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Summary of the European SERF-3 Programme

David Ward, Ian Cook

Culham Science Centre

on behalf of GianCarlo Tosato & the SERF Team

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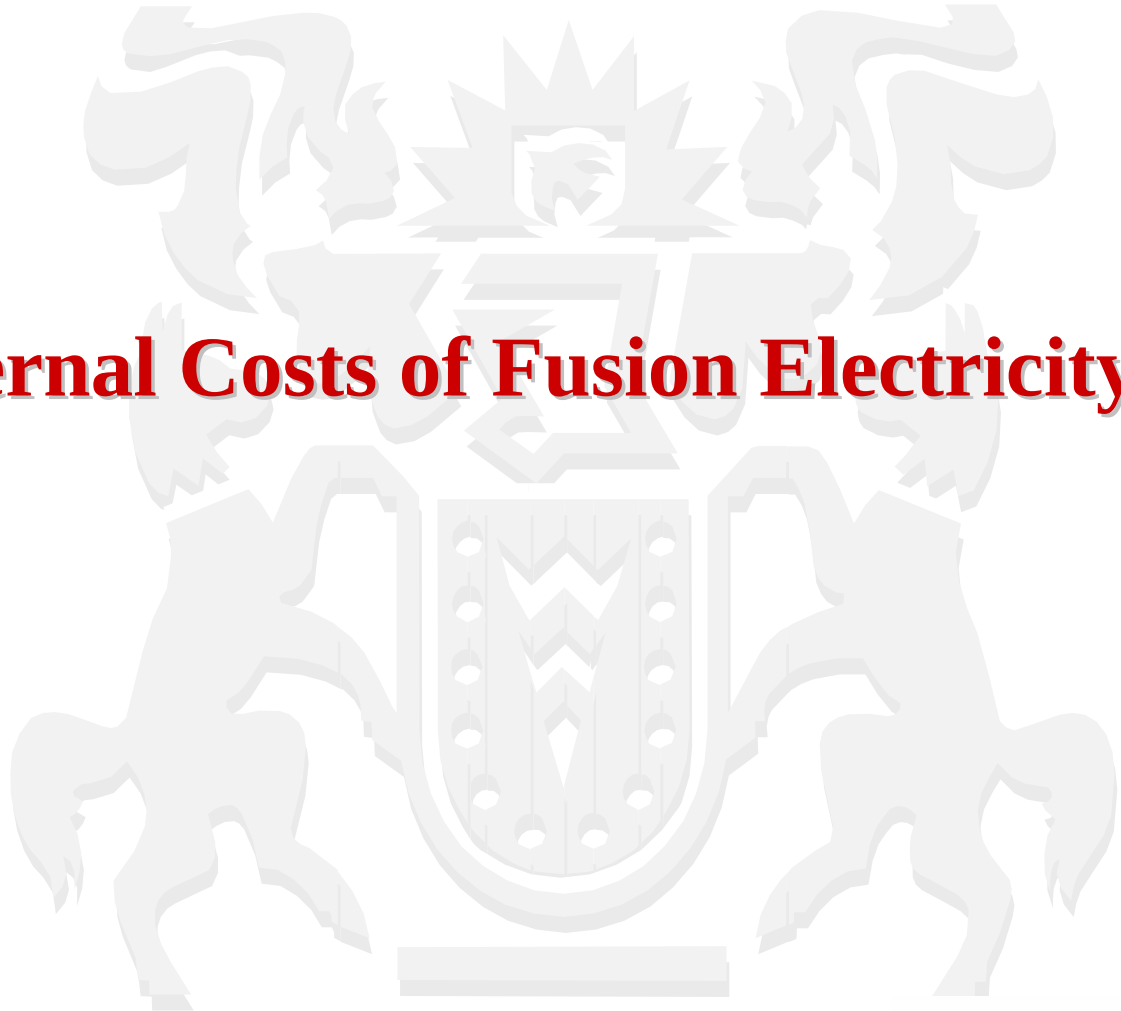
Internal Costs of Fusion Electricity



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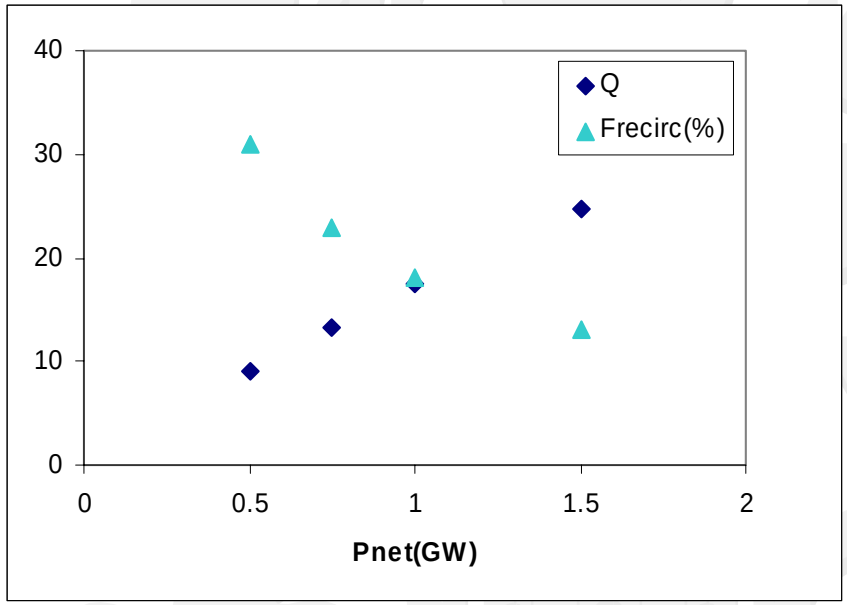
Can a fusion power plant load-follow?



Yes

(Economic penalty at operating below design power)

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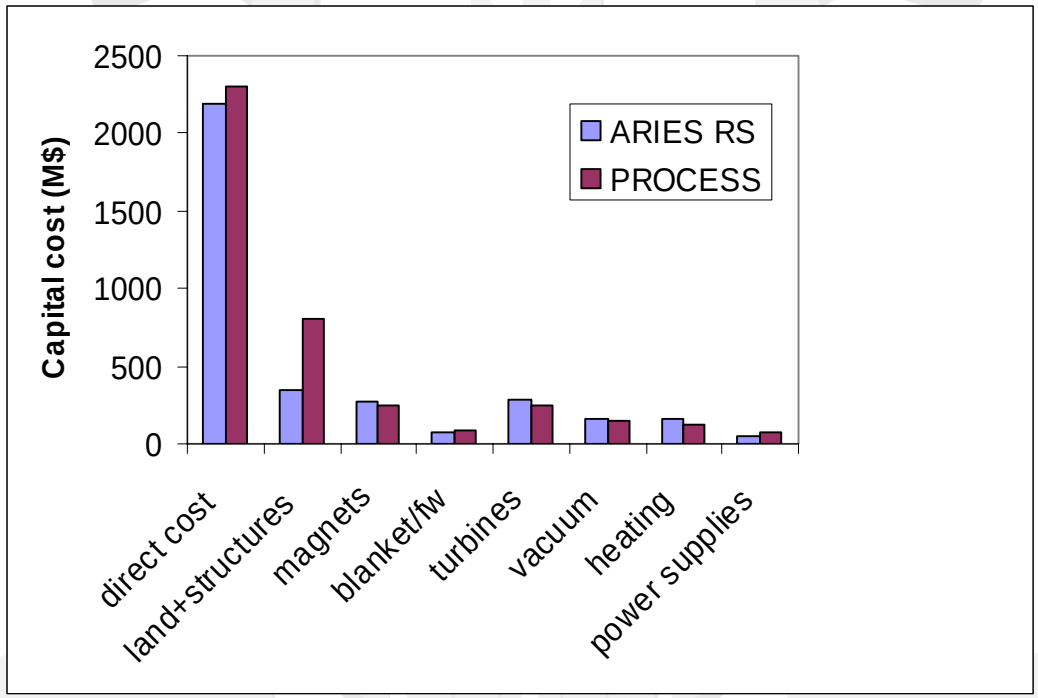
International benchmarking studies of fusion costs



EU and US cost assessments similar overall for the same assumptions. Some notable exceptions in detailed breakdown of components

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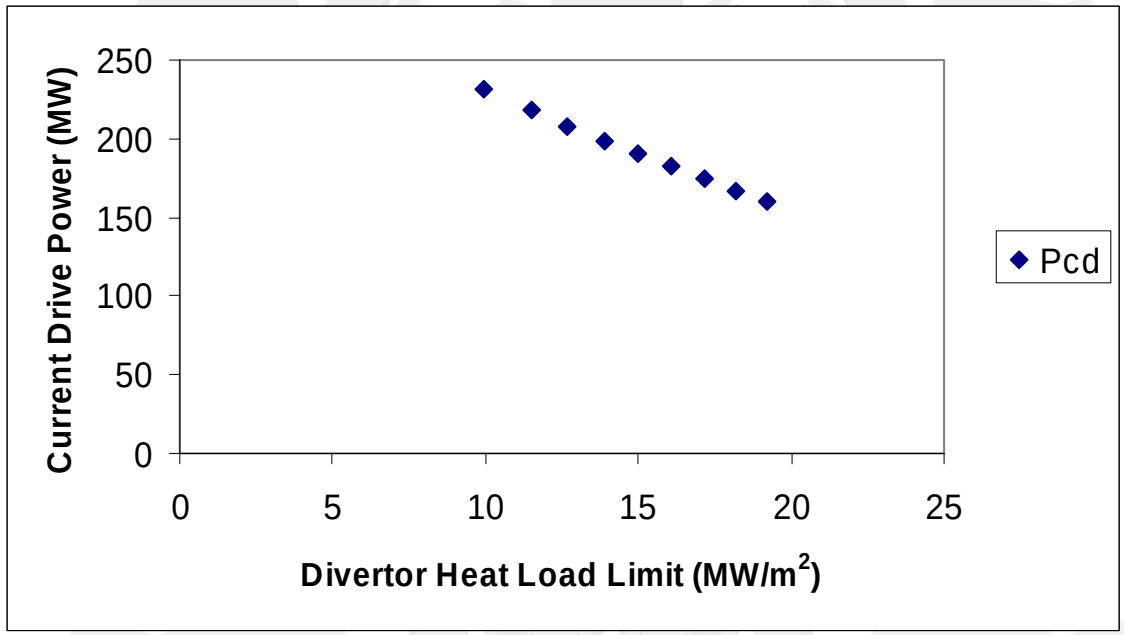
Interactions between physics and technology developments can be quite complex



Example: Higher tolerable divertor heat load imposes lower penalty on main plasma. Lower plasma current and lower current drive power becomes feasible.

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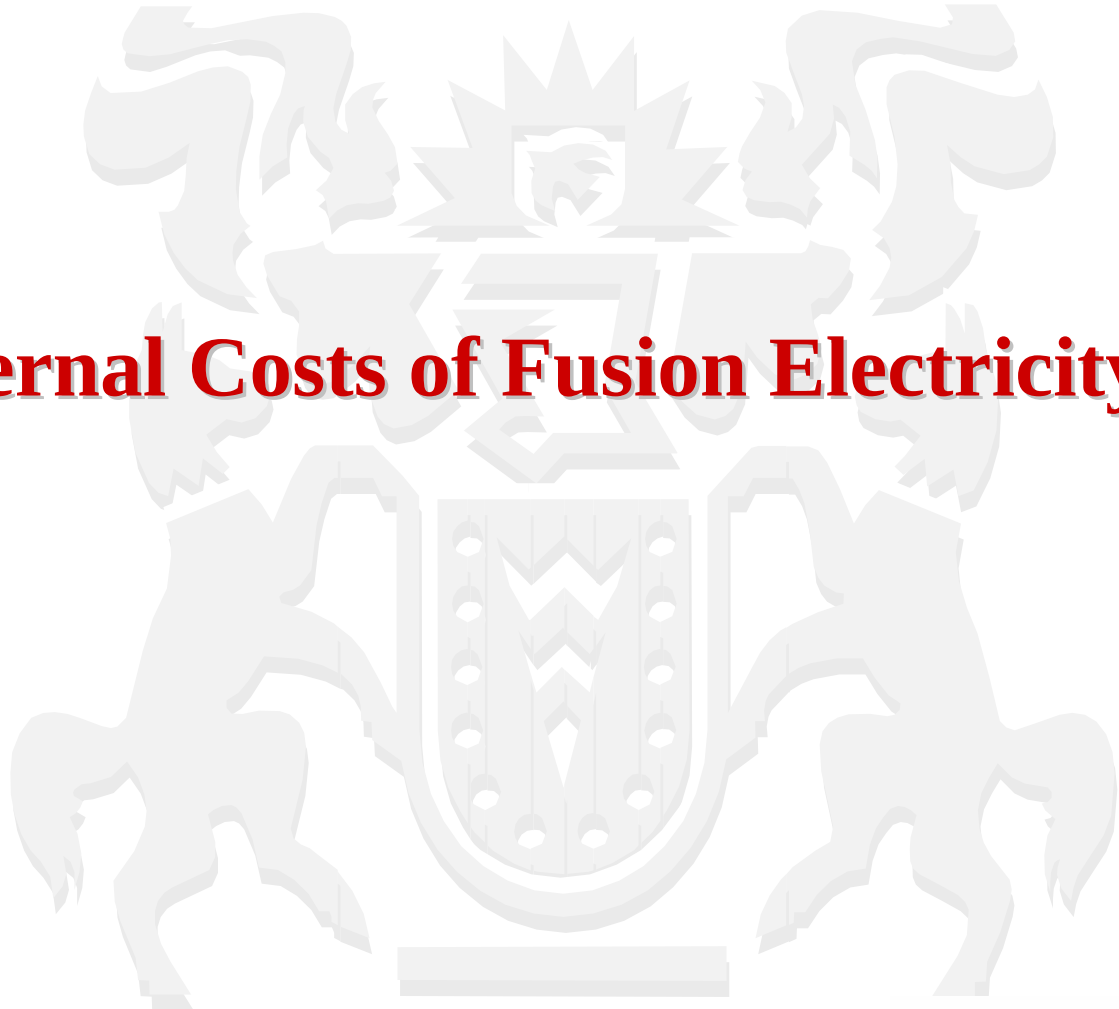
External Costs of Fusion Electricity



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External costs of wide variety of fusion power plant designs

Plant Model	FW/blanket structure	Tritium-generating material	Neutron multiplier	FW/blanket coolant
1	vanadium alloy	Li_2O ceramic pebble bed	none	helium
2	low activation martensitic steel	liquid $Li_{17}Pb_{83}$	$Li_{17}Pb_{83}$	water
3	low activation martensitic steel	Li_4SiO_4 ceramic pebble bed	beryllium	helium
4	SiC/SiC	liquid $Li_{17}Pb_{83}$	liquid $Li_{17}Pb_{83}$	liquid $Li_{17}Pb_{83}$
5	low activation martensitic steel with SiC/SiC insulators	liquid $Li_{17}Pb_{83}$	$Li_{17}Pb_{83}$	Helium and liquid $Li_{17}Pb_{83}$
6	SiC/SiC	Li_4SiO_4 ceramic pebble bed	beryllium	helium

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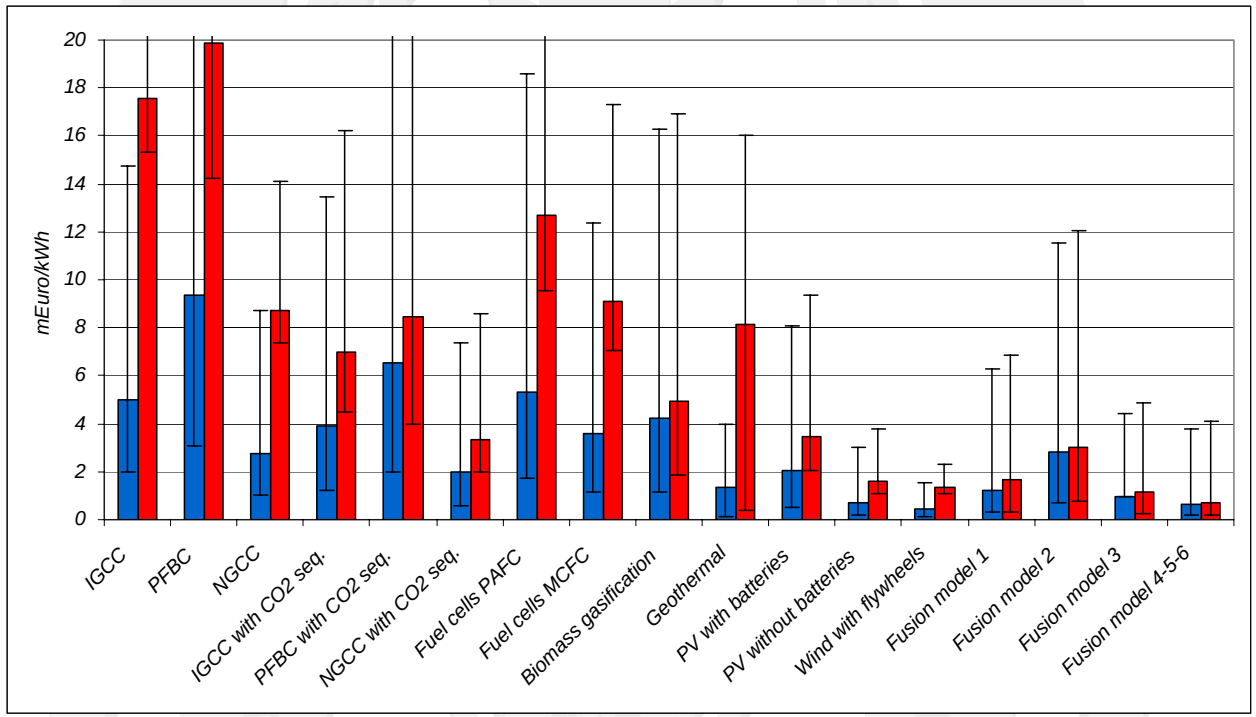
Externalities of fusion plants are the lowest achievable even by advanced technologies



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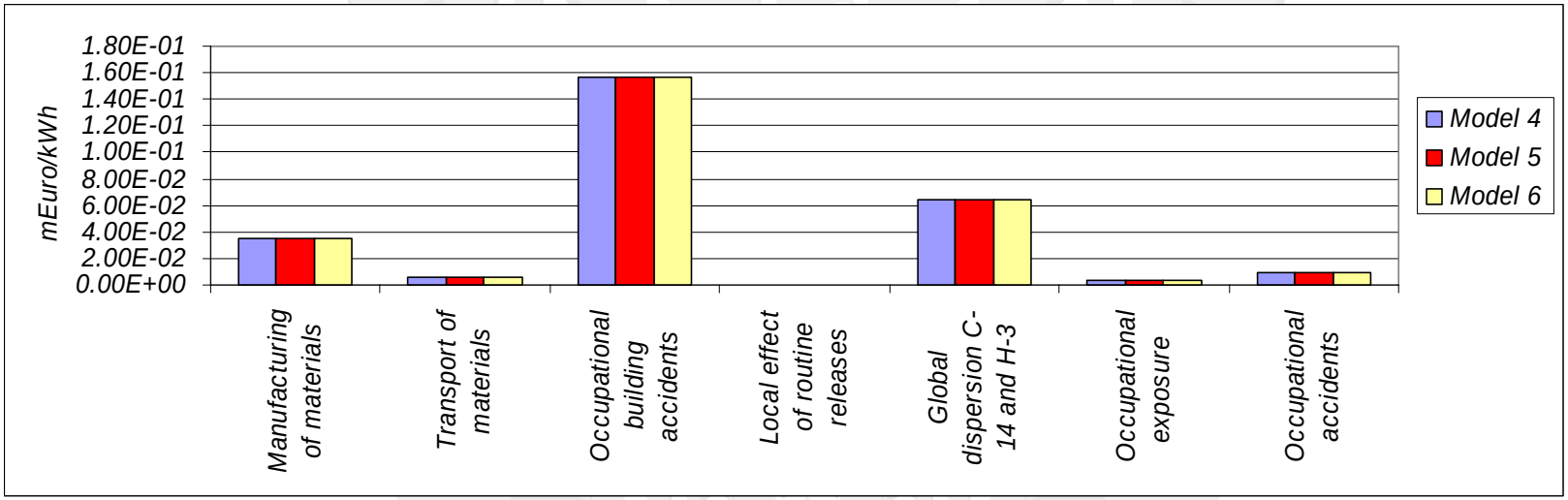
Conventional cost items make the largest contribution to the externalities



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Fusion as Part of the Energy System

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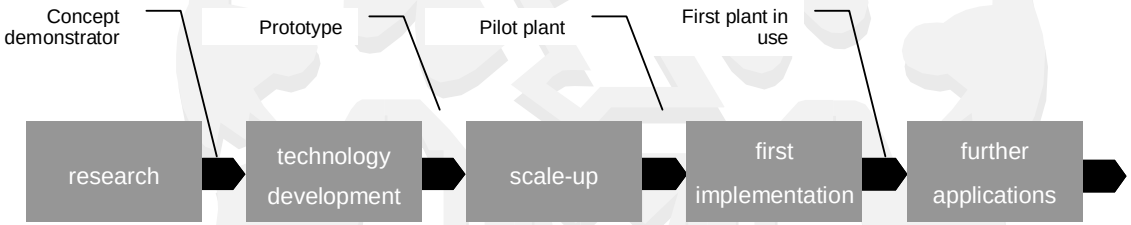
Valuation of the fusion R&D programme



Incorporates ITER, IFMIF DEMO through to commercialisation

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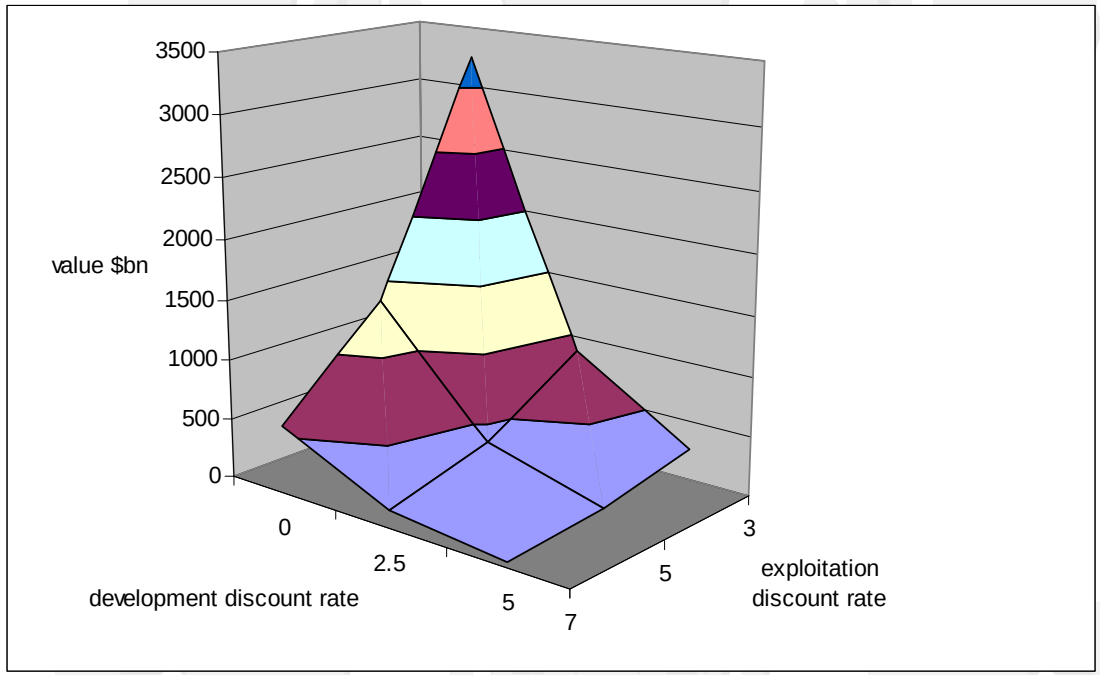
Risk-adjusted net present value of the fusion R&D programme



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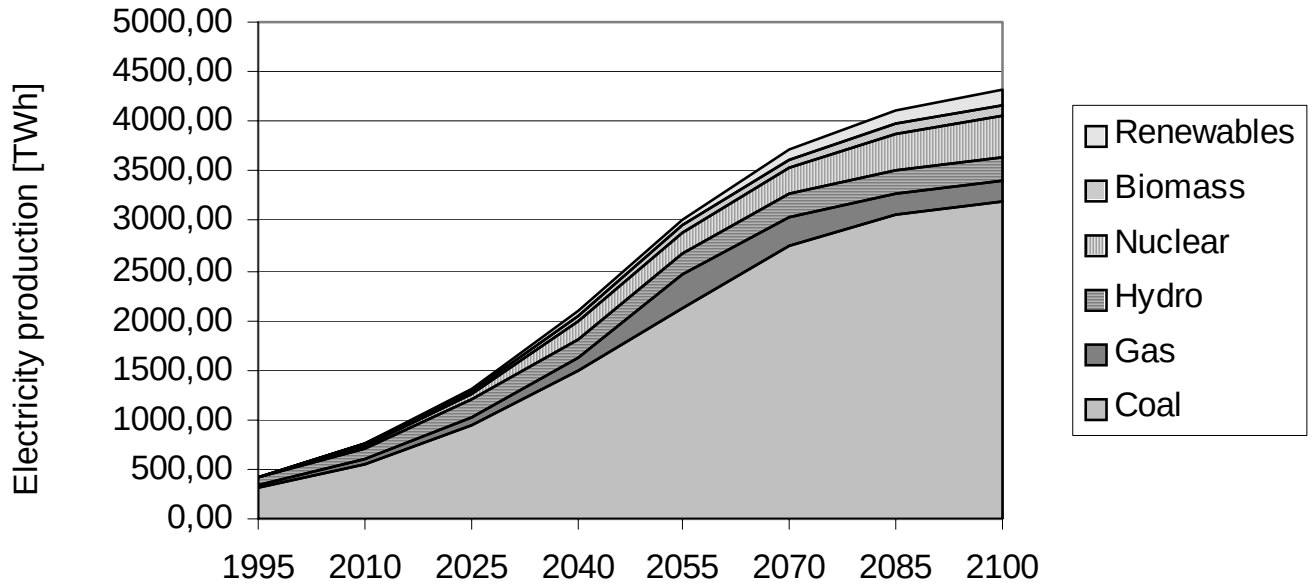
India energy scenario with no pollution constraints



Almost all coal

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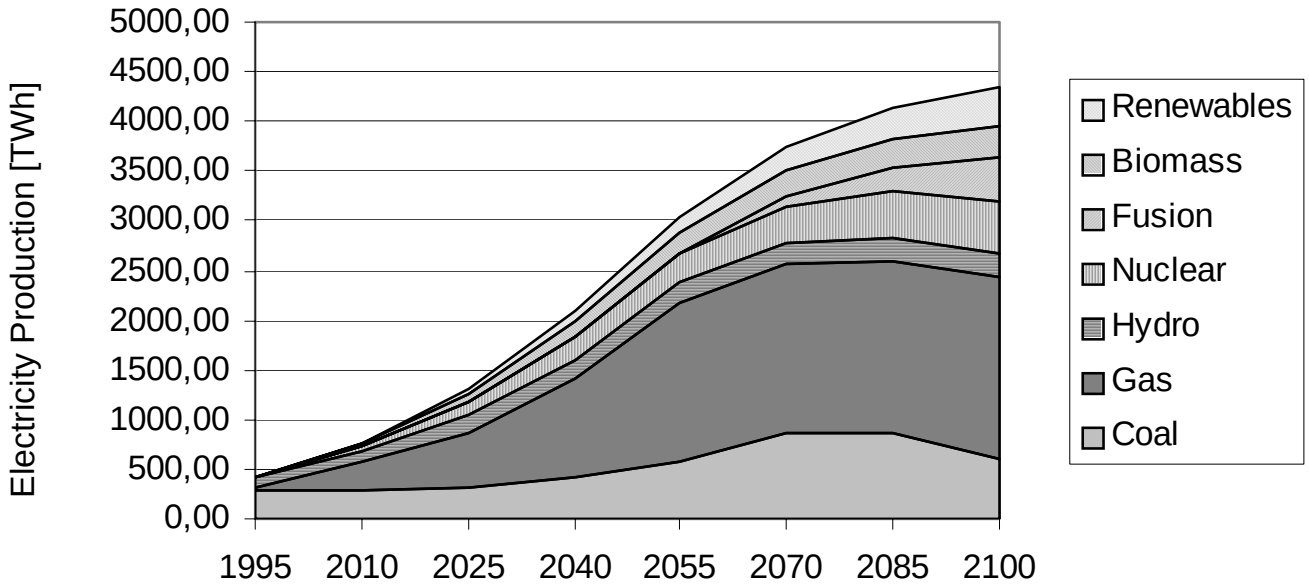
India energy scenario with CO_2 restriction



Low coal, gas takes over, others expand including fusion

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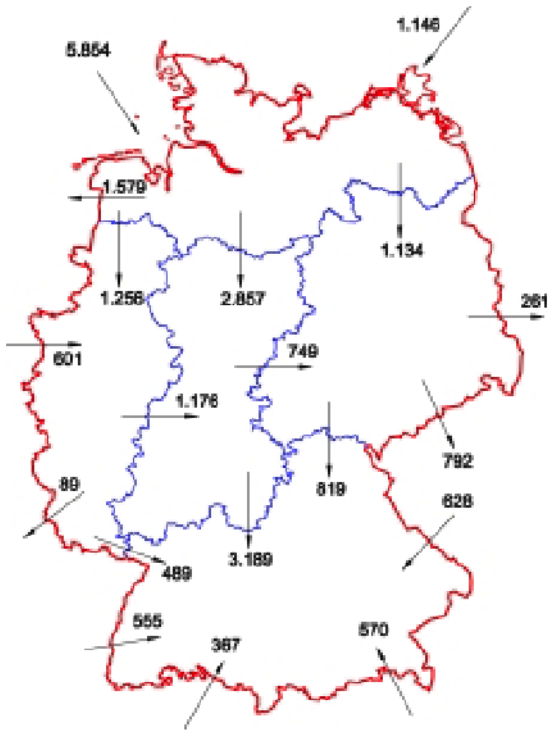
Effect of adding 7GW of generation in North Germany and removing 7GW from South



Additional power flows within Germany and trade with neighbouring countries.

System upgrades needed.

7% of power lost in transmission.

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Fusion and Public Opinion

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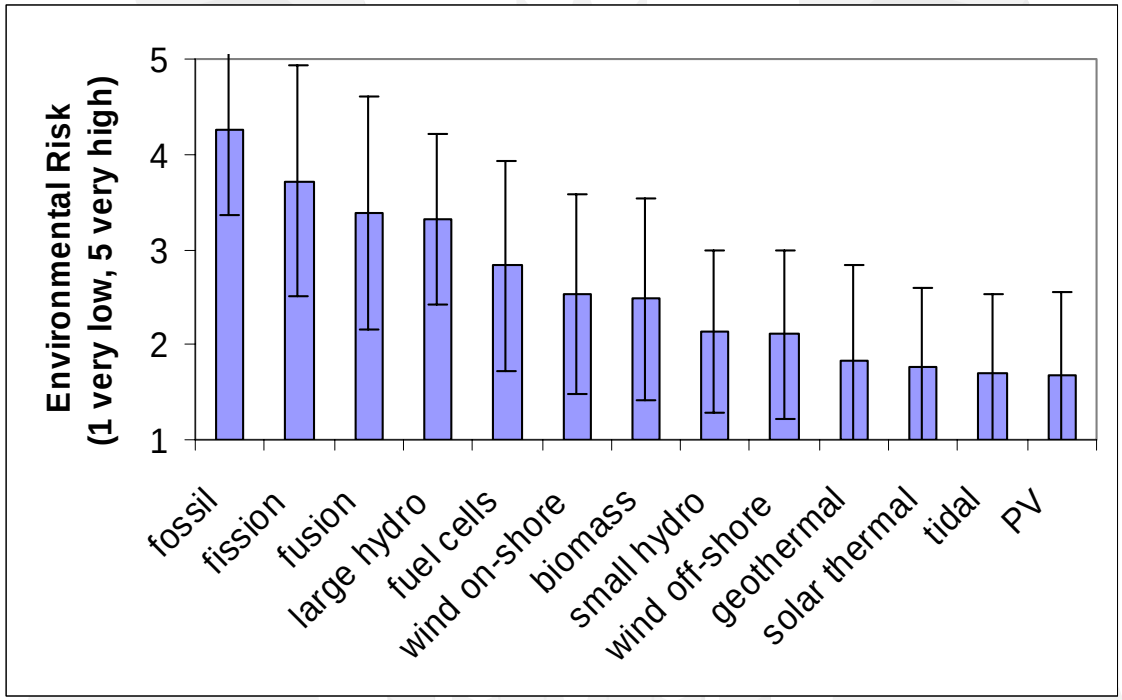
Public perception of risk associated with different energy sources



Carried out by Focus Groups analysis based around siting of ITER in Cadarache. This is somewhat at odds with the externalities assessment.

Better information on fusion required, or underestimation of risks from other sources (e.g. biomass pollution)?

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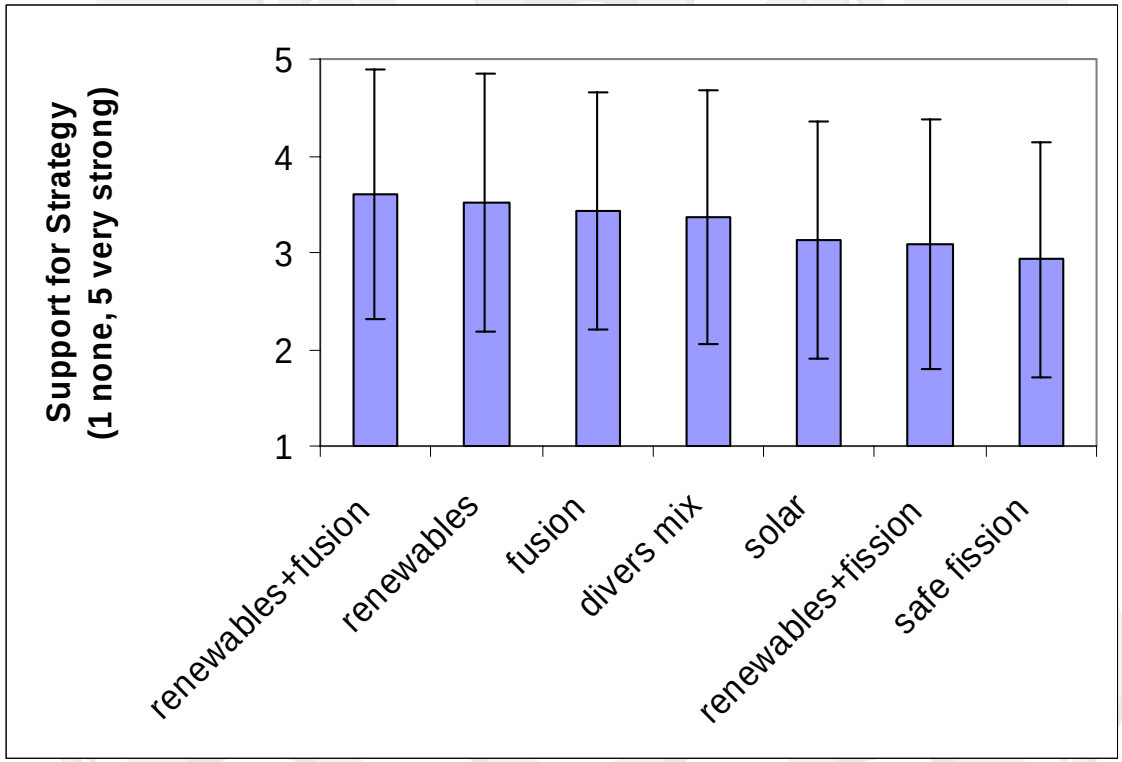
Public support for future energy strategies



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Summary of Main Points

- Internal costs of fusion:
  - **Fusion power stations will be able to load-follow**, with some economic penalty.
  - **International (EU and US) benchmarking studies show generally good agreement in the overall cost of plant and cost of electricity**.
  - Complex strong linkages between plasma physics, technology and economics have been elucidated.
- External costs of fusion:
  - **External costs of plant models utilising silicon carbide in the blankets are extremely low, even lower than the earlier plant models**.
  - For these models the largest contributions to the external costs are from conventional items such as accidents during construction.

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Summary of Main Points (2)

- Fusion as part of the energy system:
  - **The expected net present value of fusion development, derived from a probabilistic analysis, is substantially positive, in spite of the fact that successful commercial realisation is not certain**.
  - **Modelling of the future energy market in India, with pollution constraints, shows that** the growth in coal use is suppressed, in spite of the large growth in electricity consumption, and **fusion is introduced**.
  - Looking at a future electricity network as a whole there is additional value in low-carbon energy sources, such as fusion, that can provide firm power in diverse geographical locations. This additional value derives from transmission and network stability considerations.

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Summary of Main Points (3)

- Fusion and public opinion:
  - **There is a generally favourable public view of fusion as part of the future energy system, although there are apparent deficiencies in the information that is reaching the public.**

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