

“STORAGE, DSM AND GENERATION MANAGEMENT –
THE NEW ROLE OF ENERGY EFFICIENCY IN
100% RE CONCEPTS”

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PRESENTATION OVERVIEW

1. The evolving approach to grids

- Current base load generation versus variable generation
- Possible future power system management

2. The role of energy efficiency and DSM in 100% RE systems

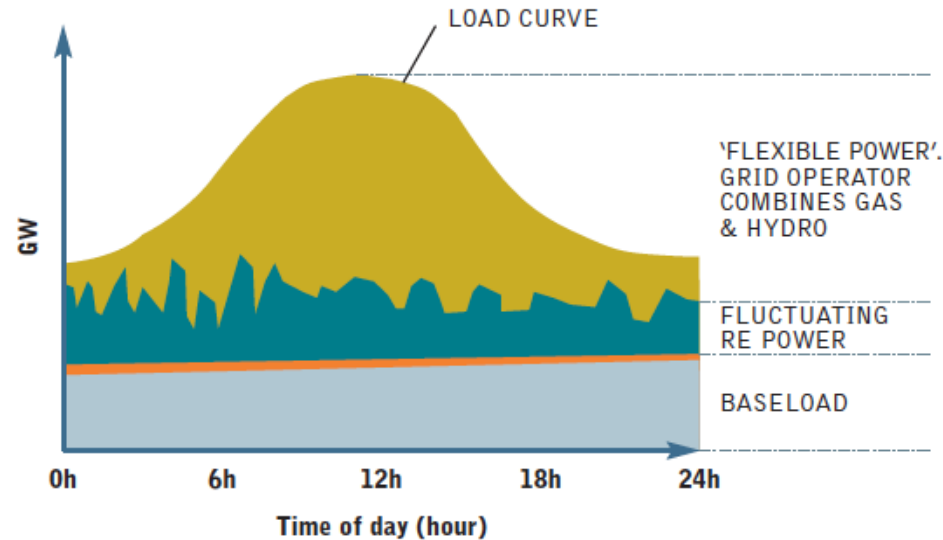
- Demand reduction – avoided new power generation capacity
- Demand shifting – better integration of flexible generation

THE EVOLVING APPROACH TO GRIDS

Current supply system

- Low shares of fluctuating renewable energy
- The 'base load' power is a solid bar at the bottom of the graph.
- Renewable energy forms a 'variable' layer because sun and wind levels changes throughout the day.
- Gas and hydro power which can be switched on and off in response to demand. This is sustainable using weather forecasting and clever grid management.
- With this arrangement there is room for about 25 percent variable renewable energy.

To combat climate change much more than 25 percent renewable electricity is needed.



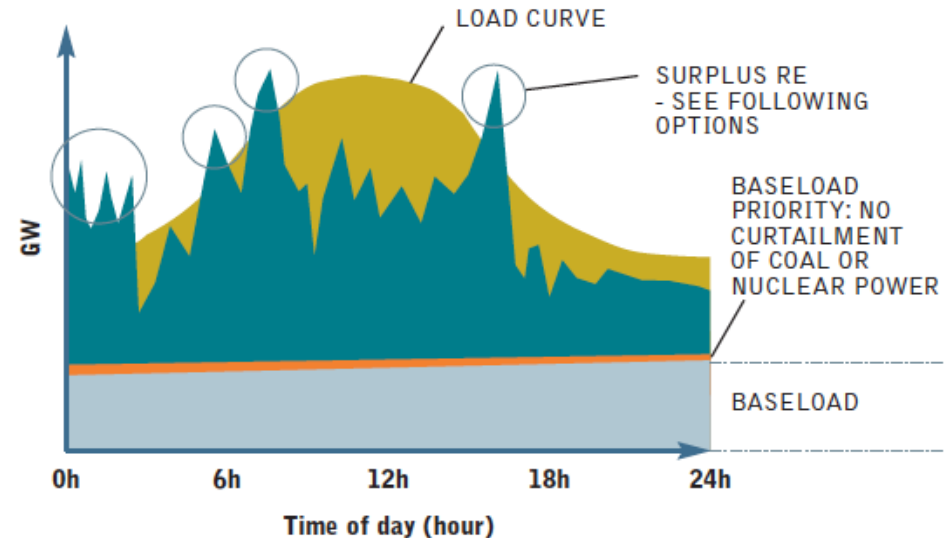
Source: Energynautics, T. Ackermann / S. Teske: 4-2014

THE EVOLVING APPROACH TO GRIDS

Supply system with more than 25 percent fluctuating renewable energy > base load priority

- This approach adds renewable energy but gives priority to base load.
- As renewable energy supplies grow they will exceed the demand at some times of the day, creating surplus power.
- To a point, this can be overcome by storing power, moving power between areas, shifting demand during the day or shutting down the renewable generators at peak times.

Does not work when renewables exceed 50 percent of the mix, and can not provide renewable energy as 90- 100% of the mix.



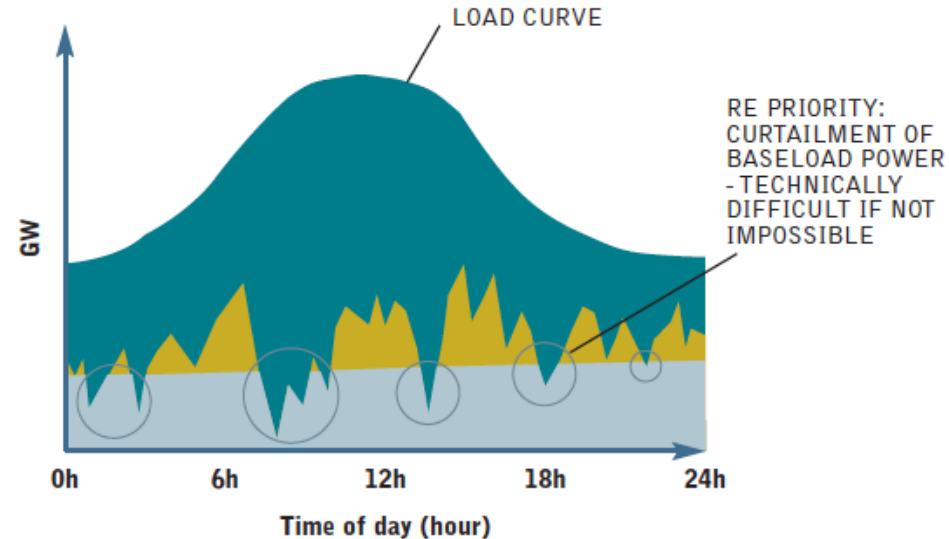
Source: Energynautics, T. Ackermann / S. Teske: 4-2014

THE EVOLVING APPROACH TO GRIDS

Supply system with more than 25 percent fluctuating renewable energy – renewable energy priority

- This approach adds renewables but gives priority to clean energy.
- If renewable energy is given priority to the grid, it “cuts into” the base load power.
- Theoretically, nuclear and coal need to run at reduced capacity or be entirely turned off in peak supply times (very sunny or windy).
- There are technical and safety limitations to the speed, scale and frequency of changes in power output for nuclear and coal-CCS plants.

Technically difficult, not a solution.

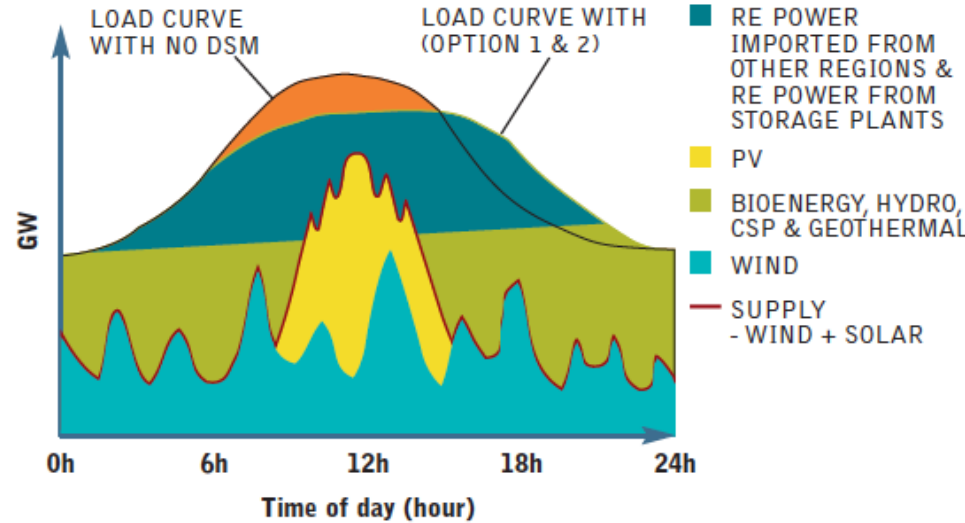


Source: Energynautics, T. Ackermann / S. Teske: 4-2014

THE EVOLVING APPROACH TO GRIDS

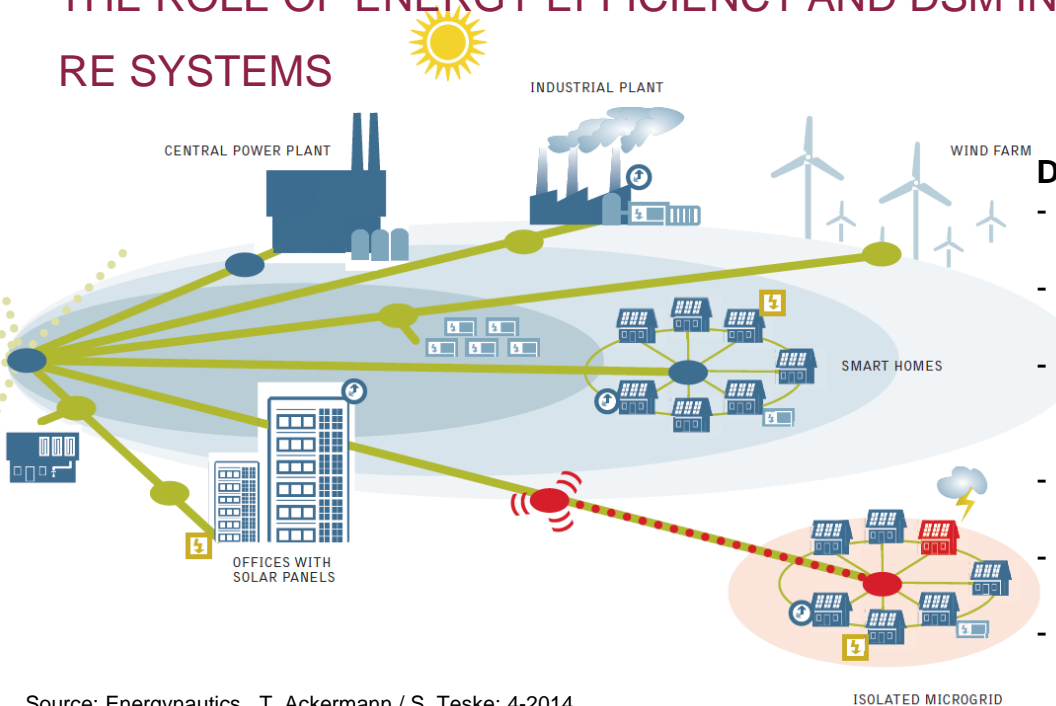
The solution: an optimised system with over 90% renewable energy supply

- A fully optimised grid, where 100 percent renewables operate with storage, transmission of electricity to other regions, demand management and curtailment only when required.
- Demand-side management (DSM) effectively moves the highest peak and 'flattens out' the curve of electricity use over a day.



Source: Energynautics, T. Ackermann / S. Teske: 4-2014

THE ROLE OF ENERGY EFFICIENCY AND DSM IN 100% RE SYSTEMS



Demand Side Management

- Requires services = business opportunities
- High value because supply security increases
- Requires technologies such as data analysis and storage technologies
- Supports Generation Side Management (GSM)
- Increased DSM + GSM = higher system stability
- Base load generation disappears as a economic concept from power markets

Source: Energynautics, T. Ackermann / S. Teske: 4-2014

PROCESSORS

EXECUTE SPECIAL PROTECTION SCHEMES IN MICROSECONDS



SENSORS ('ACTIVATED')

- DETECT FLUCTUATIONS AND DISTURBANCES, AND CAN SIGNAL FOR AREAS TO BE ISOLATED



GENERATORS

ENERGY FROM SMALL GENERATORS AND SOLAR PANELS CAN REDUCE OVERALL DEMAND ON THE GRID



DISTURBANCE IN THE GRID

SENSORS (ON 'STANDBY')

- DETECT FLUCTUATIONS AND DISTURBANCES, AND CAN SIGNAL FOR AREAS TO BE ISOLATED



DEMAND MANAGEMENT

USE CAN BE SHIFTED TO OFF-PEAK TIMES TO SAVE MONEY



STORAGE ENERGY GENERATED AT OFF-PEAK TIMES COULD BE STORED IN BATTERIES FOR LATER USE



SMART APPLIANCES

CAN SHUT OFF IN RESPONSE TO FREQUENCY FLUCTUATIONS

Thank you

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