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Portfolio Performance
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How Does Shale Gas Influence the European Chemical Industry? – A Management Survey –

Stratley Shale Gas Study Results

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Status: Cologne, May 2014

Hidden Champion

2012

Hidden Champion 2012

Stratley – Best Consultancy for the Chemical Industry

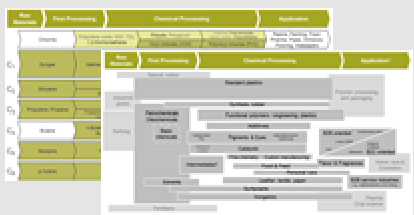
STRATLEY Portfolio Performance Incorporated

Hidden Champion 2012

Chemical industry: Stratley ranked No. 1 by clients

Independent of industry: Stratley ranked No. 1 in overall client satisfaction

Stratley offers unique knowledge of the global chemical industry based on management and consulting experience



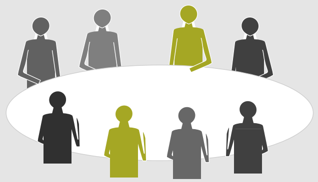
Expert view on the global **chemical industry** and extensive industry network

> 500

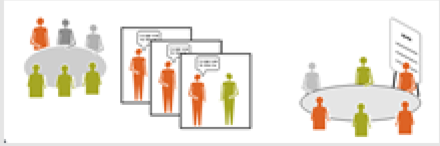
More than **500 man-years of experience** dedicated to the chemical industry

40 professionals with truly **international project record**

Offices in **relevant regions** and thus at the pulse of industry developments



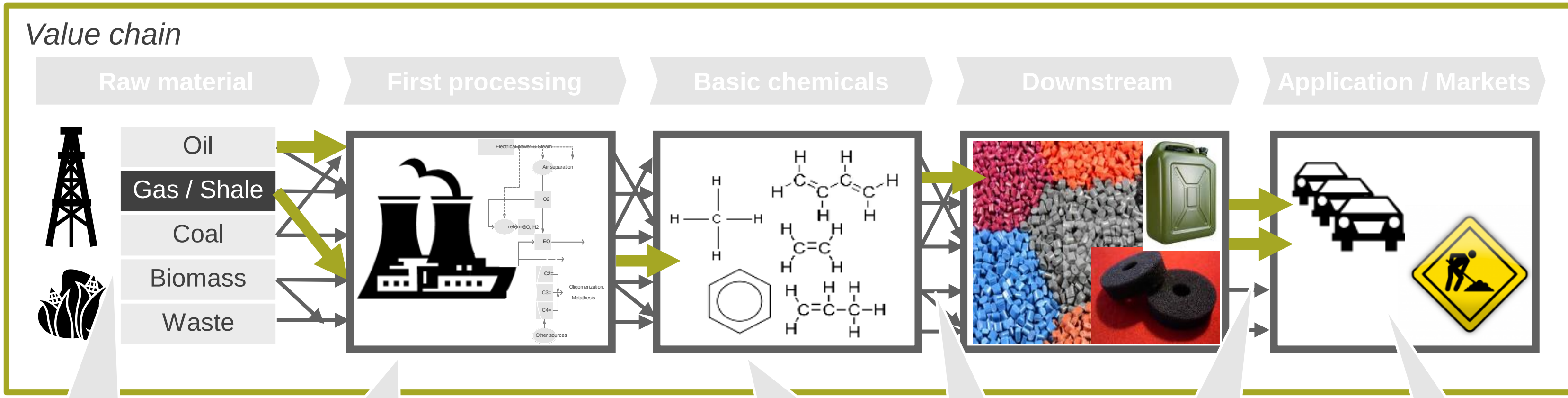
Working in **interdisciplinary and multicultural teams**



Collaborative approach with integrated teams obtaining organizational buy-in

Stratley reduces complexity to a manageable level with expertise and the big picture of chemical industry in mind

Big picture



- Expertise in shale gas
- Tracking game changer in chemical industry

- Technical expertise
- Contact to refinery
- Technology benchmarking

- Track record:
- **C_4 initiative**
- **Cumene, Phenol**
- Alternative routes to xxx

- Sourcing strategy and long-term contracts

- Driver of demand
- Substitution pressure

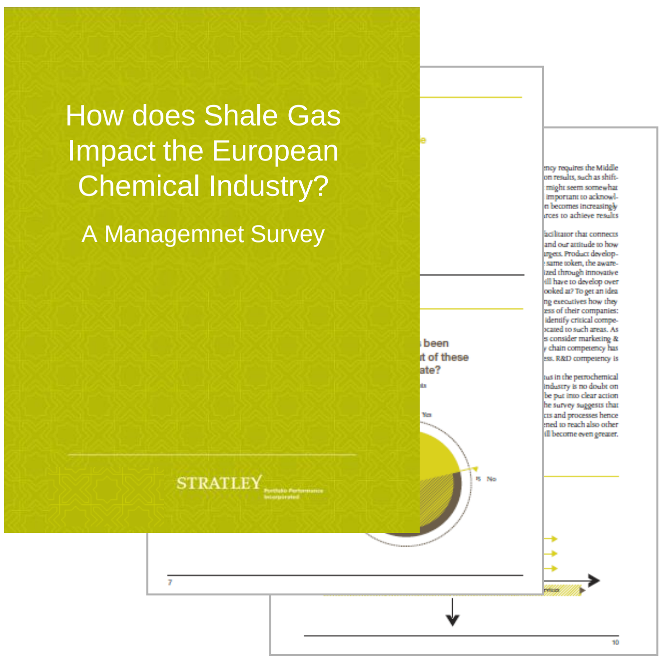
- Market trends
- Market surveys

- Business models, Site search, Pricing

Agenda

Managers see need for action in the European chemical industry to cope with US shale gas

Shale Gas Impact on European Chemical Industry – A Management Survey



- Shale gas one of the top 3 main topics
- More than 80 percent are seriously concerned due to less competitiveness of European operations and erosion of the industry
- Driving innovation regarding product, process & raw materials will be a key factor of success

Comprehensive study report available soon - Please feel free to contact us for a free copy!

Source: Stratley Shale Gas Study.

Shale gas has gained increasing attention from industry, politics and the public

US business on the rise

Rising labor costs in China, along with intellectual property rights concerns, could result in a North American manufacturing revival

ICIS, June 2012

BASF keen to explore German shale potential

Financial Times, February 2013

Upstate fracking is danger to city water supplies

NYPost, 2014

US shale gas boom could 'challenge European industry'

BBC News Jan 2014

Shale gas: opportunity or threat to the environment?

European Parliament News 2012

Natural gas

Shale of the century

The "golden age of gas" could be cleaner than greens think

The Economist, June 2012

Call for 'frack-free zones' to protect UK's wildlife and water

The Guardian, 2014

Shale gas could ease China's energy crisis – PwC

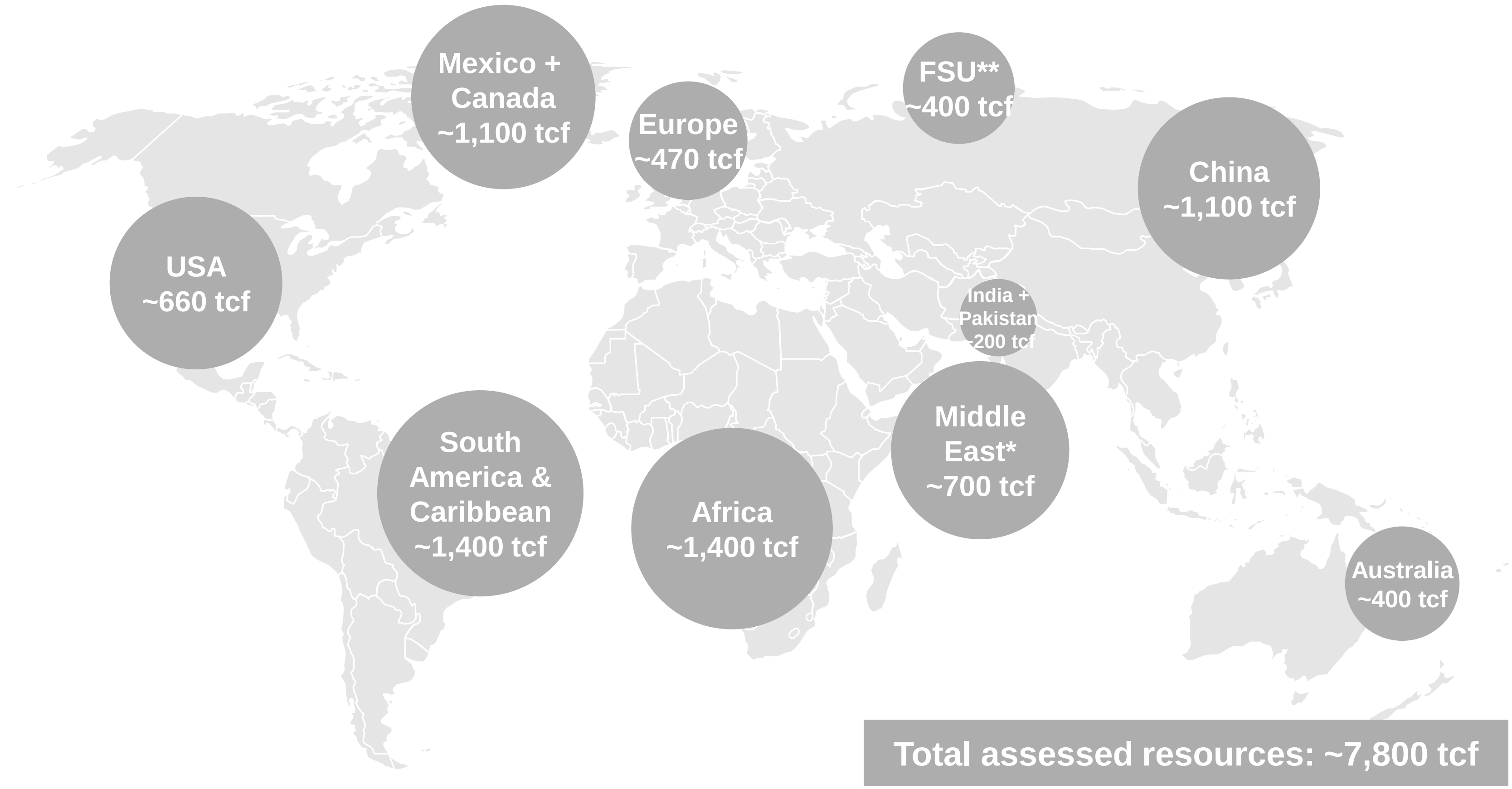
ICIS, May 2012

UK Government lifts temporary suspension on hydraulic fracturing

Eversheds, December 2012

Source: Financial Times, Eversheds, ICIS, BBC News, The Economist, NY Post, European Parliament News, The Guardian 2012, 2013 and 2014.

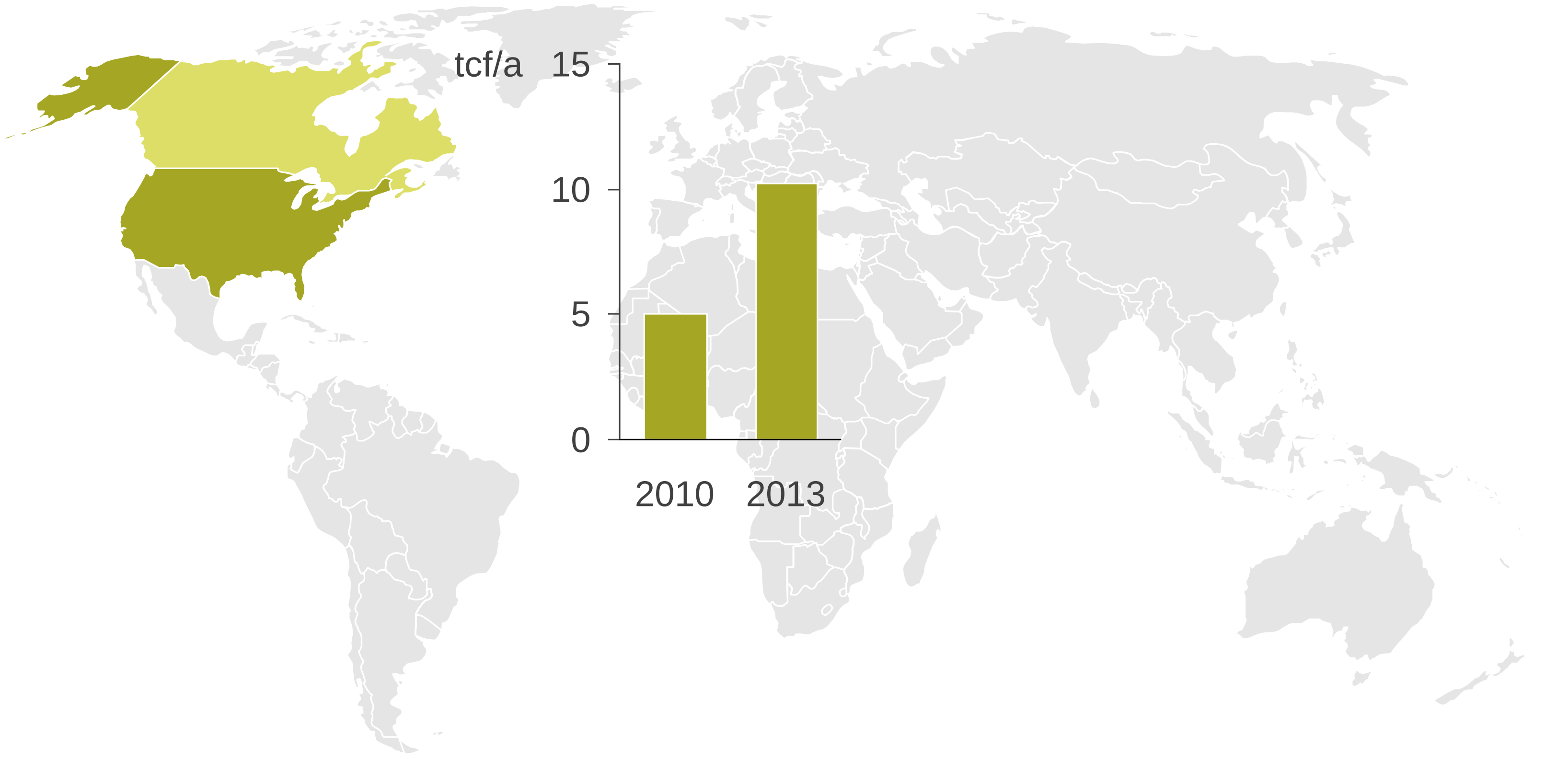
Significant shale gas resources exist in all regions – it is not just a North American topic



Source: Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States, EIA, 2013; Stratley analysis. * Stratley analysis and research, huge uncertainty due to lack of data. ** FSU = Former Soviet Union
Note: tcf = trillion cubic feet.

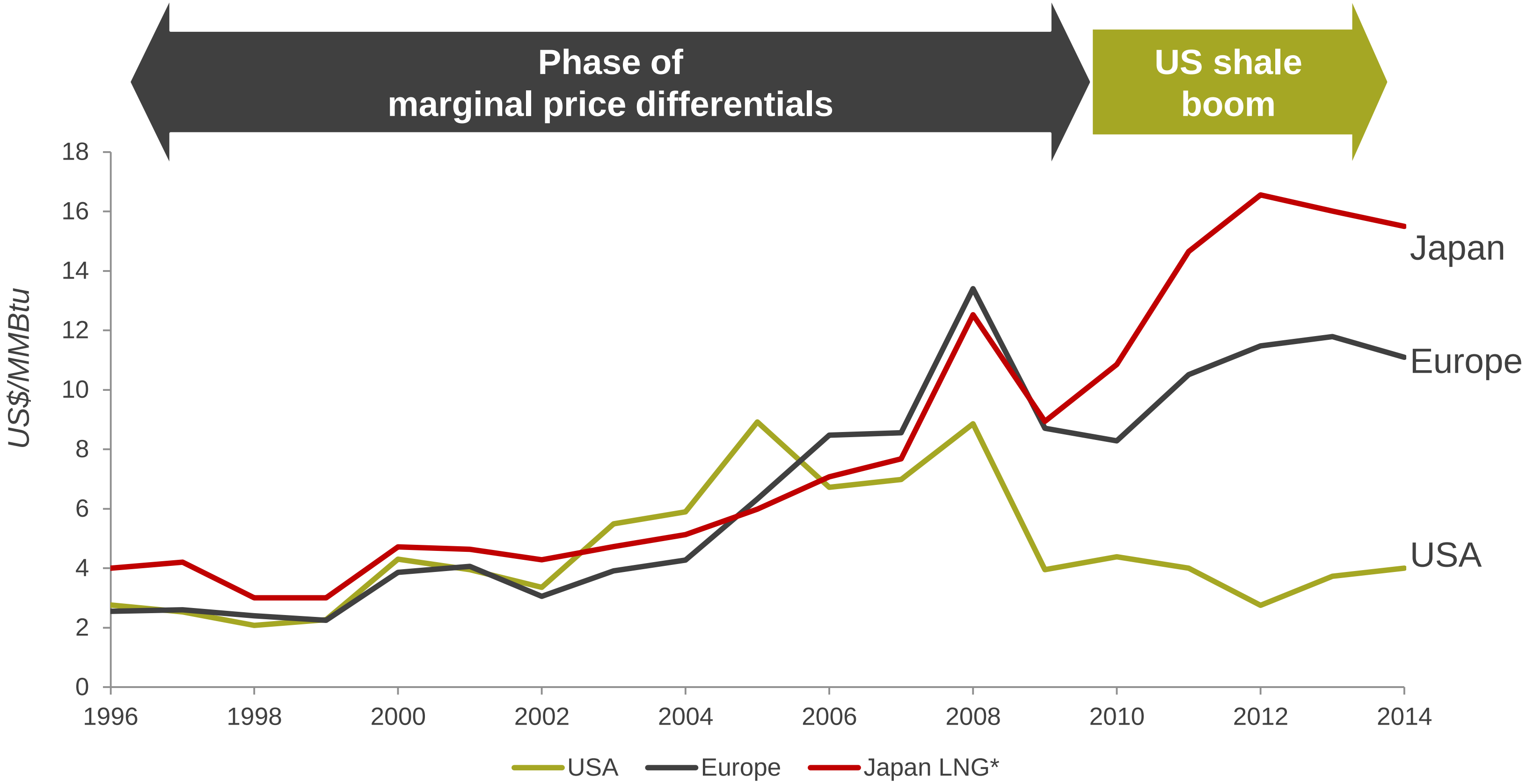
However, today North America is the only commercially producing region ...

Shale Gas Production in North America



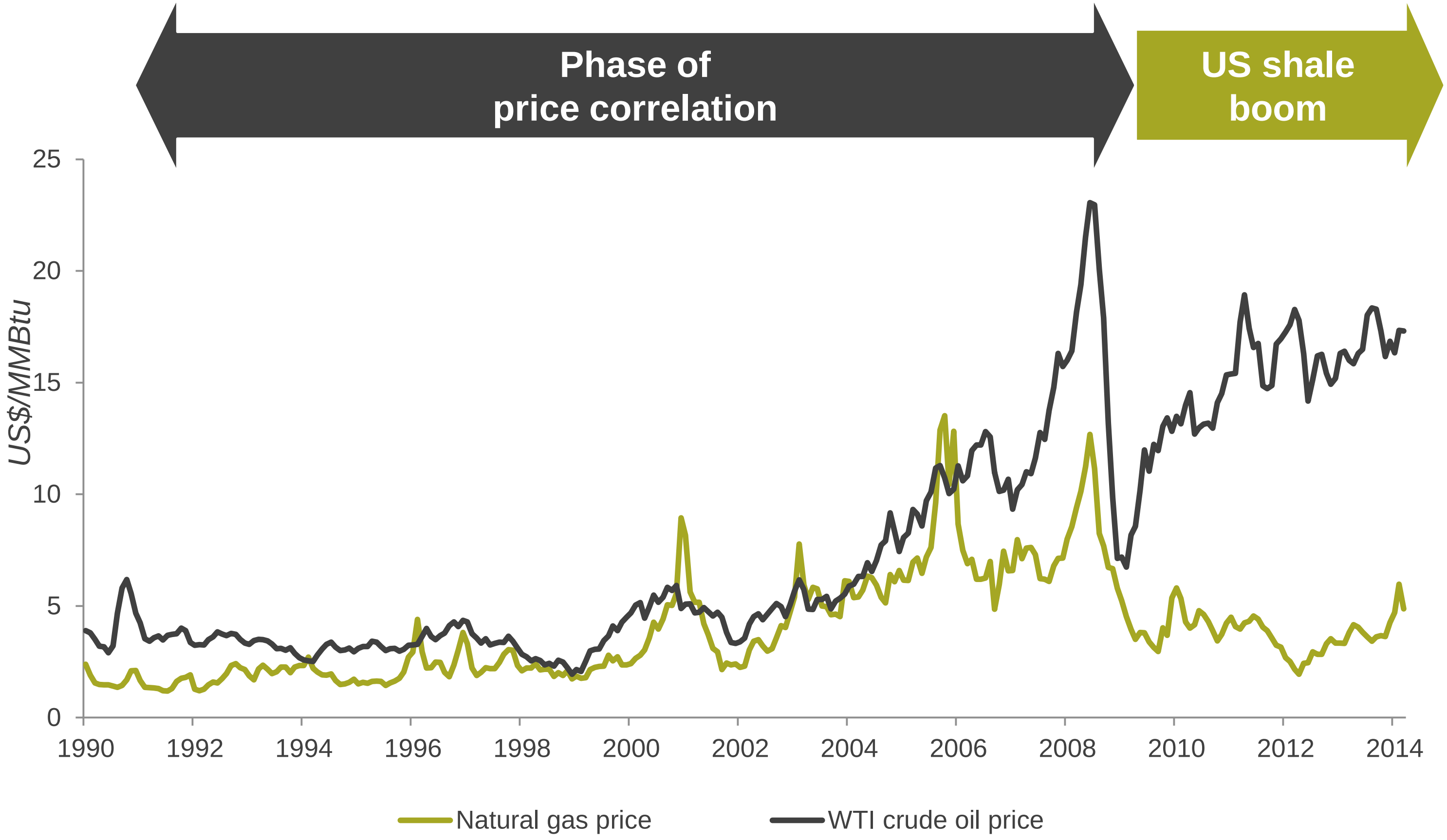
Source: Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States, EIA, 2013

..., which decoupled natural gas price in US from the rest of the world



* Significant price increase due to oil price linkage of natural gas (long term "take or pay" contracts) and increasing reliance on natural gas as energy source after the Fukushima incident. Note: LNG = Liquefied natural gas; MMBtu = million Btu.
Source: World Bank commodity price data & forecast (2013, 2014), World Economic Forum: The New Era of Gas (2011); Stratley.

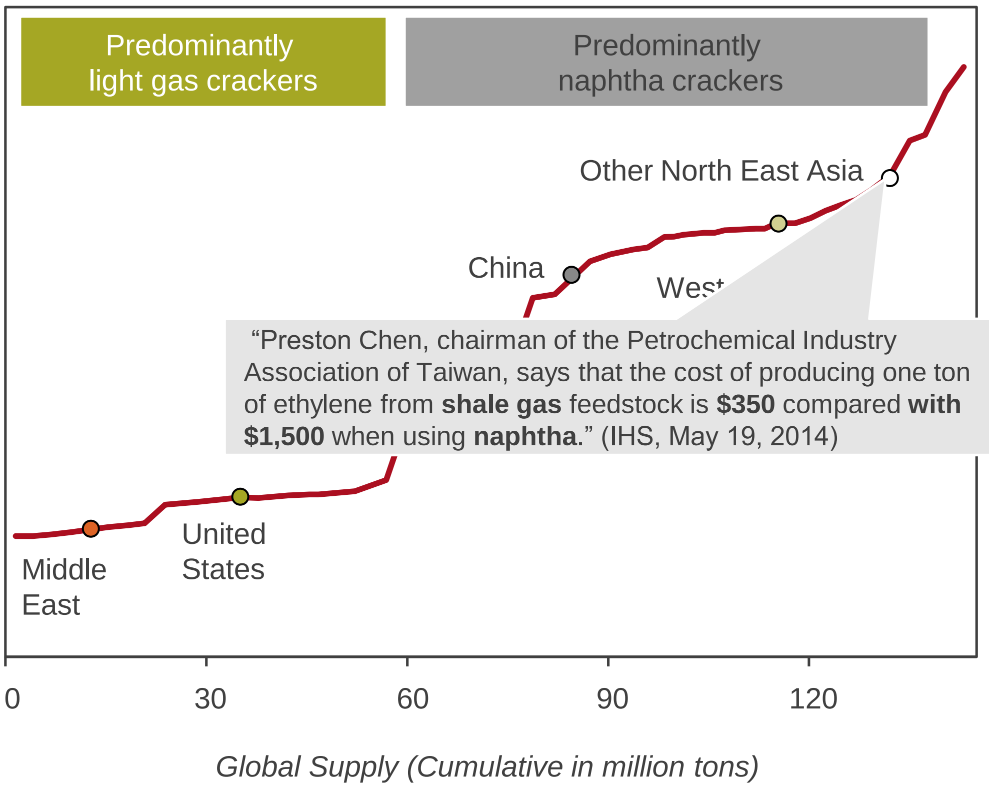
… and broke the natural gas price correlation to the crude oil price



Source: World bank, global economic monitor (GEM) commodities.

Cash costs of US ethane crackers are by far more attractive than of European naphtha cracking

Global ethylene supply curve 2011

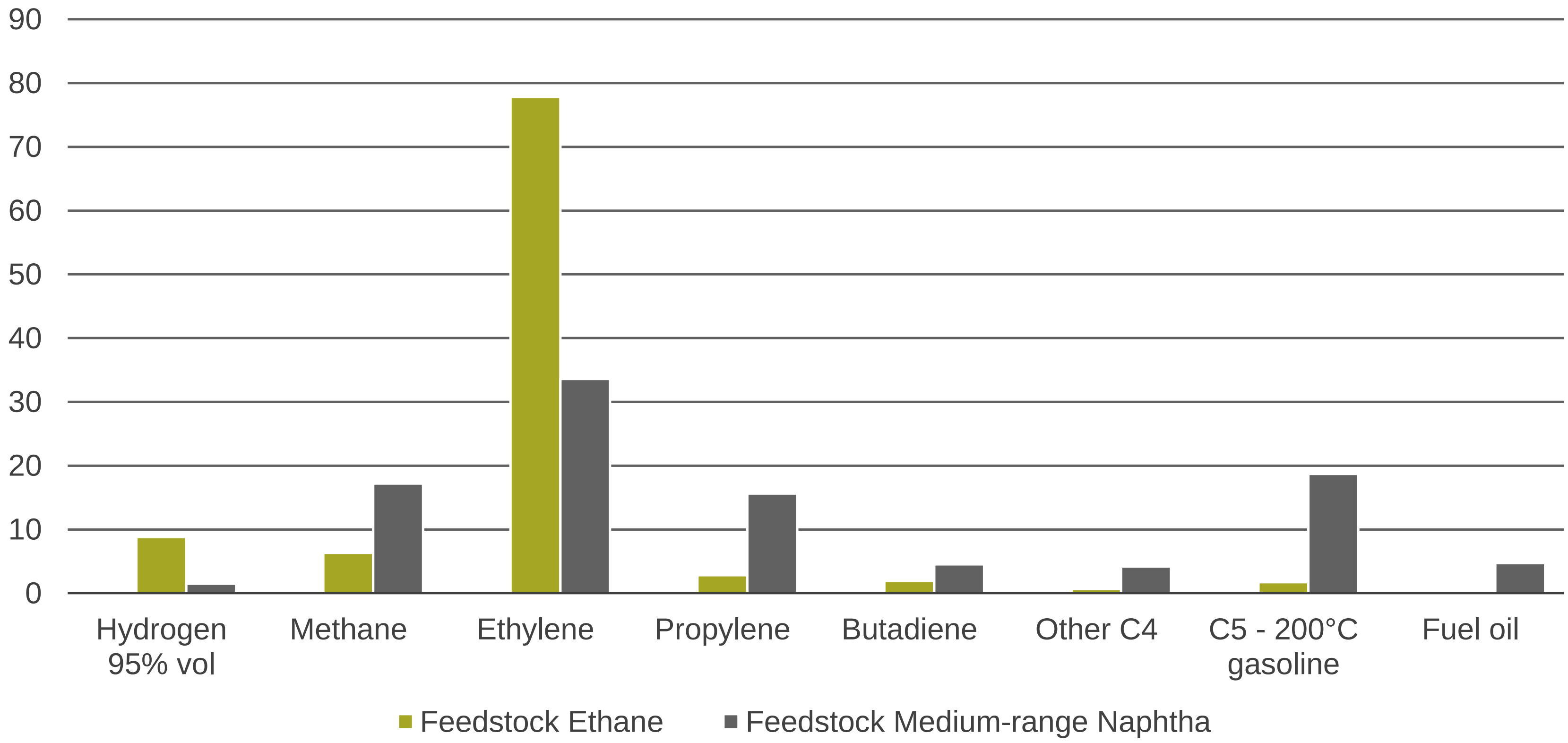


- Due to low price NGL supplies from shale gas, the U.S. developed from an historically unattractive to a highly cost competitive ethylene supplier
- "Those who have been able to move away from an oil-dominated feedstock basis have done extremely well" [Gary Adams, IHS Chemical] said." "Those that cannot … have been challenged for the most part and not are achieving the level of earnings for reinvestment"
- The petrochemical world is divided into two
  - Ethane cracking: ME & U.S.
  - Naphtha cracking: Asia & Europe

Source: Shale gas & petrochemical investment, ACC 2012; Stratley analysis.; HIS ChemWeek, March 25 / April 1, 2013

On the other hand, light cracking renders a depletion of C_{2+}, higher olefins and BTX aromatics, a further challenge

Steam cracker yield / % wt with feedstock ethane vs. naphtha

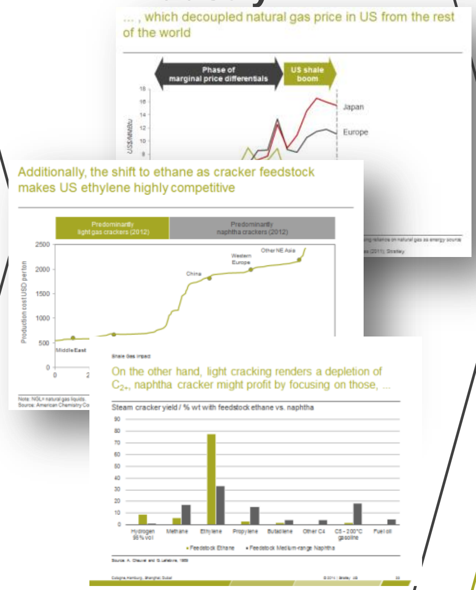


Source: A. Chauvel and G.Lefebvre, 1989

How will North American shale gas impact European chemical industry?

Shale gas boom in North America

Impact on North American **industry**



Impact on European chemical industry

- Impact on European chemical companies and current measures taken
- Impact on European chemical industry and the potential solutions

?

60 managers were interviewed to draw a comprehensive picture of European chemical decision makers' views on shale gas

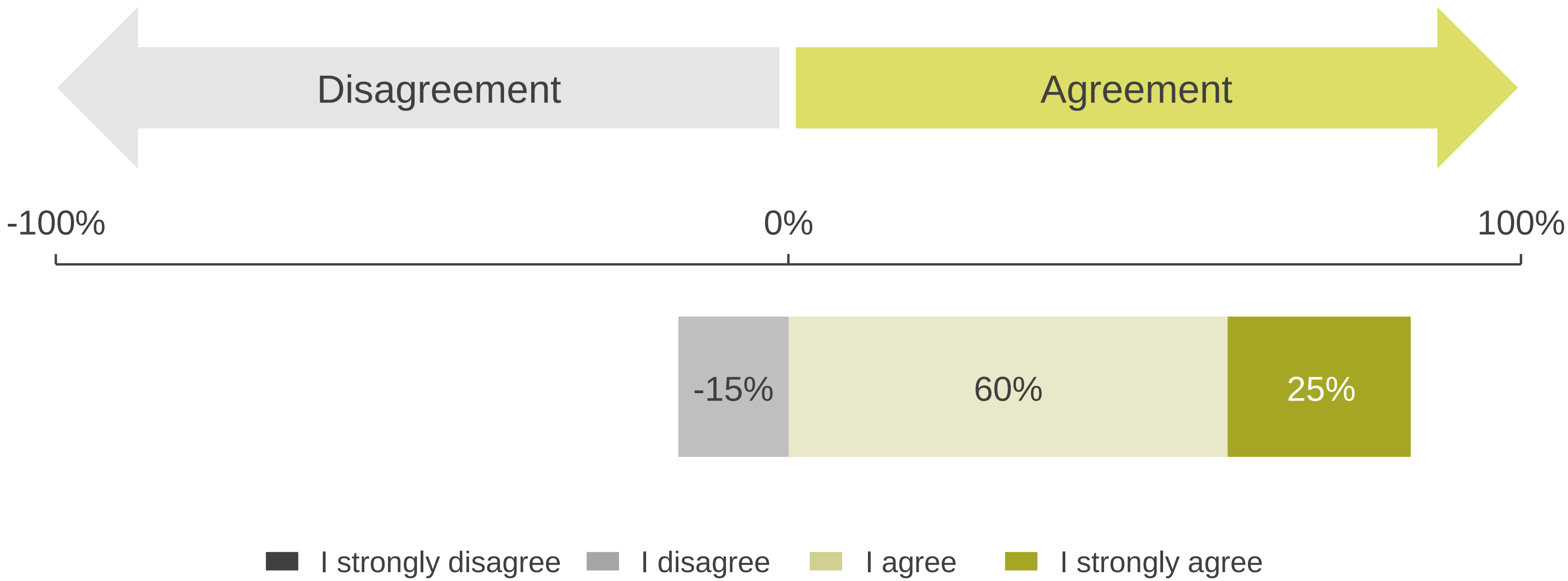
Source: Stratley analysis

Agenda

Agenda

Shale gas is more than a hype – it is expected to maintain its price advantage over crude oil at least up to 2020

“North American shale gas will maintain its current price advantage over crude oil at least up to 2020.”

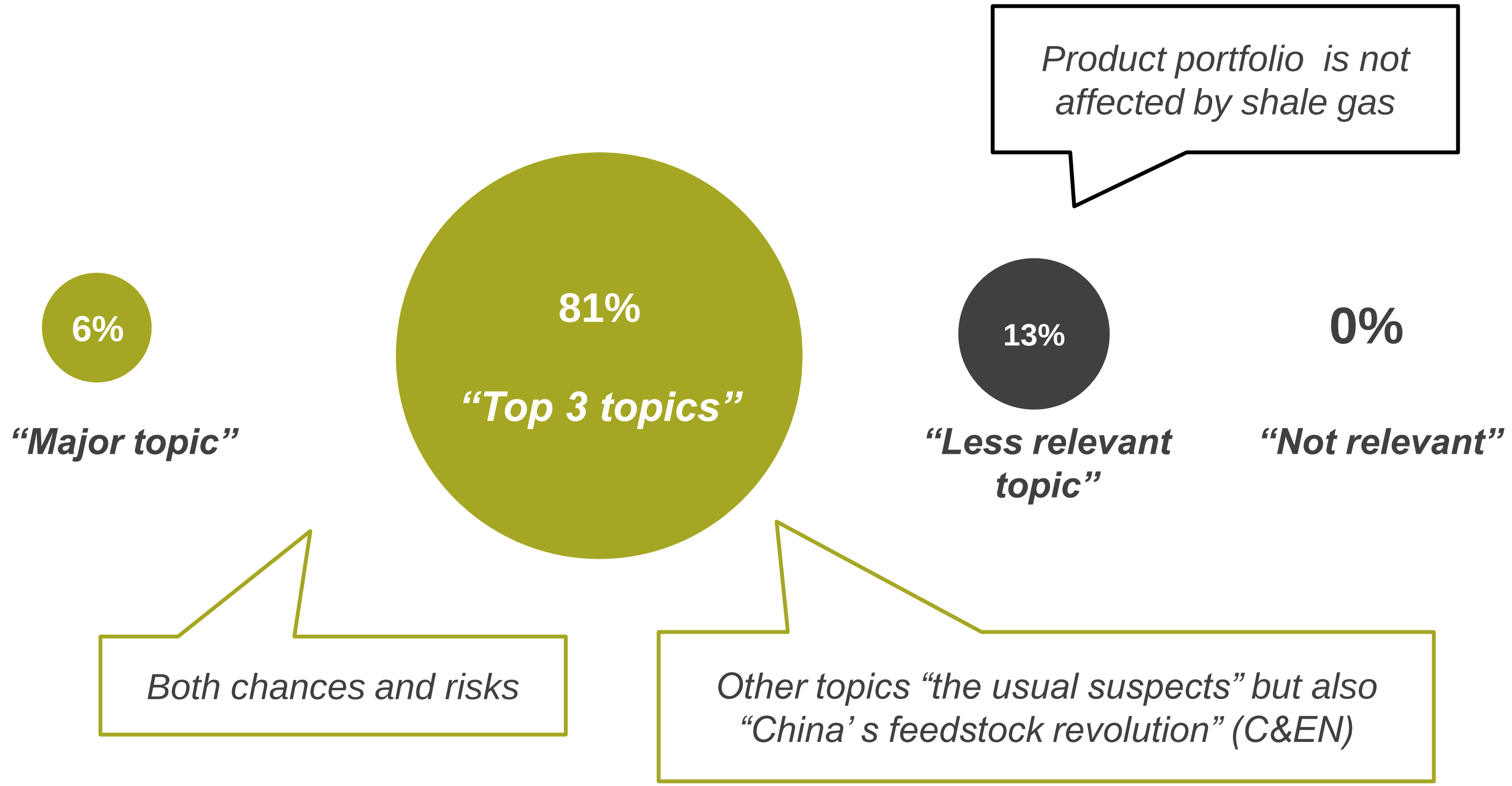


Price advantage of US shale gas over crude oil is expected to persist – but the gap will shrink

Source: Stratley Shale Gas Study

Managers in the European chemical companies consider shale gas as one of their major topics

"How important is the topic shale gas for your company / your business right now?"

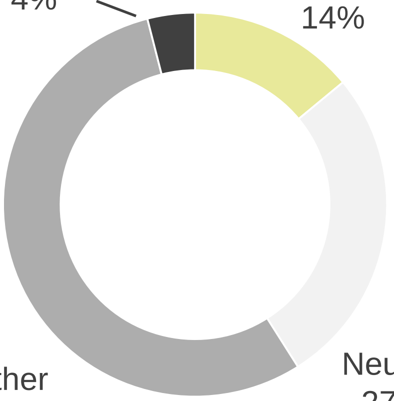


Source: Stratley Shale Gas Study

Over half of the managers stated that shale gas will have negative impact on their European businesses

Effect of North American shale gas on my company / business areas in Europe

- Increasing competition on export markets against US products make European exports difficult, US sets the benchmark
- Import of lower cost products from North America to Europe replaces local production in Europe
- Our products face substitution risks



Overall Impact

- US oil & gas business is a growing export market
- Hope to profit from US NGL imports to Europe

- Global footprint, broad product portfolio help to balance shale gas effects
- Shale gas is a regional topic; specific products don't have arbitrage windows so far
- Raw material effects are not critical due to strong demand

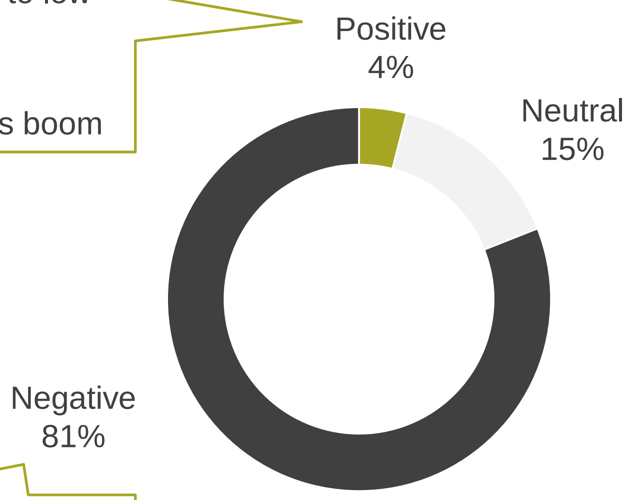
Majority expects a negative impact on their European businesses while a small group even expects a positive impact

Source: Stratley Shale Gas Study

On the level of energy cost, a vast majority see competitive disadvantages due to shale gas

Impact on competitiveness of European operations: At the level of energy cost

- Established or expected access to low cost US energy feedstock
- European natural gas is already cheaper due to the US shale gas boom



Energy impact

- Share of energy costs on COGS* is low
- Protected by high interregional market barriers

- Energy cost is a considerable part of the products' cash costs

Energy cost disadvantage is seen by most managers already today

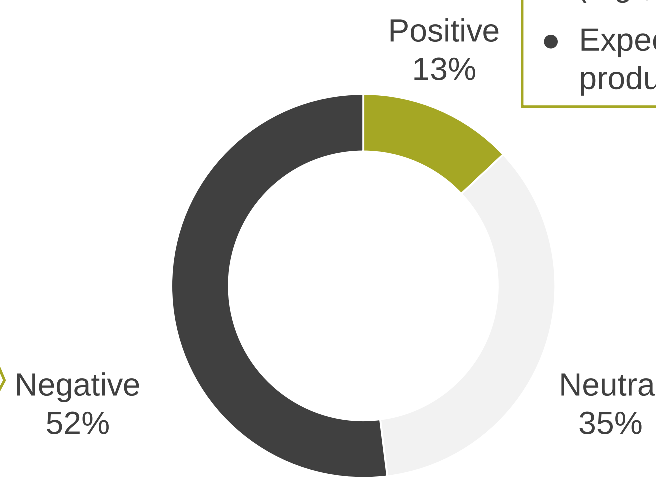
Source: Stratley Shale Gas Study. * COGS: Cost of Goods Sold

In contrast, only half of the managers see competitive disadvantages from raw material perspective

Impact on competitiveness of European operations: At the level of raw materials

- Hope for cheaper feedstock prices (*e.g.*, NGLs, ammonia, C_2 derivatives)
- Expect relative advantages for C_{4+} products compared to US

- Access to low cost US feedstock is doubtful
- Higher raw material prices, due to shortage of cracker by-product availability as a consequence of light cracking and potential cracker shut-downs in Europe



Raw material impact

- Sourcing at global markets (*e.g.*, BTX*)
- Higher raw material costs can be passed on to customers
- Global footprints allow compensation for disadvantages in Europe

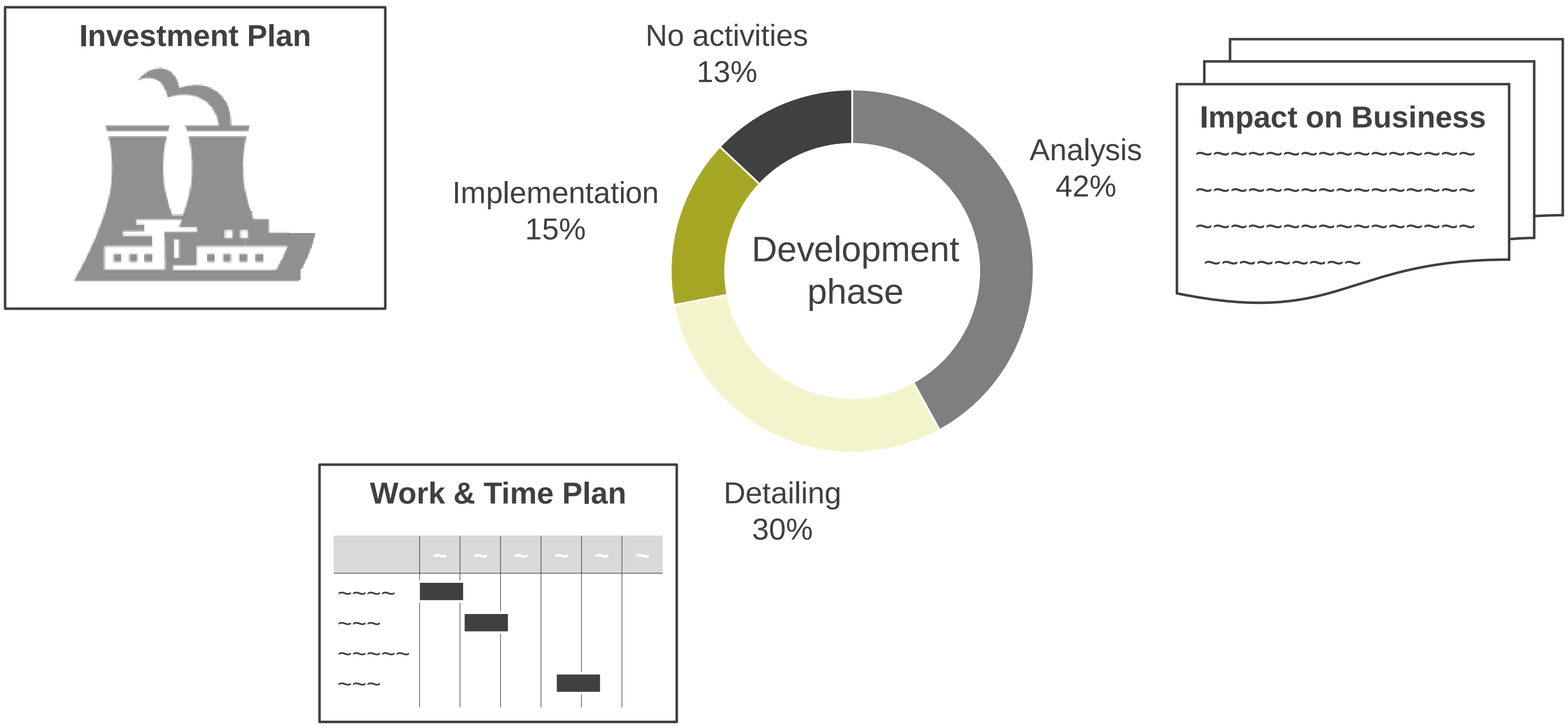
Raw material impact depends on many complex factors – impact will be seen in future

Source: Stratley Shale Gas Study. * BTX: Benzene, Toluene, Xylene

Agenda

Managers see the need to act on the shale gas challenge, however current activities are still at early stages

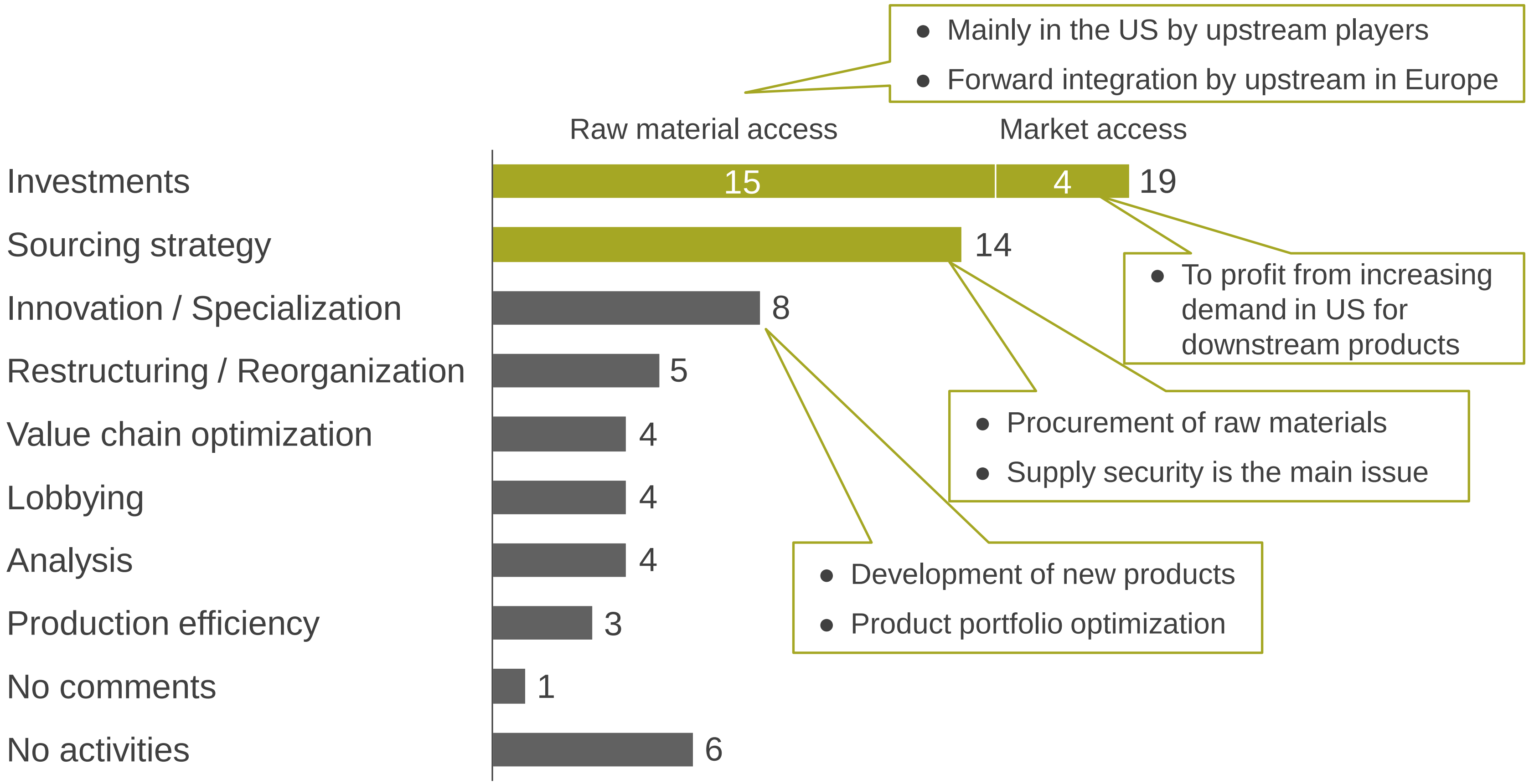
Phases of current activities to cope with shale gas challenges



Source: Stratley Shale Gas Study.

Current measures concentrate mainly on investments and sourcing strategy as reactions to shale gas impacts

Measures taken by European chemical companies due to shale gas implications



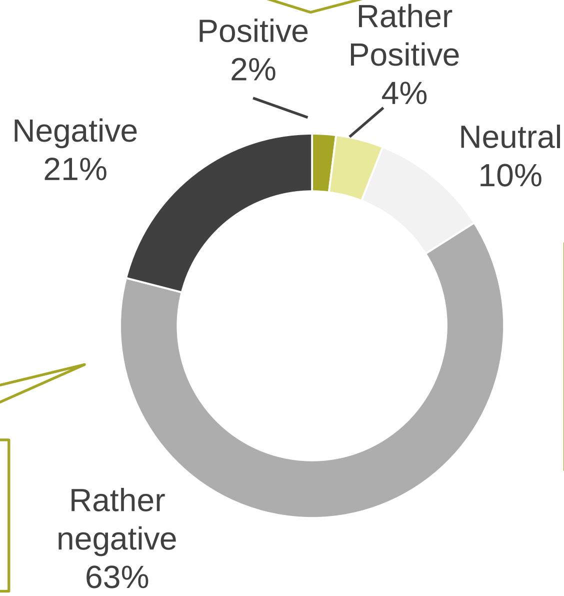
Source: Stratley Shale Gas Study.

Agenda

Managers are generally pessimistic about the future of the European chemical industry

Impact of North American shale gas on European chemical industry

- US as an export market for specialty chemicals
- Europe could profit from US NGL imports



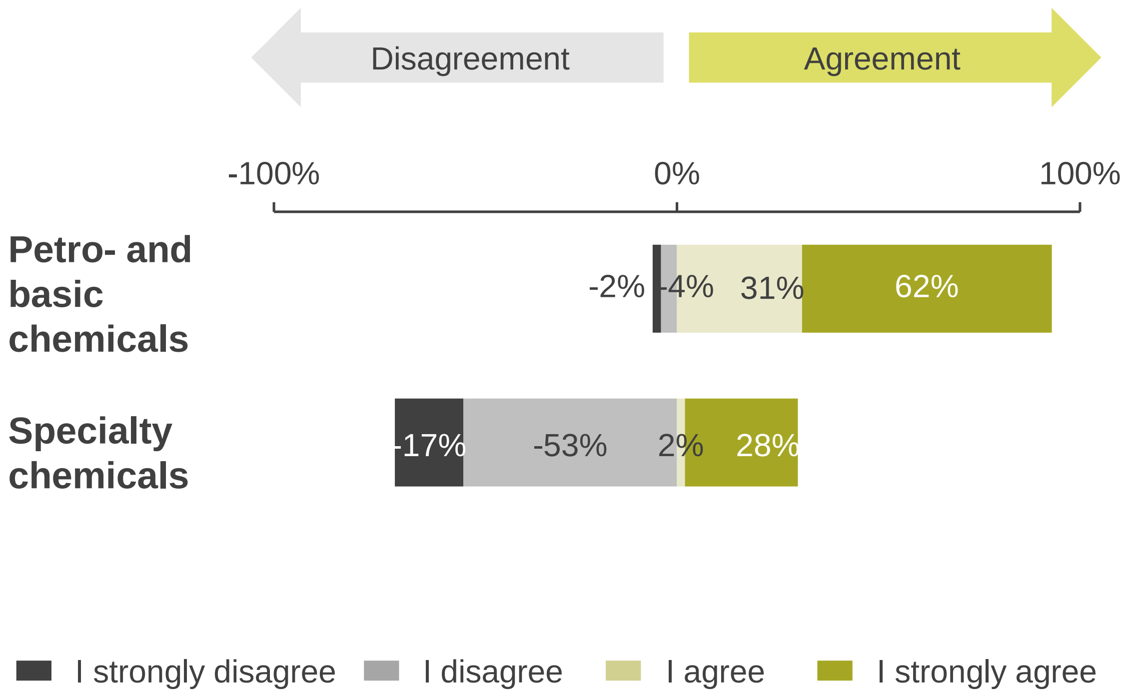
Shale gas not as the driver, but only as an accelerator of existing challenges in the industry, e.g., lacking growth and resource availability

Decreasing competitiveness of commodity and energy intensive chemical industry

Source: Stratley Shale Gas Study.

Stronger impact is seen for petrochemicals and basic chemicals compared with specialty chemicals

"European chemical industry will be impacted by North American shale gas"

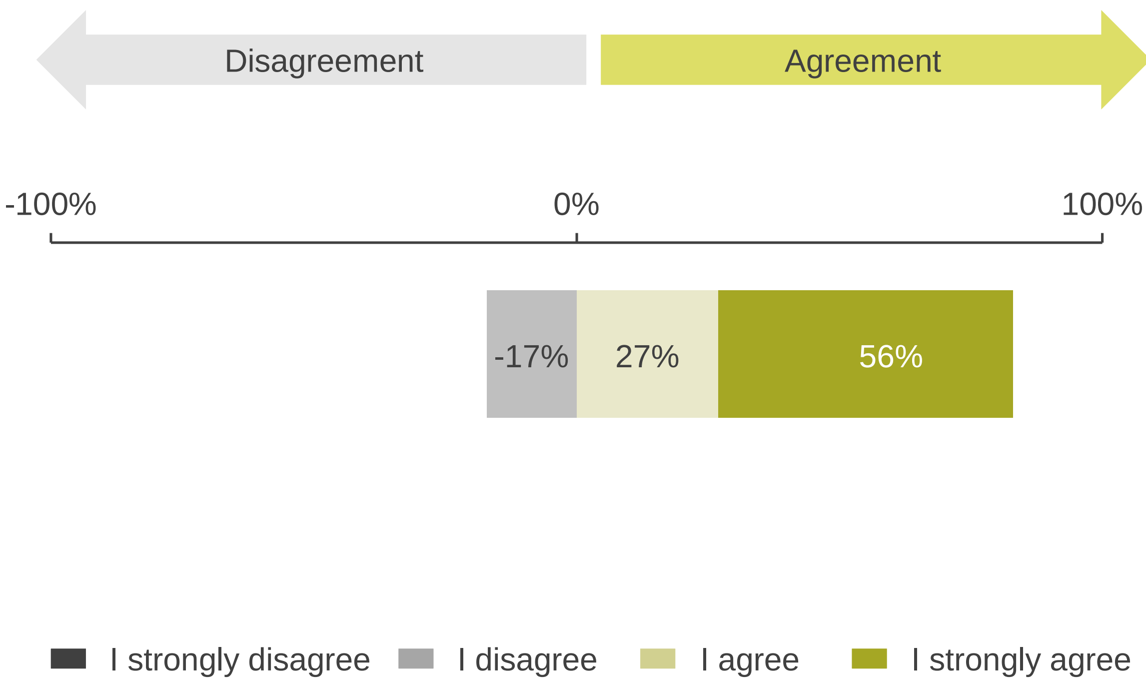


- Europe's petrochemical industry is facing a tough future – especially small, outdated and non-integrated assets
- Specialty chemicals are estimated to be less affected. Some segments might even profit from rising US demand
- However, some participants pointed out that effects in the upstream of chemical value chains will translate into the downstream industry as well: Raw materials and supply security will be endangered

Source: Stratley Shale Gas Study

Shale gas will lead to shrinking and restructuring of European chemical industry starting from the upstream

"North American shale gas will lead to a restructuring of the European chemical industry in the mid-term"



- Decreasing competitiveness of commodity and energy intensive chemical industry
- Shift of production and investment to the US along with increasing chemical trade flow from US to Europe
- Neglect of investments in Europe
- Fear of domino effects: What happens to the "healthy" cluster if one player exits?

Source: Stratley Shale Gas Study.

Agenda

Agenda

I. Introduction

II. Shale Gas Impact on Individual European Chemical Companies

III. Shale Gas Impact on European Chemical Industry in General

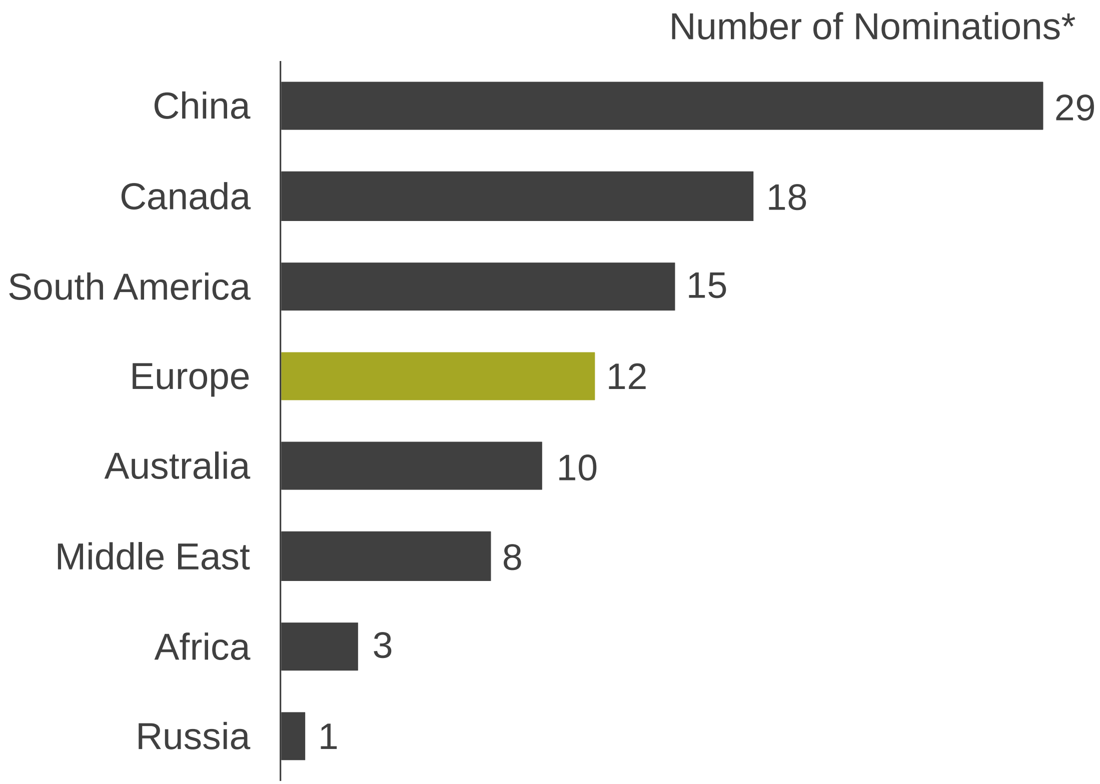
IV. How Should Europe Act upon the Challenges?

   I. How Far Away Is European Shale Gas?

   II. Call for Action

Although managers support shale gas production, Europe is not expected to be the next shale gas producing region

Which regions or countries will be the next main producers of shale gas?



- China is seen as the next major producer mainly due to resource size, political supports and high energy dependence on coal
- However, the replication of US shale boom is not expected elsewhere
- The extent to which European shale gas will impact gas prices in Europe is disputed

Source: Stratley Shale Gas Study. * Multiple answers possible.

Public resistance and lack of regulatory environment are considered to be the main hurdles

Hurdles to producing shale gas in Europe

1 Social & Political Factors

- Environmental aspects and public resistance
- Regulatory environment

2 Economic Factors

- Lack of industrial infrastructure
- Production costs

3 Technical Factors

- Production know-how
- Quality of European shale gas resource

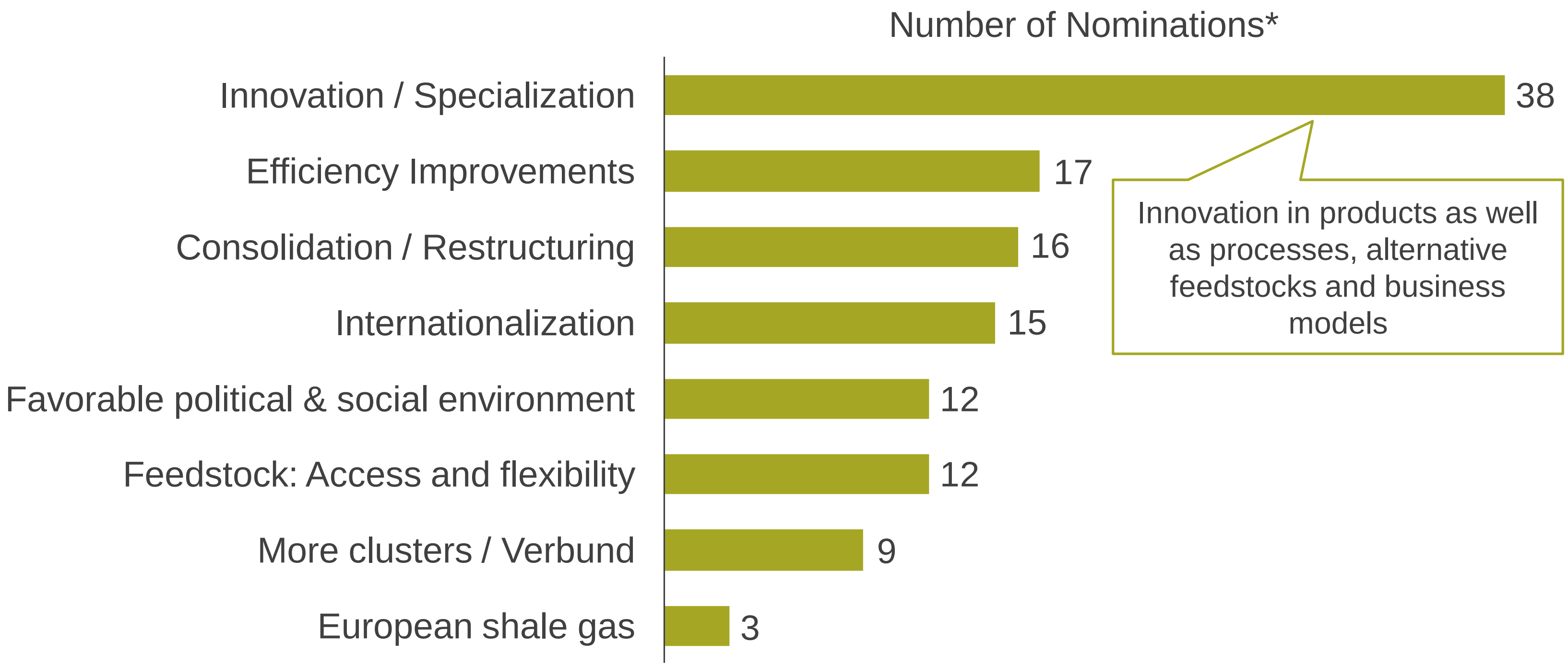
- Participants perceive environmental risks as manageable if shale gas production were to be performed to European safety standards
- However, today the public and political resistance has turned shale gas into an emotional topic across Europe that is a major hurdle in the eyes of industry managers

Source: Stratley Shale Gas Study.

Agenda

Managers believe that innovation and specialization is the key to coping with the shale gas imposed challenges

How can European companies survive the increasing competition?



Beyond innovation and specialization, shale gas in Europe should be pursued as part of a comprehensive European energy strategy

Source: Stratley Shale Gas Study. * Multiple answers possible.

European chemical industry should reinforce and expand innovation activities

INNOVATION

Products	Processes	Raw Materials
• Introduction of new products • Performance improvement for current products	• Reduction of energy and raw material consumption • Minimization of unwanted by-products or maximization of desired by-products	• Use of alternative raw materials which show • Synthesize existing raw materials by new production routes

European chemical industry has all it takes to stay competitive in the long term!

Source: Stratley Shale Gas Study

Many thanks for the effort and the time to all interview partners !

Many thanks to all the colleagues of Stratley for preparing this study, in particular:

Sponsor of this study:	Dr. Walter Bürger-Kley, Founding Partner Stratley
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Thank you!

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