The future of the global energy market – circular economy in energy industry

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Agenda

1. Global operating environment
2. Trends affecting the energy industry
3. Principles of circular economy in the energy industry
4. Circular economy case examples
5. Concluding thoughts
1. Global operating environment
Disruption is happening on multiple industries
1. Global operating environment
We are in the sixth wave of innovation, and technological and social change is accelerating.
1. Global operating environment
Global megatrends are altering the operating environment – each industry must adapt
What does all this mean for the energy industry?
2. Trends affecting the energy industry
The energy industry is not immune to changes in the operating environment

1. Resource efficient and clean world
2. Digitalization and new technologies
3. Urban, responsible, and global consumer

NB! These are Valmet’s perception of three main megatrends for the industry
2. Trends affecting the energy industry
What are the implications of these three megatrends in the energy industry?

1. Resource efficient and clean world
   - Stringent regulations on emissions
   - Rising resource prices

2. Digitalization and new technologies
   - Decreasing price of renewables
   - Power-to-X: storing excess renewable energy
   - Need for power reserves during demand peaks
   - Remote control of energy use

3. Urban, responsible, and global consumer
   - Electric mobility
   - Consumer interest in renewable energy sources
   - Decentralized energy production and storage
   - New business models and servitization
2. Trends affecting the energy industry

Resource efficient and clean world

**EU**
- 85% of heating and cooling in the EU is still based on fossil fuels – national actions to decarbonize need to be taken
- The utilization of excess heat could cover the entire heating need of buildings in Europe

**USA**
- In CA, all new homes built after 2020 are required to utilize solar power
- 2018 NJ law requires 50% of utilities’ energy to be renewable by 2030

**China**
- The Inner Mongolia Autonomous Region (IMAR) has the highest wind capacity in China, with 18 GW installed
- IMAR is trialing wind-to-heat to reduce curtailment of windpower on cold winter nights when the heat from CHP plants is on high demand
2. Trends affecting the energy industry
Digitalization and new technologies

**USA**
- Digital peer-to-peer trading platform known as Brooklyn Microgrid
- Allows solar energy *prosumers* to buy and sell credits without central utility

**Germany**
- Smart battery company, Sonnen, allows its 10,000 customer households to *trade surplus energy* with each other

**Finland**
- *Unsubsidized wind* is now competitive in areas once considered unfeasible, leading to a surge in wind farms
- *Two-way district heating* is piloted in multiple locations

**Netherlands**
- Eneco offers home monitor that lets users *control energy use via an app*
- Eneco also purchases excess energy from users’ home batteries

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2. Trends affecting the energy industry
Urban, responsible and global consumer

- **Norway**
  - Electric cars made up 39.2% of 2017 new car sales in Norway
  - Constitutes a major shift for nation’s energy grid

- **Canada**
  - Bullfrog Power offers a **green electricity package** for customers who want energy from renewable sources only
  - Package also supports the development of renewable projects throughout Canada

- **Japan**
  - Recycles 77% of urban plastic waste
  - Unrecyclable waste used in waste-to-energy plants
Which of the three trends affecting the energy industry is most relevant for your business?

a) Resource-efficient and clean world
b) Digitalization and new technologies
c) Urban, responsible, and global consumer

Vote!
Wanted: a business philosophy that responds to these megatrends
From linear economy to circular economy

A circular economy is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times.

Circular economy allows economic growth while optimizing the use of resources, deeply transformed patterns of production and consumption chains, and designs for new industrial systems.

3. Principles of circular economy in the energy industry

Introduction to circular economy: how to optimize the use of resources and where to do it
3. Principles of circular economy in the energy industry
Circular economy example: Innorent helps meet temporary real estate needs

The needs for built environment are sometimes short-lived.
Innorent builds, leases and supplies temporary, movable facilities such as retail spaces or warehouses.

Most of Innorent’s structures can be collapsed and transferred directly to a new destination.
Any materials that can not be transferred immediately are recycled to be used as material for new buildings.
3. Principles of circular economy in the energy industry
Circular economy in the energy system strives for the most efficient use of natural resources, end use energy as well as excess energy and side streams

What is optimized in the energy system from a circular economy perspective?

1. Use of energy sources
2. Use of side streams and excess energy
3. End use of energy

Sources: Circular economy in the energy industry – Deloitte Oy for Finnish Energy
3. Principles of circular economy in the energy industry
From a circular economy perspective, the energy system can be optimized through 3 key tactics

1. Circular economy of energy production
Renewable energy, waste-to-energy, fuel conversion, recycling the materials from energy production plants

2. Industrial symbiosis and municipal-level circular economy cooperation
Utilisation of the energy industry’s and other industries’ excess energy and side streams, municipal and industrial cooperation

3. Circular economy in the customer interface
Demand response, two-way district heat, energy-as-a-service, energy efficiency of the end user

How is the energy system optimized from a circular economy perspective?

Circular economy tactics of the energy industry

Circular economy in the energy industry can be categorized into the circular economy of energy production, circular economy established through cooperation with other actors and circular economy of the customer interface.

Sources: Circular economy in the energy industry – Deloitte Oy for Finnish Energy
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3. Principles of circular economy in the energy industry
Circular economy tactics of the energy industry positioned along the energy value chain

**Energy value chain**

**Examples of circular economy tactics**

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**Circular economy tactics**

- Energy use of side streams
- Utilization of excess heat
- Utilization of ashes
- Planning the recyclability of materials from energy production plants and grids
- Renewable energy
- Energy recovery from waste
- Fuel conversion
- Products and services enabled by smart grids
- Heating-as-a-service
- Electricity-as-a-service
- Lighting-as-a-service
- Energy efficiency services
- Lifecycle services for properties
- Demand response
- Two-way district heating
- Exhaust-air heat pumps
- Recycling materials from energy production plants, utilization as material or energy
- Disposal of unexploitable waste

Sources: Circular economy in the energy industry – Deloitte Oy for Finnish Energy
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Which circular economy tactics have already been applied in your company’s operations?

1. Renewable energy, waste-to-energy, fuel conversion, recycling the materials from energy production plants

2. Utilisation of the energy industry’s and other industries’ excess energy and side streams, municipal and industrial cooperation

3. Circular economy in the customer interface: Demand response, two-way district heat, energy-as-a-service, energy efficiency of the end user
Case examples of circular energy solutions
4. Circular economy case examples

Case example: Hamburger Containerboard (HC) opted for an on-site power plant that makes use of residues from paper recycling.

Challenge

HC was faced with multiple energy related challenges:
• High cost of purchased power due to high grid costs and taxes in Hungary
• Heat production based on purchased natural gas – need for CO₂ certificates
• High cost of waste disposal (80 000 tons/annum) further price development is forecasted

Circular solution

• Valmet CYMIC circulating fluidized bed (CFB) Boiler has high flexibility:
  • Can utilize eg. bark and other wood fuels
  • Boiler flexibility allows for the use of paper mills’ residues as fuel

Outcome

• 95 % of the waste generated at the site is recovered
• Majority of the waste is utilized for energetic purposes - high flexibility in fuel use helps to utilize the waste
• The site is independent from natural gas and power supply systems – it has a full and uninterrupted energy supply

Valmet CYMIC multifuel boiler
4. Circular economy case examples
Case example: Side stream asphaltene from Neste oil refining becomes fuel for Sappi Kirkniemi paper mill

**Challenge**

Sappi was interested in finding new ways to improve efficiency and cost savings at their Kirkniemi mill

As part of a new diesel refining process, Neste produces the byproduct **asphaltene** at its Kilpilahti facilities in Porvoo

**Circular solution**

- Neste approached Sappi about supplying asphaltene as a fuel source
- Valmet had delivered a CYMIC multifuel boiler with CFB technology to the Sappi Kirkniemi paper mill in 2015

**Outcome**

- Valmet’s CYMIC multifuel boiler provides fuel source flexibility, which enabled the use of Neste’s side stream:
  - In November 2017 asphaltene burning began at maximum allowed share, 30% of fuel mix, **reducing the need for pulverized coal**
  - Valmet’s Selective Non-Catalytic Reduction helps control increased NOₓ levels

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4. Circular economy case examples
Case example: Vantaan Energia’s waste-to-energy plant has installed flue gas condensors, which recover heat to district heating and reduce emissions

**Challenge**
Vantaan Energia has been under pressure to improve efficiency, and the flue gas leaving the plant contains ample energy:
- The energy originates in (i) water contained in the fuel (waste) and (ii) water steamed in the boiler
- This energy normally escapes out to the atmosphere, without the water vapor condensing back into liquid form

**Circular solution**
- Valmet has supplied a flue gas cleaning system to Vantaan Energia Oy's waste-to-energy plant
- The flue gas cleaning system has improved the plant's energy efficiency and district heating capacity, in addition to reducing its emissions

**Outcome**
- Flue gas condensation can recover significant amount of heat from flue gas
- The recovered heat can be used in district heating, to save fuel, and in heating up turbine condensate
- Cleaned condensate can be used to replace bought city water, eg. in making demineralized boiler water
- Using cleaned condensate can reduce operating costs and increase overall efficiency
4. Circular economy case examples
Case example: Tampereen Sähkölaitos have utilized the Valmet DNA Energy Management System for better fuel demand and production planning.

**Challenge**
- Tampereen Sähkölaitos, who provide electricity, heat and district cooling in the Tampere area, was looking for efficiency benefits for its production planning.

![Lielahi & Tammervoima CHP plants](image)

**Circular solution**
- Valmet DNA Energy Management System helps the company to optimize:
  - production plans for day-ahead electricity trading
  - production plans for making start and stop decisions for units
  - scenarios for long-term investment planning
  - Reveals deviations between optimal and real operation in the past also

**Outcome**
- Tampereen Sähkölaitos can now better take into account e.g. the district heat needs as well as the fuel prices and availability of the plants
- This improves the **energy and financial efficiency** of the plants

- Optimized production plans
- Load and Price Forecasts
Putting everything we have seen together ...
5. Concluding thoughts

**Constant change**
Megatrends are forcing businesses to **rethink** their operations in every industry

*How do you future-proof your business for these changes?*

**Source of inspiration**
Circular economy thinking offers an answer to many megatrends – it is a **platform** for cost savings and a **driver** of innovation

*How can you benefit from this thinking?*

**Value chain thinking**
In a circular economy, **cooperation and coordination** with other players, even from other industries, is the key for success

*Are you ready for cross-industry cooperation?*
Thank you!

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