Outlook for RWE's nuclear operations

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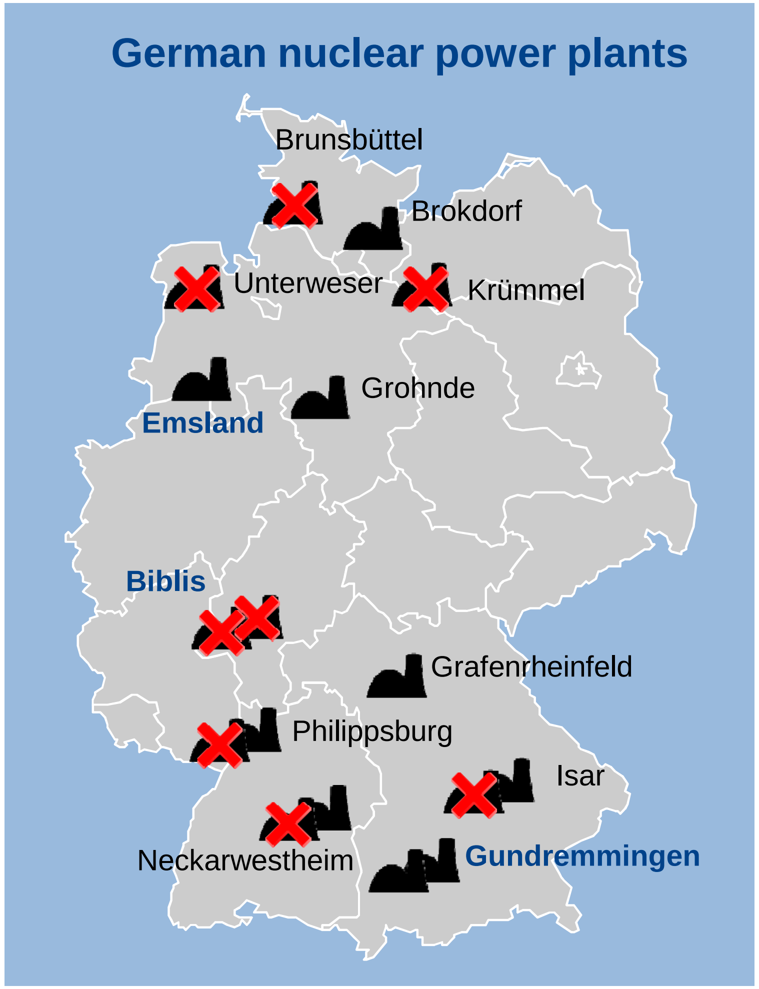
Overview of German nuclear power plants



Power plant	Net capacity MW	Commercial commissioning	Shutdown
Biblis A	1,167	1975	In 2011: 8,409 MW
Neckarwestheim I	785	1976	
Biblis B	1,227	1977	
Brunsbuettel	771	1977	
Isar 1	878	1979	
Unterweser	1,345	1979	
Philippsburg 1	890	1980	
Kruemmel	1,346	1984	
Grafenrheinfeld	1,275	1982	31.12.2015
Gundremmingen B	1,284	1984	31.12.2017
Philippsburg 2	1,392	1985	31.12.2019
Grohnde	1,360	1985	31.12.2021 4,058 MW
Gundremmingen C	1,288	1985	
Brokdorf	1,410	1986	
Isar 2	1,400	1988	31.12.2022 4,039 MW
Emsland	1,329	1988	
Neckarwestheim II	1,310	1989	
	20,457		

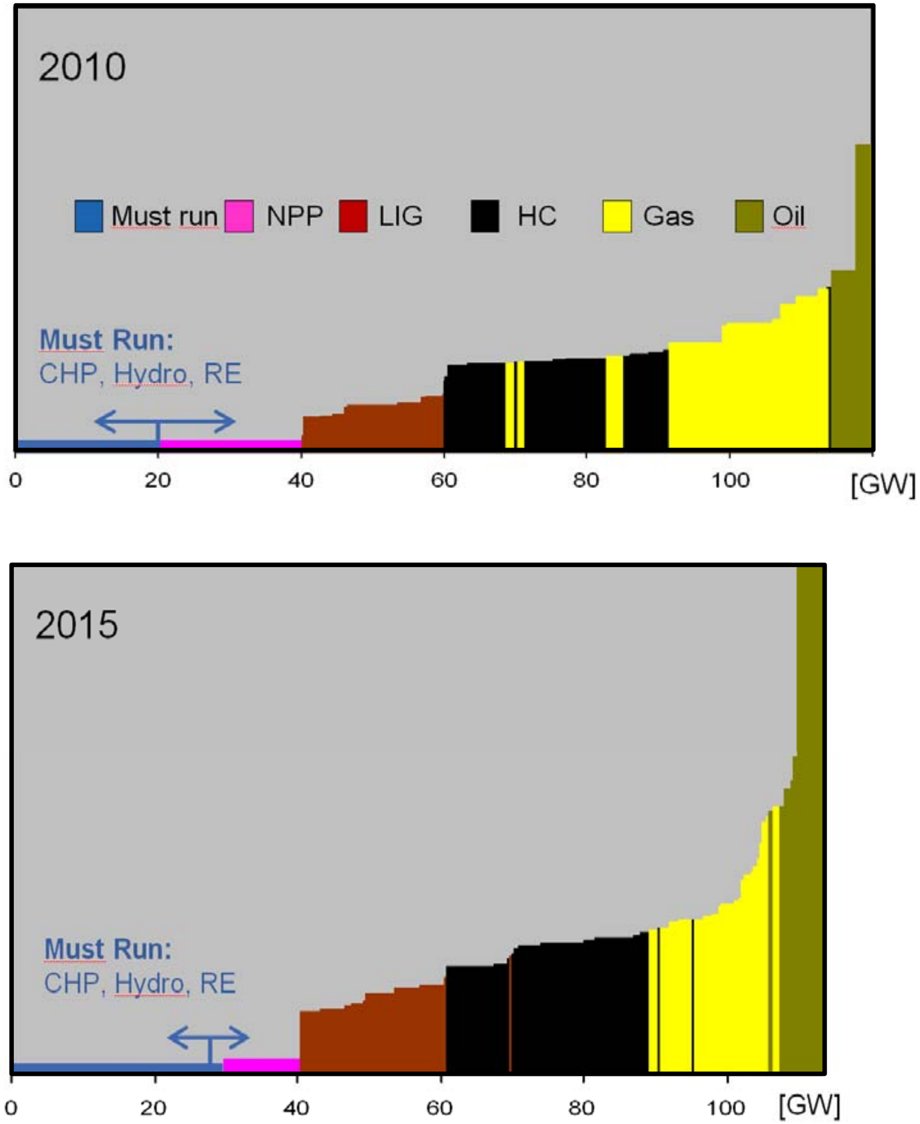
RWE power plants.

Agenda

1.	Operational outlook for the nuclear fleet
2.	The nuclear stress tests
3.	Decommissioning of nuclear power plants

NPP in stable baseload as long as in the market

German Merit Order



> German NPP remain in stable base load position in the German merit order.

> Until final shut down NPPs with high economic value.

> Flexibility to buffer fluctuating RE through large fleet of mid-load plants and export capacities.

> Redispatch of NPP as result of high RE inflow at best as a exception.

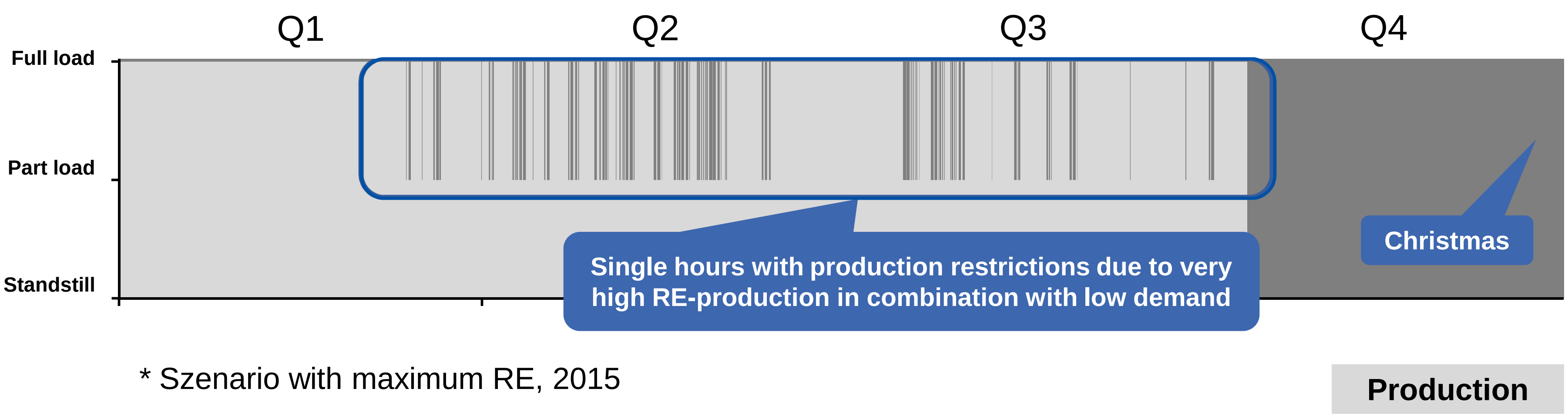
Stable base load characteristic for NPP in all scenarios at least in the medium perspective

> Even in scenarios with very high RE-production NPP in stable base-load position with >7500 h/y.

> Load following flexibility enables NPP even in hours with massive over-production to react flexibly by power reduction on stable part load level.

> Export as further flexible valve for short-term overproduction.

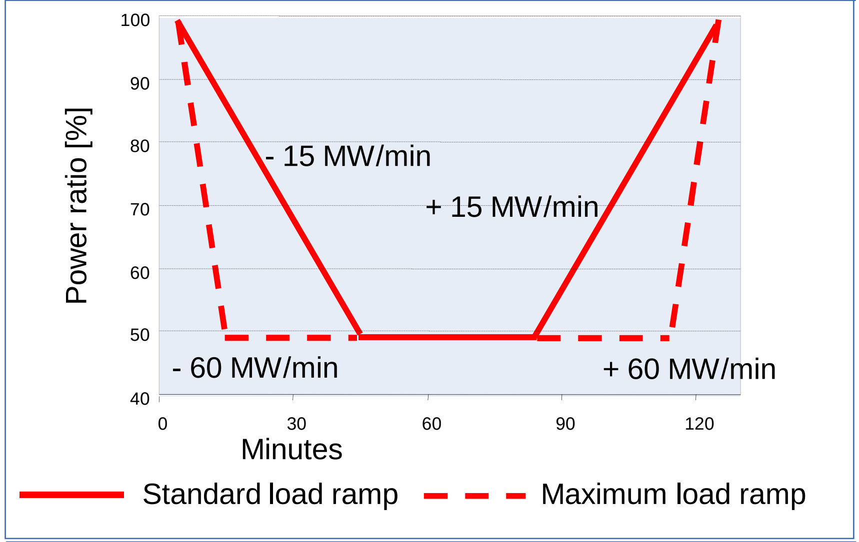
Production pattern of German base-load plant 2015*



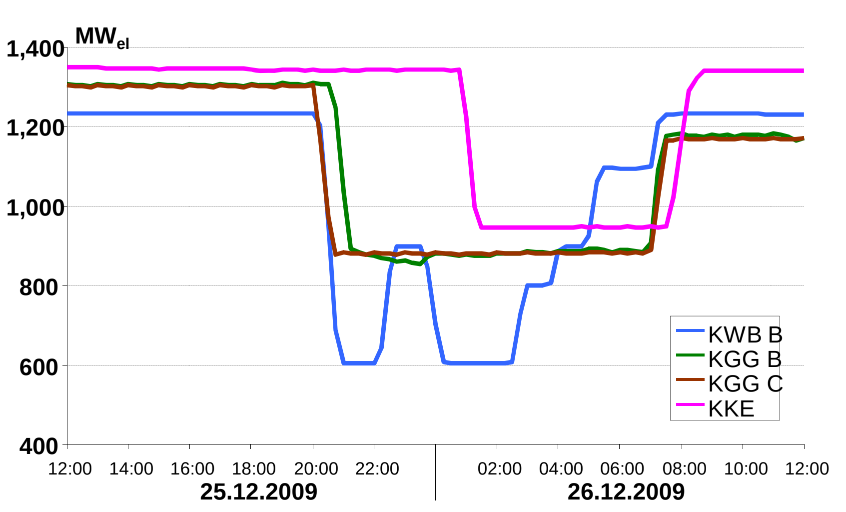
* Szenario with maximum RE, 2015

NPP with high flexibility reserves

Load ramp NPP



Adjustability of RWE-NPP



> German NPP designed for flexible and part load operation.

> Load ramps of +/- 15 MW/min used in today‘s operation mode.

> Load ramps of +/- 60 MW/min technically feasible.

> Load abatements used even today in case of low demand and high RE production.

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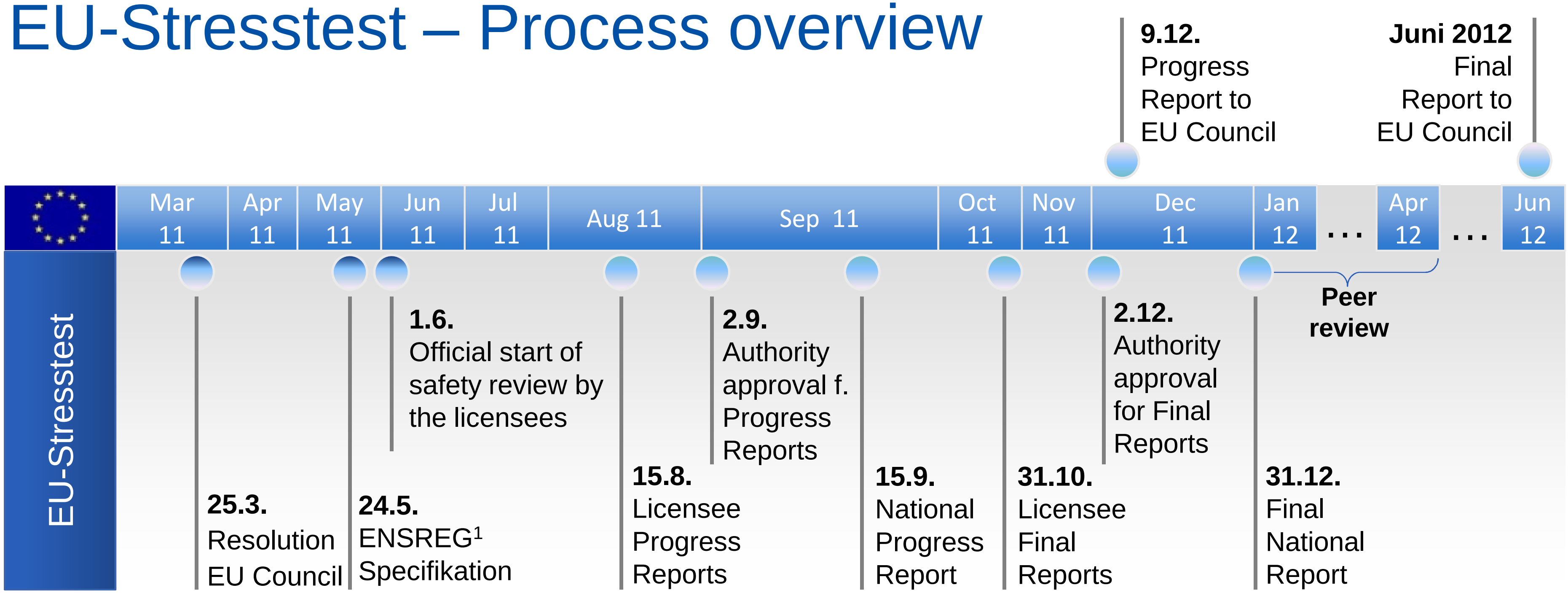
3.	Decommissioning of nuclear power plants

German Safety Review and EU stress tests

- German Safety Review (RSK-SÜ, by Nuclear Safety Commission) well before the EU stress tests started.
- Thus, the German operators are considerably advanced in investigating "Fukushima"-topics for their plants.
- Result of RSK-SÜ: High level of protection and robustness in all plants
  - No systematic relation between safety, type, generation or age of the plants.
  - A high robustness of the German NPPs is demonstrated with reasonable safety margins for all postulated severe accident scenarios even beyond design.
  - Consequences of the review results are under discussion with the relevant authorities.
- Result of EU stress tests: No new findings for German power plants.

EU-Stresstest – Process overview



> Safety review process by licensees and regulators completed end of 2011.

> Fifteen national nuclear regulators of the EU member states as well as Switzerland and Ukraine submitted final national reports for more than 140 NPP units.

> The results are subject to a Peer-review process until end of April 2012 consisting of a
  - Topical review investigating the technical details of the presented results and a
  - Country review verifying the regulatory processes applied.

> Public meeting of stakeholders will take place on 17th January 2012 in Brussels.

[1] European Nuclear Safety Regulators Group

Agenda

1.	Operational outlook for the nuclear fleet
2.	The nuclear stress tests
3.	Decommissioning of nuclear power plants

What are the special challenges of decommissioning?

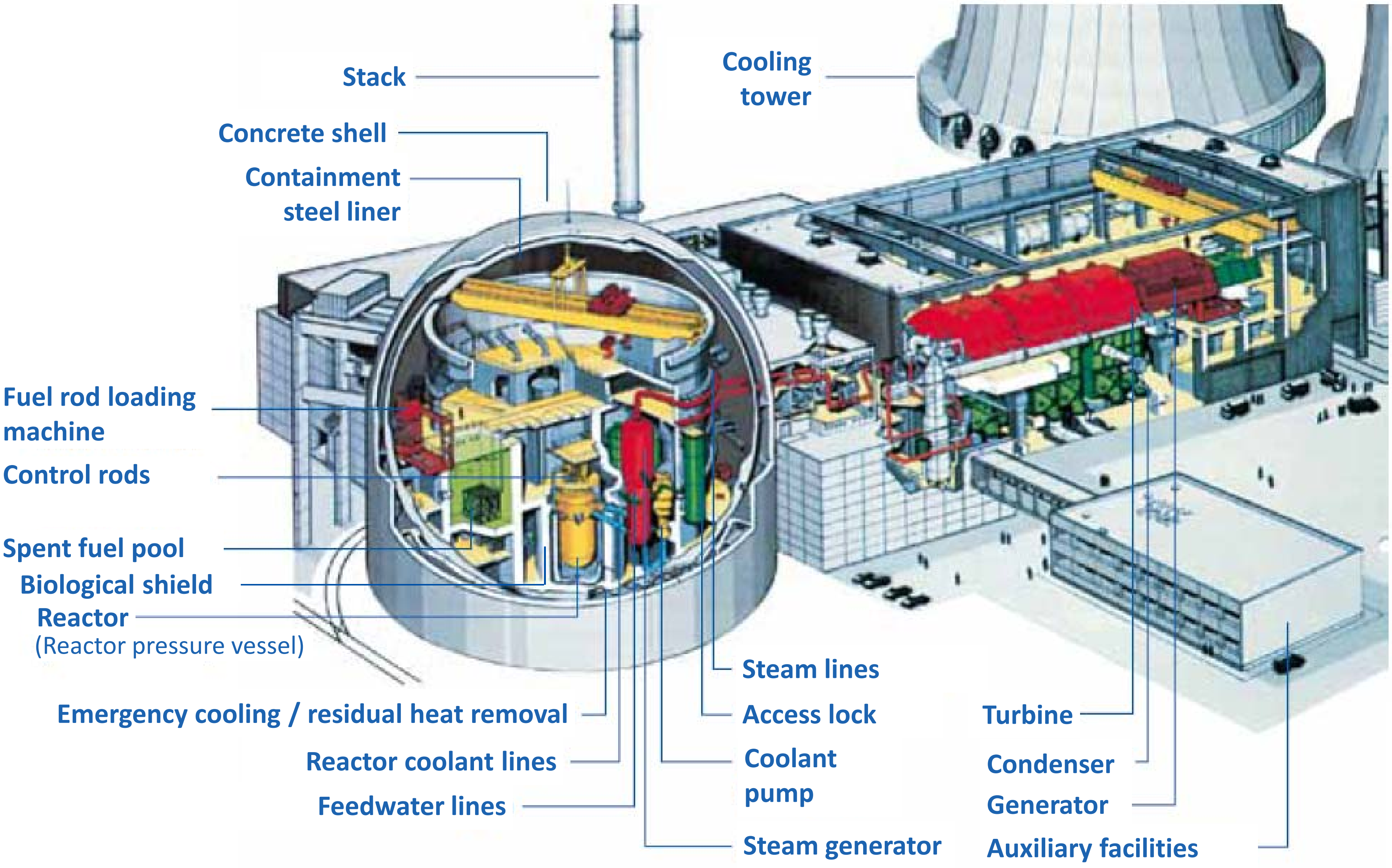
> NPPs in multiyear post-operation phase legally stay under their operating license.

> Decommissioning license necessary to start major dismantling works.

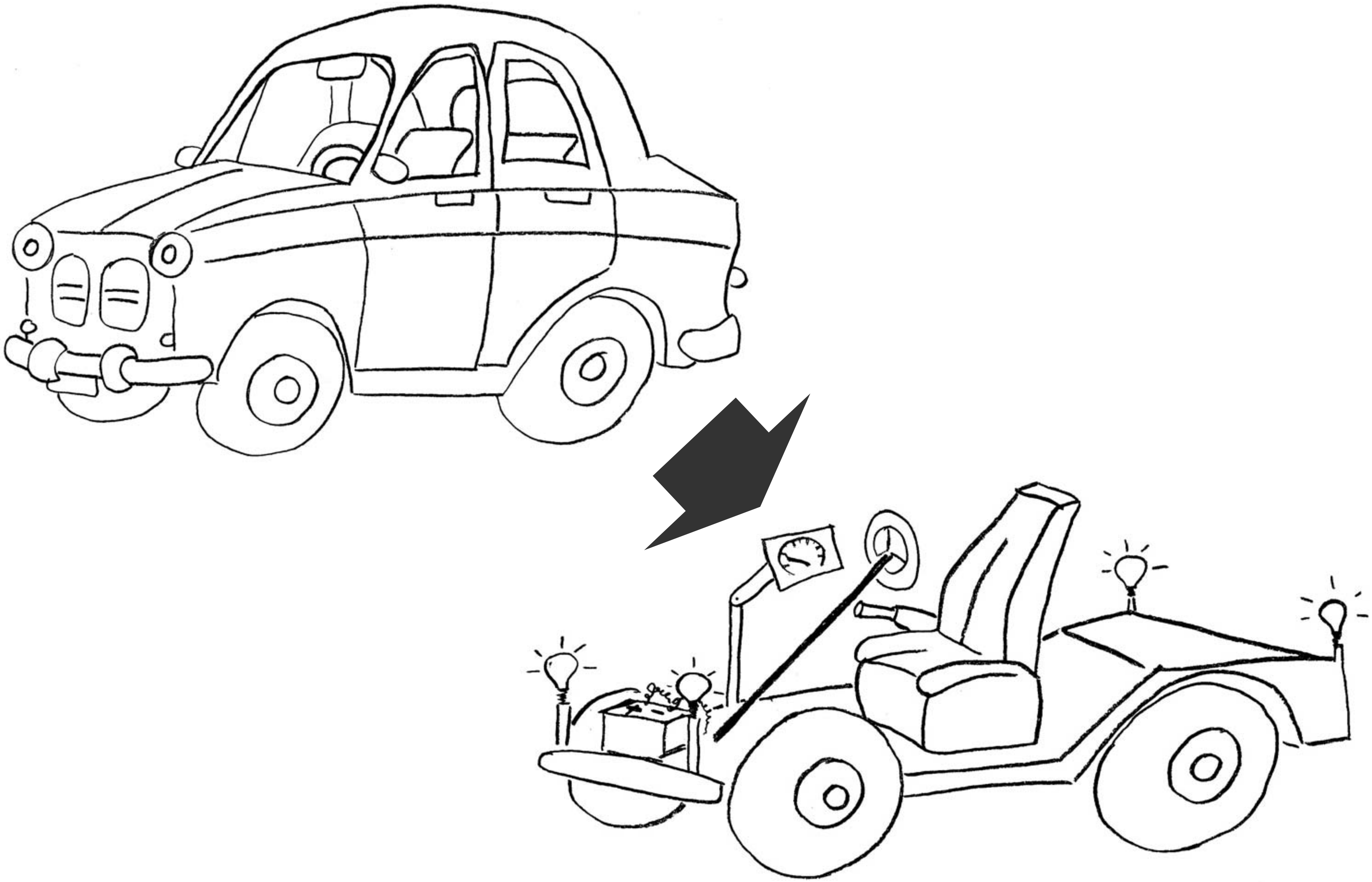
> Availability of vital safety functions in post-operation and dismantling phase under strict supervision of regulators, experts and radiation protection.

> Minimization of the economic burden under preservation of adequate safety levels.

Example: Biblis nuclear power station



Comparison to the decommissioning of a car



Decommissioning Options (I)
Definitions and Phases

Operation → Post operational Phase → Decommissioning

	Post operational Phase	Decommissioning
	5-7 years	Appr. 50 years (30 years of Safe Enclosure)

Deferred Dismantling (Safe Enclosure)

- For the time being, fuel elements are being cooled in fuel pools until they are suitable for dry-cask (CASTOR) storage on site

Preparation of Safe Enclosure (SE) → Operation of Safe Enclosure → Transition from SE to dismantling → Dismantling

Preparation of Safe Enclosure (SE)
- Partially dismantling
- Modification of infrastructure

Operation of Safe Enclosure
- Care and Maintenance

Transition from SE to dismantling
- Dismantling planning and licensing
- Preparatory work

Dismantling
- Dismantling of contaminated and activated systems, structures and components
- Materials and waste management (treatment, conditioning, packaging)

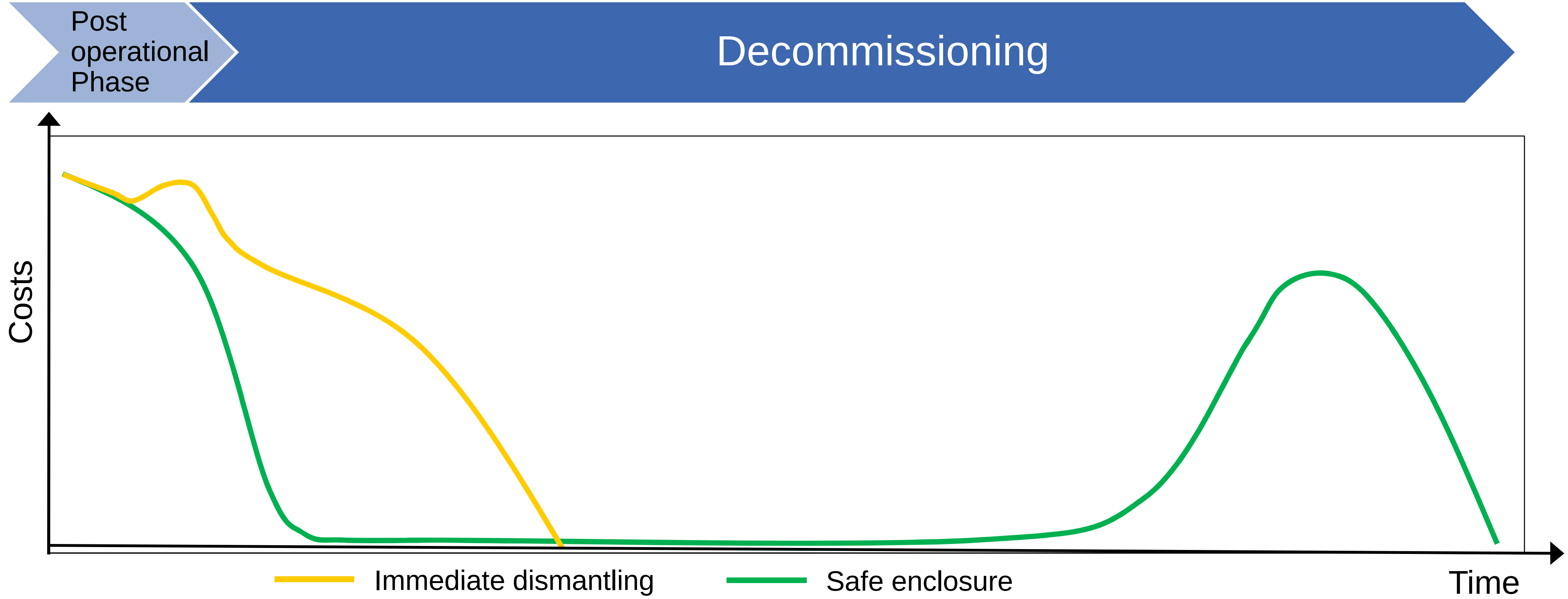
Immediate Dismantling

- Systems no longer needed to be shut down
- Treatment of operating materials and waste

15-20 years

Dismantling
- Dismantling of contaminated and activated systems, structures and components
- Materials and waste management (treatment, conditioning, packaging)

Decommissioning Options (II)
Cash flows and decision criteria



Immediate dismantling:

+ staff / know-how available
+ higher public & political acceptance
+ site available for future use
- earlier cash-out
- Interim storage facilities necessary

Safe enclosure:

+ dose reduction by radioactive decay
+ costs postponed to the future
+ Independent from interim storage /final repository
- Irreversible loss of staff / know-how

Nuclear Provisions

Provisions for uncertain liabilities as per IAS 37

Public-law liabilities under Sec. 9a of the Germany Atomic Energy Act:

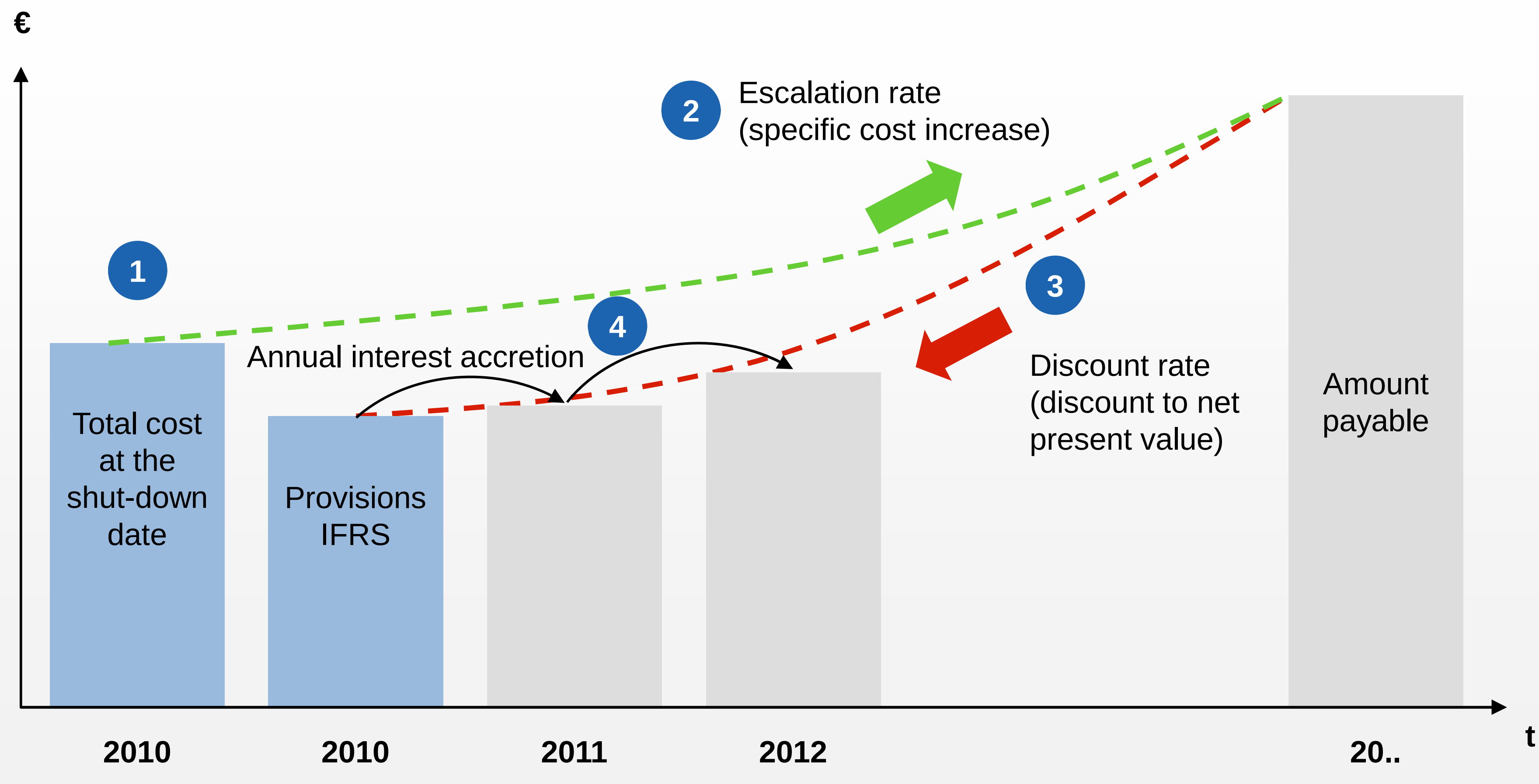
- „Polluter-pays-principle“
- operator is responsible for waste-management and decommissioning
- obligation by the operator, to deliver all radioactive waste to the state
- obligation by the state to build and operate final repositories

Provisions are made for	RWE fiscal year 2010: €10,010 million
> Disposal of spent nuclear fuel assemblies Flasks, transport, conditioning, intermediate and final storage	€4,831 million
> Decommissioning of nuclear power plants Post-operation phase, dismantling, removal, final storage	€4,490 million
> Disposal of radioactive operating waste (e.g. cleaning cloths, oils, resins) Conditioning, flasks, intermediate and final storage	€689 million

Inflation of current cost to the assumed disposal date by a set inflation rate;
then discounting of the result back to today (discount rate 5.0%)

How the Size of the Provision is Determined

Schematic description



Decommissioning Success Factors

> Shift from operational excellence to dismantling project

> Dismantling is long term demolishing under strong restrictions regarding radiation protection

> Flexible dismantling and materials/waste management planning
  - Logistic and waste stream concept
  - Optimization of plant service operation, e.g. new modular systems for energy and media supply, ventilation and evaporation
  - Combination of off-site and on-site dismantling as well as waste treatment

> Optimisation of the licensing strategy
(reduction of partial licences, in an extreme case only one overall licence)

RWE has a broad experience in all these fields

RWE Decommissioning Experience – Examples

Immediate Dismantling

NPP Kahl
(BWR, 16 MW_{el})
Green Field (10/2010)

NPP Gundremmingen
Unit A (BWR, 250 MW_{el})
Dismantling nearly completed

Experiences:
> Dismantling and Decontamination Technology Developments
> Waste treatment optimization
> Final release of buildings and site
> Future nuclear use (Technology Centre Unit A)

NPP Mülheim-Kärlich
(PWR, 1,219 MW_{el})
Dismantling of contaminated parts

Experiences:
> Shut down and simplifi-cation of systems
> New "mobile" systems as surrogate for existing residual operation systems
> Partial release of buildings and terrain

Deferred Dismantling

NPP Lingen
(BWR, 240 MW_{el})
Transition from SE to dismantling

Experiences:
> Preparation and operation of safe enclosure

Conclusions:
> Extensive experiences from decommissioning of nuclear power plants since more than 2 decades
> Technical feasibility in compliance with safety and radiation protection standards is proofed
> All necessary technologies are available and were employed effective several times
> Qualified service providers are available
> Provision calculation model is established, well accepted and reliable

Dismantling Process (I)
(Immediate dismantling)

1	Licence procedure	
2	Dismantling of contaminated systems and components	
3	Dismantling of activated components (RPV*)	

* Reactor pressure vessel

Dismantling Process (II) (Immediate dismantling)

4 Dismantling of biological shield

5 Dismantling of remaining components

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Dismantling Process (III)
(Immediate dismantling)

6 Decontamination and release of buildings

7 Pulling down of buildings

Dismantling Process (IV) (Immediate dismantling)

8	Release of terrain (greenfield)	

Final repository sites Konrad & Gorleben

Konrad	Gorleben
Final repository for <u>non-heat-generating waste</u> (low- and intermediate-level waste, also medical waste) 	Final repository for <u>heat-generating waste</u> (fuel rods, waste from reprocessing etc.) 
> Former ore mine (1957 – 1976) > Consented for 303.000 m³ of waste packages, sufficient for all non-heat-generating waste from operation and decommissioning > Approx. 95% of total waste volume is non-heat-generating > Planning approval procedure started in 1982 > Consent in 2002, last instance in 2007 > Costs so far: 1.2 billion €* > Total costs: ca. 3.2 billion €	> Unused salt dome > Begin of selection process from 140 salt domes in the 70ies, Federal government selected Gorleben in 1977 > Exploration 1979 to 1999 > Moratorium from 2000 to 2010 > Search for alternative locations currently under discussion > Costs so far: 1.6 billion €** > Total costs: ca. 3.9 billion €
Commissioning around 2019 expected	**Commissioning in 2030ies possible**

* Utility share: 64.4%
** Utility share: 96.5%

Conclusions

> The recent change in German energy policy leads to the final shutdown of 8 nuclear power plants, of which 2 belong to RWE

> Different decommissioning options
  - Immediate dismantling
  - Safe enclosure

> Provisions for decommissioning and final storage were made in sufficient amount

> RWE has a solid expertise in all important fields of decommissioning
  - Immediate Dismantling: VAK, Mülheim-Kärlich, Gundremmingen A
  - Safe enclosure: THTR, Lingen

> Industrial market for materials and waste treatment well established

> The availability of the final repository site Konrad is an essential success factor

VAK = Versuchsatomkraftwerk Kahl
THTR = Thorium-Hoch-Temperatur-Reaktor