

Contribution of Fusion Energy to Low-carbon Development under the Paris Agreement and Accompanying Uncertainties

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FIP/P3-2

Analytical framework and assumptions of uncertainties

Uncertainty of future socioeconomic development

SSP1: Sustainability

SSP2: Middle of the road

SSP5: Fossil-fueled development

SSP: Shared Socioeconomic Pathway

GMT: global mean temperature
CS: climate sensitivity

Uncertainty of the long-term target of the Paris Agreement

Path-I: GMT increase of 2.0°C under the CS of 2.5°C

Path-II: Stabilizing GMT increase of 2.0°C under the CS of 2.5°C

Path-III: Stabilizing GMT increase of 2.0°C under the CS of 3.0°C

Path-IV: Stabilizing at 450 ppm CO₂eq

Uncertainty of fusion energy development*

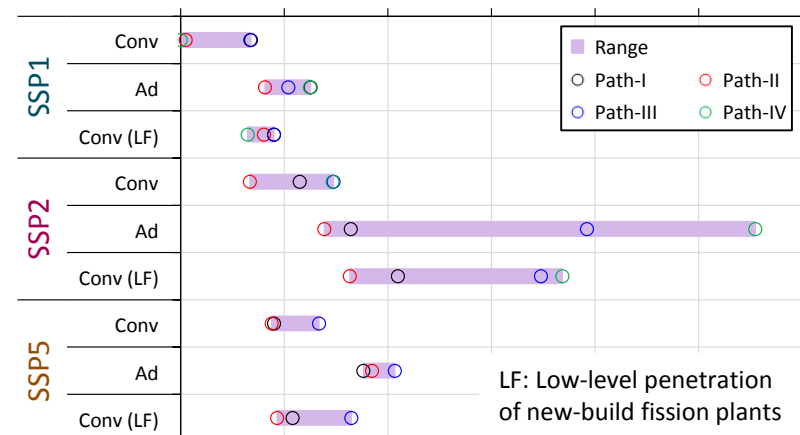
Conv: Conventional R&D (Capital costs = 8.5 \$/W)

Ad: Advanced R&D (Capital costs = 6.6 \$/W)

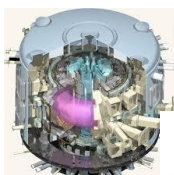
*Maximum plant availability = 90%; Life time = 40 yr; Annual expense ratio = 12%; Fuel and back-end costs = 2.0 \$/MWh; Maximum limit of annual capacity introduction = 2 GW/yr by region

Introduction of fusion power plant

Global fusion power plant capacity in 2100 [GW]

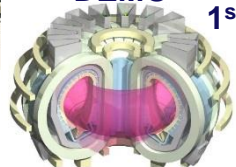


ITER



- Increase plant availability (steady-state operation)
- Increase power output

DEMO



1st Commercial plant



Fusion energy development scenario

- Reduce manufacturing costs (learning effect)
- Apply advanced materials
- Reduce volume of hot cell
- Simplify SC coils

8th Commercial plant



- Increase power output
- Downsize (compact design)
- Improve and simplify maintenance scheme

Summary

- Clear strategies of fusion energy development for economic competitiveness are pivotal
- The role of fusion energy becomes more important in the case of
 - ✓ Deeper and more rapid decarbonization
 - ✓ Less potential of zero-emission energy and/or affordable natural gas in country