

BREAKING NEWS

▶ POWER OUTAGES



**CLEVELAND, NEW YORK, OTTAWA,
TORONTO, TOLEDO REPORT OUTAGES**

S&P 500 ▲ 6.48

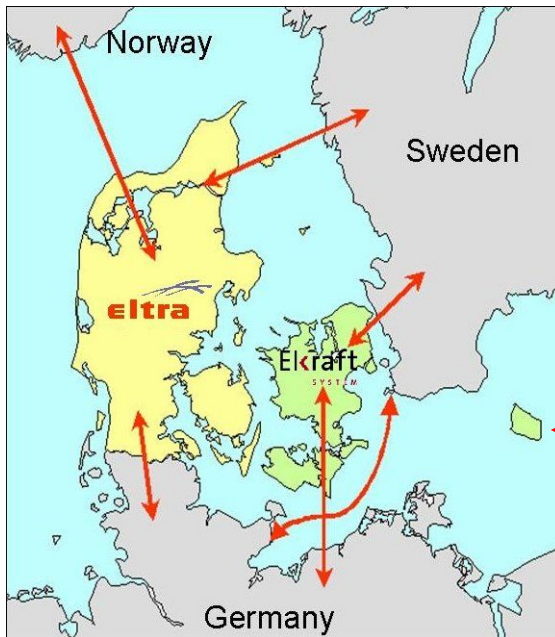
▶ SUPPORT WEST AFRICAN PEACEKEEPERS IN LIBERIA.



After 14 August 2003:

A Wave of European Blackouts

23 August	Helsinki
28 August	London
23 September	Southern Sweden and Eastern Denmark
27 September	Italy

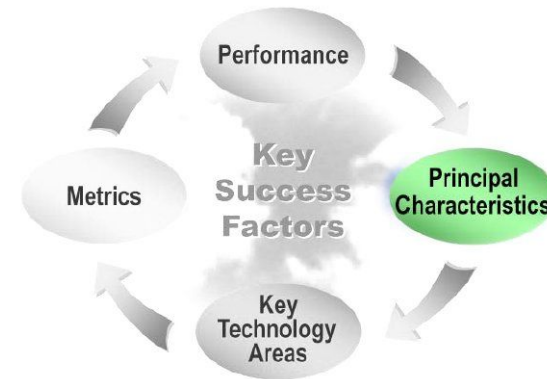


- Eastern Denmark has 2 gas turbines for black starts
- Both failed 23 September
- None of the local CHP-units were prepared for a black start
- Only the island of Bornholm was able to restart on its own

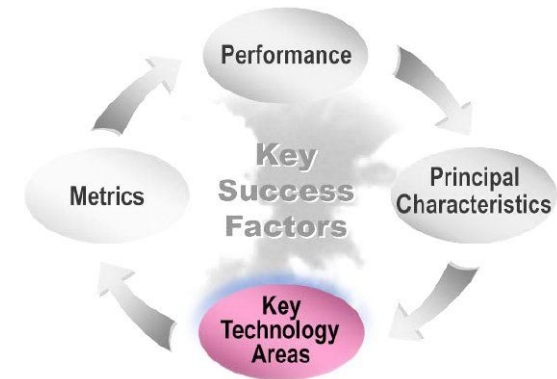
A boom in interest for power engineering followed!

A vision

- A new generation of large CHP plants
 - designed for flexible operation
- Active demand side participation
- Interacting electricity and heating systems
 - Local CHP plants must actively contribute to system balancing
- An extended electricity market
 - New market services, including ancillary services and a new retail market
 - Market rules encouraging flexible behavior (supply and demand)
- Efficient emergency response
- Active local sub-grids
 - designed for local voltage control and dead start
- Reliable service and business opportunities for all system users

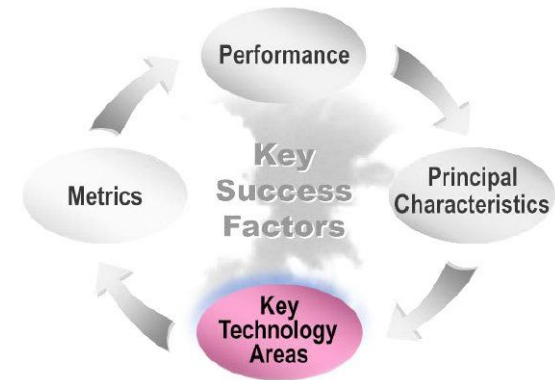


The CHP balancing potential

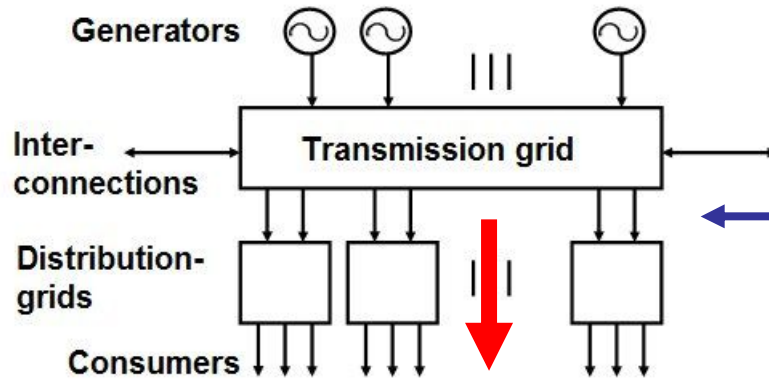


- Accumulator tank in a small scale CHP system:
 - 2 ‰ of annual heat output (excluding pipes)
- 1 ‰ of Danish CHP heat output: 35 GWh
 - Danish CHP systems could easily absorb 3 GW for several hours
- Technologies (to be supported by market services):
 - Direct water heating
 - Heat pumps
 - A new generation of large CHP units designed for intermittent operation
 - Small scale CHP plants to be redesigned for providing system services

A new sub-grid design



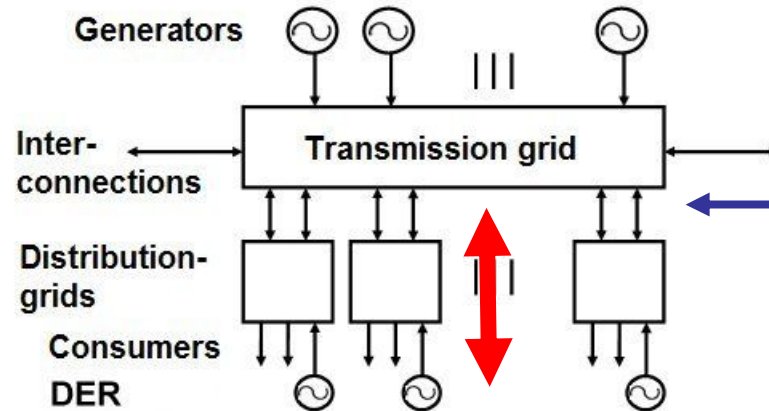
Centralized generation:



The predictable interface

- allowing independent control of transmission and distribution grids in the past

Distributed generation:



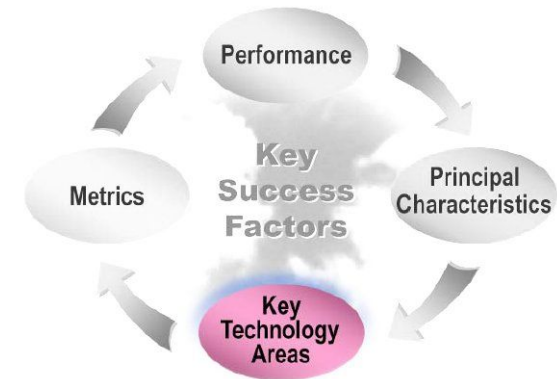
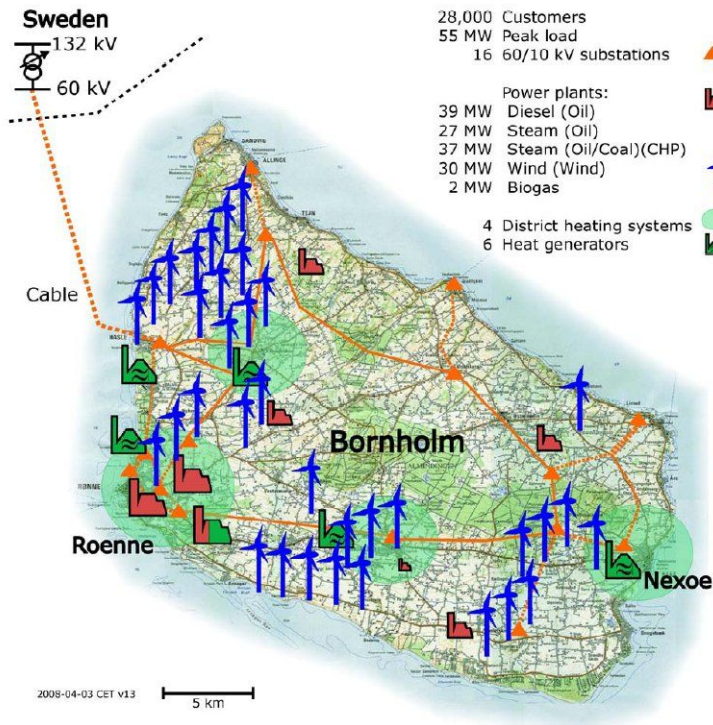
An unpredictable interface

- requiring integrated control of transmission and distribution grids and advanced local automation

Discussion:

Sub-grid design in phase 2 Demonstration project at Bornholm?

1 % of Denmark



- Max 55 MW – 239 GWh
- Wind energy 53 GWh (22 %)
 - Preparing 40 % wind energy
- Generation:
 - 14 diesel (oil): 30 MW
 - 1 steam (oil): 27 MW
 - 1 steam (oil/coal): 37 MW
 - 35 wind: 30 MW
 - 1 biogas: 2 MW
- 4 DH systems: 205 GWh

It is possible to integrate a lot of wind power

There are no easy solutions

- but fascinating challenges for enthusiastic R&D teams

