>> PERSPECTIVES_2012

THE FUTURE OF CHEMICAL AND PHARMACEUTICAL PRODUCTION IN GERMANY

CMF JUNE 19, 2012 – FACILITATED BY DR. MICHAEL REUBOLD, CHEMANAGER

>> MANAGING THE ENERGY SHIFT.

PREPARATION IS KEY TO FUTURE SITE READINESS

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ACHEMA PERSPECTIVES 2012

Preparation is key to future site readiness

Frankfurt, June 19, 2012

Roland Berger
Strategy Consultants

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A.

Energy prices remain a major challenge for the German chemicals industry

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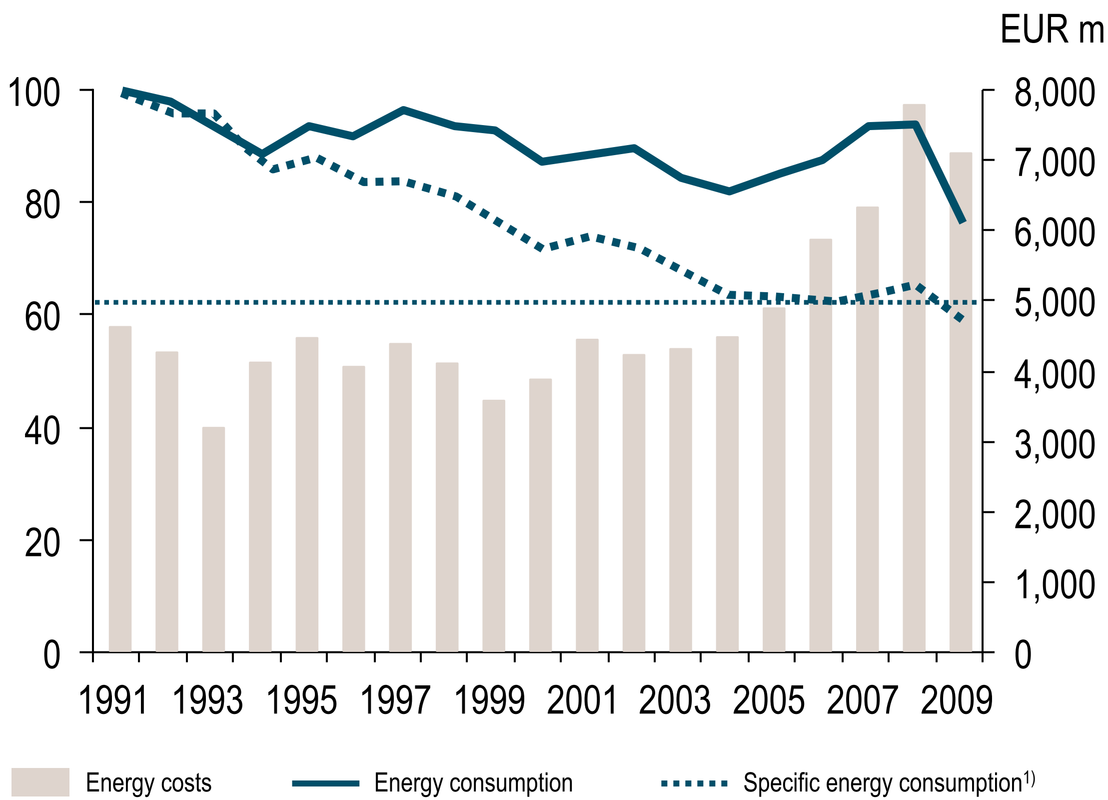
The chemicals industry in Germany has experienced a significant improvement of its energy consumption over the last 20 years…

Development of energy consumption [Index with 1991 = 100]



1) Specific energy consumption measures the amount of energy used to produce one output unit

> Chemicals industry in Germany **reduced** its **specific energy consumption by 40%** over the last 20 years
  - Investments into **up-to-date power plants** and more **energy efficient processes**
  - Large production sites have implemented the **"Verbund"** (i.e., material and energetic integration of processes)
  - Esp. **automation technologies** help managing the increasing complexity of interwoven processes

> However, at the same time – esp. over the last 5 years – the industry experienced a **massive increase of energy costs**

Source: VCI; Roland Berger

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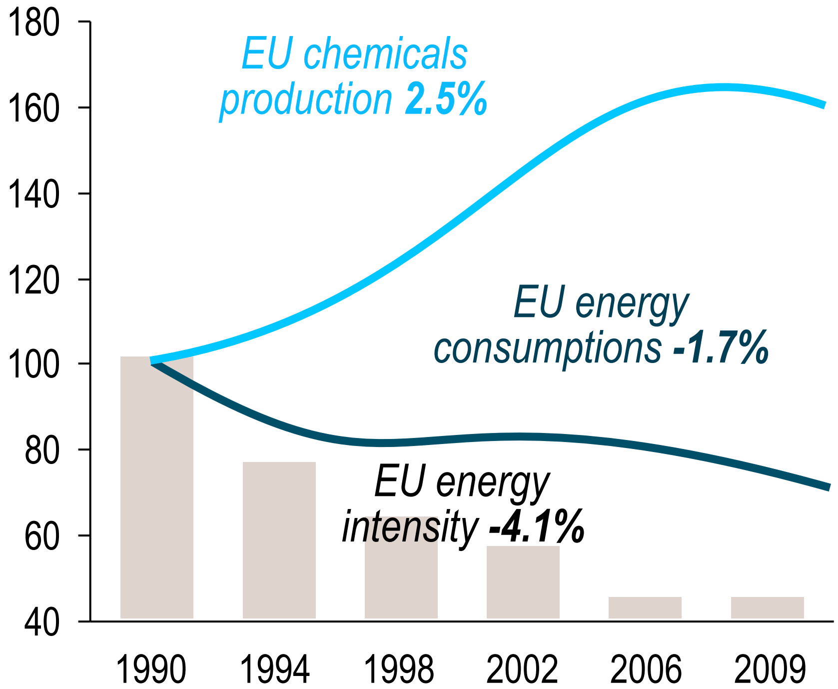
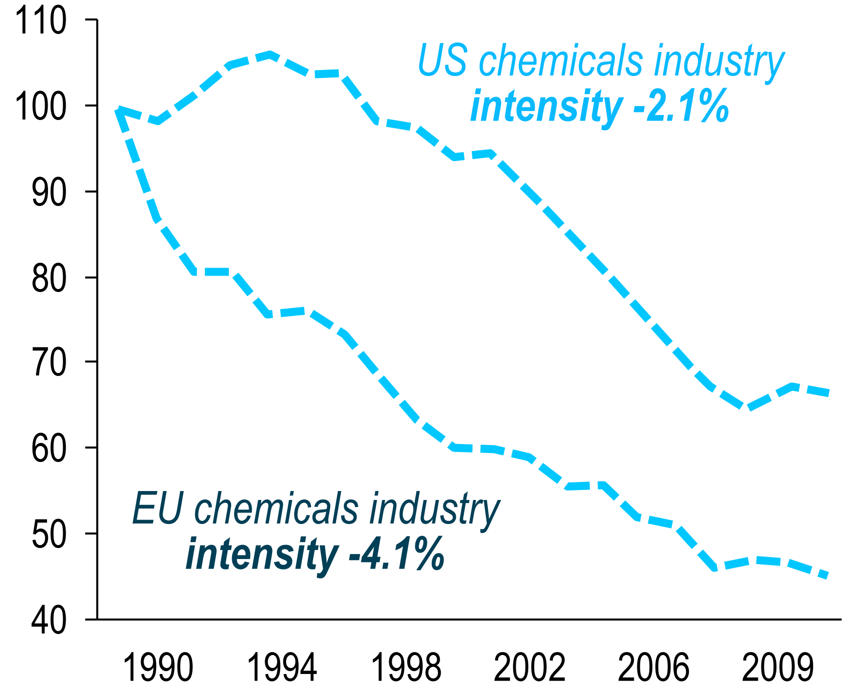
…this development is not only limited to Germany, but also observable for the European and US American chemicals industry

Development of energy consumption [Index with 1990 = 100]

EUROPEAN perspective
Average growth rate p.a. 1990-2009



EU versus USA
Average growth rate 1990-2009



Source: Eurostat; Cefic Chemdata International; Roland Berger

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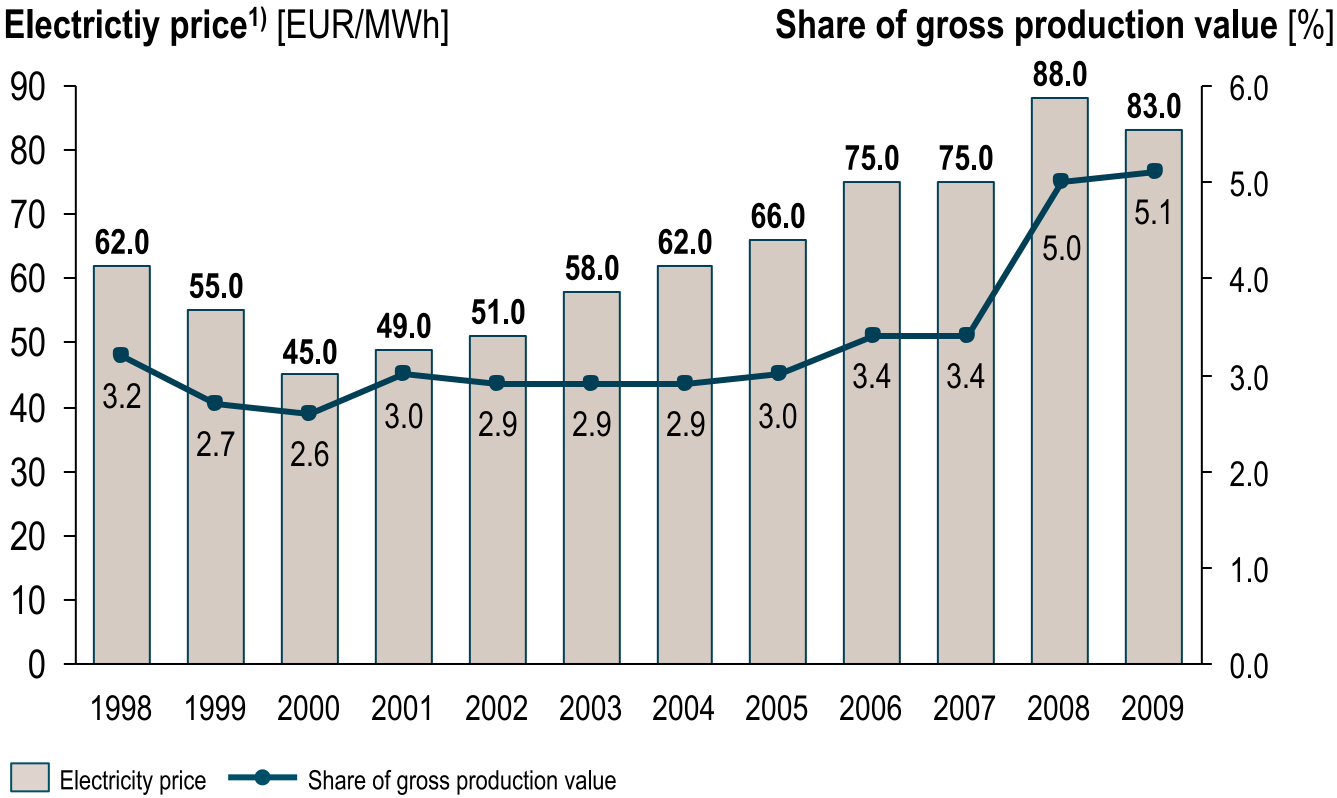
However, efficiency improvements haven't been sufficient to compensate for rising energy prices - Rising energy cost share

Development of energy costs



1) Average annual price for industrial customer in Germany

Chemicals industry **hasn't been able to compensate for rising energy prices** through efficiency measures in the last years

Source: Statistisches Bundesamt; BMWI; Roland Berger

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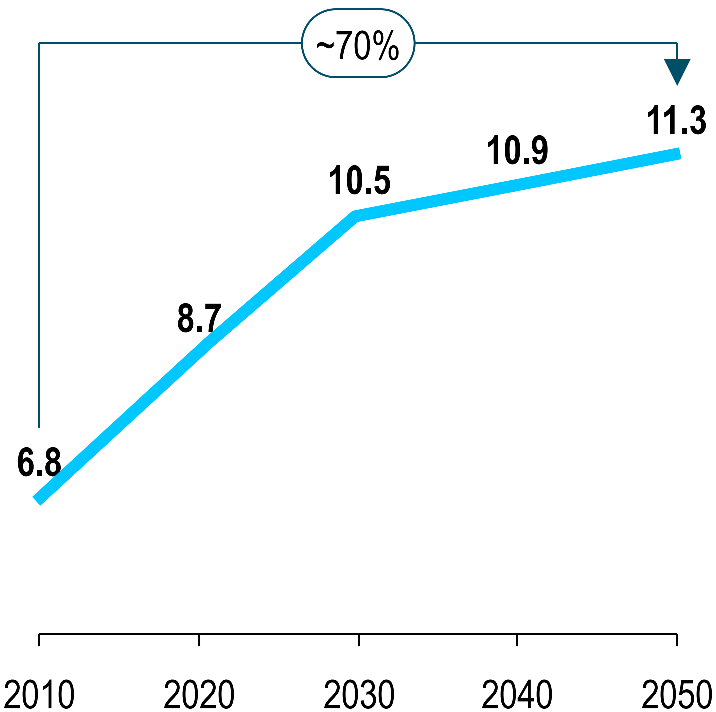
The price for electricity is expected to rise by 70% within the next 50 years

ELECTRICITY PRICE DEVELOPMENT 1)
[EUR ct/kWh]



DRIVERS

> The earlier than planned **nuclear phase out** drives electricity price increases due to shortening supply

> **Construction of electricity grids** needed for the development of renewable energies will further drive the electricity price

> There will be higher costs for **CO_2 certificates** and **fossil fuels** in the future – Utility companies will pass on these extra costs to their customers

> An additional cost increase is expected due to the **Renewable Energy Law (EEG) allocation**

Drivers are very **Germany-specific**

Thus, **threat of additional cost exposure** for German chemicals industry

1) vbw (2010) – based on "Muddling through" scenario

Source: vbw; Prognos; Roland Berger

B.

Optimization and cooperation – Two sides of one medal

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Energy challenge needs to be tackled along two dimensions to ensure strategic site readiness

RISING ENERGY PRICES

Chemical site

PRODUCTION

Use of energy for product treatment (e.g., thermal treatment, synthesis)

PRODUCTION ENVIRONMENT

Supply of required energy for production (typically electricity, steam or cooling water)

Strategic levers to tackle energy challenge

- Technology usage
- Technology development

Present achievements strongly driven by own efforts

- Optimized energy generation
- Ecological "Verbund" strategy

Additional potentials exploitable through cooperation and shift from service to savings approach

STRATEGIC SITE READINESS

Source: Roland Berger

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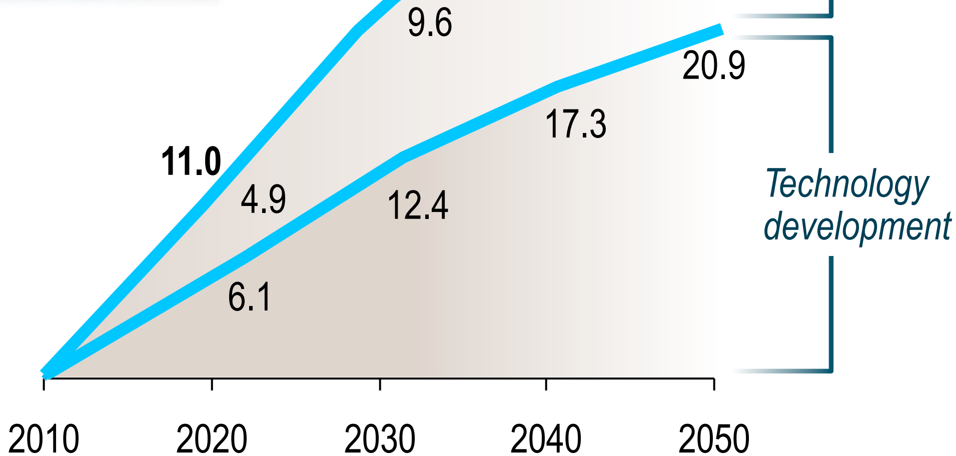
Based on a Roland Berger study the chemicals industry can im-prove its production-related energy efficiency level by 37% to 2050

Efficiency improvement potential [%]



Levers to 2020

The **synthesis process** only offers an efficiency improvement potential of approx. **10% within the next 10 years –** Equipment used for synthesis (e.g., calcination units, extraction units) offer efficiency improvement potentials through **construction optimizations**

Additional improvements due **broader implementation** of energy saving **technologies aiming at increasing the efficiency of machine drives** (e.g., rotation speed controls, automatic shutdowns)

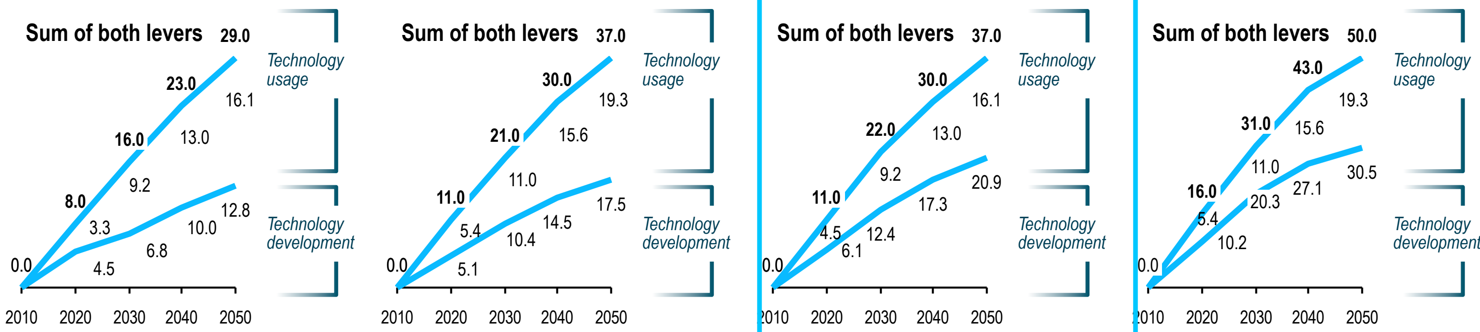
Source: Expert panel; Roland Berger

Compared to other industries the chemicals industry uses extensively new technologies – Well positioned for realization of potential

Cross-industry comparison of RB study results

	Processing of stones and earth	Metal fabricating industry	Base chemicals	Paper and pulping production
Electricity costs [2010]	0.5 bn	1.2 bn	2.6 bn	1.5 bn
Usage of available efficiency technologies [%]	63%	50%	70%	52%

Improvement potentials to 2050



Source: Expert panel; Roland Berger

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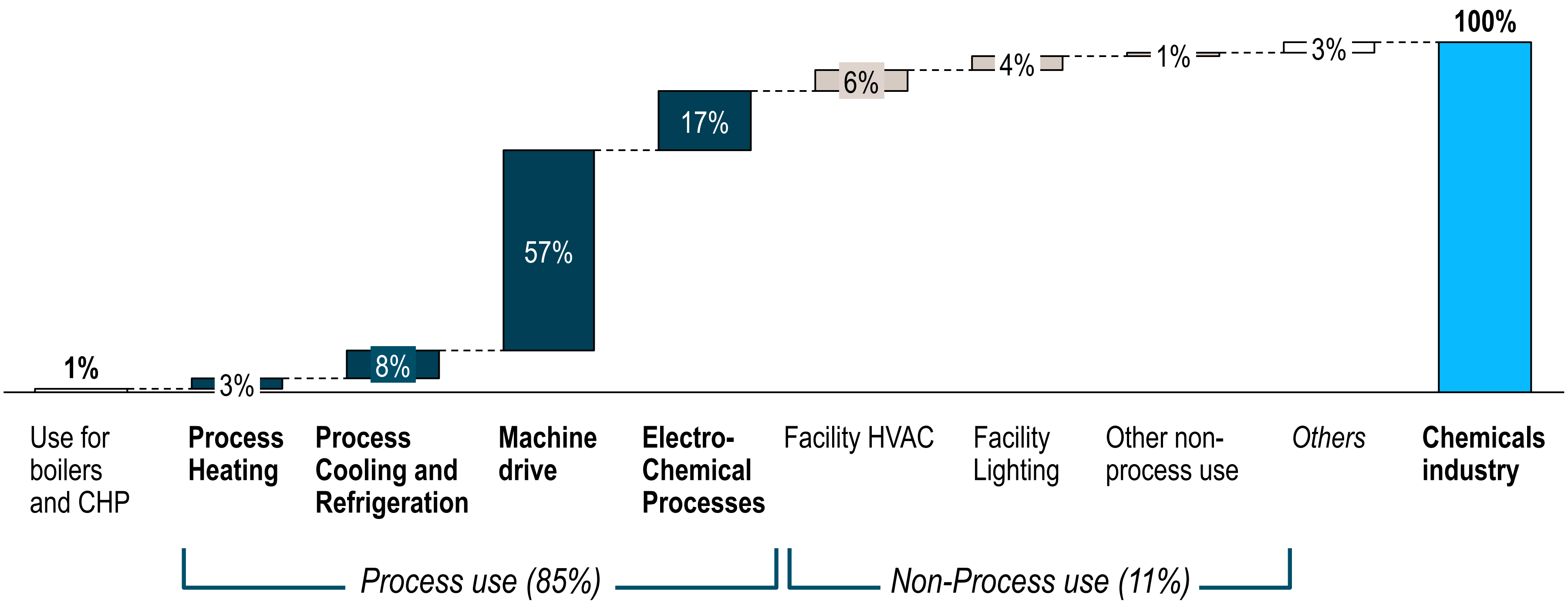
Majority of electricity consumed by the chemicals industry is for process use – Machine drives and electrochemical processes

End use of electricity in the chemicals industry



Source: IEA; Roland Berger Strategy Consultants

Degree of implementation of energy saving technologies differs significantly – Opportunity to exploit available potential

Overview about process industry companies using energy saving technologies

ENERGY SAVING TECHNOLOGY	DEGREE OF IMPLEMENTATION [%] [1)]
Electric motors with rotation speed control	65%
Recovery of kinetic and process energy	51%
Control concept for shutdown of machines in times of low	43%
Heat and power combination	27%
Usage of high efficiency pumps	17%
Low-heat joining processes	10%

1) Based on survey from 2009 – reflecting implementation degree in companies above 250 employees

Source: Fraunhofer Institut

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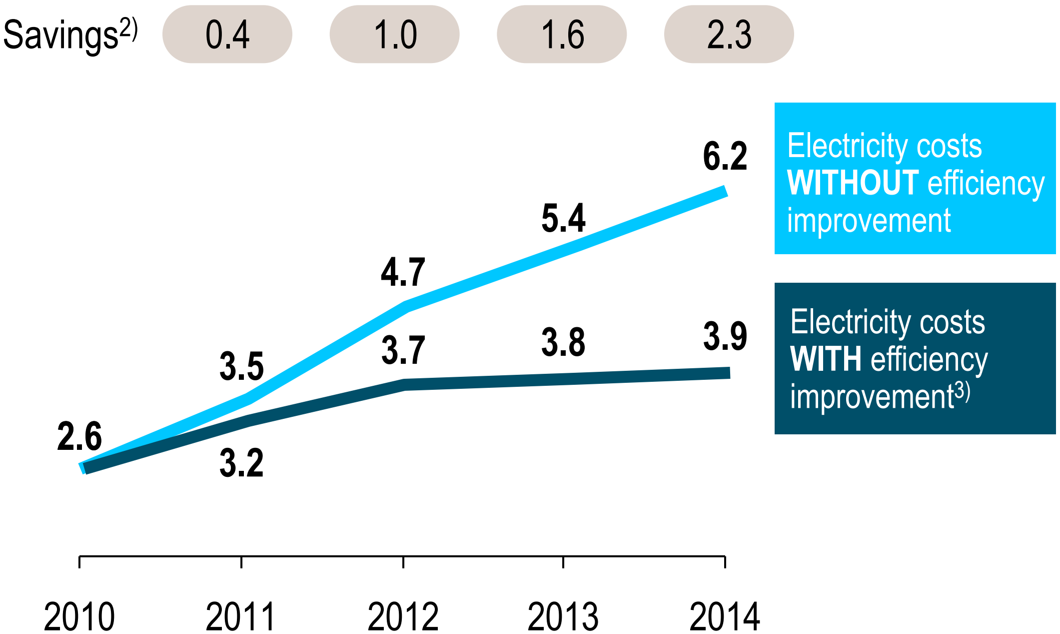
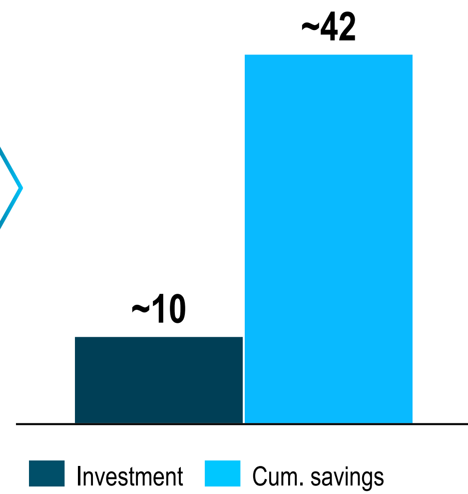
Chemicals industry could save EUR ~42 bn to 2050 by implementation of potential efficiency measures – Investment of EUR ~10 bn

Electricity costs development [EUR bn] 1)



Cost/benefit comparison [EUR bn]



Realization requires **UNDERSTANDING OF SPECIFIC ACTION NEEDS**

1) Assumptions: Annual production growth of 1%, nuclear phase out, built up of renewable energies according to development scenario of the German Government
2) In the respective year
3) Investment costs not considered

Source: Expert Panel; Prognos; Roland Berger

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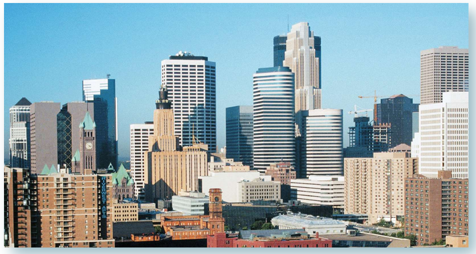
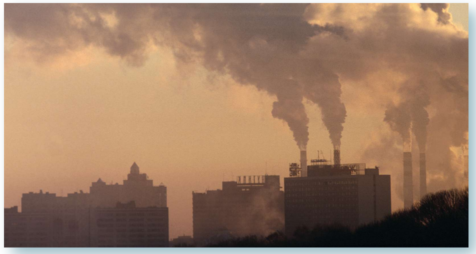
Shortage of resources is one major driver for the establishment of chemical parks globally

URBANIZATION



INDUSTRIALIZATION



SHORTAGE OF RESOURCES

Establishment of chemical parks as an instrument for **INDUSTRIAL POLICIES** and **SAFEGUARDING OF RESOURCES**

ECONOMIC STEERING

> Attraction of new businesses by providing an integrated infrastructure in one location
> Creation of new job opportunities and attraction of qualified employees
> Eligibility of chemical parks for governmental benefits

CLUSTERING

> Concentration of dedicated infrastructure in a delimited area to reduce the per-business expense of that infrastructure
> Concentration of businesses around a dedicated value chain
> Focused business initiatives through improved cooperation between companies

ENVIRONMENTAL PROTECTION

> Separation of industrial uses from urban areas to reduce the environmental and social impact of industrial uses

RESOURCE MANAGEMENT

> Provision of localized environmental controls that are specific to the needs of an industrial area
> Saving resources through efficient use of by-products and residuals

Source: Roland Berger Strategy Consultants

Roland Berger Strategy Consultants

In Germany, today's shape of its multi-user chemical park and site landscape is the particular result of three transformation waves

1. WAVE

~ 1990 – 2000

Split-up of large companies

- Reorganization of large integrated companies (e.g., Hoechst AG, Hüls AG)
- Legal spin-off of infrastructure entities, mostly under the umbrella of a major user

2. WAVE

~ 2000 – 2010

Opening of former single user locations

- Settlement of third companies at former single user locations (e.g., BASF, Bayer, Henkel) for
  - reducing indirect costs
  - optimizing material flows
- Majority of industry parks still focused on a major user
- Further opening of locations for third companies expected

3. WAVE

since ~2010

Business incubation for new ventures

- Park operators starting to attract start-up companies beside attracting capacities from incumbent players
- Access to well-developed chemical park infrastructure and full portfolio of services
- If necessary, start-ups get connected with external service providers and experts – Thus access to product and technology networks, research and development groups, universities and colleges, other companies and markets is offered

Increasing cooperation between industry players

Source: VCI Fachvereinigung Chemieparks, Roland Berger Strategy Consultants

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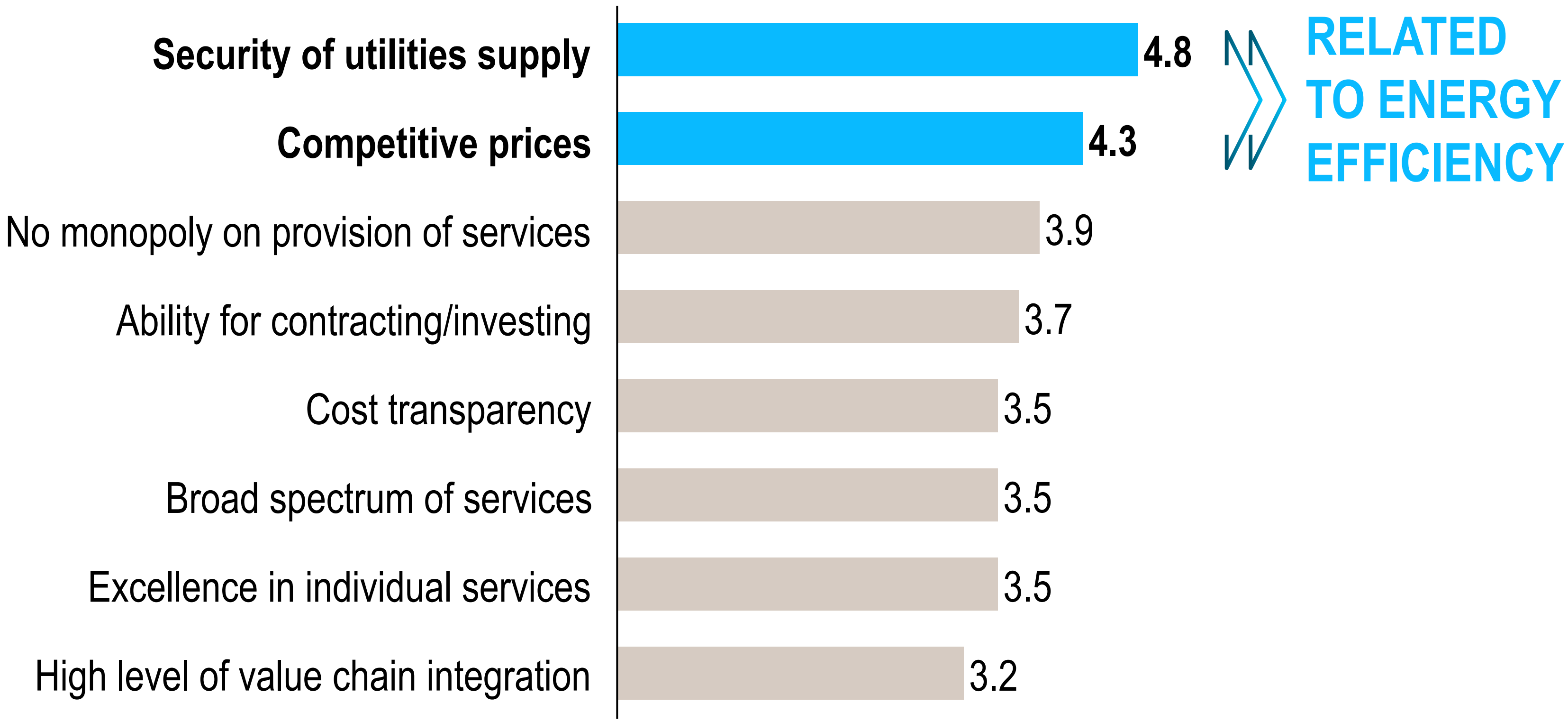
However, security of utilities supply and competitive prices are the most important expectations towards chemical park operators

Customer expectations towards chemical park operators in Germany



Average evaluation of industry experts (N = 25;   5 = I totally agree; 1 = I totally disagree)

Source: Roland Berger Strategy Consultants

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Installation of CHP power plants are an effective lever to optimize the costs of the utilities supply in a chemical park

Estimated primary energy savings by CHP

Reference power plant	Fuel type	Reference efficiency		Primary energy savings [1]
		Boiler	Power	
Current [2]	Current mix	90%	40%	20%
State-of-the-art [3]	Natural gas	90%	52.5-60%	10-40%
State-of-the-art [4]	Coal	90%	50%	12%

1) Primary energy savings are compared to average CHP efficiency of 81%
2) Current power efficiency has been estimated based on IEA Energy Statistics
3) State-of-the-art power efficiencies are based on the performance of two NGCC (natural gas combined cycle), power plants in Korea (52.5%) and efficiency of Siemens-E.ON CCGT (combined cycle gas turbine) power plant under construction in Irsching, Germany (60%)
4) Reference efficiency of state-of-the-art coal power plant with its start-up planned in 2015 in Wilhelmshaven, Germany

Source: IEA; Roland Berger Strategy Consultants

Roland Berger Strategy Consultants

Tapping this optimization potential requires new cooperation models – Park operators increasingly partner with external energy players

Optimized energy generation – snapshot on two recent examples

CURRENTA – Leistung für Chemie und Industrie

REPOWER – Unsere Energie für Sie.

> In 2010 decision to build a **430 MW CHP power plant** at the **Chempark in Leverkusen** – Completion expected for 2014
> Investment value of EUR 340 m (Repower as investor)
> Plant management through Currenta
> **Electricity also be sold to external customers**
> Repower already operating wind farms in Germany

cimo

ALPIQ

> In 2009 Alpiq opened a CHP plant on Cimo's **Monthey site**
> Thermal power of 43 MW and electrical power of 55 MW
> Steam and part of the electricity delivered to Cimo for main on-site customers (BASF, Syngenta and Huntsman)
> **Excess electricity delivered into local power grid**
> Alpiq is already operating 2 similar power plants together with chemicals companies in Northern Italy since 2006

TAKE AWAYS

> Cooperation with energy companies allows
  – **More efficient use of fossil fuels**
  – **Lower CO_2 emissions**
> Thus, **stability on energy costs**
> **Energy companies** are actively looking for opportunities to **diversify generation mixture**
> **Co-location** with allows **optimization of by-products** (e.g., steam)

Source: Company information; Roland Berger

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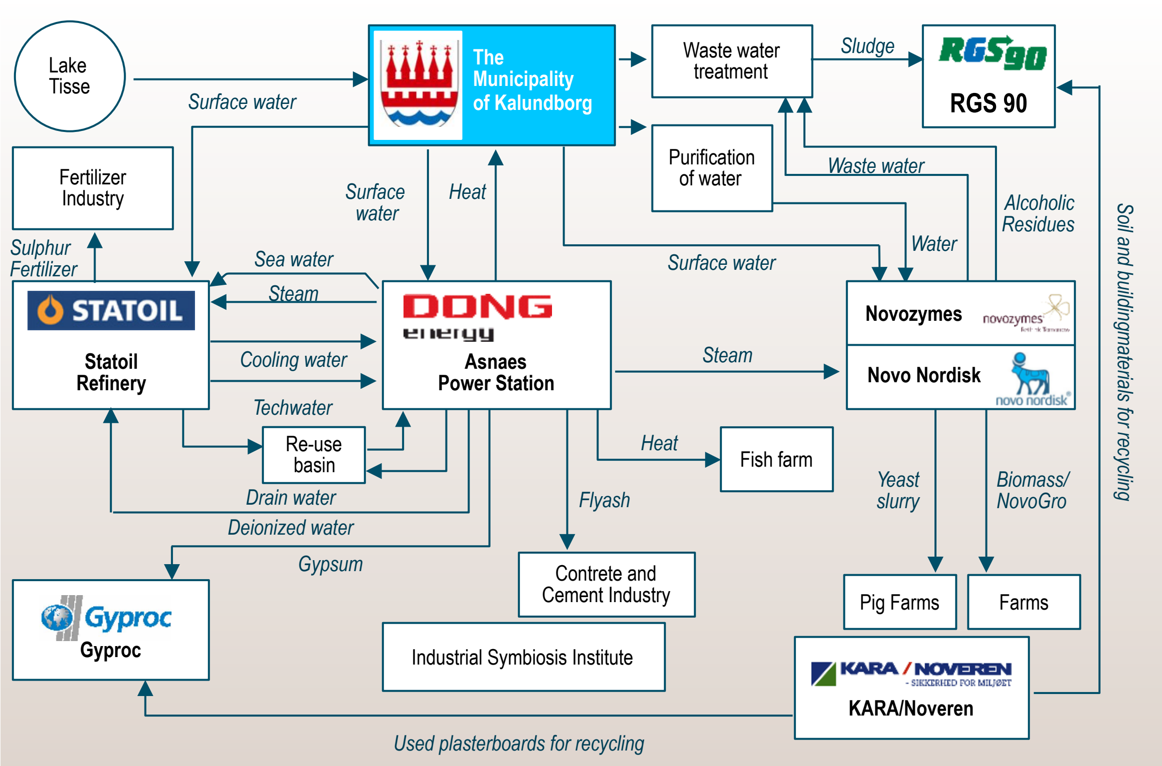
Beyond energy - The Danish Industrial Symbiosis aims at improving the environmental standard through an ecological "Verbund"

Ecological "Verbund" strategy – Industrial Symbiosis Kalundborg (Denmark)

NETWORK COOPERATION



> A **network cooperation** between seven companies and the Municipality of Kalundborg

> **Goal is to improve the environmental standard** through efficiency and exchange of utilisation of by-products

> One **company's by-product becomes an important resource to** one or several of the **other companies**

> Collaborating **partners also benefit financially** since the individual agreement is based on commercial principles

Source: Industrial Symbiosis, Roland Berger Strategy Consultants

Production environment offers additional efficiency potentials beside optimization of own production

Chemical site

PRODUCTION

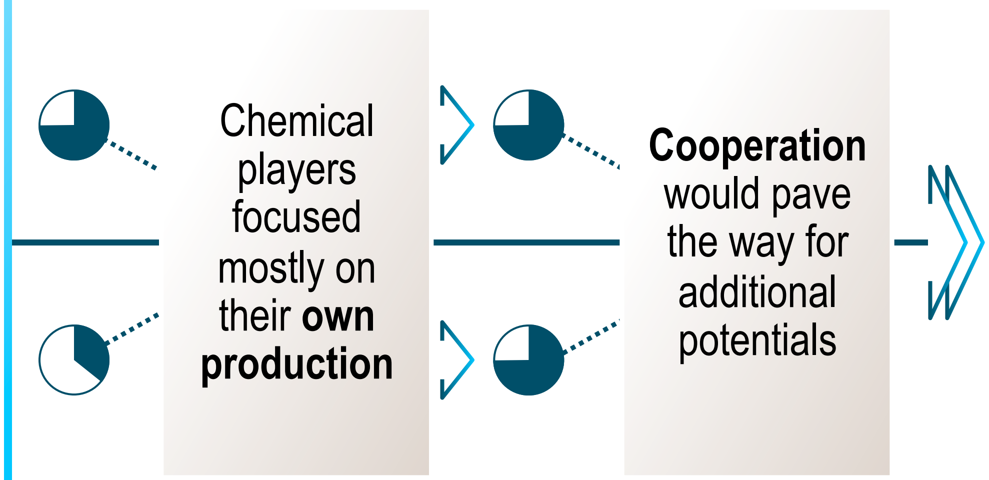
Use of energy for product treatment (e.g., thermal treatment, synthesis)

PRODUCTION ENVIRONMENT

Supply of required energy for production (typically electricity, steam or cooling water) and exchange of energy and (by-)products

Contribution so far…

…future contribution



Potential along both dimensions needs to be exploited

○ ≙ Limited ● ≙ Very high

Source: Roland Berger

C.

Food4thought – How to cope with the energy challenge

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Early adaption of the right thinking is crucial to prepare chemical sites for the next decades

Rising energy prices

Fiercer global competition

Rising ecological awareness

RELEVANT TRENDS

POSSIBLE REACTIONS – Food4thought

BE OPEN FOR PARTNERSHIPS

> Energy generation is not the core business of chemicals companies
> Instead, specialized energy companies are actively looking for new generation opportunities – co-location with chemicals companies effective lever to maximize energy efficiency

GO FOR ECOLOGICAL NETWORKING

> Design of the production environment should not only be motivated by cost reasons
> Instead, consideration of ecological aspects leads to sustainable competitive advantages

GET INVOLVED INTO TECHNOLOGY DEVELOPMENT

> Expected efficiency increases are promising and will reduce the energy burden
> Realization of step changes requires open cooperation and involvement into technology development (with both technology provider and competitors)

MEASURE USAGE OF AVAILABLE TECHNOLOGIES

> Existence of new technologies does not lead automatically to efficiency increases
> Open models – such as comprehensive industry benchmarking – provide clear indications on needs for action

Source: Roland Berger Strategy Consultants

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It's character that creates impact