



**FUSION
FOR
ENERGY**

Building the European fusion research infrastructure

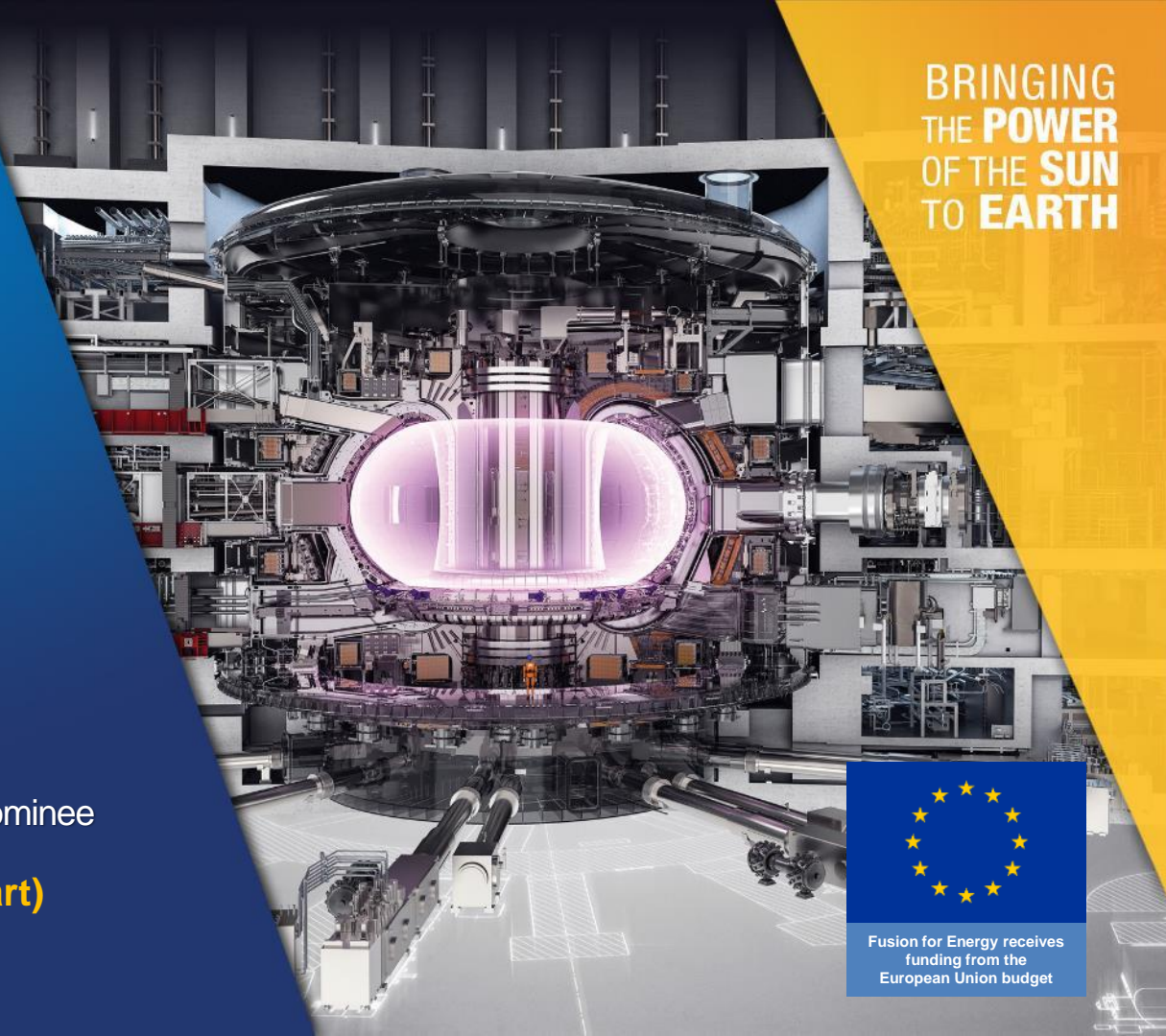
Pietro Barabaschi

Fusion for Energy Acting Director

ITER Organization Director-General Nominee

BSBF Plenary Session 1 (2nd Part)

5 October 2022

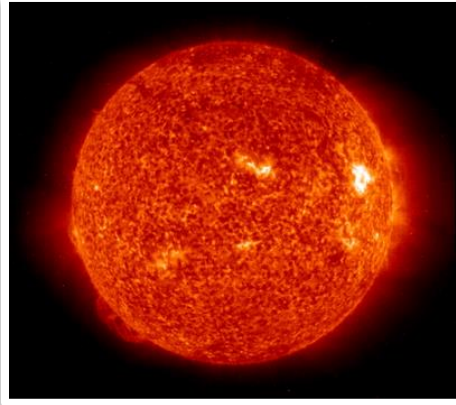


BRINGING
THE **POWER**
OF THE **SUN**
TO **EARTH**

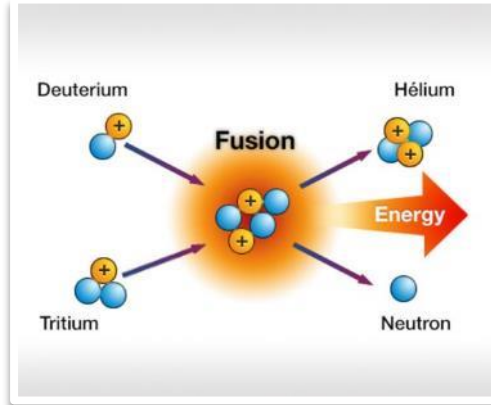


Fusion for Energy receives
funding from the
European Union budget

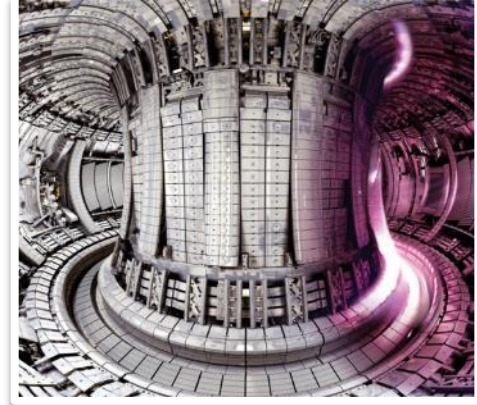
Controlled nuclear fusion is a major scientific & technological endeavor



Fusion is process that powers the sun & other stars



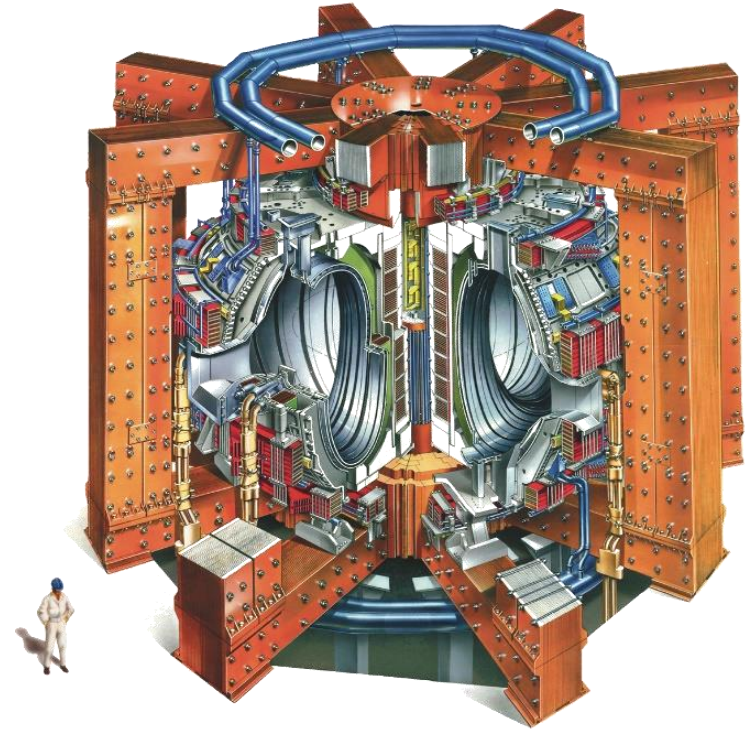
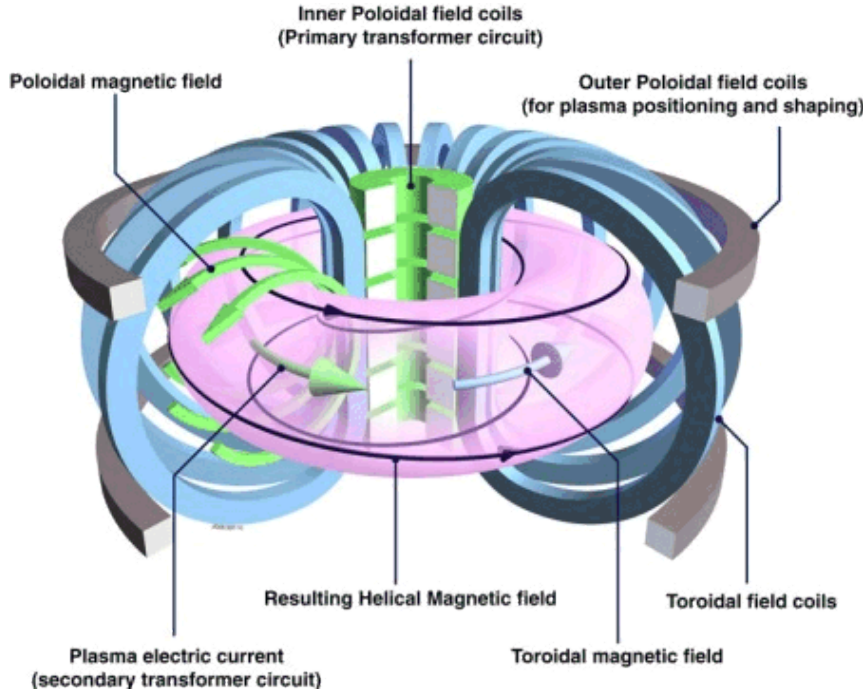
When light atoms fuse at very high temperatures, they release enormous amounts of energy



Fusion needs to confine plasma at temperatures of 100-150 million °C

Light Water Reactor fuel element	(fission)	$\sim 5 \text{ GW/m}^3$
Burning coal		$\sim 5 \text{ MW/m}^3$
DT fusion reaction in ITER		$\sim 1 \text{ MW/m}^3$
Humming bird body		$\sim 50 \text{ kW/m}^3$
Human body		$\sim 1 \text{ kW/m}^3$
Sun's core	(fusion)	$\sim 250 \text{ W/m}^3$

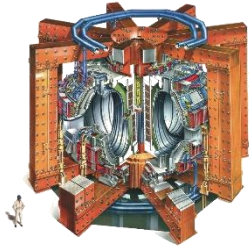
Doughnut shaped devices “Tokamaks” use magnets to confine the hot plasma for fusion



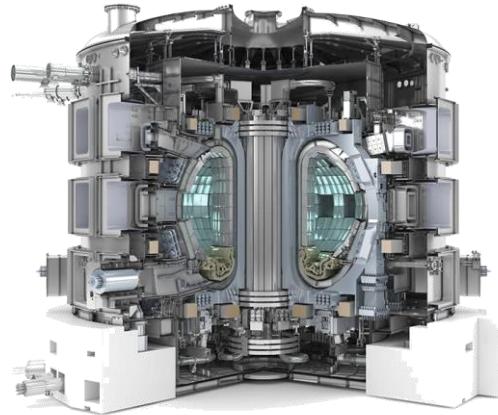
Experiment & theory show that bigger machines create more fusion reactions



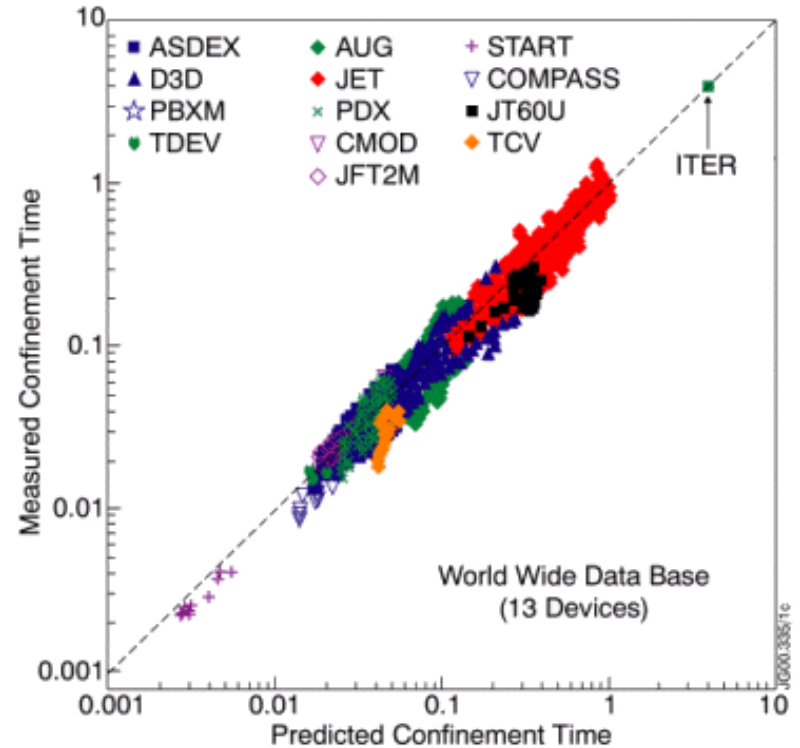
AUG
13m³



JET
100m³



ITER
840m³



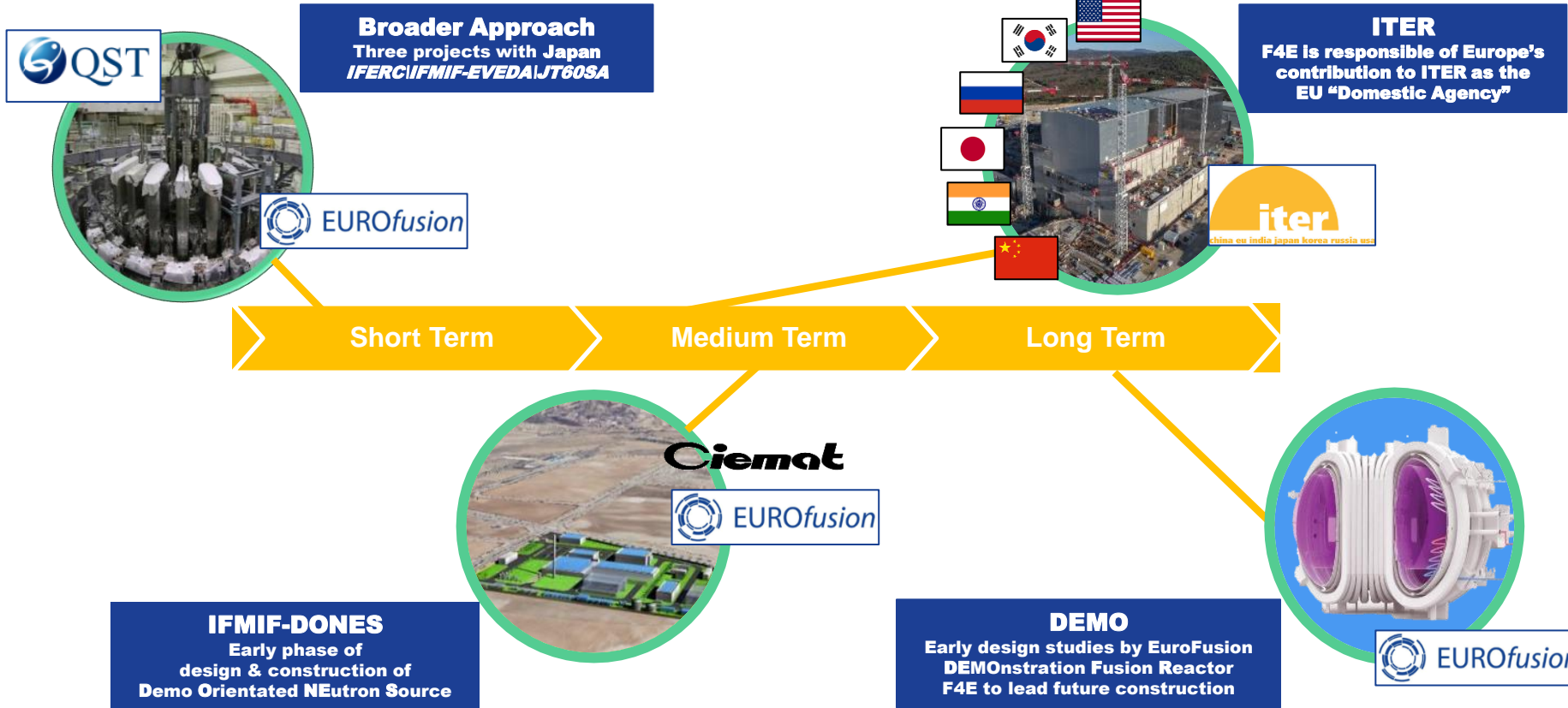
Fusion for Energy (F4E) key contributor to EU fusion research infrastructure



- ▶ F4E is EU public organization
- ▶ Set up in 2007 for 35 years
- ▶ Headquarters: Barcelona, Spain
- ▶ Offices: Cadarache, France
Garching, Germany
Rokkasho/Naka, Japan
- ▶ Staff: 435 (and >300 externals)
- ▶ Budget: ~€13 billion (2008 values) until 2027



Four projects on the European Fusion Roadmap

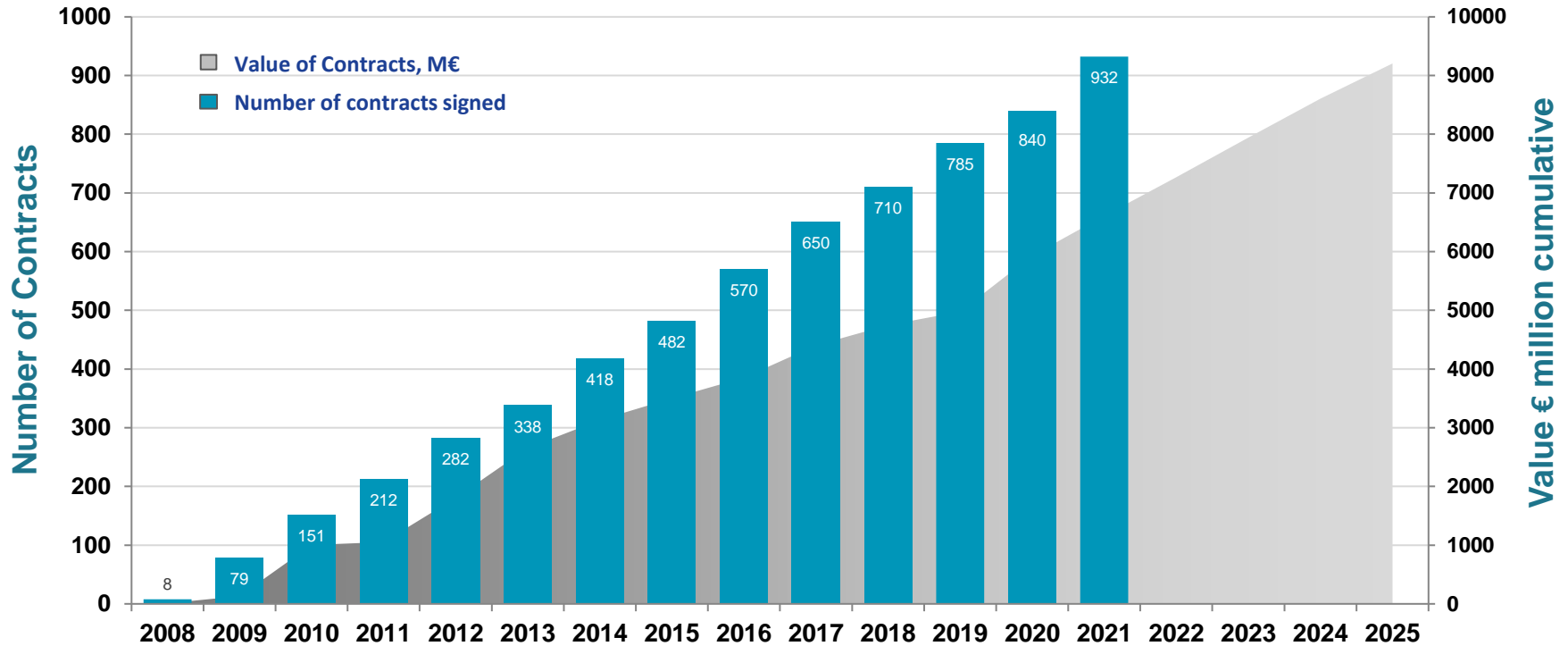


Objective 1: Deliver the European contributions to ITER and BA within budget and schedule, making best use of potential and capabilities of all members

Objective 2: Broaden European industrial base for fusion technology for long-term development of fusion as energy source, to ensure strong and competitive European participation in the future fusion market

Objective 3: Foster European innovation and competitiveness in key emerging technologies to further the development of the Innovation Union and its impact at the international level

Signed ~€6bn contracts + ~€3.5bn in 2022 - 2027



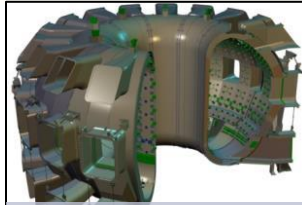
European contributions to ITER



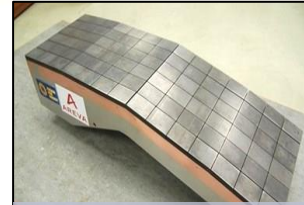
Site & Buildings



Superconducting
Magnets



Vacuum
Vessel



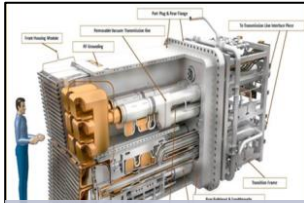
Wall Protection



Robotic Remote
Handling



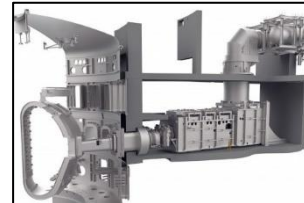
Cryoplat
& Fuel Systems



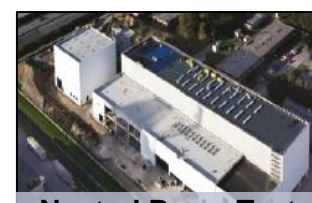
Radiofreq (Ion)
Cyclotron Heating



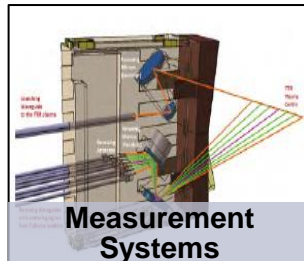
Radiofreq (Electron)
Cyclotron Heating



Neutral Beam
Injectors



Neutral Beam Test
Facility in Padua (IT)



Measurement
Systems

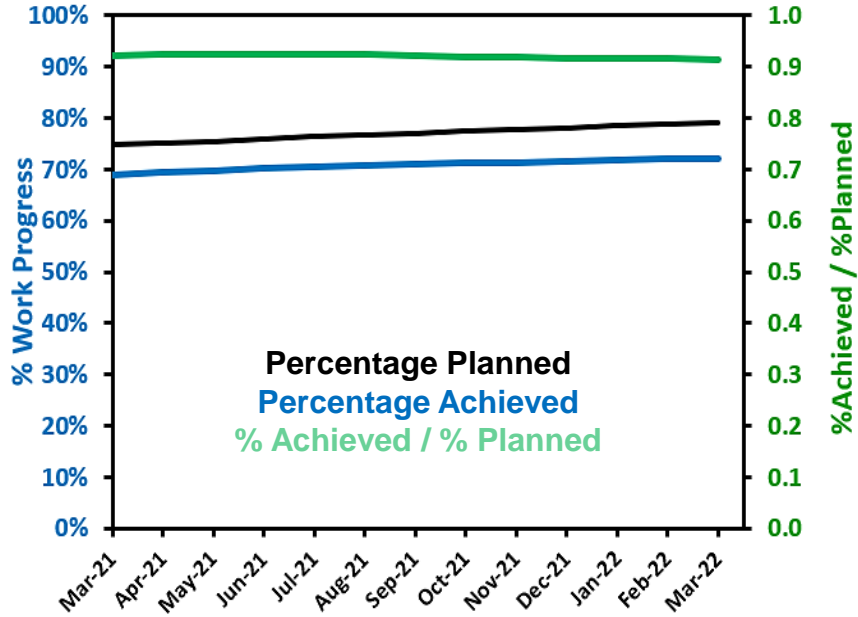


Fuel Breeding
Modules (TBM)

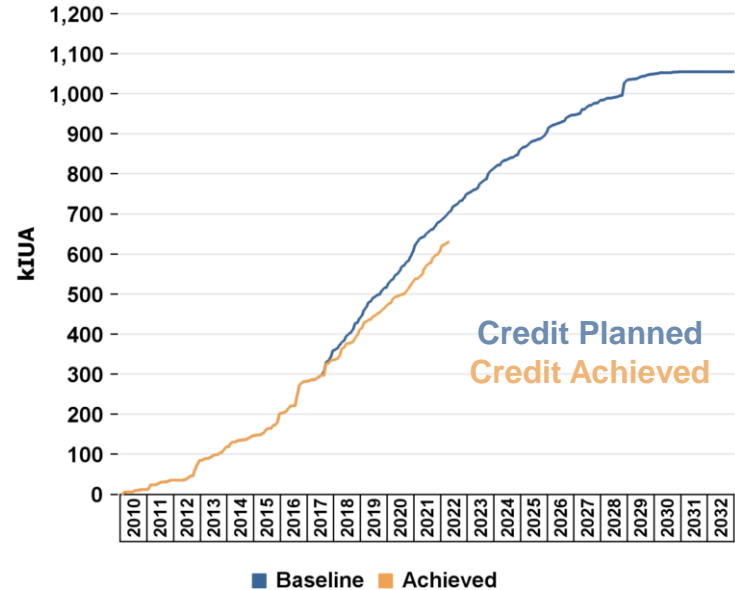
ITER now 76% complete to First Plasma F4E delivered >60% of European contribution



Physical % Complete for First Plasma



Earned ITER credit for all EU contributions

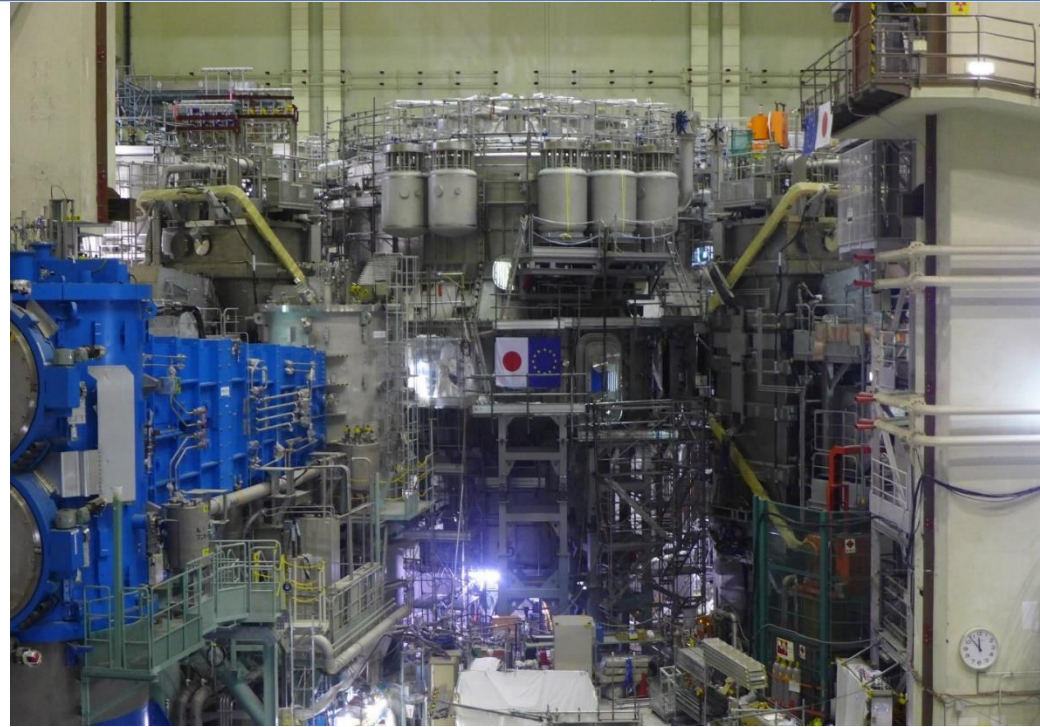




ITER Successes & challenges



Our BA projects: LIPAc and JT-60SA



A wide-angle photograph of a large-scale construction site at dusk. The sky is a mix of blue and orange. In the foreground, a worker wearing a blue hard hat and a high-visibility yellow vest with a logo on the back stands on a metal railing, looking out over the site. The middle ground is filled with various construction materials, including stacks of rebar, concrete blocks, and several large white and blue storage containers. A white truck is parked in the middle ground. In the background, a large, multi-story building is under construction, with several tall cranes (tower cranes and crawler cranes) positioned around it. The overall scene is one of active industrial construction.

Thank You



FUSION
FOR
ENERGY

Backup Slides





Site infrastructures

B27
HC

BB21,
B23, B24
HOT CELL

B71-N

Magnet Power
Conversion Buildings

Cooling Plant

Site Electrical Power Distribution

B51, B52

Assembly
building

Site
Services
Building

Buildings completed
& handed over to IO

PF Coil Fabrication Building

Cleaning
Facility
building

Buildings under handing
over process

Buildings under
construction

B34

B37

B47

B74

B11

B14

B44

B46

B45

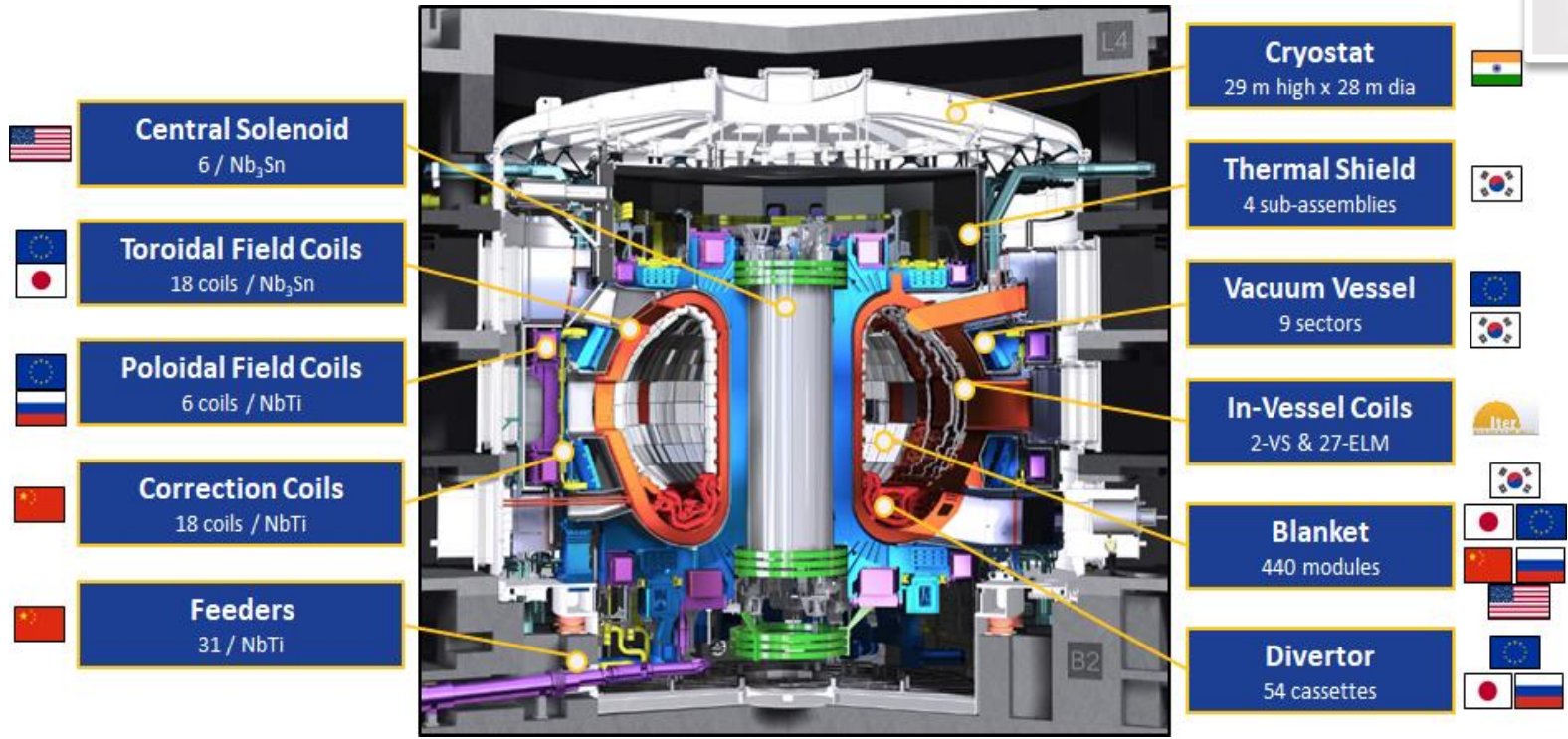
B75

B15

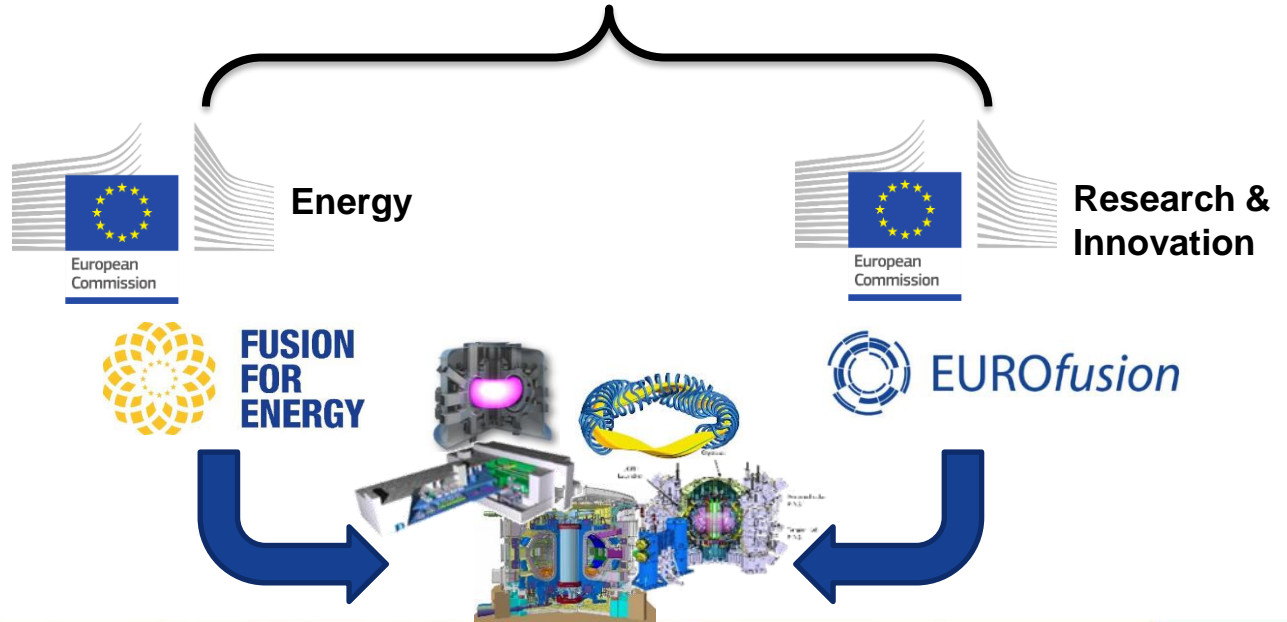
B62

B5

Other DAs contributions



Fusion in Europe: two main pillars (+1)



Fusion in Europe: industrial involvement



~3.5 billion EUR
(2022-2027)





5+ billion EUR
(2022-2027)

