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International Meeting on Chemical Safety And Security

Chemical safety and security cost or investment?

November 2012

Chemical safety and security has no boundaries

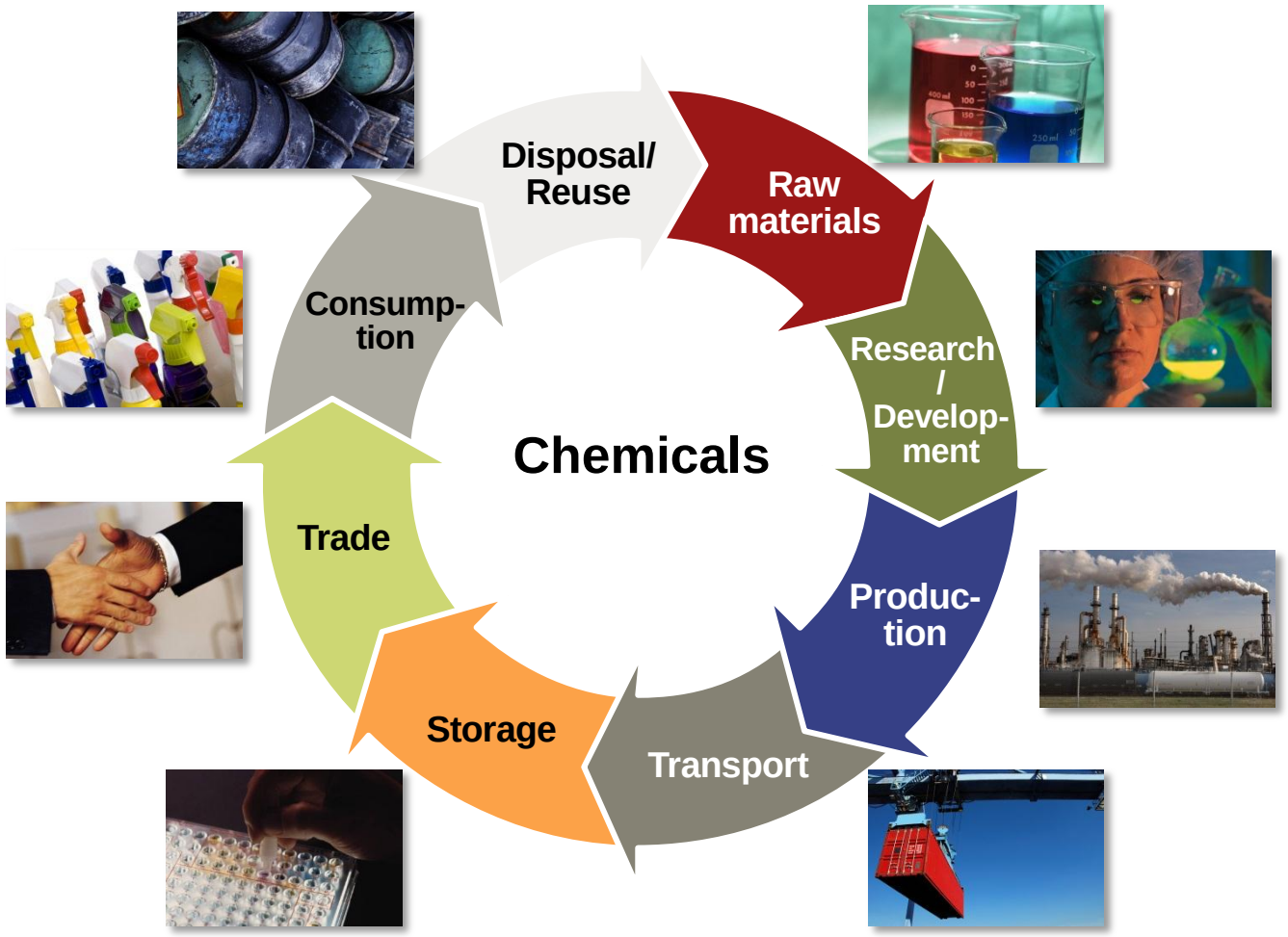
Importance of chemical safety and security is dramatically growing as we speak

To cope with increasing challenges it is vital to bring international cooperation into next level

Source: A.T. Kearney

Chemical safety and security has no boundaries as chemicals are present in virtually every aspect of our life

Chemicals life cycle



Source: A.T. Kearney

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Chemical safety and security is gaining on importance as new trends are driving global market environment

Chemicals related industry trends

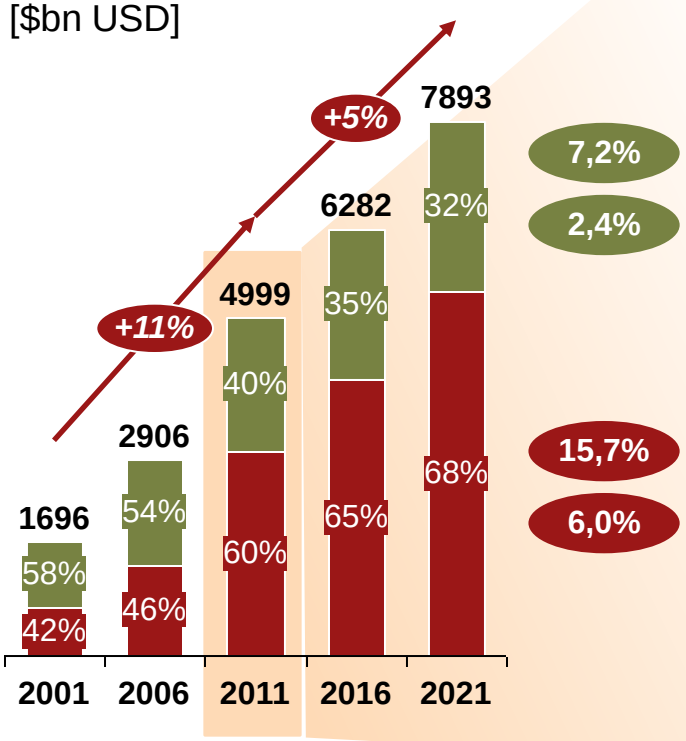
Increase and shift in chemical production	• There is hardly any sector where chemicals are not used **and industry where chemicals do not play an important role** • Chemical market is **growing rapidly** predominantly in **developing countries** • **Necessity for longer distances chemicals transportation** from deve-loping countries is increasing as chemical production is more centralized
Strong penetration of chemical intensive products	• Consumption of a wide range of **chemical intensive products** like plastic increases over time
Increased chemical emissions	• Many industries do not produce chemicals as a core business but produce significant amounts of **chemicals as by-products**
Rising pressure on stakeholders with different agendas	• Profit maximization/price reductions by **limiting necessary investments** at the expense of safety (results of shareholders, market pressure) • **Different time horizons, distribution of costs and investments** among various stakeholders involved in chemicals safety and security • **Safety negligence** is still an important **reason for chemical accidents**
Increasing danger of using chemical as a weapon	• **Intensification of terrorist attacks** involving the use of chemicals (misuse of industrial chemical agents, attacks with toxic chemicals, improvised chemical devices)

Source: American Chemistry Council 2012; United Nations Environment Programme - Global Chemicals Outlook 2012

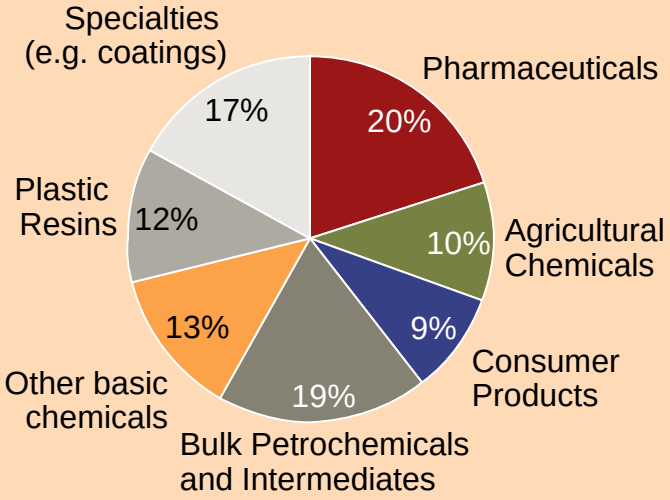
Chemical market is rapidly growing predominantly in developing countries

Global chemical market snapshot

Global chemical value of output (produced and shipped) [$bn USD]



Global chemical value of output by segments in 2011 [%]



Other basic chemicals: inorganic chemicals, synthetic rubber, man-made fibers

- Global chemical sales is forecasted to grow about 3% per year till 2050
- Shift of chemical industry from highly industrialized to developing countries.
- Predicted compound annual growth rate of chemical value of output in years 2011-2021: Nafta 2,8%, Western Europe 2,0%, Asia-Pacific 6,4%

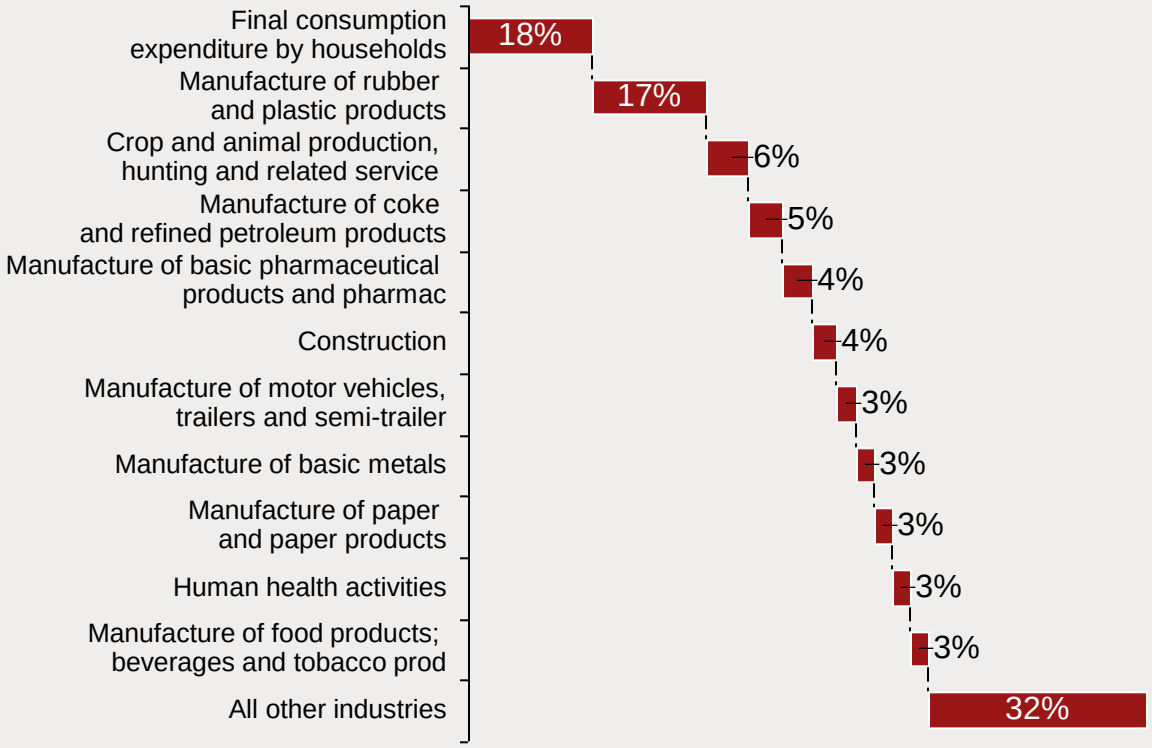
Developed countries
Developing countries
- 2001-2011 Compound Annual Growth Rate
- 2011-2021 Compound Annual Growth Rate

Source: American Chemistry Council; United Nations Environment Programme - Global Chemicals Outlook 2012

There is hardly any sector where chemicals are not used and industry where chemicals do not play an important role

Customer sectors of the EU chemicals industry

Output of chemical products industry is used in all sectors of the economy



- 143,835 chemical substances have been pre-registered under the pre-registration requirement of the European Union's chemicals regulation (REACH)
- Chemicals play an integral part of our lives (selected cases):
  - Food – e.g.: use of colors, antioxidants, emulsifiers, stabilizers
  - Work – e.g.: production of glue, paper, pens, cleaning
  - Health – e.g.: medicines, ointments
  - Spare time – e.g.: chlorine in the swimming pool
  - …

Source: Eurostat, Global Chemicals Outlook UNEP

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Asia-Pacific region attracts majority of world chemicals investment

World foreign investment climate

A.T. Kearney FDI Confidence Index 2012

	2007	2010	2012
China	1	1	1
India	2	3	2
Brazil	6	4	3
US	3	2	4
Germany	10	5	5
Australia	11	7	6
Singapore	7	24	7
UK	4	10	8
Indonesia	21	19	9
Malaysia	16	20	10

General Foreign Direct Investment trends

- Recovery brings the shift to the large and medium-sized emerging markets
- Continuation of economic uncertainty in Europe and US
- Rising income, urban mitigation and increased demand for consumer goods in China continue to attract foreign investors

Chemicals sector investment trends

- China and the rest of the Asia-Pacific region is leader accounting for 73% of world chemicals capital spending in 2010, up from 39% in 2000.
- Capital spending in Western Europe reached US$46,3 bn in 2010 (10% of world capital spending in value terms US$464,3 bn)
- The contribution of Western Europe declined from 22% in 2000 to about 10% in 2010

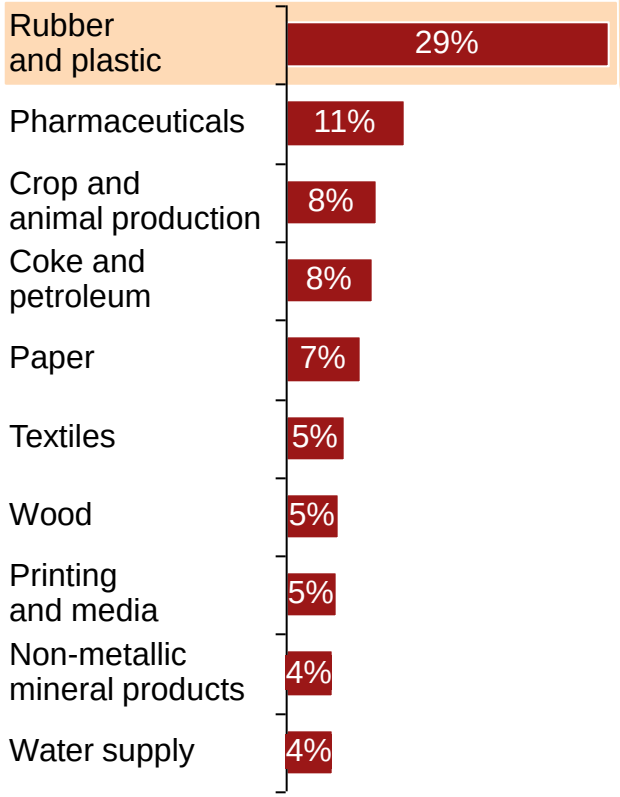
The FDI Confidence Index is constructed using primary data from a proprietary survey of senior executives of the world's leading corporations. Participating companies represents 27 countries and span 17 industry sectors. The Index is calculated as a weighted average of the number of high, medium and low responses to questions about the likelihood of direct investment in a market over the next 3 years.

Source: Cefic, A.T. Kearney

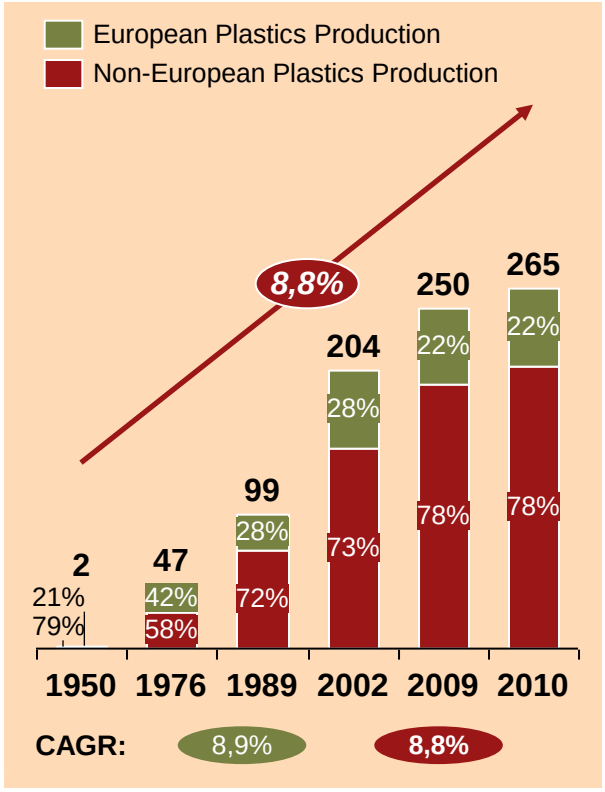
Production of a wide range of chemical intensive products like plastic increases over time

Example of strong penetration of chemical intensive products

Use of chemical industry products in differentia sectors[1]



World Plastics Production
[mil t]



- Consumption of a wide range of chemical intensive products increases over time
  - Products containing plastic or rubber are more chemical intensive (e.g. electrical and electronic equipment like cell phones, laptops)
- Chemical intensity of products is not changing rapidly over time

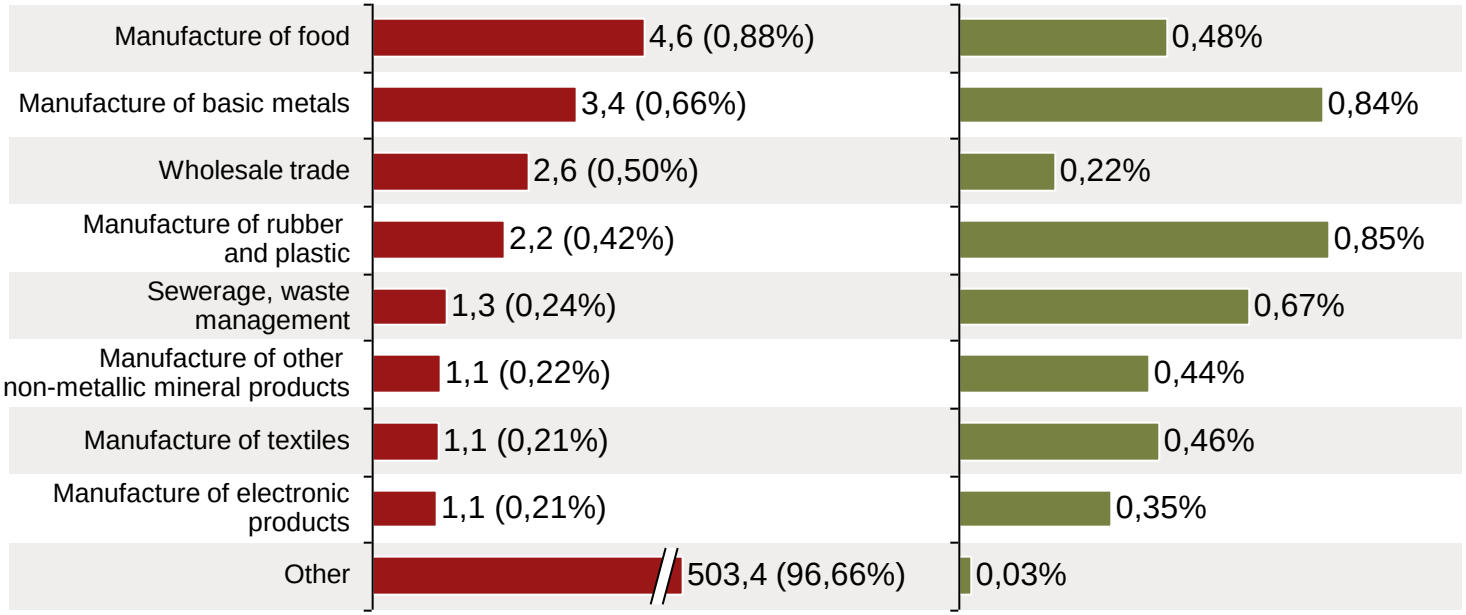
1. Year 2008; EU 27 data
Source: Eurostat, Plastics Europe Market Research Group

Also industries that do not produce chemicals as a core business emit significant amounts of chemicals as by-products

Chemicals and chemical products supply in EU

Chemicals and chemical products supply
[EUR bn; %]

% of chemical by-products in particular industry output [%]



- In EU in 2008 **almost 13%** of chemicals and chemical products **valued almost 67 EURbn** were by-products of non-chemical industry

Chemical safety and security is increasingly important for entities that have no expertise in the area of chemical industry

Source: Eurostat,

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Setting/complying with chemicals safety & security is a real challenge with numerous stakeholders involved

Selected benefits and costs of chemical safety and security

Stakeholder	Benefits	Costs
Customers	• Safety of goods/services • Sustaining environment	• Additional costs included in goods/services
Manufacturers/ service providers	• H&S of own employees • Avoided costs of chemical accidents/ incidents • Acceptance by customers/suppliers	• Expenditures to comply with internal and external standards • Costs to settle chemical accident/incident consequences
Environment, H&S protection	• Realization of statutory targets focused purely on highest environmental, H&S protection	• Operational costs
Media	• Increased media coverage due to an accident/incident	• Investigation, publishing and legal costs
…	• …	• …

Source: A.T. Kearney

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Profit maximization by reducing necessary investments at the expense of safety can have devastating consequences

Trafigura case study

Avoided expenditures

- In 2005, a **multinational trading company Trafigura** decided to buy large amounts of an unrefined gasoline.
- Trafigura intended to use the coker naphtha as a cheap blendstock for fuels
- In 2006, after several unsuccessful attempts to dispose of the **toxic waste it was dumped at approximately 18 different locations** around the city of Abidjan in Côte d'Ivoire.
- **Cost of safe disposal of the waste in Netherlands - 665k $**
- Trafigura's 2006 profits were US$511 million

Environmental damage

- Considerable risk to wildlife in the **immediate vicinity** if had any direct contact with waste
- S**ignificant decrease** of the pH levels

Health damage

- **Tens of thousands of people** suffered from nausea, headaches, breathing difficulties, stinging eyes and burning skin.
- More than **100,000 people** were treated, according to official records
- Between **15 and 17 people died**

Material damage

- Total cost of more than **310 mil $** (including compensation, legal fees, fines)
- Huge PR costs impossible to estimate

Source: United Nations Environment Programme - Global Chemicals Outlook 2012; Côte d'Ivoire Toxic Waste Report – Greenpeace, Amnesty International 2012

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Chemical accidents are a cause of substantial costs, health damage and casualties

Examples of major chemical accidents by categories

Environmental costs	**Gulf of Mexico (2010) - BP oil spill** • $ 17.6 bn fine imposed • Marine & wildlife affected • ~ 790 km contaminated	**Ajka, Hungary (2010) - Chemical Spill** • ~ Nearby areas flooded • ~ 7000 people affected • ~40 sq.km of land affected	**Jilin ,China (2005) - Explosion & chemical spill** • 3.5 mn temporarily people left without water • ~ 5 killed, 70 injured
Material costs	**Secunda, SA (2005) - Sasol factory explosion** • Functioning of ethylene unit affected • ~ 16 killed, 146 injured	**Graniteville, USA (2005) - Train collision** • Toxic gases released • 5400 people evacuated for 2 weeks, 9 killed	**Toronto, Canada (2008) - explosion & fire** • ~1200 people evacuated from nearby areas • $ 1.8 mn in cleaning up
People deaths and injured	**Bhopal, India (1984) -Union Carbide Gas leak** • ~15000 killed • People convicted, Charges levied against the company	**Lagos, Nigeria (2002)- armory explosion** • ~1000 killed • ~ 5000 injured • 12k left homeless	**Gao Qiao, China (2003) - Gas well blowout** • ~ 240 killed • ~ 9000 injured • ~ 64,000 evacuated
Reputation cost	**Bad Fallingbostel, Germany (2012) - fire at factory of Kraft Foods** • ~1400 people evacuated • ~ 700 firefighters were called to control the fire	**Marl, Germany (2012) - fire at plant of Evonik Degussa** • 130 firefighters worked for 16 hours • 2 killed	**Toulouse, France (2002) - explosion in Total's factory** • ~29 killed • 25 law suits have been filed

Source: American Chemistry Council 2012; United Nations Environment Programme- Global Chemicals Outlook 2012, A.T. Kearney Analysis

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Commonly accidents have a number of causes leading to occurrence of unsafe conditions

Reasons for selected chemical accidents

Technical

- Equipment failure (e.g. installation of pollution control equipment, piping)
- Failure of auxiliary systems
- Use of inappropriate or poorly designed equipment (not in accordance with current standards)
- Operating beyond the equipment design limits

Organiza-tional

- Inadequate indications of process condition
- Inadequate hazard review or process hazards analysis
- Ignoring warnings
- Wrong/inadequate instructions/ policies/ directions
- Lack of process analysis in respect to chemical reactivity and incompatibility

Chemical safety negligence still allow catastrophic chemical accidents to occur

Source: Factiva, General web; U.S. Environmental Protection Agency ; Helsinki University of Technology ; A.T. Kearney Analysis

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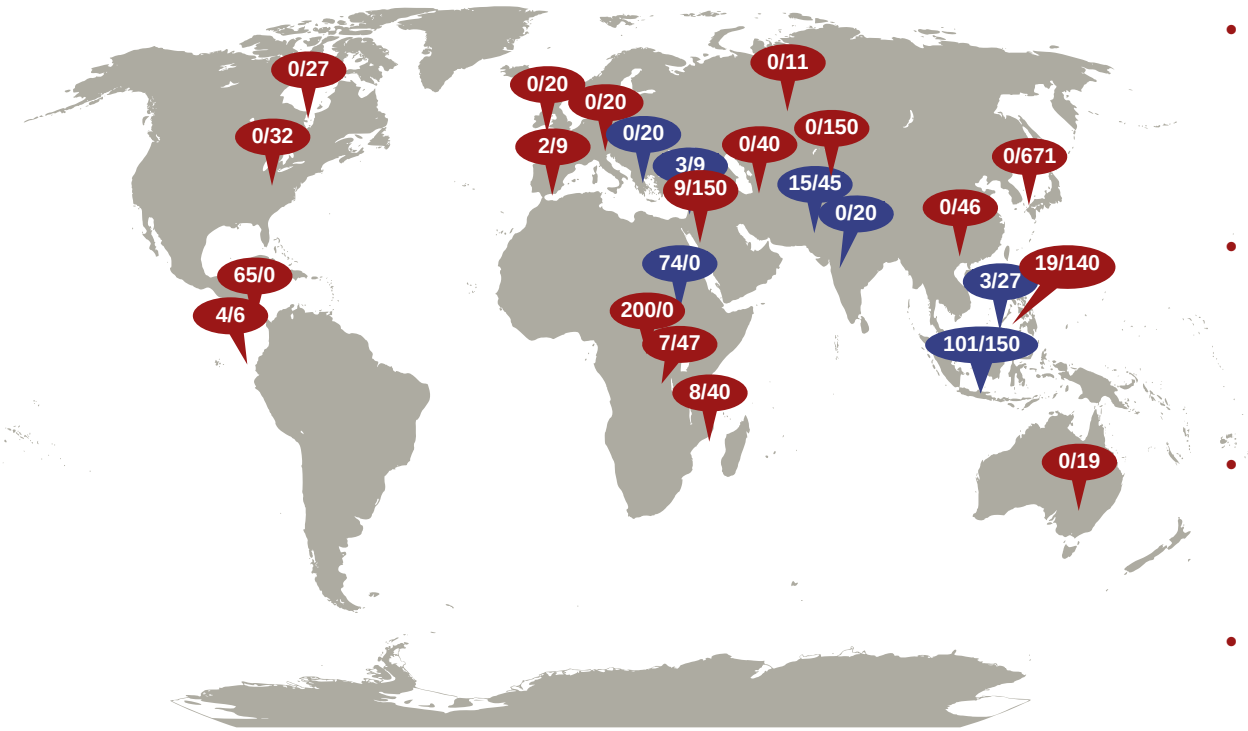
Intensification of terrorist attacks involving the use of chemicals is an important threat

Terrorist incidents



- Since 1971 there have been almost **50 thousand terrorist incidents** involving chemical weapons or explosives (CAGR for years 1971-2011 was equal 6,4%)
- Improvised chemical terrorism expands the agents of concern from the ~50 classical chemical warfare agents to **thousands of toxic industrial chemicals**
- **Expansion of terrorist attacks** with nontraditional chemical agents and delivery systems, such as improvised chemical devices
- Threat of chemical terrorism concerns under-secured and unsecured **stocks of dangerous chemical agents** and munitions

X/Y Bomb terrorist attack
X – killed, Y - Injured

X/Y Chemical terrorist attack
X – killed, Y - Injured

Source: National Consortium for the Study of Terrorism and Responses to Terrorism (START). (2012). Global Terrorism Database [Data file]. Retrieved from http://www.start.umd.edu/gtd,; A.T Kearney Analysis

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There have been no single superior organization responsible for chemical safety and security …

Examples of organizations engaged in chemical safety and security

International organizations	• Umbrella organizations coordinating regional efforts • Consultative and advisory functions • Forums for consultation and cooperation	• E.g.: Intergovernmental Forum on Chemical Safety (IFCS), Organization for the Prohibition of Chemical Weapons (OPCW)
Regional organizations	• Help companies to comply with the legislation, advance the safe use of chemicals, address chemicals of concern, provide information on chemicals	• E.g.: European Chemical Agency (ECHA)
National organizations	• Implement regulations, investigate industrial chemical accidents, set standards, provide training, outreach, education and assistance	• E.g.: Office of Chemical Safety (OCS), Central Crisis Group, Office of Chemical Safety and Pollution Prevention (OCSPP), Occupational Safety and Health Administration (OSHA)

Source: American Chemistry Council;

There is plenty of not aligned chemical safety and security management policies

Chemical safety and security standards, methods and tools

Source: American Chemistry Council; United Nations Environment Programme - Global Chemicals Outlook 2012

To cope with increasing challenges it is vital to bring international cooperation into next level

Source: A.T. Kearney