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Facilitating energy storage to allow high penetration of variable renewable energy

Minutes of Danish national stoRE workshop

7th of November 2013, Trinity course center at Energinet.dk

Co-funded by the Intelligent Energy Europe Programme of the European Union

Acknowledgements

This report has been produced as part of the project “Facilitating energy storage to allow high penetration of intermittent renewable energy”, stoRE. The logos of the partners cooperating in this project are shown below and more information about them and the project is available on www.store-project.eu

The work for this report has been coordinated by EMD International A/S

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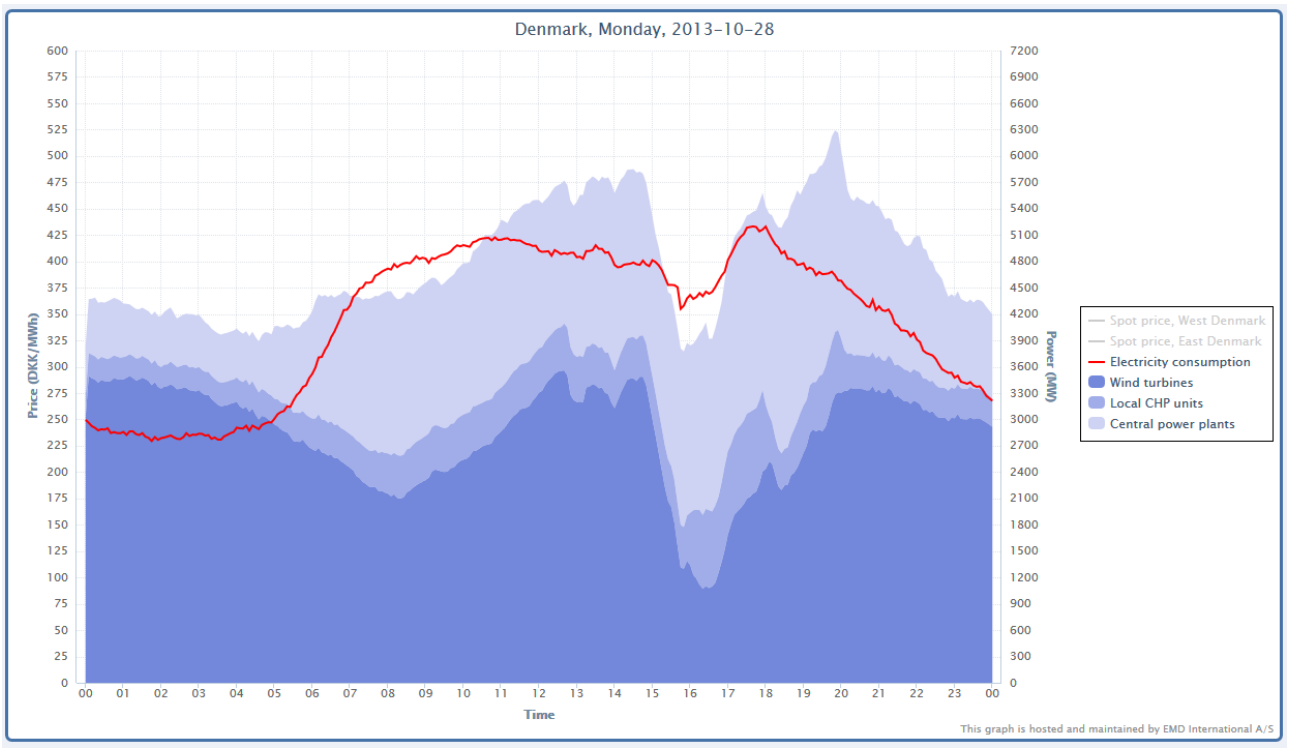
Extreme weather conditions surrounding the work shop

The weather conditions in Denmark a week before the work shop certainly showed a good example of needed electrical capacity (e.g. from electricity storage) when integrating fluctuating productions from renewable energy sources.

A storm passed Denmark 28th of October. The wind power generation dropped from 3,600 MW to 1,088 MW in several hours since the turbines automatically stops at 25 m/s, to be seen at www.emd.dk/el.



All available power generation in Denmark was asked to go into force majeure mode.

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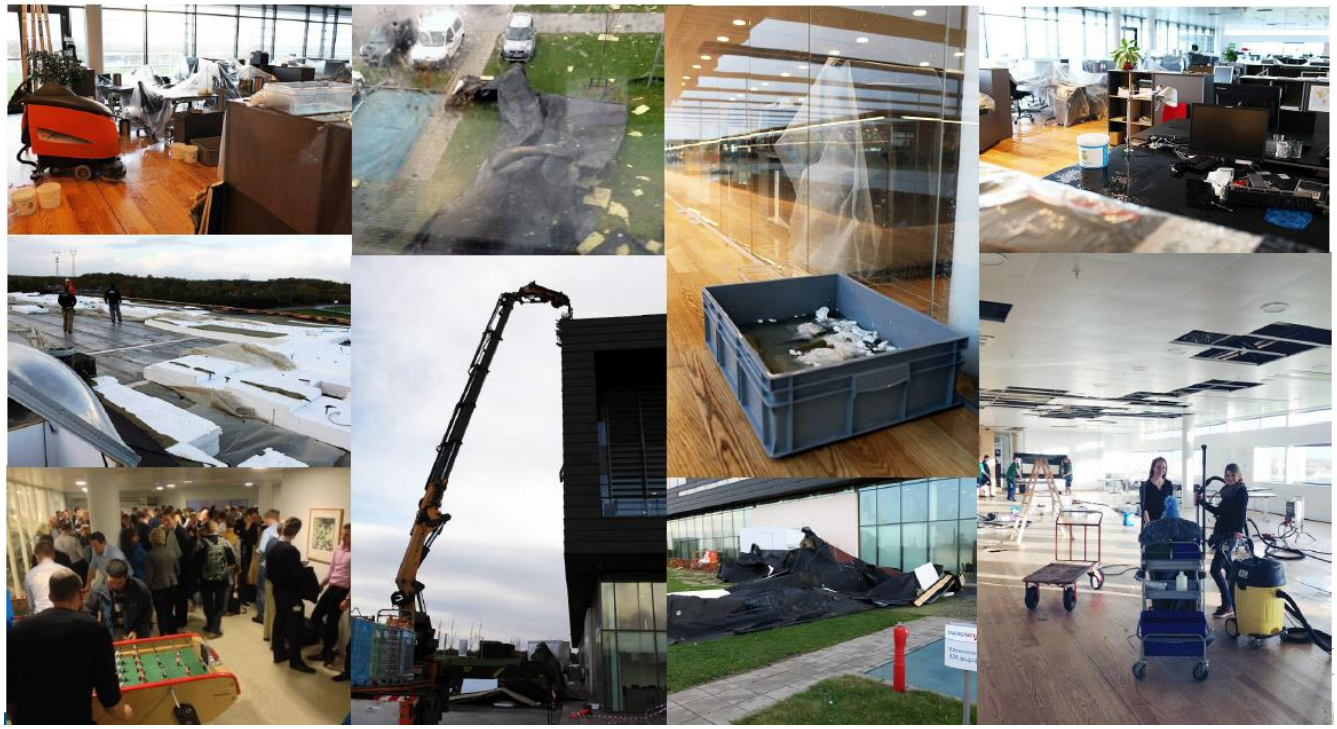
The Energinet.dk head quarter in Fredericia was sincerely damaged, since 1/3 of the roof disappeared, and heavy rain caused severe water damages.

The main control room at the head quarter was close to point of evacuation, and for three hours the entire building (except the control room) was evacuated to the basement.

ENERGINET.DK

The Energinet.dk building was not robust!

Pictures showing the result of the October 28th 2013 storm



Pictures from the normal situation of the head quarter

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The minutes from the workshop

The workshop started with a welcome by Anders N. Andersen, which explained why the workshop had been moved from the head quarter of the Danish Transmissions System Operator, Energinet.dk, due to the storm.

After this welcome the Danish Transmissions System Operator, Energinet.dk, had two presentation concerning the Danish need for electricity storage with increasing amount of wind energy in Denmark, presented by Kim Behnke & Jeannette Møller Jørgensen from Energinet.dk. These two presentations can be downloaded from http://www.store-project.eu/en_GB/consultation-denmark.

Anders N. Andersen presented the ongoing works in the stoRE-project. He mentioned the initial list of barriers for electric storage in Denmark and list of barriers for electric storage in Norway, to be seen at http://www.store-project.eu/en_GB/consultation-denmark.

The reason for bringing in Norwegian PHS is that a larger expansion of PHS in Norway will affect the economy in Danish CAES and that in Denmark Norwegian PHS is widely considered as a better solution. Hereto comes that a large PHS in Norway recently (2007) has been designed and that an approval application was submitted. The status is now that this application is withdrawn and the project is waiting for better regulatory conditions.

Important barriers/questions concerning Danish CAES is amongst others:

- Would it be likely for a CAES plant to obtain approval/concession under the Danish underground act?
- Would it be possible to be exempted from added Public Service Obligation electricity fee (PSO-fee) for electricity bought for storage?
- Would it be possible to be exempted from added electricity tax for purchase if the electricity is bought for storage?

Important barriers/questions concerning Norwegian PHS is amongst others:

- Unclear government regulation concerning compensation for operating pumped hydro storage station.
- How to overcome the lack of local acceptance
- How to satisfy regional authorities request for influence and share in the economic pie.

Tomas Söderlund from Powerquest in Sweden presented his considerations about if further development of wind energy in Denmark is promoting the establishment of pump back and pumped hydro in Sweden. His presentation can be found at http://www.store-project.eu/en_GB/consultation-denmark.

After the presentations, a fruitful discussion at the workshop followed in plenum.

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Amongst others the work of http://www.ease-storage.eu/ was mentioned. It was suggested that the value of distributed storage should also be investigated. Energy storage as Power2Gas should be considered. And it was agreed upon that energy storage in Denmark were deeply affected by the situation in surrounding countries.

Examples of feedback from the consultation process

In this section is mentioned examples of feedbacks that has been received from the consultation process until know. These feedbacks will be used for revision of the list of barriers for electricity storages and ways to overcome them will be suggested, including recommendations for revision of the regulatory and market frameworks.

The following 5 questions have been the starting point for the dialogue with stakeholders.

- *Synes du vi har brug for mere ellagring i det danske energisystem? hvorfor eller hvorfor ikke?*
- *Norsk vandkraft, f.eks. udvidet med Pump Back, kan i væsentligt omfang deltage i integrationen af dansk vindmølleproduktion. Har du mødt væsentlige grunde til at der i Danmark herudover skal etableres Compressed Air Energy Storage (CAES) i danske salthorste?*
- *Hvad ser du som de væsentligste barrierer for at der etableres CAES i Danmark?*
- *Hvilken lovgivning finder du skal ændres for at der kan etableres CAES i Danmark?*
- *Hvilke barrierer ser du for at Danmark i væsentligt større omfang kan anvende norsk vandkraft til at integrere dansk vindmølleproduktion?*

These questions is about if the stakeholder consider that Denmark needs more electricity storage, if Norwegian hydropower is sufficient and conceived barriers.

Statkraft from Norway has contributed with the following viewpoints:

Fra vår side er det et poeng å få frem at store vannkraftmagasiner i Norge kan bidra med fleksibilitet inn i kraftsystemet selv uten investeringer i pumpekraft. Magasinene er store nok til at vi kan holde igjen store mengder energi og importere fra Danmark når det er et overskudd der, også eksportere til Danmark når det blåser mindre. Fordi magasinene er så store betyr det bare at vi holder igjen produksjonen og tømmer vannet saktere ved behov (uten at vi trenger pumper for å fylle opp med vann i mellomtiden). Hvordan utvekslingen skjer vil være avhengig av prisforskjeller og overføringskapasitet (kabler). Skal vi benytte denne muligheten bedre er det behov for enda bedre overføringskapasitet mellom Norge og Danmark enn det er i dag.

Til spørsmålet du stiller i tittelen er svaret: Gitt at det fører til større prisforskjeller mellom

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peak og off-peak i Norge, så kan det bidra.

Jeg håper at StoRE prosjektet tar med seg at stor vannkraft med store magasiner kan bidra med lagring og fleksibilitet også uten pumper. Om ikke annet så bør det tas med i en anbefaling for videre arbeid, ettersom det ikke er en del av mandatet til prosjektet.

In this viewpoint Statkraft put forward that there is that much water in the reservoirs of Norwegian hydro power plants, being able to integrate big amounts of wind productions without installing pump back.

Other examples of feedback from the consultation process is shown below:

På sigt forventer vi, at der vil være et øget behov for fleksibelt elforbrug og produktion. Et elsystem med stigende mængder fluktuerende produktion vil som udgangspunkt have et større behov for øget værdiudnyttelse af billig strøm, ligesom der kan forventes at opstå flere perioder hvor elprisen er relativt høj. Udskydning eller frakobling af elforbrug kan i denne sammenhæng også ses som en form for ellagring, ligesom traditionel elproduktion på termiske værker stadig vil kunne bidrage i perioder med høje elpriser. Deciderede ellagringsteknologier, såsom CAES, mener vi skal konkurrere i de forskellige elmarkeder med disse andre former for adaptivt forbrug/produktion.

In this feedback is suggested that demand side management shall be considered on equal term with CAES.

Generelt kan der høstes mange fordele ved køb og salg af el på tværs af landegrænser, og derfor vil danske anlæg som udgangspunkt konkurrere i internationale markeder, såsom NordPool Spot.

Cross boarder trading shall be promoted.

Der kan dog være forskellige hensyn, såvel tekniske som politiske, som gør, at man på sigt kan vurdere det hensigtsmæssigt at bibeholde en vis andel indenlandsk produktion. I den betragtning vil et CAES-anlæg i Danmark i princippet være ligeså attraktivt som andre typer teknologier placeret i Danmark.

Jeg synes det er væsentligt i forhold til at skabe en balance mellem udlandsforbindelser og egen elkapacitet i Danmark. Det er væsentligt at vi ikke binder hele vores energisystem op mod udlandet. I krisesituationer vil der sandsynligvis finde en slags protektionisme til nationale forsyningssikkerhed, sættes før eksport af energi.

Denmark should in the future have own electrical capacity – CAES could be a part of this national capacity.

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Såfremt der er lovgivning som af den ene eller anden årsag uretmæssigt belaster CAES eller andre ellagringsteknologier fra at deltage på lige fod med de øvrige elforbrug/elproduktionsteknologier, kan der være et behov for at se på dette.

Regulatory barriers for CAES should be analyzed.

Primært kapacitetsbegrænsninger på udvekslingsforbindelserne mellem Danmark og Norden, som dog udbygges med Skagerak 4-kablet til idriftsættelse ultimo 2014.

Limited interconnectors is a problem for the exchange of electricity with Norway.

Jeg synes dog det er fint, som et F&U projekt, for at videreudvikle CAES. CAES kan blive interessant i nødstilfælde for at holde elsystemet kørende.

CAES could be developed as a R&D project.

Et væsentligt lager, som ikke udnyttes fuldt ud er også lagerene på de danske fjernvarmeværker. 50 GWh. Disse bør anvendes før dyrere lagring benyttes.

Storage of electricity as heat in big thermal stores at district heating plants, when the energy eventually shall be used as heat, shall be developed first.

Ikke de store barrierer, men mange lande vender sig mod Norge som lager. Danmark ligger gunstigt i forhold til Norge, men fremadrettet kan strømmen fra Norge blive forholdsvis dyr. Forsyningssikkerheden. Elkapaciteten kommer til at stå i Norge ikke Danmark.

Denmark cannot rely on Norway, since other countries will also use Norwegian hydro power for integrating RES.

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The participants in the workshop

Kim Behnke	Energinet.dk
Jeannette Møller Jørgensen	Energinet.dk
Leif Tambjerg	EMD International A/S
Anders N. Andersen	EMD International A/S
Rune Grandal	Syddansk Universitet
Aidan Cronin	Siemens Wind Power A/S
Tomas Söderlund	Powerquest
Peter M. Thorsen	Compliant Energy
Michael Papapetrou	Wirtschaft und Infrastruktur GmbH & Co Planungs-KG (WIP)
Thomas Maidonis	Wirtschaft und Infrastruktur GmbH & Co Planungs-KG (WIP)
John Anagnostopoulos	National Technical University of Athens, Mechanical Engineering (NTUA)
Annicka Wann	MWP, Malachy Walsh & Partners
Monica Kane	MWP, Malachy Walsh & Partners
Raquel Garde	CENER, National Renewable Energy Centre
Karl Zach	Energy Economics Group - TU Wien (EEG)
Thomas Weiss	Helmut-Schmidt-Universität, electrical Engineering Department (HSU)
Anders Bavnhøj Hansen	Energinet.dk
Loui Algren	Energinet.dk
Niels Træholt Franck	Energinet.dk
Stian Boye Skaatan	Energinet.dk
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EMD International A/S

List of Participants in the National Workshop in Denmark

Fredericia (Denmark) – 7 November 2013

No.	Name	Organisation	Signature
1	Thomas Maidonis	WIP	
2	Monica Kane	Mahony Walsh & Partners	Monica Kane
3	Annicha Wann	University College Cork	A.W
4	Rune Grandal	University of Southern Denmark	
5	LEIF HOLM TAMBJERG	EMD	
6	Anders B. Hansen	Energinet.dk	Anders B Hansen
7	LOU ALGREN		
8	Niels Troholt Frandt	Energinet.dk	
9	John Anagnostopoulos	NTUA Athens	
10	Stian B. Knatten	Energinet.dk (Statnett SF)	
11	Anders N Andersen	EMD	
12	Raquel Garde	CENER	R.G
13	Michael Poppelau	WIP	
14	Rasmus Sørensen	Energinet.dk	

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15	Karl ZACH	TU Wien - EEG	Karl Zach
16	Thomas Weyss	HSU	
17	Kim Behnke	Energinet.dk	–
18	Jeannette Møller Jørgensen	Energinet.dk	–
19	Aidan Cronin	Siemens Wind Power	–
20	Tomas Söderlund	Powerquest	–
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