

STORRUN WIND FARM



Vintervind 2010

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DONG Energy – Overview

DONG Energy is one of the leading energy companies in Northern Europe

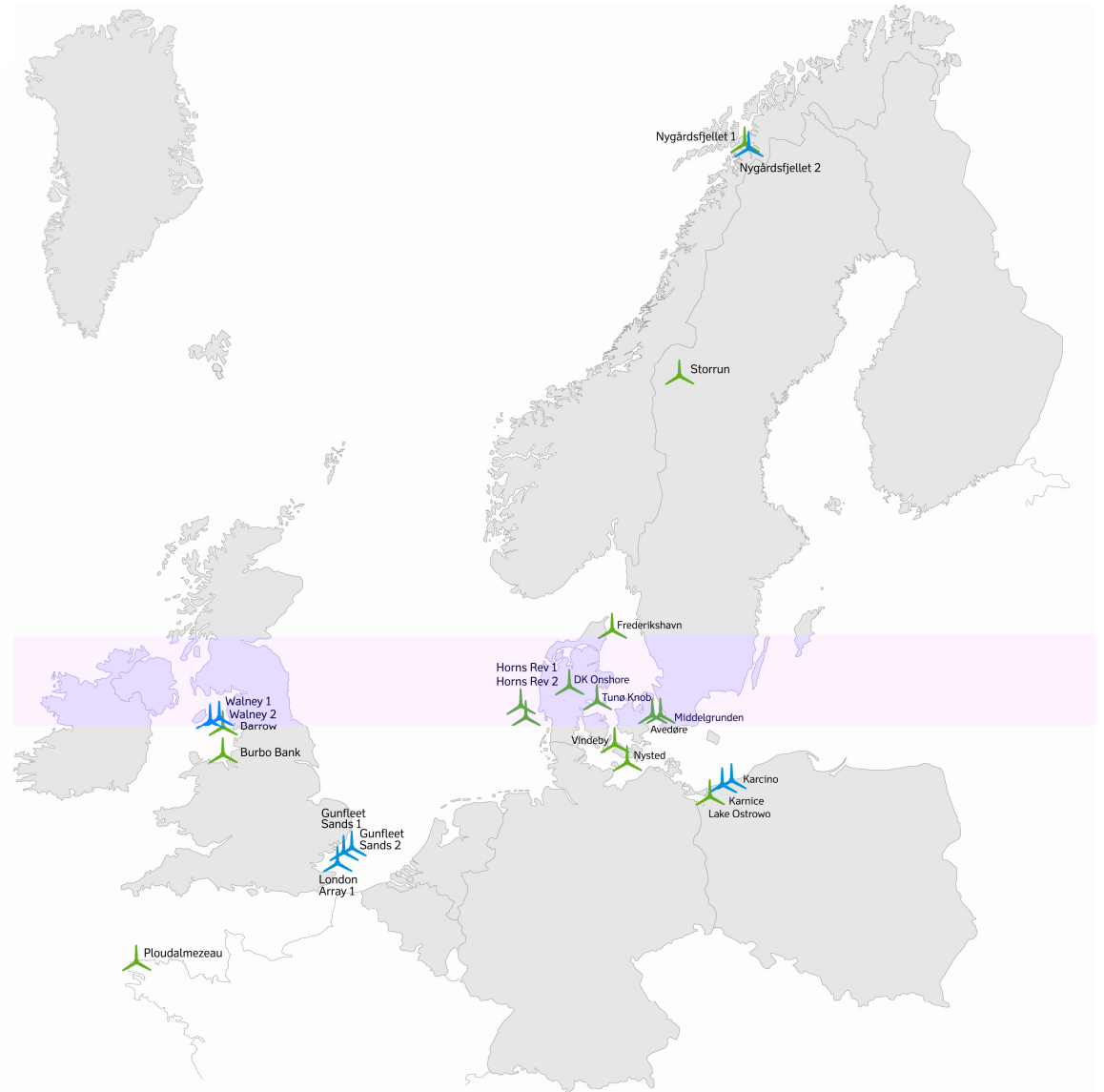
We are headquartered in Denmark. Our business is based on procuring, producing, distributing and trading in energy and related products in Northern Europe

The average number of employees in 2008 was 5,347, an increase of 385 employees compared to 2007



Wind assets in operation

	Total capacity MW	DONG Energy share MW
In operation		
Avedøre	7	4
DK onshore	209	209
Frederikshavn	10	10
Horns Rev 1	160	64
Horns Rev 2	209	209
Middelgrunden	40	20
Nysted	166	132
Tunø Knob	5	5
Vindeby	5	5
Nygårdsfjellet 1	7	3
Storrun	30	24
Barrow	90	45
Burbo Bank	90	90
Lake Ostrowo	31	31
Ploudalmezeau	9	9
	<u>1068</u>	<u>860</u>
Under construction		
Nygårdsfjellet 2	25	13
Gunfleet Sands 1	108	108
Gunfleet Sands 2	65	65
London Array 1	630	315
Walney 1	184	138
Walney 2	184	138
Karcino	51	51
Karnice	30	30
	<u>1277</u>	<u>858</u>
Total capacity	2345	1718



STORRUN – PROJECT OVERVIEW




WHERE ?

- Jämtland, Sweden
- 150 km NW of Östersund
- Scarcely populated area (Fjäll)

WHAT ?

- 12 x 2,5 MW Nordex N90
- Wind regime – approx. 7,2 m/s at 50 m
- Altitude approx. 700 m
- AEP – approx. 80 GWh
- Grid Connection: 220 kV line approx. 3 km from the site
- Civil works: Approx. 8 km roads, 12 crane pads



Projektet stöds af
 Energimyndigheten

DONG
energy

CONSTRUCTION

Construction start	June 2008
Roads finished	October 2008
Cable work finished	April 2009
Foundations finished	June 2009
Turbine erection start	July 2009
Turbines commissioned	December 2009



Cold Climate Modifications

	Normal Version	Cold Climate Version
Low temperature operation range	Down to -20° C Restart at -18° C	Down to -30° C Restart at -28° C
Survival temperature range	Down to -20° C	Down to -40° C



PILOT PROJECT

February 2009 – December 2011

Overall activities:

1. WTG effect on birds in mountain areas
2. Verification of orographic efficiency
3. Icing of wind turbines

Project partners: Nordex AG
LM Glasfiber
Uppsala Universitet
(Mankiewicz AG)



Wind turbine effect on birds in mountain areas

Scope

- Investigate whether wind turbines effect birds in mountain areas
- Part of conditions in environmental permit

Activities

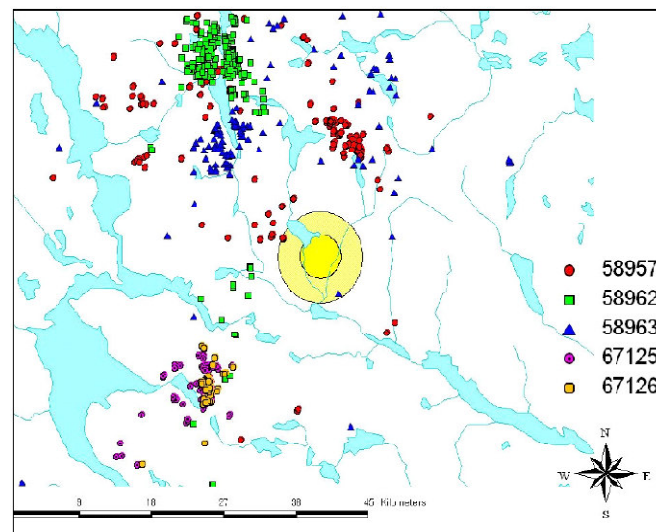
- Field surveys, marking of birds etc.
- Baseline field studies 2003-2008
- Plan effect studies 2010-2011

Financed by

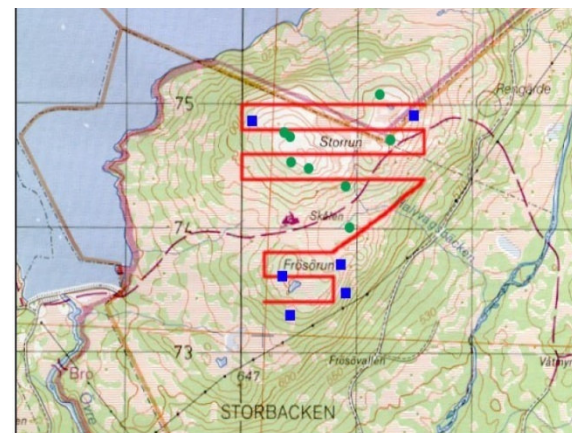
- Statens Energimyndighet (Vindval)

More info on

- www.dongenergy.com/Storrun



Figur 20: Kungsörningarnas aktivitetsområden i området runt boplatserna. Data från både 2005 och 2006 finns med. Cirkelarna anger ett område med 2,5 och 5 km radie runt vindkraftanläggningen.



Figur 15: Resultat av hönsfågelinventeringen i maj 2006. Inventeringen utfördes från syd till nord. Dalripor representeras av gröna cirklar och orrar av blå kvadrater.

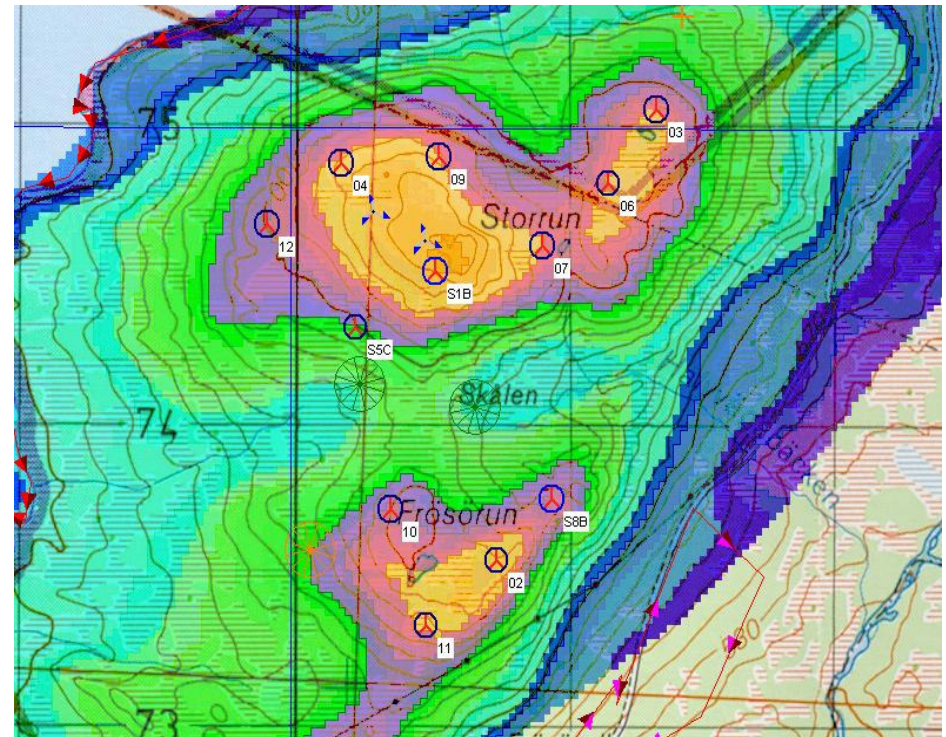
Verification of orographic efficiency

Scope:

- Improved understanding of production estimation in complex terrain = 'fjäll'
- Improved basis for siting of met-masts, i.e. production estimates

Activities

- Analysis of production from 'full-scale test site' depending on wind direction
- Comparison of different models
- Evaluation of influence on error from location of met-masts and terrain features



Orographic efficiency:

$\frac{\text{WTG actual mean production}}{\text{WTG calculated production}^*}$

*at met-mast location

Icing of wind turbines

Scope:

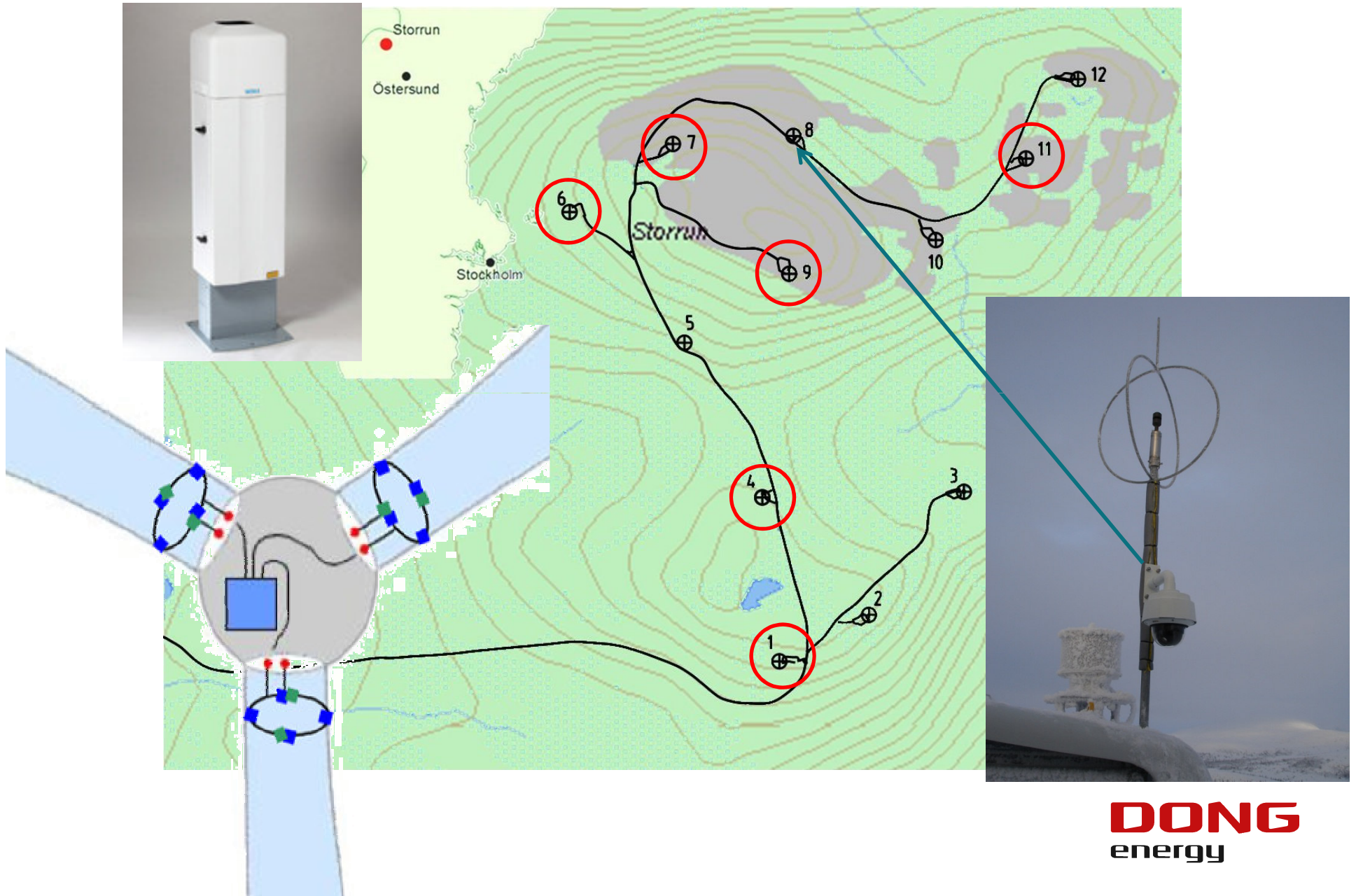
- Improved adjustment for icing losses in production estimates
- Reduced production loss due to icing of blades

Activities:

- Determine extent of icing problems
- Calculate and validate estimates of production loss
- Testing of anti-icing coating
- Testing of blade monitoring systems
- Optimization of start-stop procedures
- Model loads of blade loads



Icing instrumentation



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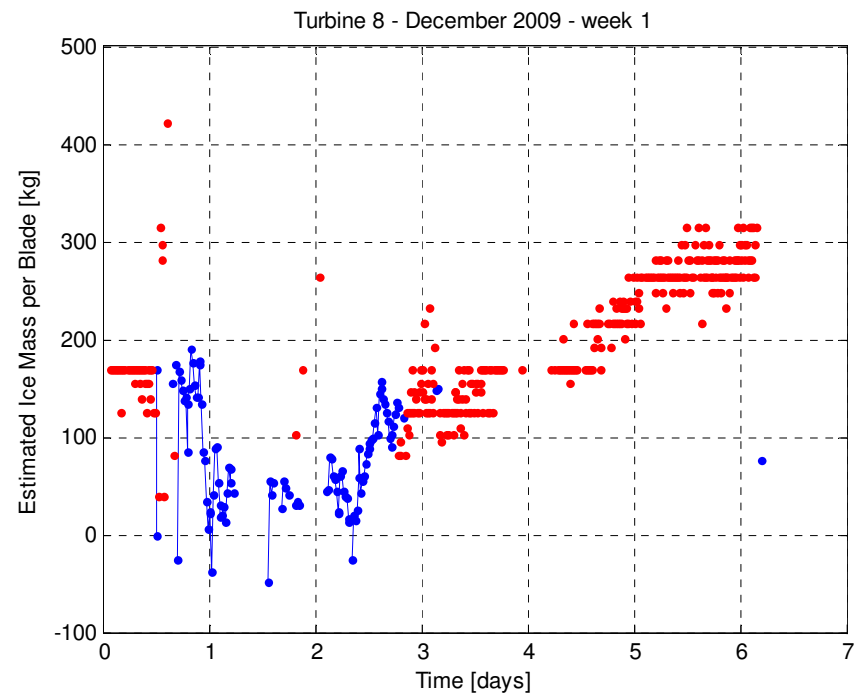
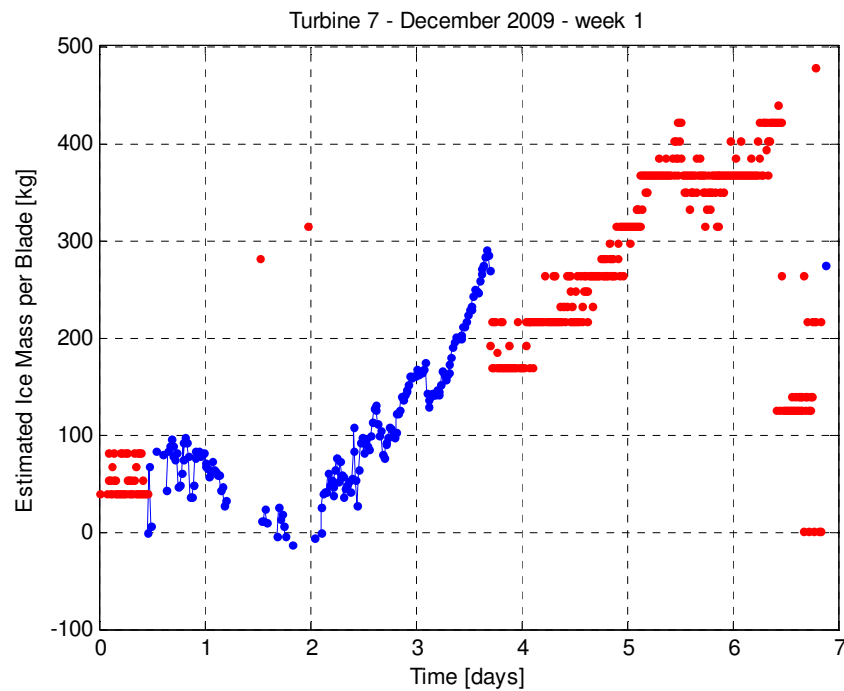


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Preliminary results

- Significant periods of icing since end October
- Min. 5-10% total production loss – this year!



Future work

Analysis

- a) Further evaluation of anti ice coating
- b) Evaluation of production losses
- c) Better understanding of the conditions under which icing occurs
- d) Loads during icing

Implementation

- e) Other means of minimizing/removing ice
- f) Operation strategy for minimizing losses due to icing
- g) Implementation of the ice detection system with the WTG controller



THANK YOU FOR THE ATTENTION

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