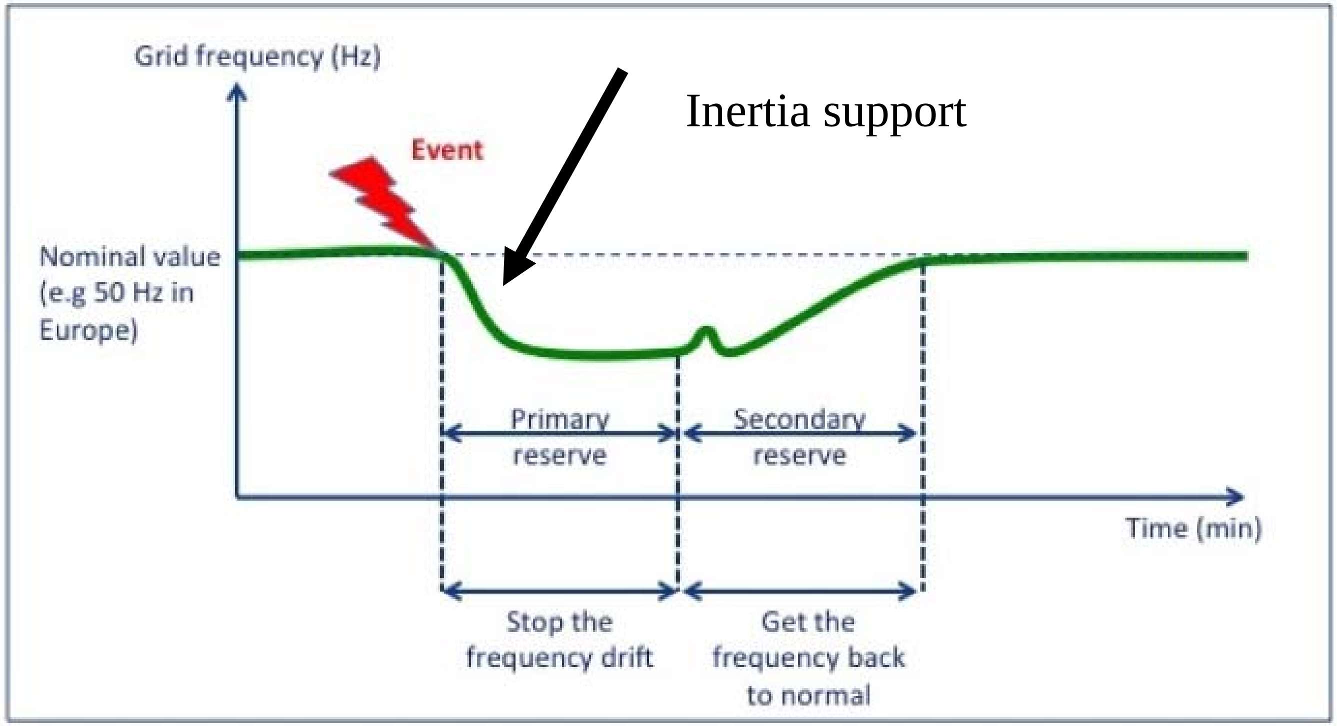
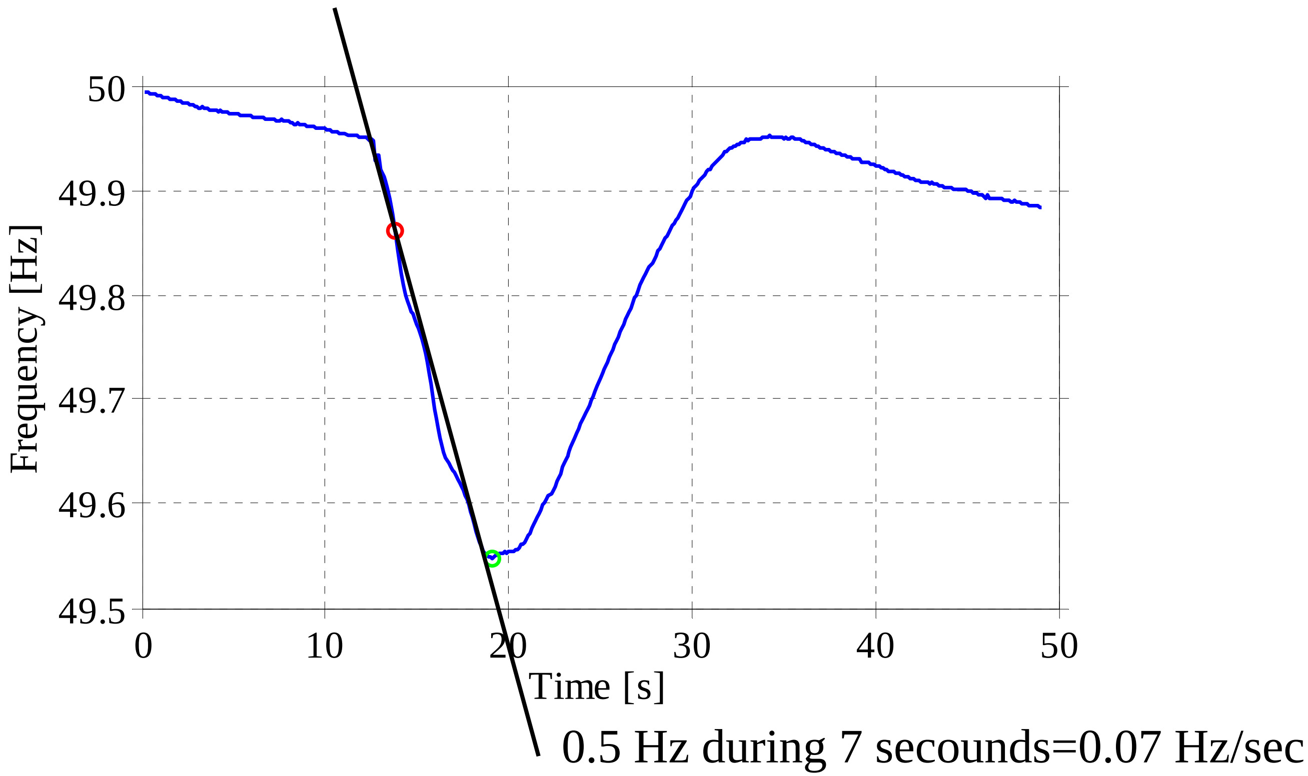
Svängmassa

Frekvenskontroll med primär och sekundär kontroll



Obalans i elsystemet på grund av nödstopp av 1000 MW i effekt



Källa: Mattias Persson, "Frequency Response by Wind Farms in Islanded Power Systems with High Wind Power Penetration"

Frekvenskontroll

$$T_{mek} - T_{el} = J \frac{\partial \omega}{\partial t}$$

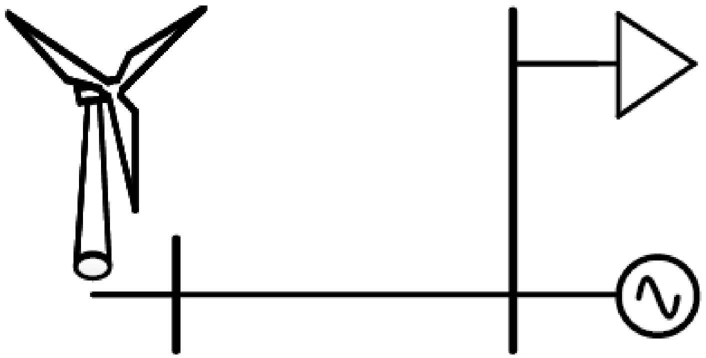
$$P = T \cdot \omega$$

- Tmek = mekaniskt moment hos turbinen
- Tel = eletriskt moment från generatorn
- J = tröghetsmoment hos roterande maskiner
- w = rotationshastigheten hos generatorn
  = frekvensen på spänningen

Olika energislag

Vattenkraft	synkronmaskin	automatisk svängmassa
Kärnkraft	synkronmaskin	automatisk svängmassa
Vindkraft	asynkronmaskin	kontrollerad svängmassa
Solkraft		ingen svängmassa

WT Inertia support strategies



Simulation and data description

1. Load step: **0.1 pu**
2. Constant wind (7.5 m/s)
3. 50 % **WPR**

WPR=Wind Power Ration

Case 1: 100 % Hydro
Case 2: 50 % WPR without frequency support
Case 3: 50 % WPR with Inertia Emulation support

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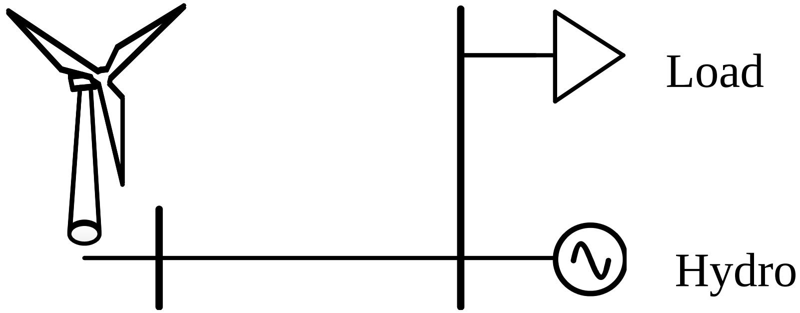
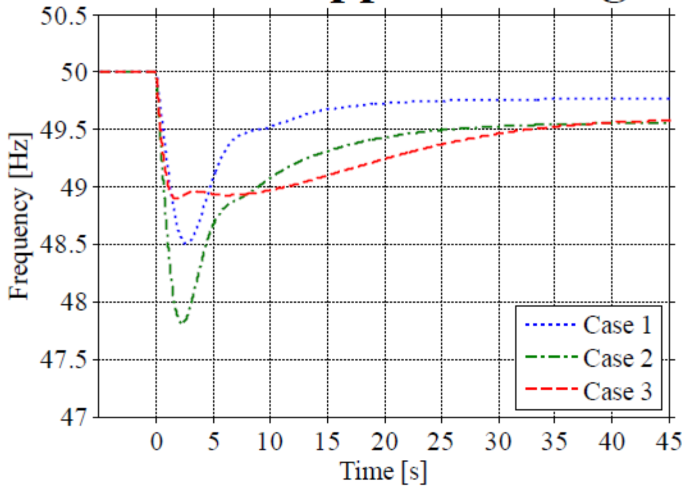
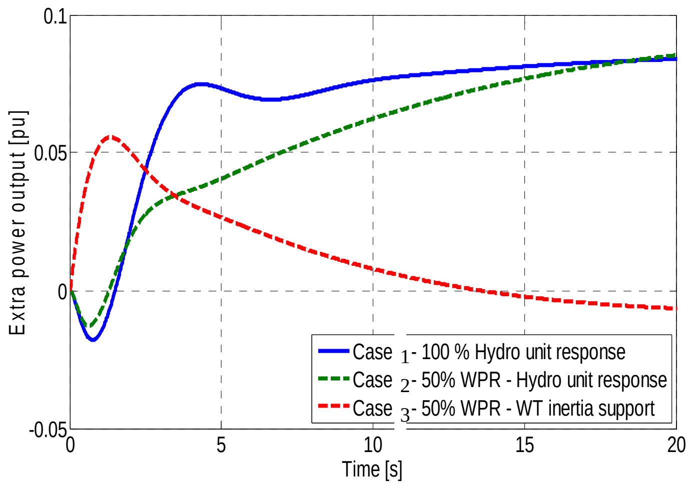
Frequency Responce with and without Wind Power



WT Inertia support strategies





Case 1: 100 % Hydro
Case 2: 50 % WPR without frequency support
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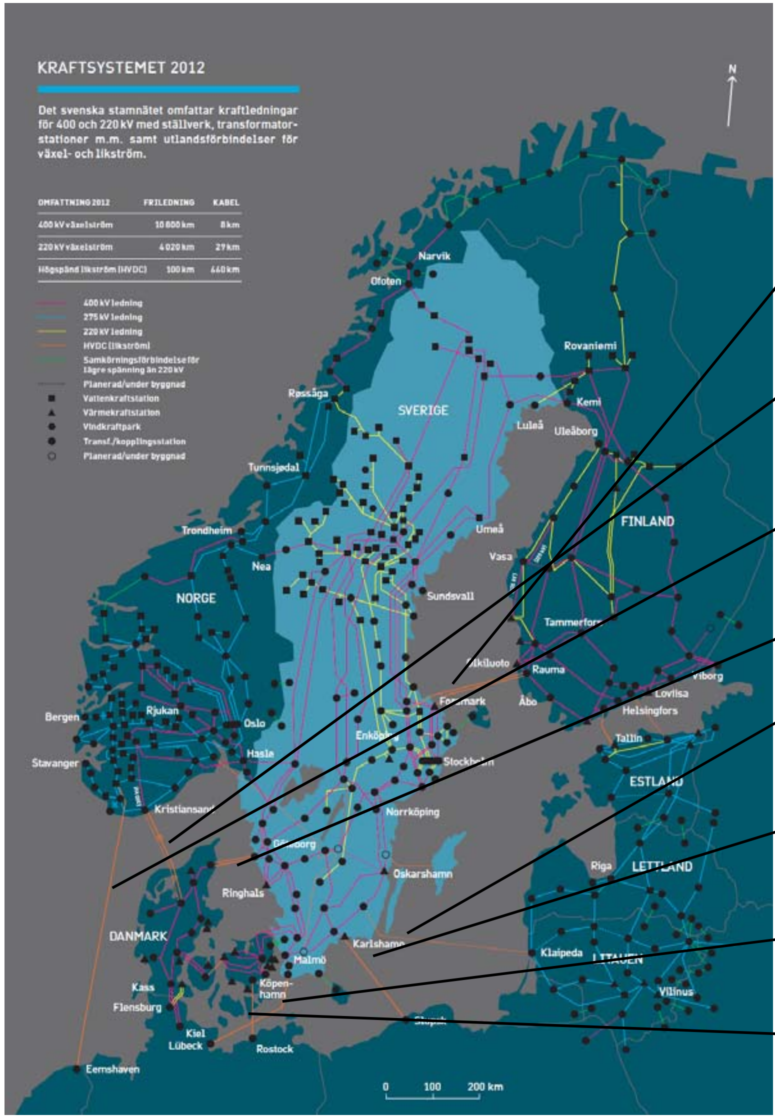
CHALMERS

Σ=51 TWh
Σ =6500 MW



Power: 550 MW, 800 MW
Energy: 11,5 TWh

Power: 250, 440, 700 MW,
Energy: 12 TWh

Power: 700 MW,
Energy: 6 TWh

Power: 600 MW,
Energy: 5 TWh

Power: 700 MW,
Energy: 6 TWh

Power: 600 MW,
Energy: 5 TWh

Power: 600 MW,
Energy: 5 TWh

Power: 600 MW,
Energy: 5 TWh

AVANCEZ

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CHALMERS