Bayer MaterialScience

Sustainable Solutions

Focus on Building Construction

Agenda

Bayer MaterialScience – Company Introduction

Bayer is an inventor company, focused on Polyurethanes and Polycarbonates. We carry a wide range of materials that go into industries we encounter daily; construction, furniture, automotive to name a few.

Bayer's Sustainability Initiatives

With the rapidly changing world, some notable megatrends have emerged. There are accelerating changes in technology leading to dynamic market changes, a fast growing population is leading to changing societal demographics. The need for mobility has increased and needs for healthcare for an aging population are growing. Most importantly, we are witnessing global warming and climate change. Bayer as a company addresses all these changes with our products.

Sustainable Solutions for Building Construction

Of all megatrends, perhaps the most impactful trend is the world's changing climate. Buildings are responsible for more than 40 % of global energy use. As consumers, all of us can play a part by demanding materials that encourage energy savings and increase our personal comfort.

Science for a Better Life

As an inventor company, we strive towards delivering tomorrow's vision. Here's a snapshot of our future. vision

Bayer MaterialScience

Agenda

Bayer MaterialScience – Company Introduction

Bayer's Sustainability Initiatives

Sustainable Solutions for Building Construction

Science for a Better Life

Bayer MaterialScience

Bayer – an inventor company and a global enterprise

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Creating value through innovation and growth

Bayer is a global corporation active in healthcare, nutrition and high-tech materials.

- Group sales: € 31 billion
- Number of employees: 108,400
- R&D investment: € 2.7 billion

Bayer MaterialScience provides high-tech polymer solutions:

- in polyurethanes, polycarbonate and special applications,
- for a wide range of industries, including: automotive, construction, electrical / electronics, medical, furniture and leisure

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As of Dec. 31st, 2009

MaterialScience is Focused on Polyurethanes and Polycarbonates

Polyurethanes
€3.8bn, -27%

#1; approx. 24% market share (preliminary)

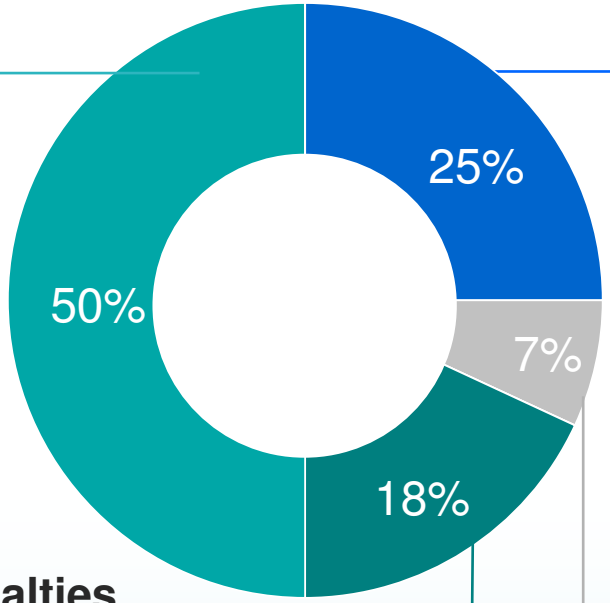
Applications: rigid and soft foams in construction (insulation), furniture (mattresses) and automotive

Polycarbonates
€1.9bn, -23%

#1-2; approx. 28% market share

Main brand: Makrolon

Applications: electro/electronics, construction, automotive, sports/leisure



Coatings, Adhesives, Specialties
€1.4bn, -20%

#1; >40% market share (arom. and aliph. isocyanates)

Applications: automotive & transport, construction, furniture & wood

Industrial Operations
€0.5bn, -24%

Internal supplier of chlorine, sodium hydroxide solution, hydrogen, hydrochloric acid; incl. other sales

€7,520m, -25%

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FY 2009 sales

All growth rates are y-o-y and Fx- and portfolio adjusted

Broad Diversity of Applications Reflects High Versatility of Our Polymers

Polyurethanes

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Serving a wide range of industries

Chemical Industry
8%

Industries < 5 %
(Sports & Leisure,
Packaging,
Home, Garden,
Textiles & Clothing,
Mechanical and Plant)
14%

Other < 2 %
(e.g. Medical Engineering,
Health Care,
Mining, Animal Tags)
13%

Wood & Furniture
17%

Automotive
18%

Electrical / Electronics
16%

Construction
14%

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Materials for life

Bayer MaterialScience provides high-tech polymer solutions:

- through its 14,300 employees worldwide,
- in polyurethanes, polycarbonate and special applications,
- for customers in a wide range of industries, including: automotive, construction, electrical / electronics, medical, furniture and leisure,
- generating annual sales of € 7.5 billion (2009)
- with an R&D investment of more than € 200 million (2009), customer projects account for additional € 140 million

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What the market needs

Our strategy focuses on:

- Developing new applications, such as waterborne polyurethane dispersions for cosmetic and medical products, Durflex® rail track hardening systems, or solar panel frames
- Developing new materials to drive growth, such as carbon nanotubes to improve material performance, or polyether polyols incorporating CO_2 as a building block
- Developing new technologies, such as polyurethanes for building insulation, or films with special properties

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Polyurethanes – **the sustainable material**:
unlimited opportunities to save
natural resources and energy

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Accelerating changes in technology /
Dynamic market changes

Growing population /
Changing societal demographics

Healthcare
Revolution

Globalization /
Urbanization

Global Megatrends:
The world is changing

Climate change and global warming
Energy – shortage of fossil resources

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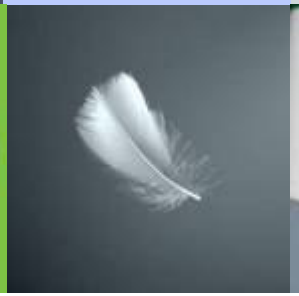
Polyurethanes – the sustainable material

Potential –
open to be re-invented

Effects –
saves resources & energy

Properties –
best insulator,
lightweight & durable



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Old refrigerators - power-hungry appliances:
Replacing them with A++ appliances would cut annual CO_2 emissions in Europe by 20 million tons*

* Source: Siemens/BSH

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Refrigeration

Fresh food at home

- PUR insulation has helped to reduce the energy consumption of refrigerators from 1950 to 2005 by 65%*
- PUR enables energy-saving design solutions and the integration of innovative design ideas
- Possibility to further reduce overall energy consumption of refrigerators via enhanced technology and new designs, which avoid door opening (eco-fridge, single product dispenser)
- Integration of new energy concepts e.g. utilization of solar energy

Market size PUR for refrigerators: 930kt (2008)
Growth rate: 8.7% (-2012)

* Source:CECED (European Committee of Domestic Equipment Manufacturers)

Polyurethanes = PUR

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Cool chain

Fresh along the way

- PUR is the best insulating material at the lowest comparable weight
- PUR insulation contributes to food security in an environment of increasing scarcity (up to 50% of today's food production is wasted*)
- Solutions for the first and last mile - further reduction of overall energy consumption throughout the cool chain

Market size PUR in cool chain: 500kt
Growth rate: 3.3% (-2012)

*Source: ISOPA

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14,3% of greenhouse gases worldwide origin from the transportation sector making it the third largest emission source*

*Source: World Resources Institute

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Automotive

Moving the future

- PUR offers light-weight, durable solutions for structural parts, combined with design freedom, comfort and safety
- Vehicle weight can be reduced by up to 30% using PUR lightweight composites (10 % less weight = reduction of fuel consumption by 5%)*
- PUR offers sound absorbing materials to minimize engine noise inside the car
- New PUR applications related to alternative energy vehicles

Market size PUR in automotive: 600kt (2008)
Growth rate: 3% (-2012)

*Source: McKinsey

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Transportation

Moving the future

- PUR as component for innovative mobility concepts
- PUR offers solutions in mass transportation (light weight, specific properties in coatings etc.)
- Use of recycled materials (paper) or natural fiber mats as reinforcing materials for spray composites
- Replacing tropical wood in container floors with lightweight and durable PUR composites (Pultrusion).

Market size PUR in transportation: tbd
Growth rate: tbd

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The global demand for energy will double by 2060*

*Source: Royal Dutch/Shell

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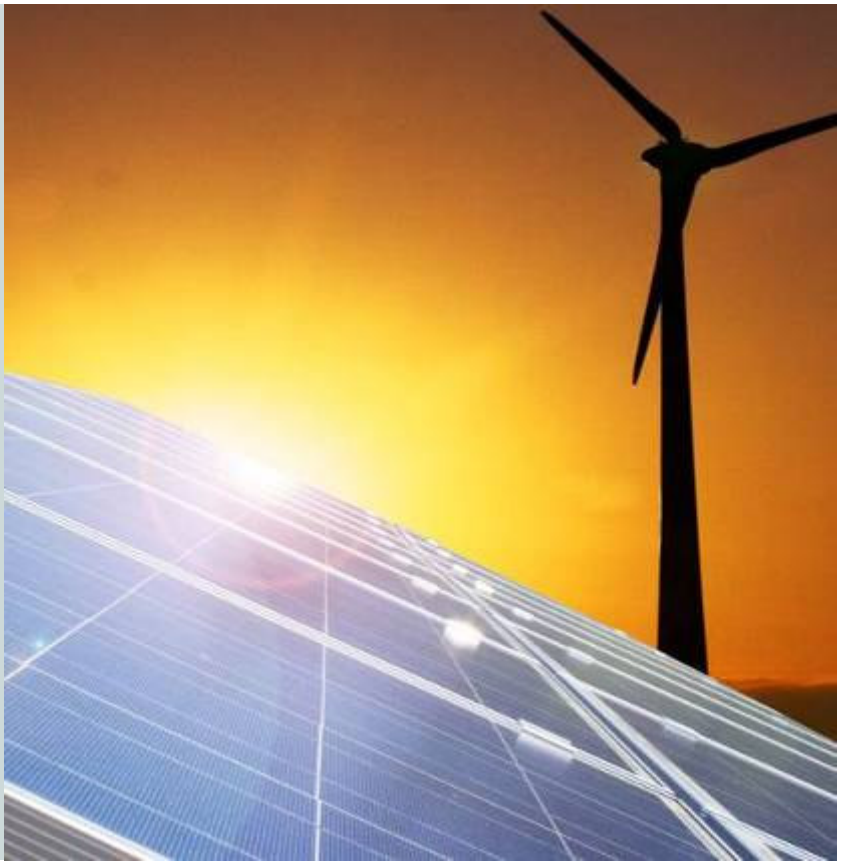
Energy

Supporting the switch to alternative energies

- PUR offers effective solutions for alternative energy sources (e.g. solar modul framing and films, in roof installation …)
- Introducing PUR as new lightweight material to maximize energy efficiency and durability of wind mill blades
- PUR pipe insulation allows efficient district cooling/heating systems

Market size PUR in energy: tbd
Growth rate: tbd



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Back pains are considered the most expensive common disease

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Quality of life

Enabling a comfortable life

- Offering new solutions using combination of PUR material and advanced technology to improve functionality and durability (e.g. protheses)
- Lowering limitations and increasing flexibility for handicapped people (C-Leg, Otto Bock)
- Improvement of working conditions e.g. gel cushions against mouse-finger effect
- New PUR properties in use as artificial skin and concepts for homecare as already realized in the Care-o-bot nursing robot

Market size PUR in quality of life: tbd
Growth rate: tbd

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Mattresses and cushions

Prevention and medical treatment

- PUR Mattresses & cushions custom fit to the body, eliminating pressure points and allowing a comfortable, pain-free sleeping position
- Viscoelastic foam and gel mattresses help to prevent and treat pressure ulcers
- PUR mattresses on top – win mattress test of Stiftung Warentest (categories comfort, durability, sleeping climate with good to very good ratings)*

Market size PUR mattresses and cushions: 3630kt (2008)
Growth rate: 3% (- 2012)

*Source: Stiftung Warentest 3/2004

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Buildings are responsible for more than 40% of global energy use

Source: WIFO

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Industry and society require

- Low-emission buildings
- Energy-efficient architecture
- Sustainable solutions
- Modular systems

Photo: Hearst Tower, New York (Green Building)

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Our solutions

- Rigid polyurethane foam for high- and low-temperature insulation
- Lightweight, stable and transparent polycarbonate sheets
- Components for durable, efficient photovoltaics
- Flame retardant polycarbonate blends for smart energy metering and cabling
- Materials for low- and zero-VOC paints, coatings and adhesives
- Polycarbonate for energy-saving LED and other interior lighting solutions
- A concept for zero-emission buildings

Customers in the construction industry account for 18 % of the total sales of Bayer MaterialScience (2009)

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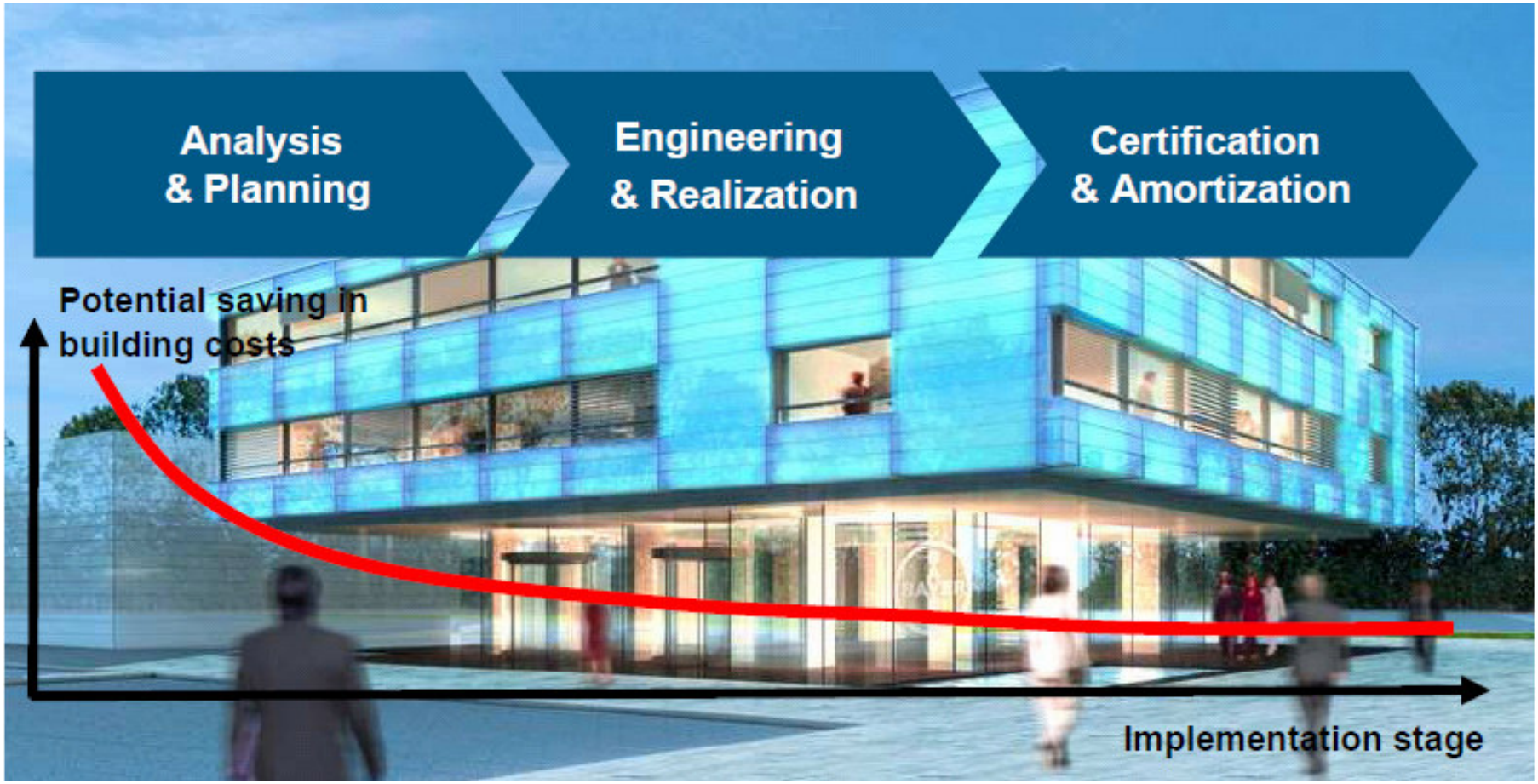
Integrated planning and realization
Key to eco-friendly & cost efficient construction



Source: WIFO

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Toward zero emissions

EcoCommercial building

- Rigid polyurethane foam for high- and low-temperature insulation
- Lightweight, stable and transparent polycarbonate sheets
- Components for durable, efficient photovoltaics
- Raw materials for low- and zero-VOC paints, coatings and adhesives
- Building a network of specialists

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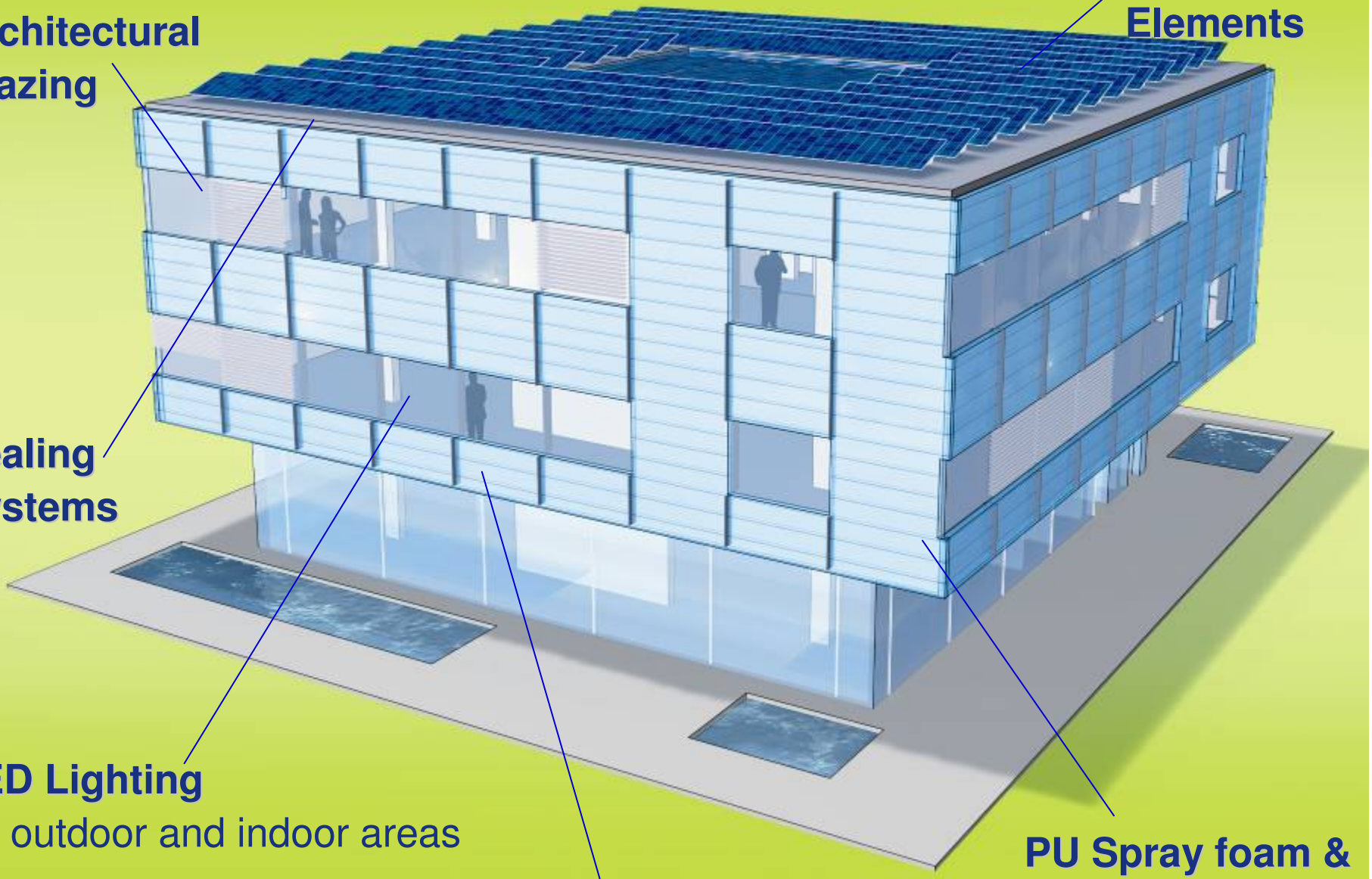
Holistic Approach to Building Envelope



Photovoltaic Elements

Architectural Glazing

Sealing Systems

LED Lighting
for outdoor and indoor areas

Coating Systems

PU Spray foam & PIR panels
for thermal insulation

Toward zero emissions

Bayer sustainable buildings

Bayer Admin.Bldg., Diegem, Belgium	ECB Conference Centre Pittsburgh, USA	Office Building Greater Noida, India	Day-care center Monheim, Germany
 **Total energy demand: ca 30 kWh/m³ a**	 **Zero-Emission Building**	 **Zero-Emission Building**	 **Zero-Emission Building**
•Opening May 2009 •250 office workplaces, conference rooms, kitchen & restaurant •Low-energy building with renewable energies •CO^2 emissions reduction by 300 t/p.a. •Durable LED-lighting •Rain water utilization	•Educational and R&D resource •Located on the BMS campus as a showcase of BMS technologies •Zero-emission building •Energy supply by renewable energy PV •Awards in categories of "Engineering" and "Lighting"	•40 office workplaces, 3 meeting & conference rooms, 1 lounge& display area •Total space: 760 m² on two floors •High energy efficiency •Total energy demand: ca 30 kWh/m³ a •Energy supply by renewable energy PV •Global applicability proven •Opening October 2010	•For 60 children, seminar & office room •1.000 m² of total space •High energy efficiency •Total energy demand: ca 11 kWh/m³ a •Energy supply by renewable energies •"EnOB“: Award of German "ministry of the national economy and technology"

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Building and educating for the next generation

Zero Emission Day Care Center in Monheim, Germany

Optimized energy demand		Renewable energy supply	
Hot water	1.1 MWh	Geo & solar thermal	2.6 MWh
Heating	2.1 MWh		
Light	1.0 MWh	Photovoltaic	3.3 MWh
Other Electricity	1.7 MWh		
Total	5.9 MWh	Total	5.9 MWh

Amortization of climate investments after 8 years

Polyurethane Insulation : Maximize energy efficiency

Keep the heat out and the cool in

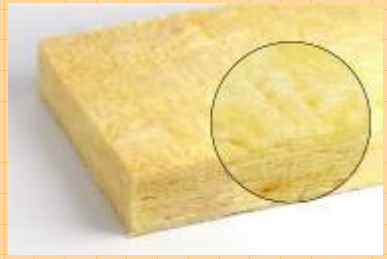
λ_R (DIN 18164T1)
W/(m·K)

PU/PIR
0.011-0.025

Best insulation

XPS 0.030-0.040

EPS 0.035-0.045



MW 0.035-0.040

Cork/Hemp
0.045-0.055

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Versatile Solutions for Every Need with Polyurethanes

Insulating Panels

Insulating Blocks

Metal-faced Sandwich Panels

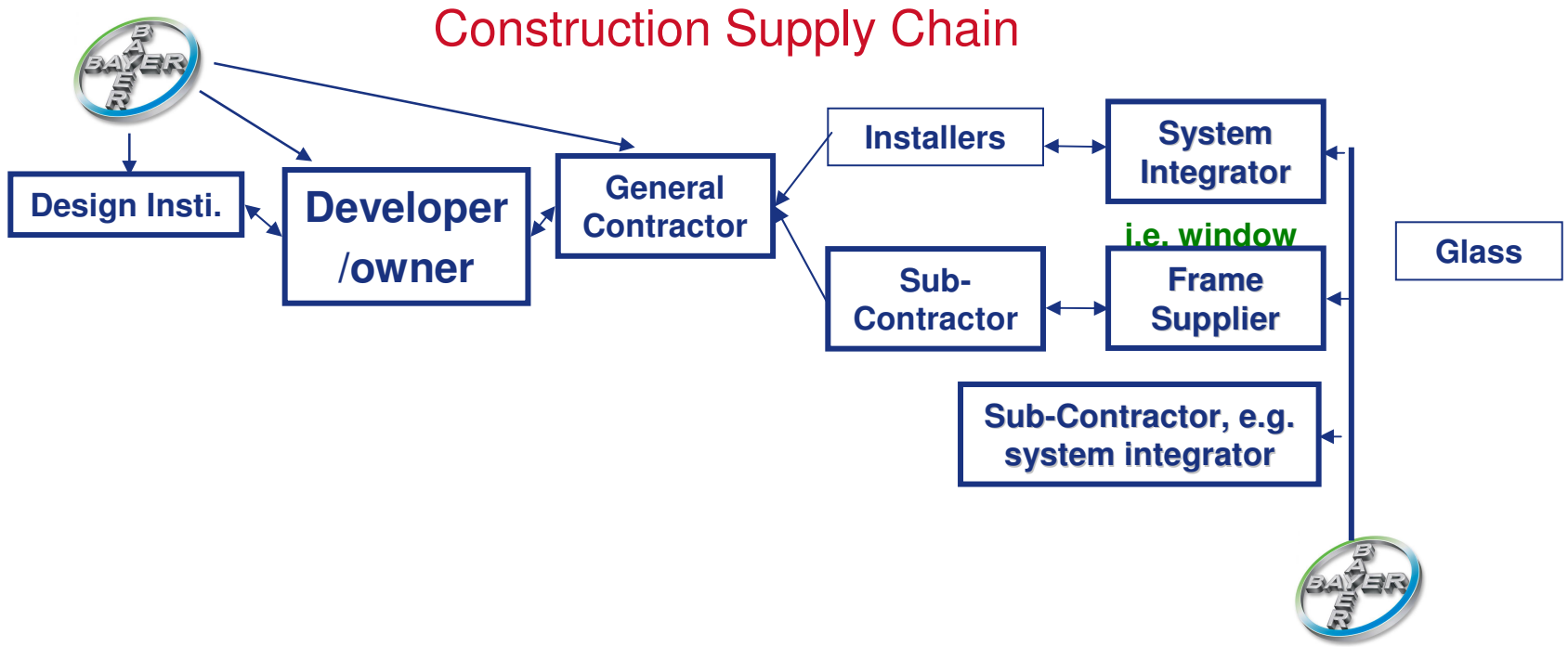
Spray Foam

Bonding Foam

On-site Injection

Open-cell Foam

Joining the industry (Materials)



Basic requirements

* Excellent co-ordination and organization skill, initiative,
* Excellent analytical and mathematic skills; Excellent handling of MS Office
* Fluent English (written and spoken) and Mandarin
* Ability to work effectively in teams, diverse group, other cultures, complex environments and under high pressure

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Joining the industry (Materials)

Options to join the trade from materials side:

- Sales & Marketing
  - Bachelor's Degree in Business or equivalent
  - Strong interpersonal and excellent communication skills to support Client contact and development activities
  - Daily interaction and strong relationships are needed within team and with customers and market influencers
- Market Development
  - B. Arch. Degree
  - Strong CAD expertise. Strong interpersonal and excellent communication skills to support Client contact and development activities
  - Understanding of green building standards and rating systems
  - Daily interaction and strong relationships are needed within team and with customers and market influencers
- Application Development
  - Degree and passion for Chemistry

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The secret of success

Innovation today

- Polyurethane insulation in buildings
- Lightweight materials for wind turbines e. g.
- Low- and zero-VOC coatings
- Polycarbonate glazing for vehicles and buildings

Innovation pipeline

- Pultrusion
- Cosmetics
- Wound care and wound closure
- Oral hygiene
- Carbon nanotubes
- Holographic data storage
- Polymer electronics
- 3D electroluminescence
- Solar panel framing

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How Polyurethanes Outperforms Other Insulation Materials

Properties	Polyurethane	XPS	EPS
K-Factor (at 25℃)	**Very Low （≤0.023）**	Low （≤0.028）	Normal （≤0.041）
Performance of thermal, gas barrier, waterproof	**Excellent**	No	No
Self-adhesive	**Excellent**	No	No
Cavity between insulation and base	**No（like fully adhesive）**	Yes（50%～60%）	Yes（50%～60%）
Seams between Insulations	**No (spray)**	Yes（vertical, horizontal）	Yes（vertical, horizontal）
Shaped wall construction	**Excellent**	Possible, but hard construction	No
Chemical stability	**Good**	Normal	Normal
Construction efficiency	**Good**	Normal	Normal
Stable period after construction	**1～2 days**	28 days	42 days
Using Temperature	**Long-Term：－30℃～90℃** **Short-Term：90℃～250℃**	≤75℃（Softening at 75 ℃ and 90 ℃ ~ 100 ℃ melting ）	≤75℃（ Softening at 75 ℃ and 90 ℃ ~ 100 ℃ melting ）
Fire performance	**Thermosetting, char → prevent spread of flame**	Thermoplastic, droplet	Thermoplastic, droplet

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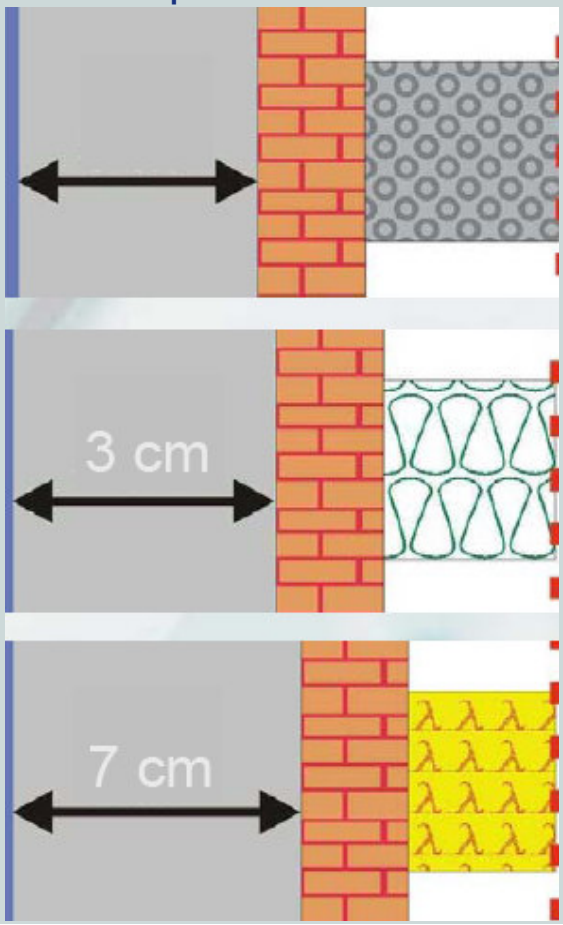
BMS Solutions
PU Board

Floor Space Increase



110 mm
mineral wool

80 mm
EPS

40 mm
PU

Baymer®, Desmodur®

- Excellent insulation properties allow thinner walls in building
- Climate and ozone friendly foaming agents
- Reduced of air leakage in building
- Application for walls, roofs and flooring
- Convenient construction

1 kg polyurethane saves 360 to 755 kg CO_2e emissions*

* Additional insulation. Savings over entire product life-cycle of 50 years, including production and end-of-life stages

CO2e: Greenhouse gases (GHG) according to Kyoto Protocol, expressed in CO_2 equivalents

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BMS Solutions

PU Spray Foam

Baymer® Spray

- Monolithic “seamless” air barrier contributes to significant energy savings
- Provides a thermal and moisture management system in a single application
- Climate and ozone friendly foaming agents
- High R-value per inch allows thinner wall construction
- Adds structural strength

1 kg polyurethane saves 360 to 755 kg CO_2e emissions*

* Additional insulation. Savings over entire product life-cycle of 50 years, including production and end-of-life stages – estimate based on rigid foam calculation

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BMS Solutions

PU Roof Coating

Baytec SPR®

- Seamless “monolithic” foam and coating application
- Eliminates seams and joints so mechanical fasteners and flashings are not required
- Adheres to almost any substrate
- “Repair, don’t replace” reduces construction materials in landfills
- High compressive strength increases durability and resists storm damage

1 kg polyurethane saves
360 to 755 kg CO_2e emissions*

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Video : PU Spray foam solutions

http://www.youtube.com/watch?v=KMVN2Os3iwk&feature=player_embedded#!

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BMS Solutions

PIR Foam

Fire resistance test

Baymer® PIR Foam

- **Good heat resistance**:
  - Degradation temperature about 400 C° (PU: 230-250 ℃)
  - Can be used at 150 C° continuously. Up to 200 C° for short time
- **Good flame retardance**:
  - High degradation temperature
  - Less release of heat & smoke during burnt
  - When burnt, PIR foam forms a surface char that helps to insulate the underlying foam from the fire
  - PUR couldn't reach the same flame retardance by adding flame retardant
- **Good stability and high strength**

Reference Project
Administration building in Diegem, Belgium

Key facts and figures:

- Location: Diegem, Belgium
- Client: Bayer AG
- Total area: 12,930 m^2 including multi-storey car park
- Use: Administration building, regional headquarters for the three subgroups of Bayer AG, 250 workstations, conference rooms, foyer with showroom, restaurant with kitchen, multi-storey car park
- Timeframe: Building started in November 2007, completed in March 2009; move-in date May 2009

Goals and challenges:

- Low-energy building
- Reduced energy consumption
- Target for energy consumption: Well within Belgian standard for administration buildings
- Planning and implementation period of less than 1.5 years including demolition of existing real estate
- Use of renewable energies
- Utilization of rain water
- Healthy room climate

Reference Project

Administration building in Diegem, Belgium

Procedure:

- Project management: Bayer Technology Services
- Architects: Schellen Architekten, Belgium
- Integration of the ECB skills network into the brainstorming and design phase
- Extensive simulations early on in the planning phase
- End-to-end planning
- Optimization of the building envelope
- Use of innovative building technology solutions

Example of activities:

- Optimum insulation with polyurethane insulating systems
- Solvent-free floor coatings
- Durable and energy-efficient outdoor LED lighting
- Daylight-controlled lighting concept with exterior screening system
- Geothermal energy: Generation of heating energy through highly efficient heat pumps
- Air-conditioning via heat exchangers with a heat recovery system
- Thermal concrete activation for cooling and heating the building
- Blind system controlled by the position of the sun

Reference Project

Administration building in Diegem, Belgium

Result – quotes from the operator:

- "Unusual architecture and optimum user benefits"
- "A sustainable energy concept with energy optimization far beyond the national standard"

BELGISCHE PRIJS VOOR ARCHITECTUUR & ENERGIE
PRIX BELGE POUR L'ARCHITECTURE & L'ENERGIE 2009

ECB Conference Centre
Pittsburgh, USA

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Reference Project

Zero Emission Day Care Center in Monheim, Germany

The World of Polyurethanes - Asia Pacific Region

APAC Construction School Proposal

Bayer MaterialScience

Objective, Scope & Target Audience

Objective

- Promotion & lead generation through educating building owners, architects, developers, media, government & academics
- Position Bayer as a leading player in Construction
- Competitive differentiation
- Prevention. Increase industry quality and safety awareness through educating on-site workers, site supervisors & partners.

Challenges

- For promotion, how to attract students to our school without being perceived as selling

Launch : September 2011

Target Audience

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