



# THE ITER PROJECT

*Here comes the sun...*

**Kirsten Haupt, Communication**  
16 June 2023





## Our energy dilemma

Increasing consumption

Fossil fuels

De-carbonization

Renewables

Nuclear fission: safety concerns, waste

CO<sub>2</sub> capture

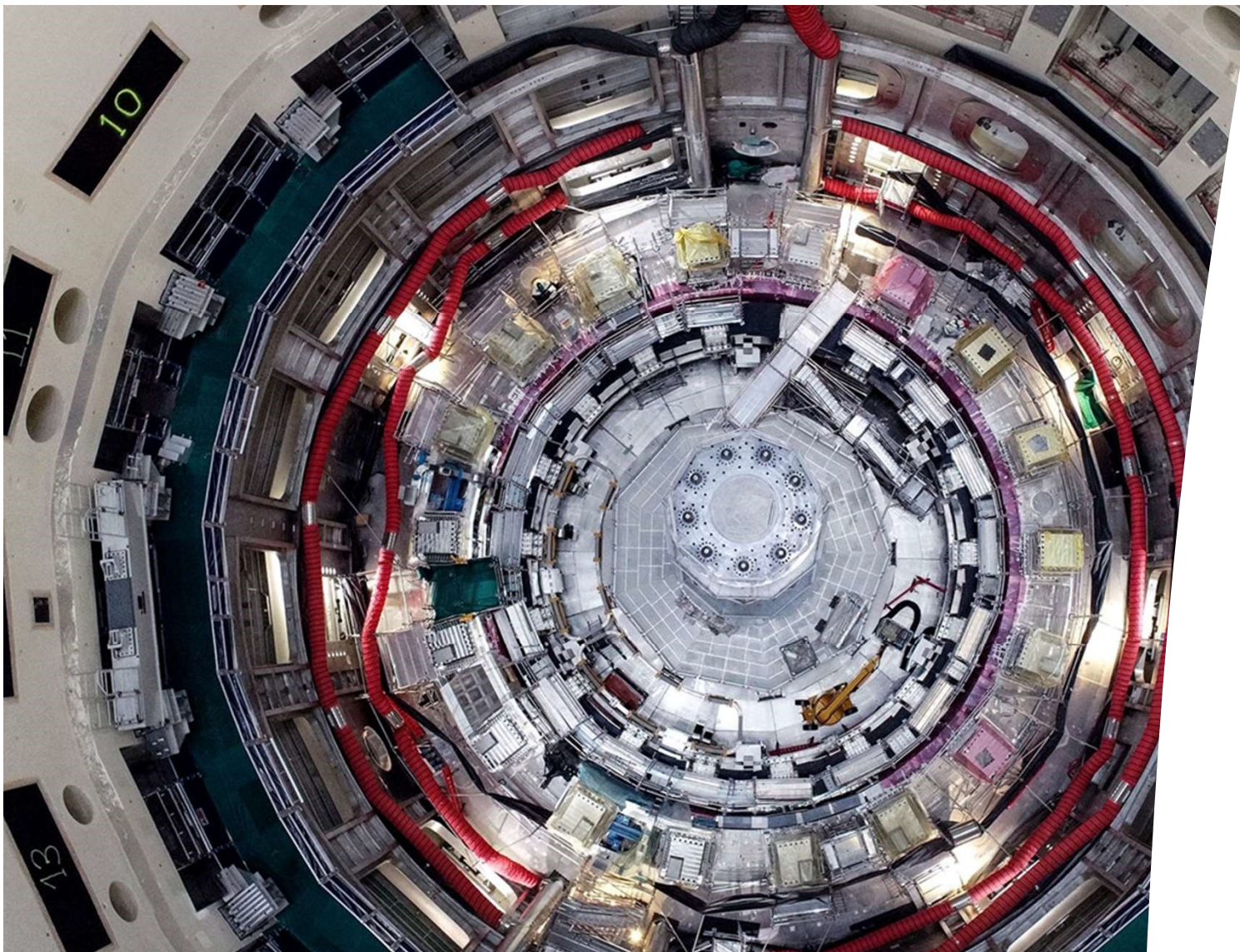




## Energy transition

Develop fusion as a promising solution to sustainable, carbon-free production of electricity for a decarbonized society.





## **A FEW INTRODUCTORY WORDS ABOUT FUSION**

**WHAT DOES  
ITER DO?**

**ITER: SOME  
BASICS**

**LATEST  
PROGRESS**





**FUSION IN THE UNIVERSE**



## **PLASMA ON EARTH**

Lightning

Northern lights

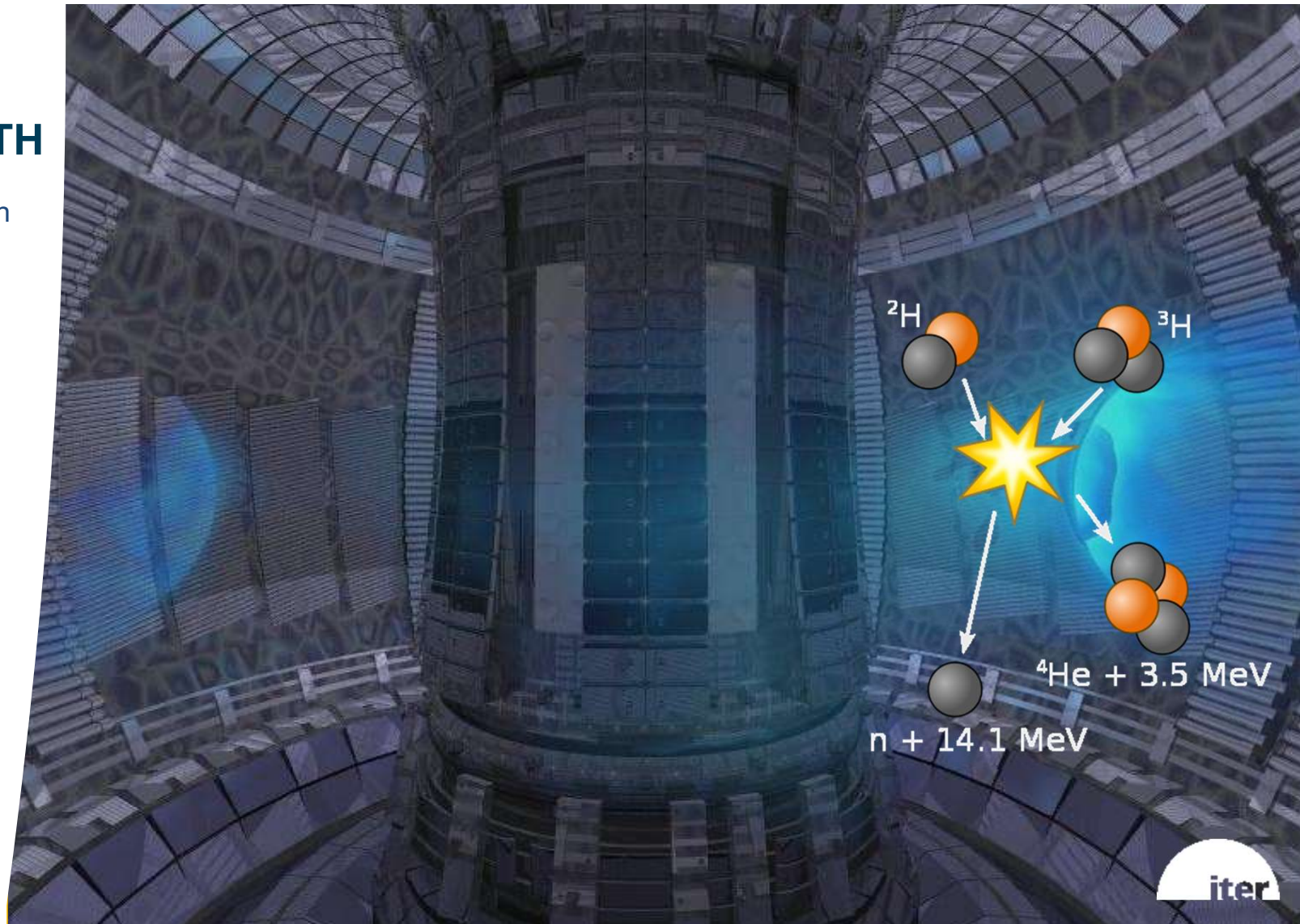
Fluorescent lights

# FUSION ON EARTH

Magnetic confinement fusion

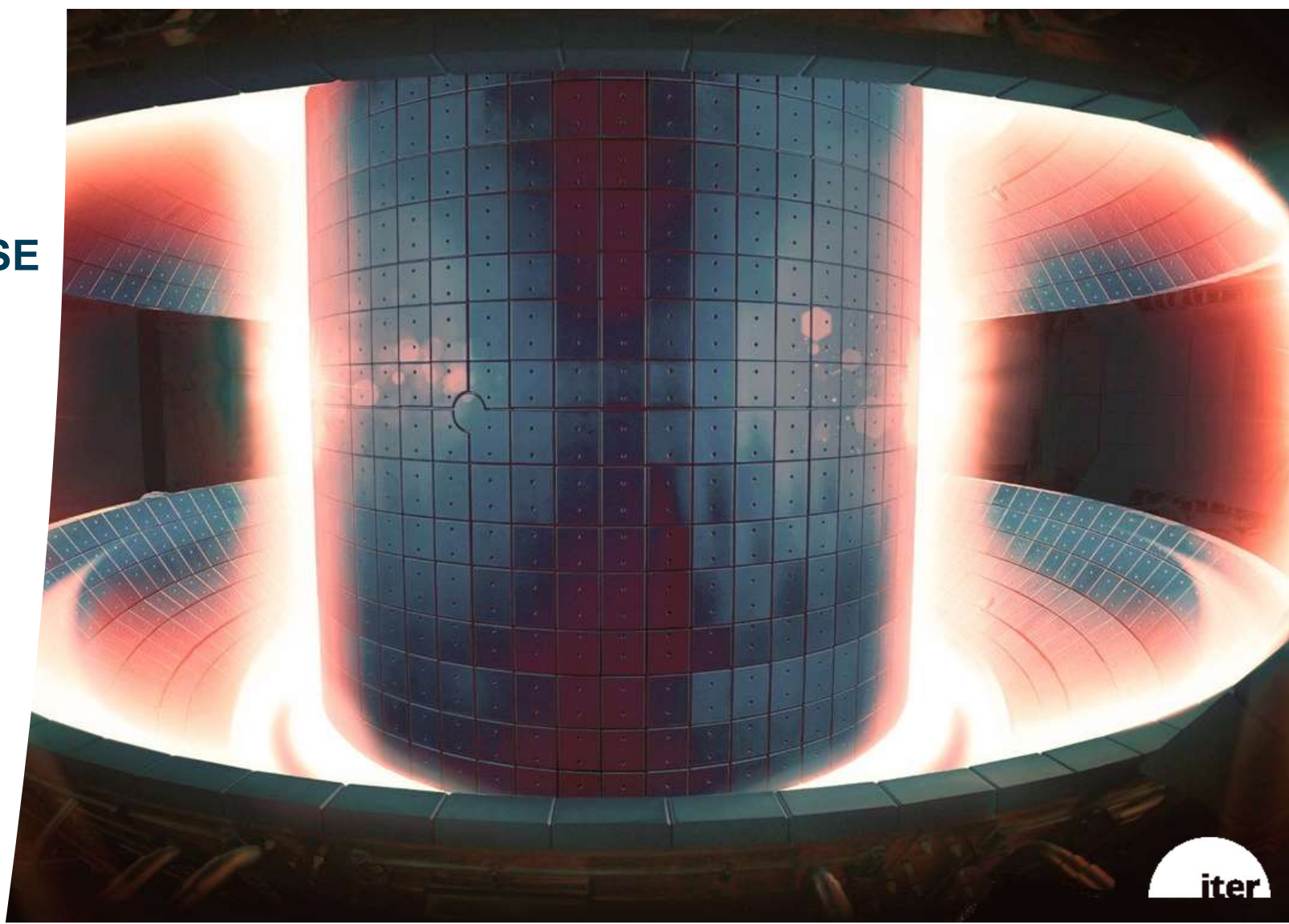
## Challenges

- Temperature
- Magnetic confinement.
- Burning plasma
- Capturing neutrons

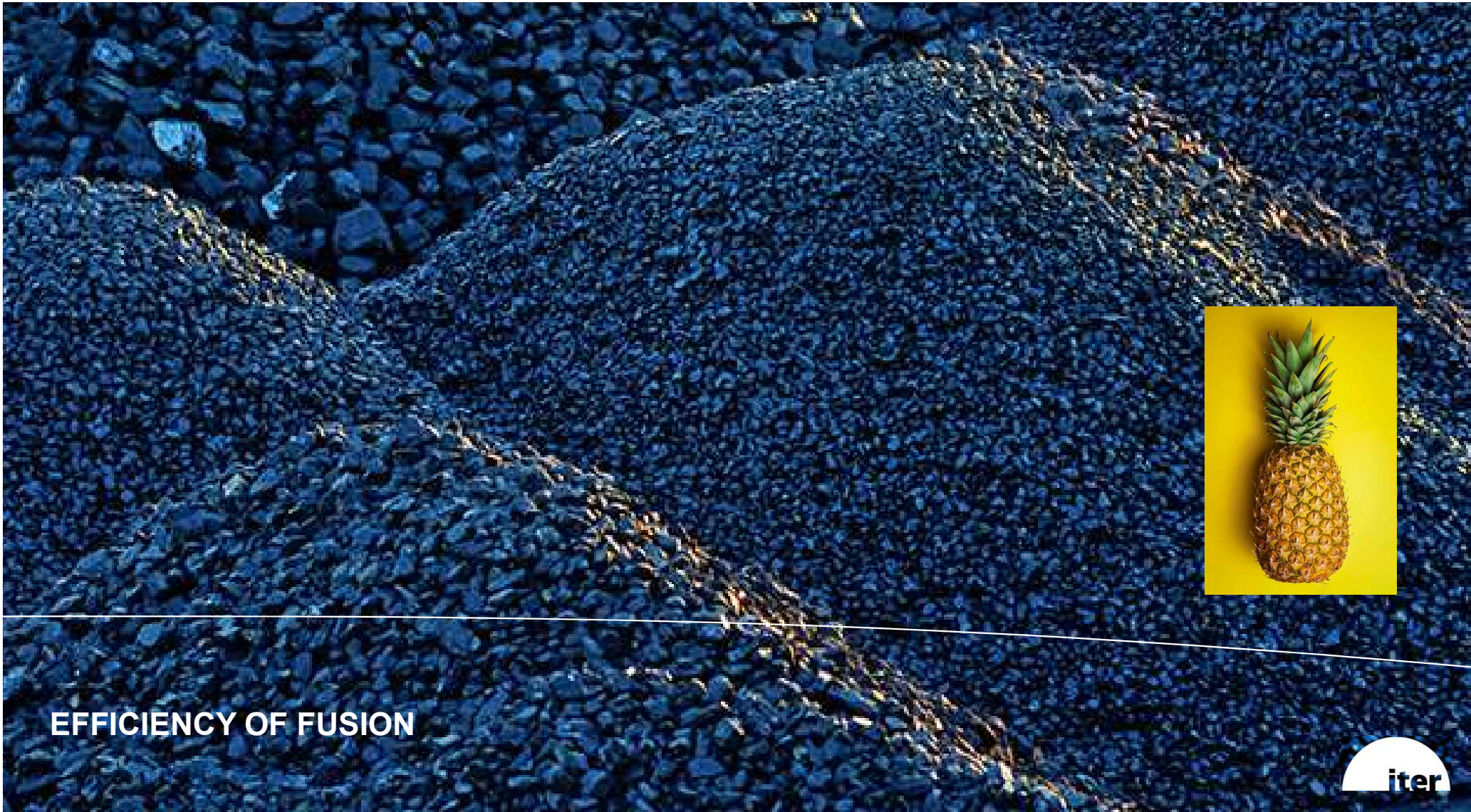


# MAKING THE CASE FOR FUSION

- Clean
- Abundant fuels.
- Safe
- Efficient

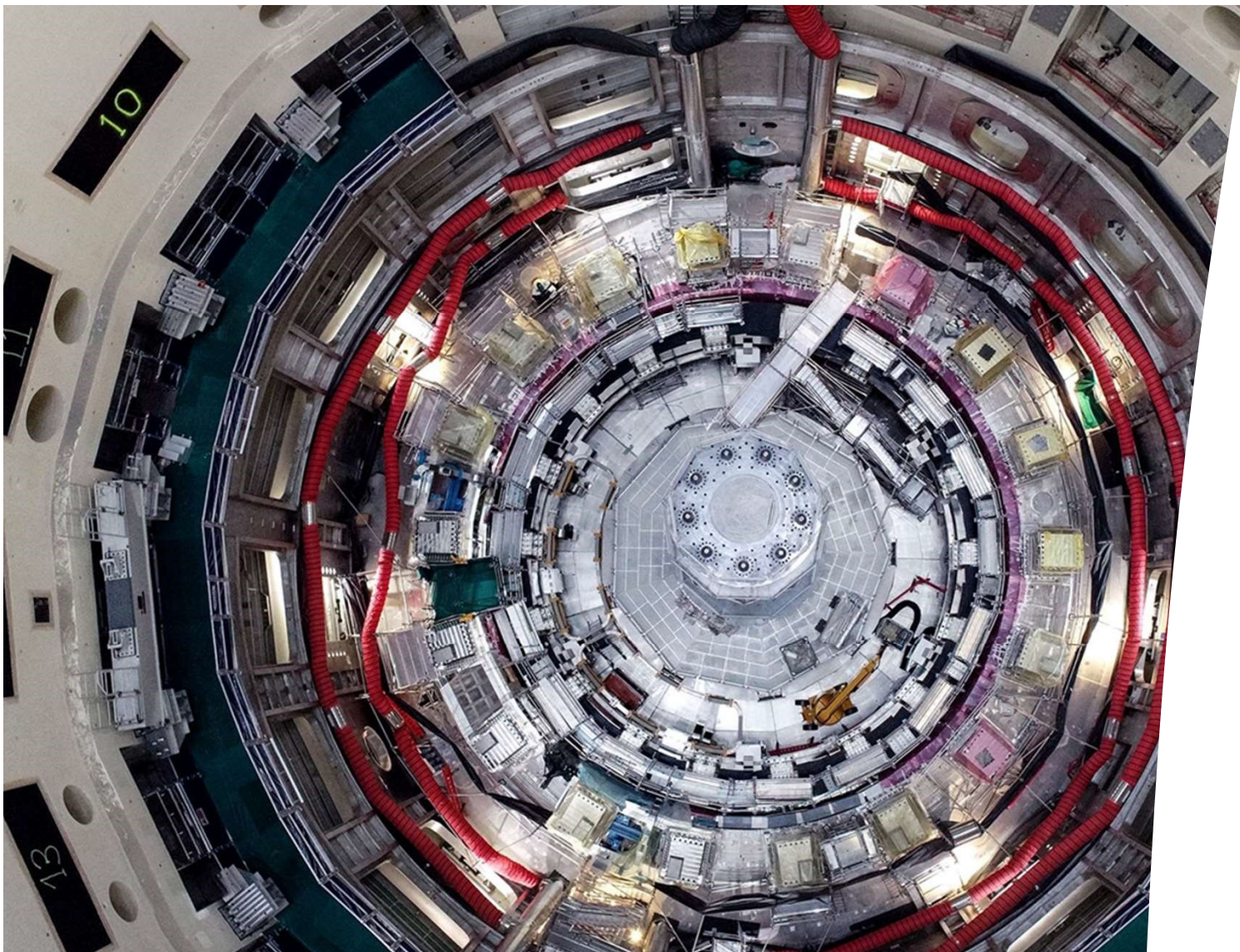






**EFFICIENCY OF FUSION**





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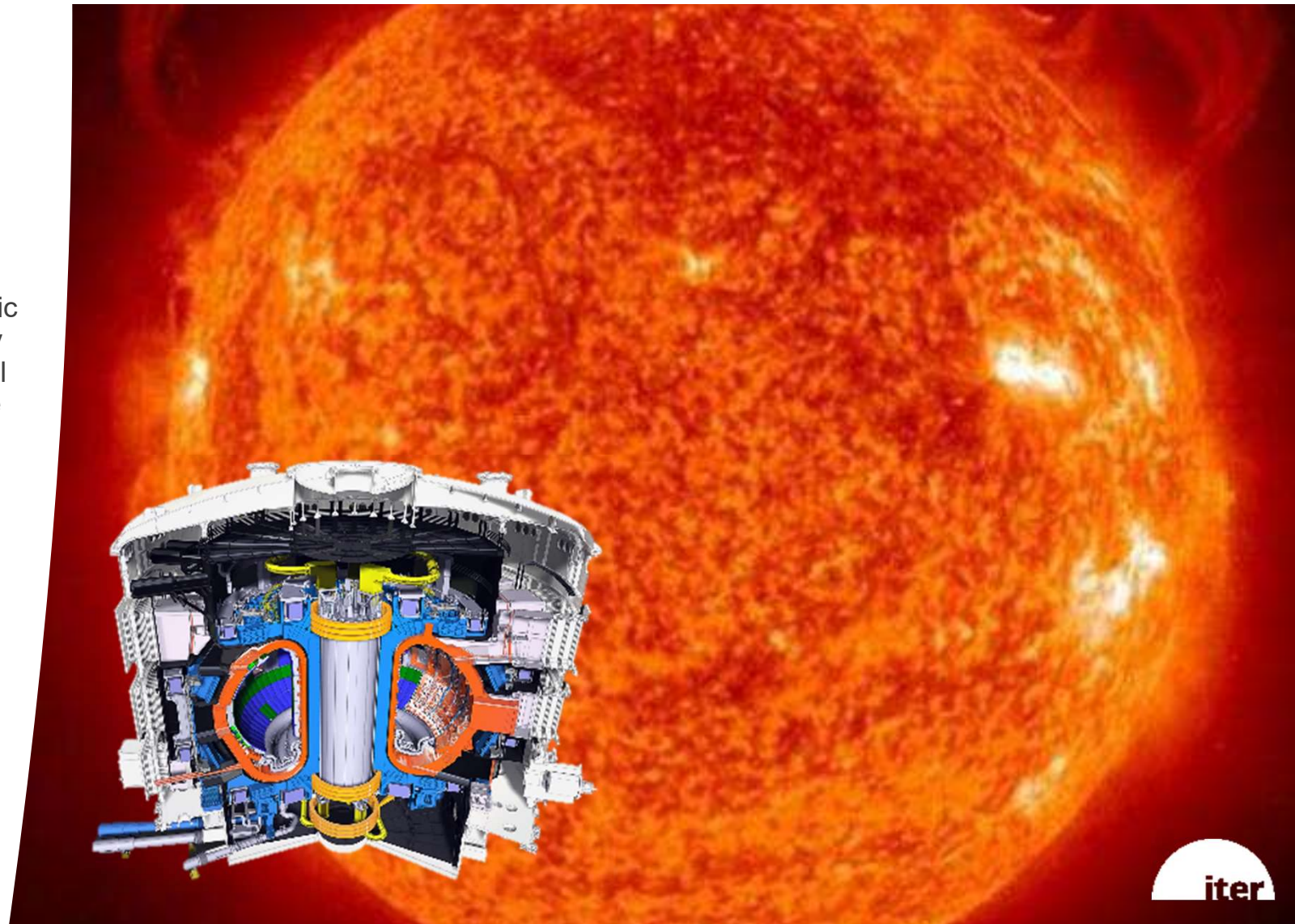


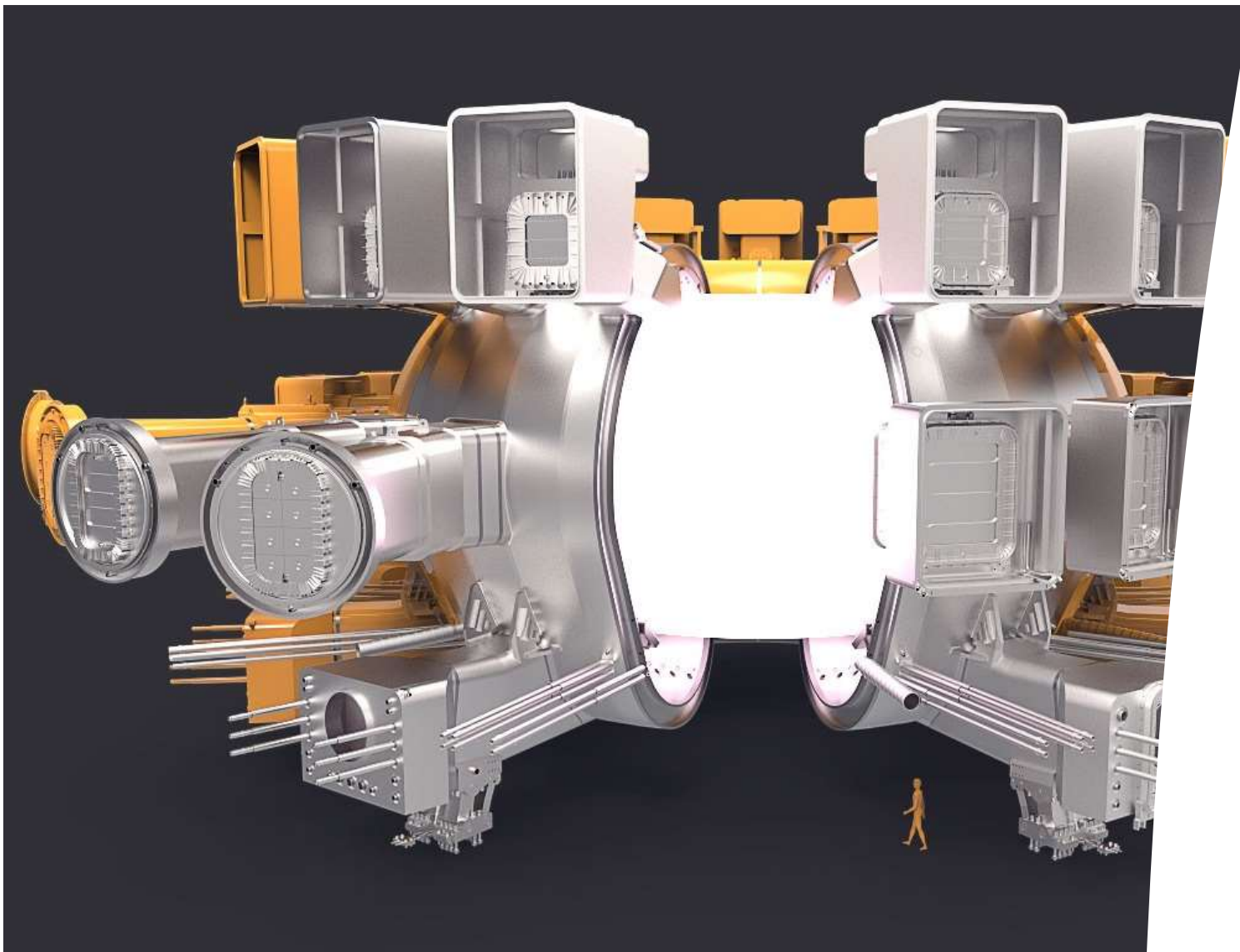
## THE ITER MISSION

To demonstrate the scientific and technological feasibility of fusion power for peaceful purposes at industrial scale

To create a controlled “burning” plasma

To achieve  $Q \geq 10$





## HOW DOES IT WORK?

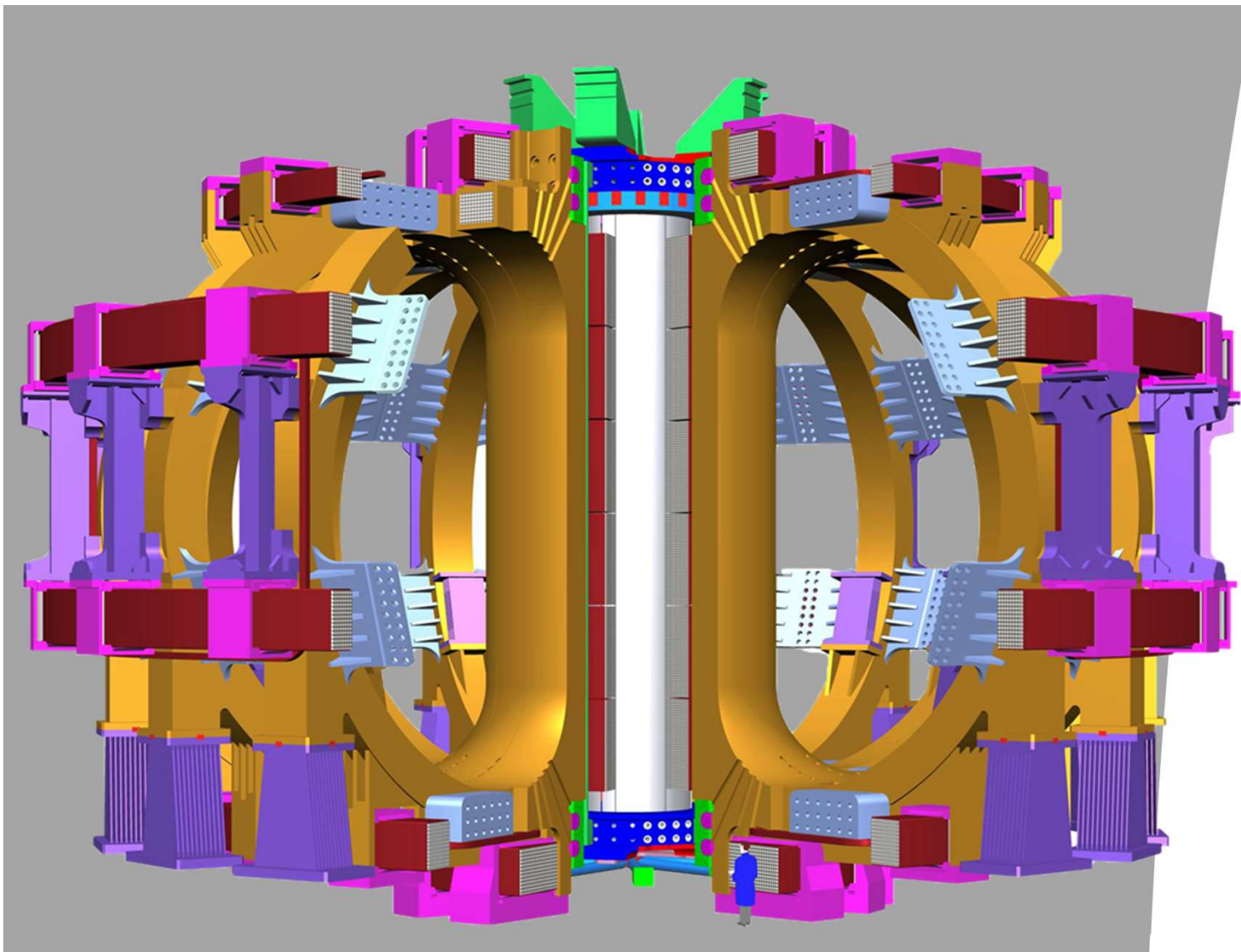
### The vacuum vessel

Double wall steel container  
blanket modules  
cooling water

High-vacuum environment

Primary containment barrier

Volume:	1,400 m <sup>3</sup>
Plasma volume:	840 m <sup>3</sup>
Weight:	8,500 t



## HOW DOES IT WORK?

### A large magnetic cage

Central solenoid

13 m high

1,000 tons

18 toroidal field coils

17 m high

360 tons each

6 poloidal field coils

8-24 m in diameter

200-400 tons



## HOW DOES IT WORK?

### The Cryostat

Largest stainless steel  
high-vacuum pressure  
container ever built

Provides high-vacuum and  
ultra-cool environment

Height:	30 m
Diameter:	30 m
Weight:	3,850 t

## HOW DOES IT WORK?

Inject DT gas.

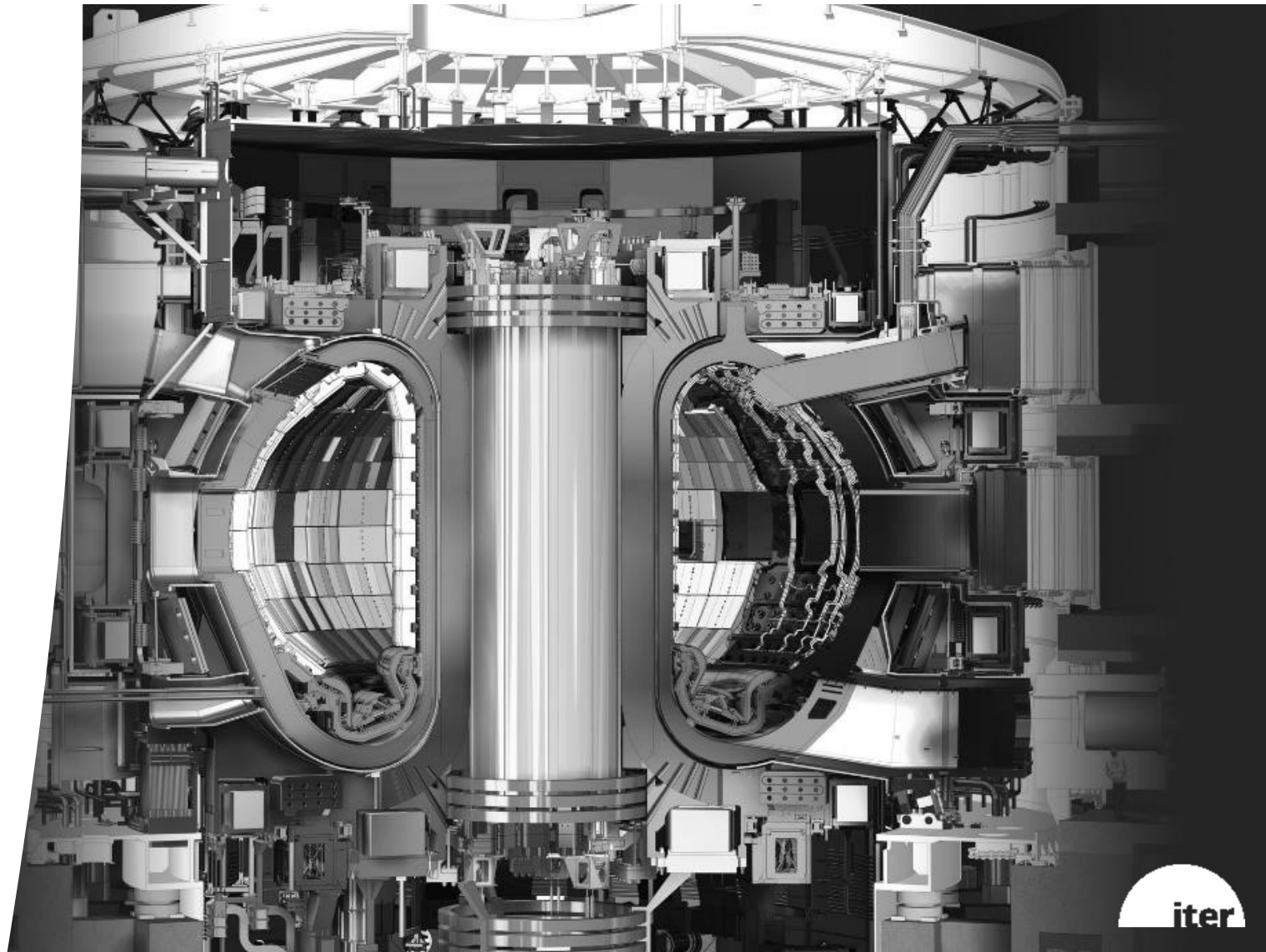
Inject electric current to convert the gas to plasma.

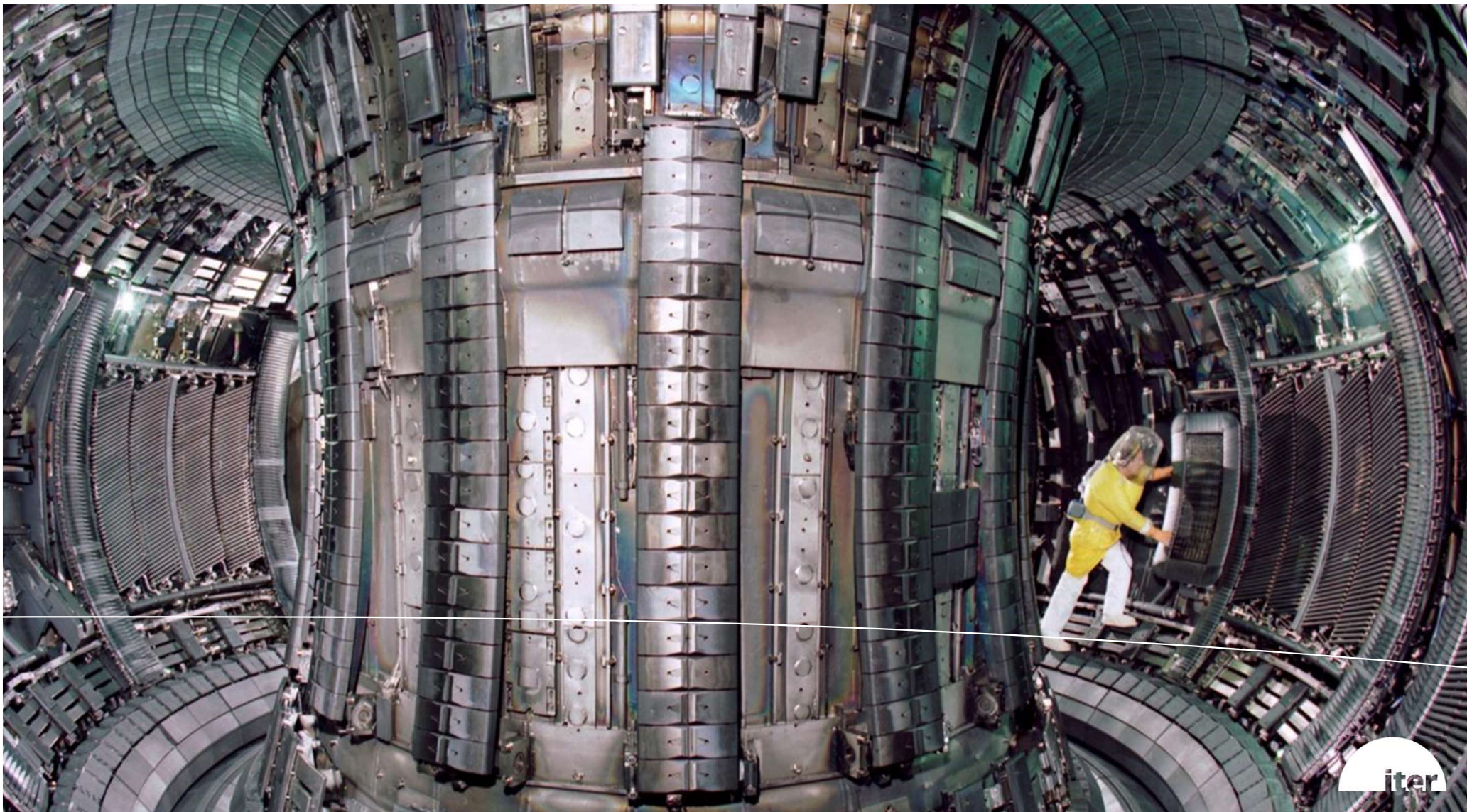
Inject electromagnetic waves.

Inject high-energy neutral particles.

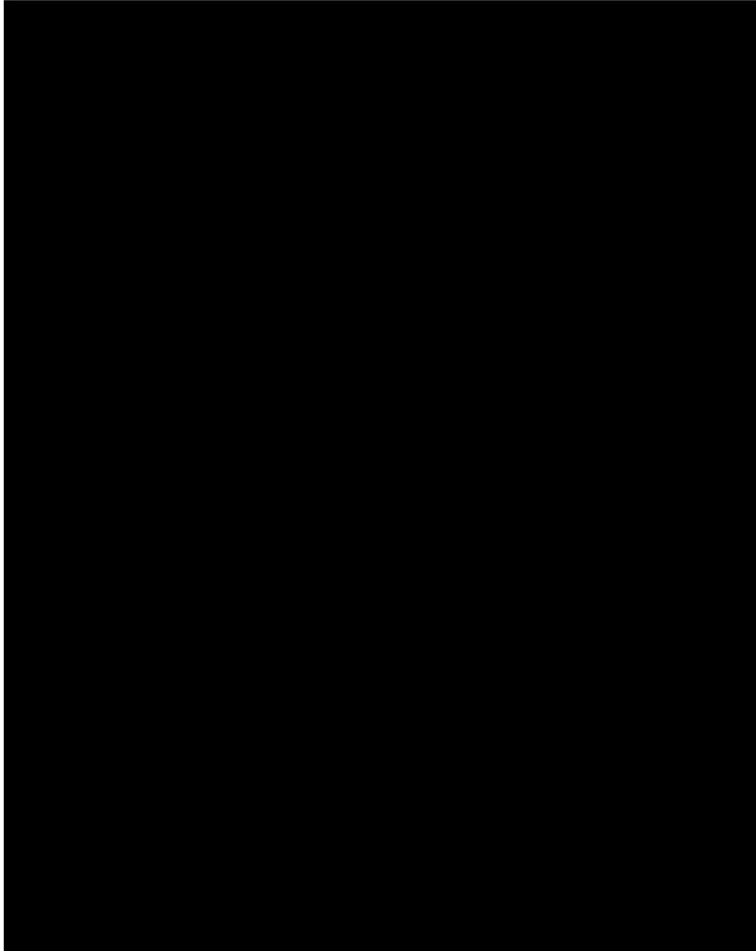
Combine these techniques to reach 150-million degrees.

***THE CHALLENGE: TO CONTAIN AND SHAPE THE PLASMA.***







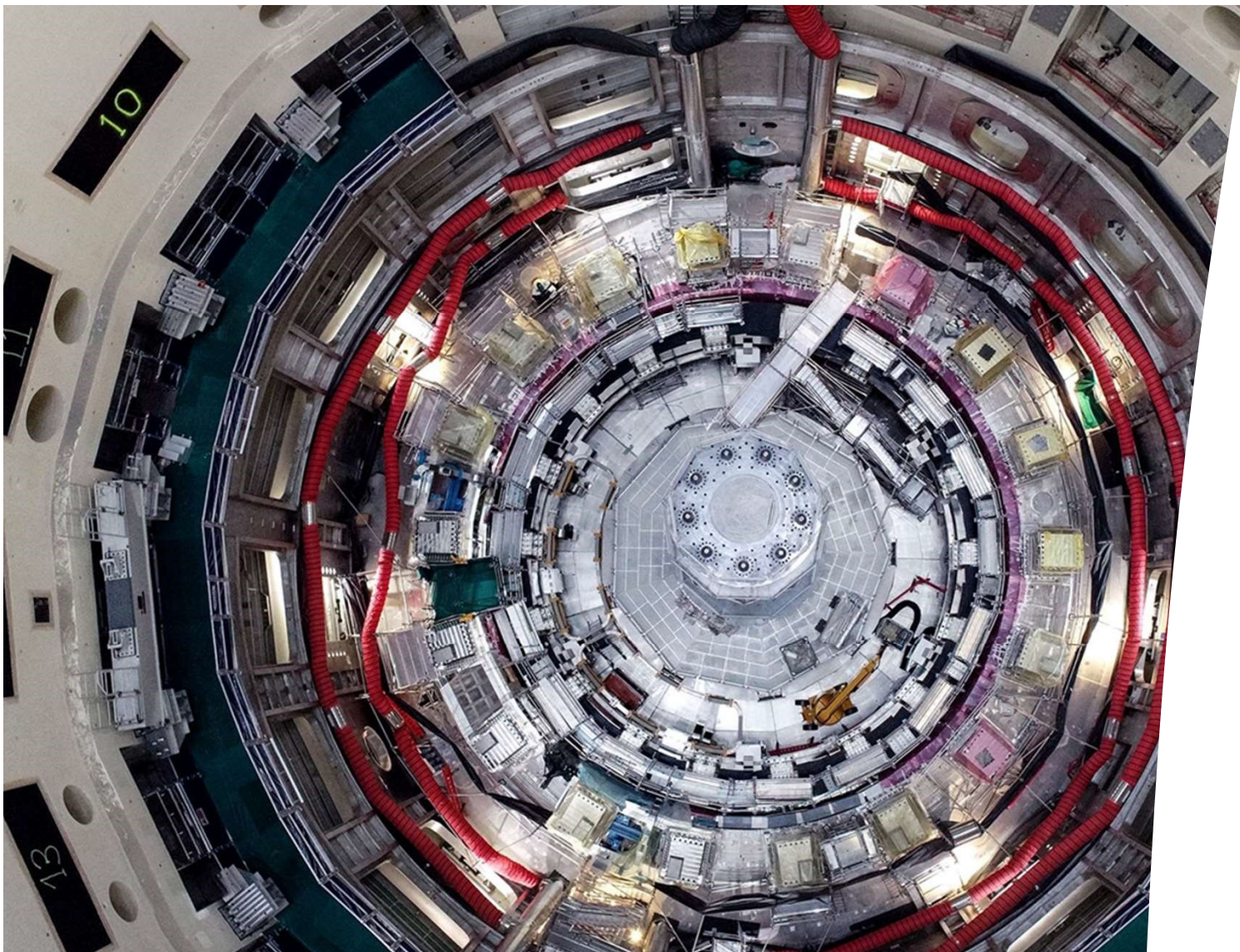


## Major milestone at JET!

Record-breaking 59 megajoules of sustained fusion energy (December 2021).

Video shows pulse in action.





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## THE ITER NARRATIVE: *FROM IDEA TO REALITY*

November 1985



November 2006



August 2010



Today





## AN INTEGRATED PROJECT

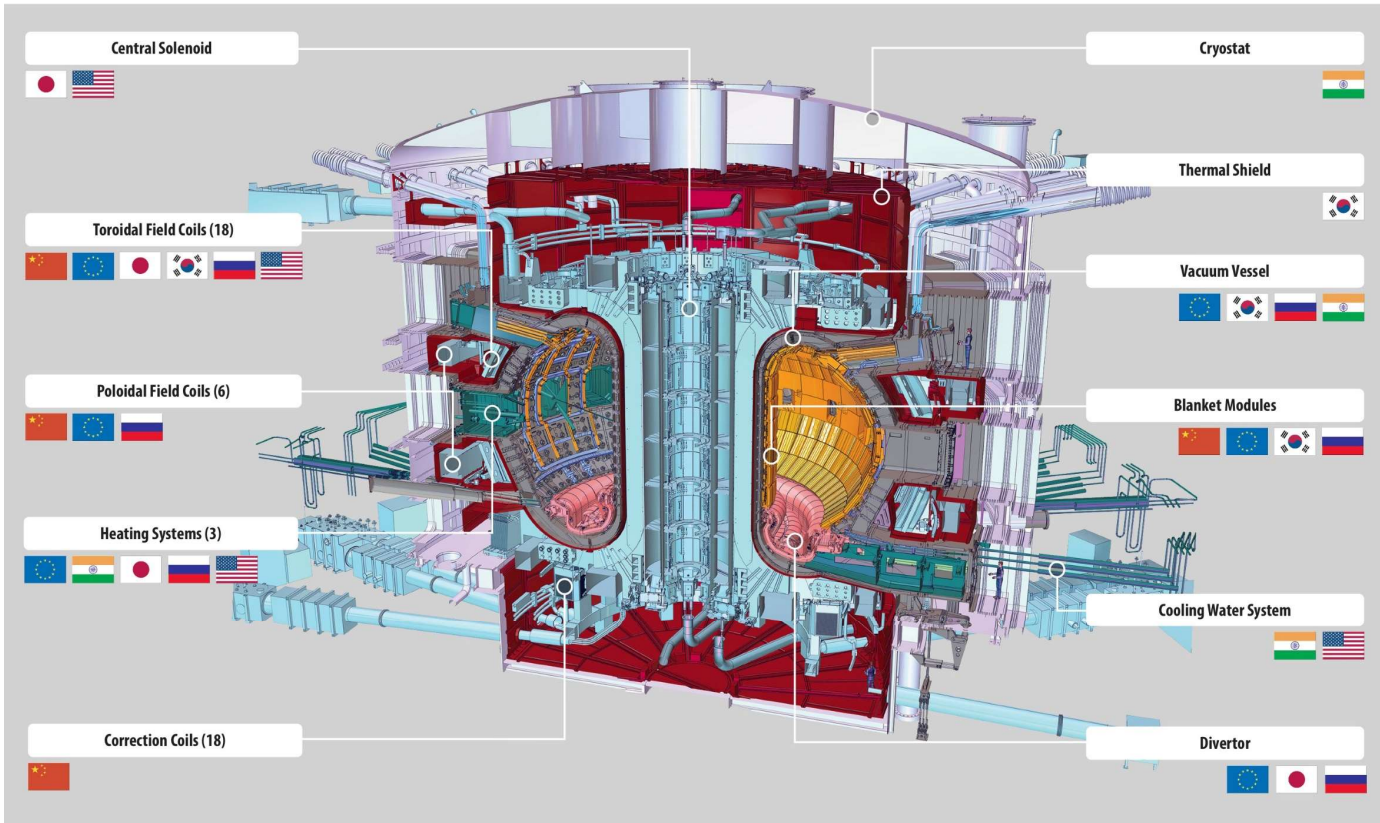
ITER = 35 countries

- 50% of the world population
- 85% of the world's GDP

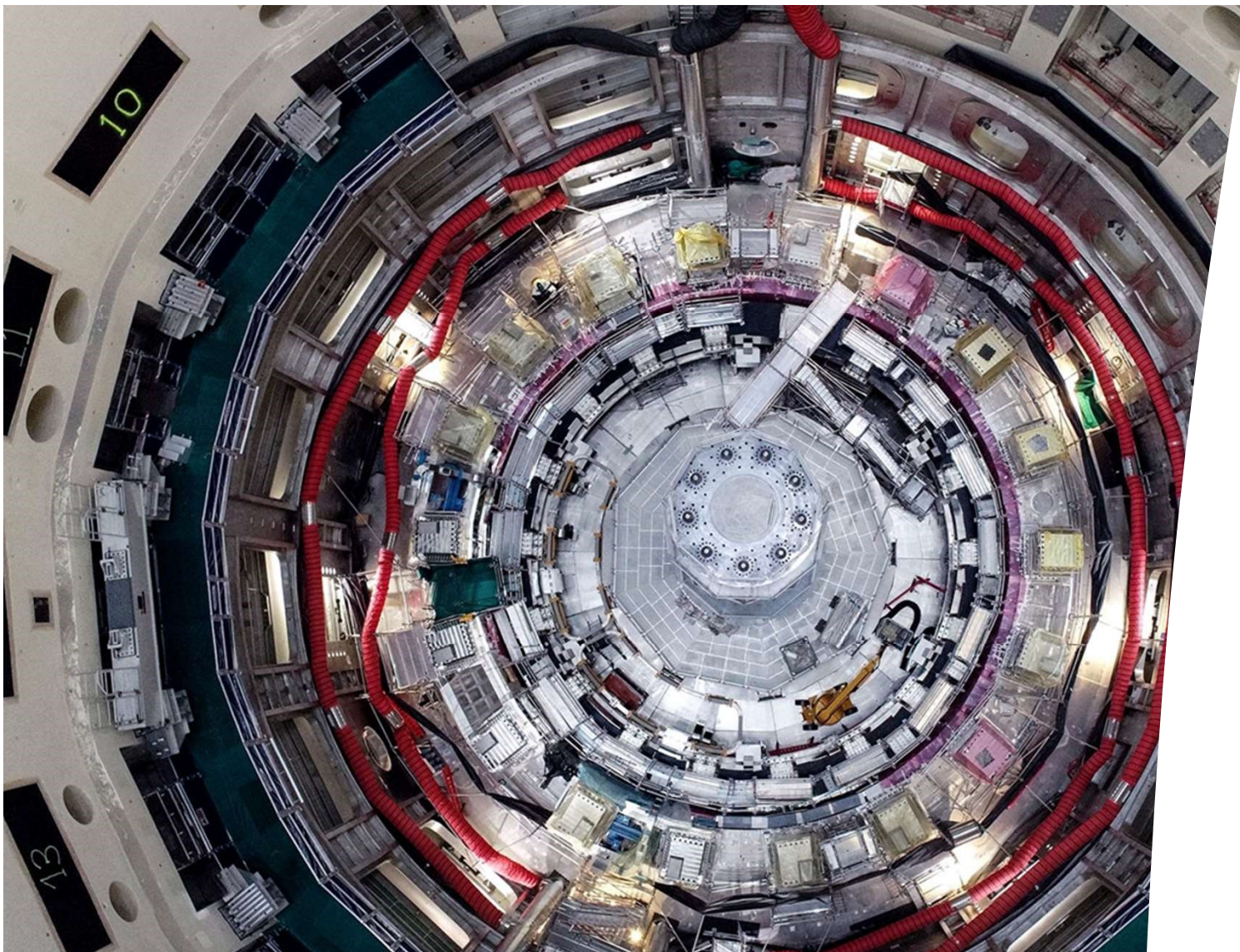
ITER Organization and Domestic Agencies

- Members contribute "in-kind" (80-90%)
- Europe, as host, contributes ~45%
- Non-EU members contribute ~9% each





## WHO MANUFACTURES WHAT?



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17 February 2023

# WORKSITE CONSTRUCTION

Aerial perspective, February 2023





## MACHINE ASSEMBLY

The docking of a spaceship – the **Cryostat base** is being lowered into the Tokamak pit.

May 2020







## MACHINE ASSEMBLY

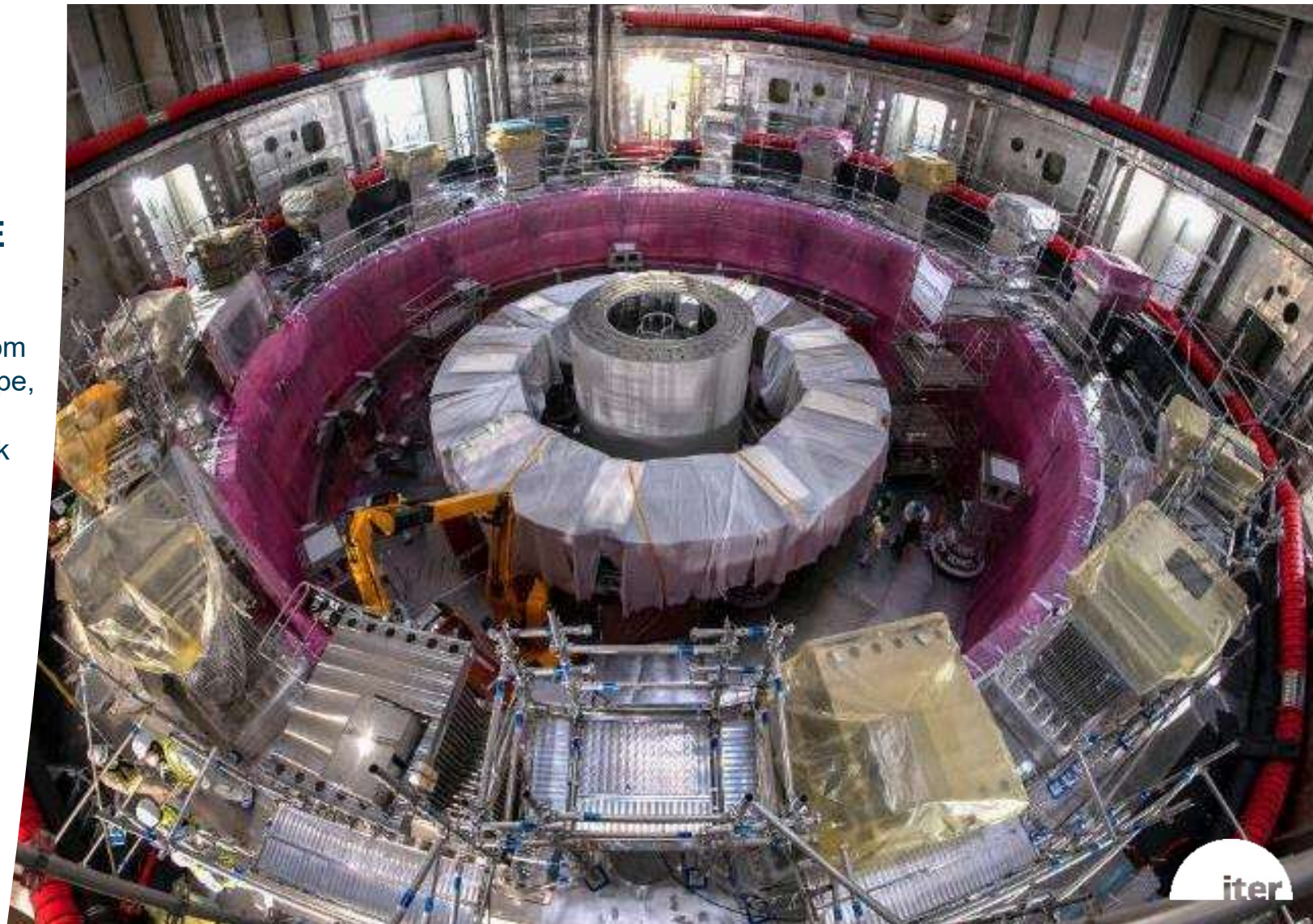
The **Cryostat lower cylinder** has been taken into the Assembly Hall and then lowered into the Tokamak.

August 2020

## ASSEMBLING THE MACHINE

**Poloidal field coil #6** from China, procured by Europe, is the first magnet to be lowered into the Tokamak pit.

April 2021

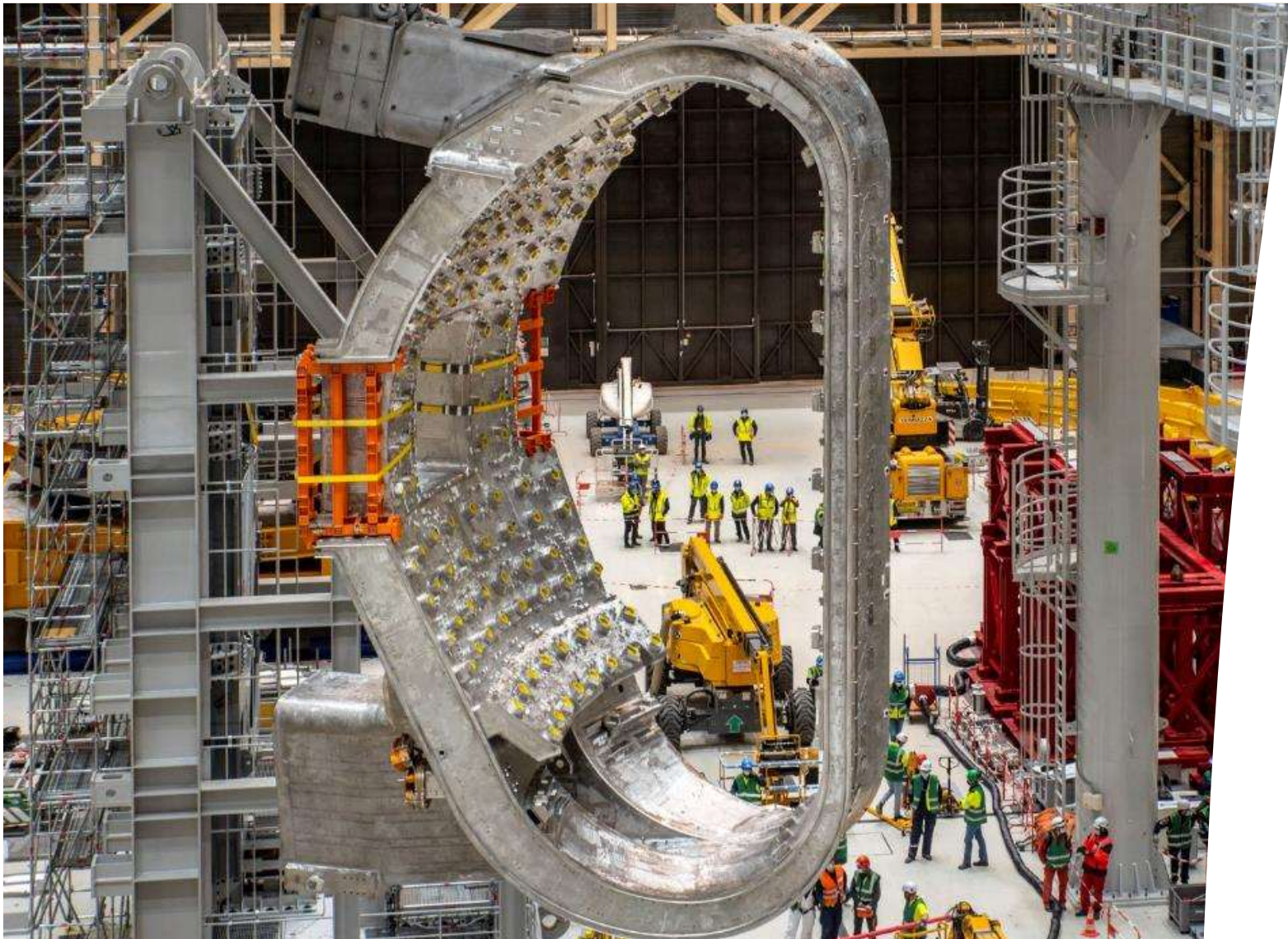


## ASSEMBLING THE MACHINE

Poloidal field coil #5 – now in the Tokamak pit!

16 September 2021

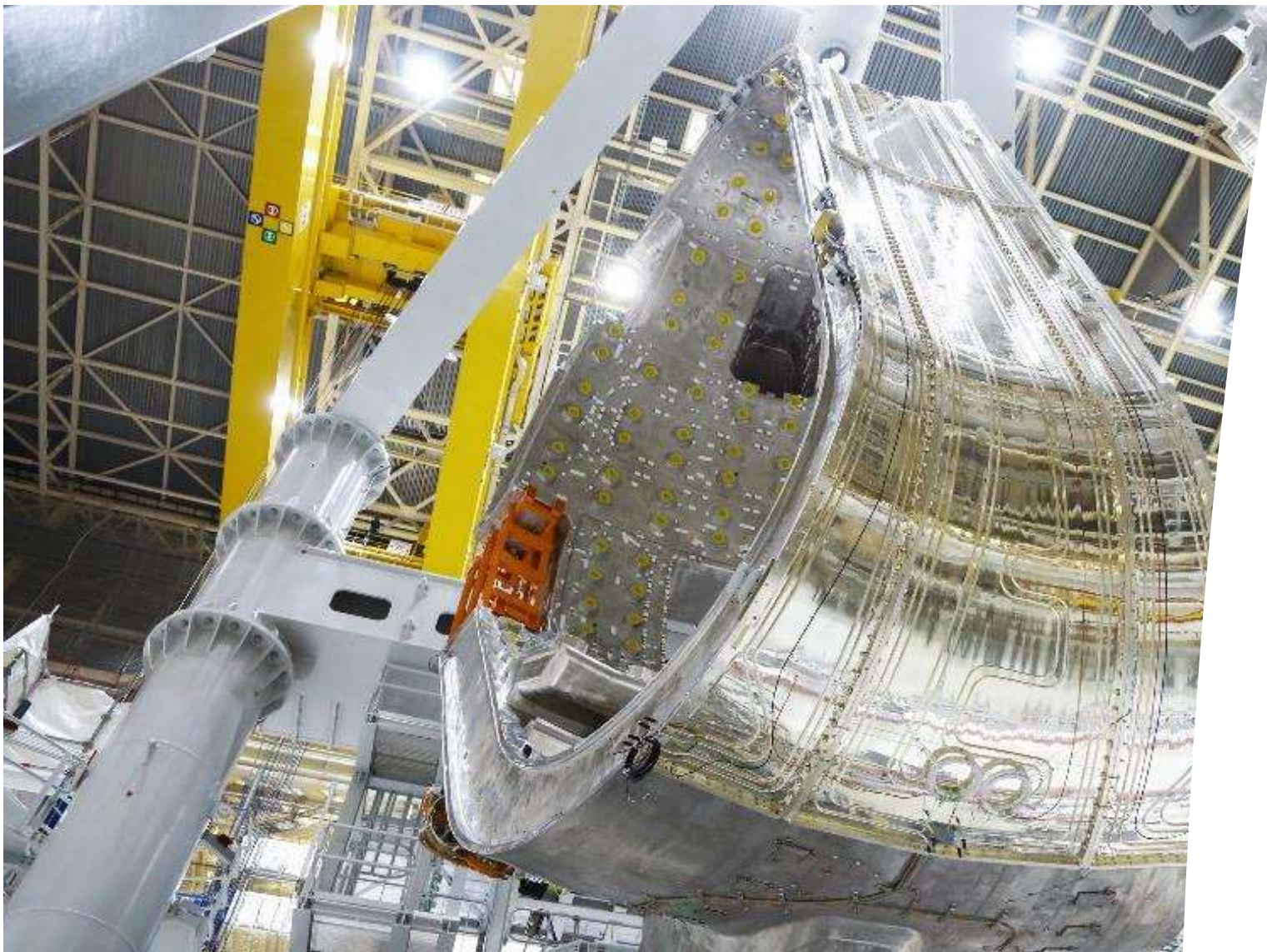




## ASSEMBLING THE MACHINE

The first 440 t **vacuum vessel sector** on its way across the Assembly Hall to the sub-sector assembly tool.

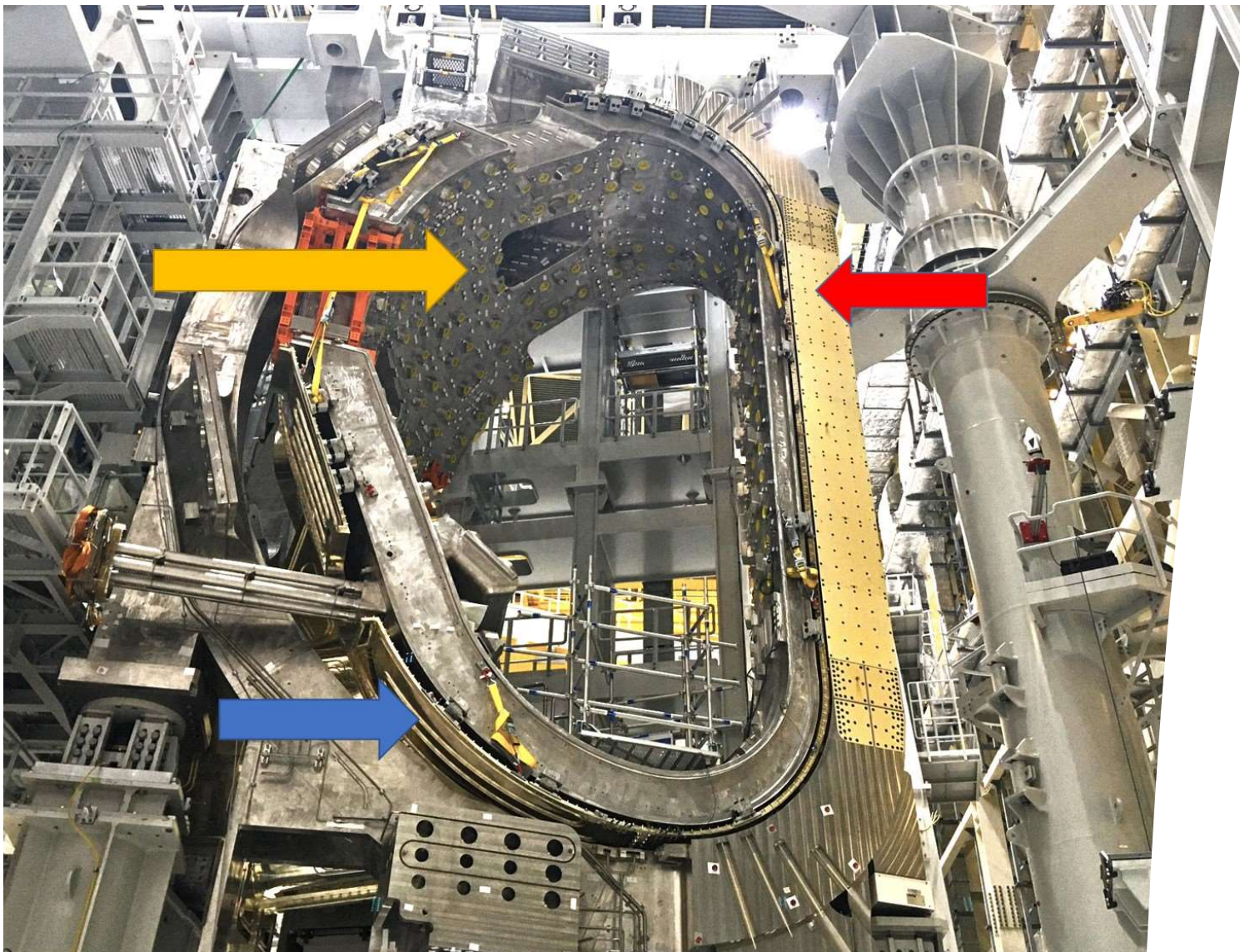
May-June 2021



## **FIRST SECTOR SUB-ASSEMBLY**

Thermal Shield added  
to the Vacuum Vessel  
sector

May-June 2021



## FIRST SECTOR SUB-ASSEMBLY

First sector sub-assembly revealed.

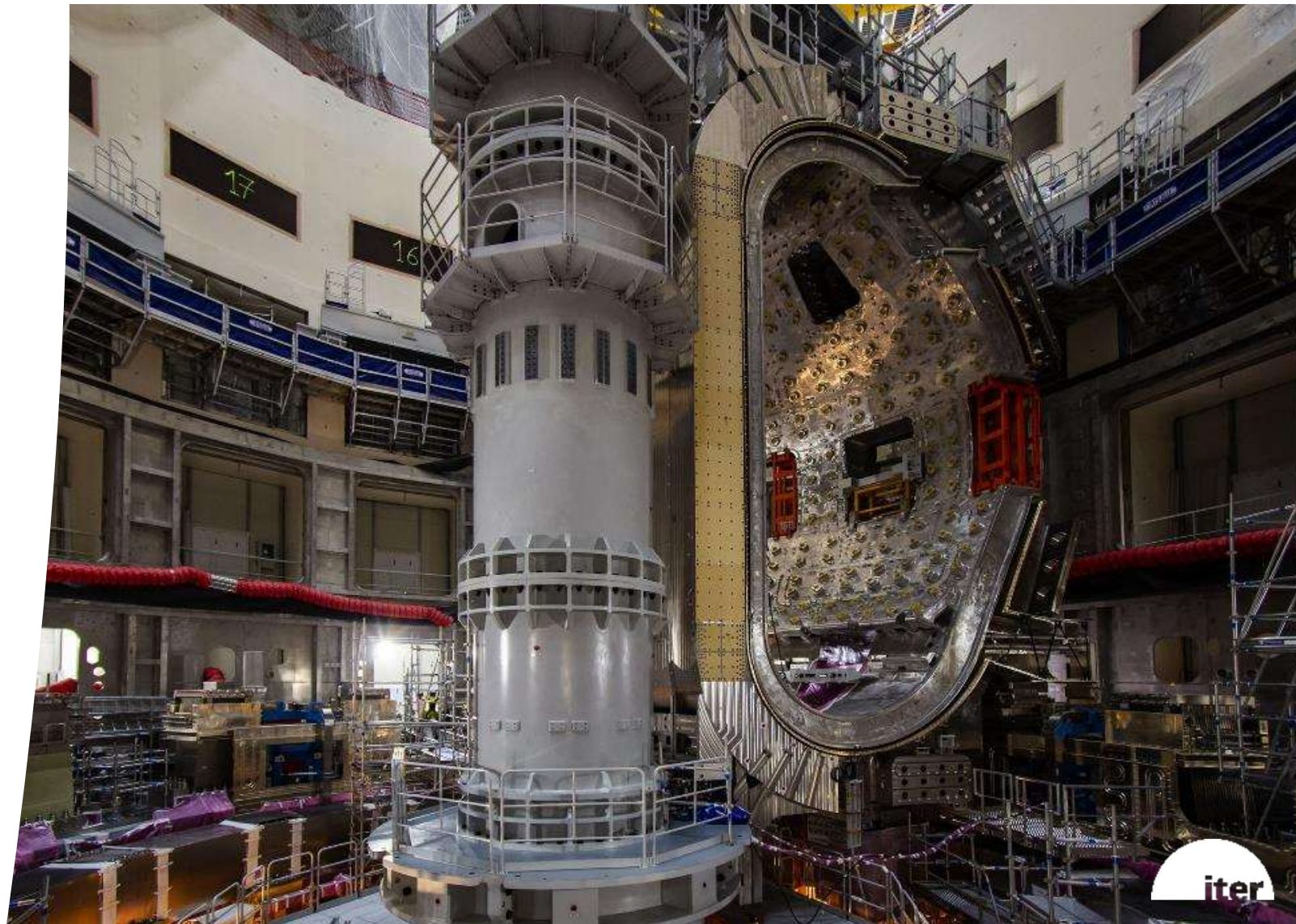
Yellow: vacuum vessel sector  
Blue: thermal shielding  
Red: toroidal field coil

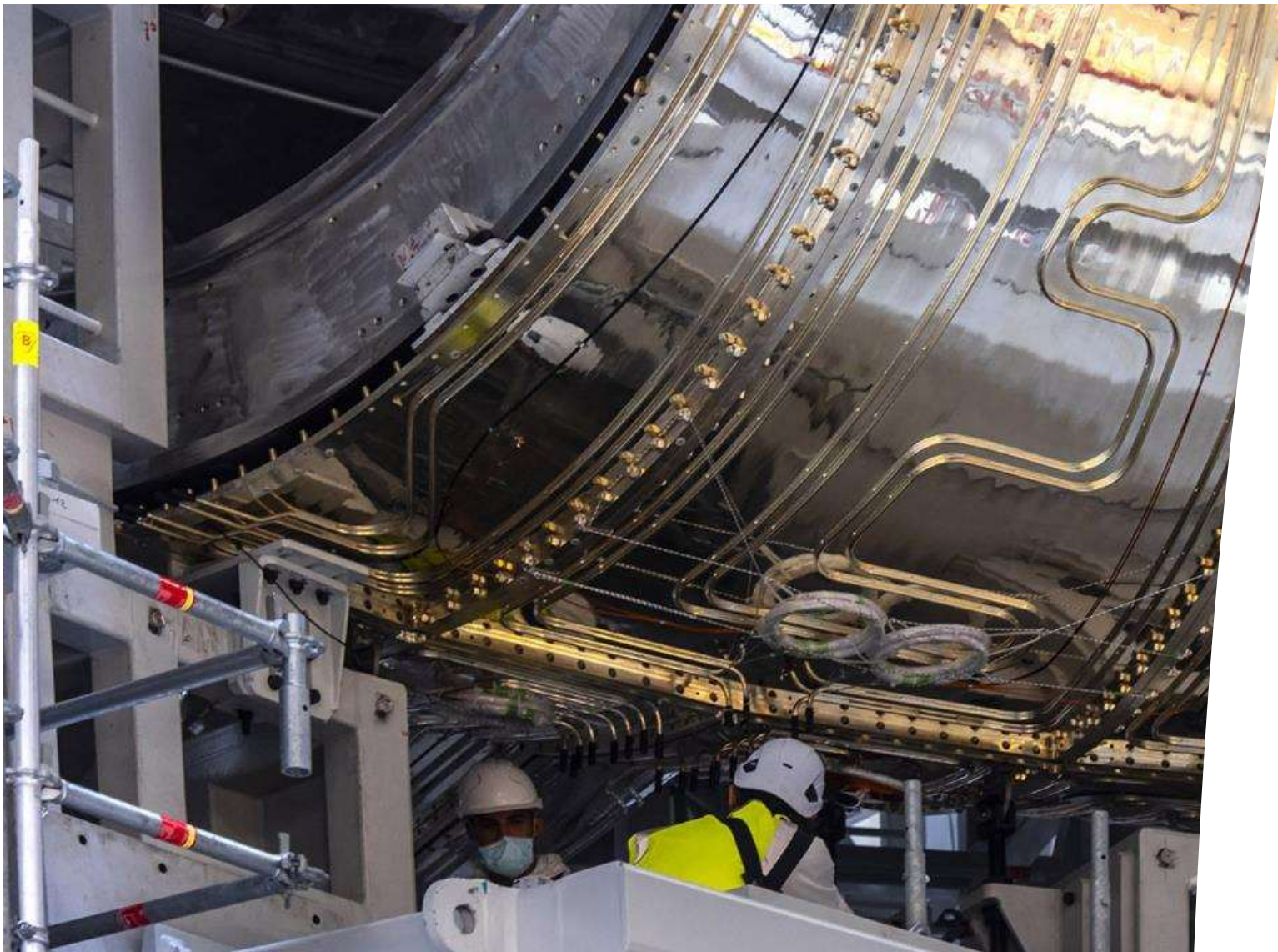
November 2021

## ASSEMBLING THE MACHINE

First complete Vacuum Vessel Sector Module installation

May 2022





## CHALLENGES OF FIRST-OF-A-KIND COMPONENTS

Leakage identified in thermal shield cooling piping due to chloride stress corrosion.

*Repair strategy defined. Accelerated procedure underway to select specialize subcontractors for the repairs.*



## CHALLENGES OF FIRST-OF-A-KIND COMPONENTS

Geometric non-conformities  
found in Vacuum Vessel  
sector field joints.

*Repair strategy defined.  
Accelerated procedure  
underway to select  
specialize subcontractors for  
the repairs.*





## CONTROL BUILDING

Construction is largely complete and is now “ready for installation.”

December 2022





# Thank you!

