


System Integration

Key for a successful energy transition

Mart van Bracht


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System Integration:

'is the process of connecting different sub-systems into a single larger system that functions as one'


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Important aspect

- Choose the appropriate system boundaries

Water-Energy-Food nexus

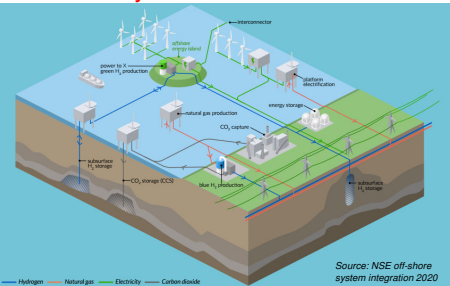


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Geographical boundary

Example: North Sea



Source: NSE off-shore system integration 2020

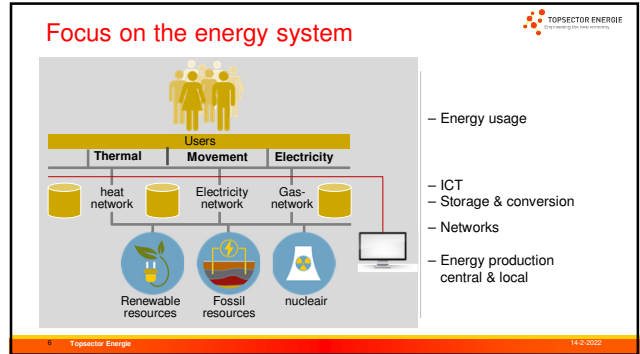


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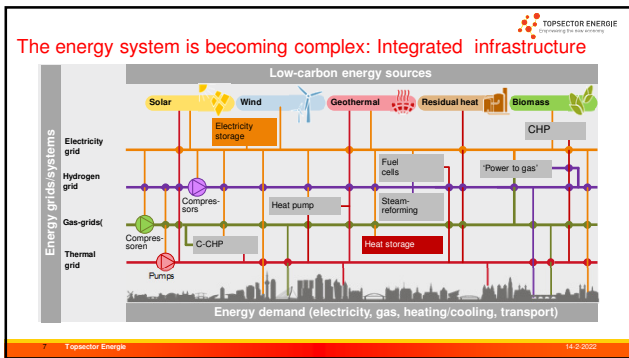
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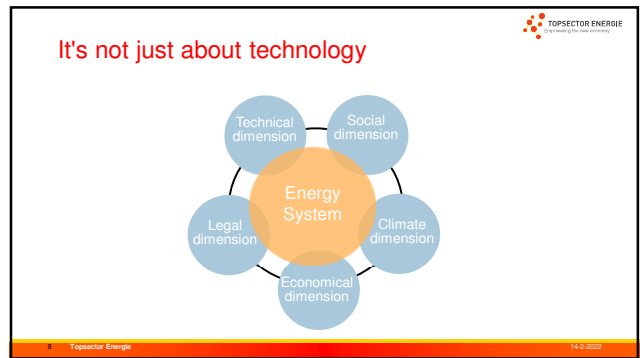
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It's beyond traditional sector coupling

Energy hub

Mobility hub

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Crucial role government, ensuring:

- An adequate form of **orchestration** → 'Holarchy'?!
 - Thinking and working from a **systems perspective**
 - Vision of our future energy system with **guiding principles**
 - A fact-based **decision-making process** considering:
 - multiple aspects (technical, economic, social, climate effects, spatial planning etc.)
 - Effective and efficient participation of all stakeholders
 - High-quality, unambiguous data, information and analytical tools

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What is a 'holarchy'?

- Holon:** an entity being simultaneously a whole and a part. Holons are self-reliant units that possess a degree of autonomy but are also simultaneously subject to control from one or more higher levels.
- Holarchy:** a hierarchy of self-regulating holons that function:
 - As autonomous wholes in supra-ordination to their parts
 - As dependent parts in sub-ordination to controls on higher levels,
 - In coordination with their local environment.

Holarchy

Holon

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'Holarchy':

- Supporting both central orchestration by the state and decision space at local and regional levels.

Reliability ← → Agility

Hierarchical systems | Holonic systems | Multi agent systems

Hierarchy | Hierarchy | Heterarchy

Fixed rules ← → Autonomy

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Characteristics energy holarchy (1/2)

- Self-organizing/ optimizing and adapting
- Combines as much as possible demand and production of energy
- Efficient use of distributed energy sources
- Each holon with a certain degree of autonomy
- Energy flow without specific routes

The diagram illustrates the concept of energy holarchy. It shows a hierarchy of holons (represented by green circles) connected by lines, with a larger 'Energy holon' at the bottom. The 'Energy holon' is shown with 'Energy' and 'Data' entering from the left and flowing out to the right. The top part of the diagram is labeled 'Holarchy' and 'Holon'.

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Characteristics energy holarchy (2/2)

- Cascaded decision-making
- Tailored decision-making possible (e.g. cooperative community)
- Data-driven
- Many opportunities for citizen participation
- Different business models possible

The diagram illustrates the characteristics of energy holarchy. It shows a hierarchy of holons (represented by green circles) connected by lines. A large inverted triangle is shown next to the hierarchy, representing cascaded decision-making. The diagram is divided into three sections: 'Authorizations' (Top level holon, Medium level holon, Lower level holon), 'Scope responsibilities', and a final section showing the hierarchy of holons.

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The illustration shows a smart farm with various energy infrastructure. It includes a house with solar panels, a cow, a wind turbine, a solar panel, a battery, a gas tank, and a power line. The farm is connected to a smart grid.

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Thanks for your attention

Contact information:
 Mart van Bracht
 E-mail: mart.vanbracht@topsectorenergie.nl
www.topsectorenergie.nl/systeemintegratie

Graphic design:
 Rietstap Vormgeving <http://rietstapvormgeving.nl/>

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