# The European Spallation Source: Designing a Sustainable RI for Europe

*John Womersley, Director General*

*Workshop on 'The Economics of Science', Brussels, June 2019*

EUROPEAN SPALLATION SOURCE

# Key challenges in building sustainable support for any science megaproject

- ✓ Science case
- ✓ Technical R&D, cost estimates understood
- ✓ Project management plan
- ✓ Credible funding and governance plan
- ✓ Stakeholder engagement
- ✓ Compelling investment case

# The investment case in a nutshell


Scientific and technological innovation is essential

- *global challenges* of energy, climate, environment, healthcare
- *economic and societal challenges* of stalled productivity and long term wage stagnation

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Materials and molecules

Where are the atoms and what do they do?

New materials, new drugs, new processes, new energy technologies

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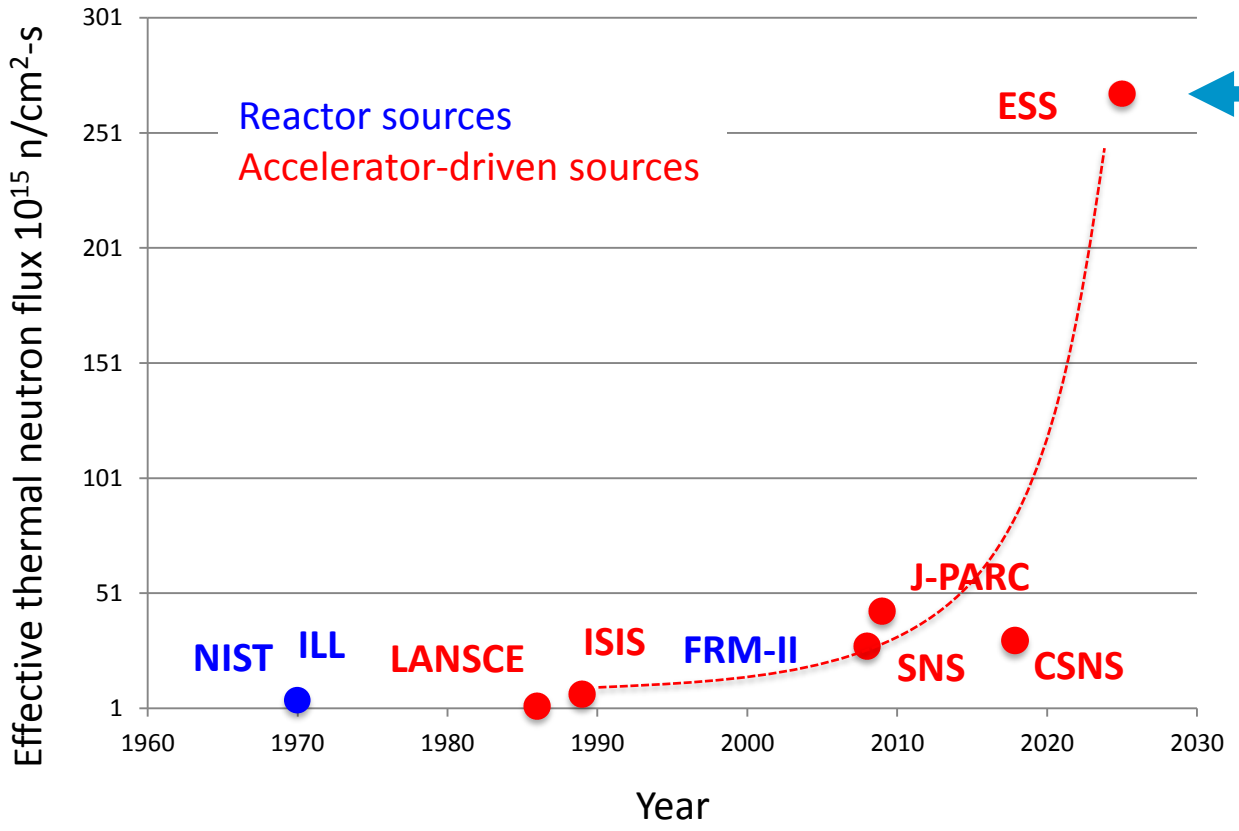


Our vision is to build and operate the world's most powerful neutron source, enabling scientific breakthroughs in research related to materials, energy, health and the environment, and addressing some of the most important societal challenges of our time.

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**1843 M€** construction cost 2013 prices

**5 MW** world's most powerful particle accelerator

2MW at start of operation

**15** experimental stations

**20 ×** more sensitive on average than today's best

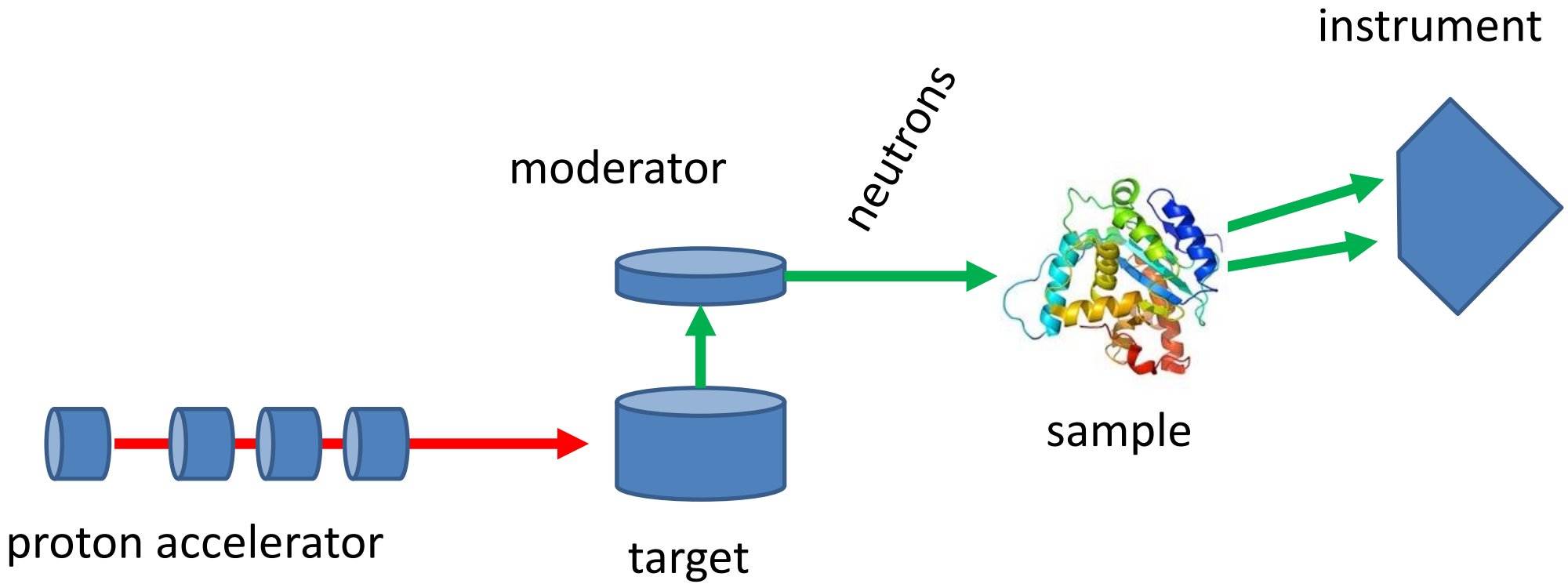
at 2MW

**800** experiments per year

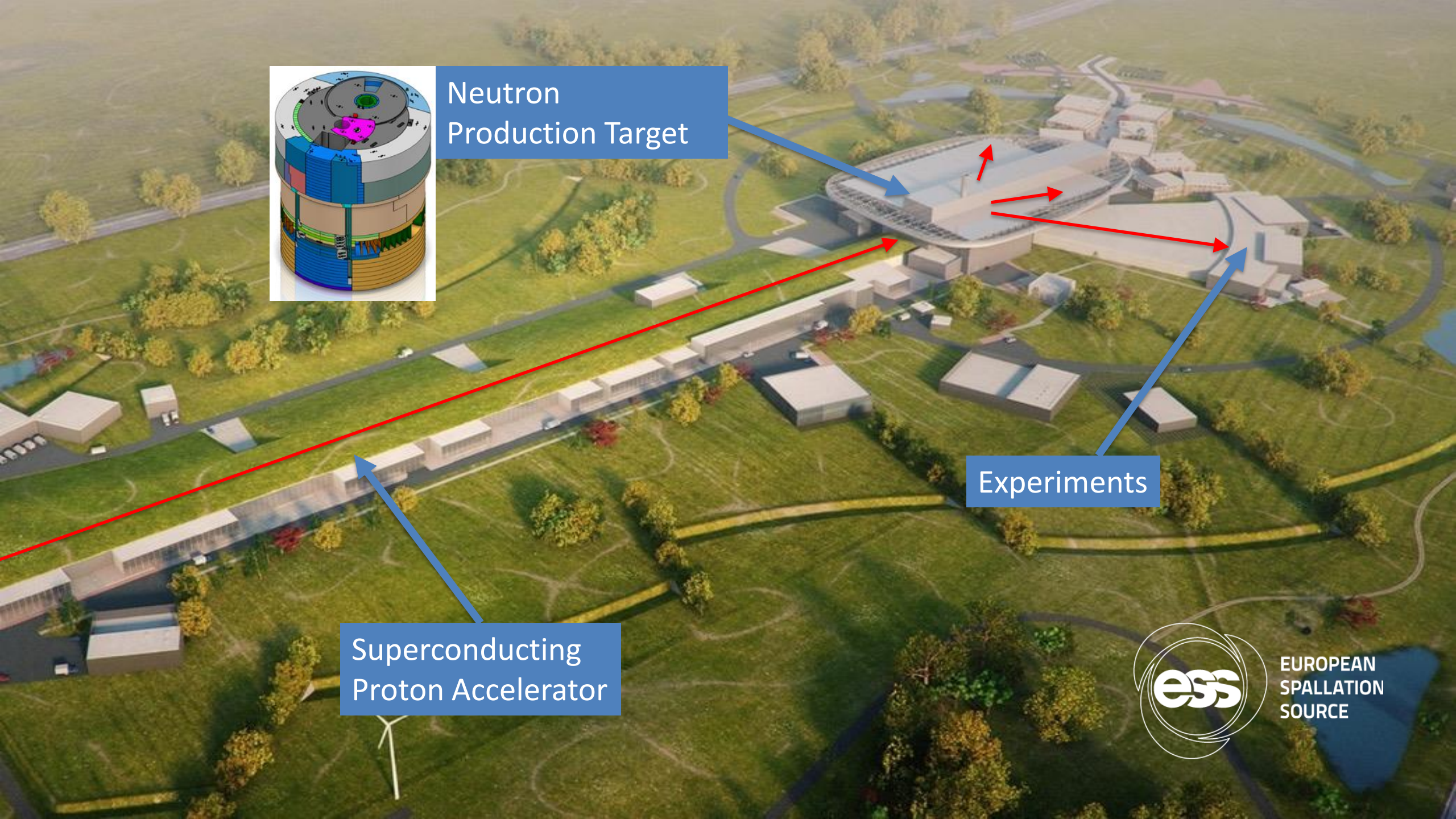
**2023** first science for users

**13** member nations in the ESS ERIC

# How a spallation neutron source works




“spallation” is the process that releases neutrons from the target nuclei


Neutron
Production Target
Experiments
Superconducting
Proton Accelerator
EUROPEAN
SPALLATION
SOURCE

# Organisation and People

**499**

Employees

**54**

Nationalities

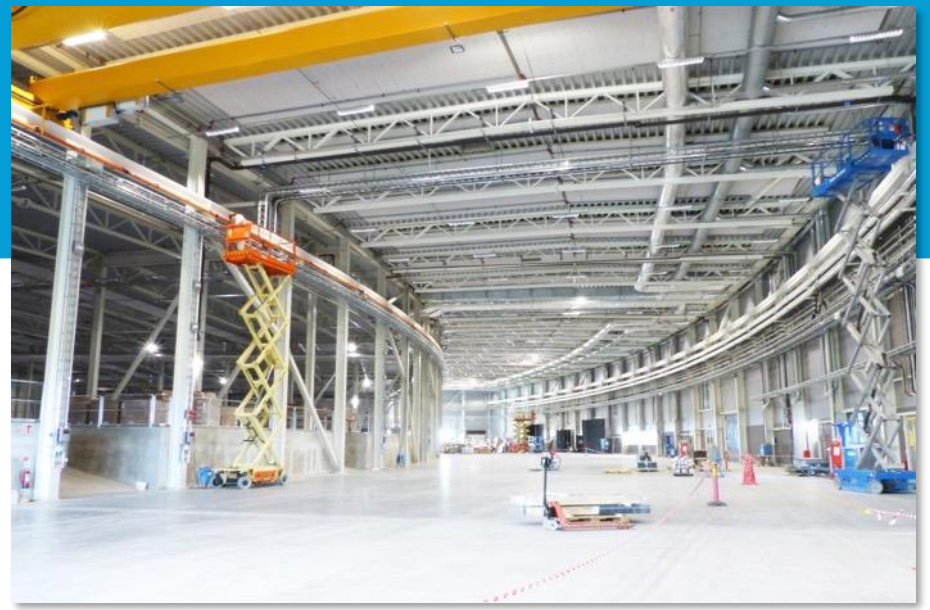
**~ 100**

Collaborating Institutions

# September 2014

# ESS is 58 % complete

- Peak of construction activity
- Accelerator commissioning started
- Instrument hall E01 handover summer 2019



# Financing and Governance

**The European Spallation Source ERIC established in 2015**

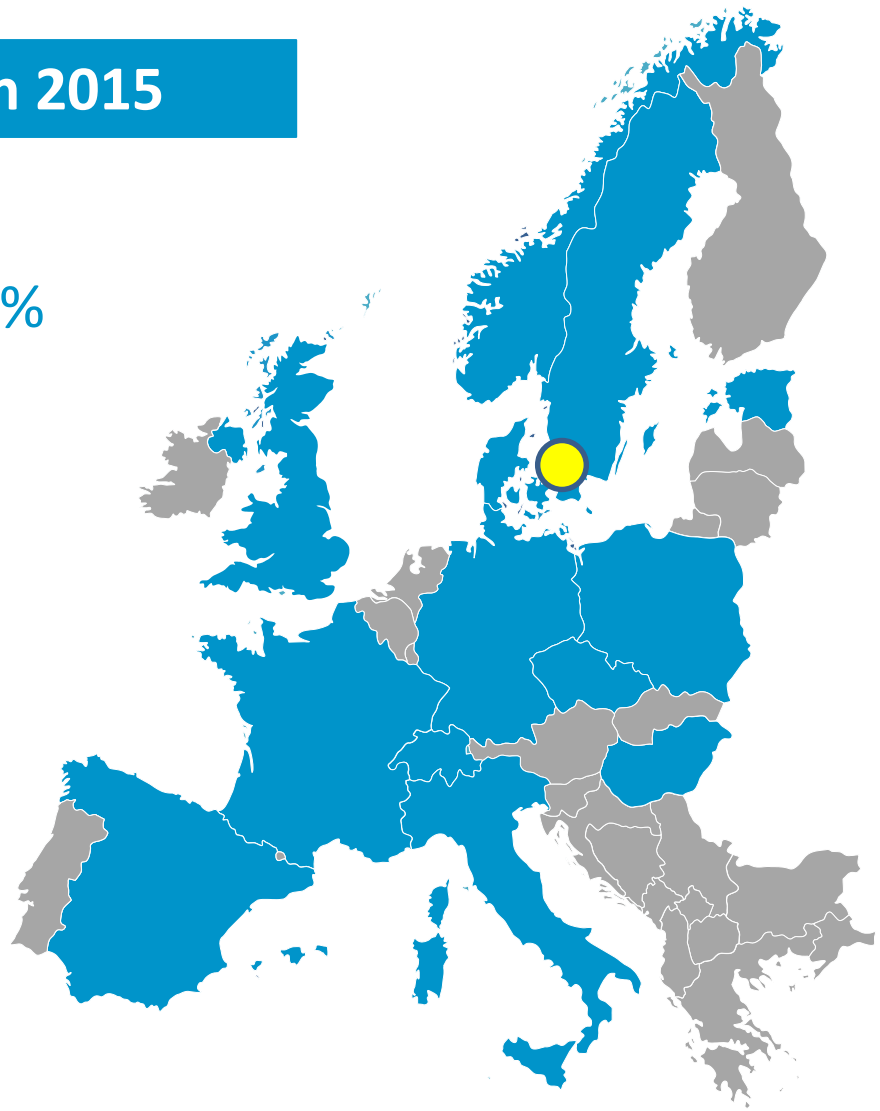
**Host Countries Sweden and Denmark**

| | | |
|---|---|---|
| Construction | 47.5% | Cash Investment ~ 97% |
| Operations | 15% | |

**Non Host Member Countries**

| | | |
|---|---|---|
| Construction | 52.5% | In-kind ~ 70% |
| Operations | 85% | |

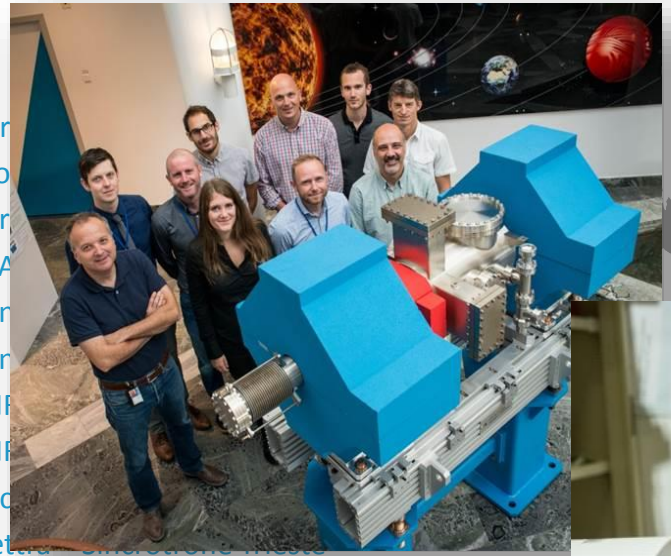
**13 European Member Countries**



# In-kind contributions

- Significant technical workpackages procured or constructed in partner countries rather than centrally
  - partner holds and manages the risk
- A project management challenge… but a political necessity
  - Helps avoid situation where the host region benefits greatly and the others just pay cash
  - ESS – 70% for non-hosts, 35% overall, just about manageable
  - ITER – 90% in kind, close to unmanageable

# ESS In-kind Partners



Aar
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CEA
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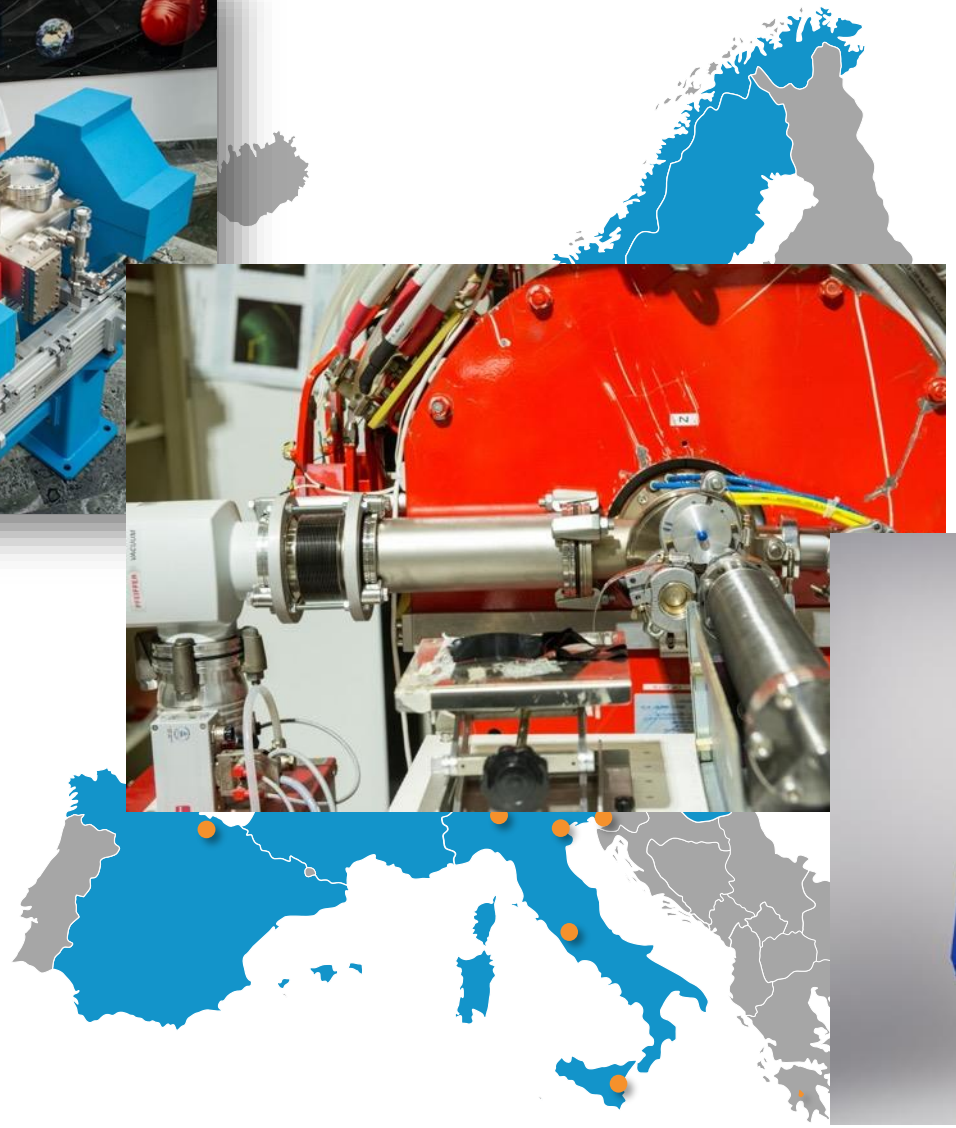
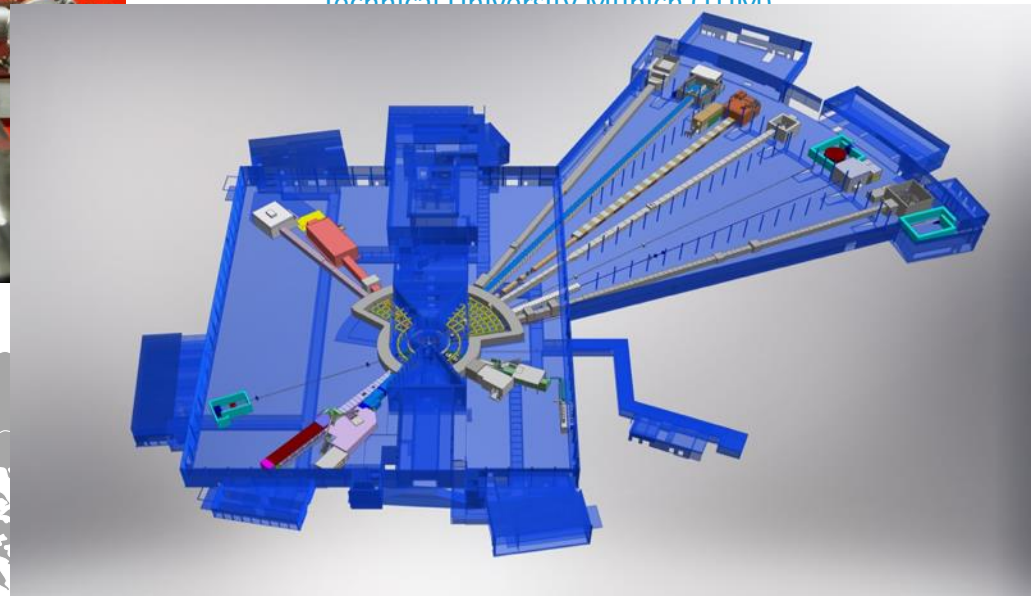
Coc
Elet
ESS Bilbao
Forschungszentrum Jülich
Helmholtz-Zentrum Geesthacht
Huddersfield University
IFJ PAN, Krakow
INFN, Catania
INFN, Legnaro
INFN, Milan
Institute for Energy Research (IFE)





ISIS - Rutherford-Appleton Laboratory, Oxford
Laboratoire Léon Brilouin (LLB)
Lund University
Nuclear Physics Institute of the ASCR
Oslo University
Paul Scherrer Institute (PSI)
Polish Electronic Group (PEG)
Roskilde University
Tallinn Technical University
Technical University of Denmark (DTU)
Technical University Munich (TUM)



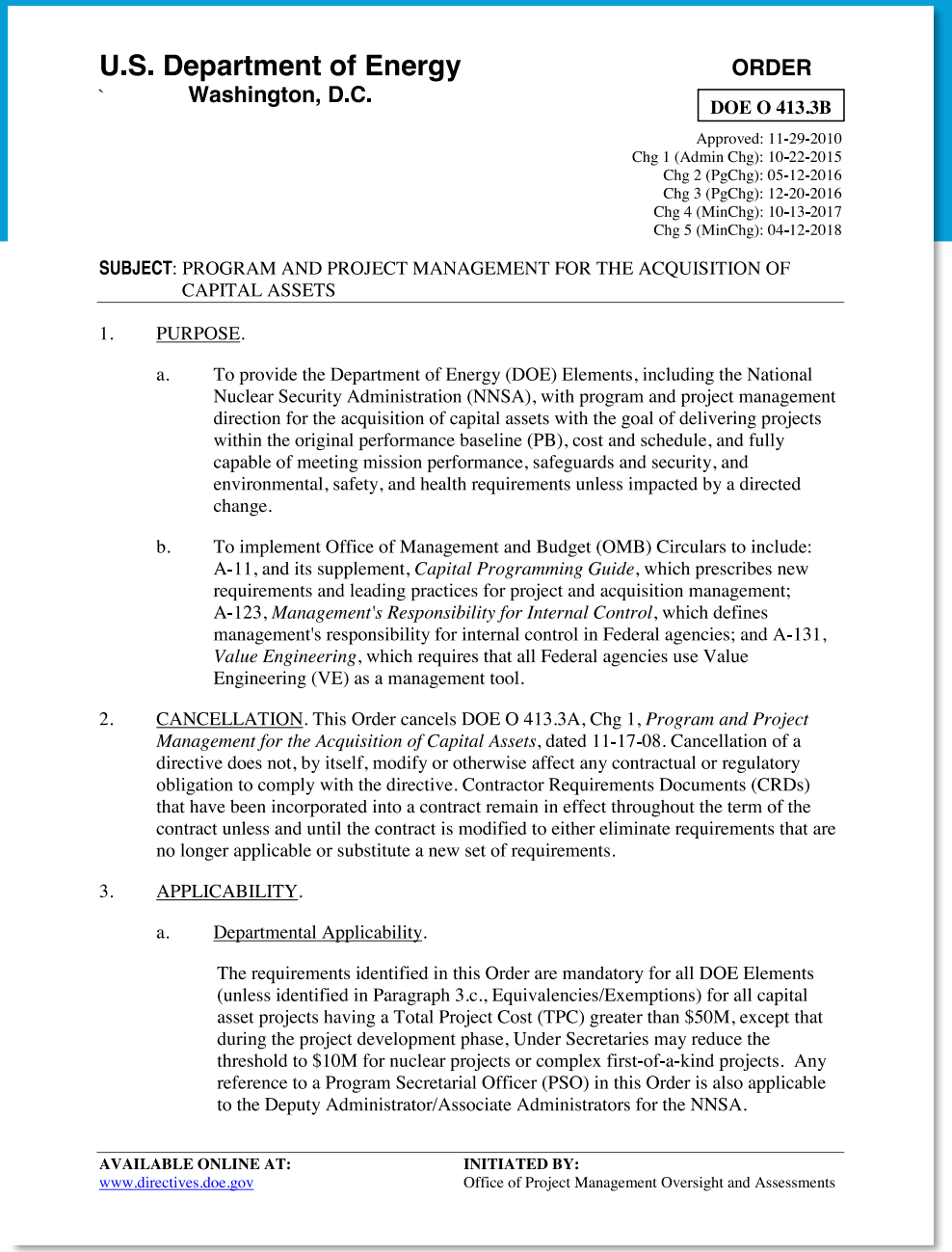

# Ion Source inauguration

# Project management

## Follow best practice

Based on US DOE Office of Project Management *energy.gov/projectmanagement/project-management*

- Resource Loaded schedule
- Sufficient contingency
- Change control process
- …



**U.S. Department of Energy**
**Washington, D.C.**

**ORDER**
**DOE O 413.3B**

Approved: 11-29-2010
Chg 1 (Admin Chg): 10-22-2015
Chg 2 (PgChg): 05-12-2016
Chg 3 (PgChg): 12-20-2016
Chg 4 (MinChg): 10-13-2017
Chg 5 (MinChg): 04-12-2018

**SUBJECT**: PROGRAM AND PROJECT MANAGEMENT FOR THE ACQUISITION OF CAPITAL ASSETS

1. PURPOSE.

   a. To provide the Department of Energy (DOE) Elements, including the National Nuclear Security Administration (NNSA), with program and project management direction for the acquisition of capital assets with the goal of delivering projects within the original performance baseline (PB), cost and schedule, and fully capable of meeting mission performance, safeguards and security, and environmental, safety, and health requirements unless impacted by a directed change.

   b. To implement Office of Management and Budget (OMB) Circulars to include: A-11, and its supplement, *Capital Programming Guide*, which prescribes new requirements and leading practices for project and acquisition management; A-123, *Management's Responsibility for Internal Control*, which defines management's responsibility for internal control in Federal agencies; and A-131, *Value Engineering*, which requires that all Federal agencies use Value Engineering (VE) as a management tool.

2. CANCELLATION. This Order cancels DOE O 413.3A, Chg 1, *Program and Project Management for the Acquisition of Capital Assets*, dated 11-17-08. Cancellation of a directive does not, by itself, modify or otherwise affect any contractual or regulatory obligation to comply with the directive. Contractor Requirements Documents (CRDs) that have been incorporated into a contract remain in effect throughout the term of the contract unless and until the contract is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.

3. APPLICABILITY.

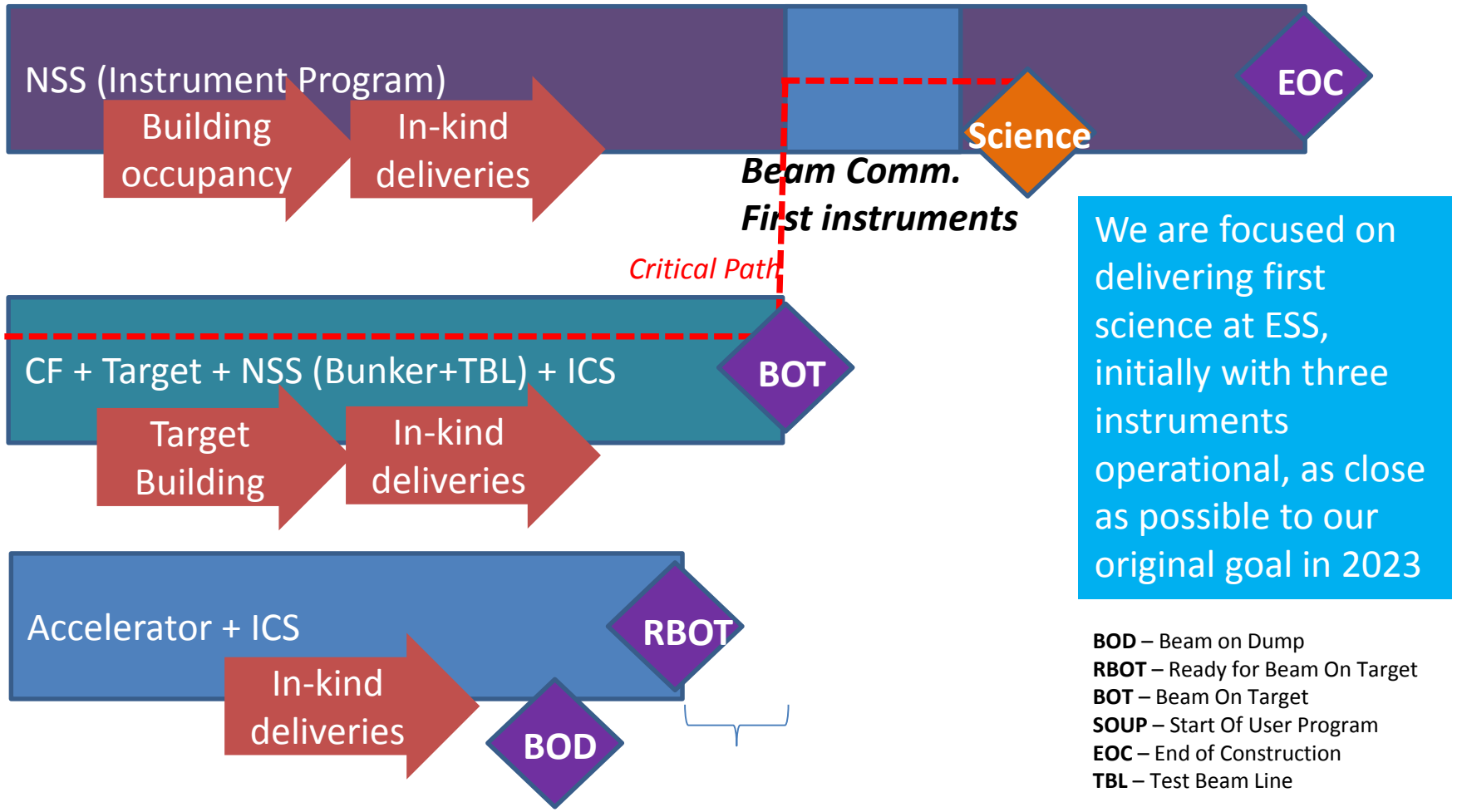
   a. Departmental Applicability.

      The requirements identified in this Order are mandatory for all DOE Elements (unless identified in Paragraph 3.c., Equivalencies/Exemptions) for all capital asset projects having a Total Project Cost (TPC) greater than $50M, except that during the project development phase, Under Secretaries may reduce the threshold to $10M for nuclear projects or complex first-of-a-kind projects. Any reference to a Program Secretarial Officer (PSO) in this Order is also applicable to the Deputy Administrator/Associate Administrators for the NNSA.

**AVAILABLE ONLINE AT:** www.directives.doe.gov

**INITIATED BY:** Office of Project Management Oversight and Assessments

# Project planning strategy




We are focused on delivering first science at ESS, initially with three instruments operational, as close as possible to our original goal in 2023

**BOD** – Beam on Dump
**RBOT** – Ready for Beam On Target
**BOT** – Beam On Target
**SOUP** – Start Of User Program
**EOC** – End of Construction
**TBL** – Test Beam Line

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- Meets modern environmental expectations
  - Green construction site
  - Purchase all electrical power from renewable sources
  - Waste heat recovery into Lund district heating system
- Support for full computing, software and analysis chain
  - Open data model, EOSC-compliant
- Development of science and innovation campus between ESS and MAX IV light source


- ✓ Science case
- ✓ Technical R&D, cost estimates understood
- ✓ Project management plan
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A few closing observations:

# Why do big projects fail to get started?

- In 2016 The European Strategy Forum for Research Infrastructures reviewed implementation progress of the projects on its roadmap

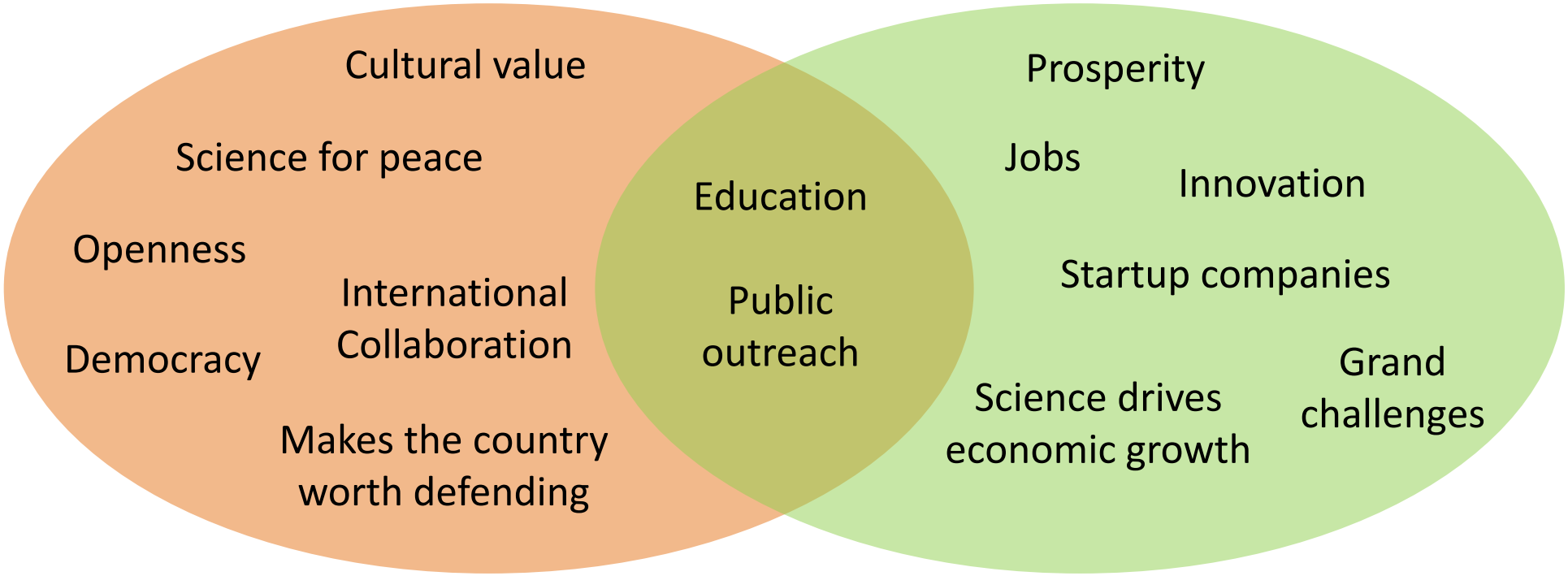
- Found **inadequate stakeholder engagement** and **lack of a credible funding plan** to be the biggest barriers
  - much more so than any weakness of the science case

# Stakeholders include

- The General Public
- Media, opinion formers
- Students
- Educators
  (STEM skills pipeline)
- University bosses
- Other science areas
- Members of Parliament
- Science Ministers
- Finance Ministers
- Opposition political parties
- Local and regional politicians
- Civil Servants
- Economists

× 13 partner countries, each with their own science strengths, industrial profile, media and decision making culture

Normative values → shift in emphasis since the end of the Cold War → Market values




Scientists are much happier over here…

… but this is where investment decisions are now made

# A parting challenge

The biggest economic challenges of our time

- Globalisation
- Together with automation and new technologies
- Leading to fewer good jobs
- Leading to low growth, stagnant wages

No one really has the answer

… but general consensus that scientific innovation and STEM skills are key

  – at least economies and people that have these skills will be better positioned

**So what is our project going to do to help?**

# Thank you!

*@johnwomersley* *@essneutron* *europeanspallationsource.se*