Behaviour and energy efficiency decision-making in chemical industry

13.10.2017 | IEA workshop | Kgs. Lyngby, Denmark

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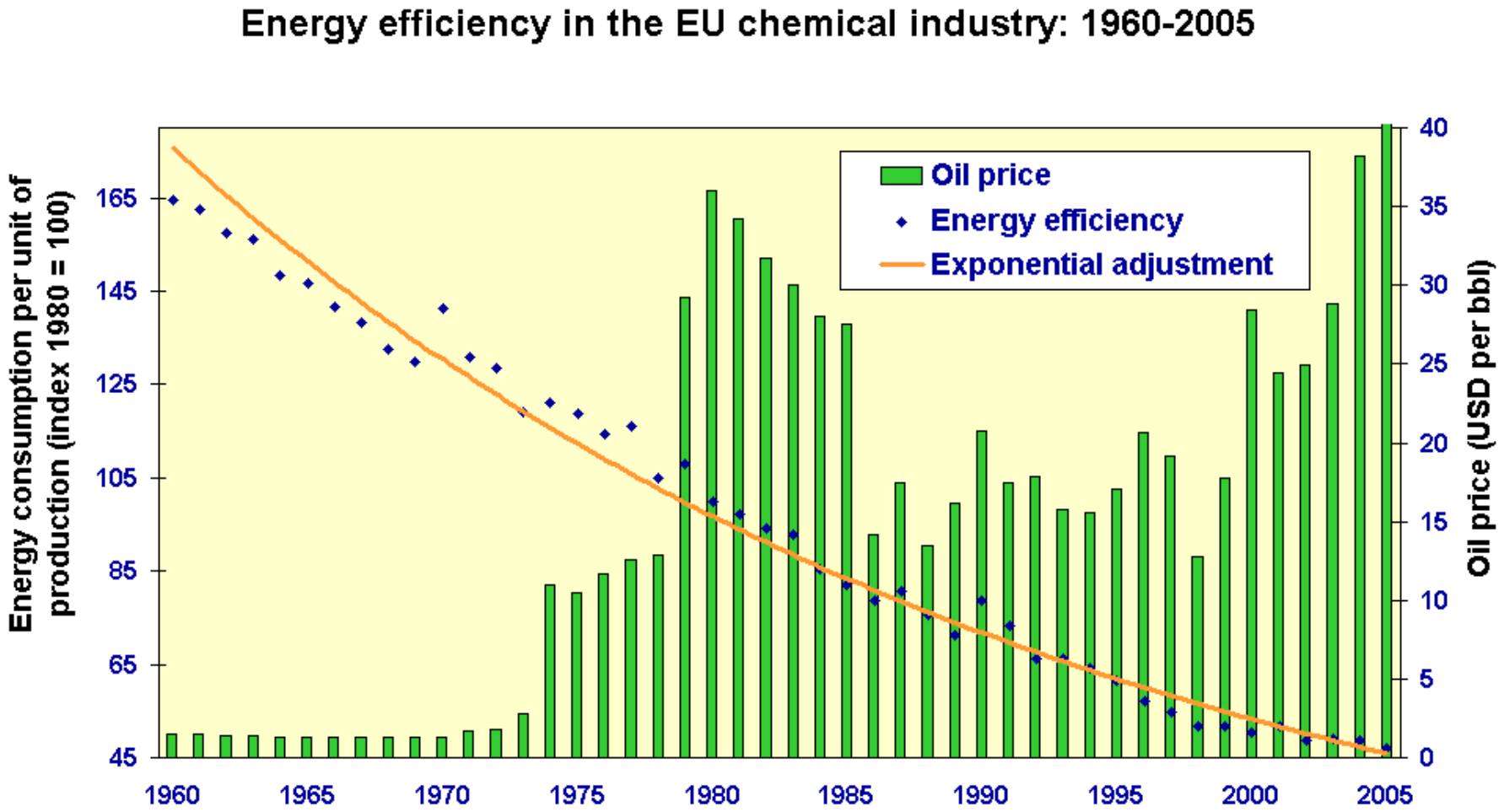
Borealis – taking on the challenges of tomorrow for more than 50 years

BOREALIS

- *Leading provider of innovative, value creating solutions in the areas of base chemicals, polyolefins, and fertilisers*
- *Strong European manufacturing footprint with integrated base chemicals, petrochemicals and polymer activities*
- *Customers in over 120 countries*
- *Around 6.600 employees worldwide*
- *Ownership Borealis: 64% Mubadala (Abu Dhabi) / 36% OMV*
- *Middle East and Asia activities through ADNOC JV - Borouge*

Measuring energy efficiency…



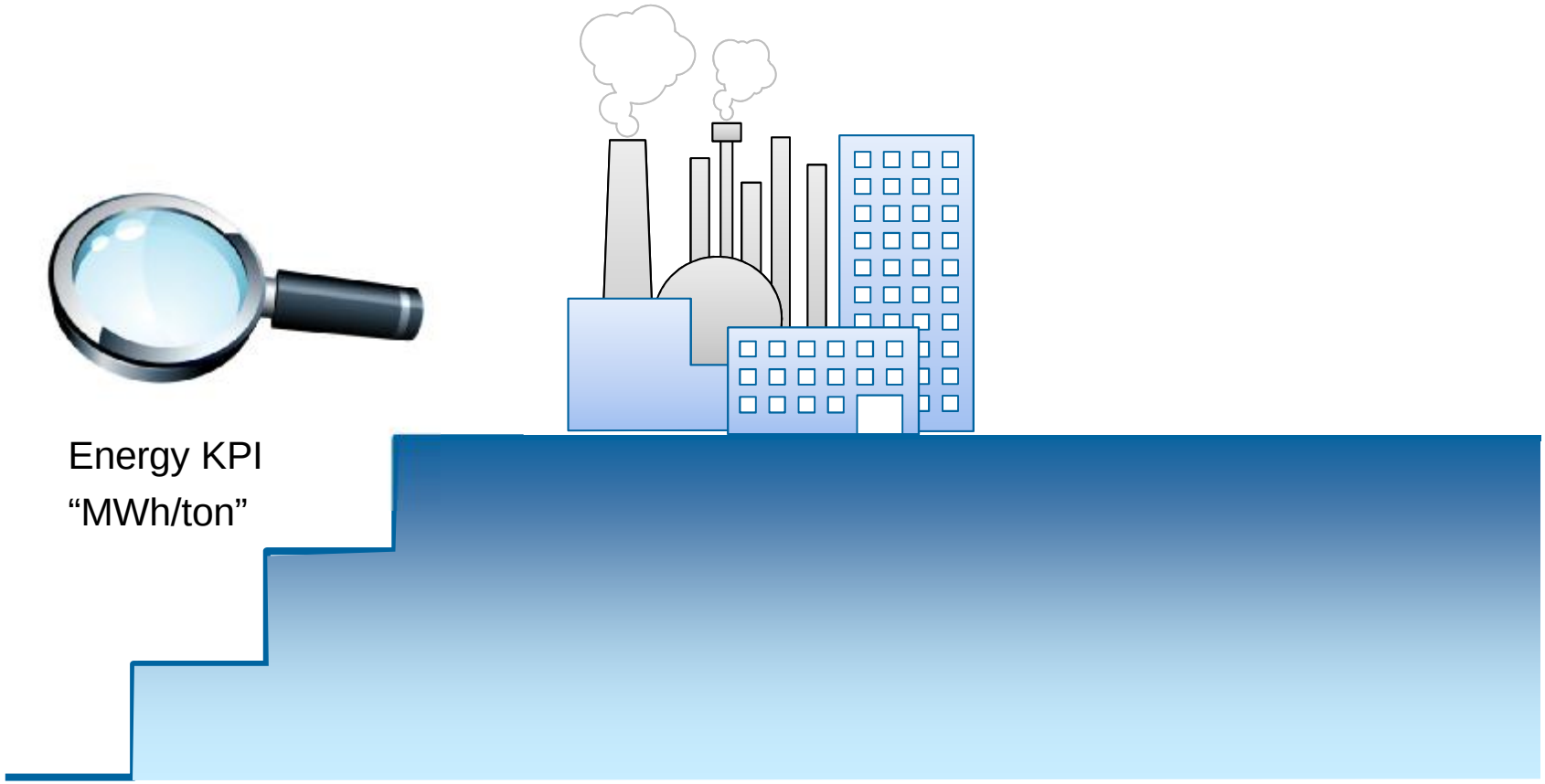
Sources: Eurostat, National Chemical Federations (NCF), IEA, UN & Cefic-ITC Analysis, INSEE

Measuring energy efficiency…

Source: Eurostat and Cefic analysis

* Energy intensity is measured by energy input per unit of chemicals production (including pharmaceuticals)

Energy KPI and energy improvement measures



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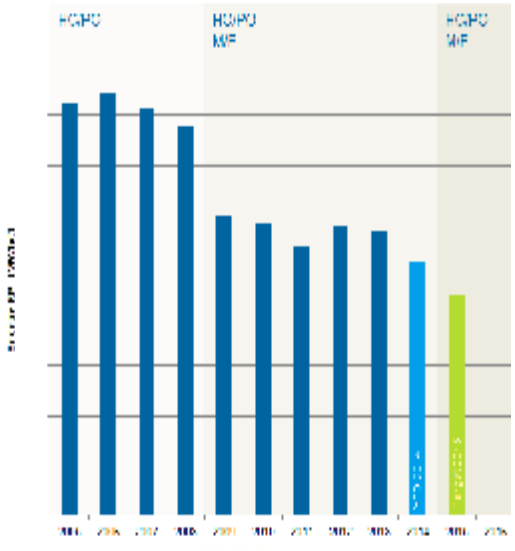
Energy KPI and energy improvement measures



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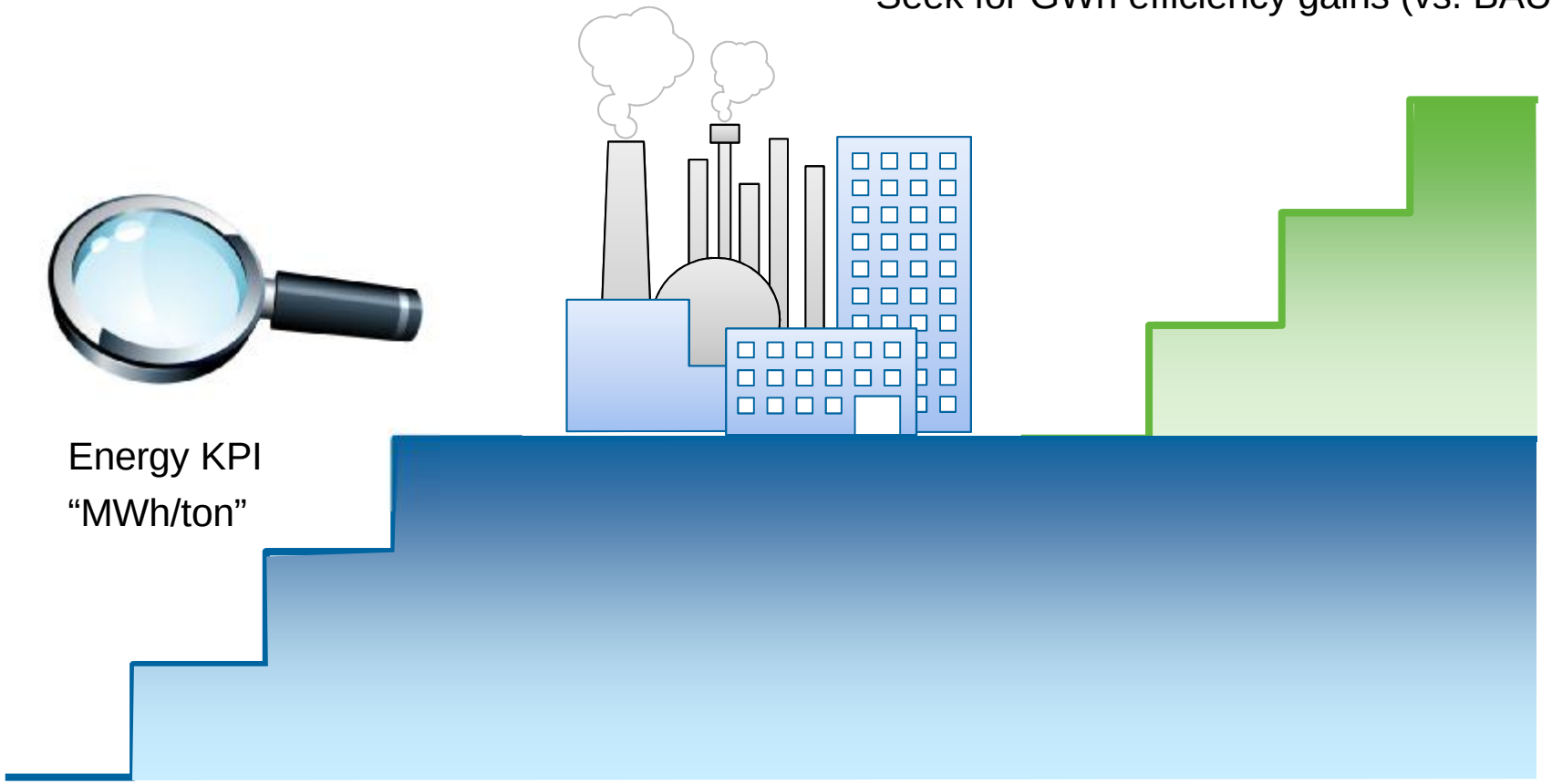
Energy KPI and energy improvement measures

Forward looking trigger to identify and realise energy efficiency improvements

Seek for GWh efficiency gains (vs. BAU)



Energy KPI

“MWh/ton”

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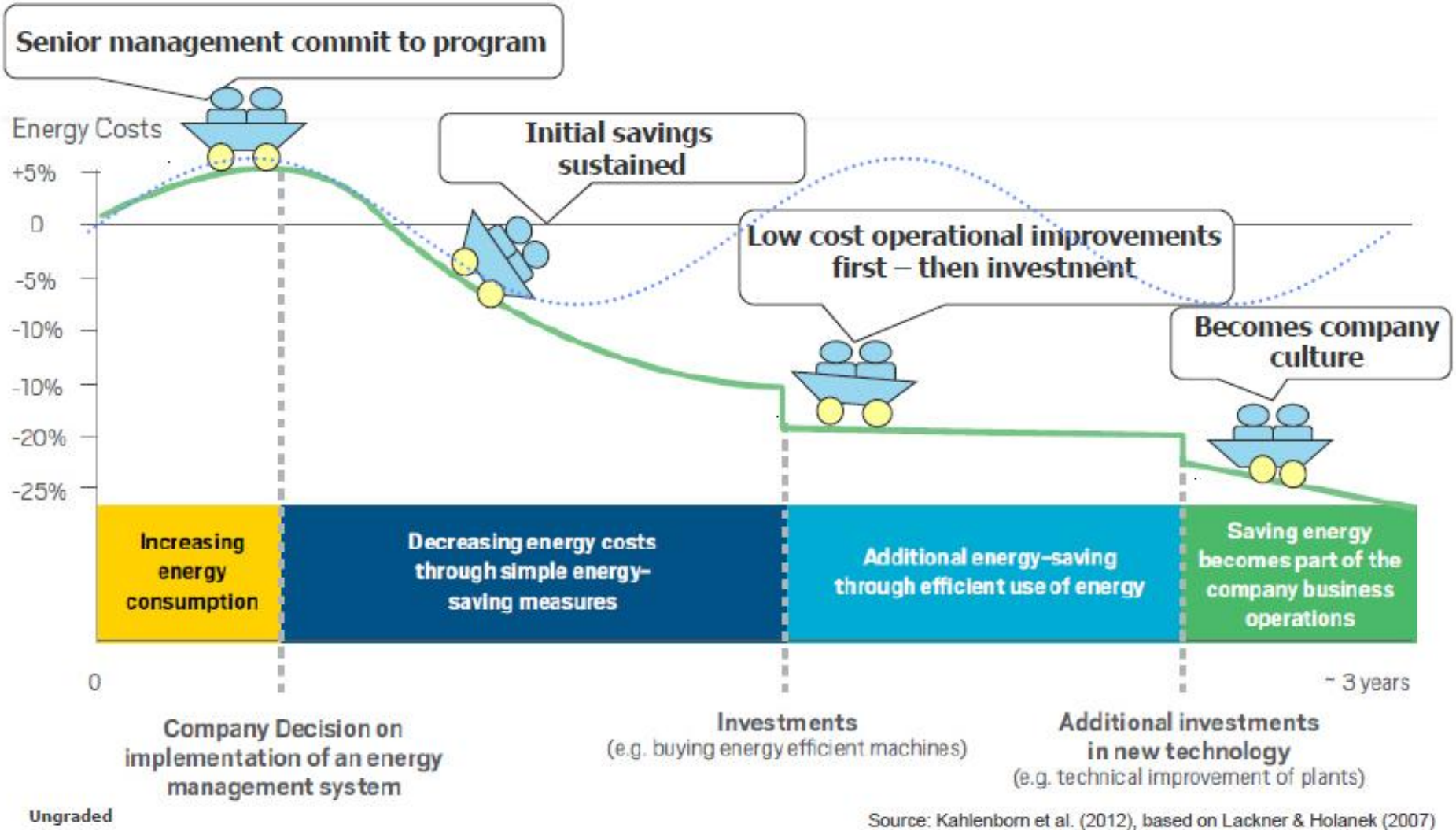
Managing change…



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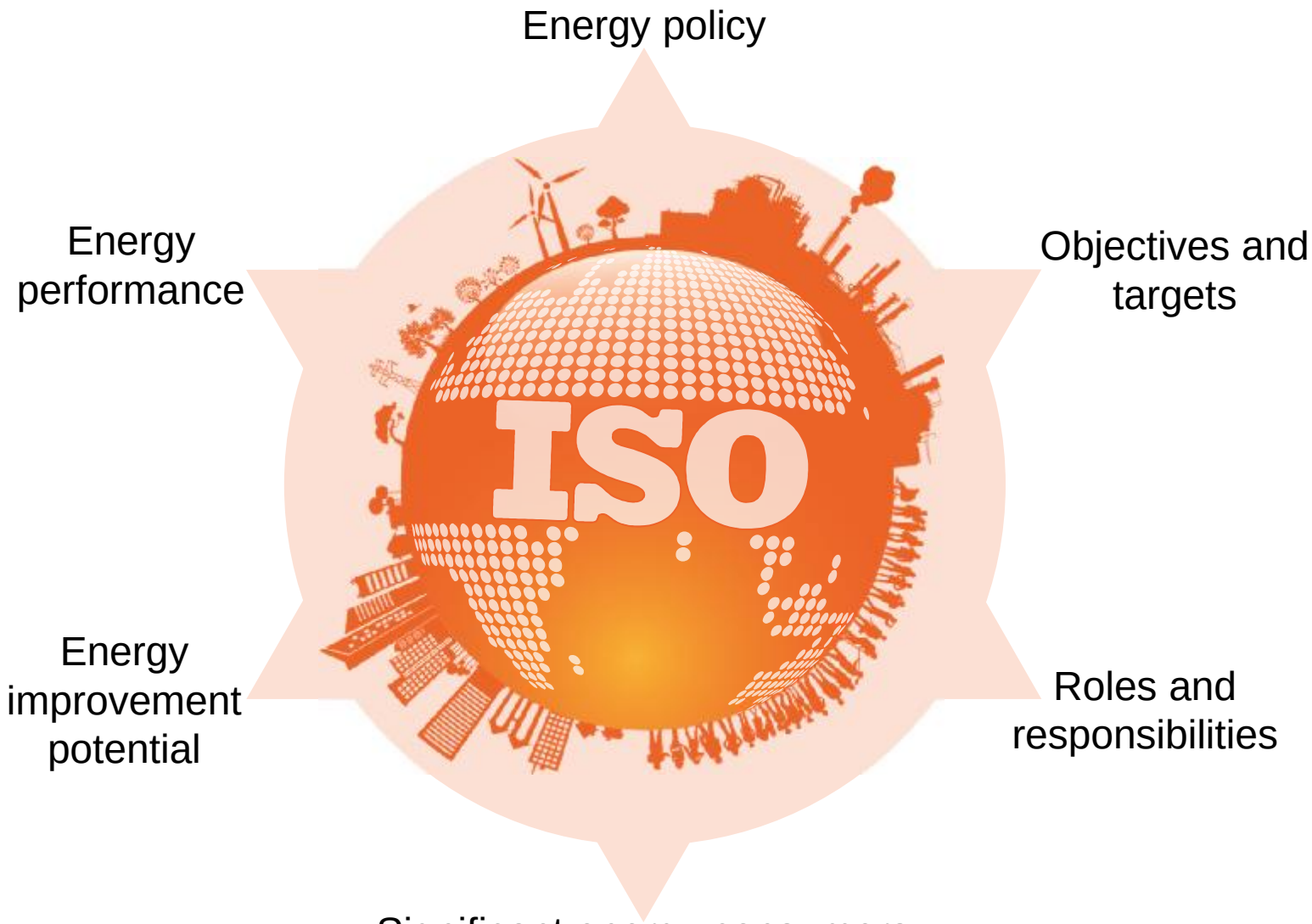
Energy Management System – ISO 50001



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Responsible Care

issued
2017

We are committed to advance sustainable development along the value chain and to give priority to innovative, value creating solutions according to the principles of Product Stewardship.

We see world class HSE and energy performance as a foundation for **leadership in Responsible Care.**

We have a Responsible Care management system based on continuous improvement and verification of our performance.

We are committed to follow legal requirements and other requirements to which we subscribe, or exceed them when they do not meet our standards.

We openly discuss Responsible Care issues with our stakeholders with the aim to further promote health, safety and the environment and to save energy along the value chain.

Mark Garrett, Chief Executive, April 2017

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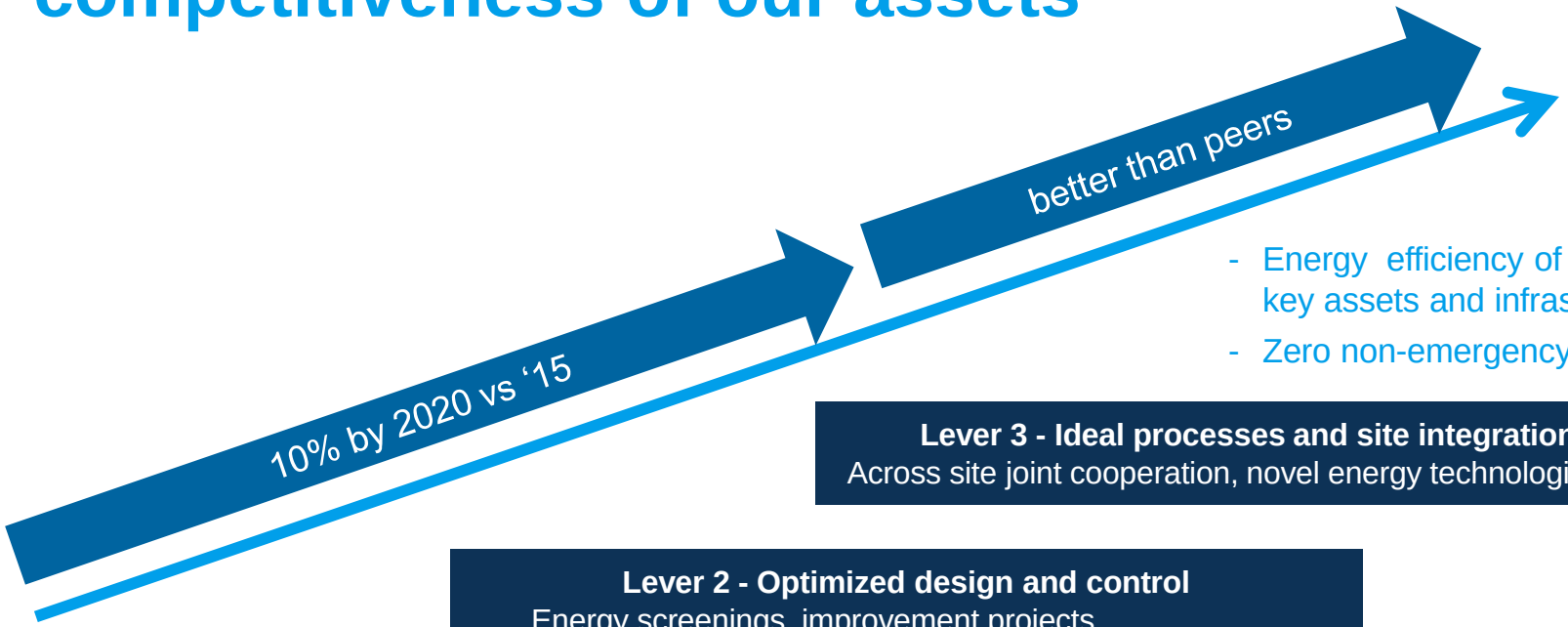
Keep Discovering

Energy & Flaring Roadmap 2020+ to increase energy efficiency and safeguard competitiveness of our assets



- Energy efficiency of key assets and infrastructure
- Zero non-emergency flaring

Lever 3 - Ideal processes and site integration
Across site joint cooperation, novel energy technologies, …

Lever 2 - Optimized design and control
Energy screenings, improvement projects, …

Lever 1 - Ideally operated plants
Energy 'trend boards', APC, …

Leadership – Leader Standard Work

ISO 50001 – Behaviour and Continuous Improvement

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Roles and responsibilities

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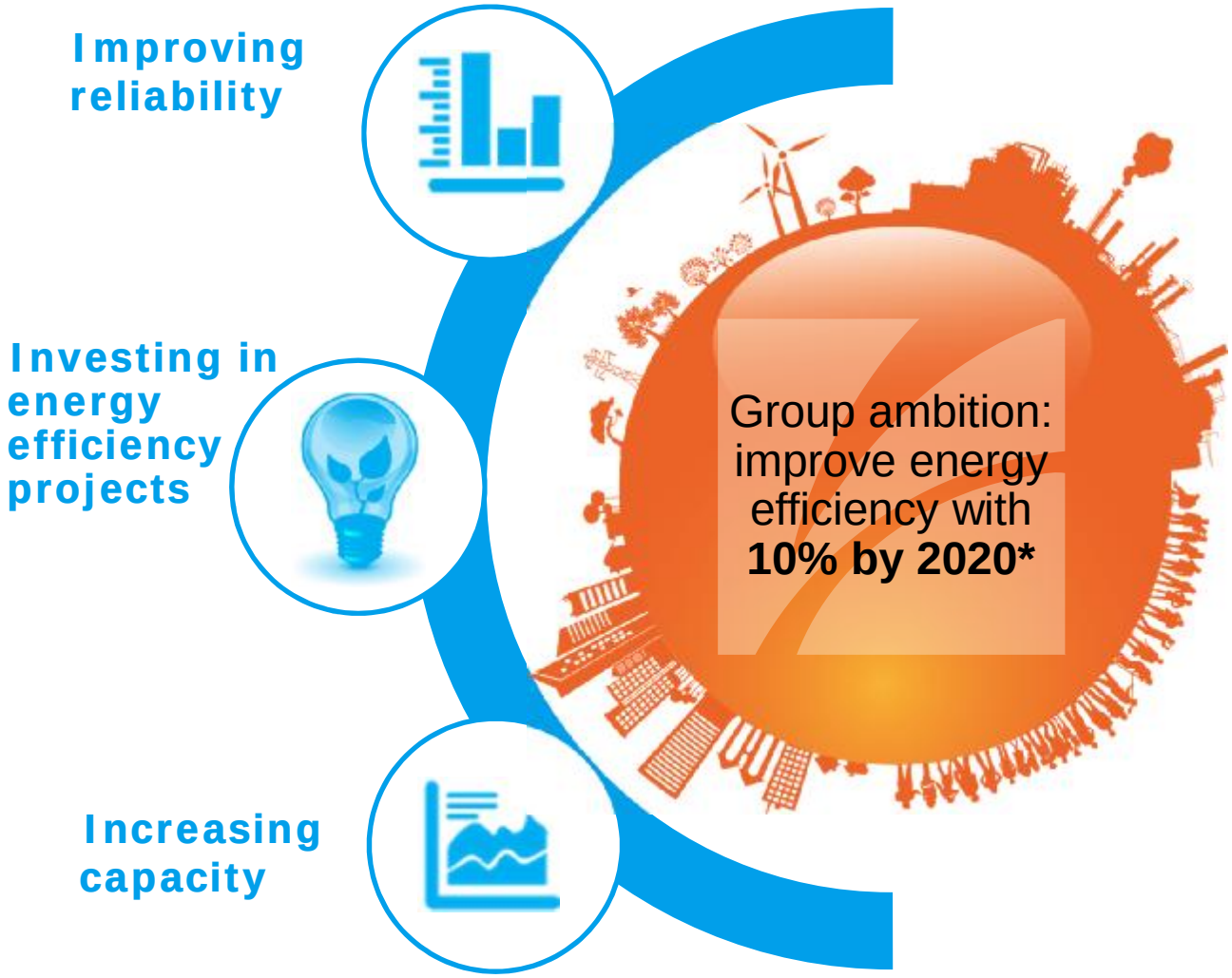
Improving Energy Efficiency at Borealis



- Aiming to boost overall long-term **competitiveness** and **sustainable growth**
- Reaching objective by **continuous focus on energy** and **commitment from all**, supported by **ISO 50001** energy management system
- Ensured by the implementation of ISO 50001

* Compared to 2015 baseline

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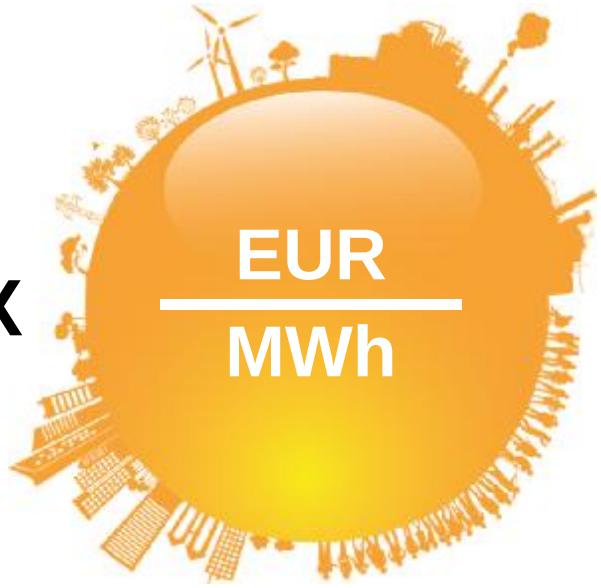
Seeking the right tone in the right context…

Energy Efficiency

EnMS will try to lower the specific energy consumption

X

Commercial/Sourcing



Smart sourcing and supply aims to lower the cost of energy

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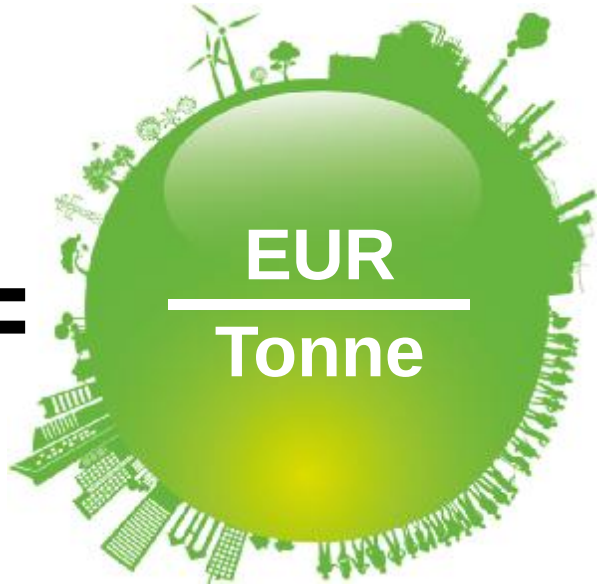
Competitiveness



Together, Borealis will be more competitive

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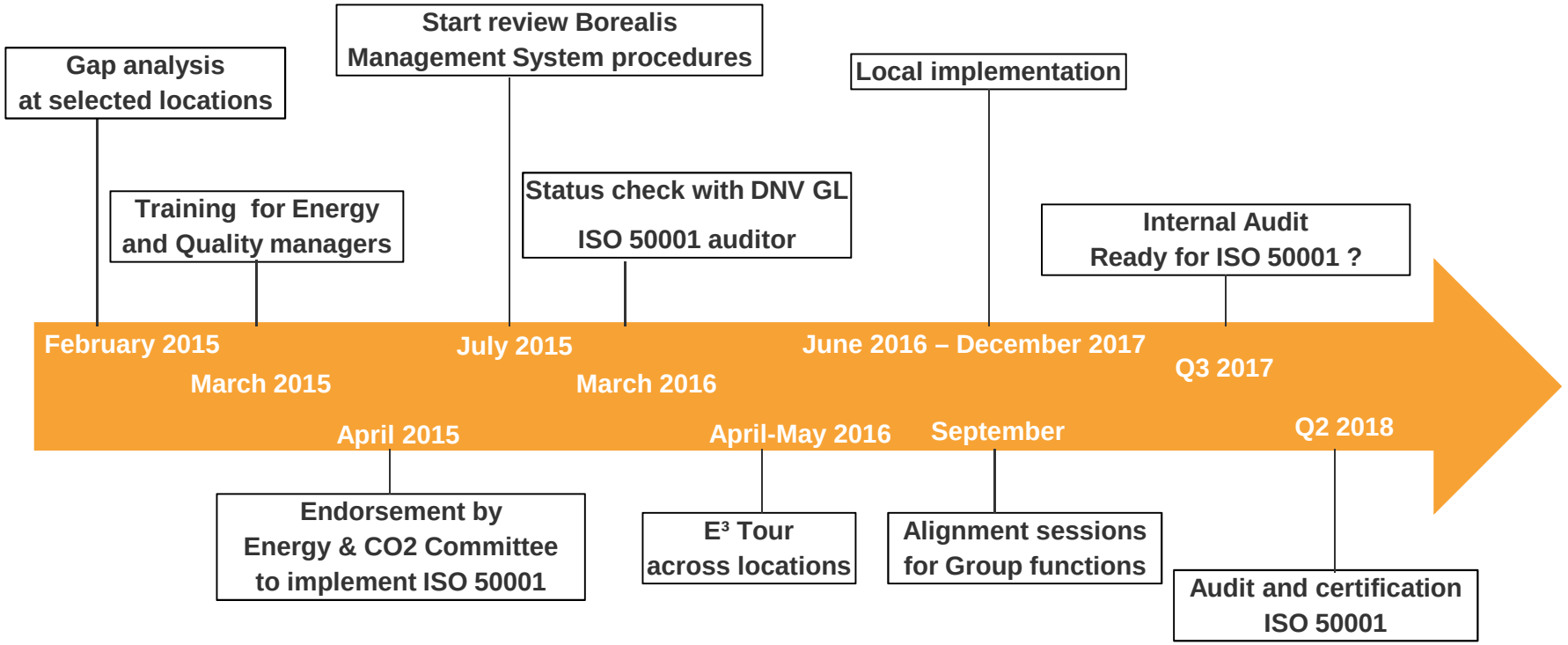
Timeline towards ISO 50001 – A genuine journey



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Reflections and (intermediate) way-forward

- Energy efficiency has always been key for energy intensive industries' competitive edge.
- Borealis consistently adheres to local Voluntary Energy Agreements. Already in early 2000s helpful to frame the Borealis take on energy – meanwhile established and sound element in EU Energy Efficiency Directive (EED).
- Group challenge to keep track with various ways of EED implementation across EU Member States, with underlying differences in energy costs, incentives & obligations schemes.
- Energy and carbon costs inclusion in business decisions has been a long standing practice in Borealis.
- Energy and Operational Excellence are mutually reinforcing.
- Borealis journey towards group-wide ISO 50001; in addition we strongly believe in the importance of building a genuine Energy Culture.
- Energy efficiency no stand-alone aspect in energy & climate policy landscape…
  … intriguing interaction ahead…

Energy integration and synergies / symbiosis

Borealis Stenungsund (Sweden) delivers around 45,000 MWh of heat to SEMAB each year.

Borealis in Kallo (Belgium): wind power production, consumed on-site and integrated into the local grid.

Borealis Beringen (Belgium) will host new municipal waste incineration plant and get power and heat supplies.

Borealis Porvoo (Finland): new combined heat and power plant with Neste and Veolia (commissioning planned in 2018)

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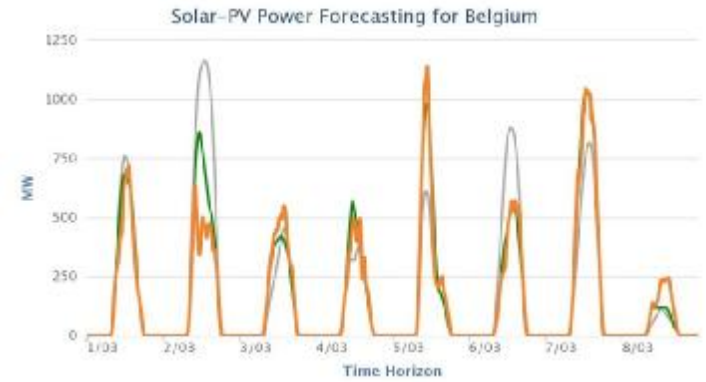
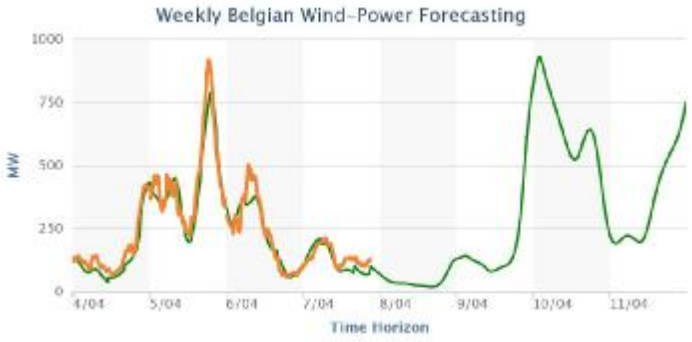
Uptake of renewable energy





Power generation gets more depending on wind and sun

Former paradigm: power consumption following demand

Paradigm shift: flexibility to reconcile intermittence and security of supply

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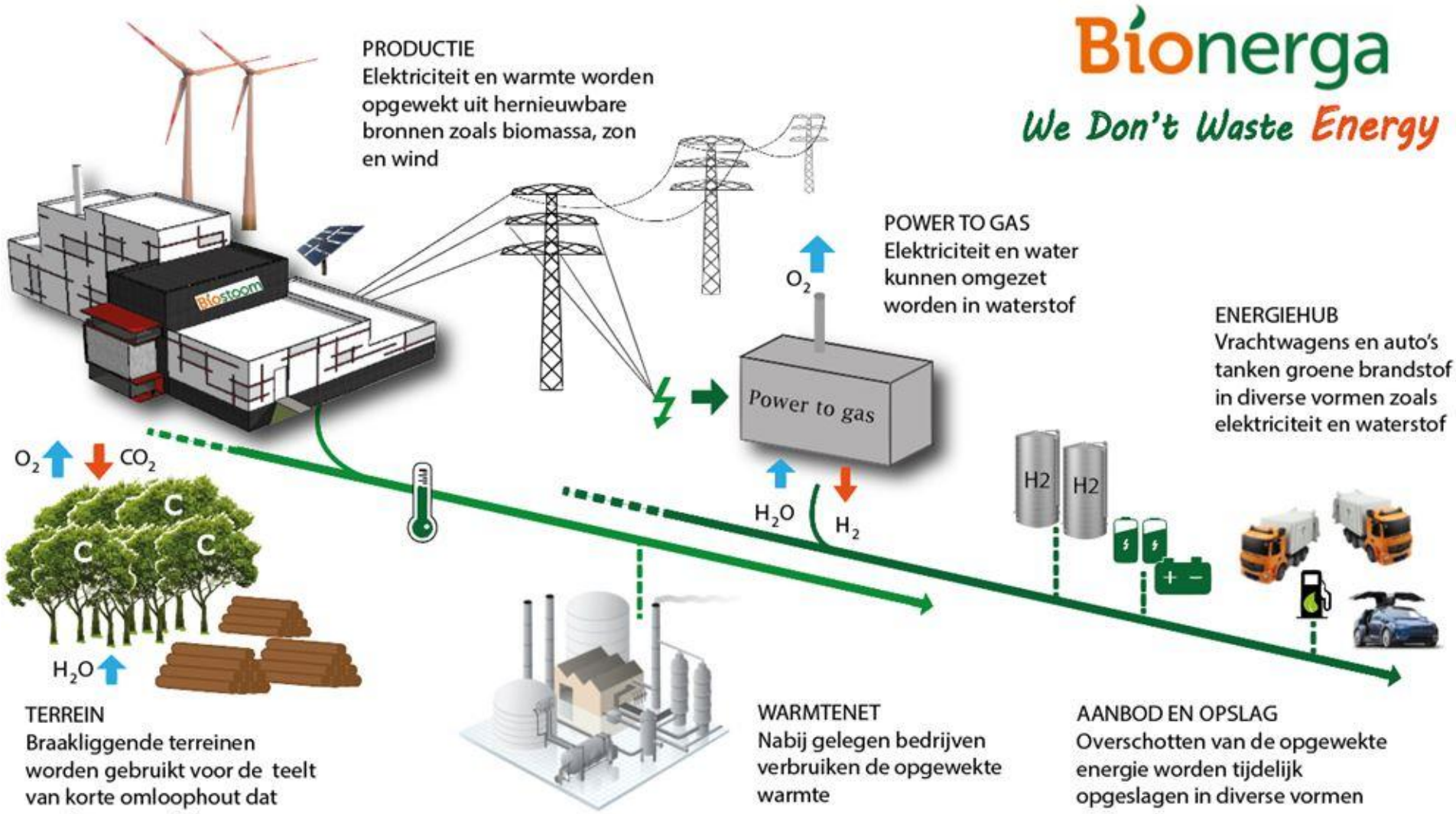

Bionerga, 25.10.2016

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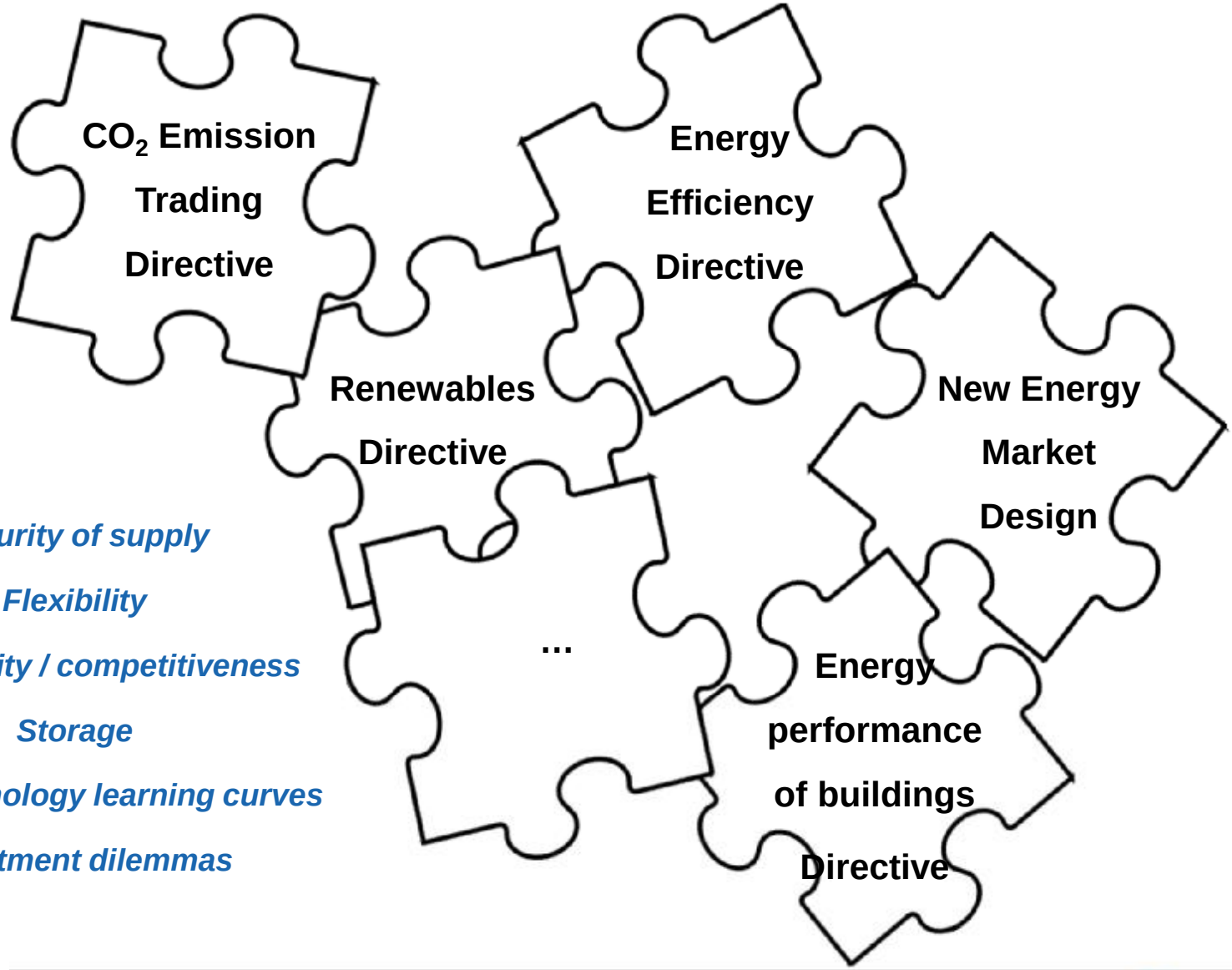
Myriad of (EU) energy and climate policies



Security of supply

Flexibility

Affordability / competitiveness

Storage

Steep technology learning curves

Investment dilemmas

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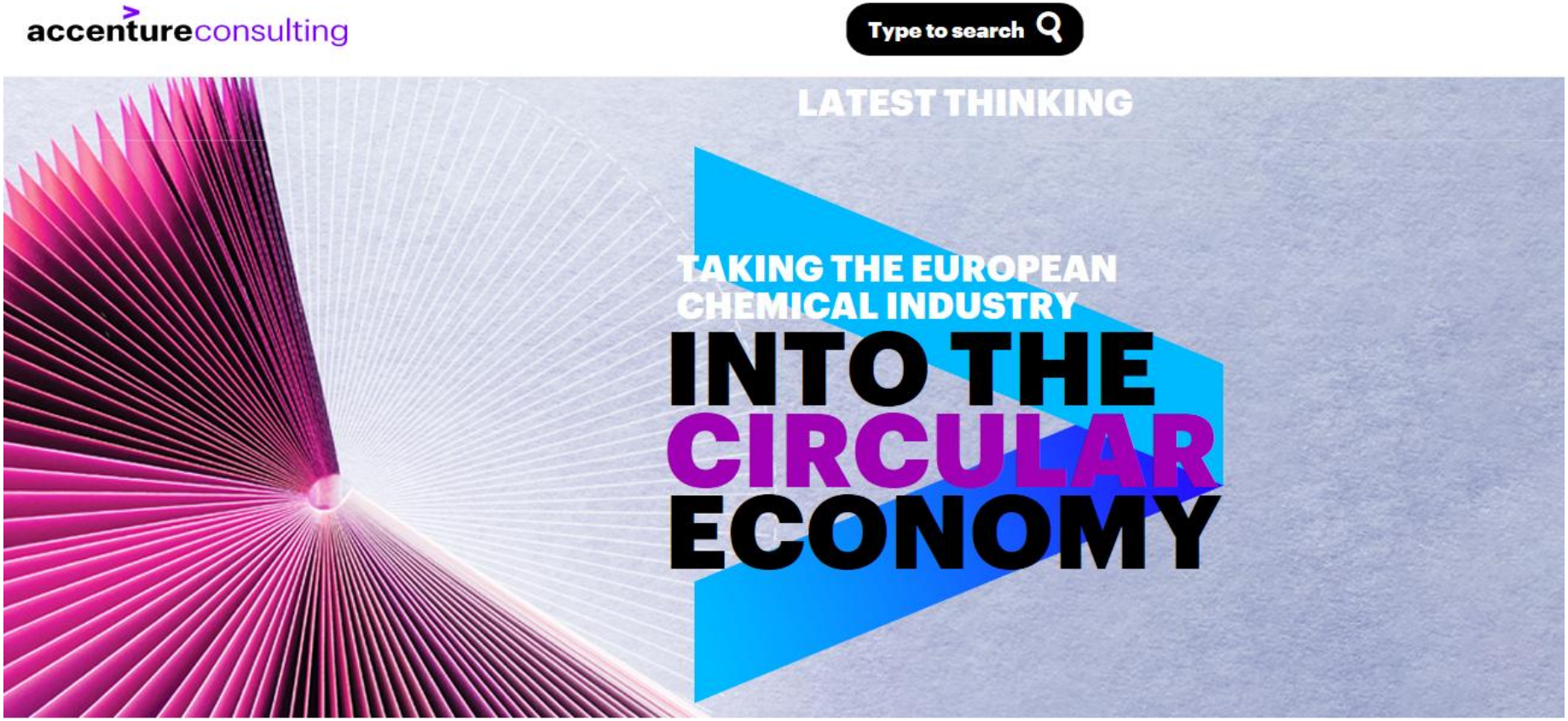
EU to aim for 100% emission cuts in new ‘mid-century roadmap’

“*EXCLUSIVE / The European Commission is preparing an update of its low-carbon economy roadmap for 2050, acknowledging that the bloc’s current target of cutting greenhouse gas emissions at least 80% by mid-century are insufficient”.*
(EURACTIV.com-24 Sept 2017)

Accenture study March 2017



https://www.accenture.com/us-en/insight-circular-economy-european-chemical-industry

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Accenture study March 2017

Figure 2: Circulation volume potential, investment and energy needs by molecule loop

Molecule loop	Volume (in Mt per annum)	Chemical assets investment needed (in EUR Bn)	Energy need (in Mtoe per annum)
1. Renewable raw materials	12	20-40	Insignificant
2. Product reuse	17	n/a	n/a
3. Mechanical recycling	19	10-20	12
4. Chemical recycling	8	30-80	3
5. Carbon utilization	10	100-140	29
Total	**66**	**160-280**	**44**

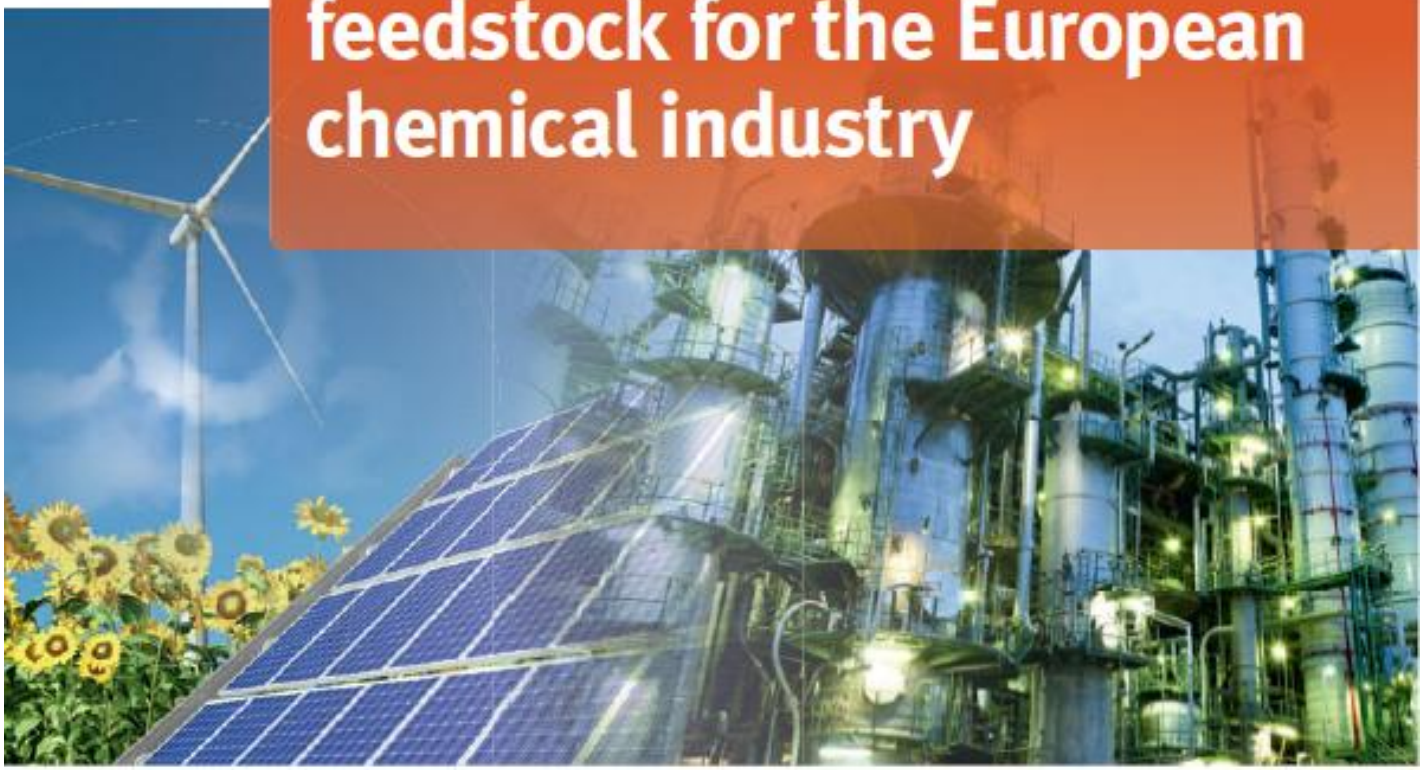
The circulation of molecules to the extent described would require large amounts of carbon-neutral energy. Accenture calculates that fueling the loops would need 44 Mtoe of additional energy. However, adopting those practices would also lead to reduced energy usage for conventional chemicals production as we know it today, leaving a net requirement of 21 Mtoe of additional energy. For illustration, that amount of energy corresponds to 19,000 standard offshore wind turbines.

Dechema study
July 2017

DECHEMA
Gesellschaft für Chemische Technik
und Biotechnologie e.V.

TECHNOLOGY STUDY

Low carbon energy and feedstock for the European chemical industry



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Dechema study
July 2017

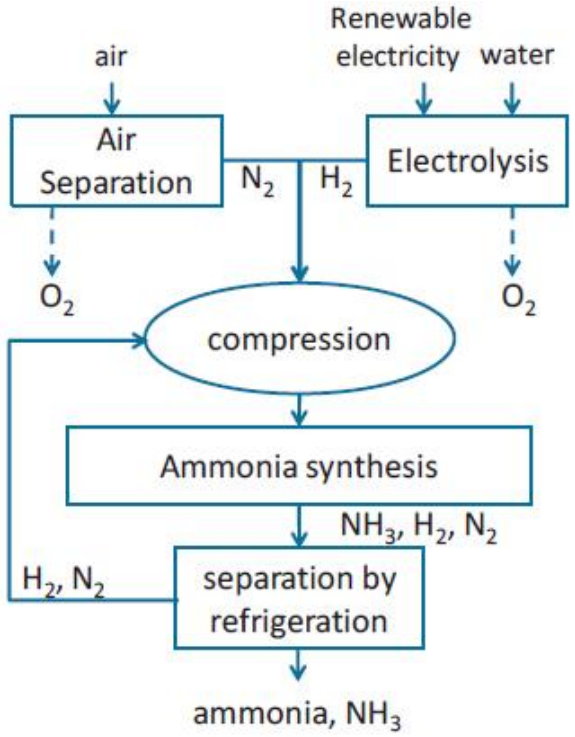

Figure 6: Scheme of low-carbon ammonia synthesis

Table 11: Comparison of energy demand

per t NH_3	Fossil (SMR+ NH_3 synthesis)	Low carbon (power to NH_3)
Energy feedstock [GJ]	21	-
Fuel demand [GJ]	10.9	-
Electricity [GJ]	0.74	38.9
Compressors	5	5
Other utilities	1.7 (aux. boiler, flare etc.)	1.19 (ASU)
Steam balance [GJ]	-4.3	0
Total energy demand [GJ] (SEC [GJ]	35.04 (14 excl. feedstock)	45.1 (49.4 incl. compensation for

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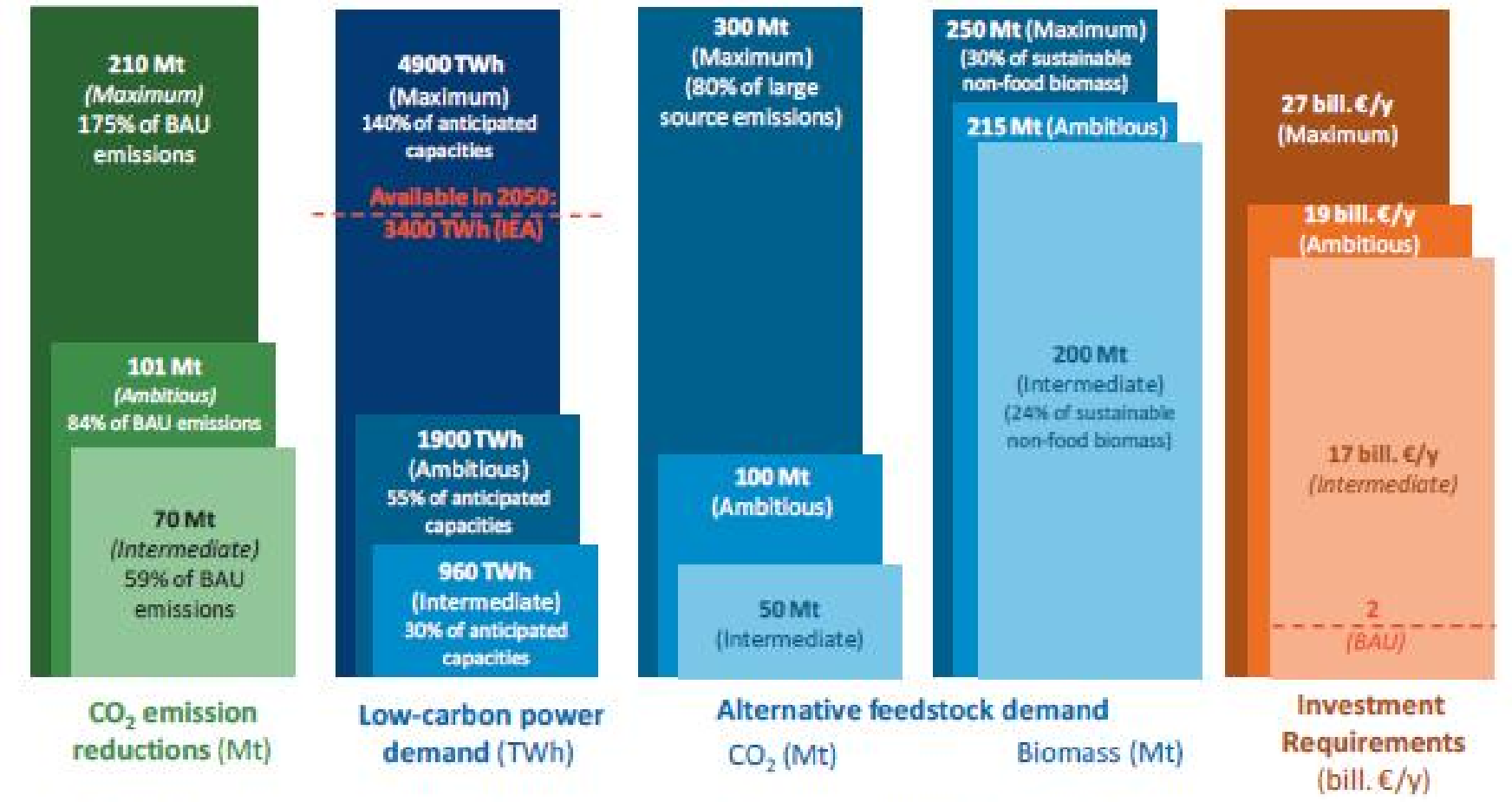
Dechema study July 2017



Opportunities and challenges for various scenarios by 2050 (without fuels applications)

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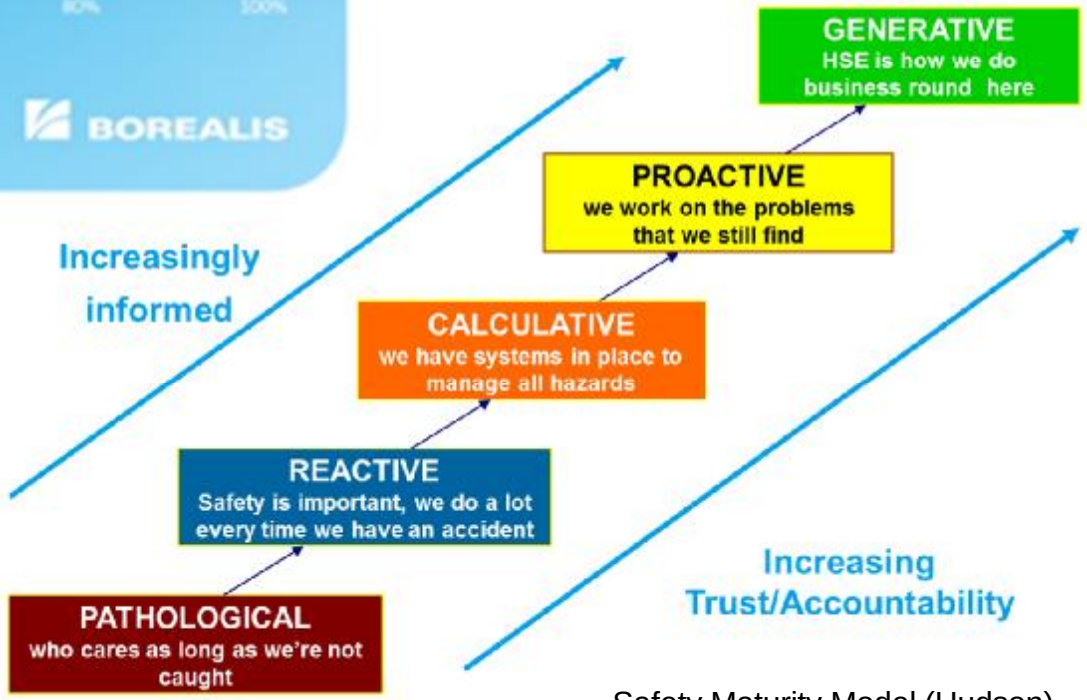
Borealis visualisation



Safety Maturity Model (Hudson)

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NOT ONLY

YOU

BUT ALL TOGETHER

Thank you

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