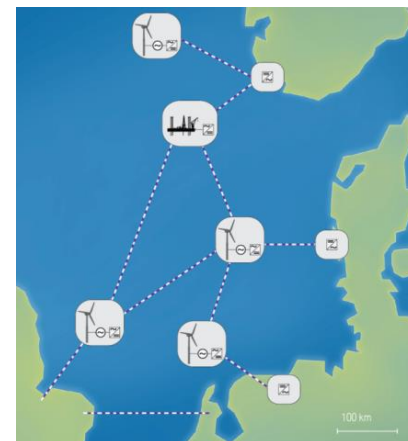


EERA DeepWind'2017

# Progress in offshore wind research and innovation



**John Olav Giæver Tande**

Director NOWITECH

Chief Scientist / Research Manager

SINTEF Energy Research

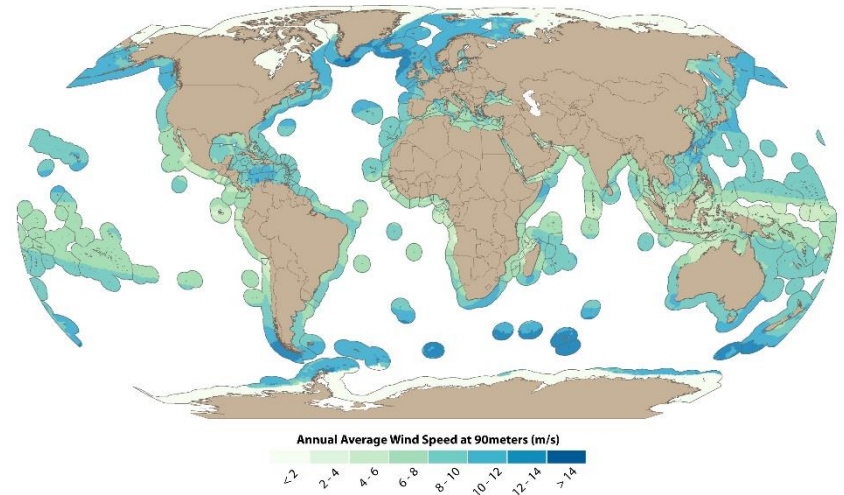
[John.tande@sintef.no](mailto:John.tande@sintef.no)



# Offshore wind is vital for reaching climate targets

- ✓ Currently small compared to onshore wind, but in strong growth
- ✓ Potential to supply 192 800 TWh/y, i.e. ~8 times the global el generation in 2014
- ✓ Can be deployed in proximity to big urban centres
- ✓ Provide long-term security of supply of clean energy
- ✓ Create new employment and industries
- ✓ Low negative environmental impact (WWF)

**Stern Review (2006):**  
**..strong, early action on climate change far outweigh the costs of not acting.**

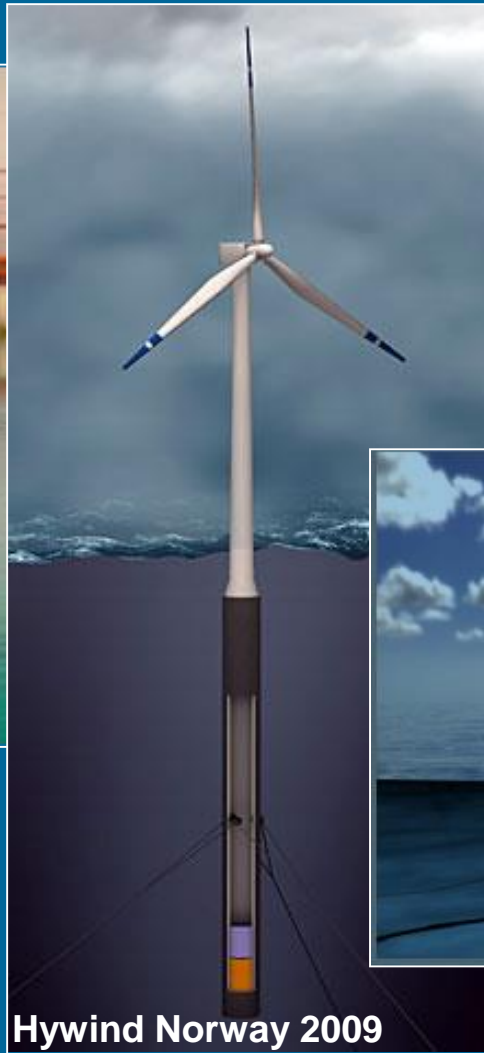


Arent, D. et al (2012) Improved Offshore Wind Resource Assessment in Global Climate Stabilization Scenarios. Technical Report. NREL/TP-6A20-55049

# A great science and engineering challenge!

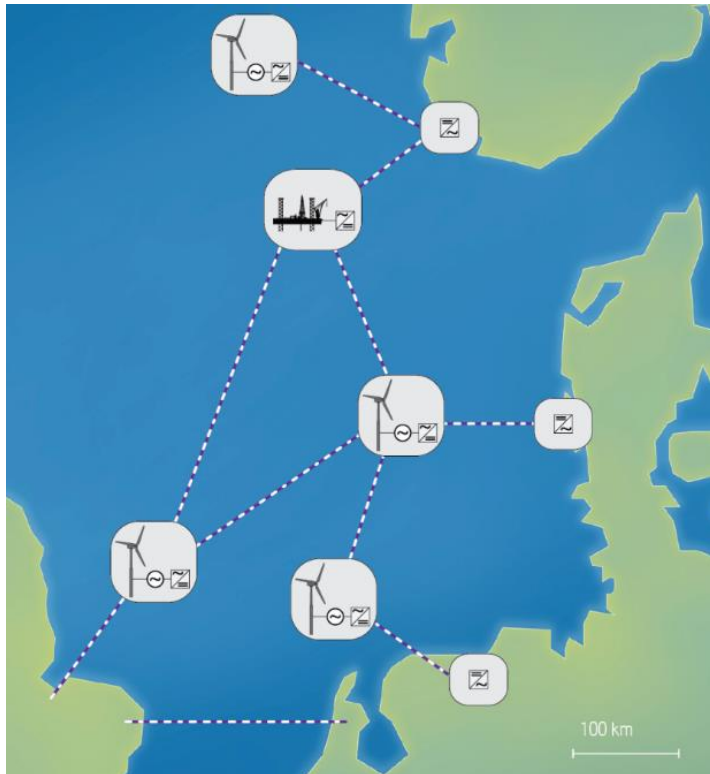


# Exciting development of floating wind



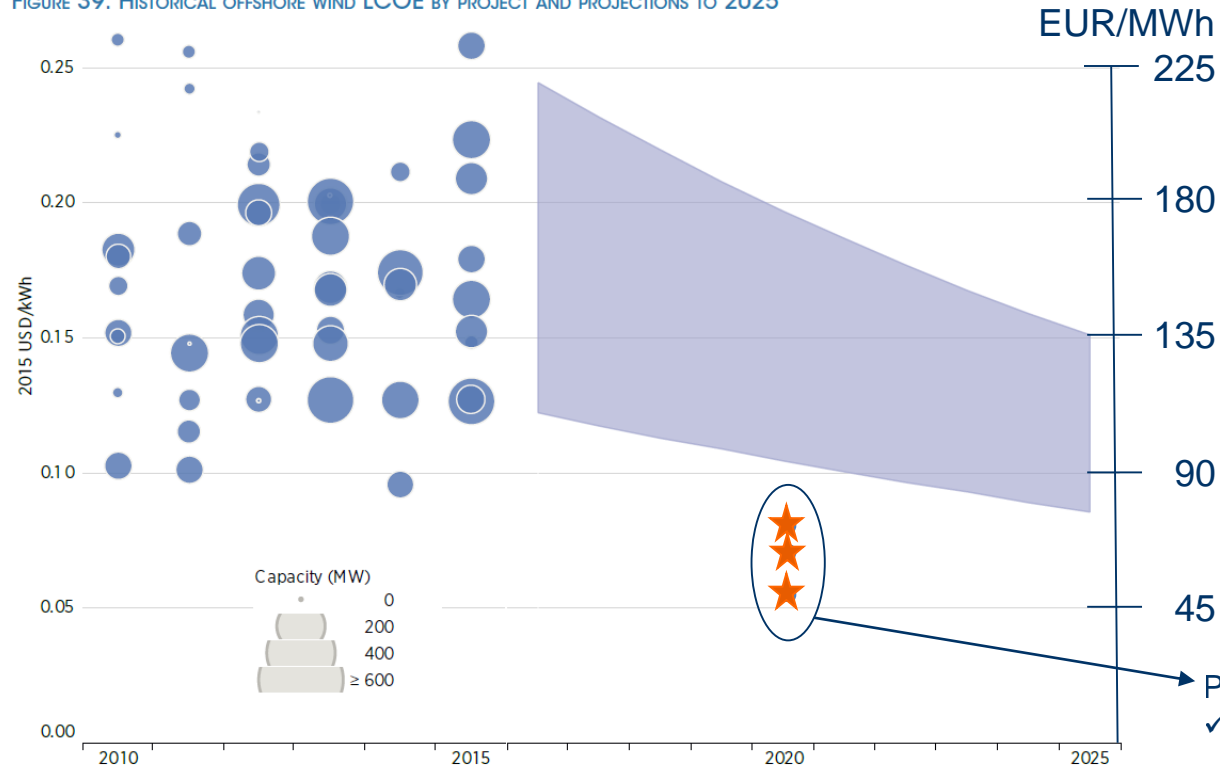


# Moving towards an North-Sea offshore grid



# Offshore wind is approaching grid parity

FIGURE 39: HISTORICAL OFFSHORE WIND LCOE BY PROJECT AND PROJECTIONS TO 2025



Source: IRENA Renewable Cost Database and IRENA, 2016b.

[http://www.irena.org/DocumentDownloads/Publications/IRENA\\_Power\\_to\\_Change\\_2016.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_Power_to_Change_2016.pdf)

Press releases:

- ✓ 72.7 EUR/MWh; Borssele NL, 700 MW, Dong, 5 July 2016
- ✓ 63.8 EUR/MWh; Vesterhav DK, 350 MW, Vattenfall, 12 Sep 2016
- ✓ 49.9 EUR/MWh; Kriegers Flak DK, 600 MW, Vattenfall, 9 Nov 2016

# NOWITECH in brief

- ▶ A joint pre-competitive research effort
- ▶ Focus on deep offshore wind technology (+30 m)
- ▶ Budget (2009-2017) EUR 40 millions
- ▶ Co-financed by the Research Council of Norway, industry and research partners
- ▶ 25 PhD/post doc grants
- ▶ **Key target: innovations reducing cost of energy from offshore wind**
- ▶ Vision:
  - large scale deployment
  - internationally leading

## Research partners:

- ▶ SINTEF Energy (host)
- ▶ IFE
- ▶ NTNU
- ▶ MARINTEK
- ▶ SINTEF ICT
- ▶ SINTEF MC

## Industry partners:

- ▶ CD-adapco
- ▶ DNV GL
- ▶ DONG Energy
- ▶ Fedem Technology
- ▶ Fugro OCEANOR
- ▶ Kongsberg Maritime
- ▶ Norsk Automatisering
- ▶ Statkraft
- ▶ Statoil

## Associated research partners:

- ▶ DTU Wind Energy
- ▶ Michigan Tech Uni.
- ▶ MIT
- ▶ NREL
- ▶ Fraunhofer IWES
- ▶ Uni. Strathclyde
- ▶ TU Delft
- ▶ Nanyang TU

## Associated industry partners:

- ▶ Devold AMT AS
- ▶ Energy Norway
- ▶ Enova
- ▶ Innovation Norway
- ▶ NCEI
- ▶ NORWEA
- ▶ NVE
- ▶ Wind Cluster Norway





## Offshore wind LCOE

# Offshore wind has cost reduction opportunities in multiple areas including scale effects

### Turbines & plant



- Larger turbines and wind farms
- Increased reliability
- Scale effects and industrialisation

### Substructures



- Standardised and optimised offshore foundation design and design criteria
- Industrialised manufacturing

### Transmission



- eBoP optimisation of substation and transmission capex
- Innovative transmission solutions
- Improved grid access

### O&M



- Low OPEX drivetrains
- Turbine and component quality
- Condition monitoring, diagnostics, preventive maintenance

Source: Siemens, MHI-Vestas, MAKE



# NOWITECH is producing excellent results



Successful innovations

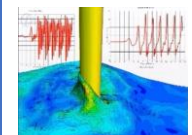
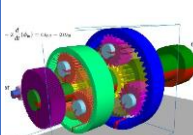
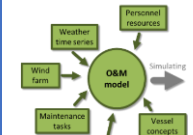
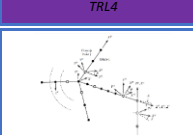


Excellence in research



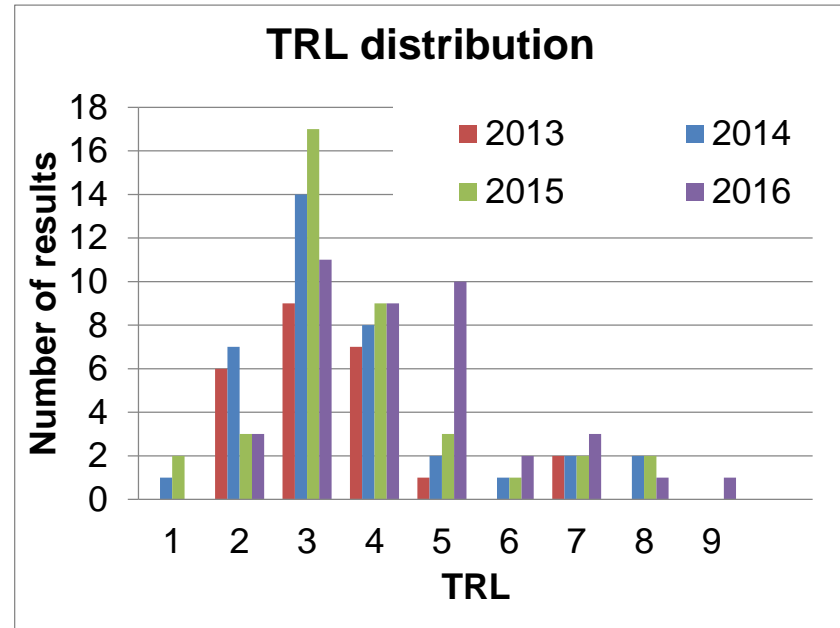
Strong educational program

# 40 innovations in progress

							
3DFloat integrated model TRL7	3DWind park wake model TRL6	INVALS general purpose optimization TRL8	Commercial grade rotor CFD TRL5	Simo-Riflex TRL7	WindOpt TRL4	Real time hybrid model test in ocean basin TRL5	Novel floater TRL5
							
Variational Multiscale Error Estimator TRL3	www.IFEM.no TRL3	www.ASHES.no TRL7	Seawatch Wind Lidar Buoy TRL9	CFD simulation TRL5	Droplet erosion resistant blade coatings TRL3	Droplet erosion testing TRL5	Fleet optimization TRL5
							
Gearbox fault detection TRL3	Gearbox vulnerability map TRL3	Dual layer corrosion protection coatings TRL5	NOWicob TRL6	Remote Presence TRL5	Routing and scheduling TRL2	Thermally sprayed SiC coatings TRL5	Buckling resistant blades TRL3
							
Fatigue damage simulation TRL4	PSST Power System Simulation TRL5	Net-Op network optimization TRL4	Viper Estimate Energy Output from Offshore Wind Farms TRL4	Smartgrid Lab HVDC grid TRL4	Control of multi-terminal HVDC grid TRL4	Wind Supply to Oil & Gas TRL3	Turbine control TRL3
							
Wind turbine electrical interaction TRL4	Network Reduction TRL3	STAS linear State-Space Wind Power Plant Analysis TRL4	PM generator magnetic vibrations TRL4	PM generator integrated design TRL3	Wind farm collection grid optimization TRL2	Long distance AC transmission TRL3	Wideband model of wind farm collection grid TRL2

# Results are migrating to commercial use

- ✓ A total of 40 results are assigned a Technology Readiness Level (TRL)
- ✓ The results include new methods, software tools and hardware products
- ✓ The results are migrating to commercial use, licence agreements, and business developments providing value creation and cost reductions.



**NOWITECH Innovation Award 2016:**  
Thomas Sauder, Erin Bachynski, Maxime Thys, Valentin Chabaud and Lars Ove Sæther (not present), all NTNU/MARINTEK, for their work on real-time hybrid model testing of offshore wind turbines.



# An attractive partner on the international scene

- ▶ Active in EERA, ETIPwind, EAWE, IEA, IEC
- ▶ Heading offshore works within EERA JPwind
- ▶ Steering Committee member of ETIPwind
- ▶ Partner in EU projects, e.g.: Twenties (2009-), DeepWind (2010-), HiPRWind (2010-), EERA-DTOC (2012-), InnWind (2012-), WindScanner (2012-), LeanWind (2014-), EERA IRP wind (2014-), BestPaths (2014-) , Lifes50+ (2015-), AWESOME (2015-),  
+ more in preparation!



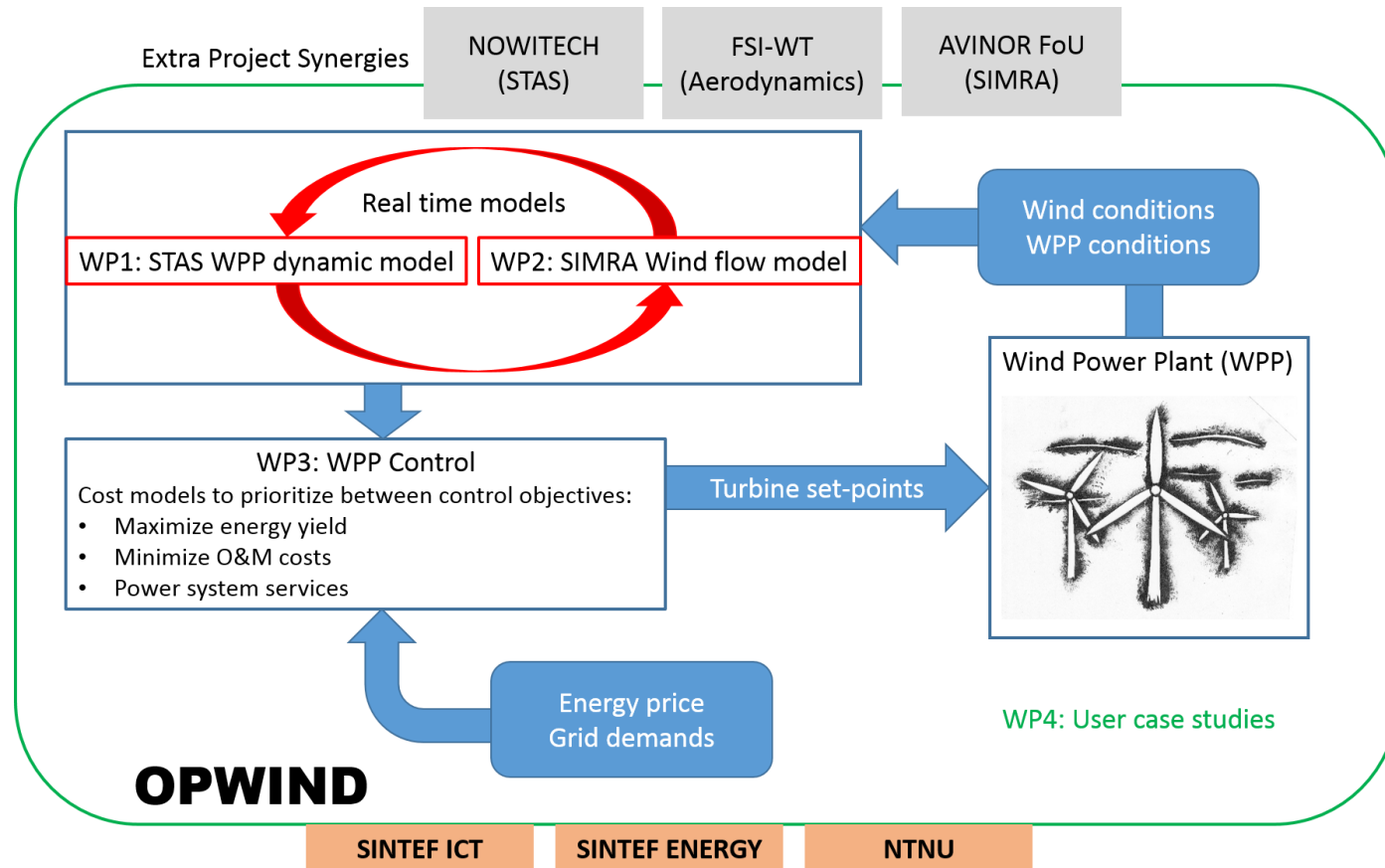
# Life after NOWITECH?



- ✓ Will be great 😊
- ✓ Excellent project portfolio
- ✓ Strong continued engagement
- ✓ Generating new knowledge, tools and innovations making offshore wind better
- ✓ Creating value for clients and society as a whole
- ✓ Contribute to reaching climate targets

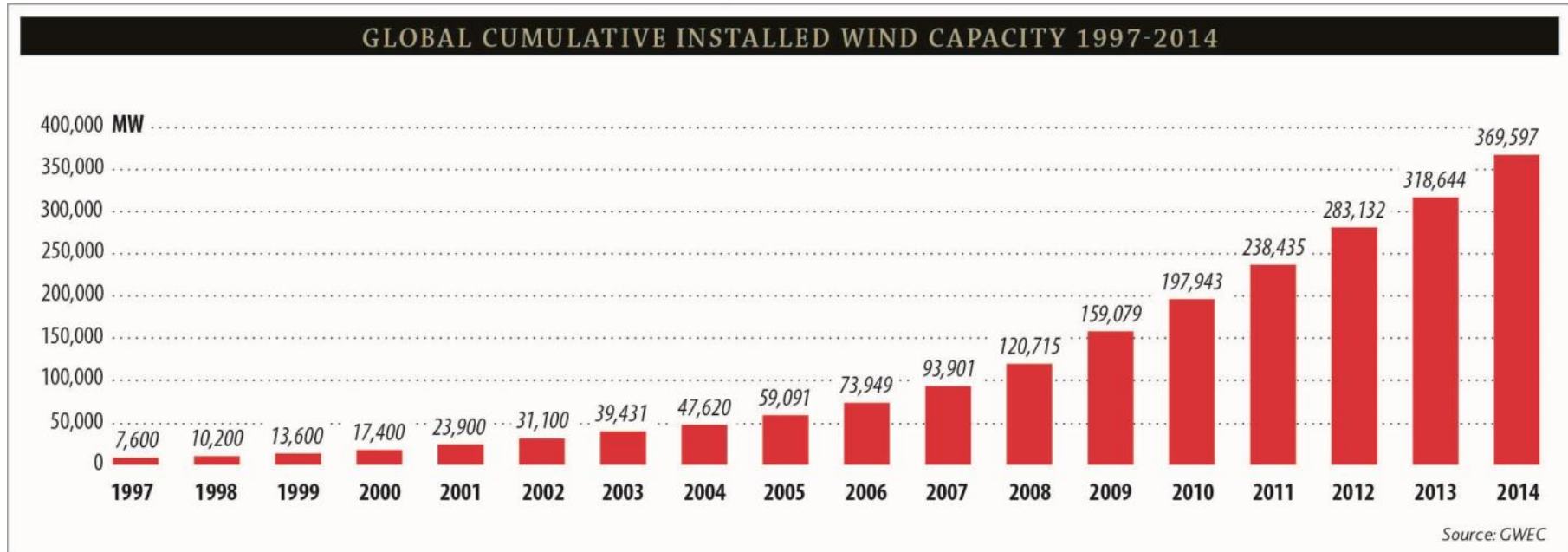
# OPWIND (2017-2020)

*To develop knowledge and tools for optimized operation and control of wind power plants, reducing costs and increasing profitability.*





# And now, a moment of zen ☺



# We make it possible!

[www.NOWITECH.no](http://www.NOWITECH.no)

**EERA DeepWind'2018**  
**15th Deep Sea Offshore Wind R&D Conference**  
**Trondheim 17-19 January, Norway**

**NOWITECH**

Norwegian Research Centre for Offshore Wind Technology

**FTN**  
CENTRE FOR  
ENVIRONMENT-  
FRIENDLY ENERGY  
RESEARCH