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SOCIO-ECONOMIC aspects of Fusion Energy

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on behalf of SERF team

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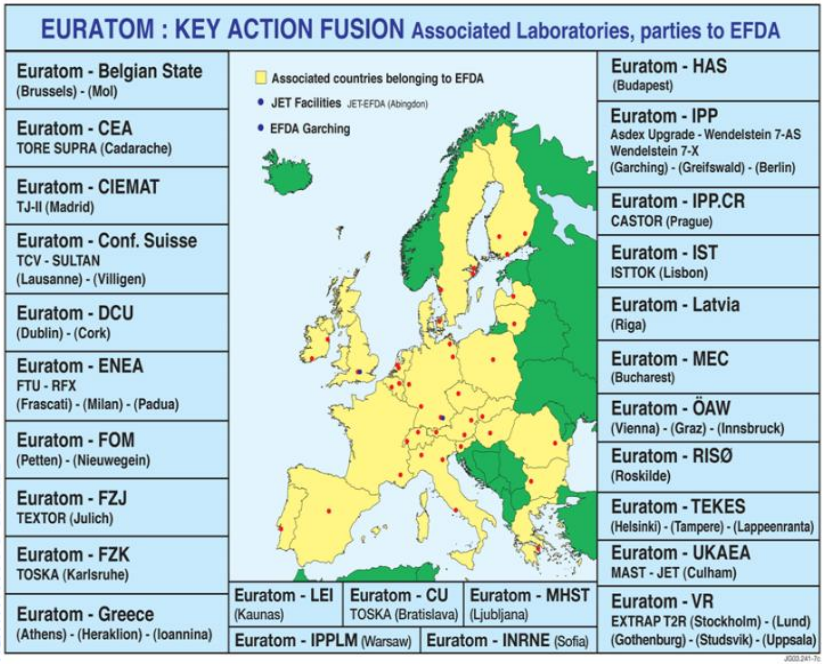
EFDA – European Fusion Development Agreement
http://www.efda.org

28 European countries signed EFDA - an agreement to work together on an energy source for the future: Fusion Energy

Studies on Socio-Economic aspects of Fusion Energy
accompany FUSION R & D in Europe
from 1997



addressing

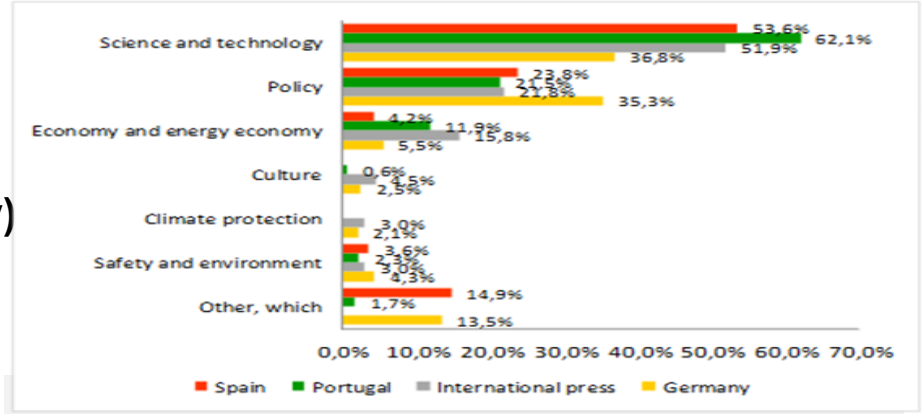
FUSION ENERGY

SOCIAL ACCEPTABILITY
and
ECONOMIC VIABILITY

These activities make also part of the
2014-2018 Work Plan
of EuroFusion Consortium

Social AWARENESS and ACCEPTABILITY:

- lay perception and reasoning about fusion
- dialog with "informed publics" (civil society)
- public discourse analysis (media coverage)



- **Scarce awareness of fusion** among lay publics
- *A certain extent of* **stigmatization of fusion** by a (better known) **nuclear fission energy**
- *A certain extent of* **positive framing: promise of energy 'abundance'** and **'cleanness'**.

RECENT: European Public Discourse on Nuclear Fission and Fusion. Confronted:

- **Fusion** and **Fission** discursive images
- Public discourses in **Germany, Portugal, Spain** and in the **English language print media addressing trans-national elites** (The Economist, Times, International Herald Tribune, Observer…, …)
- **Two periods: Before and After Fukushima**

- **Coverage of fusion: limited, irregular** but rather **positive**. **Focus on clamorous events, S &T achievements**
- **Fusion framed as a RESEARCH challenge** (Manhattan projects,…medieval cathedrals, …crusade for the Holy Grail…)
  and not as an ENERGY option
  only Germany and France high and regular coverage, fusion discussed in the context of a policy debate).
- The impact of Fukushima on fusion image minor, if any: public discourses on fusion and fission are not linked
- But: Fusion energy also **not linked (as it should be!)** to the **decarbonised economy, climate change,**

ECONOMIC VIABILITY:

Energy scenario modelling, employing a

model generator TIMES

(TIMES: The Integrated MarkAl EFOM System)

developed by IEA-ETSAP

Scenario modelling ≠ scientific foresight. **It shows how the energy system** can look like **under a range of assumptions:**

- Future population and GDP dynamics in world regions,
- Present and future energy technologies E & T features
- Emission reduction policies…,…

Fusion economics → **European Power Plant Conceptual Study, 2005**

EFDA TIMES:

- Multi-regional (17), global, long-term (2100) model
- Economic equilibrium model
- Optimization model
- Technology rich model (economic & technological features of more than 2000 technologies modelled)

- Base year 2005: IEA statistics

	Year	Overnight cost $/KW	Efficiency %	Fix O&M cost M$/GWa	Var O&M cost M$/PJ	AF %	Life
Basic plant	2050	3940	42	65.8	2.16	85	40
	2060	2950	42	65.8	1.64	85	40
Advanced plant	2070	2820	60	65.3	2.14	85	40
	2080	2170	60	65.3	1.64	85	40

Global energy models/scenarios	Horizon	Drivers	Constraints
IEA Energy Technology Perspectives	2050	Population, GDP, Prices	Emissions, technologies
IEA World Energy Outlook 2011	2035	Population, GDP, Prices	Policy, emissions, technologies
IIASA GGI scenarios	2100	Population, GDP, Prices	Policy, emissions, technologies, etc.
IIASA WEC global energy perspective	2050	Population, GWP, Prices	Policy, emissions, technologies, etc.
IPCC emission scenarios	2100	Population, GDP, Prices	Policy, emissions, technologies, etc.
ETSAP TIAM world scenarios	**2100**	**Population, GDP, Prices**	**Policy, emissions, technologies, etc.**
SHELL energy scenarios	2050	Population, GDP, Prices	Policy, resources, technologies, etc.
WETO World energy technology outlook	2050	Population, GDP	Policy, resources, technologies, etc.
WEC energy policy scenarios	2050	Population, GDP	Policy, resources, technologies, etc.

There are many models generating energy scenarios. The time horizon they cover is typically not long enough to include fusion energy

EFDA TIMES

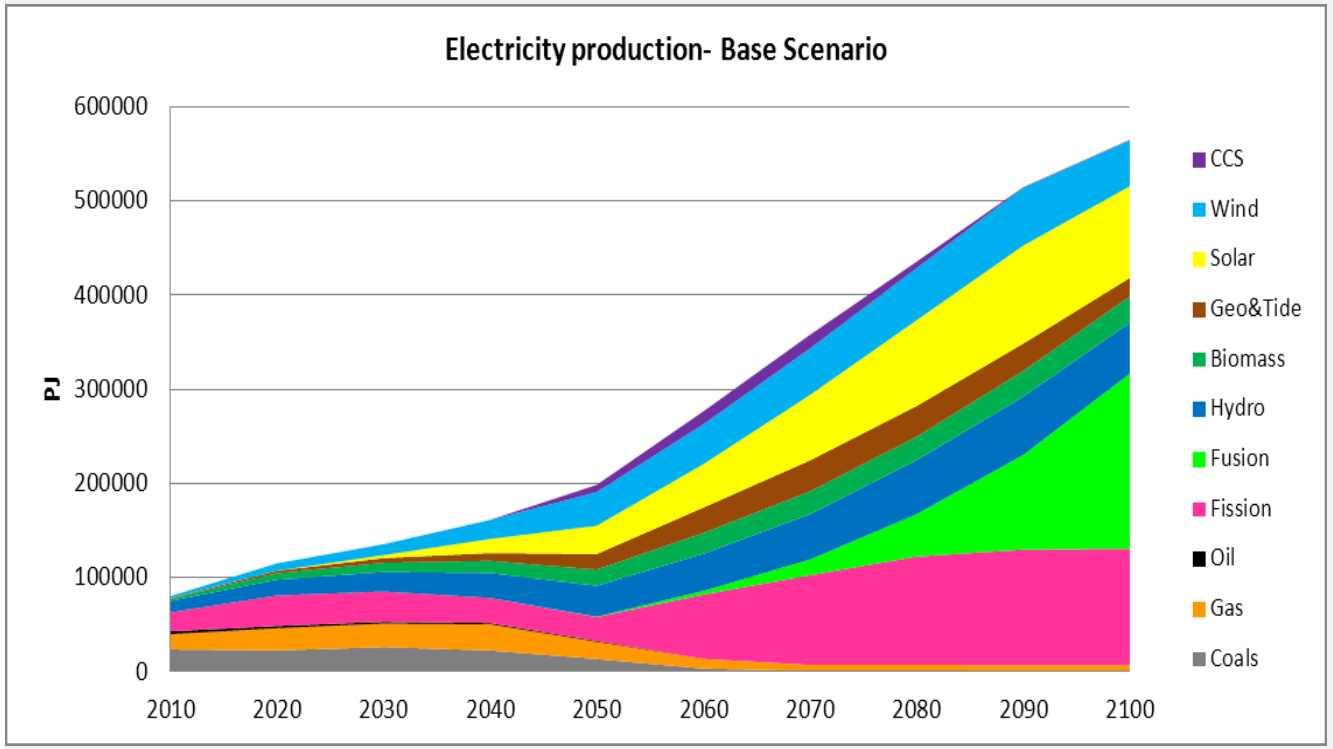
Base scenario

MAIN ASSUMPTIONS:

limit of 550 ppm of CO2 concentration by 2100
(IPCC global env.objectives)
- High demand growth
- Fusion fast track
(avv. 2050)

THE SOLUTION:

- 44% of renewables,
- 22% of fission
- **33% of fusion electricity in 2100**
- Coal phases out around 2060
- Gas technologies reduce their share to 1% (CCS plays a role in the mid-century, 4% in 2070)

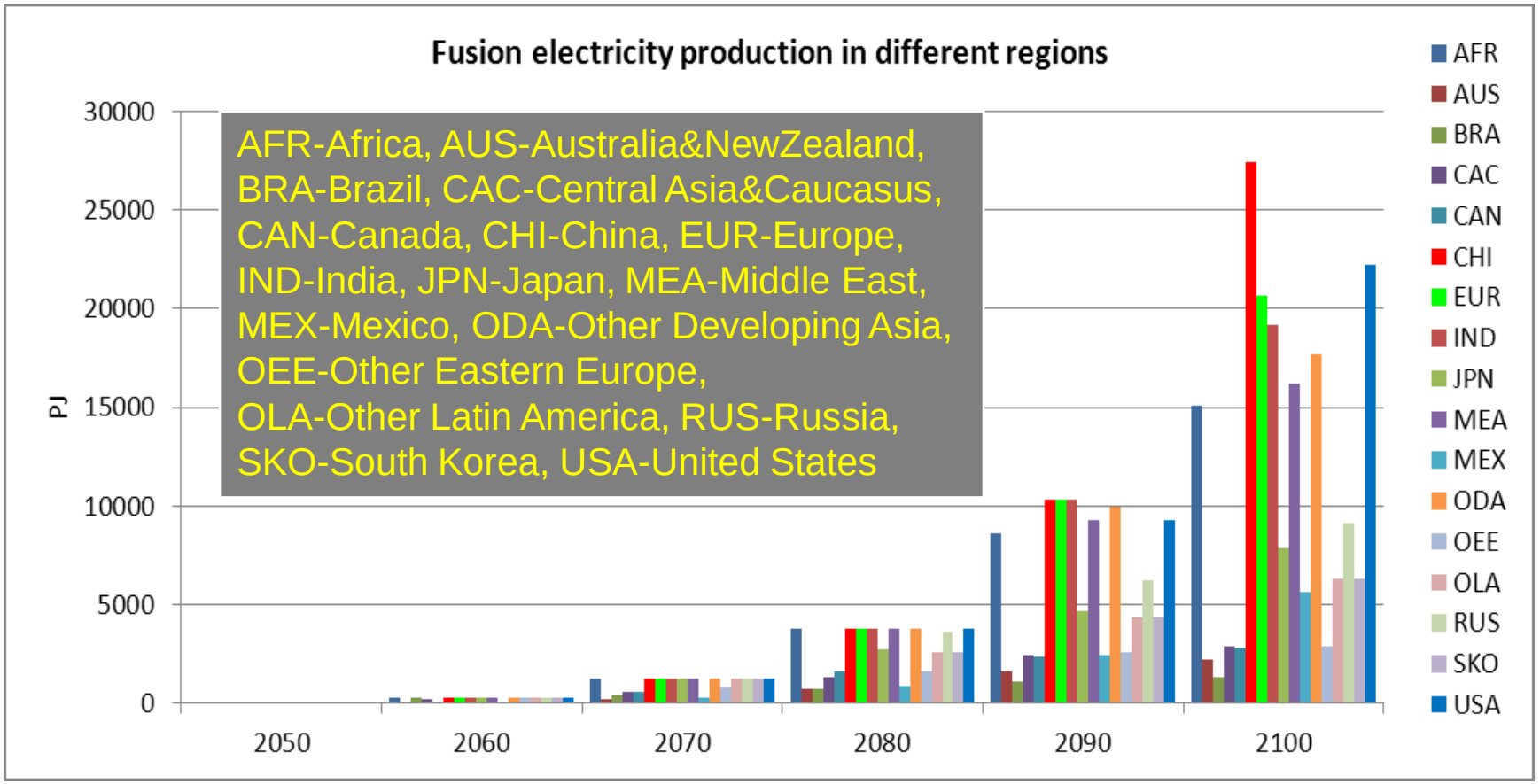


EFDA TIMES modelling - main question:

What can be the role of fusion on the energy market once it becomes available in the 2nd part of the century?

Base scenario: Fusion energy deployment in the regions of the world

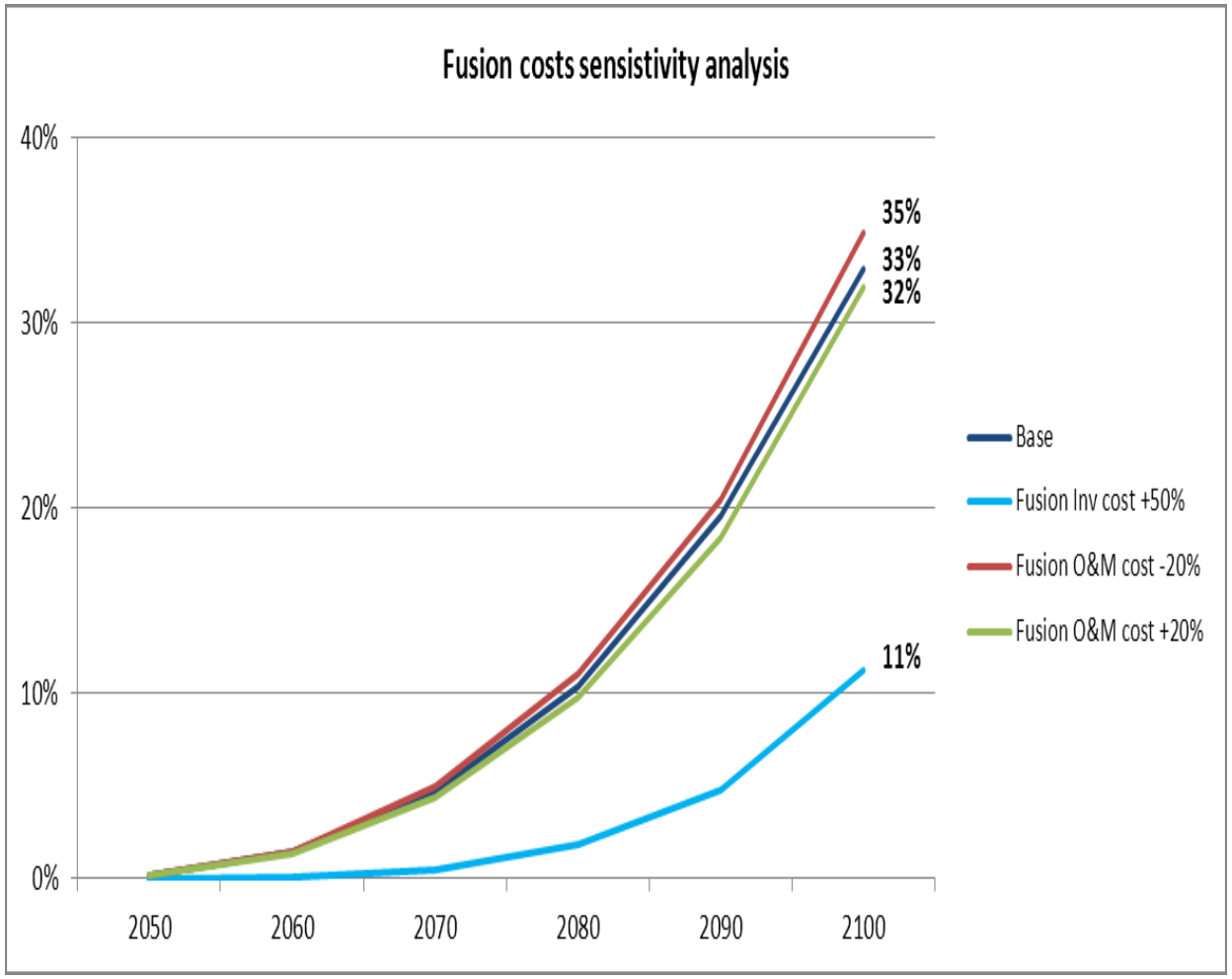
(figures from: H. Cabal, Y. Lechon, Presentation at the ETSAP TIAM - EFDA TIMES Workshop connected to 64 Semi-annual ETSAP Meeting in Seoul, Korea, 2- 4 November 2013)



Scenario analyses, examples (1):

Sensitivity analysis on fusion Investment and O&M costs

- **Base Scenario** (dark blue)
- **O & M costs decreased by 20%** (brown)
- **O & M costs increased by 20%** (green)
- **Investment costs increased by 50%** (blu):



A 20% variation of O&M costs (… life of replaceable components) does not affect the market penetration of fusion

Increase of investment cost delays fusion deployment. The 50% increase would reduce fusion share to 11%

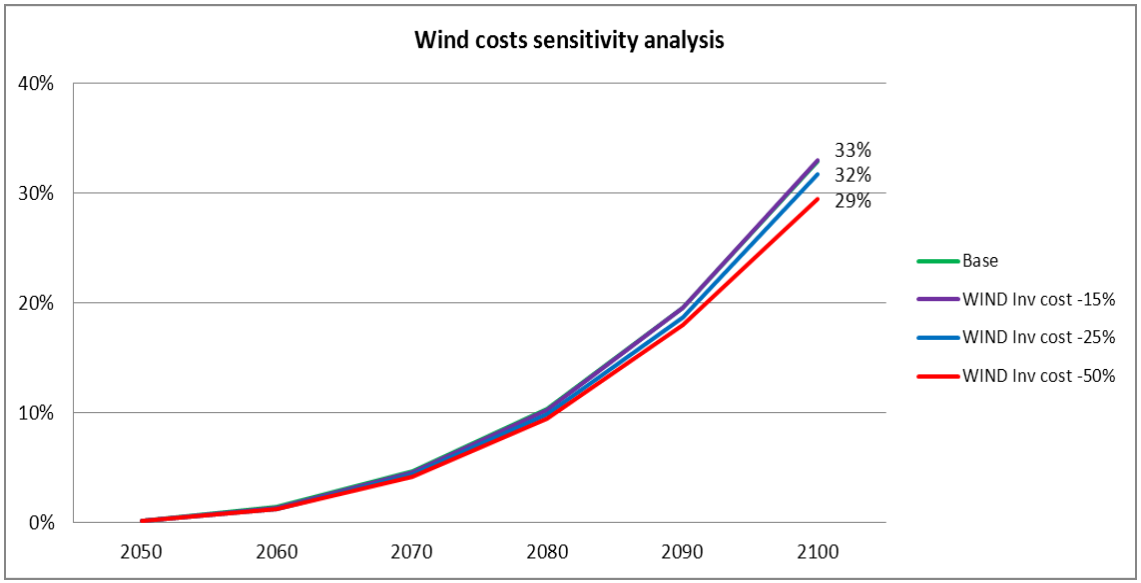
Scenario analyses, examples (2):

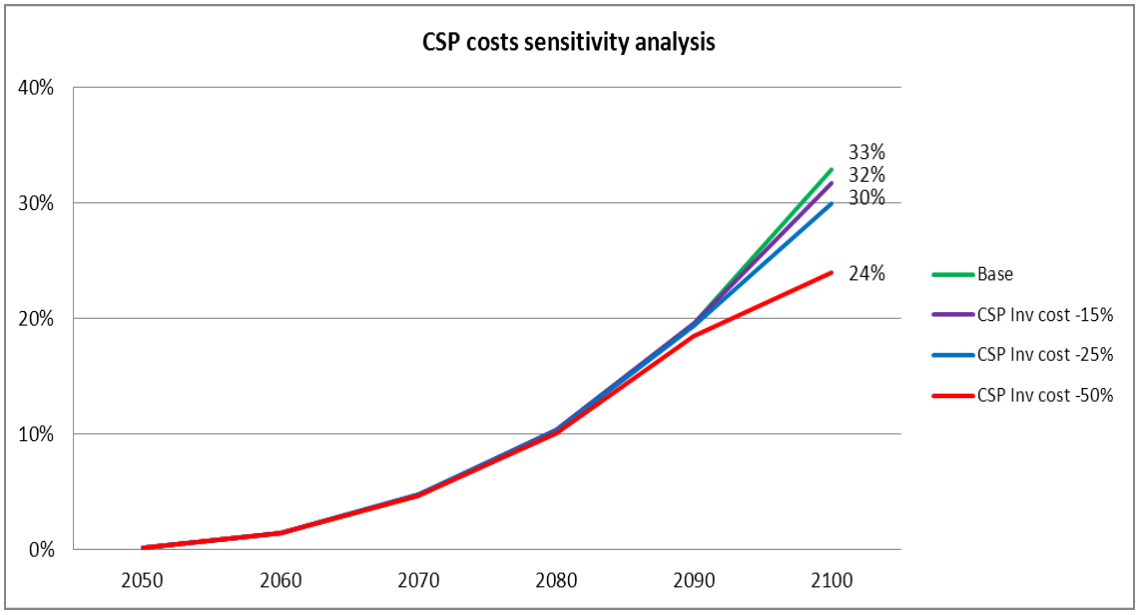
Sensitivity analysis on COSTS of OTHER TECHNOLOGIES:

Wind and CSP

The curves show fusion energy share, in scenarios with modified Wind and CSP investment costs

Fusion share would not be affected by the availability of cheaper renewable technologies in the market unless the CSP costs decreased by 50% or more





Having NO SCIENTIFIC foresight for so far future… **energy scenarios modelling** appears to be **the best available decision support tool for the long term Energy and Environmental Policy**
Examples have been shown how EFDA TIMES scenarios can be employed in this context

EFDA TIMES scenarios can be used more extensively by the fusion community
- to contribute to the global scientific energy and environmental debate
- to dialog with the civil society & stakeholders
about fusion energy role in the future decarbonised economy

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Researchers from 10 EFDA countries contributed to SERF during last 5 years:
Austria, Belgium, Denmark, Finland, France, Germany, Italy, Poland, Portugal, Spain

To the **SOCIOLOGICAL** part of SERF the following researchers recently contributed**:**
L.Alfetowicz, J.Anichini, S.André, S.de Cheveigné, A.Delicado, A.Horta, G.Meskens, I.Milch, Ch.Oltra, S.Pereira, A.Prades, M.L.Schmidt, J. Sieber, R.Sojak, P.Stankiewicz

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THANK YOU VERY MUCH

for your attention and for your interest in
SOCIO-ECONOMIC RESEARCH
carried out in the framework of
EUROPEAN FUSION DEVELOPMENT AGREEMENT