Sustainability in Cities
- Energy

Emerging solutions and critical issues for their realization

Christoph Vitzthum, Group Vice President Wärtsilä Power Plants

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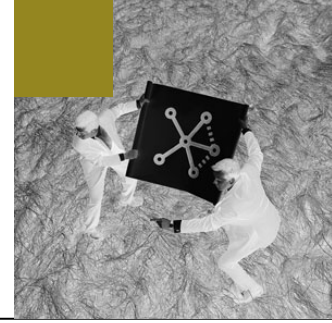
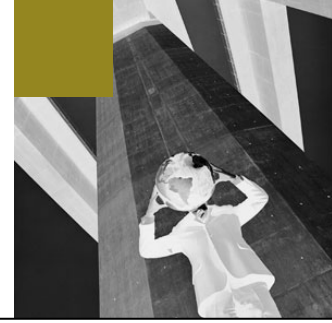
Industrial example: Towards an idealised design for *Sustainability in cities* – the case of energy



From:	**To:**
Large-scale structures for all energy	Large-scale structures for base load energy Distributed generation for peak generation Combining CHP whenever possible
Consumers purchase energy from distributors	Consumers buy and sell energy to local sub-systems
Centralised authorities monitor grid stability and distributors monitor consumption	Grid stability services forms independent market
Manufacturing and other types of plants aim to minimise energy usage and control energy price	Manufacturing and other types of plants aim to make efficient energy systems and sell spill-over energy
The energy system includes many different energy sources that may create uncompetitive pockets	The system priorities highest efficiency electricity generation and simultaneously optimises total efficiency
Large actors and bundled activities	Unbundled activities and differentiated actors
Nationally focused energy systems	International openness

Idealised design for sustainability in cities: Energy– challenges and renewal role of policy

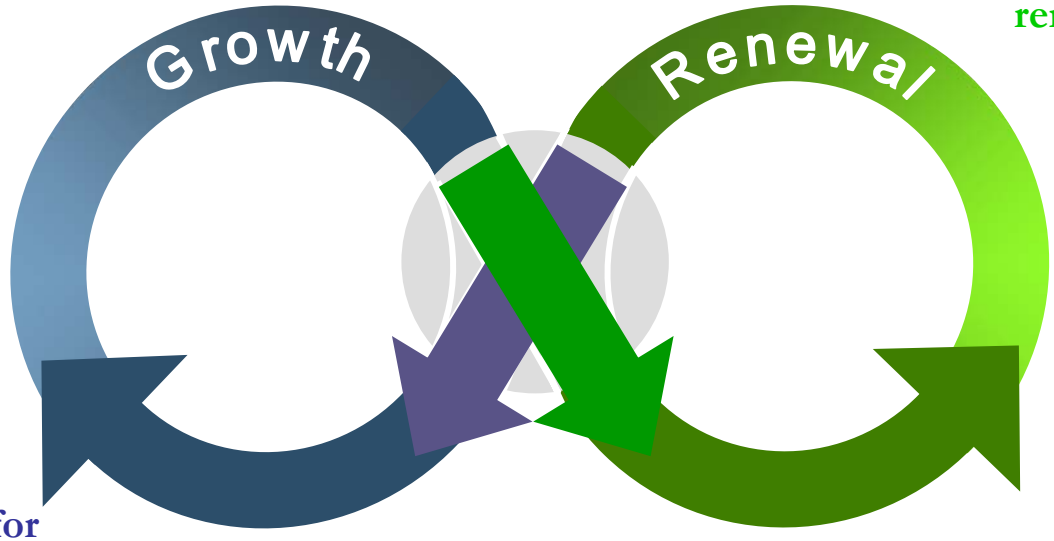


Large-scale energy production systems and bundled services reduce competition

Significant energy losses in transmission and distribution

Unused energy generating capacity in industries

Isolated markets for electricity, heat, water etc.



Stimulate enabling research, for instance metering systems and renewables

Use public procurement to develop system and production oriented providers

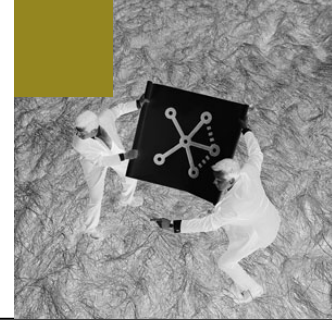
Goals for system effectiveness – minimising transmission losses

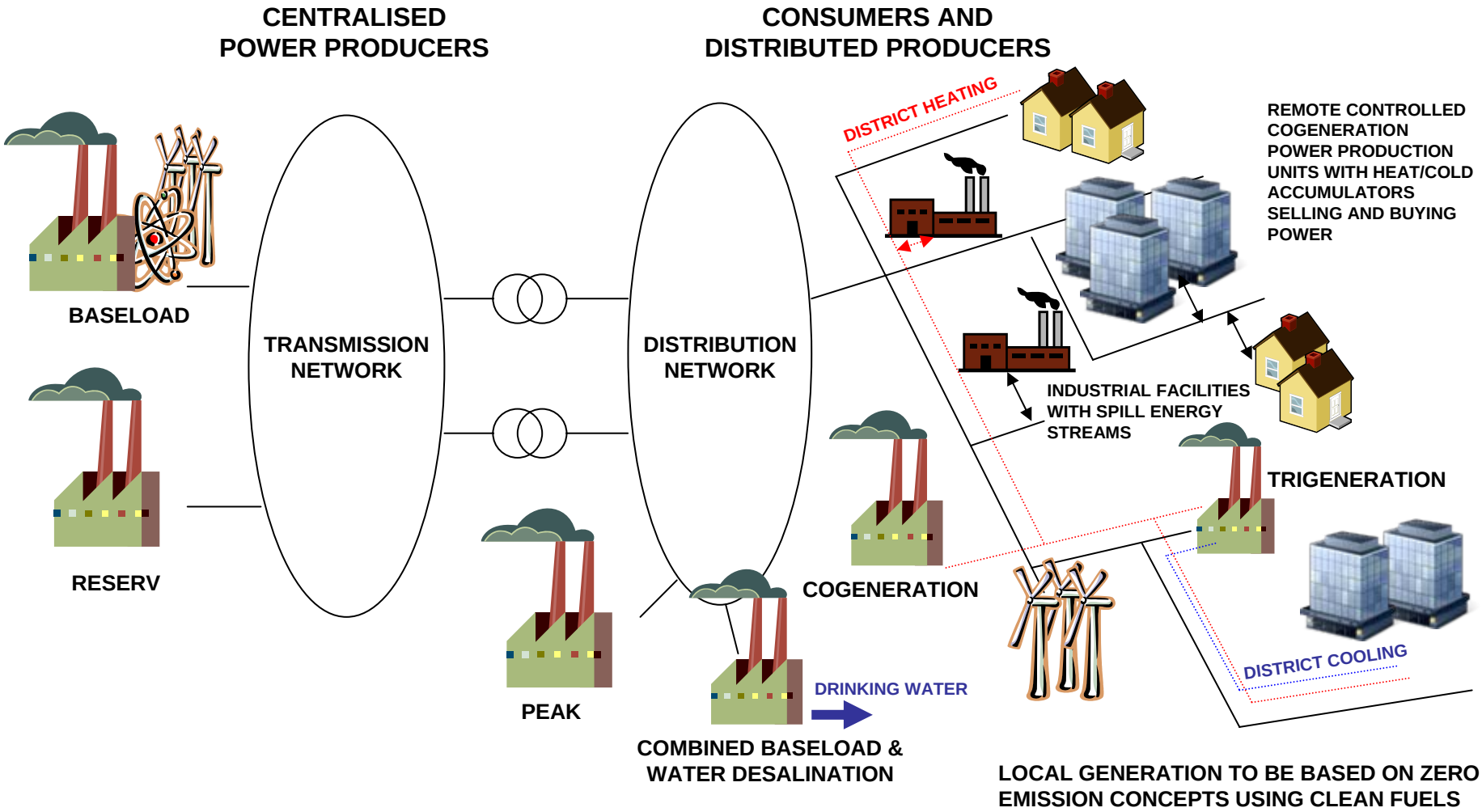
Current regulatory framework tend to favour large-scale operators and provide to small incentives for renewable energy sources

Develop regulatory framework that provide incentives for overall energy effectiveness at system level (including local markets, renewables and buy-sell system

Distributed Energies Network

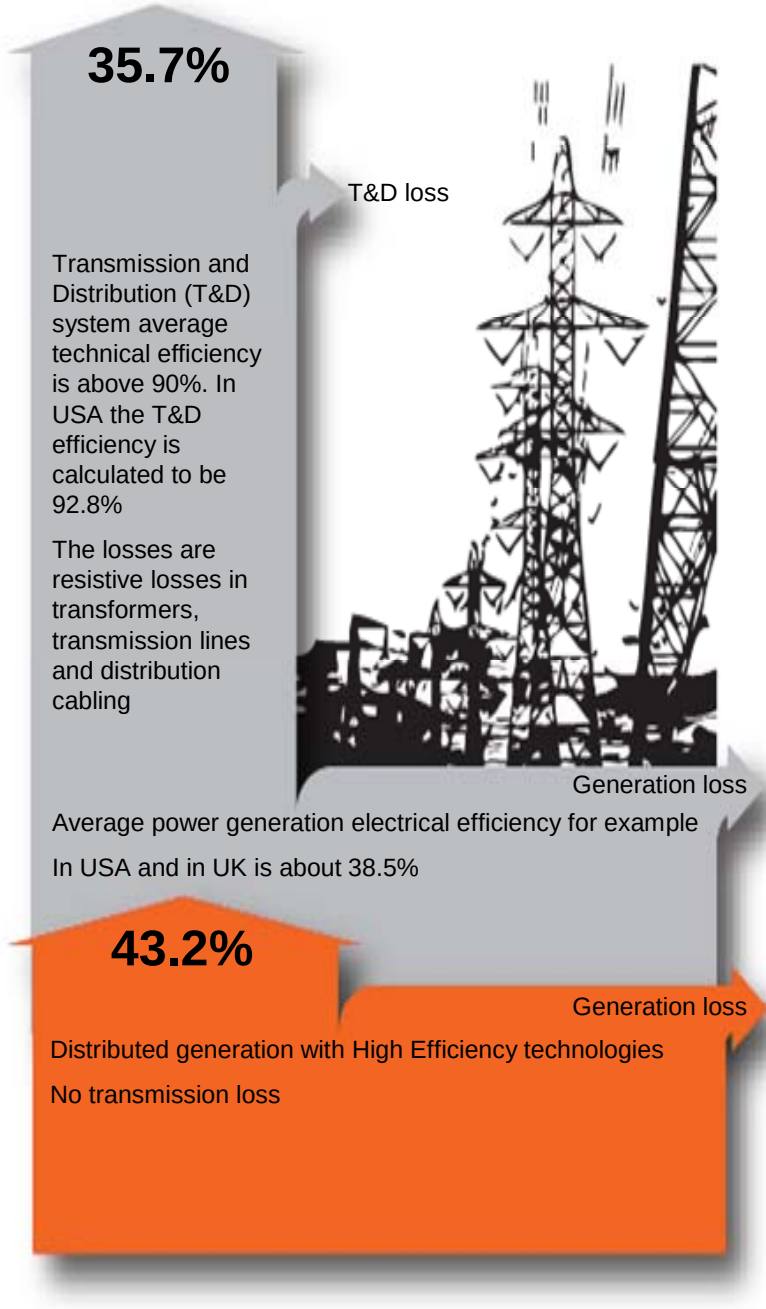
- prioritising electricity production and high total efficiency



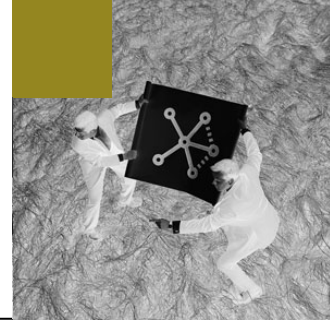


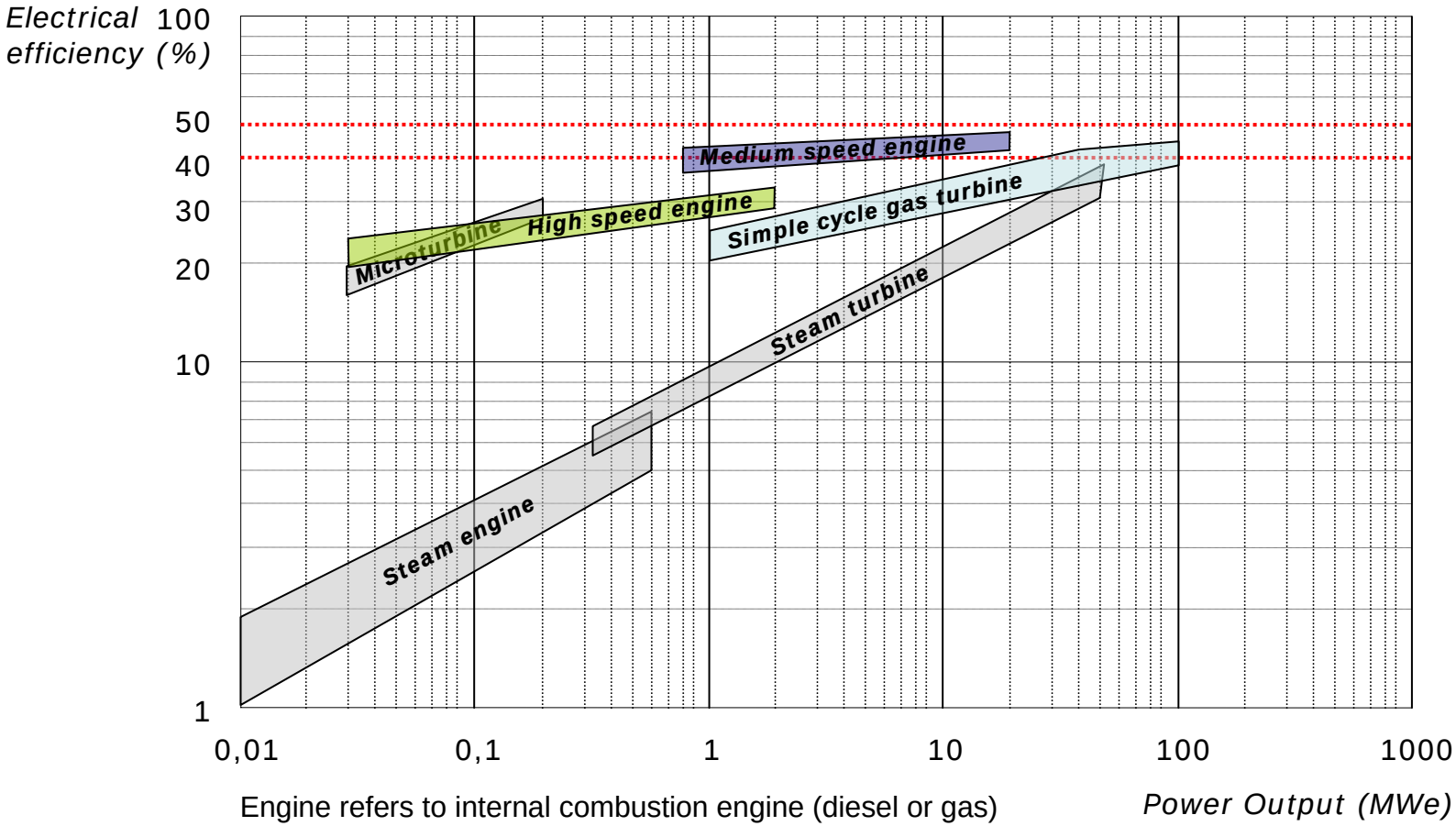
Distributed Generation(DG)

- What is Distributed Generation?
  - Relatively small plant size (typically)
    - Typical range 30kW – 15MW (…100MW)
    - Not a strict definition
  - Power is generated close to the load
    - Eliminate voltage step-up losses
    - Eliminate transmission losses
    - Eliminate step-down losses (best case, generation at same voltage as consumption)
    - Eliminate distribution losses
  - Power generation is connected to the utility (grid)
    - Normal operating mode is to run in parallel with the utility
    - Island mode operation is sometimes applied in special conditions to provide higher reliability for the consumer



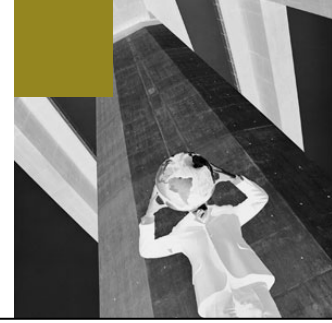
Todays DG technology comparison





Engine refers to internal combustion engine (diesel or gas)

Drivers of DG



Benefits for the local customers

- *Improve total electrical efficiency*
  - Energy prices are increasing due to higher fuel costs–high efficiency is valued
  - As power generation efficiency improvements become harder and harder, achieving a 7.5% unit improvement in total electrical efficiency is phenomenal
- *Provide secure power supply for local consumers*
  - Being able to provide own power in case of power disturbance is a significant driver for industrial customers
- *Enables CHP*
  - In many DG applications CHP is utilized as a way to achieve higher overall efficiency and better feasibility

Benefits for the utility

- *Reducing peak load impacts for the transmission system*
  - The daily and yearly load patterns present a challenge both for the power generation as well as the transmission systems
  - Transmission system investment costs can be reduced if the system can be sized using DG for peak shaving
  - Today the reality is in many places that new transmission systems cannot be built due to challenges in obtaining the Right Of Way (ROW)
- *Power factor correction*
  - Power factor correction means that reactive power is generated locally and the transmission does not carry reactive current allowing higher capacity for active power

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