

Vattenfall and CCS activities

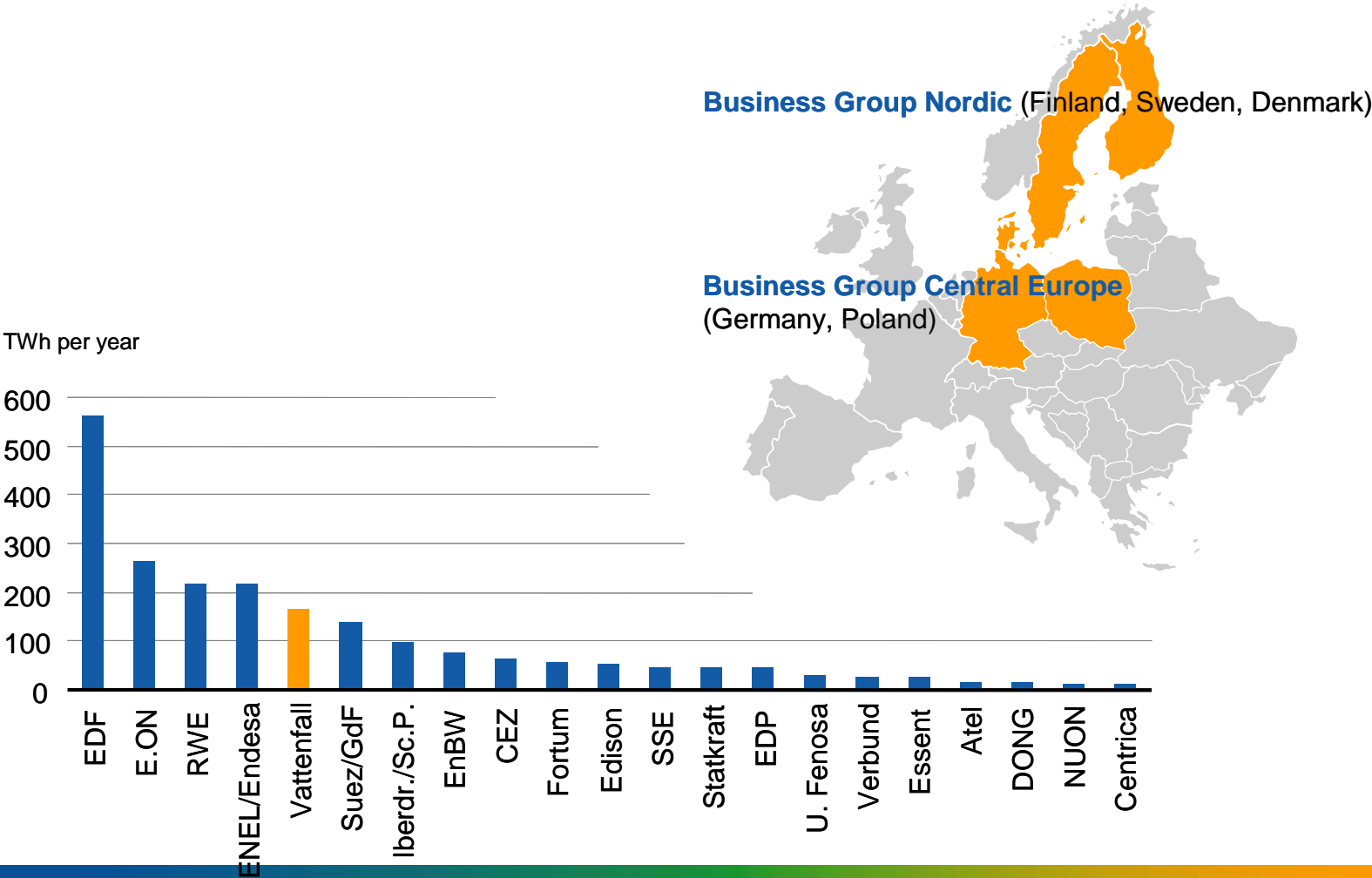
UNECE Ad hoc Group of Experts on Cleaner Electricity
Production from Coal and other Fossil Fuels
Meeting 17-18 November, 2008

Leif Brandels, Vattenfall AB, Group R&D

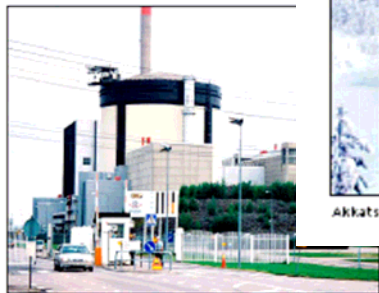
This is Vattenfall

- Europe's fifth largest electricity generator and the largest heat producer
- Operations in Sweden, Finland, Denmark, Germany and Poland
- Electricity: generation, transmission, distribution and sale
- Heat: production, distribution and sale
- 6 million customers
- 32 000 employees
- Vattenfall AB is 100 per cent owned by the Swedish state

Europe's fifth largest electricity generator



Europe's fifth largest electricity generator



Ringshals nuclear power plant



Akkats hydro power plant

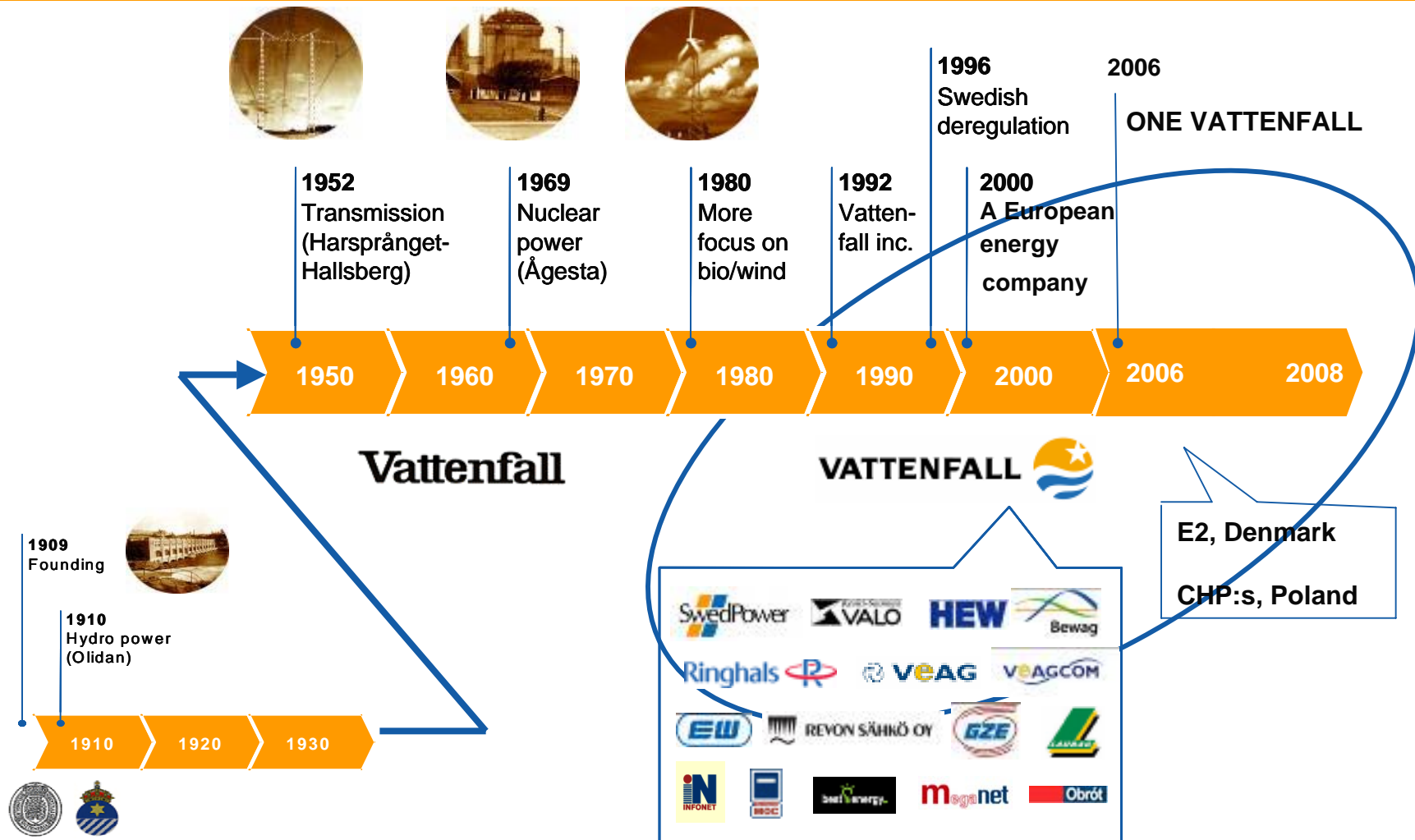


Ringshals nuclear power plant

Early with CO2 activities

- **Development from national to European Power Company**

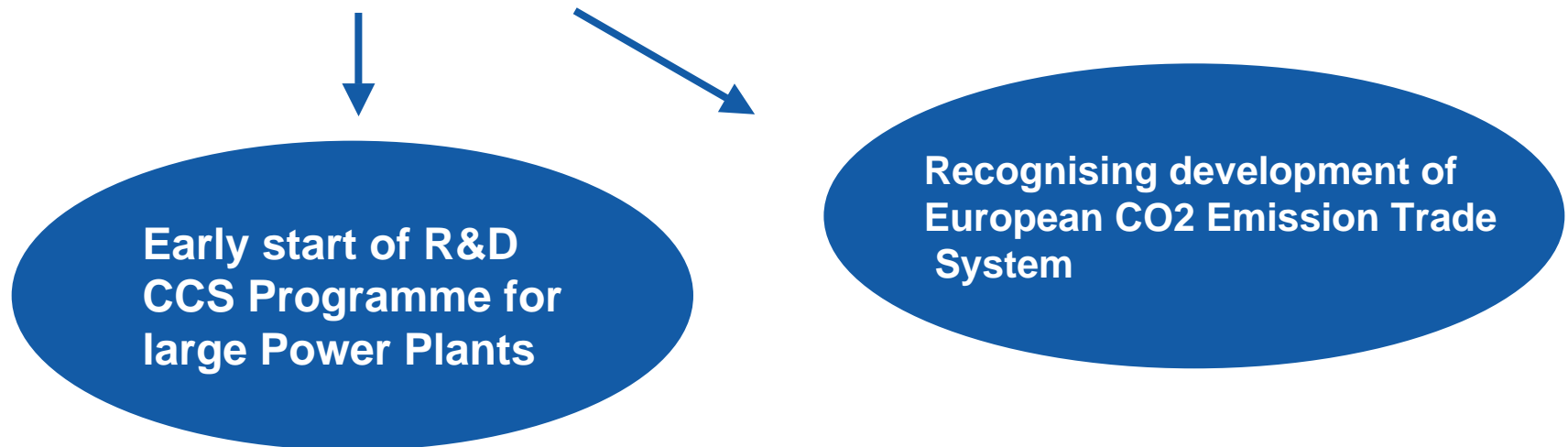
From national to European power company



Early with CO2 activities

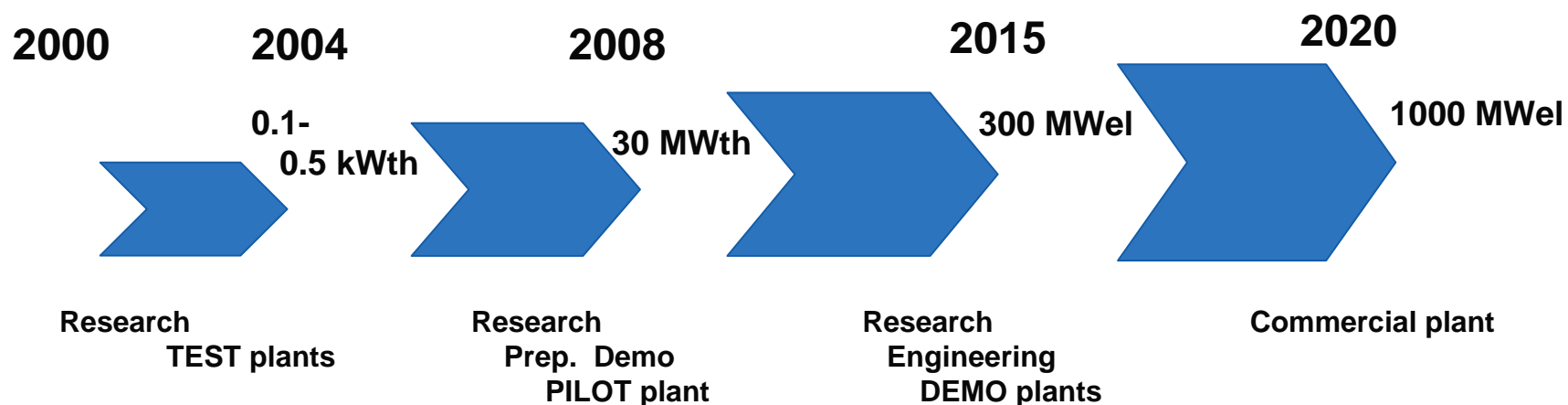
- **Development from national to European Power Company**

- Large CO2 emitter



Important for “future business”

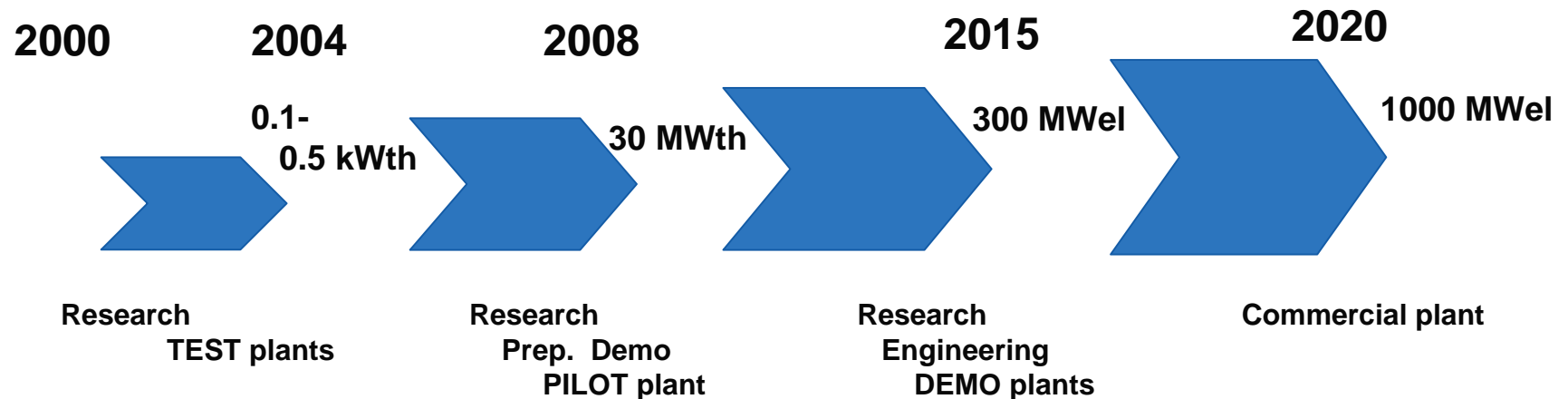
Early with R&D CCS programme for large power plants



Objective of Vattenfall's R&D project on CCS (year 2000):

- Develop commercial large scale power plant concepts for carbon capture and storage with large scale Demo 2015-18
- Reduce total cost of CO₂ captured and stored to less than 20 EUR/tonne CO₂ avoided
- Capture rate more than 95%

R&D CCS programme for large power plants

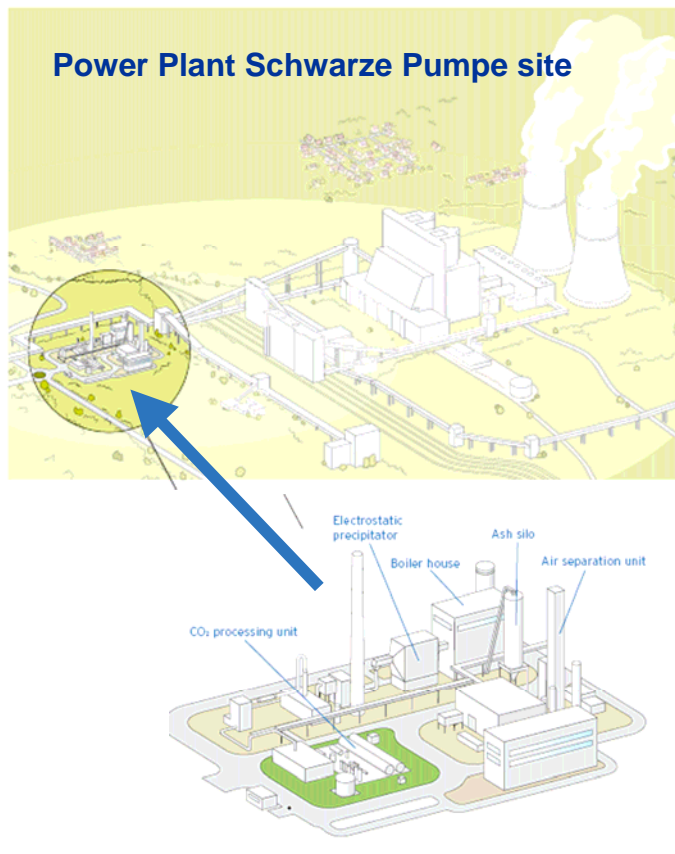


Vattenfall's R&D project on CCS carried out stepwise:

Phase 1: Feasibility studies	1999-2000	Is it possible?
Phase 2: Gap analysis	2001-2003	What is needed?
Phase 3: Concept development/Lab tests	2002-2007	Verification concepts
Phase 4: Concept verification/Pilot plant Preparation Demos/Storage	2004-2009	Verification selected technologies
Phase 5: Preparation Demos/ Storage Site selection	2008-2012	Pilot verifications Preparation Demos

Vattenfall 30 MW oxyfuel Pilot Plant in Germany

Worlds first pilot including the whole chain/components:



**Air separation
Boiler 30 MWth
Ash treatment
Electrostatic precipitator
CO₂ processing unit**



Pilot and Demo Projects

- **Schwarze Pumpe, Germany**

Pilot plant for oxyfuel technology.
In operation autumn 2008. Storage 2009

- **Mongstad, Norway**

Pilot plant for post-combustion technology. In operation 2010
Full-scale(Demo) planned operation 2014

- **Aalborg, Denmark**

Demo plant Post-combustion. Pipeline for underground storage. In operation 2013.

- **Jämschwalde, Germany**

Demo plant. Post-combustion and oxyfuel technology. In full operation by 2015 at latest.



Demo Capture and Storage in Germany



Planned Storage

Gas field under completion

In cooperation with EEG (owner GdF)

Research injection decided (CO₂ from 30 MW Pilot Plant)

Capture Jämschwalde

Post Combustion 250-300 MWe_{el} in one block

OxyFuel Combustion 250-300 MWe_{el} in one block

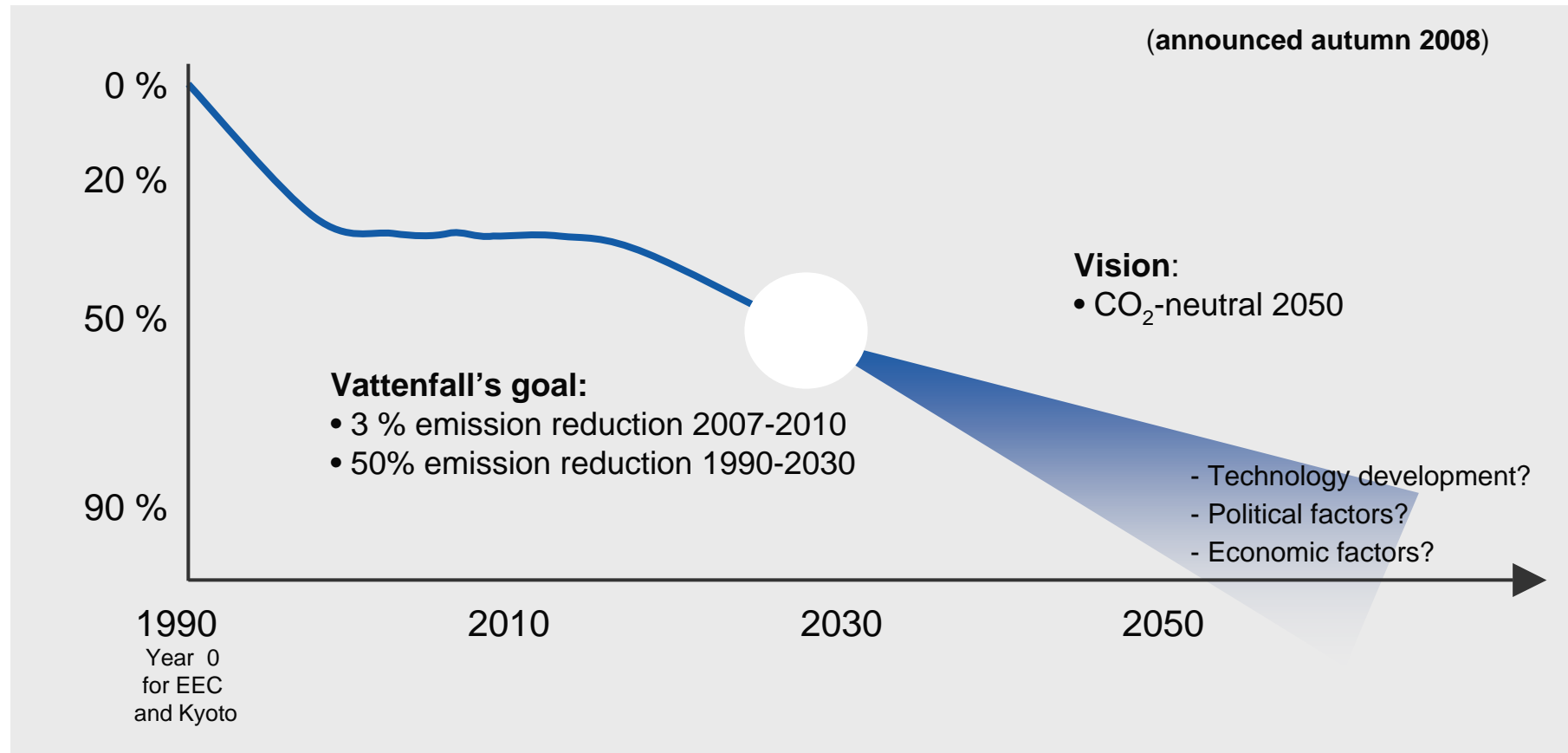


Base for present CCS activities for large power plants

- **Knowledge emanating from 8 years R&D activities**
 - Results from a large number of Research Projects
 - Research since 2000 in own "Research and Development Company"
 - Cooperation with a number of Universities and Manufacturers
 - Taking part in almost all CCS project in EC 6 FP (ENCAP, CASTOR, CO2 ReMoVe, Dynamis, CO2 SINK and a number of projects in 7 FP)
 - Taking part in the ZEP activities
 - Operating the 30 MW OxyFuel Pilot Plant
 - Taking part in the Mongstad Test Center Project
 - Preparation of a number of Demo projects including storage in Denmark, Germany

and

Vattenfall CO2 emission goals



The CO2 emission goal will be reached “partly” by introduction of CCS in coal fuelled power plants “

Needs for "CCS Progress

- **Capture**

(Rules) Large Plant investments External co-financing

- **Transport**

Rules Infrastructure Long process Strategies

- **Storage**

Rules Strategies storage/
ownership Developed "permitting"
process

Some Supporters:



CCS Progress

Examples:

EU

**EU Directive on the deployment on CCS/
The Environment Committee in the European Parliament
voted yes to a proposal to fund a European-wide demonstration
program of carbon capture and storage (CCS) projects**

World Energy Association

**World Energy Association accepts global climate goal for 2050
(Autumn 2008) “Partly CCS use”
US, Canadian, Japanese, European Power companies**

Thank you!