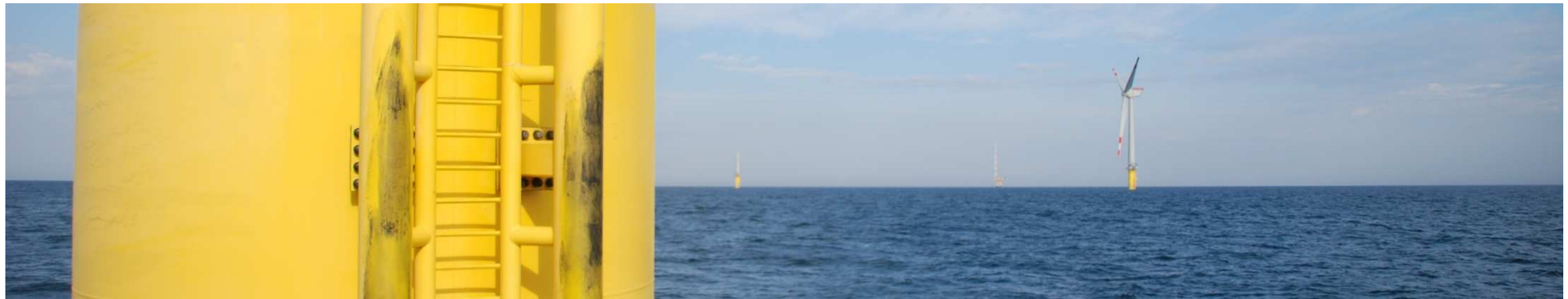


The Delft Offshore Wind Turbine Concept (DOT)

A hydraulic solution for offshore wind energy

December 2009



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Current Turbine Technology

General

- Danish concept (3 blades)
- Heavy nacelle
 - Huge gearbox + big generator
 - Huge amounts of switch gear

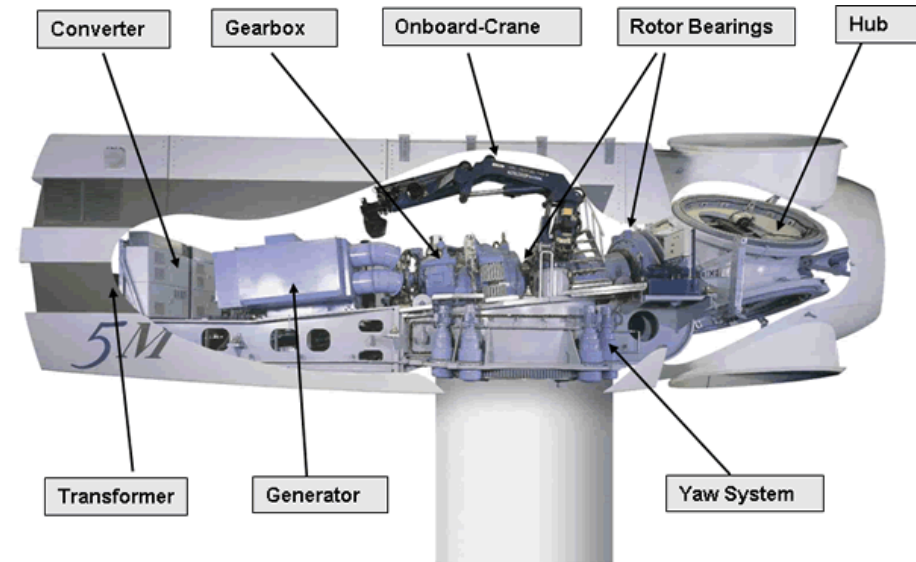
Many components

→ many failures

→ high maintenance

Offshore

- Difficult installation
- Difficult maintenance
- Not yet cost effective without government subsidies



Delft Offshore Turbines (DOT)

TU Delft: step away from incremental improvements

→ Design turbines specifically for offshore

Two main drivers:

- Size
- Cost of energy

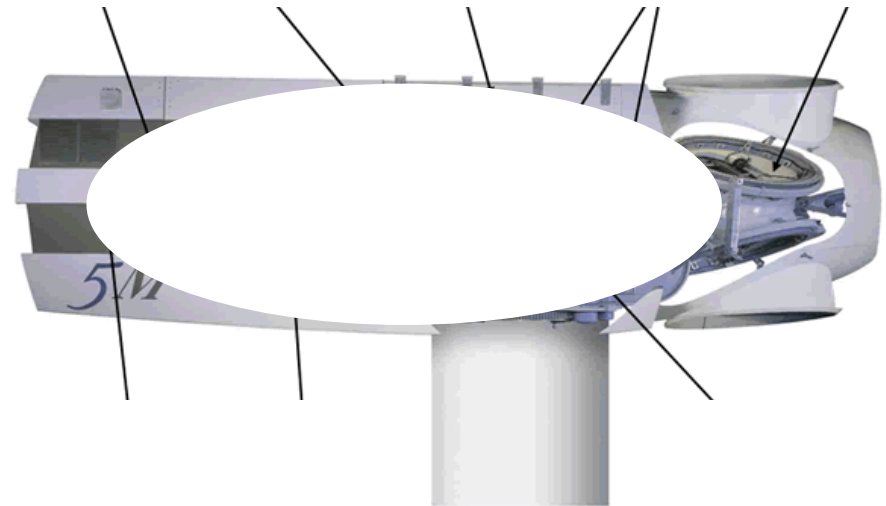
So, let us start by... ?

Delft Offshore Turbines (DOT)

Everything out of the nacelle!

So, we only have:

- rotating kinetic energy
- a point to deliver electrons



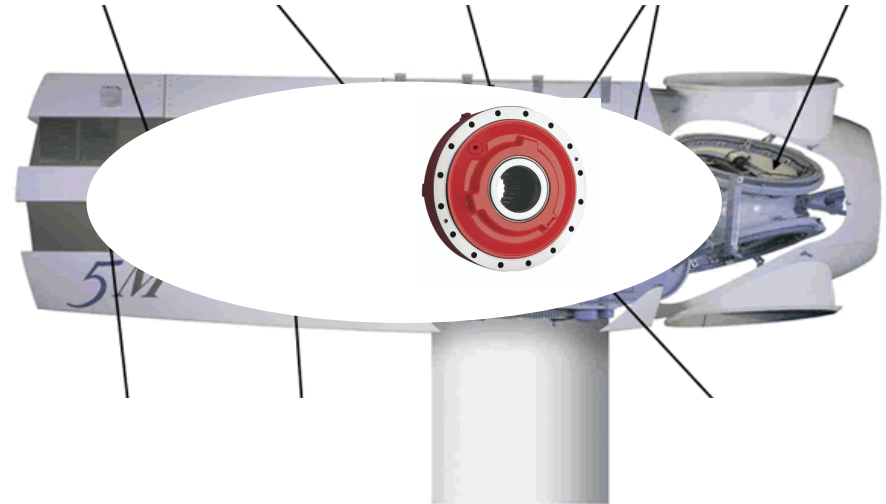
→ Everything in between is for us to design

Delft Offshore Turbines (DOT)

Power Transmission

- Current systems:
 - High top-mass
 - High cost of components
 - Dynamic loads
 - High maintenance

- Solution?
 - use hydraulic power transmission: **we pump!**



Hydraulic energy transfer

Hydraulic Wind Turbines

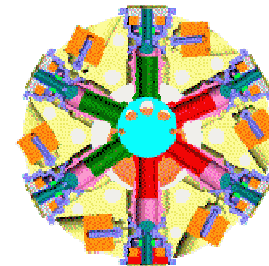


- Advantages

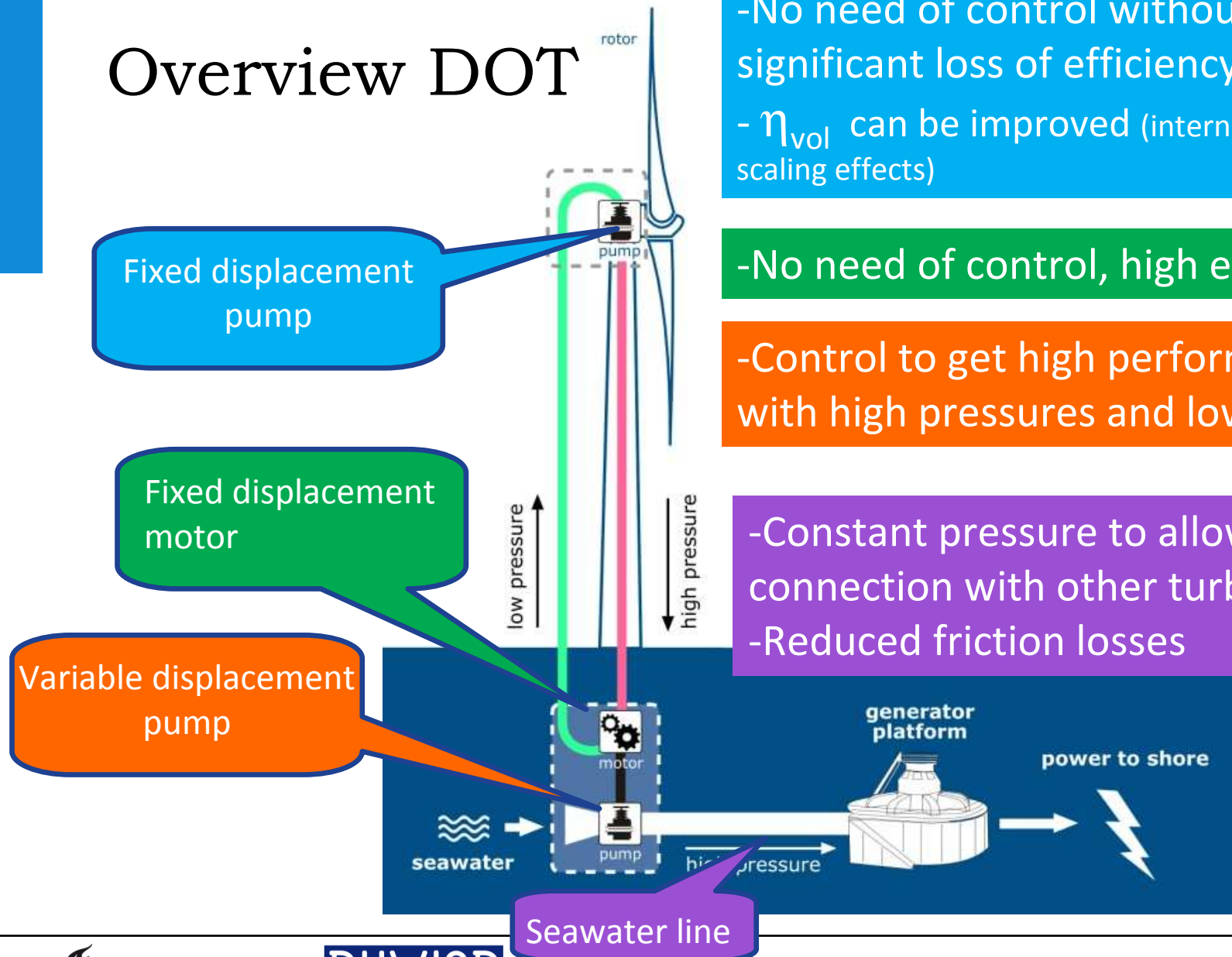
- Gearless transmission
- More robust than mechanical gearboxes
- High power-to-weight ratio
- Damping of dynamic loads
- High reliability/Low maintenance

- Challenges

- High efficiency
- Seawater as hydraulic fluid
- Wide operational range (!)
- Vital components not available (Scaling effects)



Overview DOT



-No need of control without significant loss of efficiency

- η_{vol} can be improved (internal seals and scaling effects)

-No need of control, high efficiency

-Control to get high performance with high pressures and low flows

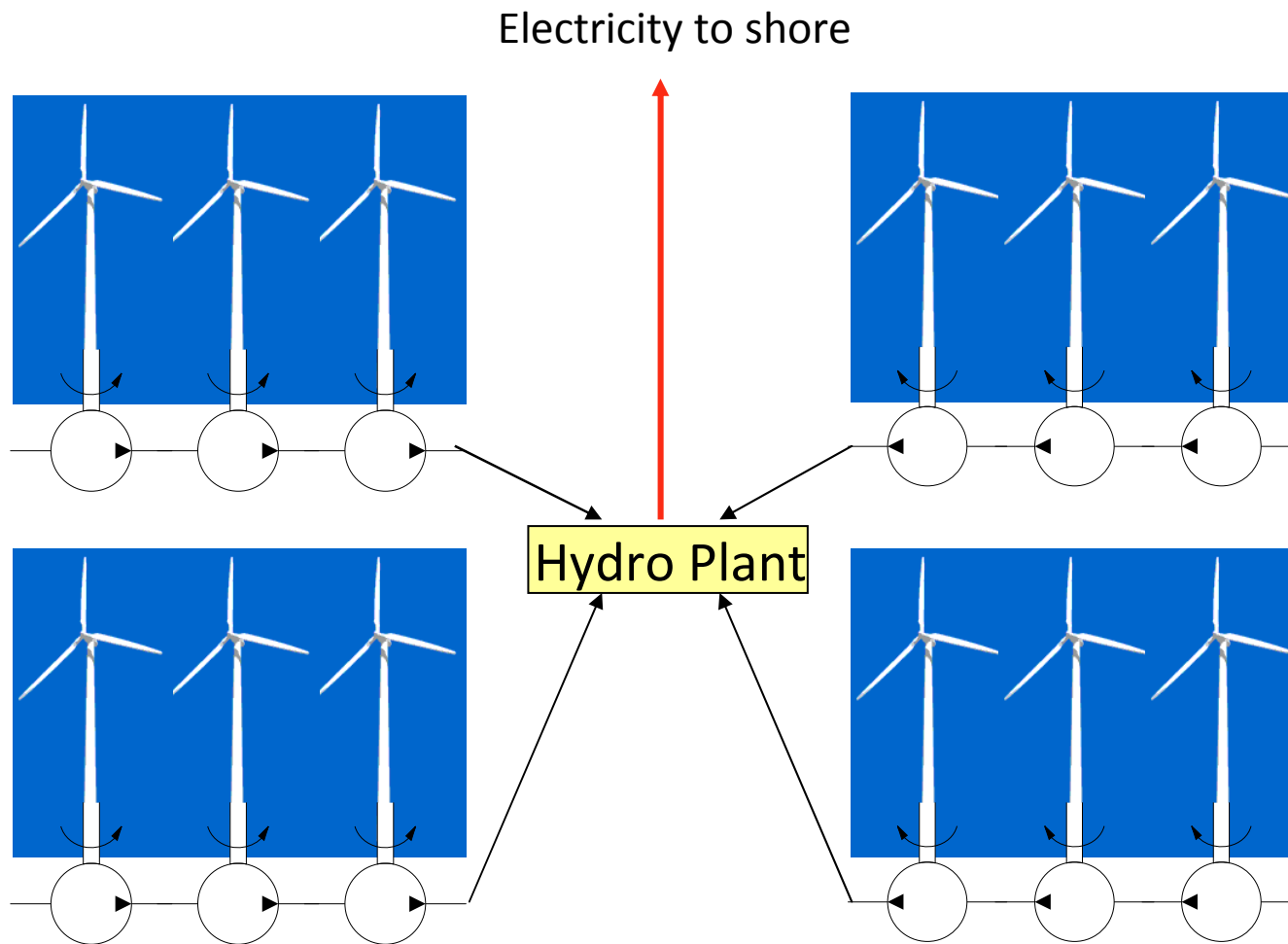
-Constant pressure to allow connection with other turbines
-Reduced friction losses

Fixed displacement pump

Fixed displacement motor

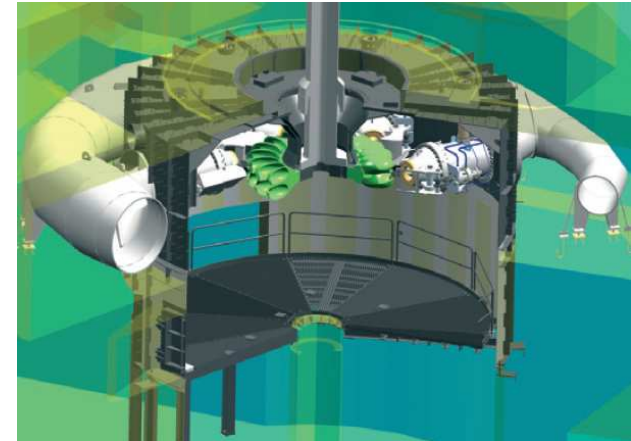
Variable displacement pump

Centralized electricity generation



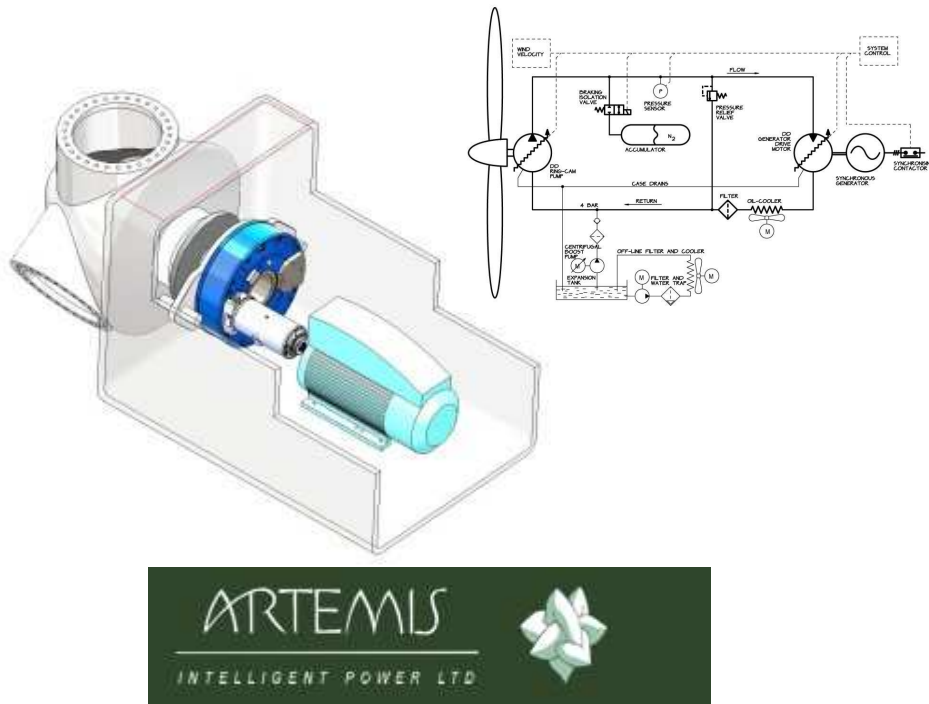
Centralized electricity generation

- Hydraulic turbines
 - Hydro- power plants have the highest operating efficiency of all known generation systems
 - No need of dam or large reservoir
 - Large capacities up to 400 MW per unit
 - High efficiency at partial loads (>90 %)
- Onshore operation and control
 - Largely automated (operating costs are relatively low)
- High Voltage



Hydraulic wind developments

Current hydraulic wind developments (Hydraulic transmission)



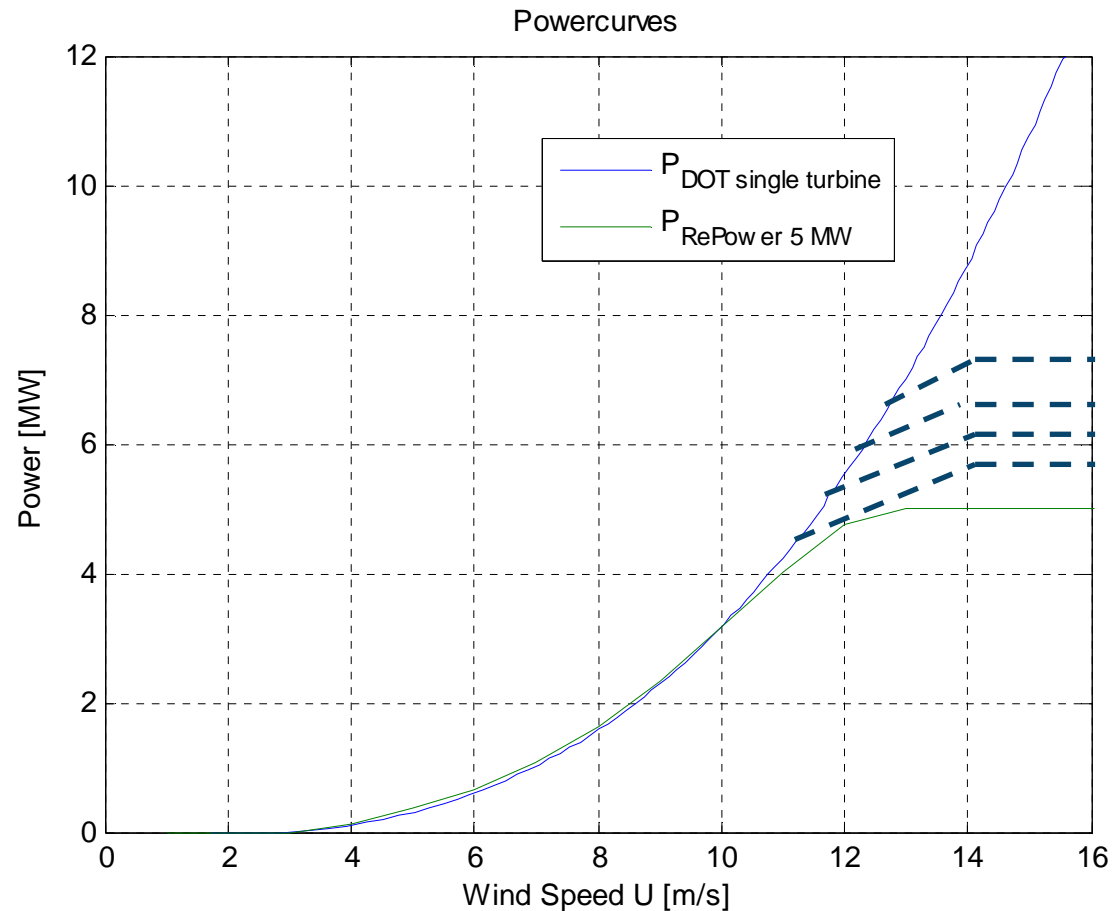
 ChapDrive



Preliminary Results

For a single turbine

- Comparable power compared with a commercial turbine
- Limited by rotor loads

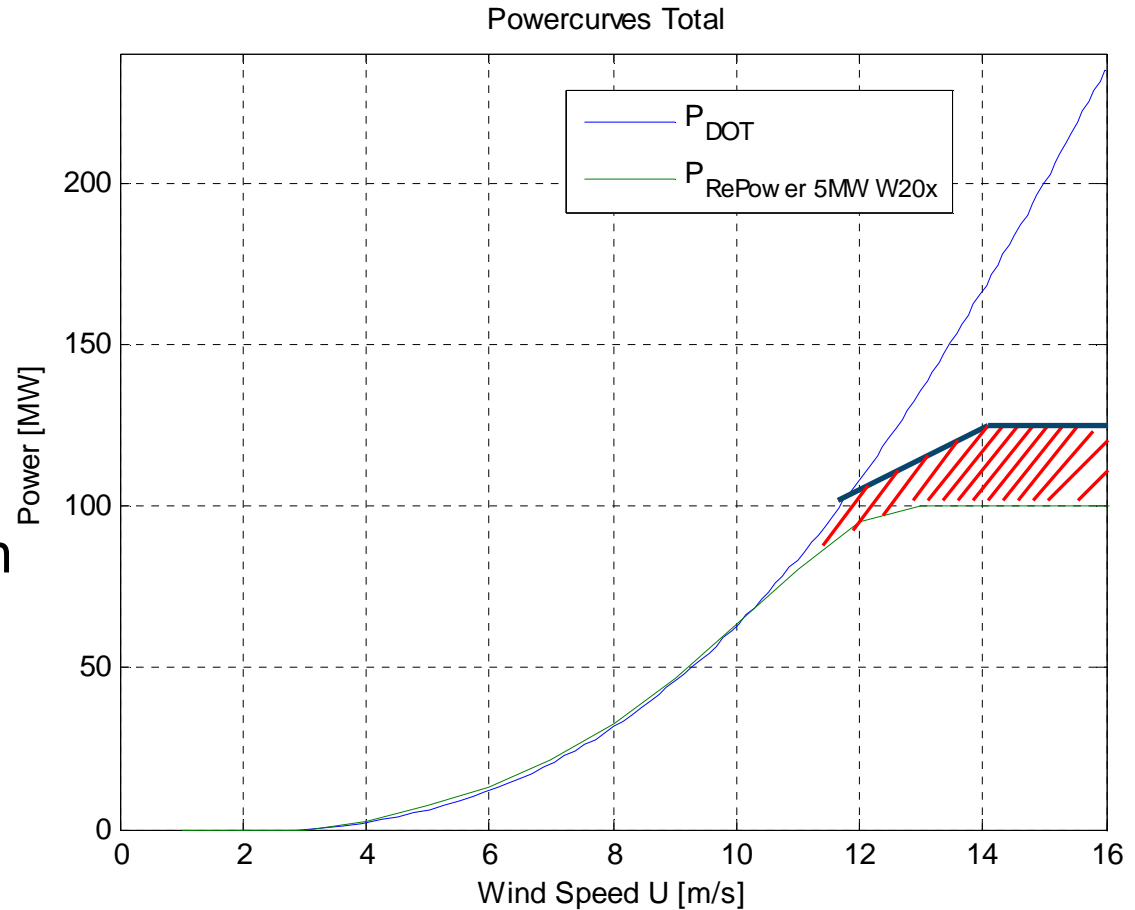


No longer limited by Max torque of individual generators!!

Preliminary Results

For 20x turbines Connected in parallel

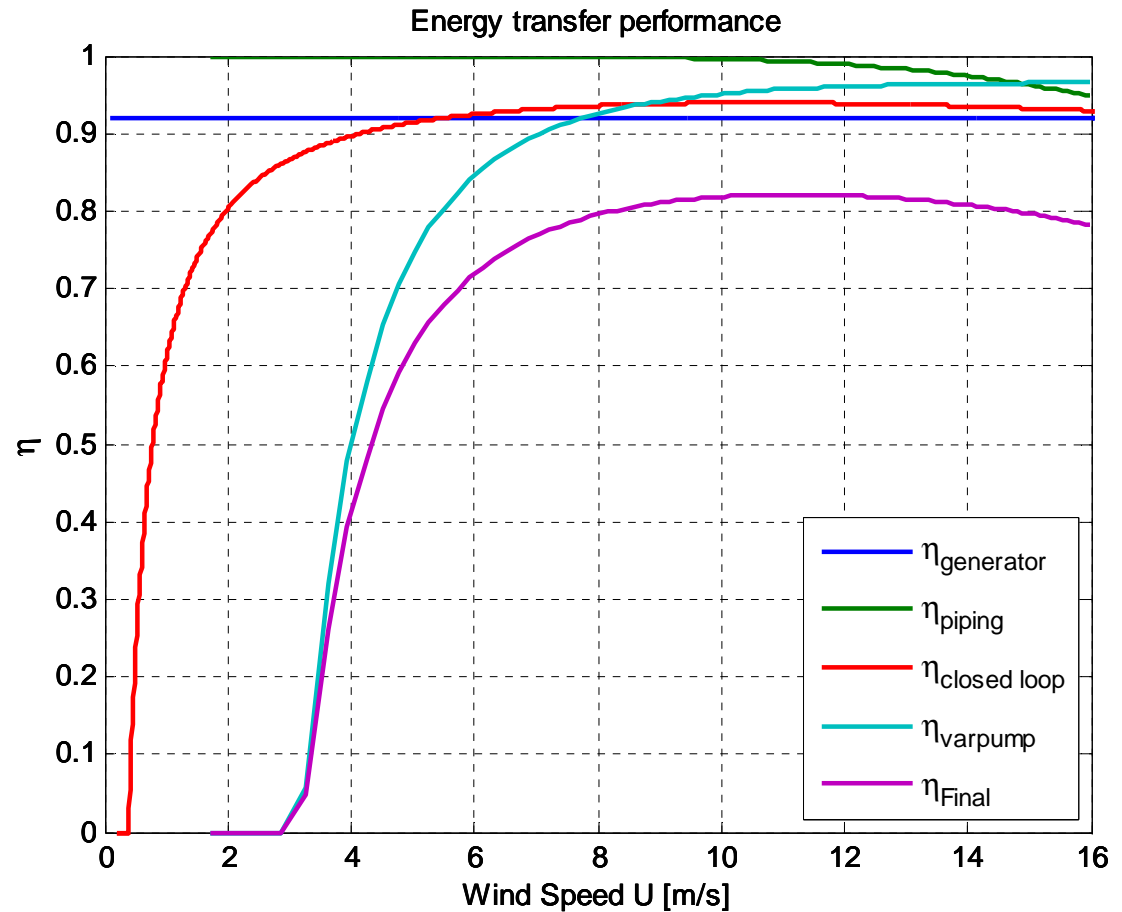
- Lower energy production for low wind speeds
- High potential for high wind speeds



Preliminary Results

Efficiencies

- Main limitation driven by the variable displacement pump performance



Conclusions

- Centralized electricity generation can be possible with hydraulics transmission
- High potential for high wind speeds
- Further analysis in dynamics and control
- Economical study needed
- Challenges
 - Seawater as an hydraulic fluid (wear and corrosion)
 - Availability of components

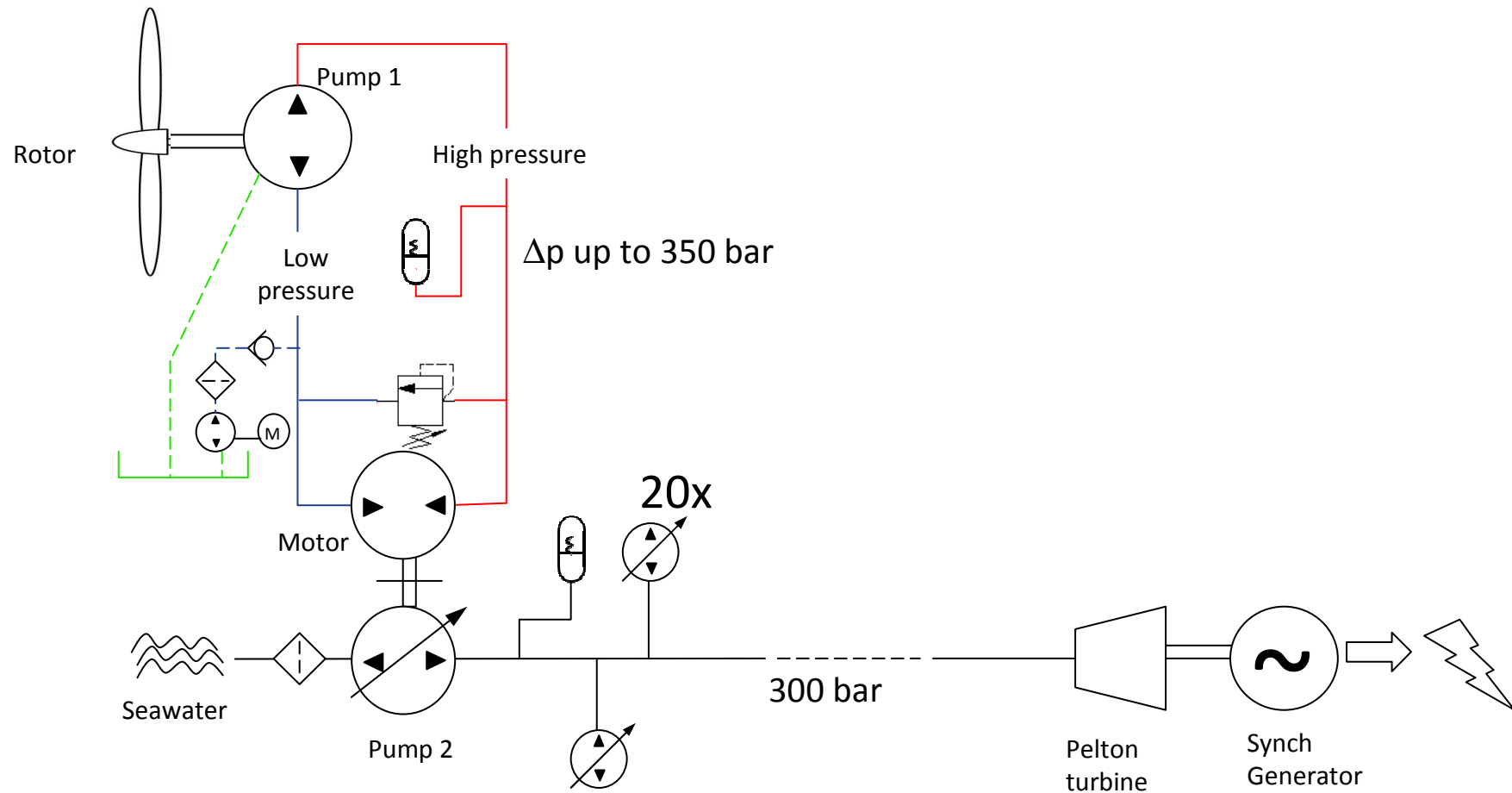
A solution for large wind offshore

Thank you!!

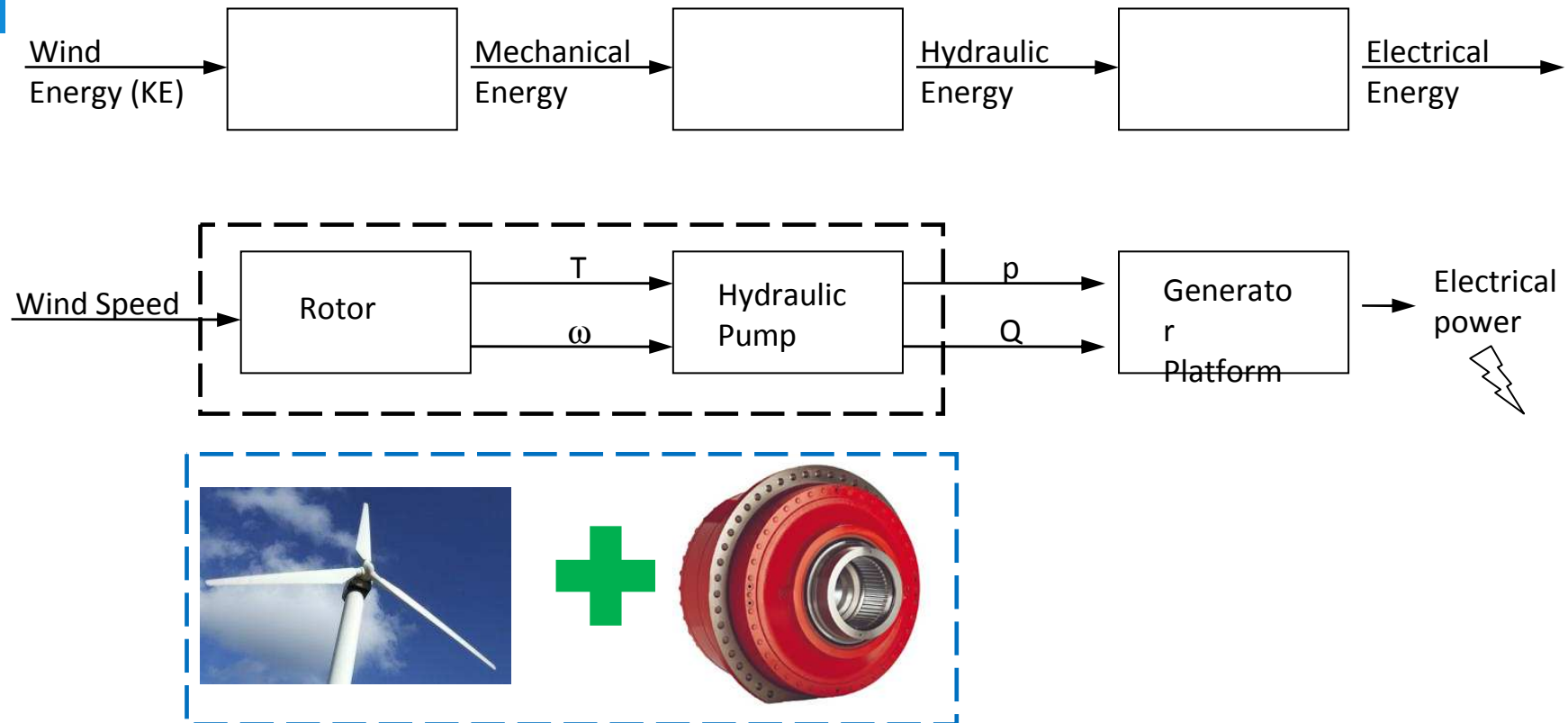
Questions...?

es, we can!

General configuration



Concept of the DOT energy transfer system



Variable displacement pump

