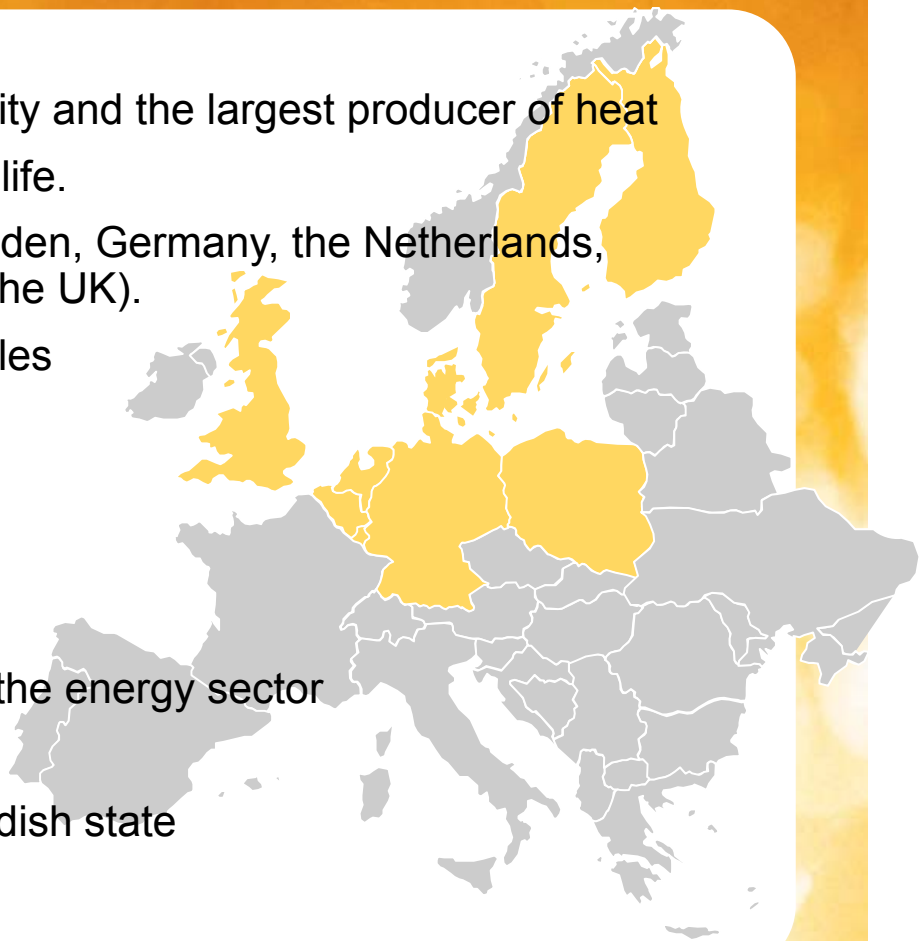
Demonstration Project Jänschwalde

Vattenfall's contribution for large scale deployment of CCS

Vattenfall at a glance

- Europe's fifth largest generator of electricity and the largest producer of heat
- Vision: Pioneering solutions for everyday life.
- Operations in 8 European countries (Sweden, Germany, the Netherlands, Finland, Denmark, Poland, Belgium and the UK).
- Electricity: generation, distribution and sales
- Heat: production, distribution and sales
- Gas: production and sales
- Mining and sales of lignite
- Energy trading in electricity, gas and coal
- Consulting and contracting operations in the energy sector
- ≈ 40,000 employees
- Vattenfall AB is wholly owned by the Swedish state



Vattenfall's roadmap for CCS

Concept-studies

Testrigs:
0.1 – 0.5 MW_{th}

Pilot plant:
30 MW_{th}

Demonstration plant:
≈ 300 MW

Commer. plant:
≈ 1000 MW

2001	2004	2008	2015	>2020
• theoretic Investigations	• Research • Basic principles • Combustion characteristics	• Demonstration of the complete process chain • Interaction of components • Validation of test rig results • Investigation of scale up criteria	• Verification und Optimisation of components • Reduction of risks • Verification of commercial availability (subsidies necessary)	• Economic and competitive power plant concept

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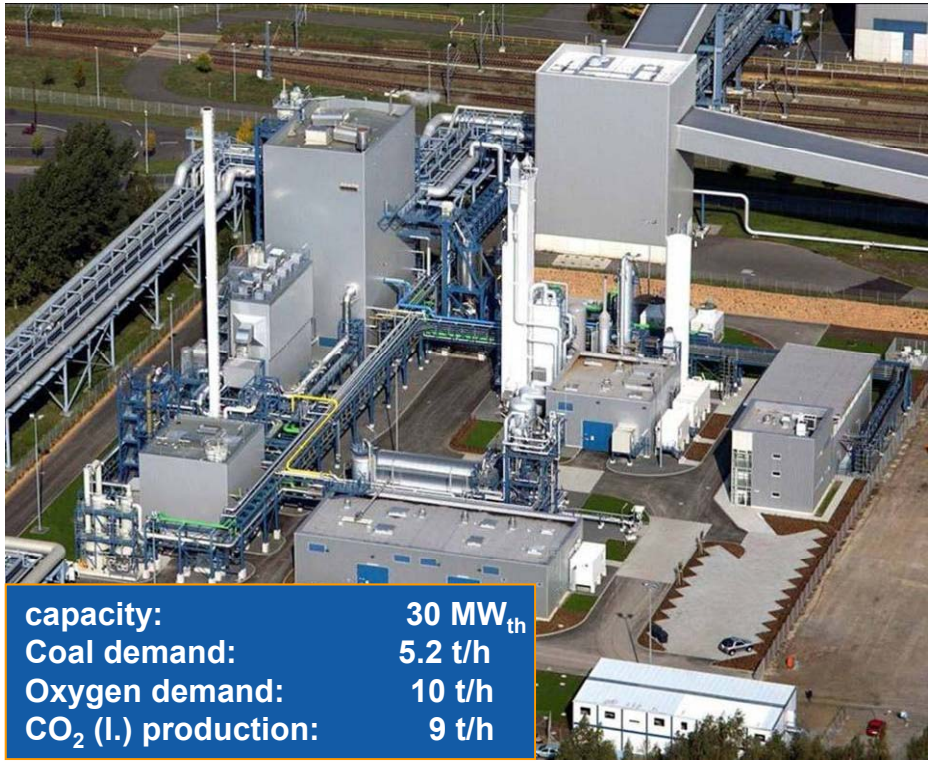
Vattenfall‘s Oxyfuel Pilot Plant



capacity:	30 MW_{th}
Coal demand:	5.2 t/h
Oxygen demand:	10 t/h
CO_2 (l.) production:	9 t/h

- Commissioning September 2008
- Until now approx. 11,600 operating hours
- CO_2-separation rate 90 %
- Approx. 7,200 t CO_2 captured
- Good CO_2-quality
- High plant availability
- Technology works
- Ready for scale-up

The promising results of the Oxyfuel pilot plant are the basis for design and layout of the CCS demonstration project.

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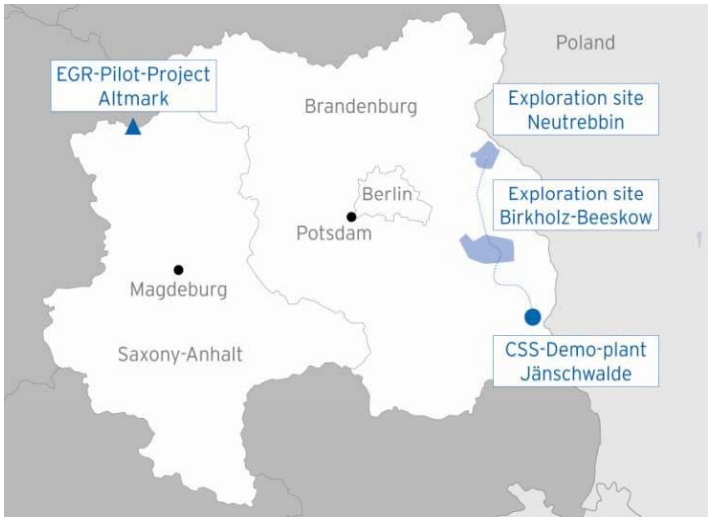
Historical time line of the demonstration project

2004	Study on selection and evaluation of suitable geological structures for CO_2 storage
2007	Brief study on application of the Oxyfuel technology at Jänschwalde power plant location in demonstration size
02/2008 – 04/2009	Elaboration of an extensive feasibility study on constructing a CCS demonstration plant at Jänschwalde power plant location
10/2008	Planning study: geo-technical exploration program for two saline aquifer structures
04/2009	Planning study: 3D-seismic for saline aquifer structures
07/2009	Start of planning/engineering activities and modification of the technical concept
05/2010	Implementation of the new technical concept with significant increased efficiency (28 → 36 %) and reduction of CO_2 to be stored annually (2.7 → 1.7 Mt/a)
05.01.2010	Signing of the „Grant Agreement“ with the European Commission for subsidies under EEPR framework
09.02.2011	File in application for subsidies under NER300 framework

CCS demonstration project Jänschwalde

- Installation of two CCS technologies:
  - Oxyfuel (separate Block 250 MW_{el})
  - Post Combustion Capture (retrofit 50 $MW_{el,equiv}$)
- Evaluation of potential routing for CO_2 pipeline
- Evaluation of potential storage options
- Commissioning 2015/2016
- Investment of 1.5 bn €
- Receive funding as one of six projects under frame of EEPR (180 million €)
- Filed in application for funding under frame of NER300



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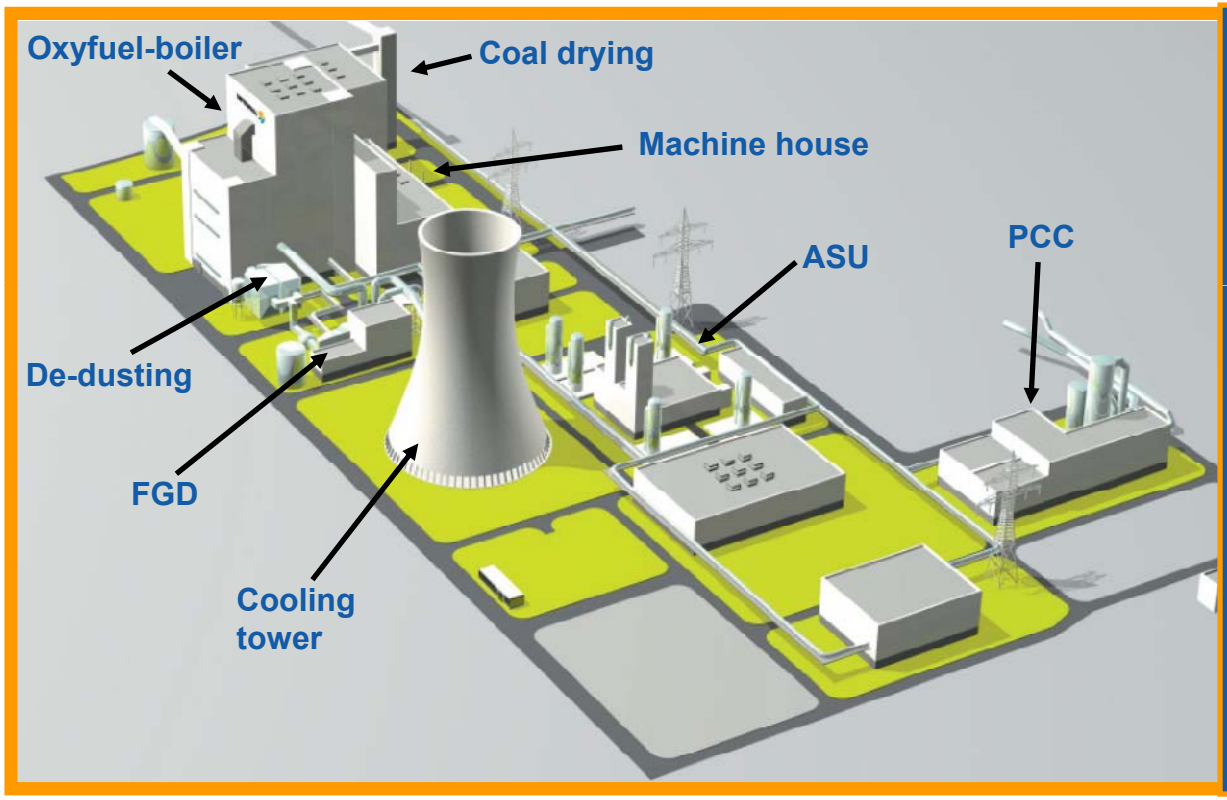
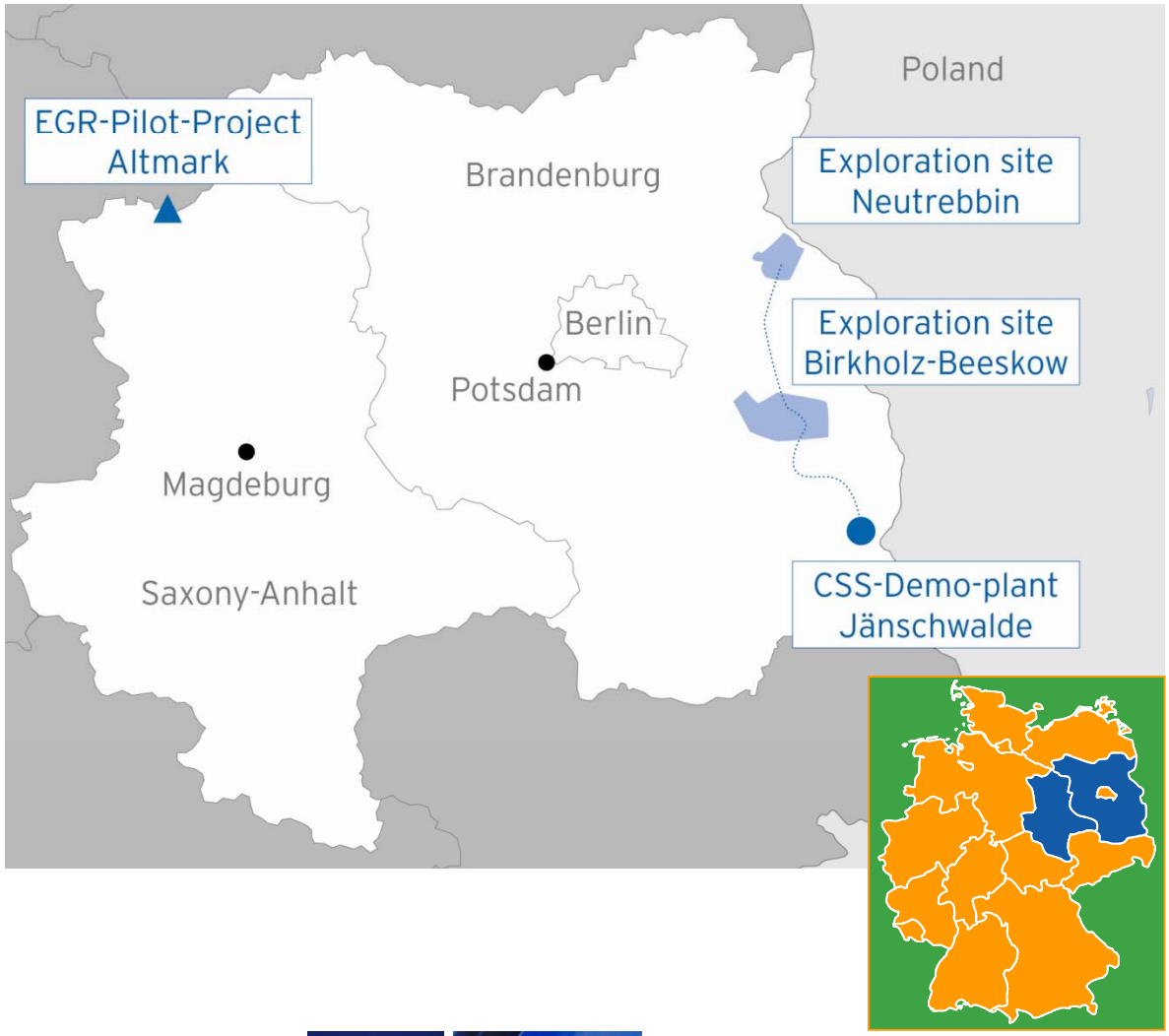
Characterisation of the capture part



- Demonstration of two CCS technologies for lignite
- Process parameter at state of the art
- Highest demand on efficiency
  $\eta = 36$ (38 %)
- Base load operation with flexible load range (50 to 103 %) for best possible integration of renewable generation
- High availability (≈ 97 %)
- Capture and storage of
  ≈ 1.7 million t CO_2 per year

Potential storage sites

- Favourite storage location from today's perspective is saline aquifer Birkholz-Beeskow.
- This formation offers:
  - Three separate cap rock layers
  - Storage horizon approx. 1,200m deep
  - Storage capacity for the whole lifetime of the plant
- Saline aquifer Neutrebbin and natural gas field Altmark are back-up options



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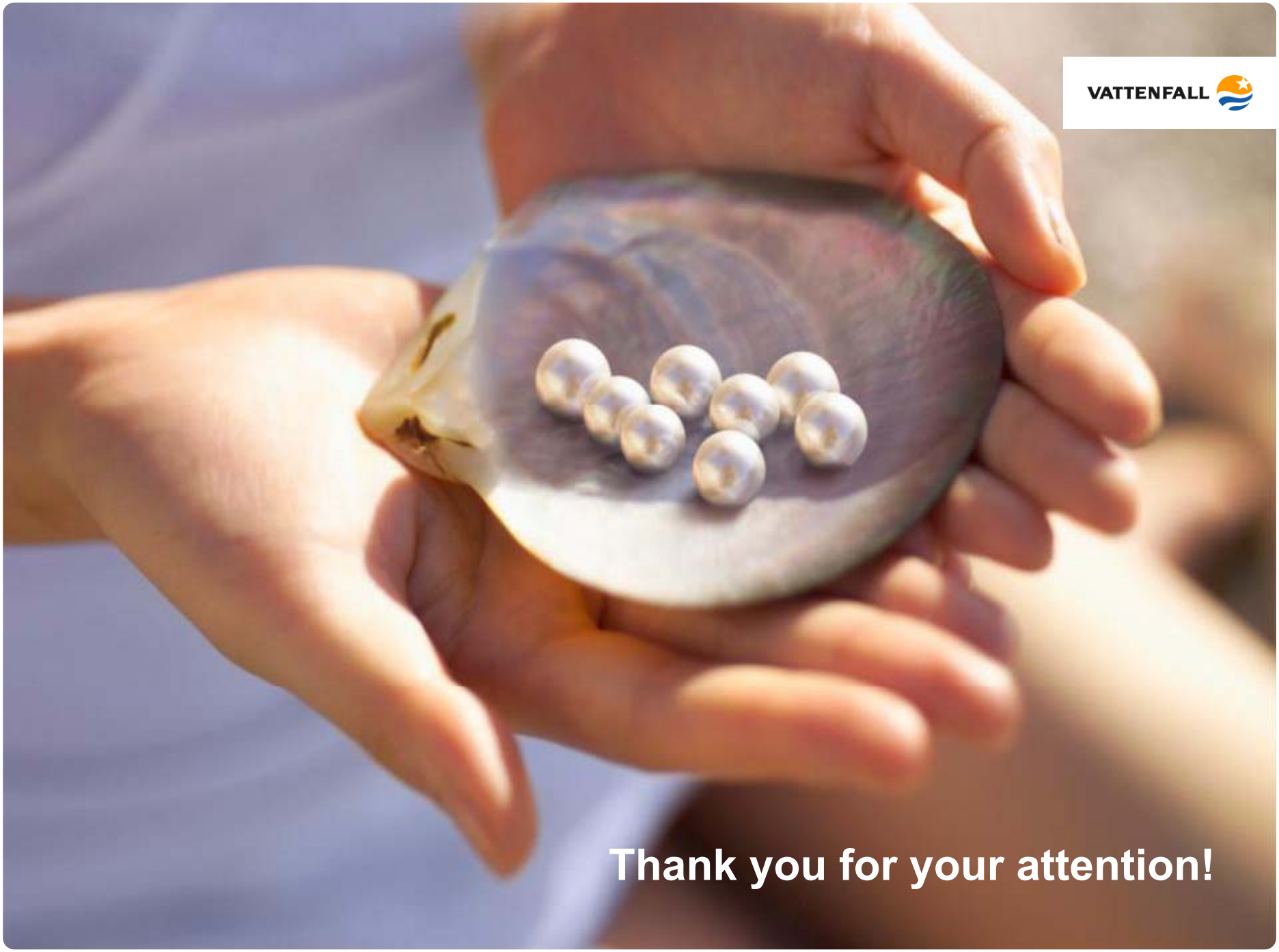
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Thank you for your attention!