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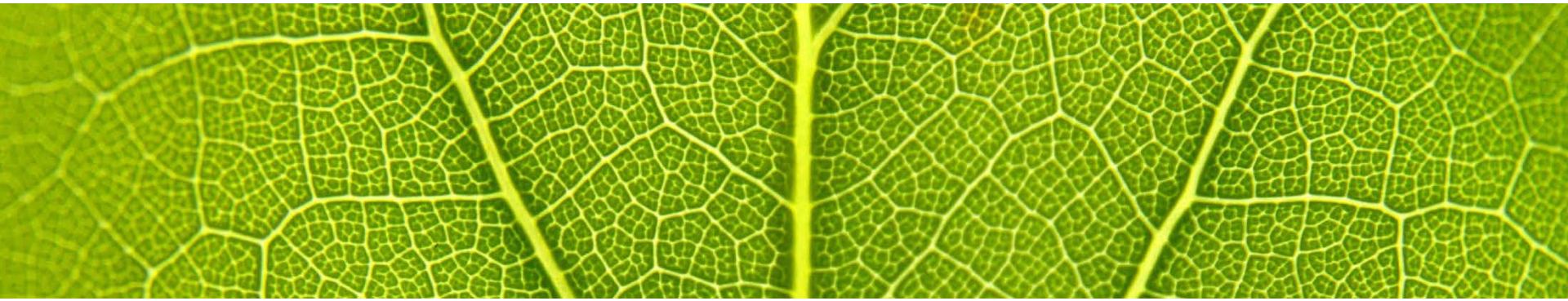

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Flexibility Tracker:

Progress towards high RES systems

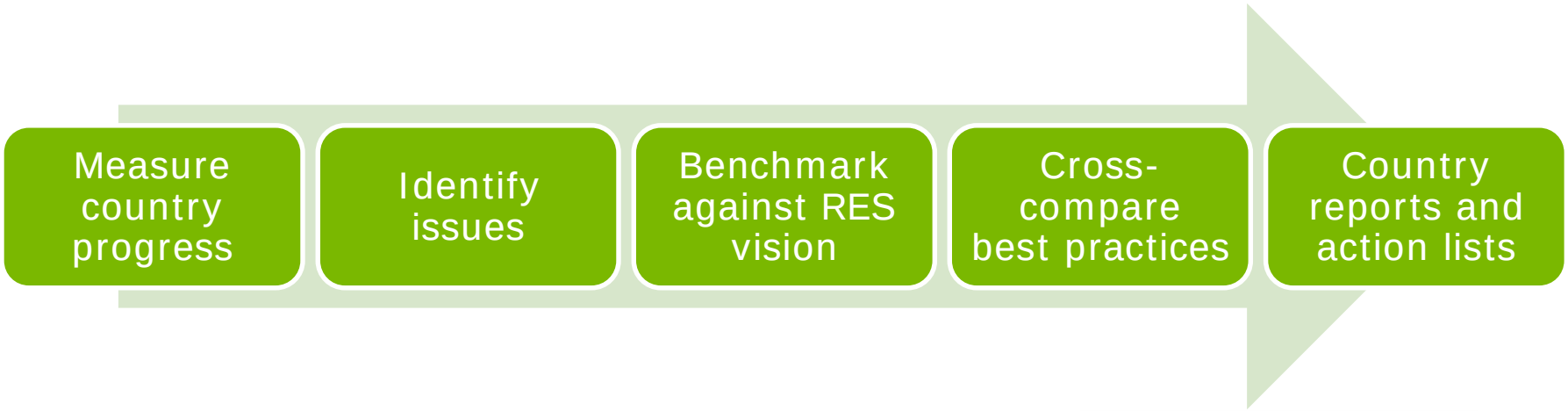
Edwin Haesen, Sr Consultant

13/10/2016, Brussels

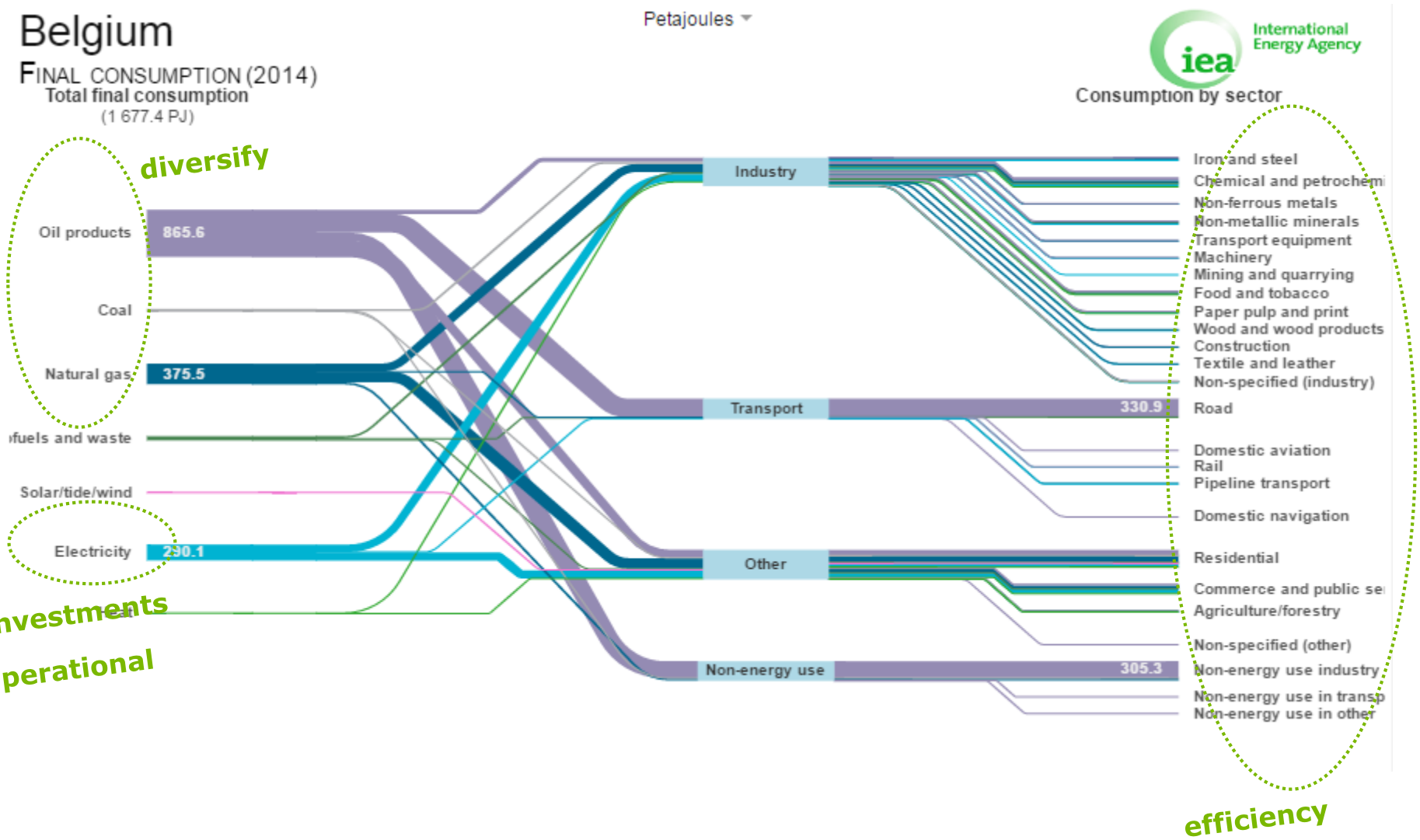
IEA-DSM workshop

Power system flexibility as a prerequisite for higher variable RES shares

- What is “flexibility”
- Options of flexibility resources
- Actions to unlock resources
- The Flexibility Tracker to monitor individual systems, identify gaps, and establish best practices

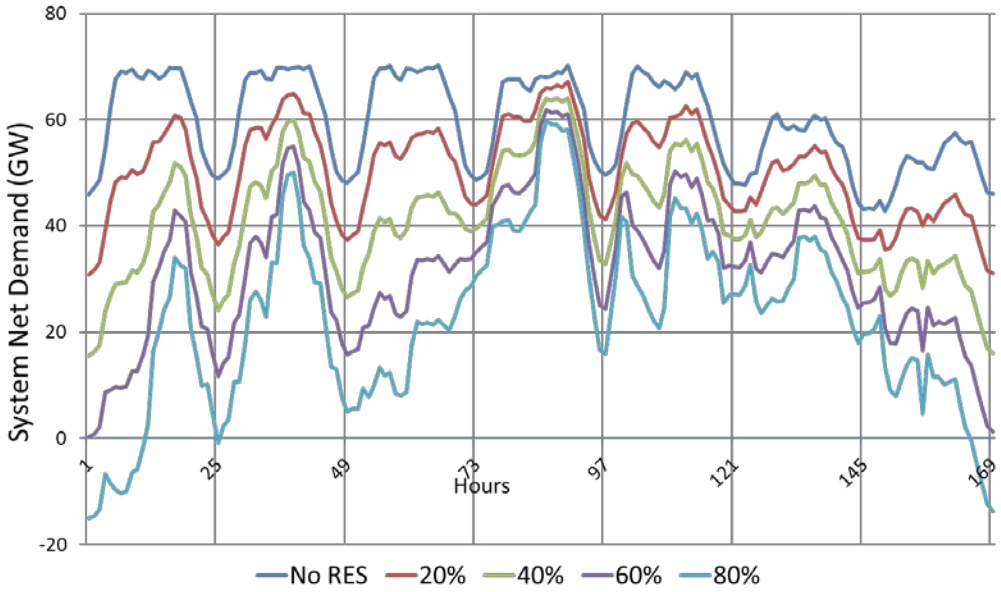


What is…



What is …

- **What do we understand as “Flexibility”?**
  - Extent to which a power system can adapt generation and consumption as needed to maintain system stability in a cost-effective manner.
  - Or shorter: Flexibility is the ability of a power system to respond to changes in demand and supply



- **What can be signs of inflexibility?**
  - Recurring severe frequency excursions
  - RES curtailments
  - Re-dispatch
  - Area control errors
  - Negative market prices
  - Price volatility
  - Loss-of-load
  - Overcapacity
  - …

- **What are the limits of a flexibility option?**
- **What are the barriers?**

What is “flexibility” in power systems? Can we measure it?

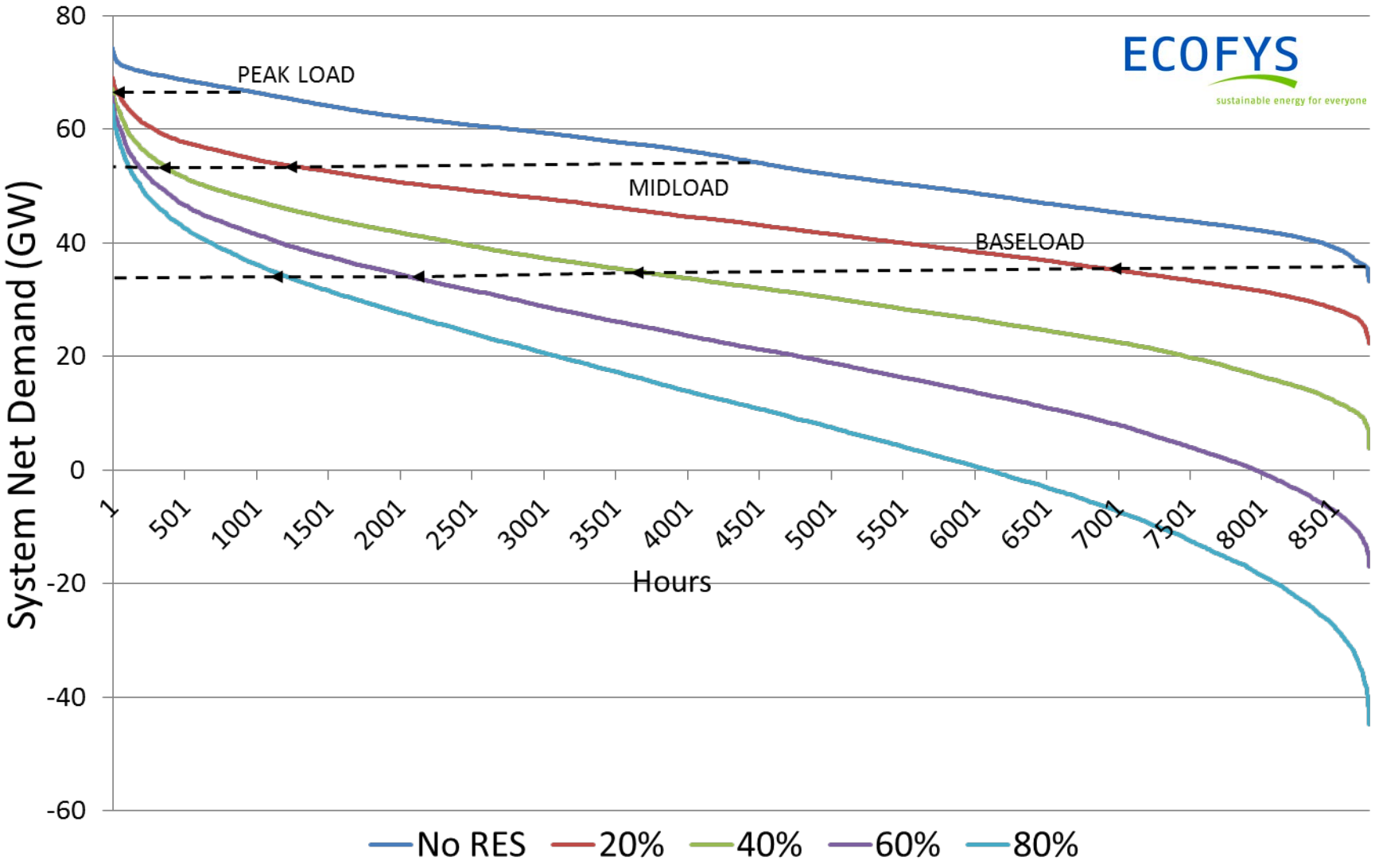
(Very) Simple: MW in spare generation available

More realistic: MW available for ramping up and down

The essence: negligible Loss of Load Expectation

Questions with increasing shares of VRES: which measure, how much, at which cost, local or regional, only electricity …?

Net demand (and prices) pushed downwards
→ Reduced full load hours for conventional technologies



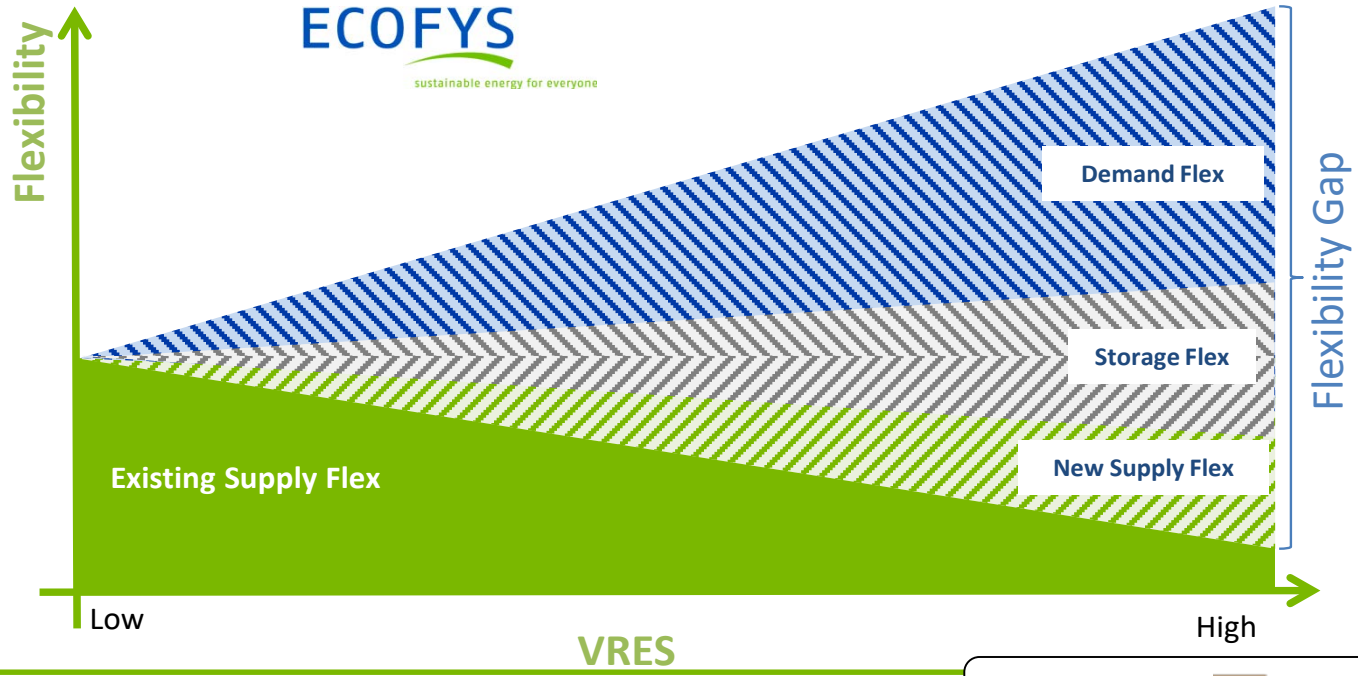
Impact of increasing shares of VRES
→ a flexibility gap calls for new flexibility options

Low VRES

- Flexibility need:
  - Demand variations
  - Supply uncertainty (unit loss)
- Flexibility provision:
  - Supply side (conv. power plants)

High VRES

- Flexibility need: ↑
  - Higher (net) demand variations
  - Supply uncertainty (unit loss)
- Flexibility provision: ↓
  - Lower from supply side (conv. generators displaced by VRES)



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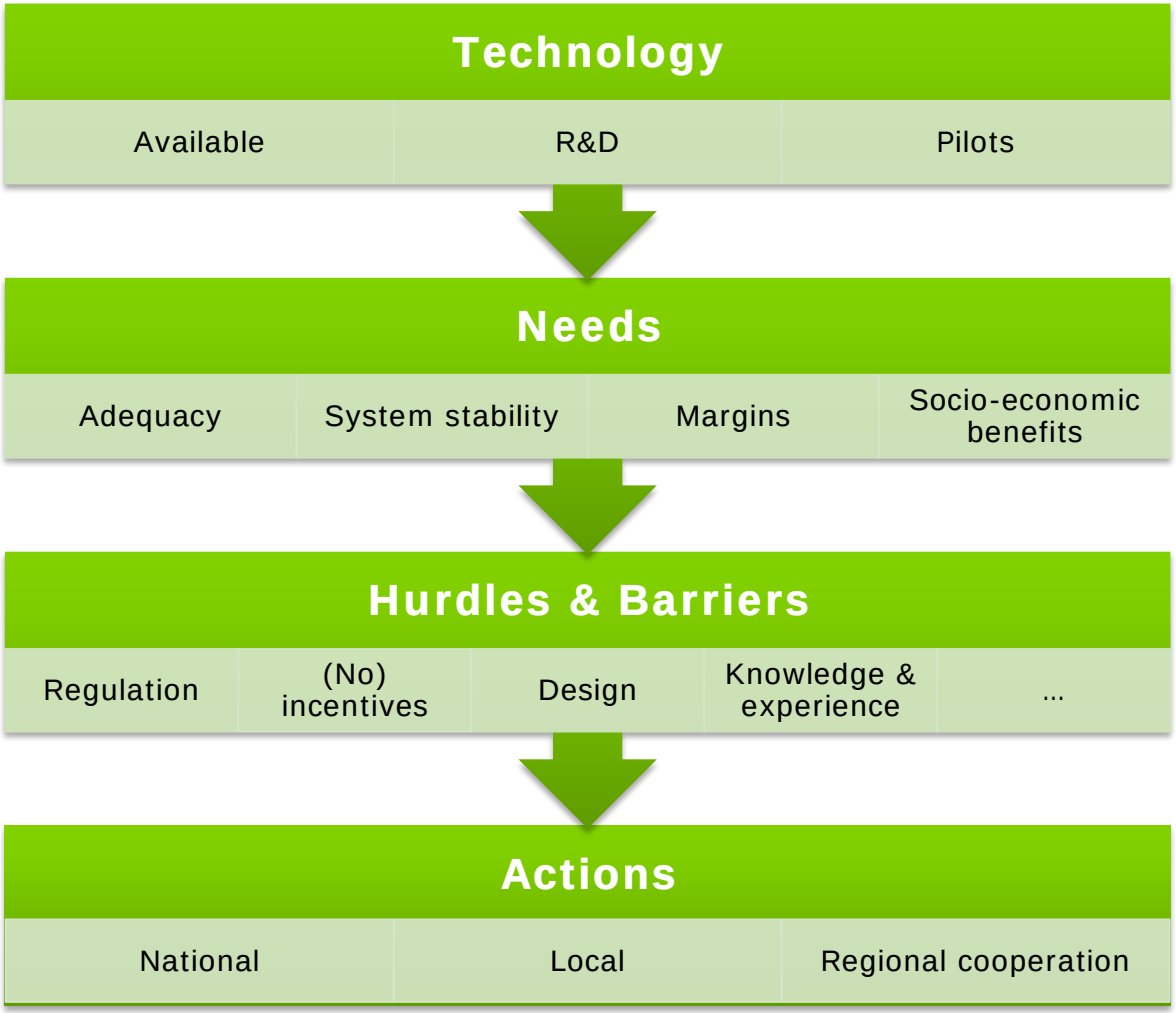
How do we usually tackle key flexibility questions?



Flexibility tracker focus

- **Monitor**
- **Compare**
- **Learn**

Strategic action list to unlock resources

Near-term Regime Integrating low VRES levels

- Reserve requirements
- Distribution networks start hosting DER
- Shift in grid planning

Mid-term Regime Penetration in the 50% range

- Market incentives
- Demand side flexibility
- Smarter use of all sources
- Pooling and sharing of resources
- Market and system operation changes
- Energy storage

Long-term Regime Very high penetrations

- Supplying Power During Low Output Level Events
- Efficient Use of High Output level Energy
- Stable Operation with Non-synchronous Generation
- Flexibility across all energy vectors

Overview of flexibility options

sources

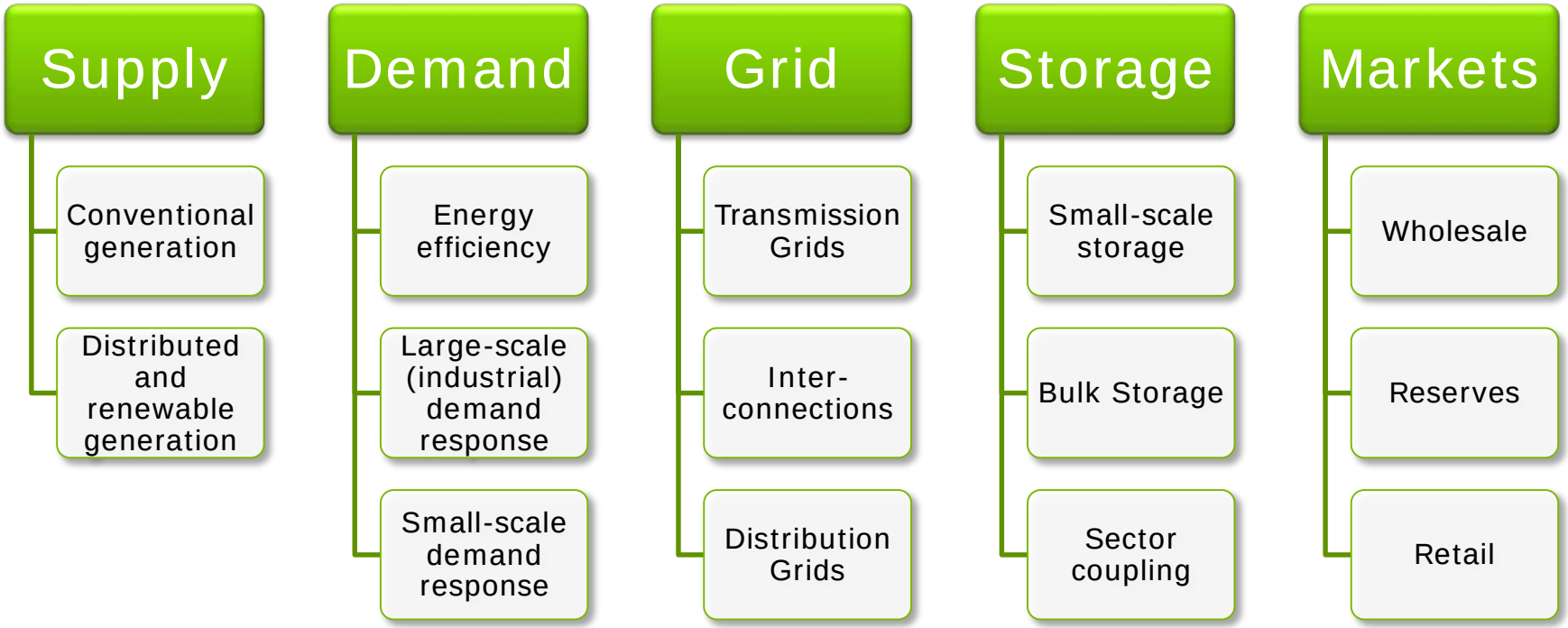
- Demand
- Supply
- Storage

enablers

- Grid
- Markets

Flexibility Tracker
progress of a power system towards 100% VRES readiness

- **Scoring of power systems (countries) across 14 KPIs**
- **KPIs linked to flexibility sources and enablers**
- **Based on 80 standardized questions and response weights**



Flexibility Tracker
progress of a power system towards 100% VRES readiness

How is the KPI presented?

- Score from 1 (low readiness) to 5 (high readiness)

What is the methodology based on?

- Standardized questions, response thresholds and weighting
- Refined based on peer review and test applications

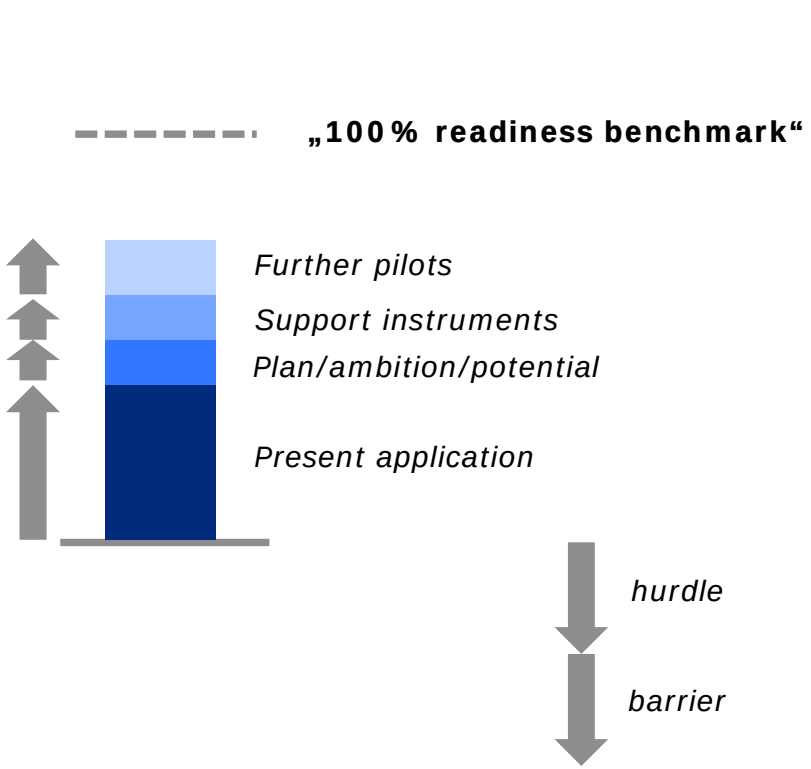
What does a higher score mean?

- vast potential
- substantial application
- clear policy incentives
- concerted RD&D efforts
- awareness/action
- and any combination thereof.

What it does not indicate?

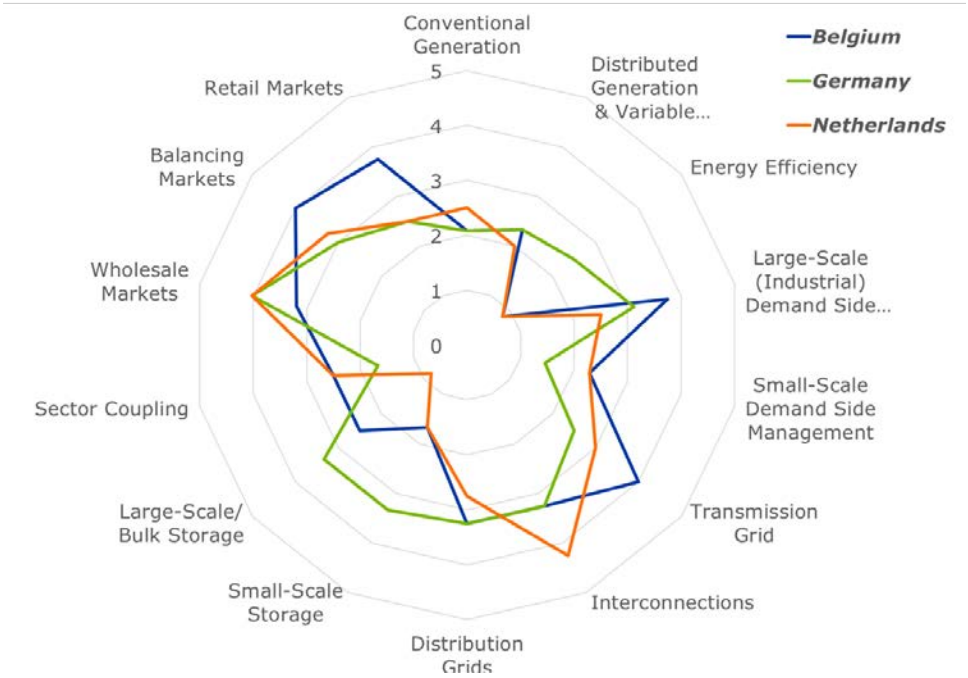
- Does not score today's or yesterday's flexibility need
- Does not indicate an optimal (cost-based) balance of solutions
- Does not asses scenario-specific (e.g. adequacy) issues

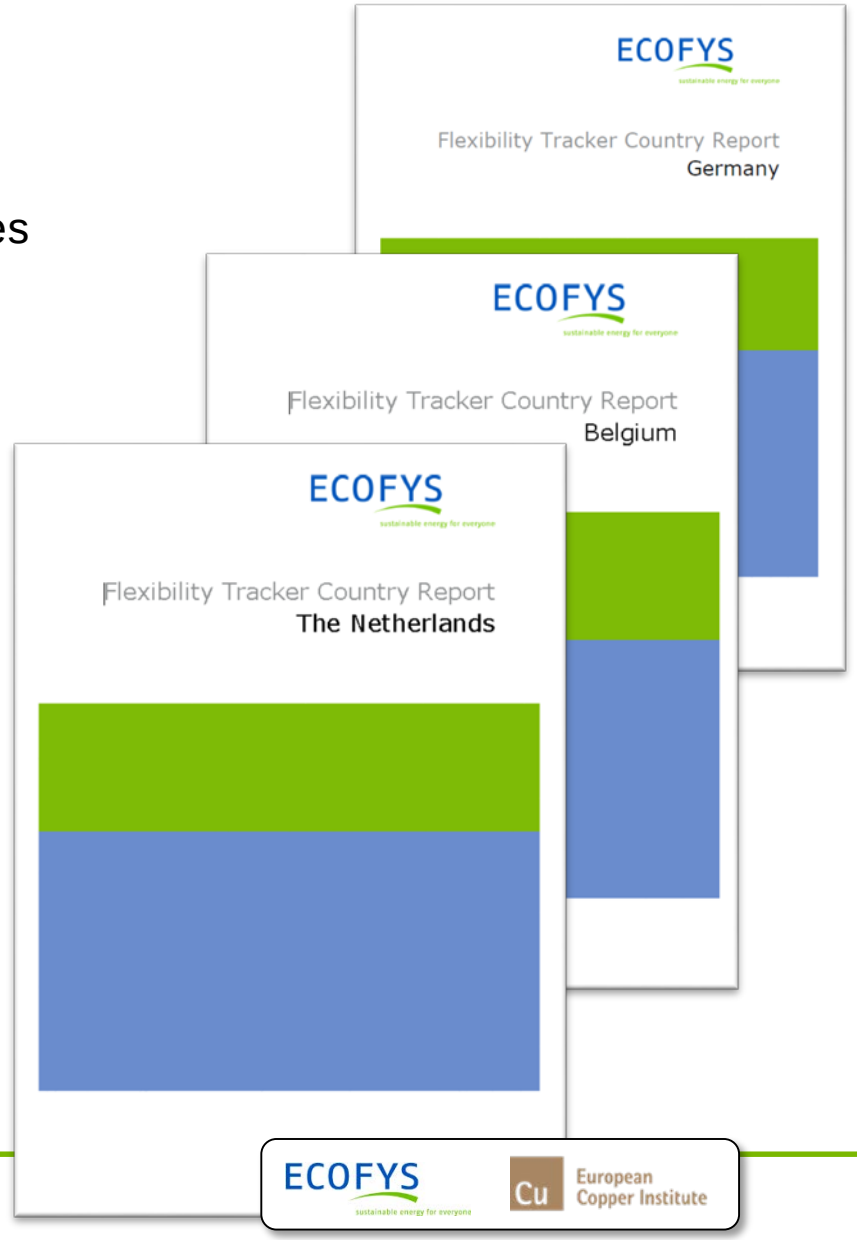
Flexibility Tracker
100% ready benchmark



Flexibility Tracker
progress of a power system towards 100% VRES readiness

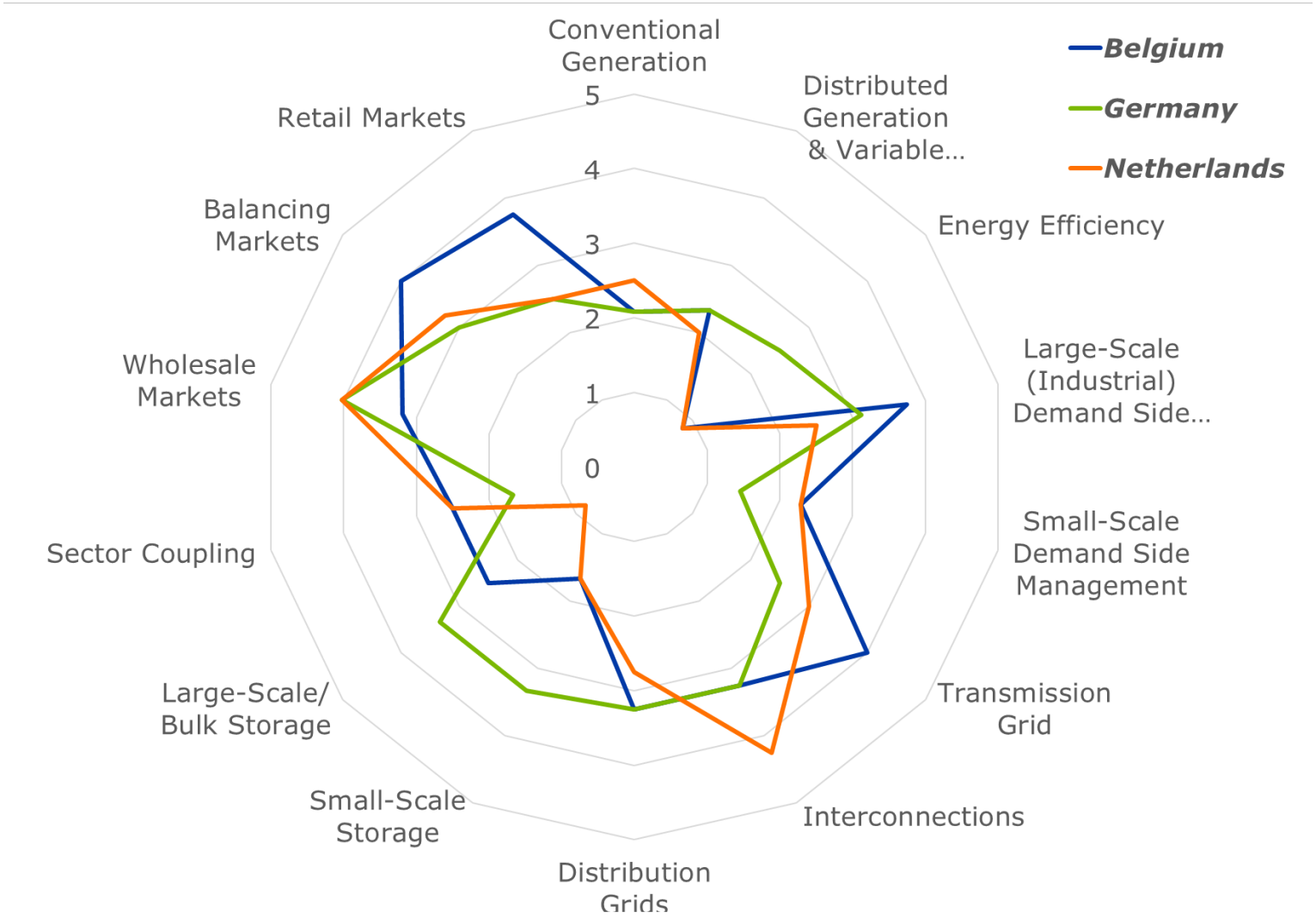
- Country reports, covering
  - Fact sheet
  - 14 flexibility KPIs and main messages
  - Country comparison
  - Recommendations for action





Flexibility Tracker

progress of a power system towards 100% VRES readiness



Flexibility Tracker

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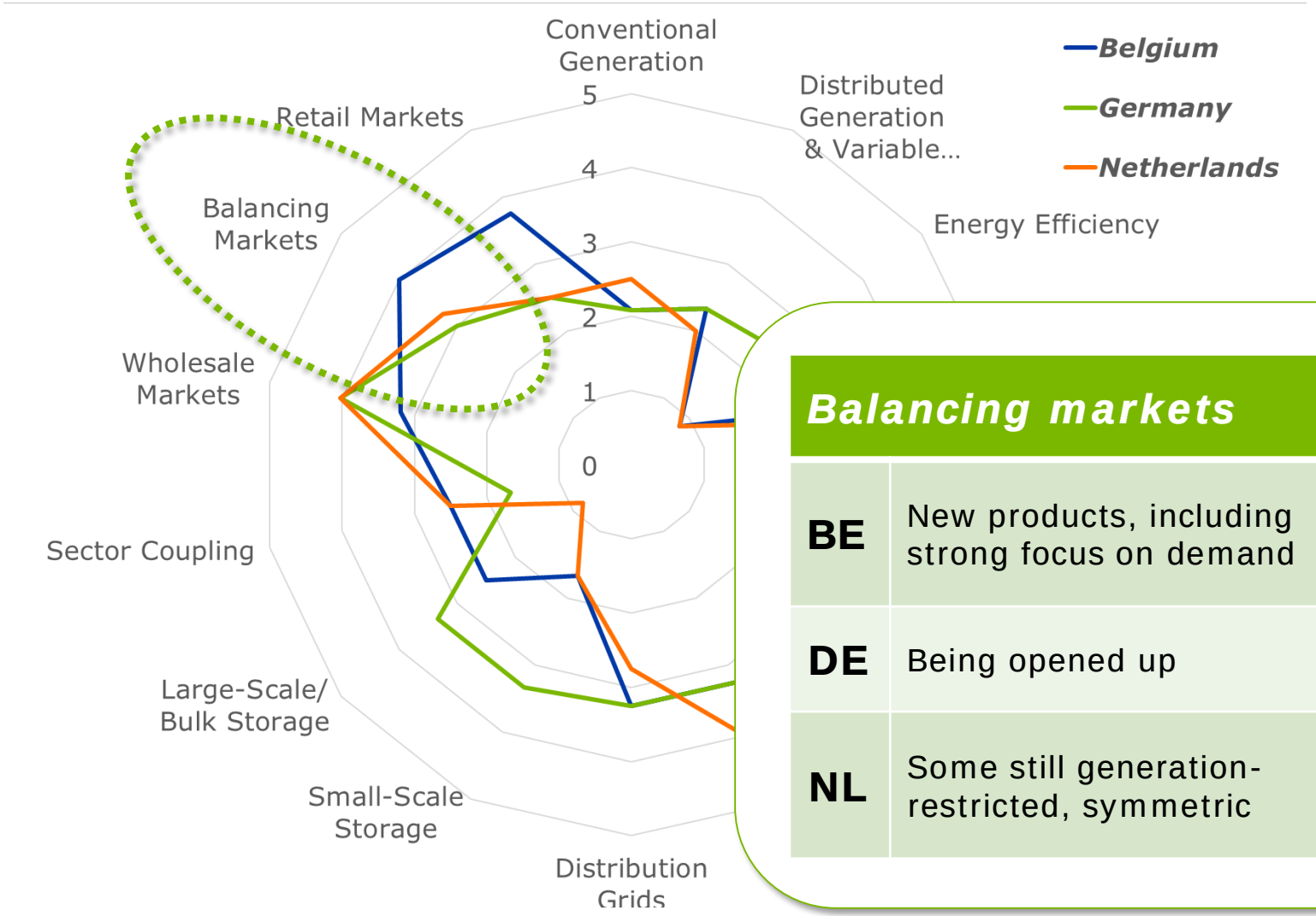

Balancing markets

BE	New products, including strong focus on demand
DE	Being opened up
NL	Some still generation-restricted, symmetric

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Flexibility Tracker

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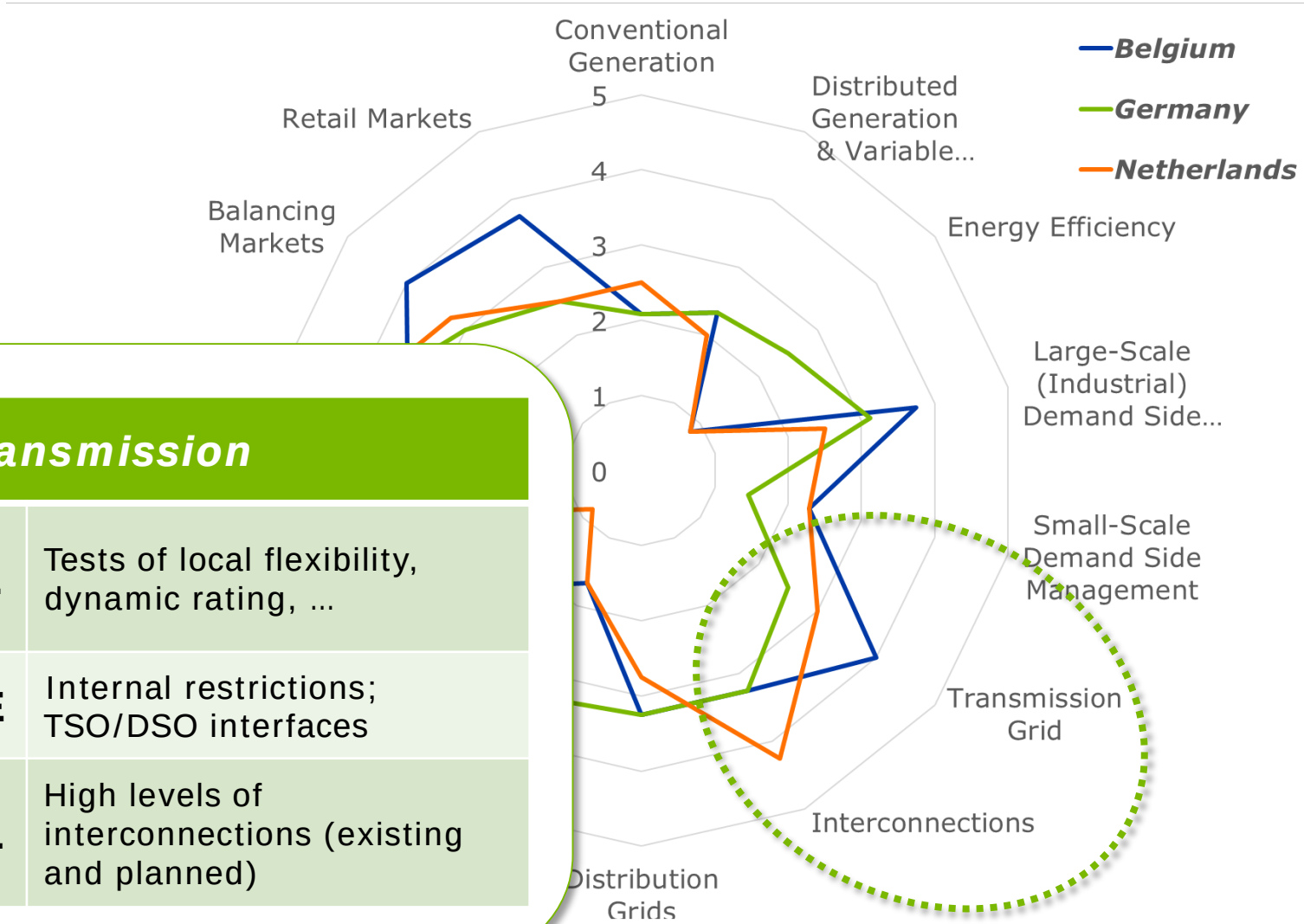
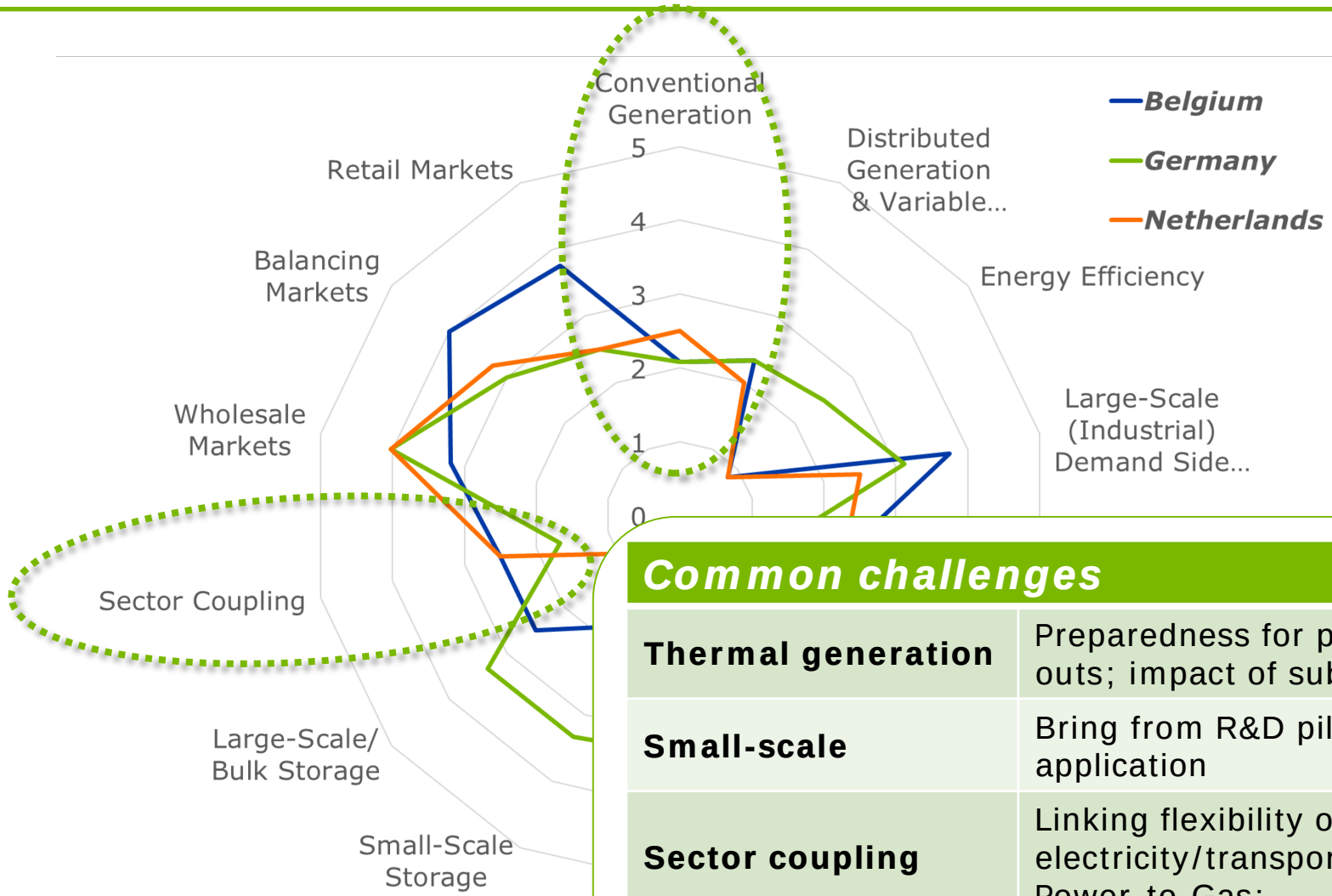


Transmission	
BE	Tests of local flexibility, dynamic rating, …
DE	Internal restrictions; TSO/DSO interfaces
NL	High levels of interconnections (existing and planned)

Flexibility Tracker

progress of a power system towards 100% VRES readiness

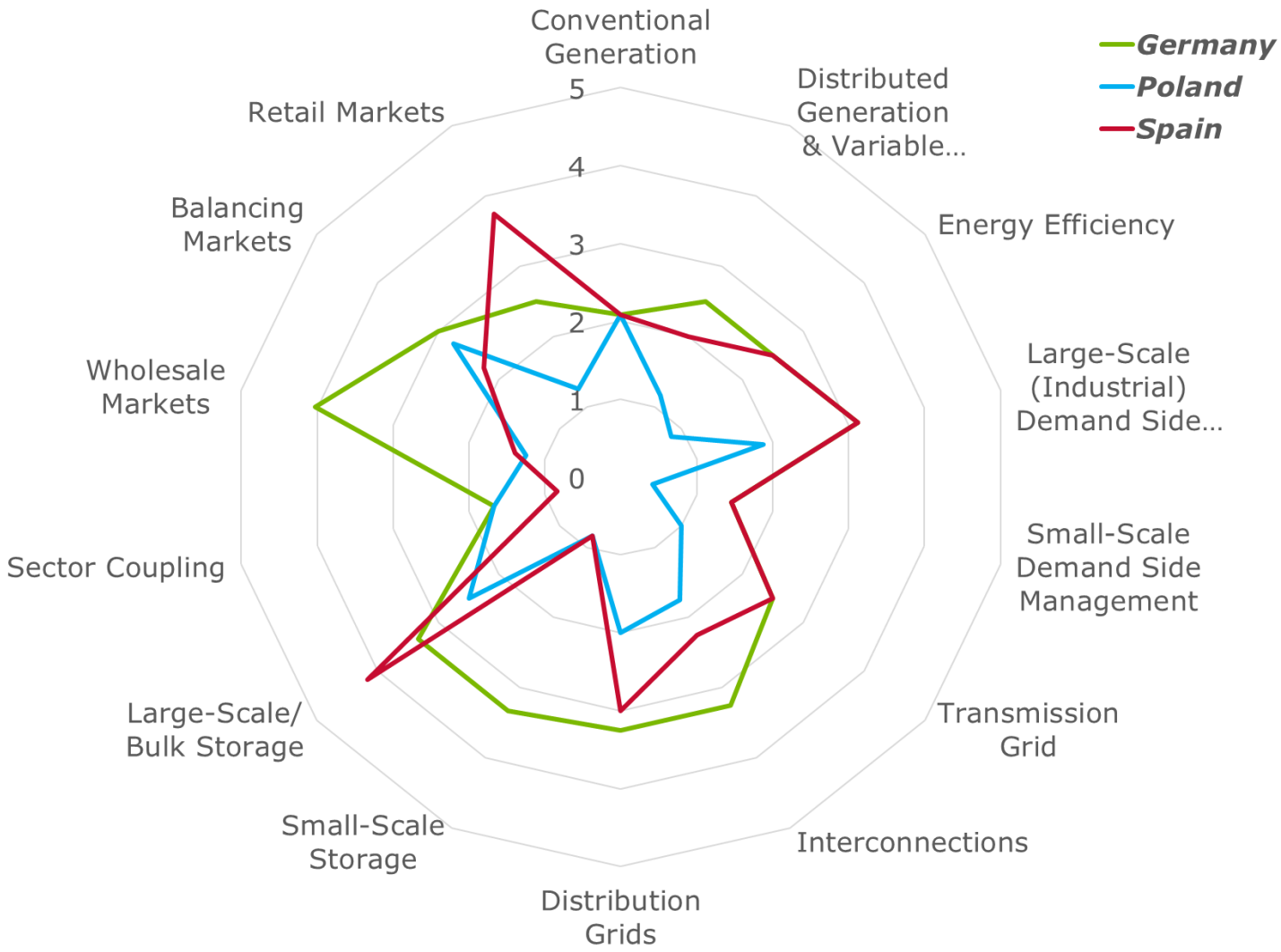


Common challenges

Thermal generation	Preparedness for phase-outs; impact of subsidies
Small-scale	Bring from R&D pilots to application
Sector coupling	Linking flexibility of heat/ electricity/transport; Power-to-Gas; …
Further regional integration	Pool resources

Flexibility Tracker

progress of a power system towards 100% VRES readiness



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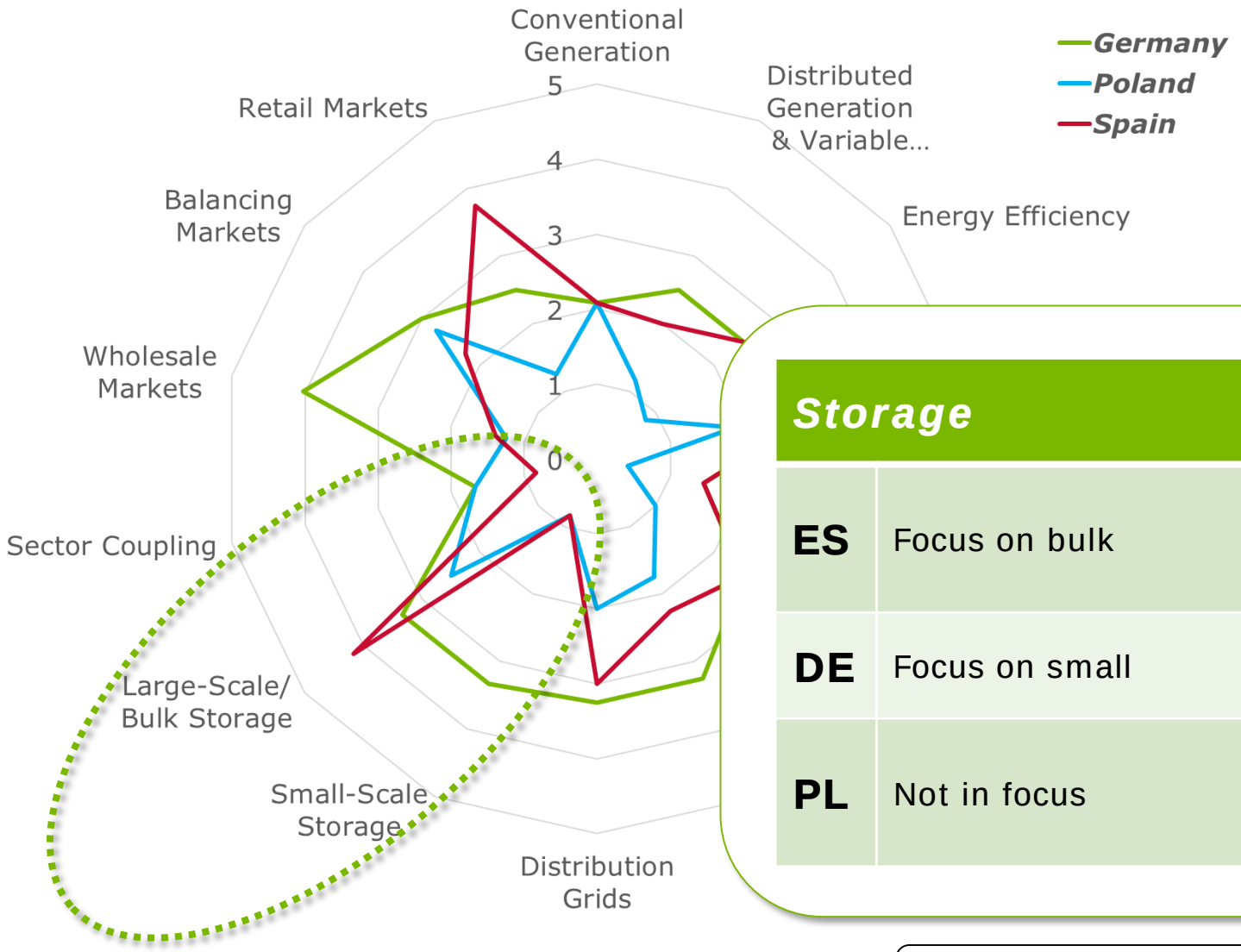
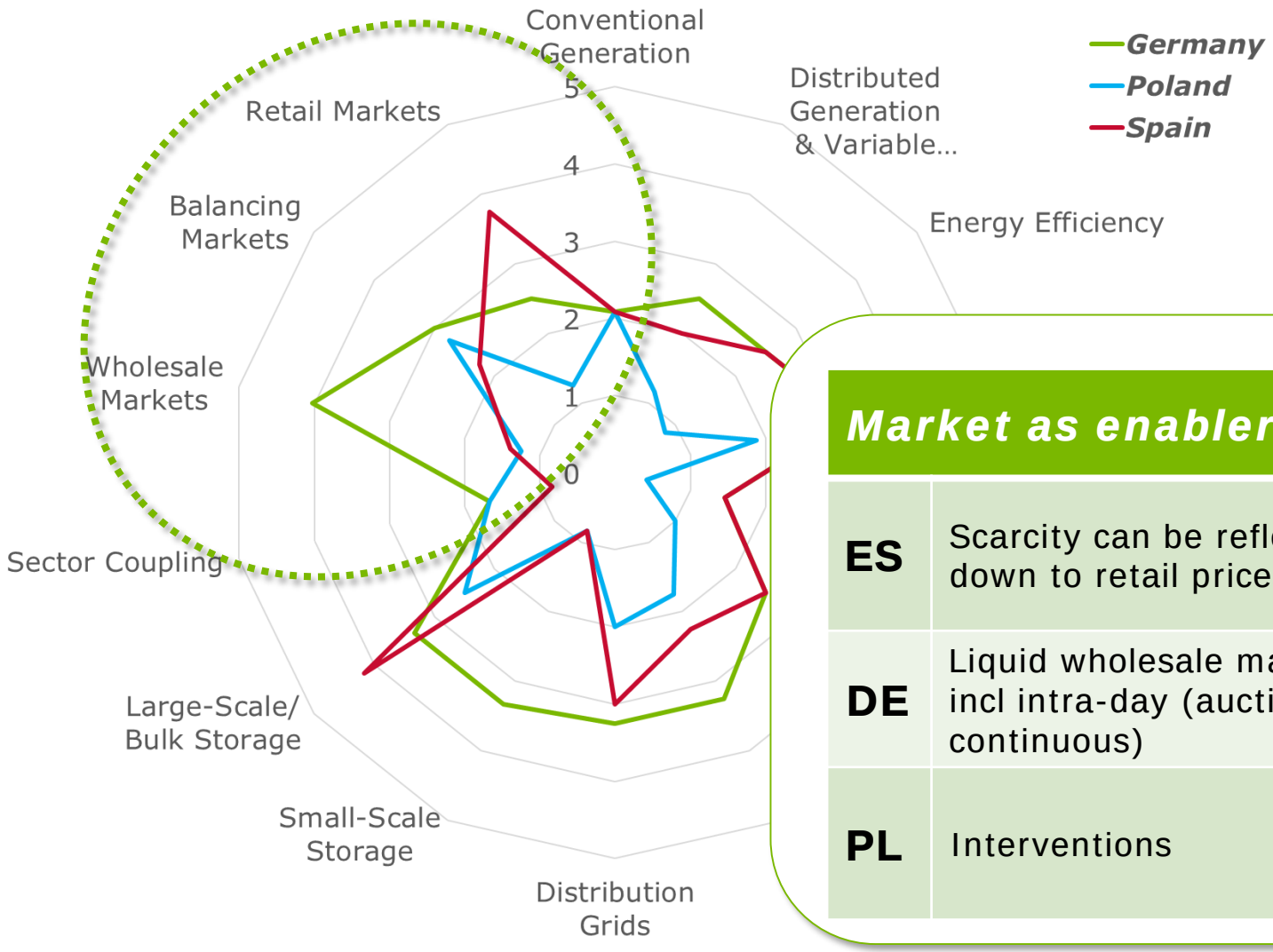


Storage	
ES	Focus on bulk
DE	Focus on small
PL	Not in focus

Flexibility Tracker

progress of a power system towards 100% VRES readiness

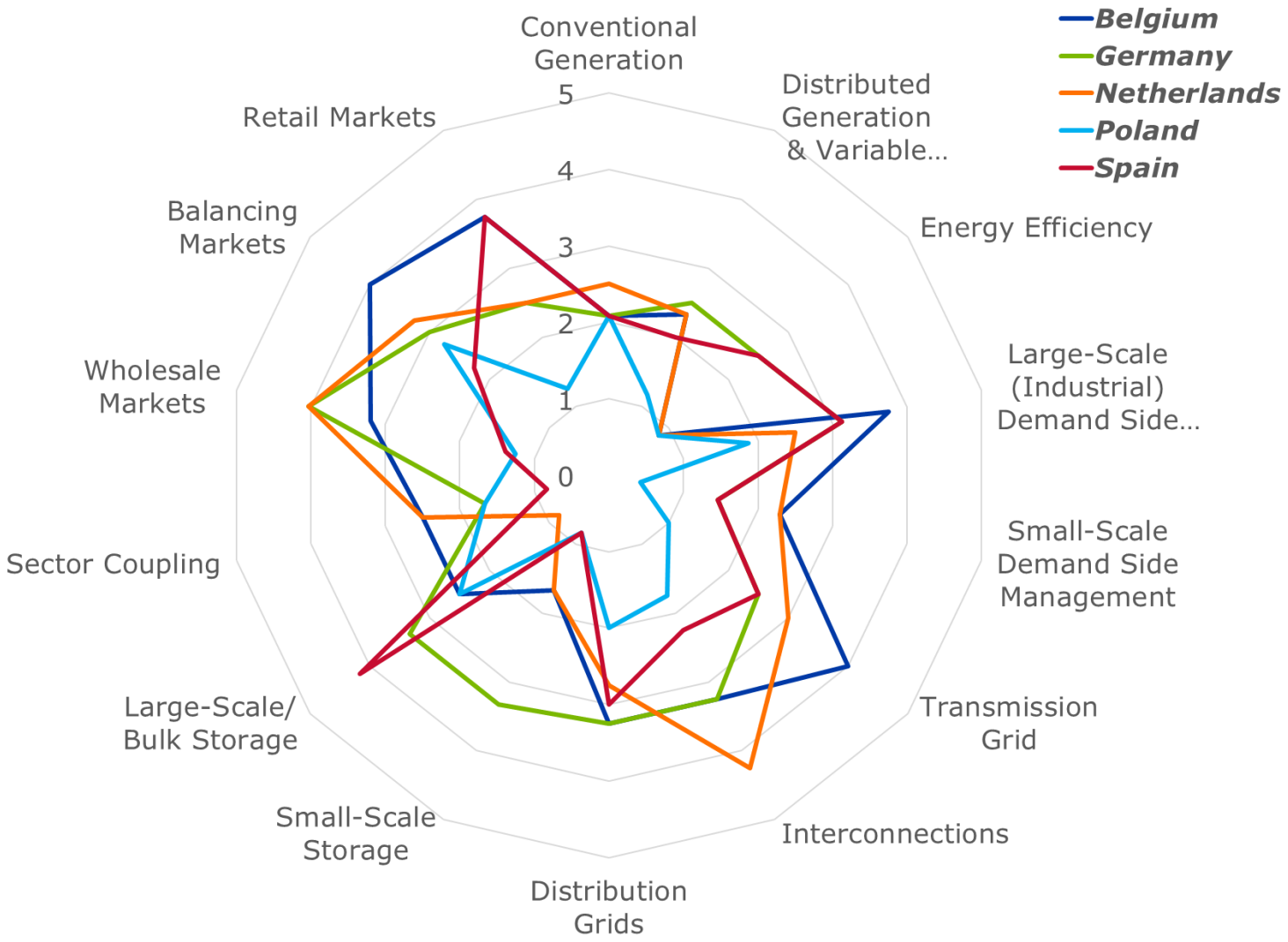


Market as enabler

ES	Scarcity can be reflected down to retail prices
DE	Liquid wholesale markets, incl intra-day (auction – continuous)
PL	Interventions

Flexibility Tracker

progress of a power system towards 100% VRES readiness



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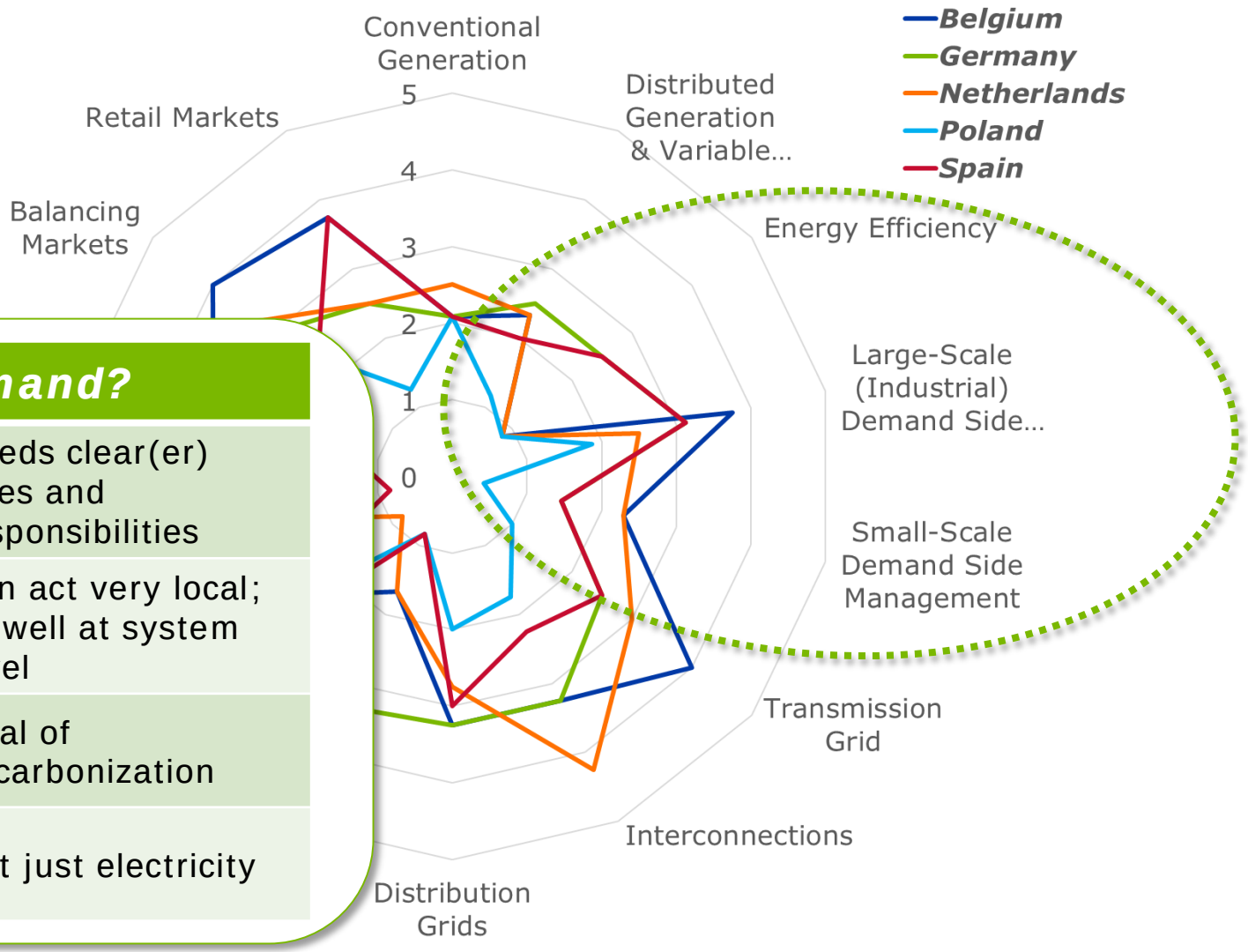
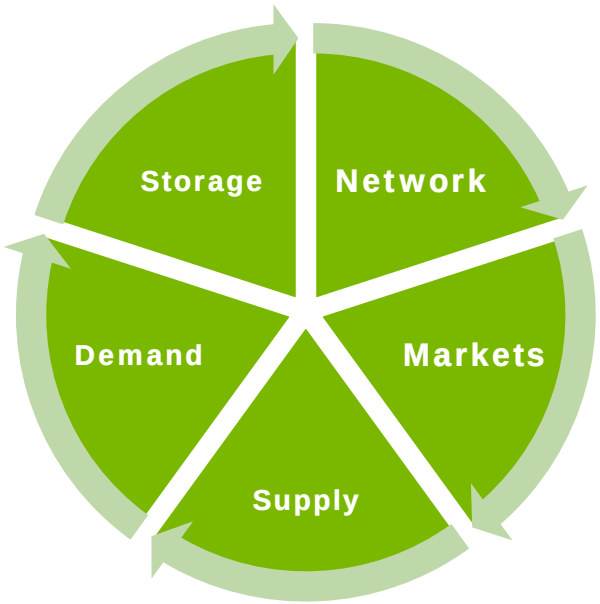


Role of demand?	
Access	Needs clear(er) roles and responsibilities
Potential	Can act very local; as well at system level
Efficiency	Goal of decarbonization
Energy	Not just electricity

In summary

- Methodology to track flexibility progress
  - Across all sources and enablers
  - Readiness for high RES systems



- Applied for first test cases
  - BE, NL, DE, PL, ES

- To be extended to other cases (national and regional; Europe and beyond)
- To foster understanding, set best practices

Thanks for your attention!

> Edwin Haesen
> Senior Consultant, Energy Systems and Markets
> E.Haesen@Ecofys.com
> +32 (0)2 880 41 05

> http://www.ecofys.com

Ecofys: Mission, Vision & Values – Facts & Figures

Mission
sustainable energy for everyone

Vision
Based on our deep expertise in energy & carbon-efficiency, renewable energy, energy systems & markets, and energy & climate policy, we develop smart policies and solutions and bring them to life.

We know that, if we act now, by 2050 our global energy system can be sustainable, secure, affordable and fully based on renewable sources.

We aim to create a sustainable energy system for everyone.

Values
Dedication Originality Impact Trust

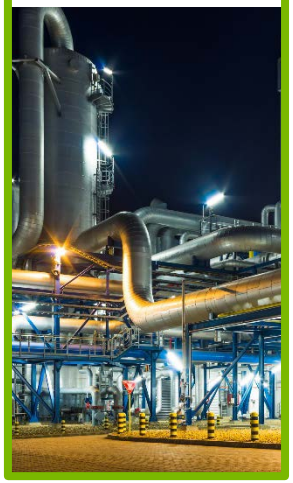
Facts & Figures

- **Founded in 1984**
- **Over 200 professionals, 6 offices in 5 countries**
- **Over 500 clients served across 50 countries**
- **Leading experts: the Nobel Peace Prize 2007, awarded to Al Gore and the IPCC, was supported by 10 Ecofys experts**
- **Eneco Shareholder since 2009**

Ecofys: domains of expertise

Urban Energy

Sustainable Industries and Services



Energy Systems and Markets

Energy Policies

Climate Strategies and Policies

sustainable energy

for everyone