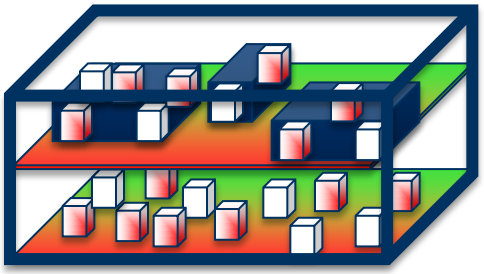
Research and Application Projects

PLANCK Technikum

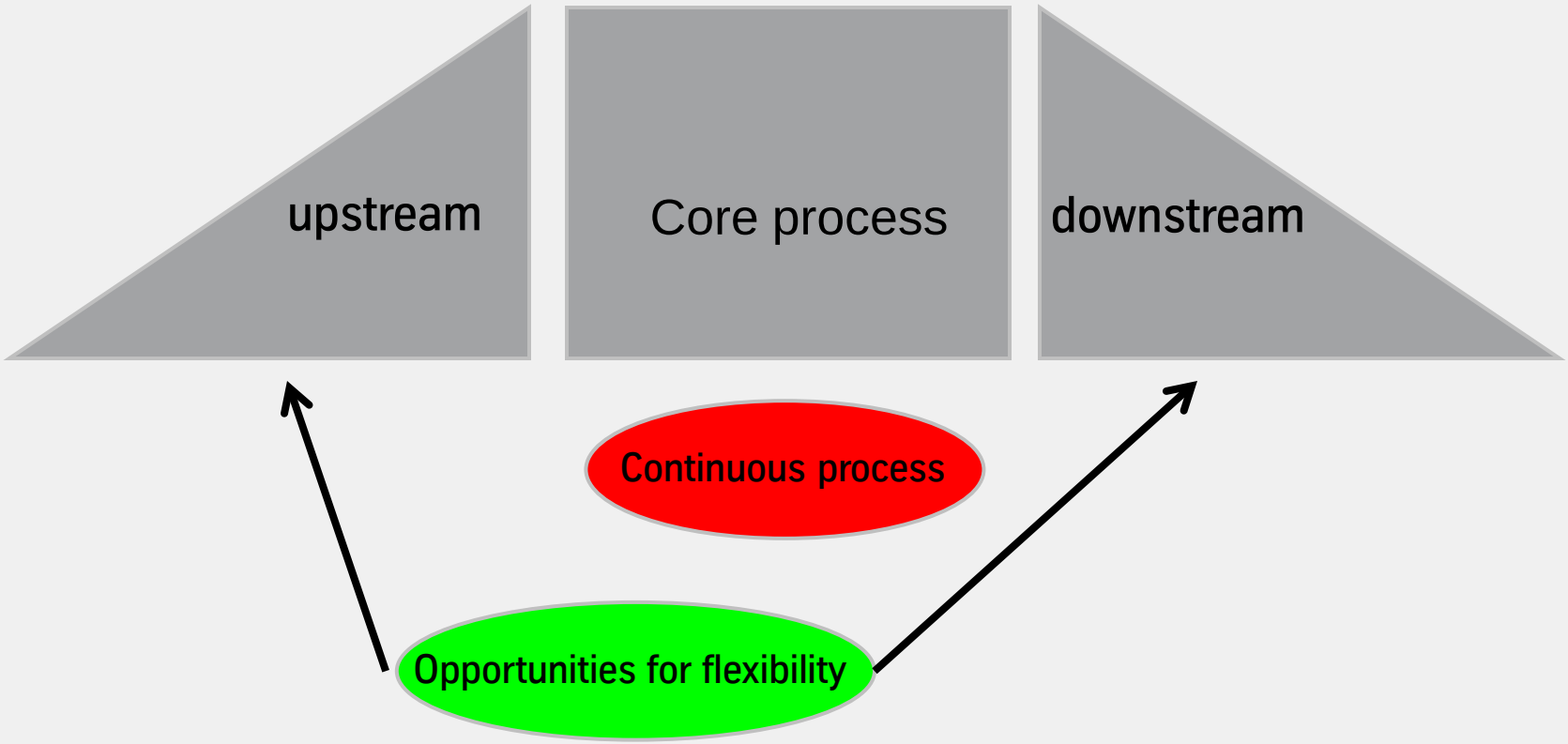
Commercial Implementation

Implementation

Transfer-Research

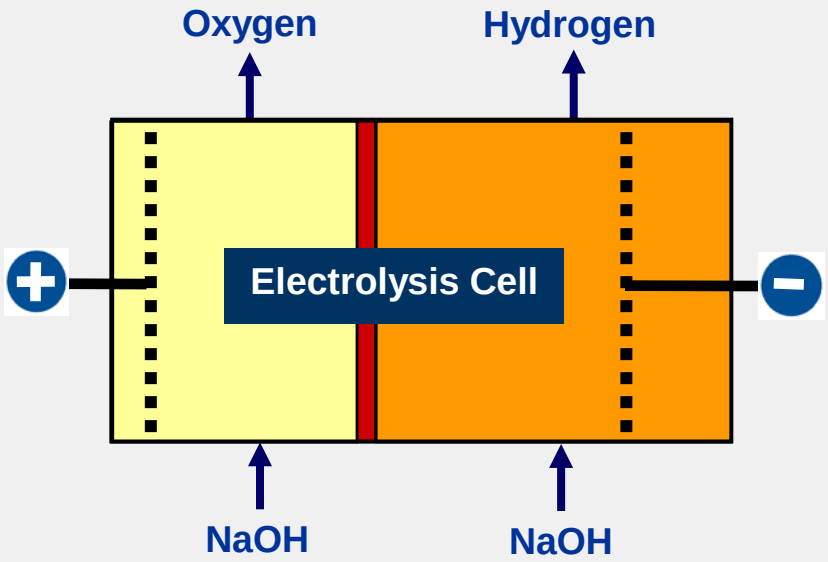


Identify Flexible Parts of the Task



Future Energy System
Module Hydrogen Electrolysis

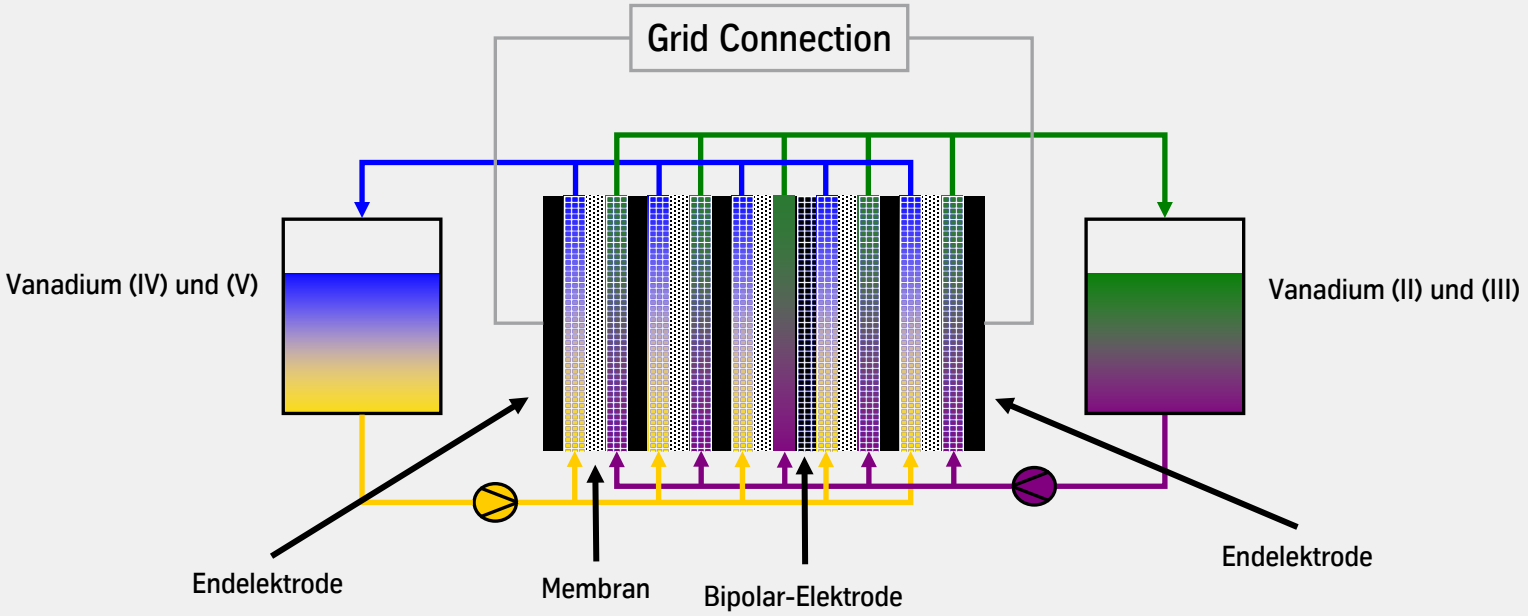
Objective: Efficient production of Hydrogen as a key element for storage of power in products, e. g. PLANCK, power-to-gas, …



Functional principle UHDENORA water electrolysis

Future Energy System
Module Redox Flow Energy Storage Systems

Objective: Storage of large quantity of power over a long time period.



Functional principle of a Redox Flow Storage System

Optimization of the Battery Production Process

Objective: Establish the ability to build efficient battery production systems in Europe

Market entry strategy

Raw materials → Cell assembly → Module assembly → Battery assembly

Existing Know-how at project start

Need for know-how built-up at project start

Cell assembly	Formation	Module assembly	Battery assembly	Battery test
				

Thank you very much for your attention.