

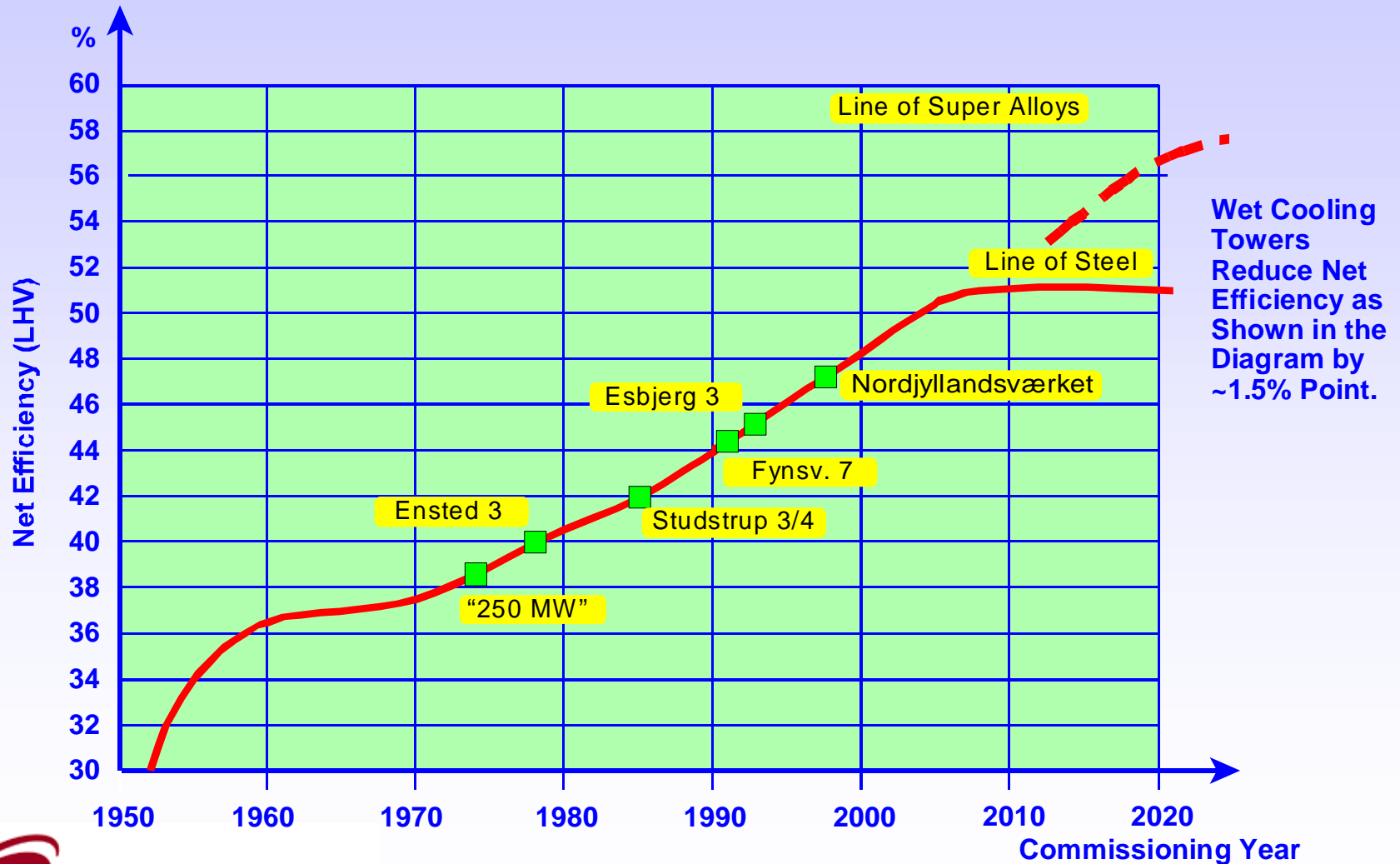
AD 700



Advanced 700°C PF Power Plant

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Development in efficiency of Elsam's coal-fired power plants



Nordjyllandsværket

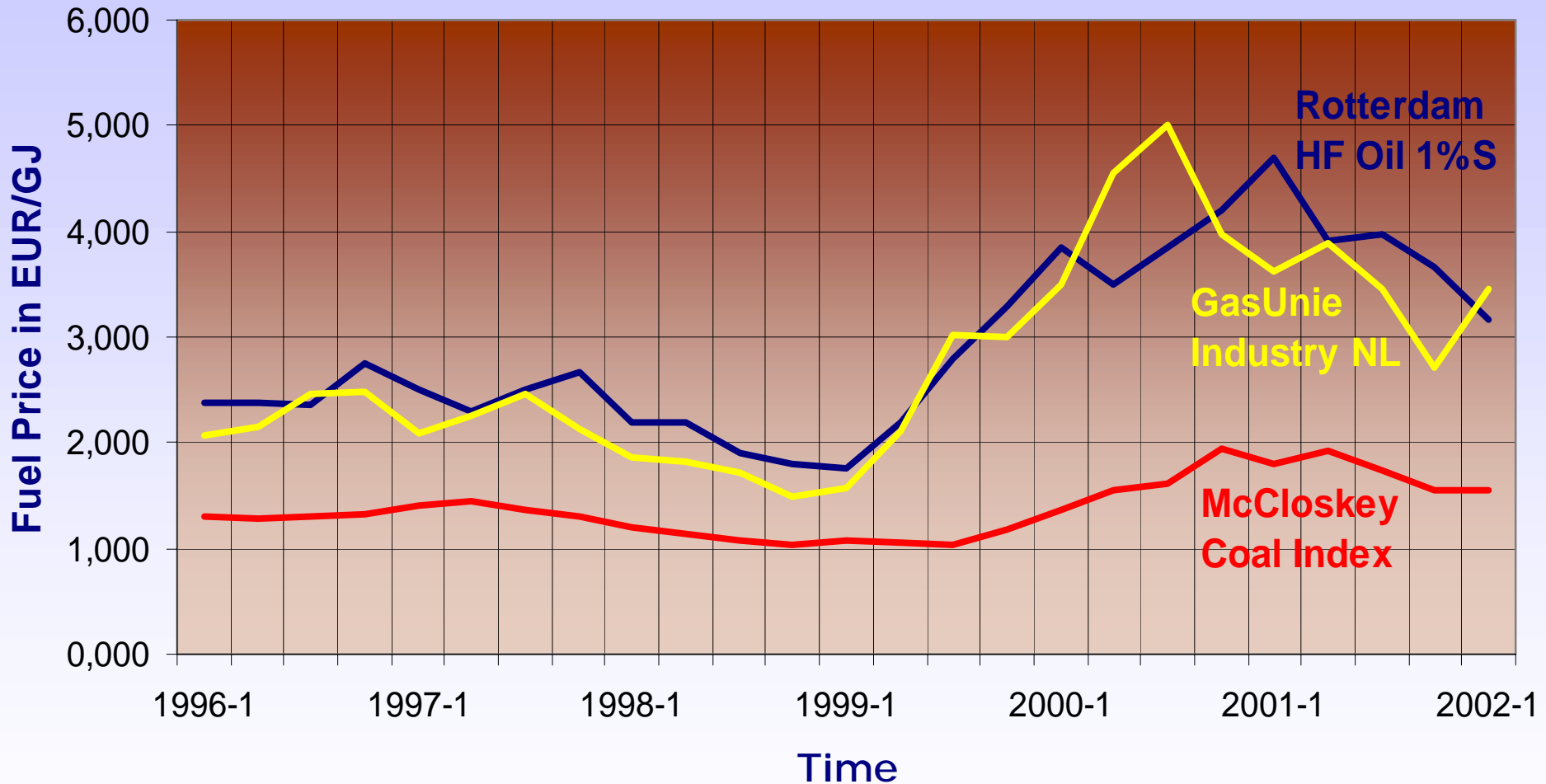
Steam Parameters

- Live steam 290 bar, 580 C
- Reheat 1 74 bar, 580 C
- Reheat 2 19 bar, 580 C

Characteristics of Coal Based Power Generation

- Abundant reserves
- Many independent producers of coal
- Low and stable prices of imported coal
- Security of supply is threatened without coal
- Clean Coal Technology is sustainable and with a large development potential

EU Fuel Prices for Power Generation



Coal-Based Technologies Investigated Since Mid 70s.

- IGCC (Buggenum, Puertolano)
- PFBC (Escatron)
- Pressurised Pulverised Coal CC (Steag)
- Ultra Super Critical (Commercial Available)
- AD 700 Project

The 600 C family

Power station	MW	Steam parameters	Fuel	Year of comm.	Eff. %	Nat.
Matsuura 2	1000	255bar/598°C/596°C	PC	1997		J
Skærbæk 3	400	290bar/580°C/580°C/580°C	NG	1997	49	DK
Haramachi 2	1000	259bar/604°C/602°C	PC	1998		J
Nordjylland 3	400	290bar/580°C/580°C/580°C	PC	1998	47	DK
Nanaoota 2	700	255bar/597°C/595°C	PC	1998		J
Misumi 1	1000	259bar/604°C/602°C	PC	1998		J
Lippendorf	934	267bar/554°C/583°C	Lignite	1999	42.3	D
Boxberg	915	267bar/555°C/578°C	Lignite	2000	41.7	D
Tsuruga 2	700	255bar/597°C/595°C	PC	2000		J
Tachibanawan 2	1050	264bar/605°C/613°C	PC	2001		J
Avedøre 2	400	300bar/580°C/600°C	NG	2001	49.7	DK
Niederaussen	975	265bar/565°C/600°C	Lignite	2002	>43	D
Isogo 1	600	280bar/605°C/613°C	PC	2002		J

AD 700 Objective(s)

The purpose of the project is to prepare, develop and demonstrate the next generation of pulverised coal-fired power plants featuring advanced steam data (700/720°C, 375 bar).

Resulting in efficiencies in the range of 52-55%, fuel savings and CO₂ emission reductions of up to 15% compared with the best available technology (BAT) of today.

BAT year 2000: Approx. 600°C, 290 bar, 47%

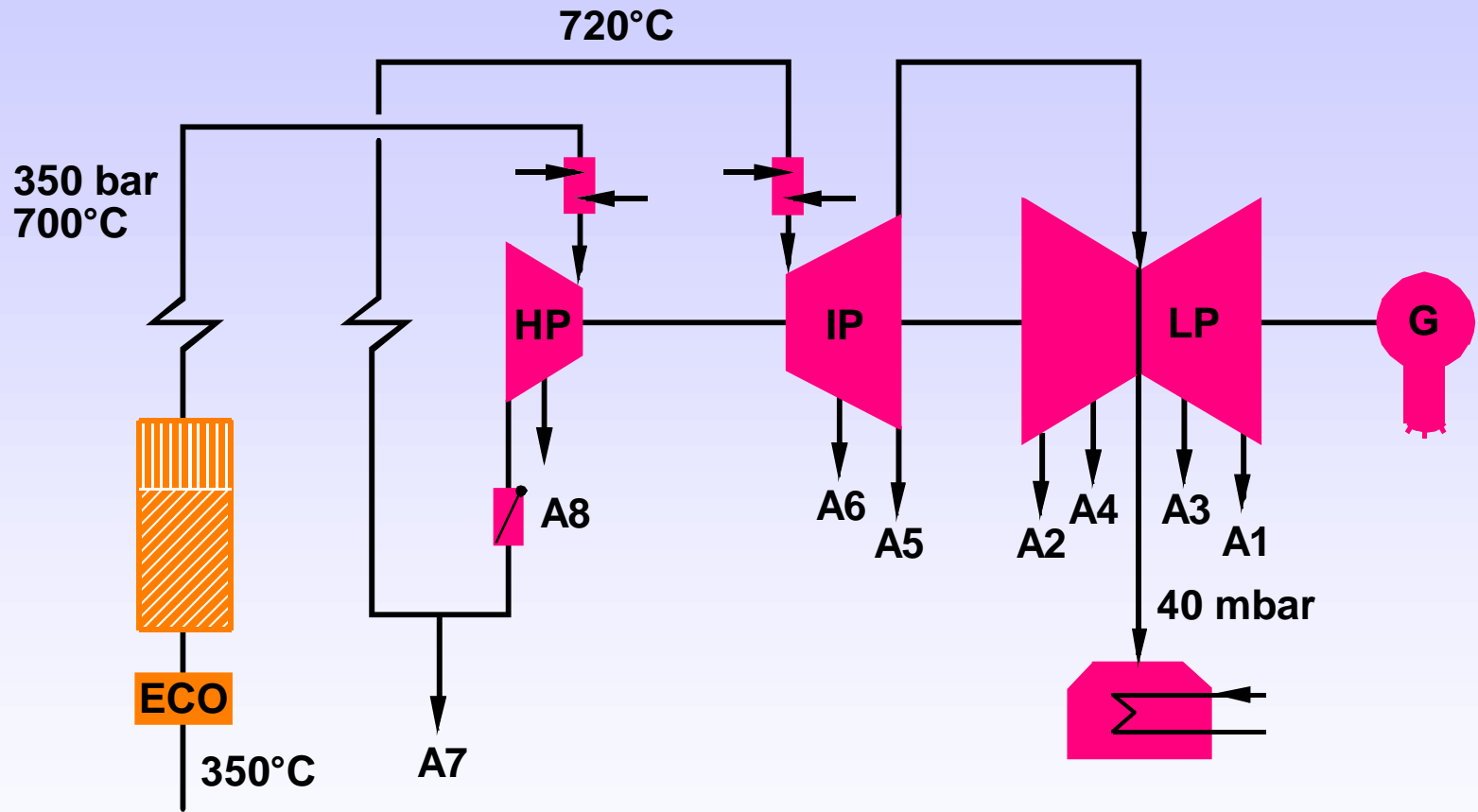
AD 700 Results so far in phase 1 1998-2003

- Materials identified;
- Materials test in progress;
- Thermodynamical cycle agreed upon;
- Feasibility study shows competitiveness;
- New boiler concepts, which reduces the amount of superalloys.

AD 700 Goals in phase 2 2002-2005

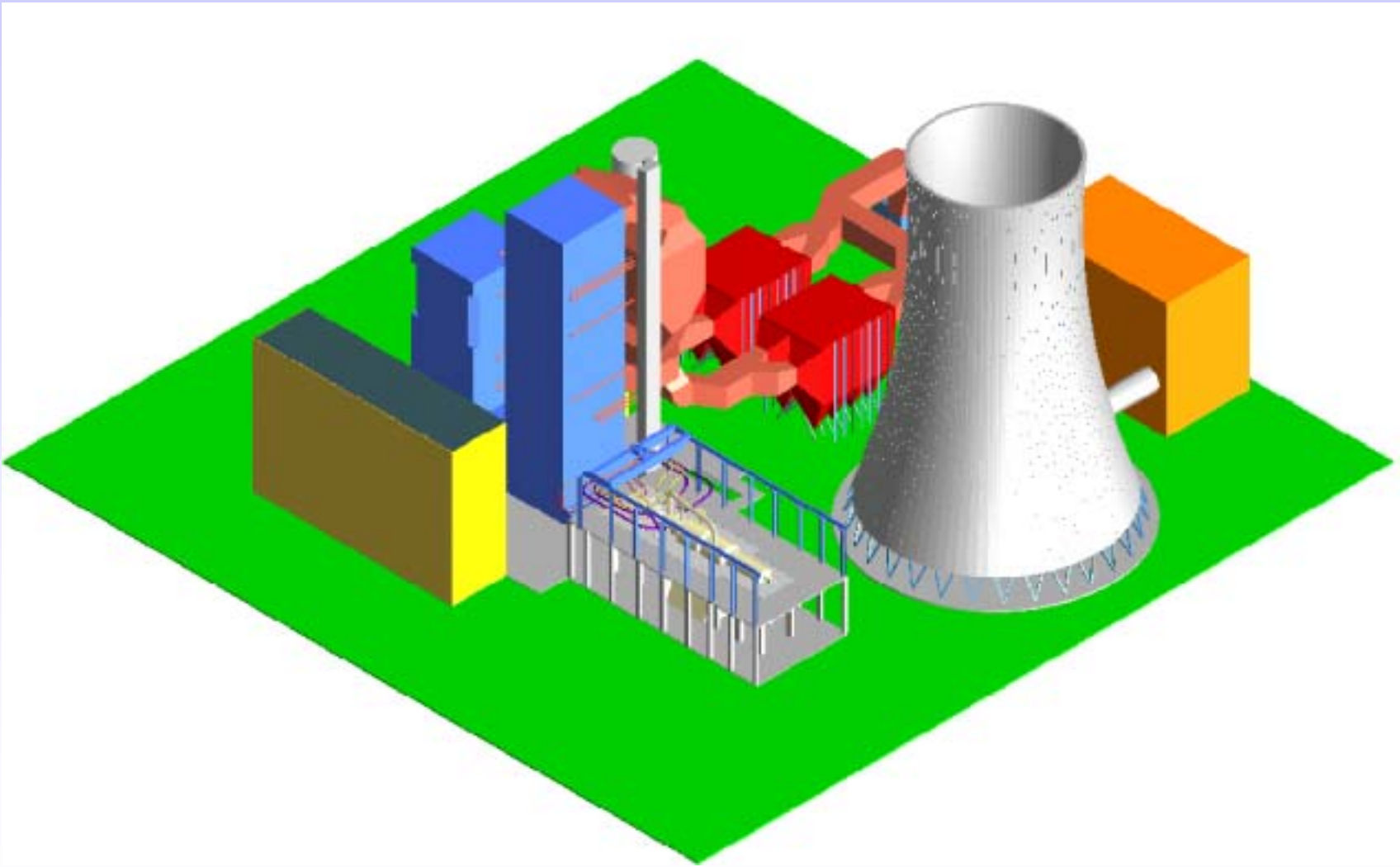
- Design and test of critical components
- Further study of innovative designs to reduce the amount of superalloys
- Concept for a test facility
- Business plans for a commercial plant

The AD 700 cycle

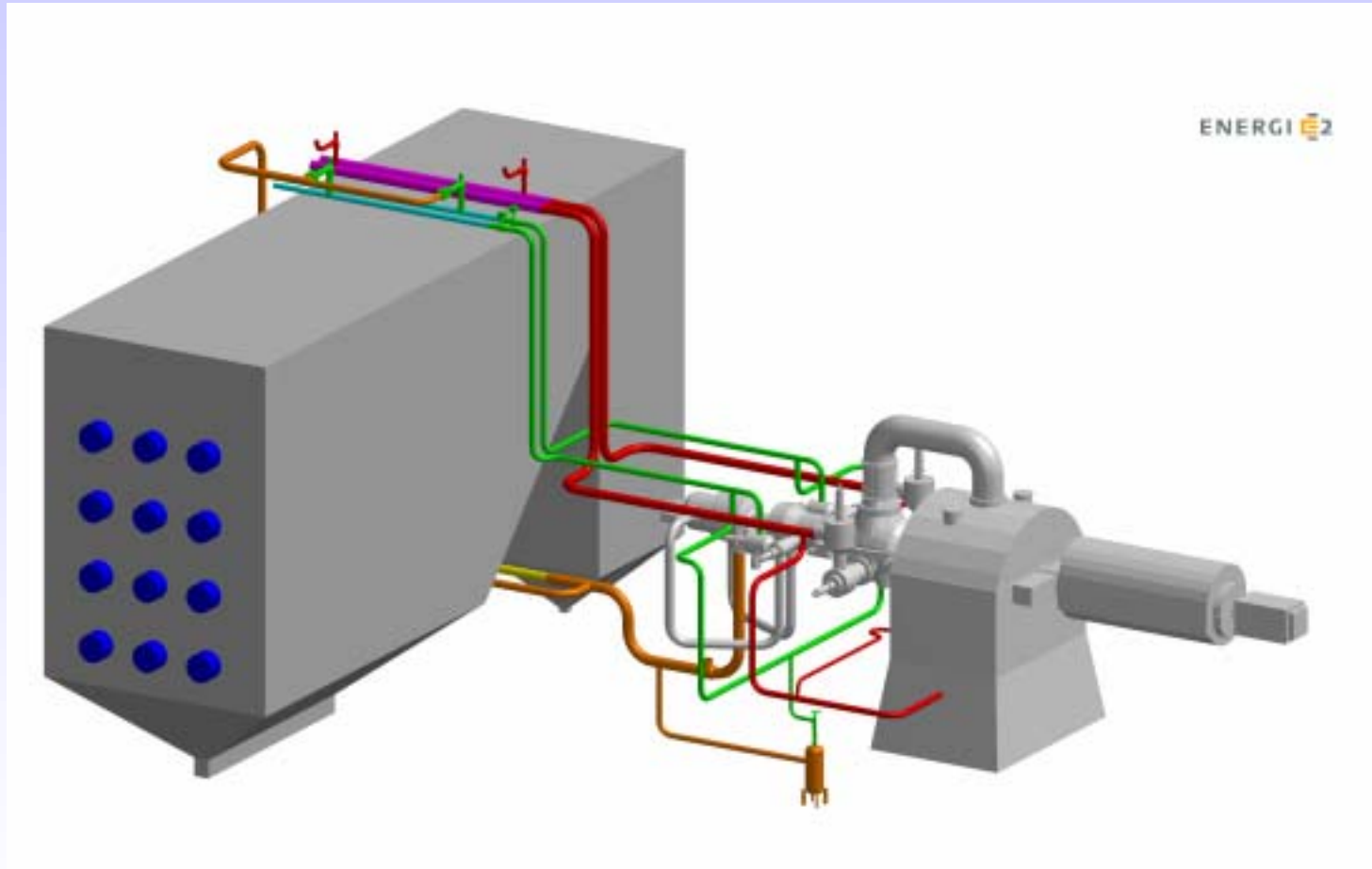


Net Efficiency \square 50-51%

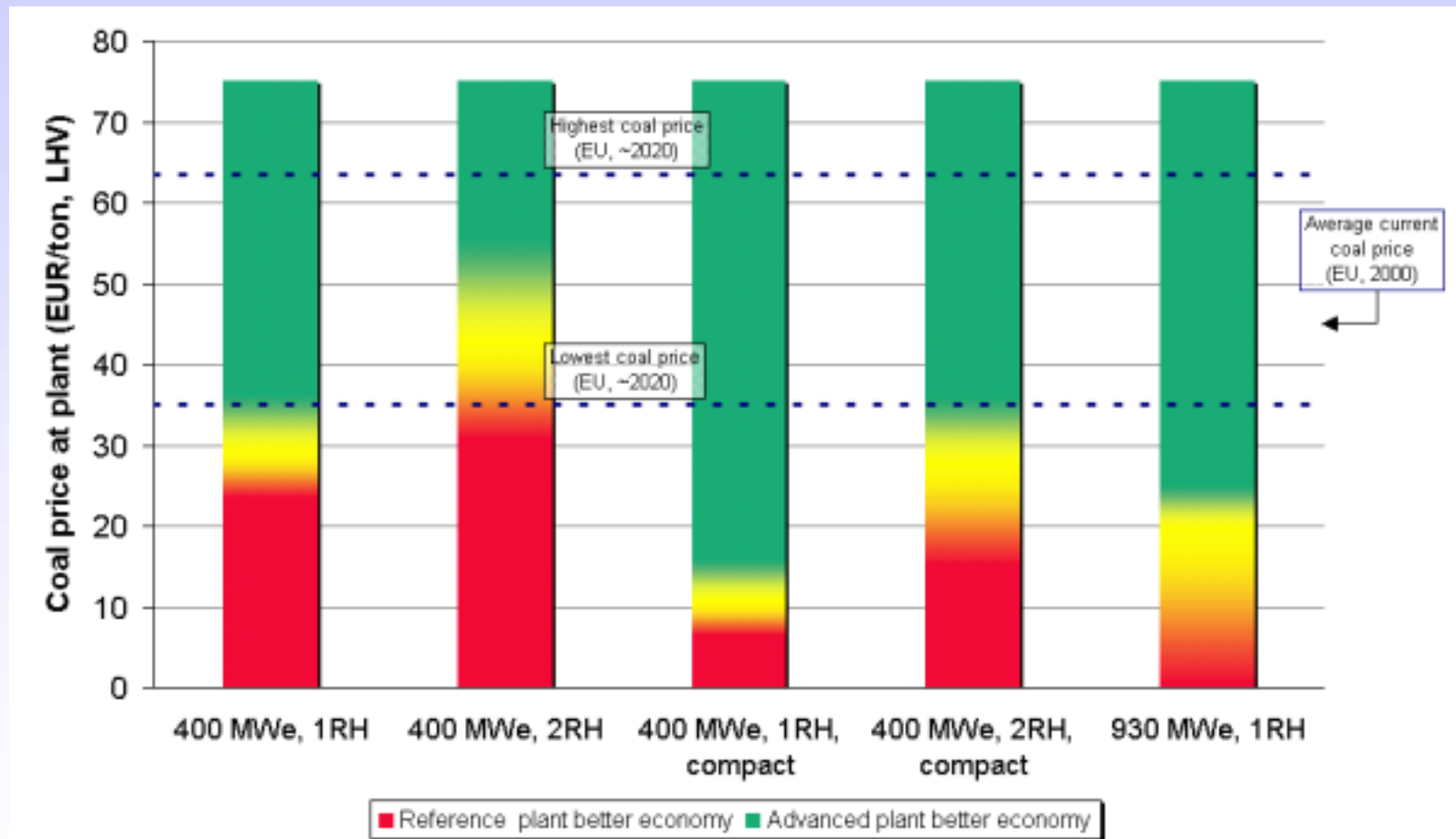
Compact Design. Twin Tower Boiler by ALSTOM.



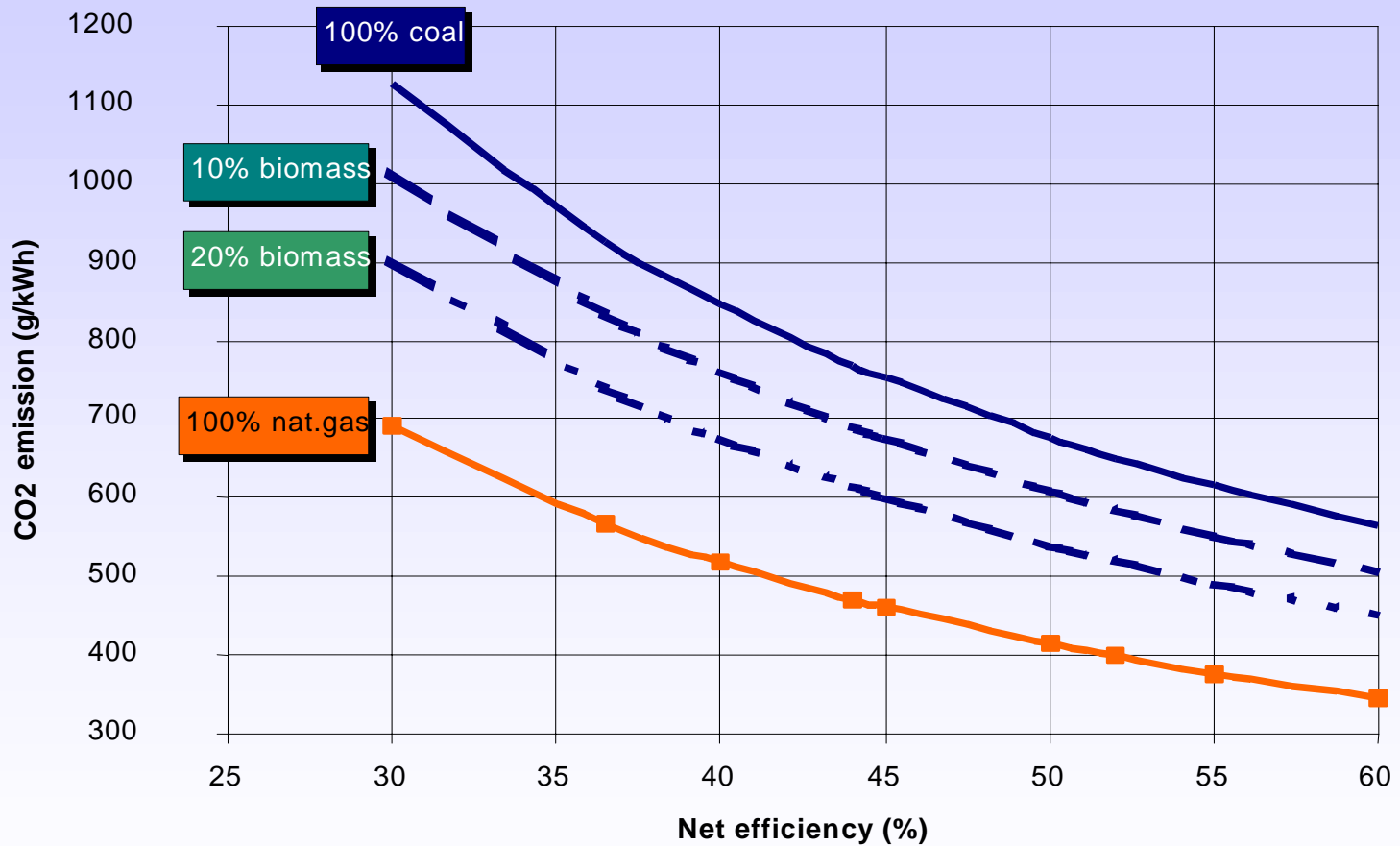
Compact Design. HF Boiler by Siemens



AD700 Technology. Cost Estimates. Round 1. Inland Location



Effects of co-firing



Creep Strength of Materials for Steam Piping at 600°C

12% Cr Steel - X20 : 59 N/mm²

9% Cr Steel - P92 : 123 N/mm²

Super Alloy Estimate: > 300 N/mm²

Targets for the Joint European Advanced 700°C Project

Martensitic Steel: 100 N/mm² at 650°C

Austenitic Steel : 100 N/mm² at 700°C

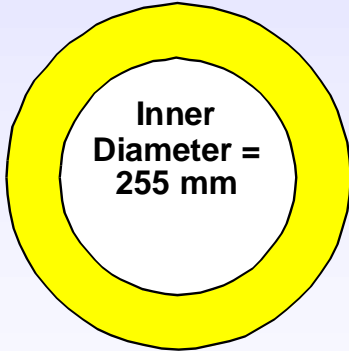
Super Alloys : 100 N/mm² at 750°C

NI-based materials for AD 700

Element	Ni	Cr	Co	Mo	Other
Material					
625	63,5	21,5	0	9	6
617	52	22	12	9,5	4,5
C263	51	20	20	6	3
740	50	24	20	0	6

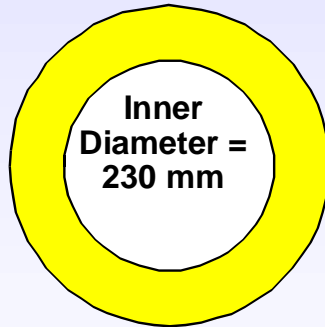
Wall Thickness of Three Live Steam Pipes. Output 400 MW and 2 Steam Lines in Parallel

Esbjerg 3
250bar/560/560°C



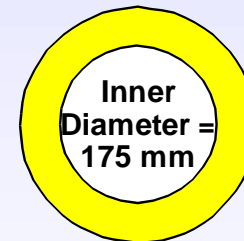
X20CrMoV121
WT = 58 mm

Nordjylland 3
290bar/580/580/580°C



P91
WT = 60 mm

ADV 700
375bar/700/720/720°C



Super Alloy
WT = 42 mm

Emax Initiative

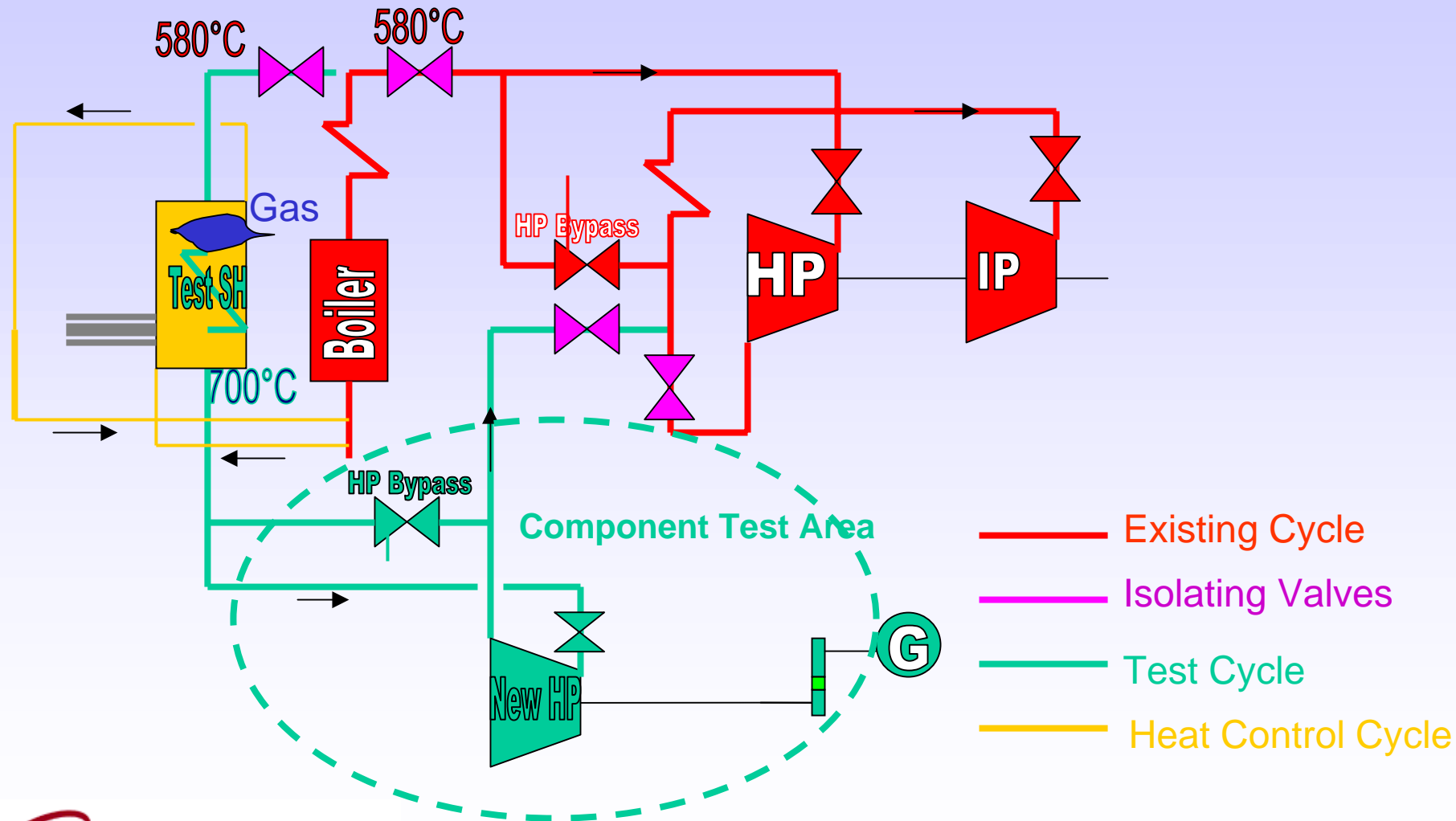
- The background is an expected huge need in Europe to replace plants which are more than 40 years old around 2010.
- The goal is to have the AD700 technology ready for commercial plants as early after 2010 as possible.

Partners of the Emax Group

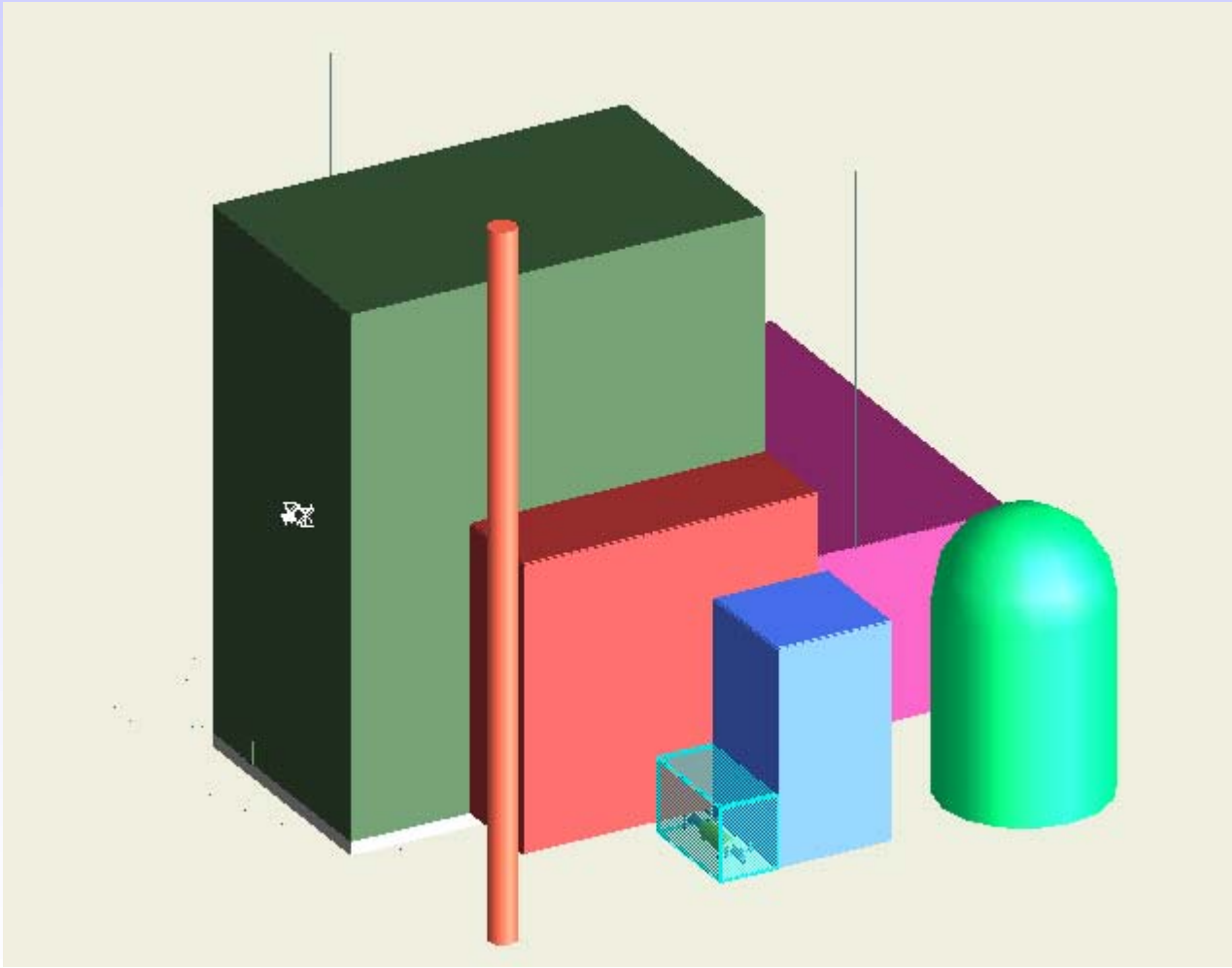
- E.ON Energie
- EdF
- Electrabel
- Elsam
- EnBW

- Enel produzione
- RWE
- Vattenfall
- VGB
- Energi E2

Coupling of Test Facility. Draft



Buildings for Test Facility. Draft



AD 700+ Emax. Time Schedule

Phase	Description	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
1A	Conceptual feasibility		█	█	█															
1B	Material property demonstration		█	█	█	█	█	█												
2A	Basic design for Phase 3						█	█	█											
2B	Material property demonstration						█	█	█	█										
3	Full Scale Test Facility (FSTF)							█	█	█	█	█	█	█	█	█				
3A	Contracts							█												
3B	Engineering & procurement								█											
3C	Construction									█	█									
3D	Operation of FSTF & feedback to Partners											█	█	█	█	█				
4	Emax. First-of-its-kind commercial plant												█	█	█	█	█	█	█	
4A	Planning and procurement												█	█						
4B	Construction & commissioning														█	█	█	█	█	