



## Innovations in Chemistry - Enabler for other industries

Wolfgang Reich

Scouting & Strategy Advanced Materials & Systems Research, BASF

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 **BASF**

We create chemistry

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Chemistry as enabler - intro

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BASF examples

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Outlook

# Chemicals remains a growth industry



Agriculture



Health & nutrition



Energy & resources



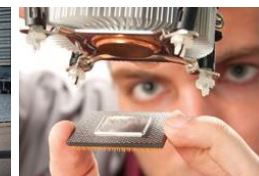
Construction & housing



Consumer goods



Transportation



Electrical & electronics

## Chemistry as enabler for current and future needs

~10bn



... people by 2050

70%



... of the world population will live in cities by 2050

50%



... more primary energy consumption by 2050

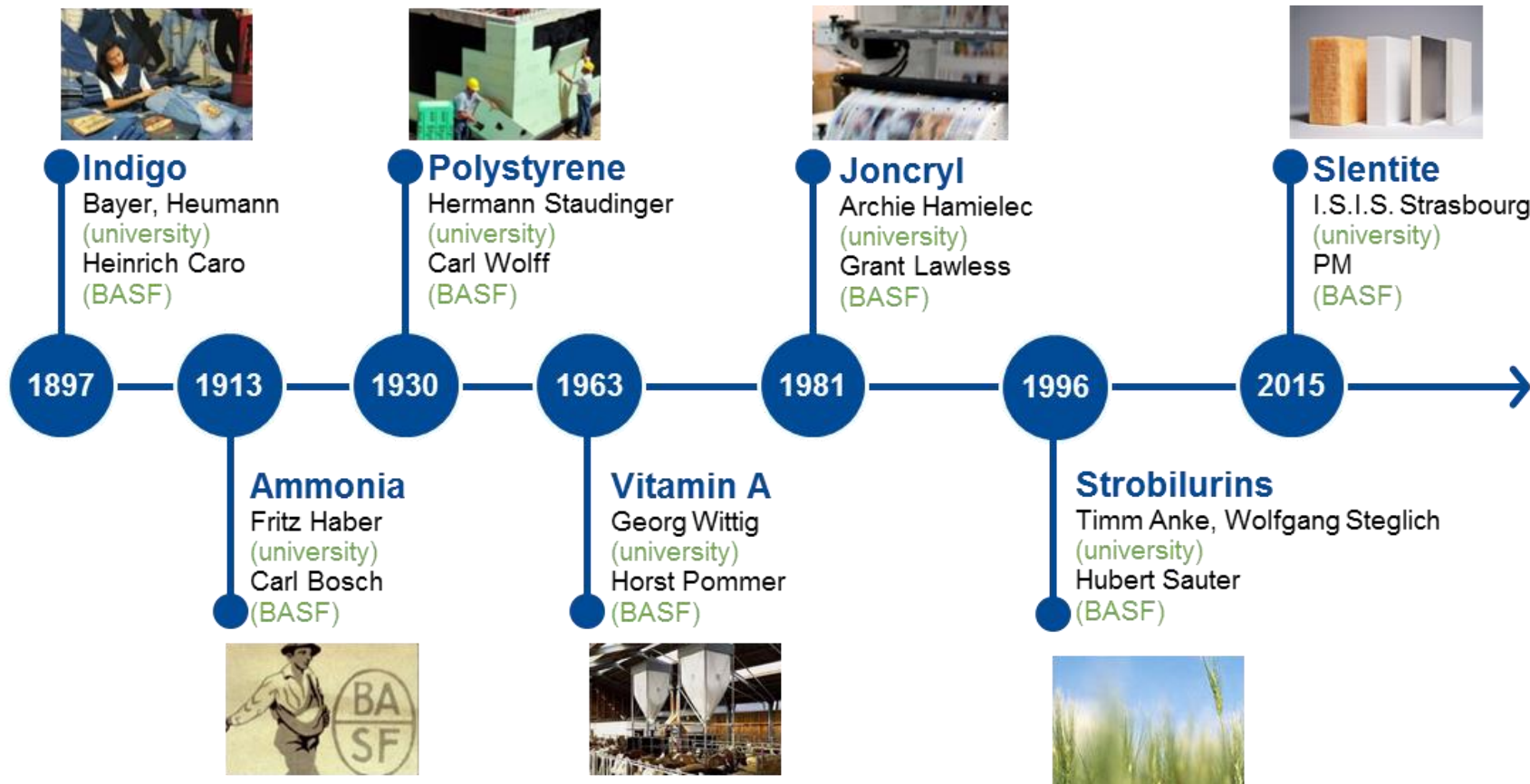
30%



... more food needed by 2050



# Innovation examples from BASF – results of Open Innovation



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# Agriculture – Feeding the World Fertilizer and Crop Protection

## At 1900 the future nutrition of the fast growing world population is a challenge

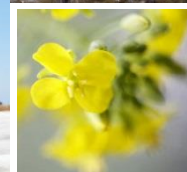
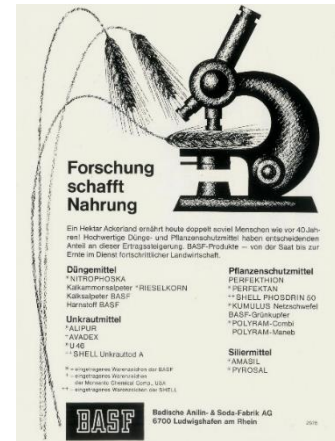
The ammonia process „fixed“ nitrogen from air – the age of mineral fertilizers started and together with crop protecting agents they ensure higher yields in harvesting

### ■ Fertilizers

- Haber-Bosch-Process/Ammonia synthesis (1913) – Basis for synthetic nitrogen fertilizer
- First complete fertilizer: Nitrophoska (1927)

### ■ Crop protecting agents

- First product: Herbicide U46 (1949)
- New class of actives: Strobilurine (1996)



pictures: BASF

# Agriculture

## – Ammonia synthesis

### ■ History and importance

- Process developed by Haber and Bosch
- 1913 first ammonia plant in Ludwigshafen-Oppau
- Development of high pressure reactors necessary
- One of the chemical processes with the highest impact in the world (>100 m t/year)

### ■ Industry relevance also via derived products (e.g. Nitric acid)

- Fertilizers
- Urea resins
- Explosives
- ....



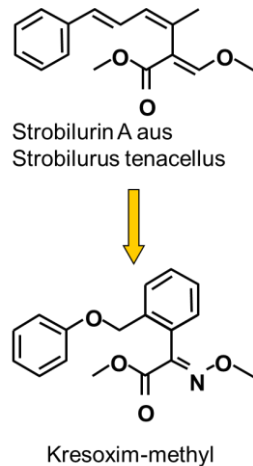


# Agriculture

## – Protecting crops with Strobilurins

### ■ History and importance

- One of the first crop protecting agents developed based on nature
- Systematic screening of natural active ingredients more in focus



### ■ Milestones

- 1977 Timm Anke,  
University Kaiserslautern  
discovers Strobilurin A  
  
Wolfgang Steglich,  
University Bonn  
finds the structure
- 1983 BASF Research-team  
develops fungicide  
application of Strobilurine
- 1995 Kresoxim-methyl as lead  
structure
- 2001 F 500, commercial fungicide

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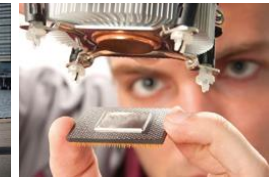
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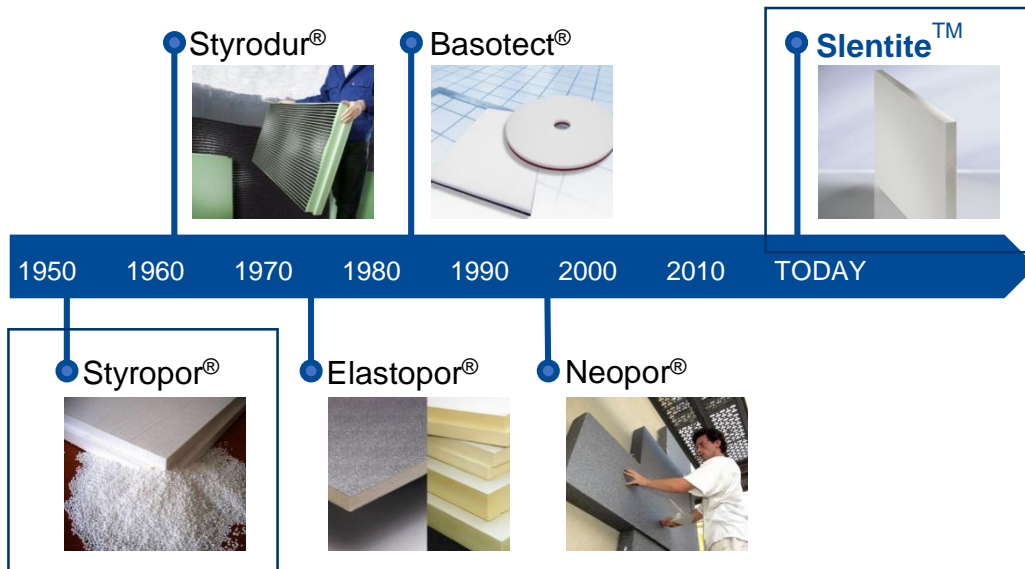


... more food needed by 2050

# Energy & Resources/Construction Efficient Insulation

“Thick walls have good insulation properties” is still the slogan in the 50ths in housing – energy saving construction was not the topic.

BASF foam materials insulate against heat and cold as well – saving high amounts of energy



# Energy & Resources/Construction – Polystyrene Styrofoam

## ■ History and importance

- First technical polystyrene (1931) synthesized
- Styrofoam developed by accident “Schuhcremedose” in 1950
- One of the top produced plastics globally

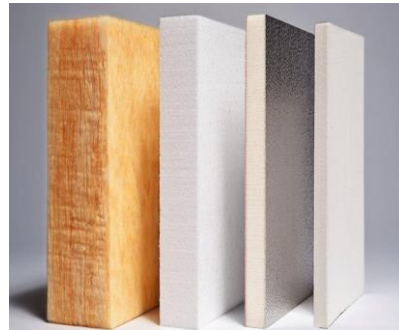
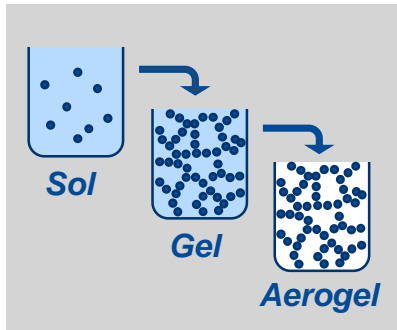
## ■ Industry relevance

- Construction
- Packaging
- Electrical equipment (e.g. switches)
- ...



pictures: BASF

### Efficient energy management with organic nanoporous aerogel



- Excellent, space-saving insulation performance with  $\lambda < 16 \text{ mW/m}\cdot\text{K}$
- Robust insulation panel with good workability
- Open-porous structure encourages humidity regulation in interior spaces

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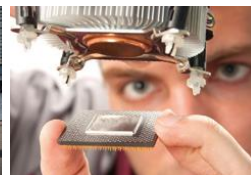
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# Consumer goods

## Making Colors Available for Everybody

Having colored clothing was just a privilege of rich and mighty people as dyes came from nature and were short

Synthetic dyes made a difference:

- Alizarin (1869)
- Methylene blue (1877)
- Indigo (1897)
- Indanthrene (1901) – for more color fastness
  - “unbeaten in wash, light and weather fastness”



Automotive Color Trends 2016/2017  
"Parallax"



pictures: BASF

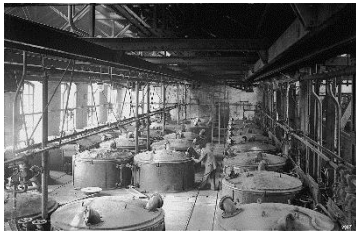
# Consumer goods

## – Textile dyes: Indigo

### ■ History

- Indigo was only available from natural sources in 19<sup>th</sup> century, rare and expensive
- Structure was enlightened by Adolf von Baeyer; first optimized syntheses worked out 1880
- BASF developed a synthetic route within 17 years and spent a fortune

Indigo production at BASF 1890



### ■ Industry relevance

- Textile dyeing
  - ▶ Only few years of strong usage and replaced soon by Indanthrene for color fastness
- Application in denim fashion

Indigo label at 1903







# Consumer goods

## – Durable and light sport shoes

Infinergy® - First expanded thermoplastic polyurethane

### Challenge

- Need for sport shoes with low density, long durability high resilience and high elasticity

### Solution

- The first closed-cell, elastic particle foam based on TPU combines the elasticity of a rubber with the advantages of a foam.

### Result

- Infinergy®, the material with an outstanding rebound effect and long-term durability is already used in adidas running shoes



# Boost innovation via cooperation



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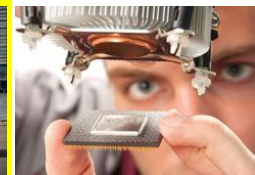
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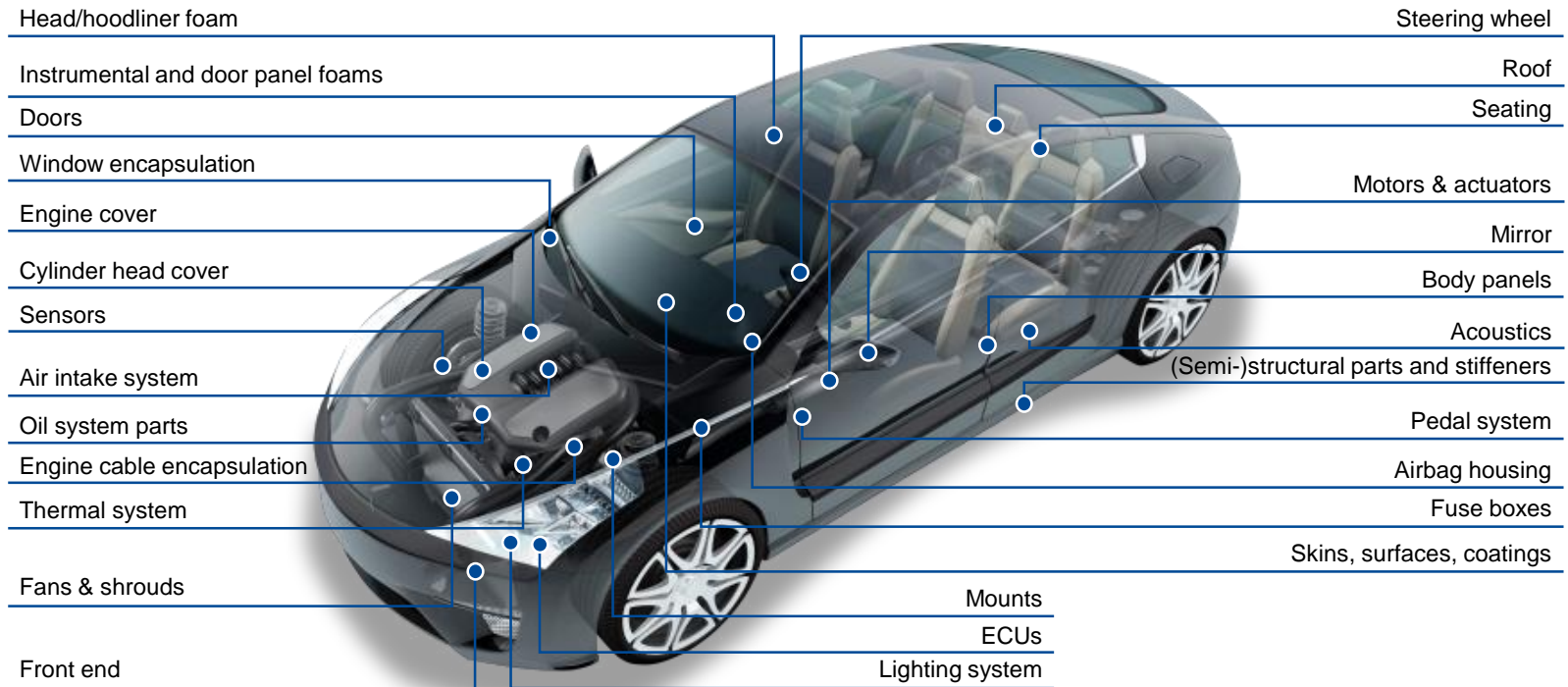
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# Transportation

## – Innovative system solutions for the automotive industry



# Innovations in chemistry are enablers for sustainable development

**Collaboration**

**Portfolio management**

**Digitalization**

**Speed**

**Persistence**

**Diversity**

**Management support**

**Timing**

**Vision**

# Is it all about a vision?

“If you want to build a ship, don't drum up people to collect wood and don't assign them tasks and work, but rather teach them to long for the endless immensity of the sea.”

Antoine de Saint-Exupery



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