

Vattenfall`s Oxyfuel Pilot Plant

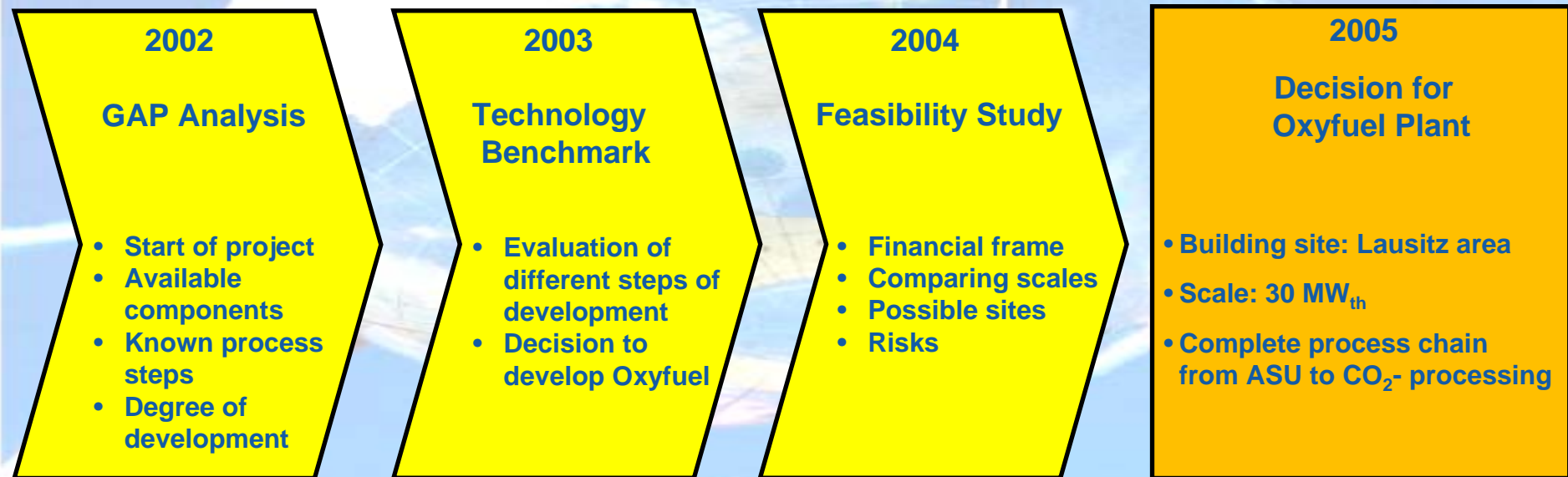
First Experiences from Commissioning and Operation

Euracoal

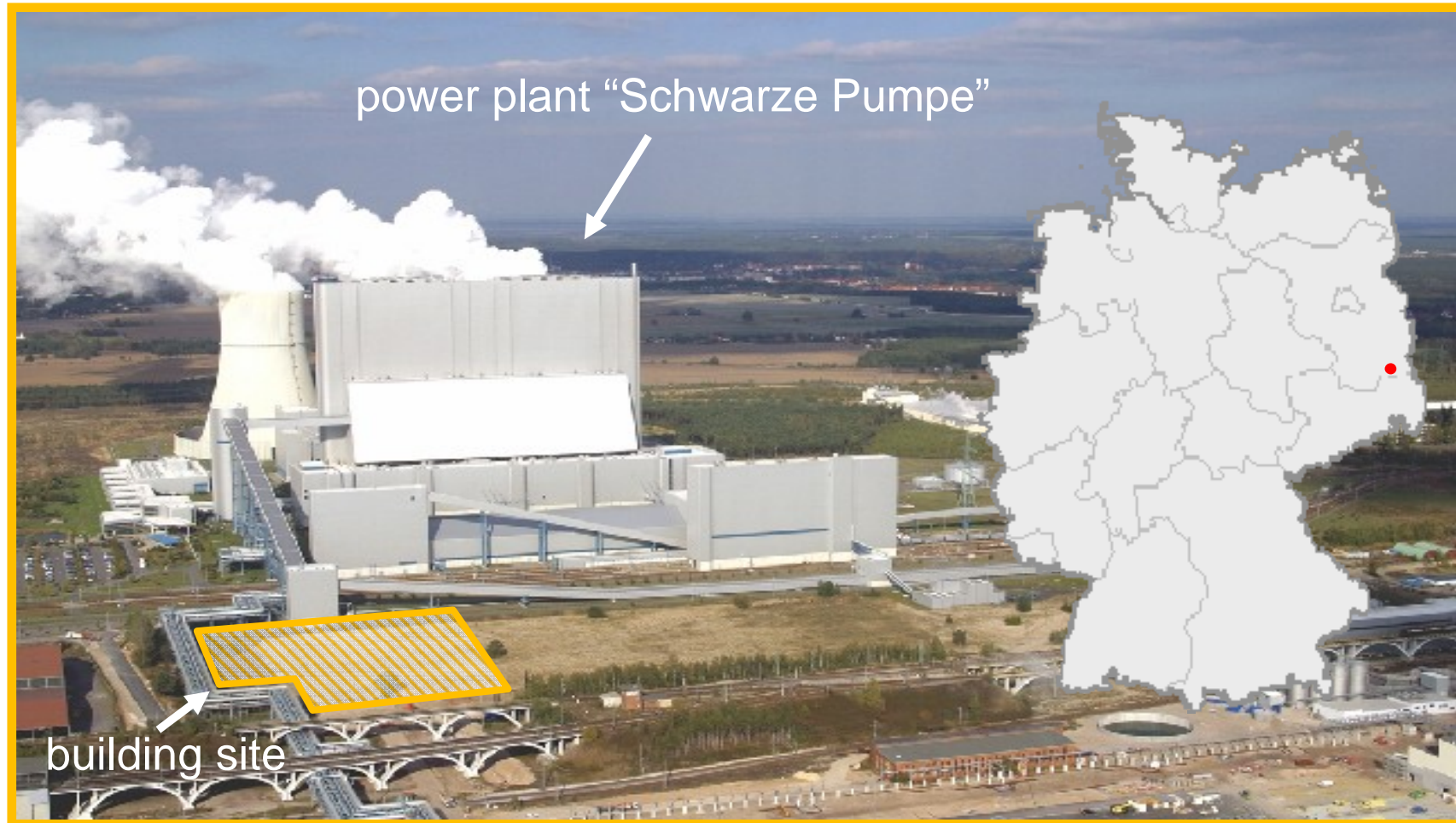
Brussels, 26.01.2009

Dr. Hartmuth Zeiß, Member of the Board, Vattenfall Europe Mining & Generation

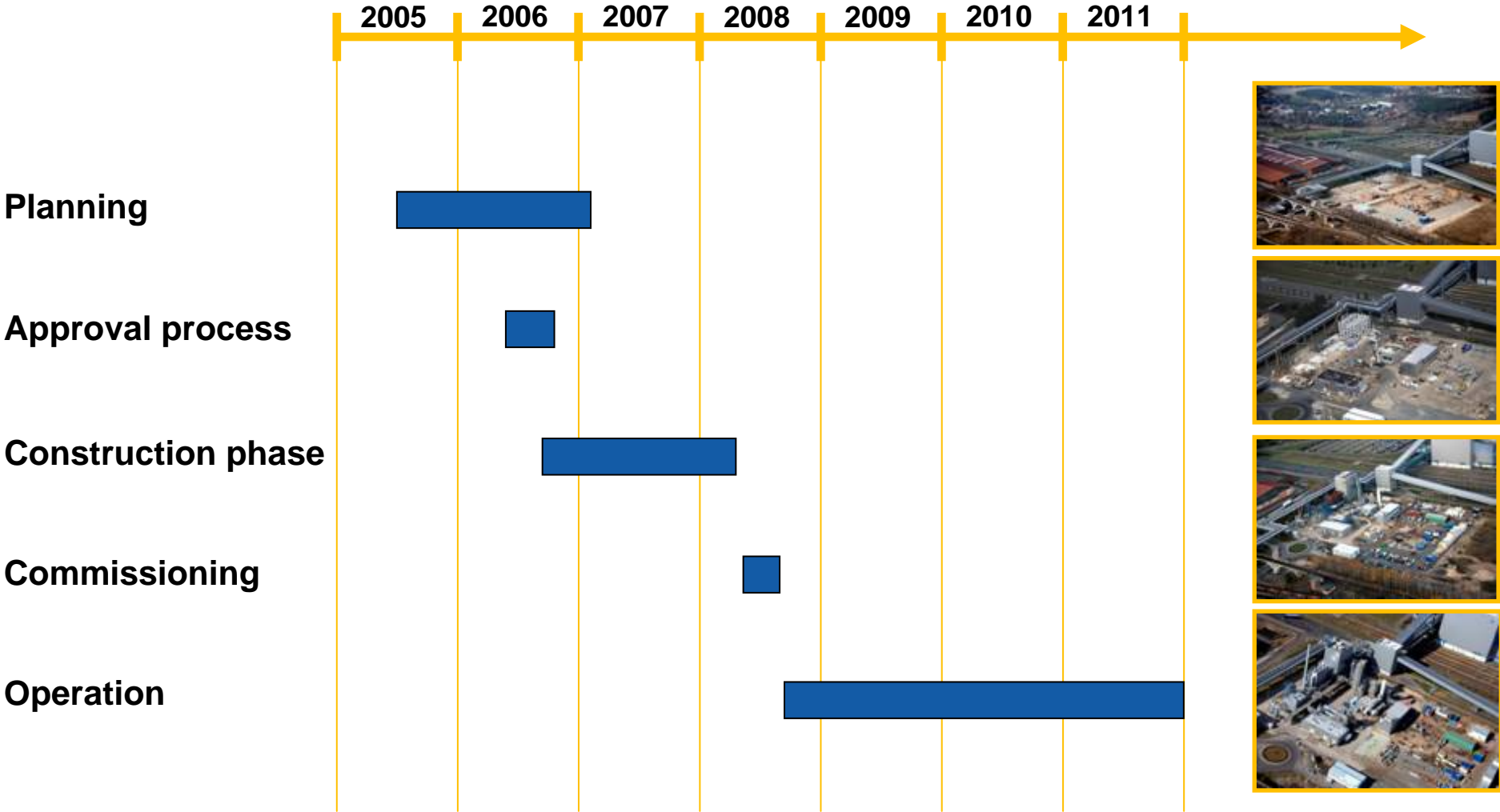
Decision process for the Oxyfuel Pilot Plant



Location of the Oxyfuel Pilot Plant



Time schedule of the project



The Oxyfuel Pilot Plant

Thermal capacity: 30 MW_{th}
Coal demand: 5.2 t/h
Oxygen demand: 10 t/h
CO₂ (liq.) production: 9 t/h
Capture rate: 90 %

Electrostatic precipitator

Flue gas desulphurization

Flue gas condenser

Boiler

Air separation unit

Social and switchgear building

CO₂-plant

Webcam: www.Vattenfall.de/CCS

Milestones during project realisation

- **July `05** project start
 - **23.11.06** notice of approval
 - **March `08** end of construction
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- **05.06.08** first fire (ignition burner)
 - **26.06.08** first coal fire (main burner)
 - **20.08.08** first Oxyfuel operation
 - **03.09.08** first separation of CO₂
 - **09.09.08** official inauguration



Challenges

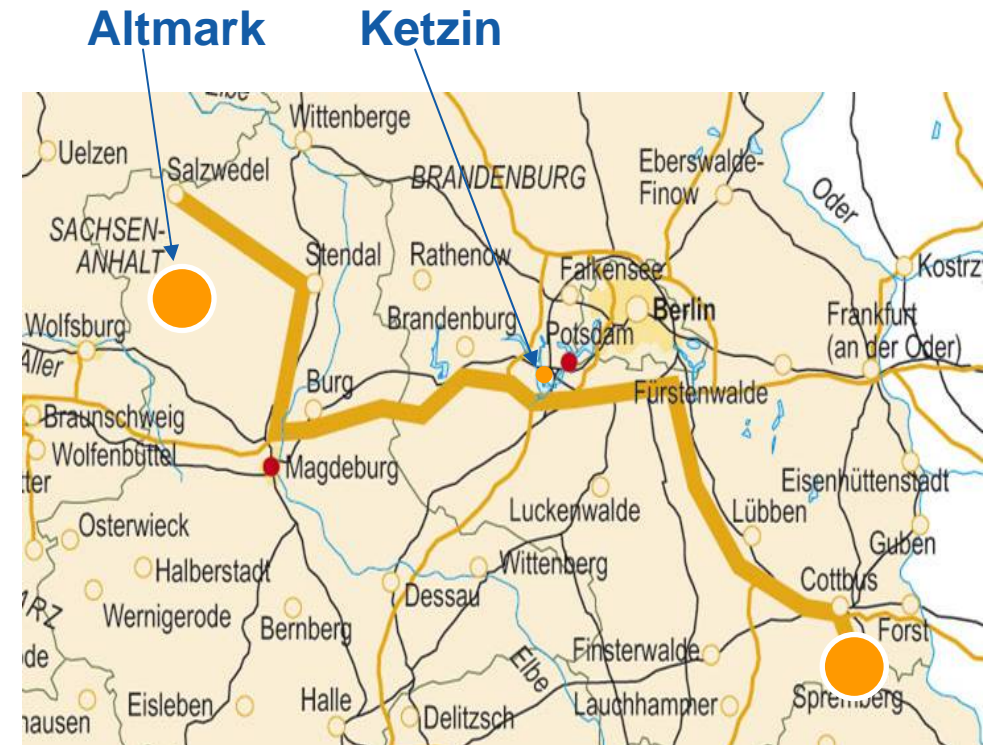
- Implementation of approx. 15 new technical concepts and specifications.
- Miscellaneous innovations where necessary to fulfill the new requirements of the Oxyfuel process in comparison to conventional power plants, e.g.:
 - Provision of Oxygen
 - Operation on both air and oxygen
 - Flue gas recirculation
 - FGD: external oxidation and high sulfur removal
 - Flue gas condensation and high aerosol precipitation
 - CO₂ processing and liquefaction under pressure



Transport concept for pilot phase



- Transport with trailers
- 7 to 9 vehicles per day
- distance: aprox. 350 km
- Storage in depleted gas field



Status of the Oxyfuel Pilot Plant

- Commissioning of all components and systems finished (Aug. 2008).
- Security and function test by technical authority (TÜV) finished (Sept. 2008).
- Permission for regular operation by technical authority granted (Sept. 2008 for air operation, Oct. 2008 for Oxyfuel operation).
- Optimization and verification of warranted characteristics finished.
- Functionality of the Oxyfuel process is verified in pilot scale.
- Until beginning of January 2009
 - 430 hours of Oxyfuel operation
 - separation and liquefaction of $> 100 \text{ t CO}_2$
- After first measurement campaigns in November/December 2008, start of the test program in January 2009.



Outlook on test program

- Variation of coal quality (moisture, sulphur content, particle size).
- Tests of special measurement technique for flue gas composition and CO₂ monitoring.
- Material tests for demo plants and 700°C technology under Oxyfuel atmosphere.
- Testing of different burners.
- DeNO_x tests at the boiler and for the vent gas stream from the CO₂ plant.
- Test of an integrated dry lignite ignition burner.
- Tests with bituminous coal.



Vision of the next generation power unit



Concept 1
Oxyfuel boiler

Concept 2
Post combustion capture

Lessons learned: Schwarze Pumpe to Jämschwalde

- The integration of chemical plant parts (ASU, CO2P) needs more attention regarding technical regulations, nomenclature and standards.
- New operating concepts for bigger Oxyfuel units have to be developed, considering different behavior of the whole plant in start up and shut down.
- Oxyfuel power plants will have a demand of high skilled employees for operation, engineering and maintenance of the new components (ASU, CO2P).
- For engineering and erection the time schedule of “conventional” power plants fits for Oxyfuel power plants too, but there will be more time needed for commissioning.



Summary

- Oxyfuel works in pilot scale, emission limits are kept.
- Successful integration of plant parts from chemical engineering (ASU, CO₂P).
- Gained experiences from approval process and implementation of secondary clauses for CCS power plants.
- CO₂ monitoring over the whole technology chain (capture – transport – storage) developed for the first time world wide.
- World wide first application for participation in the emission trading market for a CCS plant.
- First steps towards full scale CCS plants is successfully done.



Thank you for your attention!