EUROPEAN SPALLATION SOURCE

European Spallation Source
Overview and Status

02 June 2016

Partner Day at the Latvian Ministry of Science and Education

James H. Yeck
Director General
European Spallation Source ERIC


A partnership of
17 European nations
EUROPEAN
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SOURCE


Lightning
New materials
Solar energy
Food
Medicine
Pacemakers
Tailor made materials
Mobile phones
Cosmetics
Implants
Transportation
Geo science
Bio fuels

Properties of neutrons for measurements

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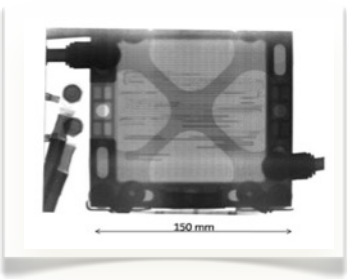
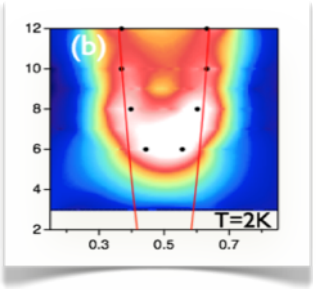
Charge neutral
Deeply penetrating



Li motion in fuel cells

Help build electric cars

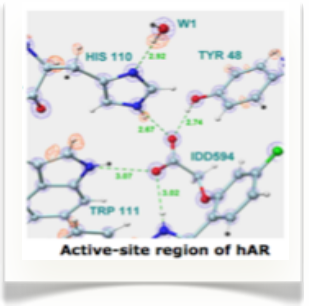
Magnetic moment (spin)
Directly probe magnetism



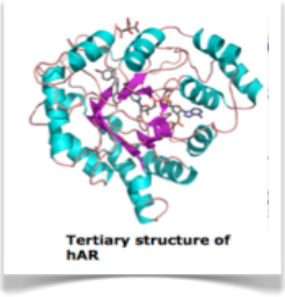
High-Tc superconductivity

Efficient high speed trains

Scattering
Sensitive to light elements

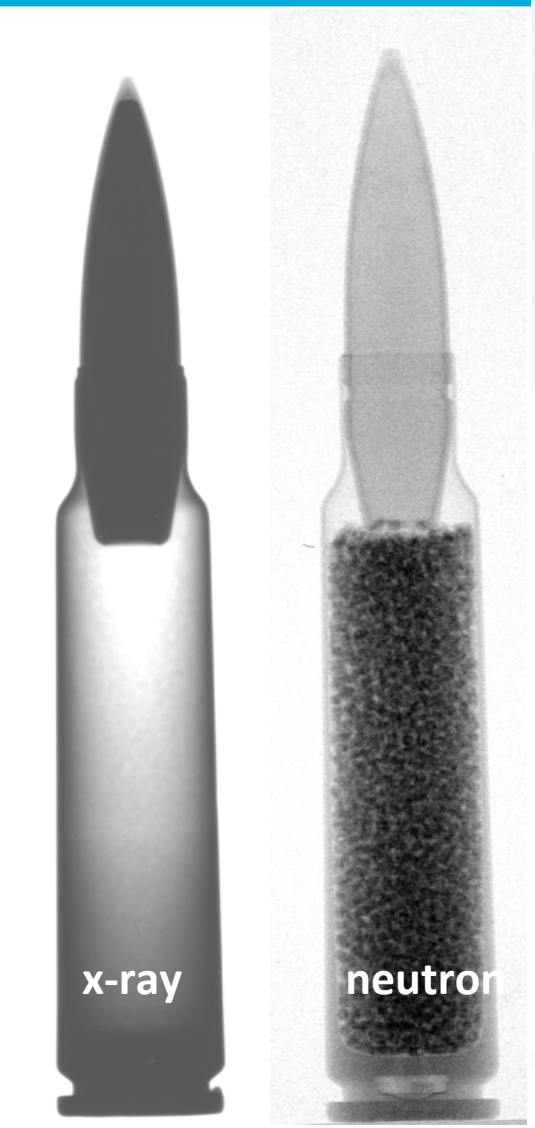


Actives sites in proteins

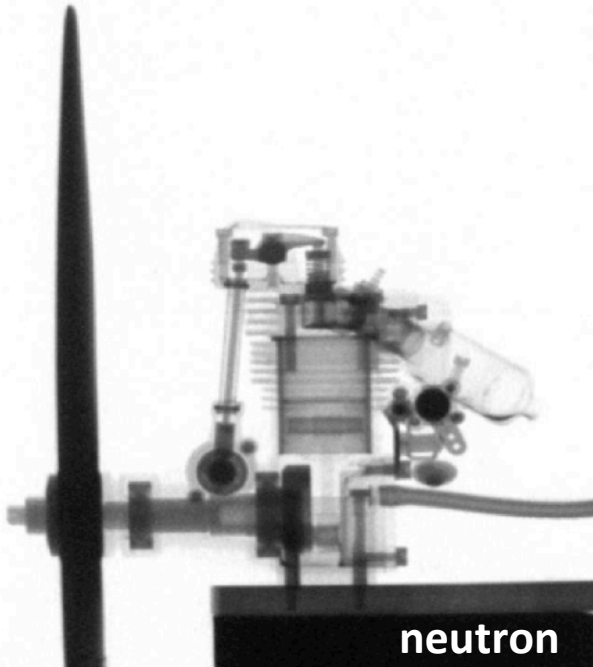


Better drugs

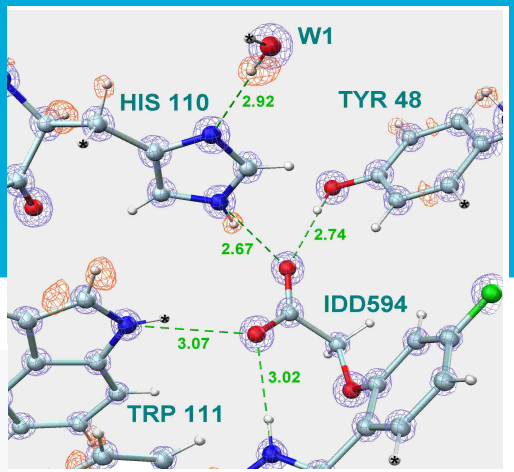
Neutrons see the Light Elements

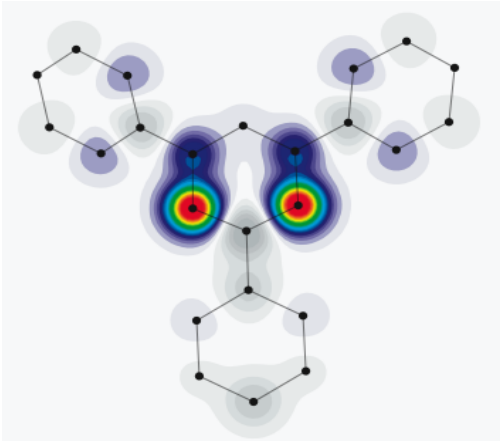


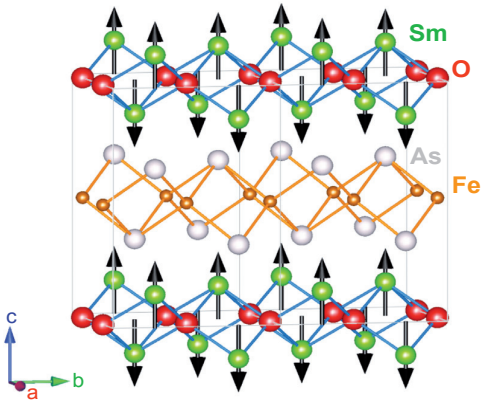
Images from the NIAG group, PSI, Switzerland.



What do the Neutrons Tell Us?





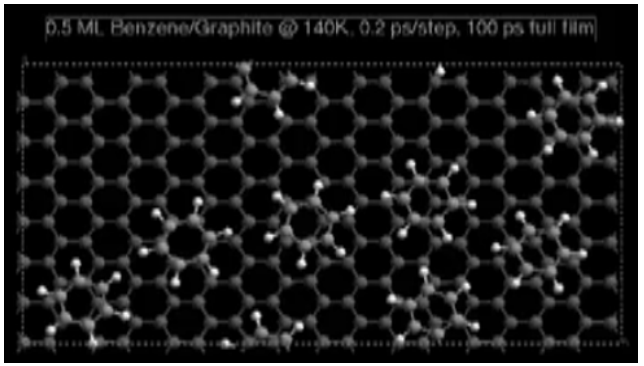


- Structure to molecular and atomic level
- Dynamics
- Magnetic structure
- Imaging

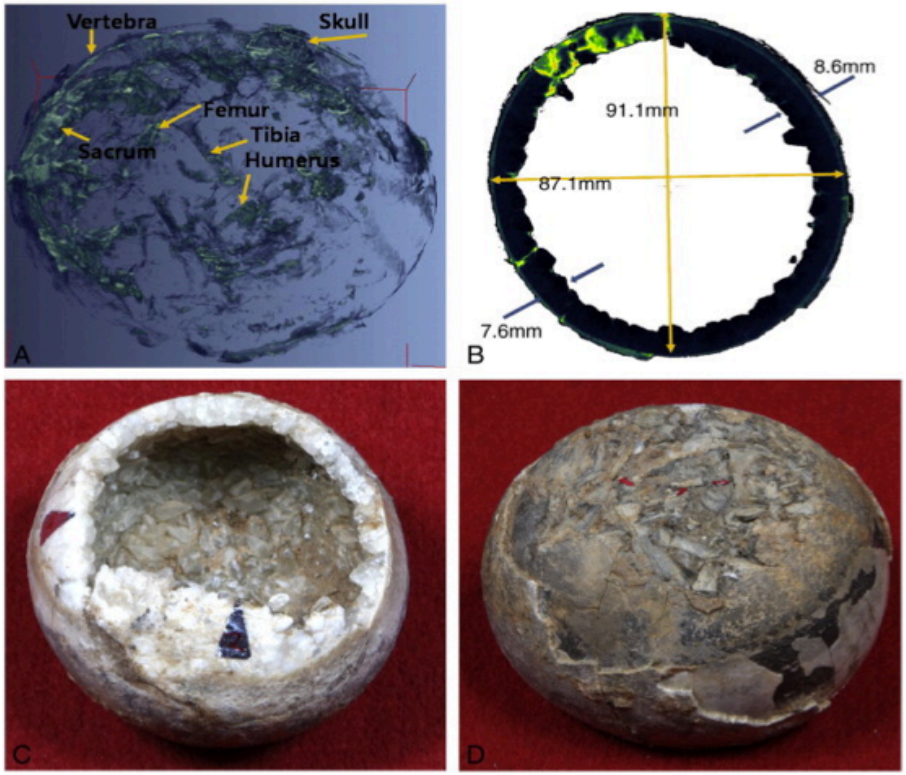
-> A wide range of science areas

- A wide range of time- and length-scales can be probed
- Deeply penetrating and non-invasive
- A unique probe for magnetism
- Uniquely sensitive to protons and isotope selective

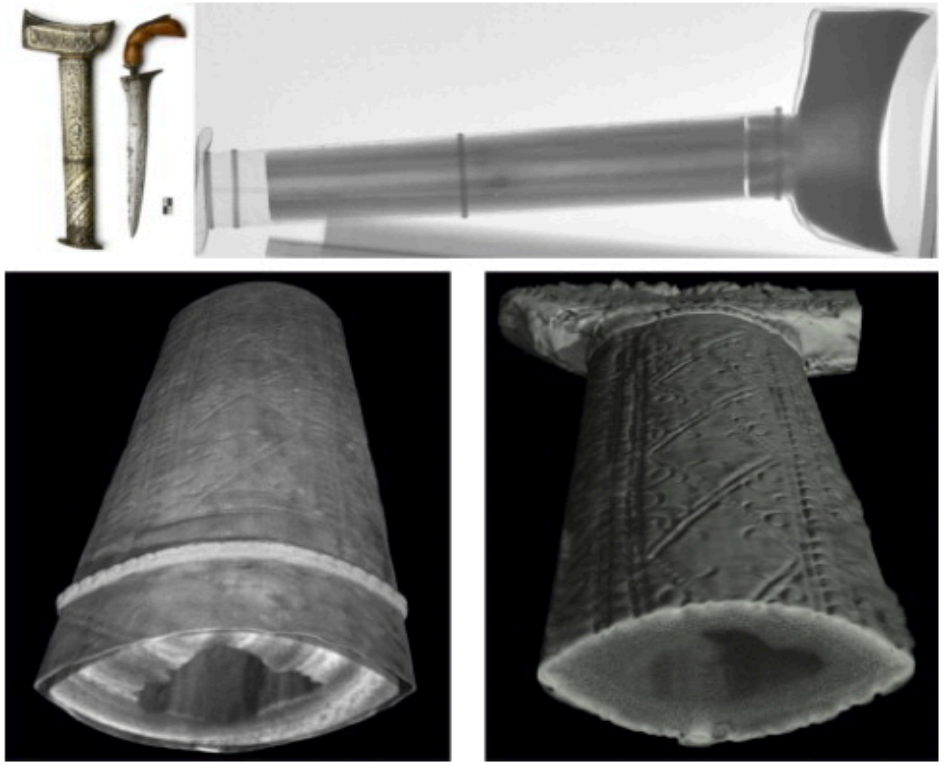
-> Highly complementary to X-rays and other probes



Neutrons for Archaeology and Cultural Heritage

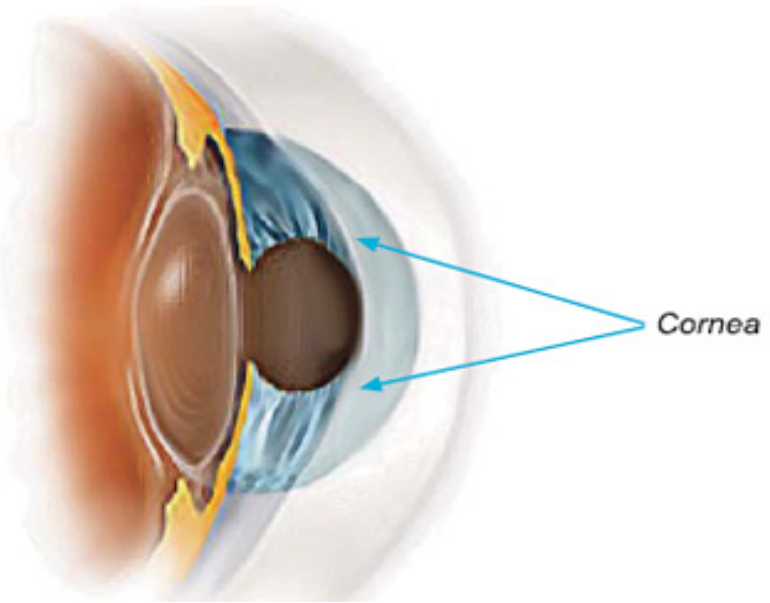


Dinosaur egg



Indonesian dagger sheath, silver outside wood.

Advanced Materials for Health



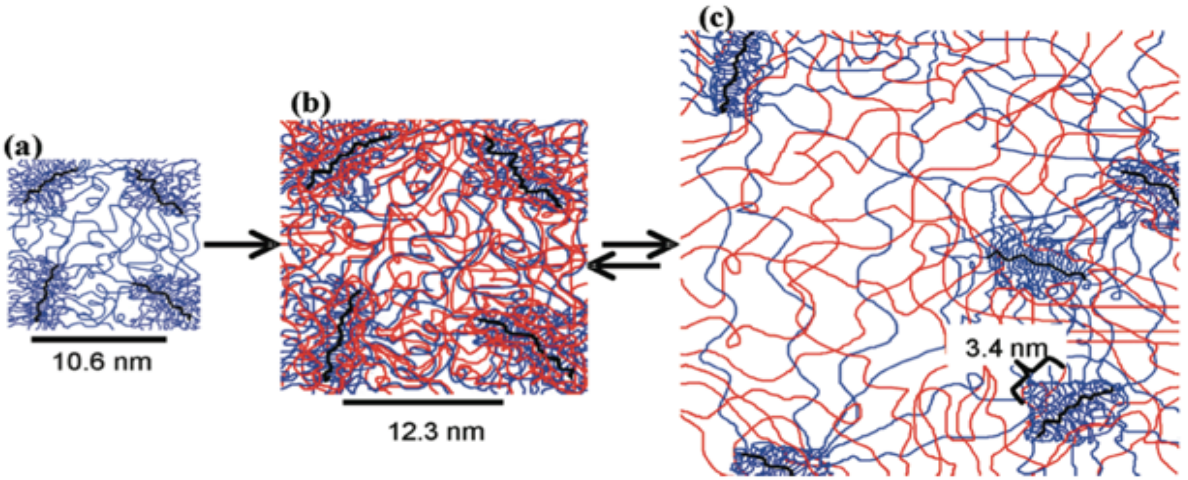
Swelling of a double network hydrogel designed for use as a cornea replacement.
(Frank Group, Stanford)

Double network hydrogels provide strength and resiliance together with high water content.

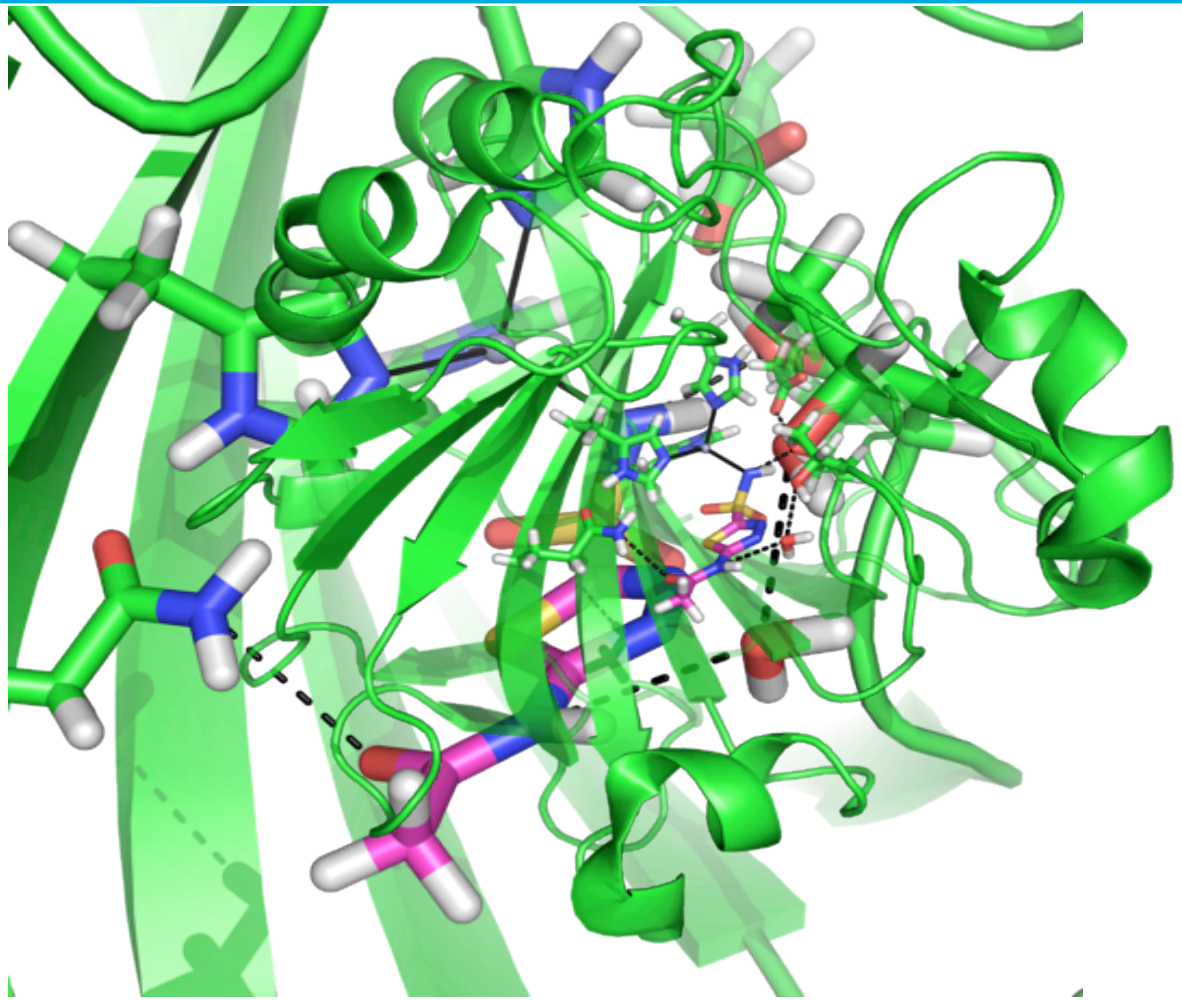
Gel structure forms over **multiple length scales.**

Kinetics of gelation can be rapid needing **sub-second** time resolution.

Neutrons provide the structure of each component in the presence of the other.



Neutrons reveal how drugs interact with drug targets



The enzyme carbonic anhydrase transports CO_2 and regulates blood acidity. It is a major player in some cancers, glaucoma, obesity and high blood pressure

Neutron crystallography pinpoints protons and waters in the active site, showing how the drug Acetazolamide binds

Image: Fisher, S. Z. *et al*. 2012 JACS

How ESS works

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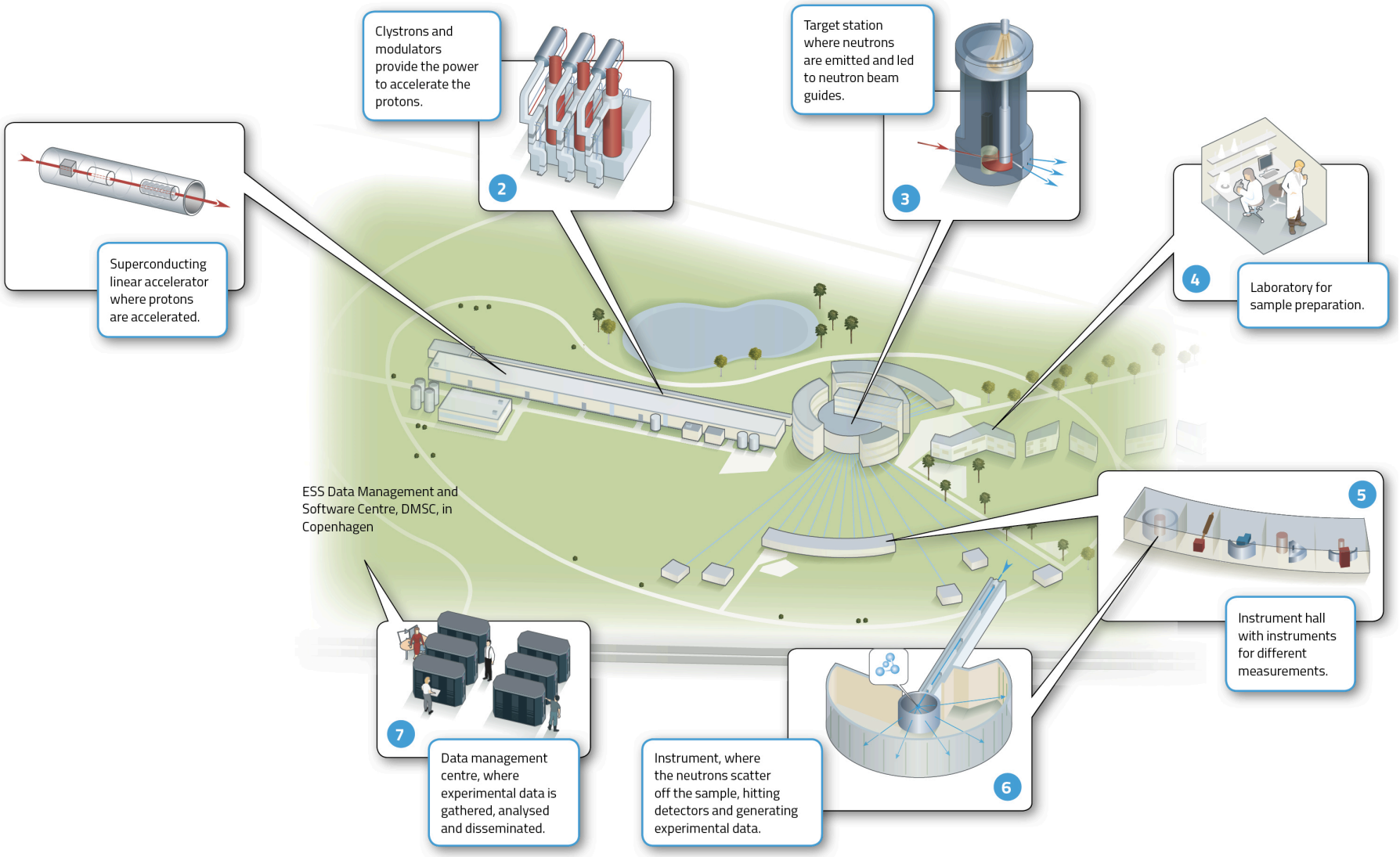
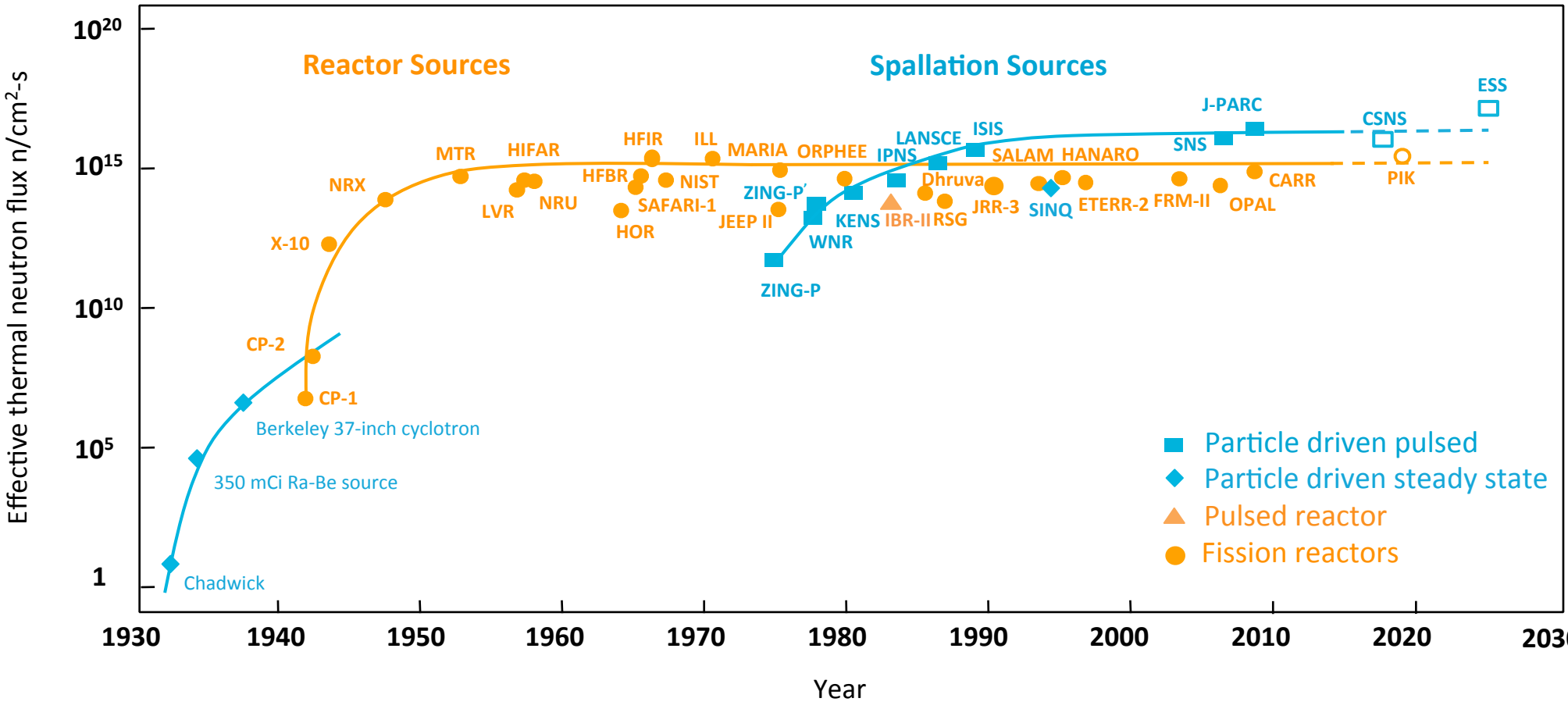
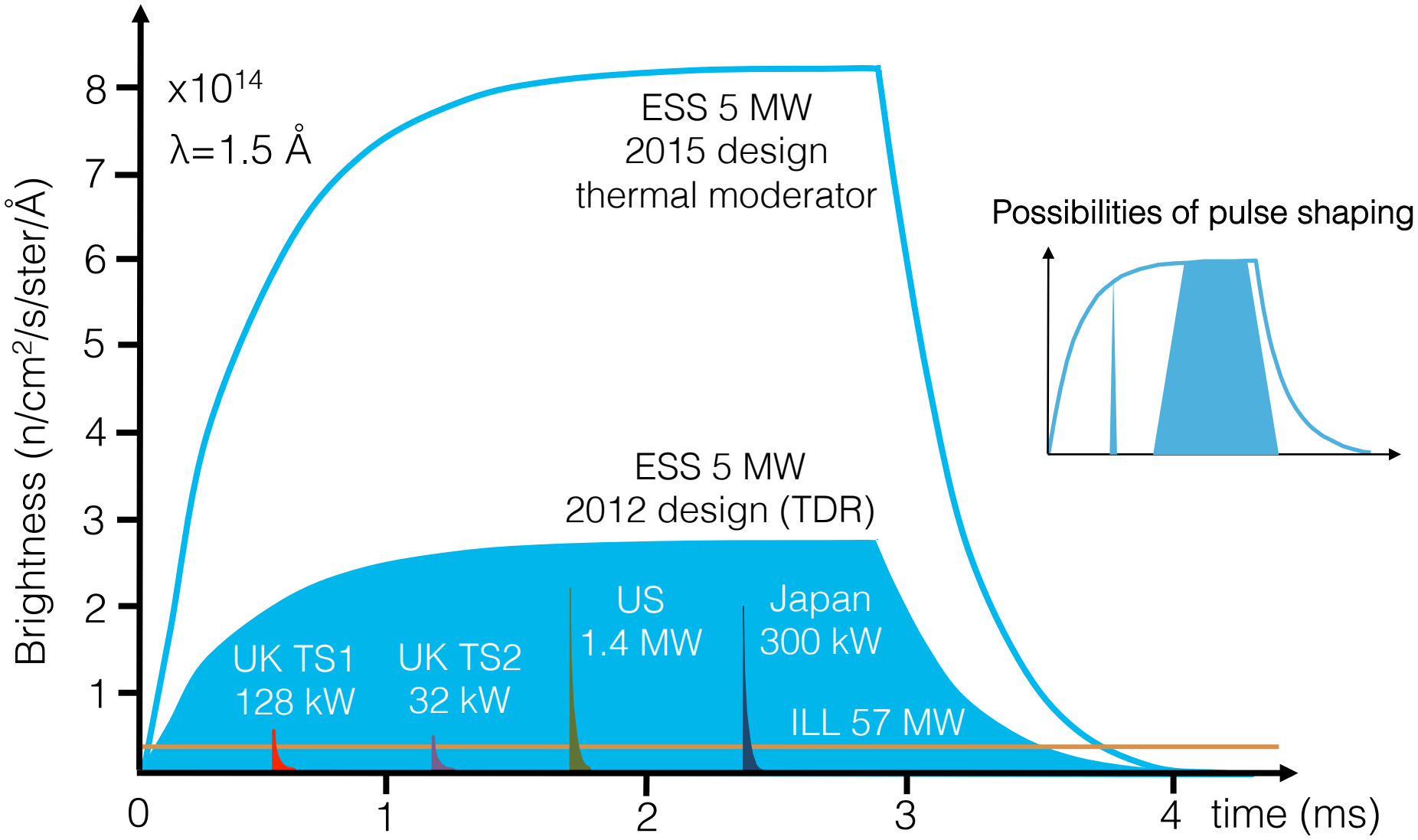


Neutron facilities – reactors and particle driven



(Updated from *Neutron Scattering*, K. Skold and D. L. Price, eds., Academic Press, 1986)

ESS long pulse potential



Journey to deliver the world's leading facility for research using neutrons

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Financing includes cash and deliverables

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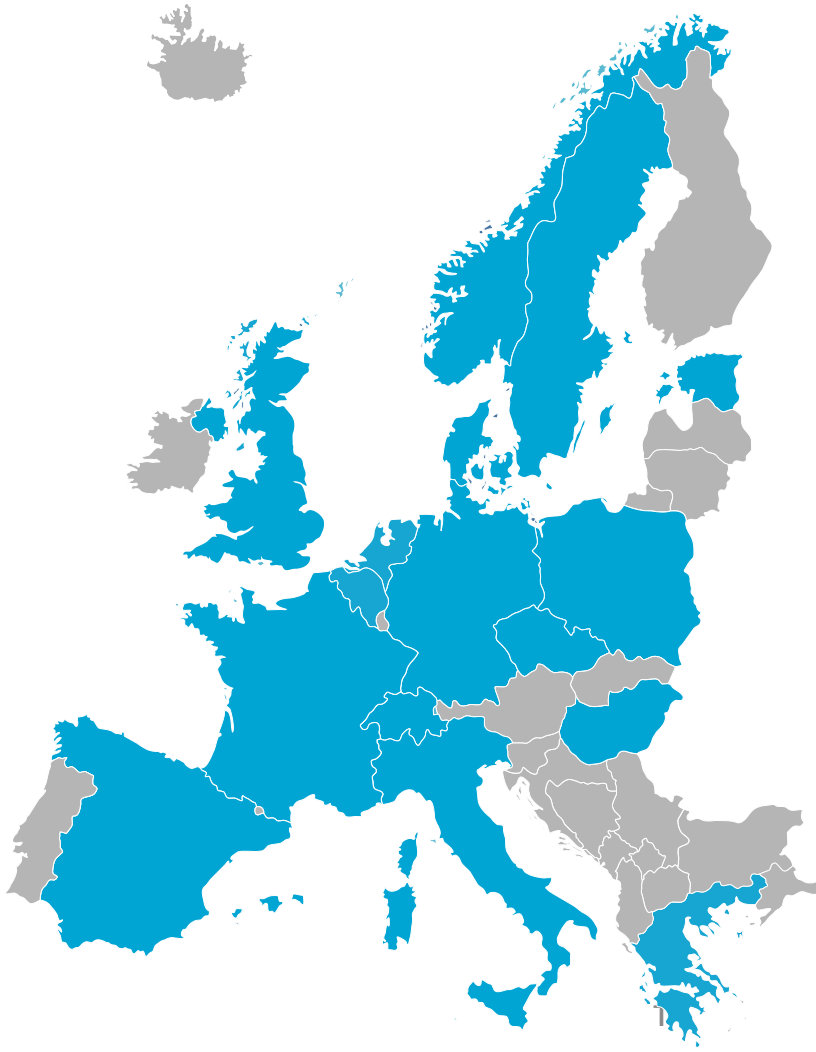
Host Countries Sweden and Denmark

Construction 47.5% Cash Investment ~ 97%
Operations 15%

Non Host Member Countries

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



Construction investment

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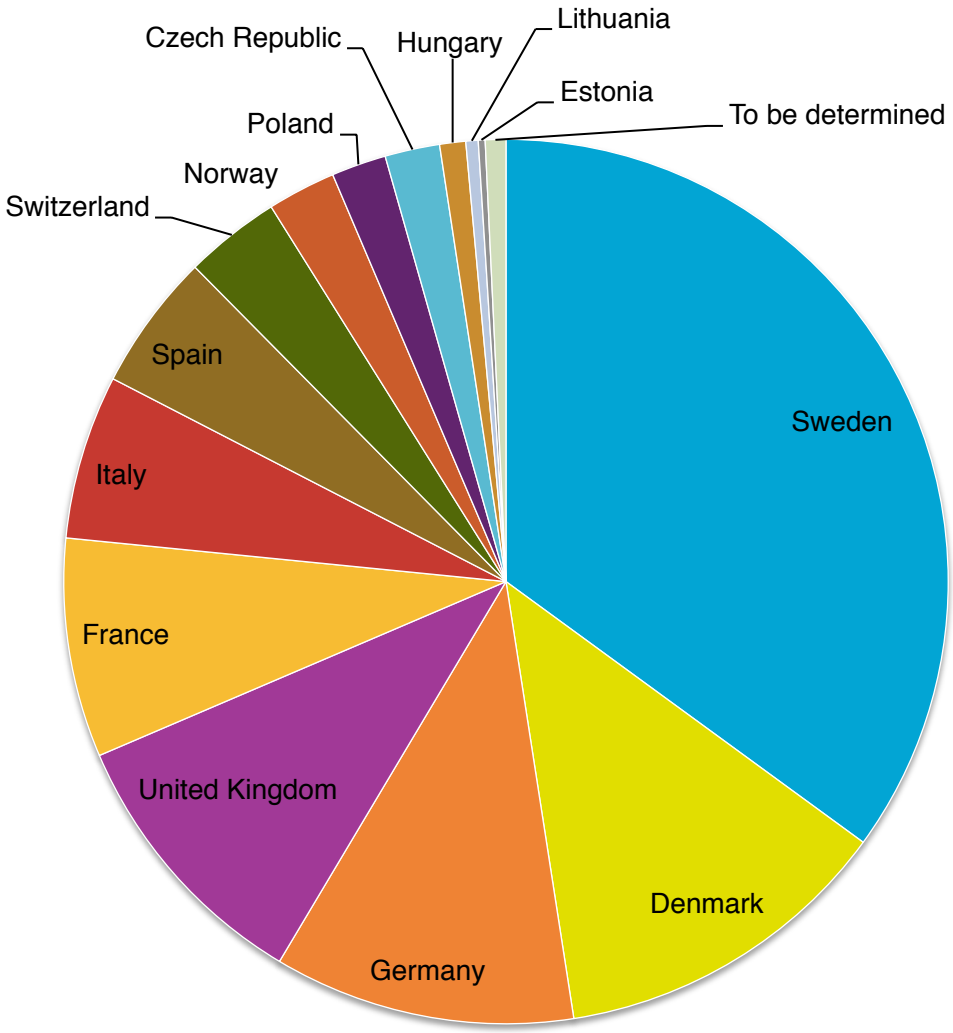
CURRENT

Sweden (member)	**35.0 %**
Denmark (member) *	**12.5 %**
Germany (member) *	**11.0 %**
United Kingdom (founding observer)	**10.0 %**
France (member)	**8.0 %**
Italy (member)	**6.0 %**
Spain (founding observer) *	**5.0 %**
Switzerland (member)	**3.5 %**
Norway (member)	**2.5 %**
Poland (member)	**2.0 %**
Czech Republic (member)	**2.0 %**
Hungary (member)	**0.95 %**
Lithuania (future member)	**0.45 %**
Estonia (member)	**0.25 %**
Total *	**~99 %**

FUTURE

Belgium (founding observer)	*tbd*
Netherlands (founding observer)	*tbd*
Greece (future observer)	*tbd*
Turkey (future observer)	*tbd*
Latvia, Portugal, Finland	*tbd*



**** Includes Pre-construction Costs, Current Construction Commitment ~97%.***

ESS AB transitioned into European Research Infrastructure Consortium (ERIC)

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ESS AB

- Swedish limited liability corporation
- Owned by the Swedish and Danish governments

transfer of assets, obligations and personnel on Oct 1, 2015

European Spallation Source ERIC

- European Research Infrastructure Consortium
- Sole governing body: the European Spallation Source ERIC Council, comprised of representatives from the Member and Observer Countries

Ground Break & Foundation Stone Ceremony

Ground Break Event

- 2 September 2014 (200 guests)
- Official start of the construction!

Foundation Stone Ceremony

- 9 October 2014 (700 guests)
- Programme on site including speeches, partner video, walking tour and reception
- Science Symposium in Lund
- Mobilized partners and stakeholders for construction!

ERIC Plate Ceremony

Handing over of the ERIC Plate

- 8 September 2015 (60 guests) onsite
- Marked the transition from ESS AB to The European Spallation Source ERIC
- Speakers:
  - Robert-Jan Smits, Director-General for Research and Innovation, European Commission
  - Helene Hellmark Knutsson, Swedish Minister for Higher Education and Research
  - Dr. Esben Lunde Larsen, Danish Minister for Higher Education and Science

ESS looking towards MAX IV and Lund University

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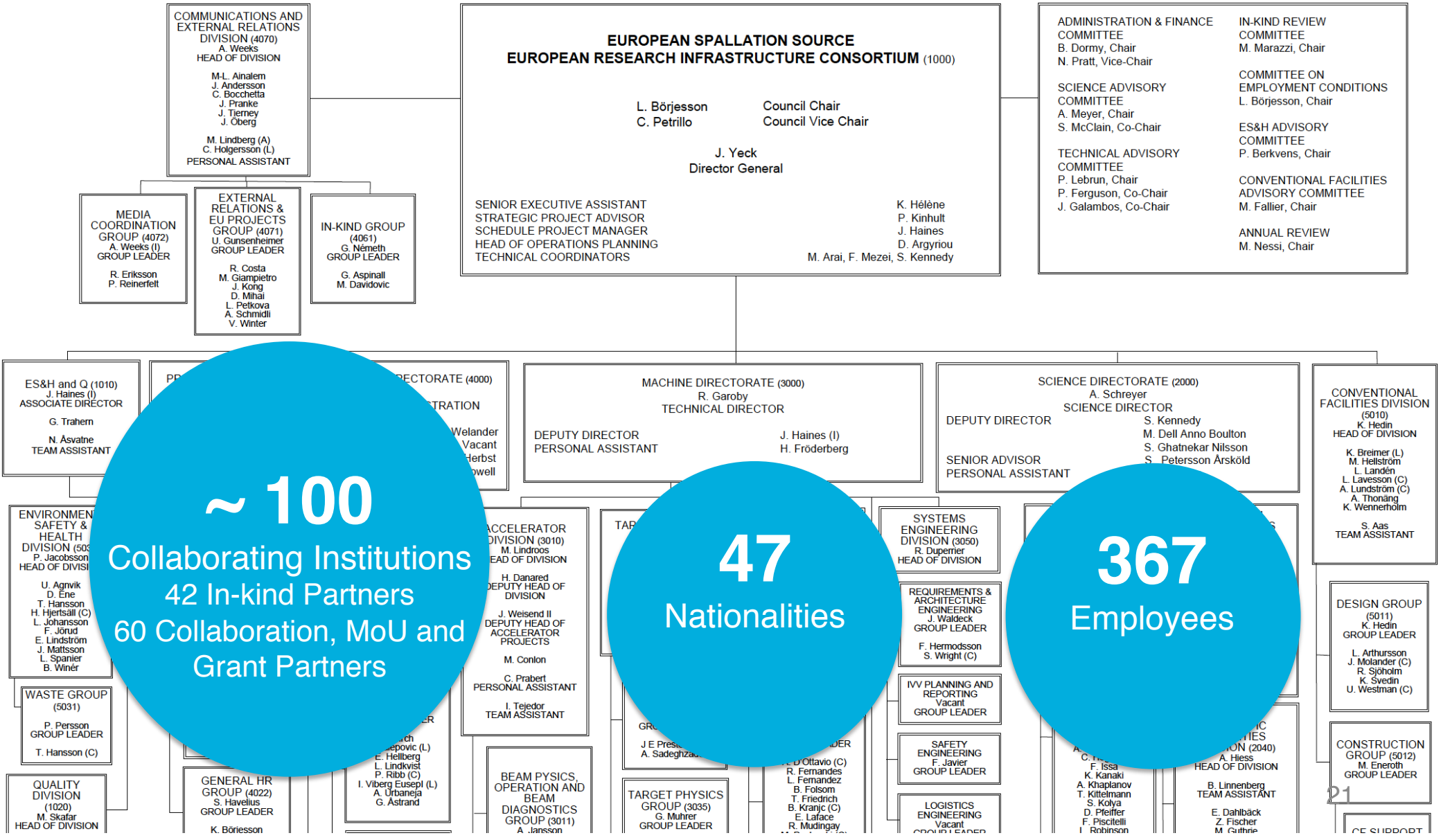
ESS target building

Organisation



~ 100
Collaborating Institutions
42 In-kind Partners
60 Collaboration, MoU and Grant Partners

47
Nationalities

367
Employees

Partner institutions delivering the design & construction of ESS

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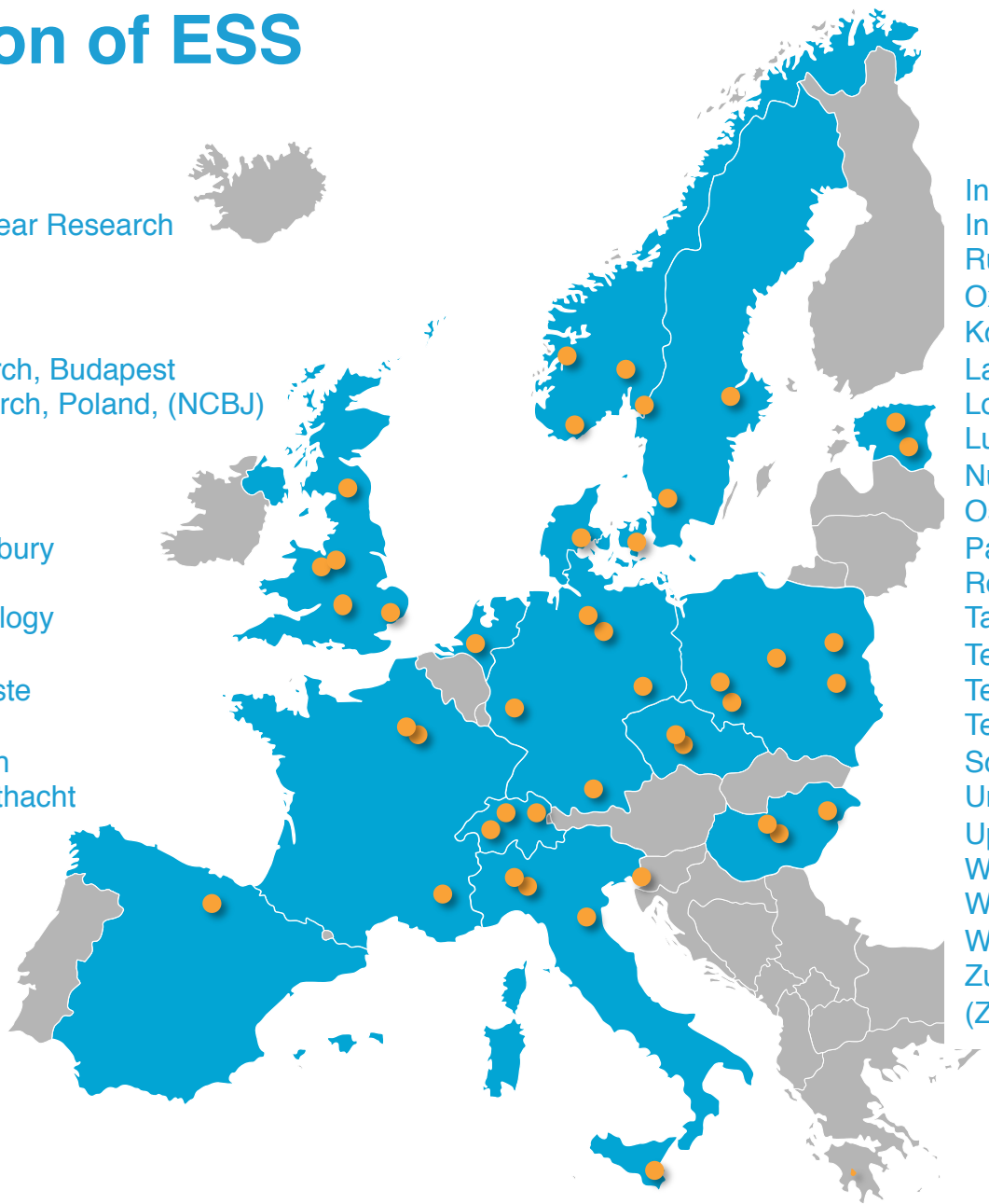
Aarhus University
Atomki - Institute for Nuclear Research
Agder University
Bergen University
CEA Saclay, Paris
Centre for Energy Research, Budapest
Centre for Nuclear Research, Poland, (NCBJ)
CERN, Geneva
CNR, Rome
CNRS Orsay, Paris
Cockcroft Institute, Daresbury
DESY, Hamburg
Delft University of Technology
Edinburgh University
Elettra – Sincrotrone Trieste
ESS Bilbao
Forschungszentrum Jülich
Helmholtz-Zentrum Geesthacht
Huddersfield Univesrity
IFJ PAN, Krakow
INFN, Catania
INFN, Legnaro
INFN, Milan



Institute for Energy Research (IFE)
Institut Laue-Langevin (ILL)
Rutherford-Appleton Laboratory, Oxford(ISIS)
Kopenhagen University
Laboratoire Léon Brilouin (LLB)
Lodz University of Technology
Lund University
Nuclear Physics Institute of the ASCR
Oslo University
Paul Sherrer Institute
Roskilde University
Tallinn Technical Univesrsity
Technical University of Chemnitz
Technical University of Denmark
Technical University Munich
Science and Technology Facilities Council
University of Tartu
Uppsala University
WIGNER Research Centre for Physics
Wroclaw Univesrity of technology
Warsaw University of Technology
Zurich University of Applied Sciences (ZHAW)

Key Project Parameters

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- Deliver on the Technical Design Report performance and Steering Committee commitments
  - **5 MW accelerator capability**
  - **Cost Book construction cost of 1.843 B€$_{2013}$**
  - **Cost Book annual operations cost target of 140 M€$_{2013}$**
  - **22 "public" instruments (16 included in the construction budget)**
- Start w/ unconstrained resources (technically limited schedule) and develop credible project execution plans
- Comprehensive review of project baseline and execution plans
- Secure funding and resources and align schedules with the available resources

ESS construction cost baseline

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(Jan 2013 pricing)	M EUR
Conventional Facilities	531.9
CF scope supported by host countries	-93.0
Accelerator Systems	510.2
Target Systems	155.2
Integrated Control System	73.0
Design & Engineering	33.7
Neutron Scattering Systems	350.0
Project Support & Administration and Licensing	123.8
Contingency	158.2
Total Construction Budget and ESS Cost Book Value	1843.0

ESS Schedule Objectives

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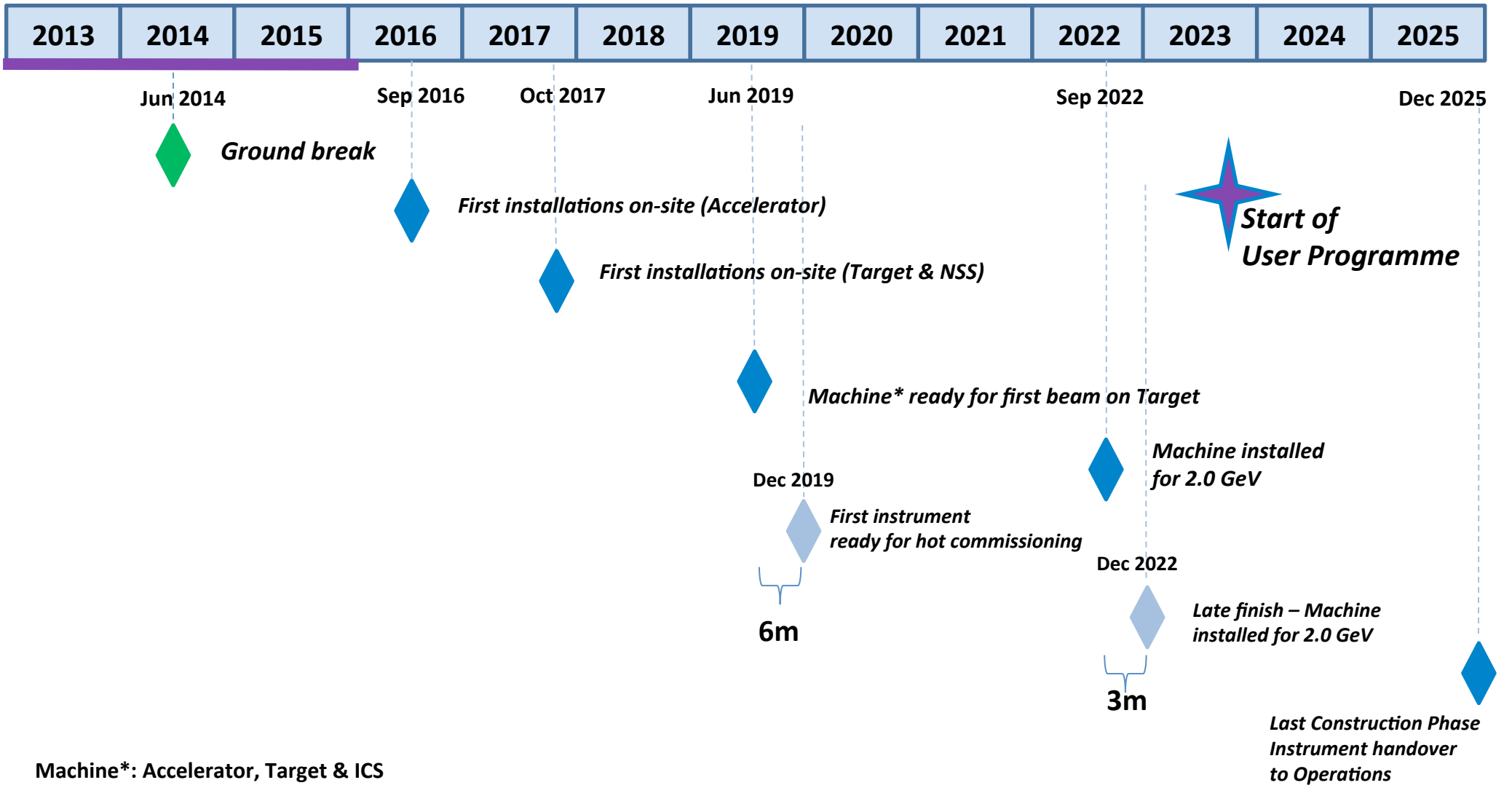
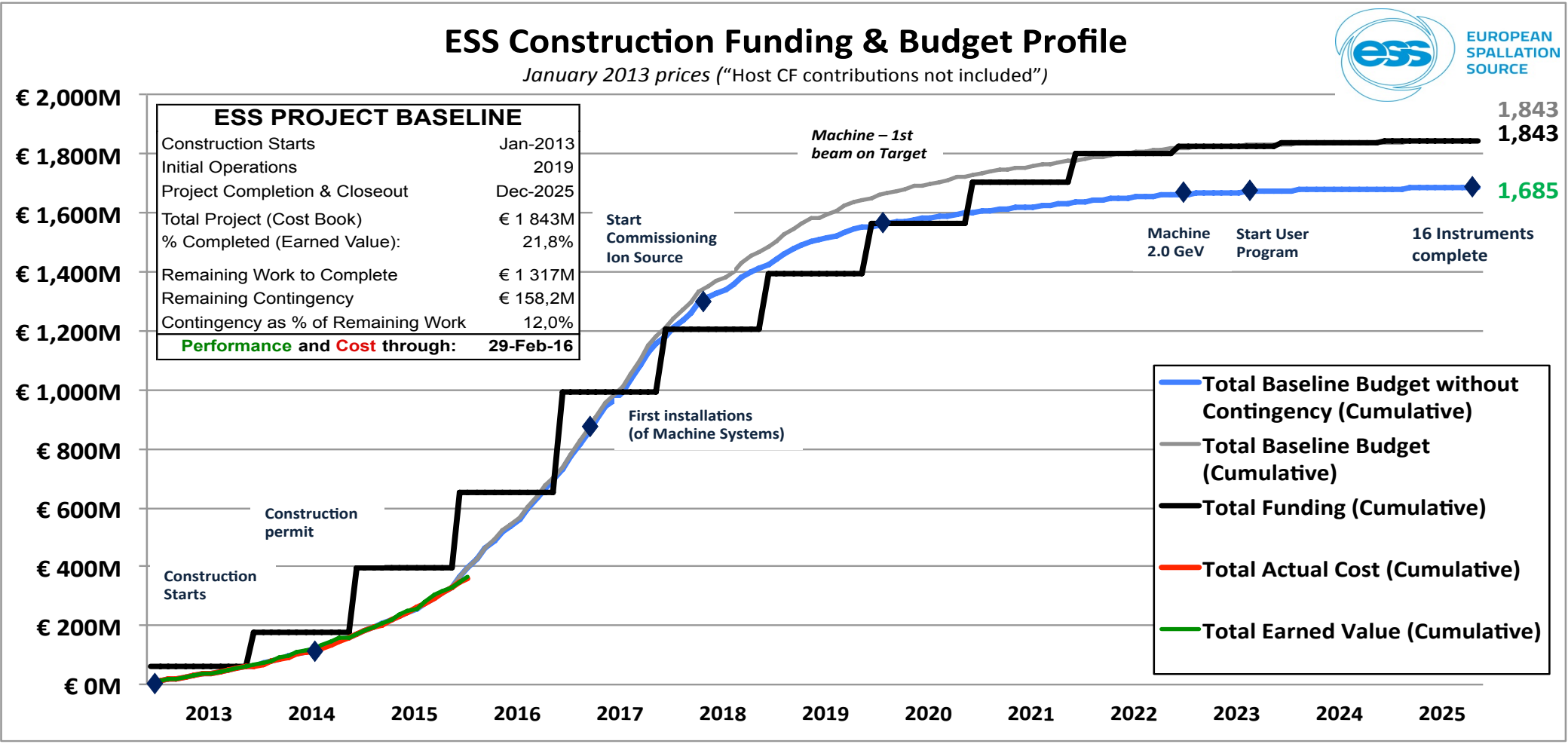


Machine*: Accelerator, Target & ICS

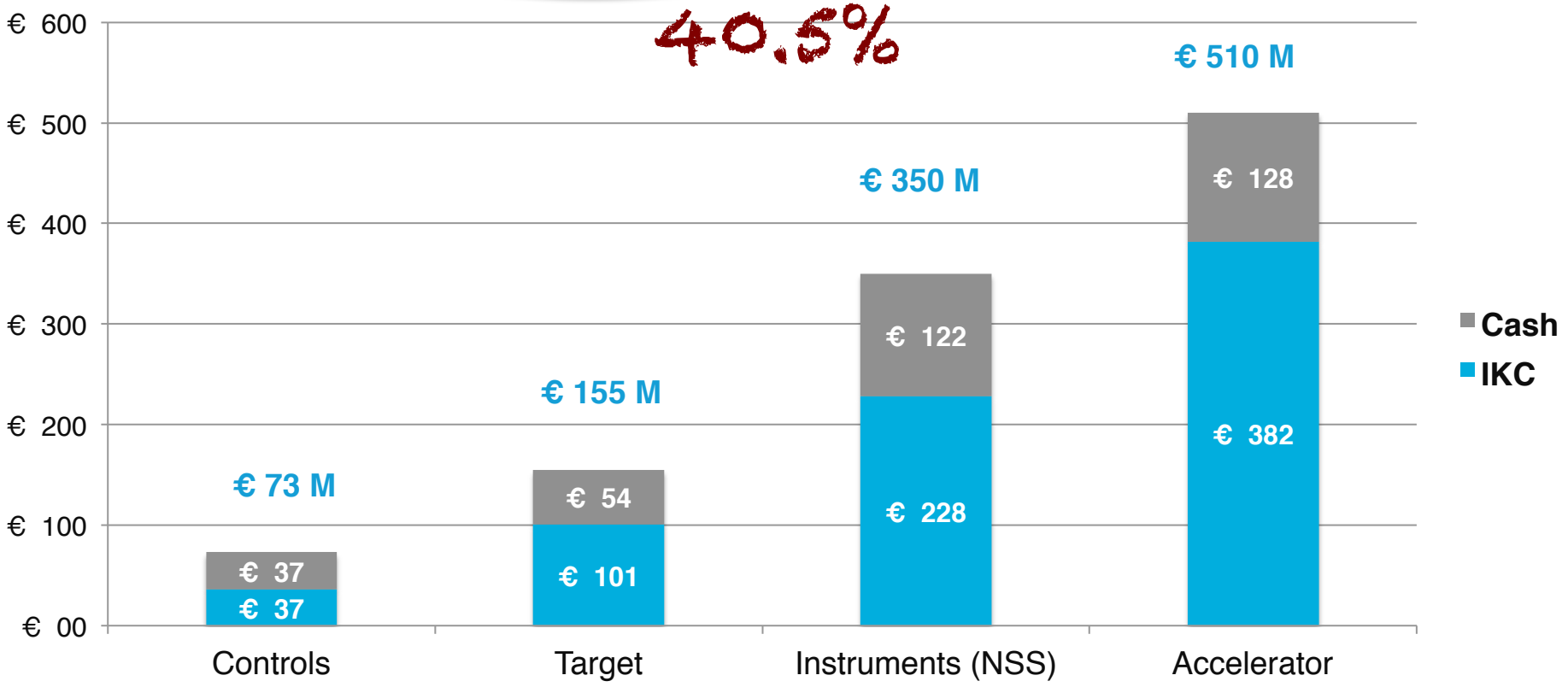
Current S-curve based on February data



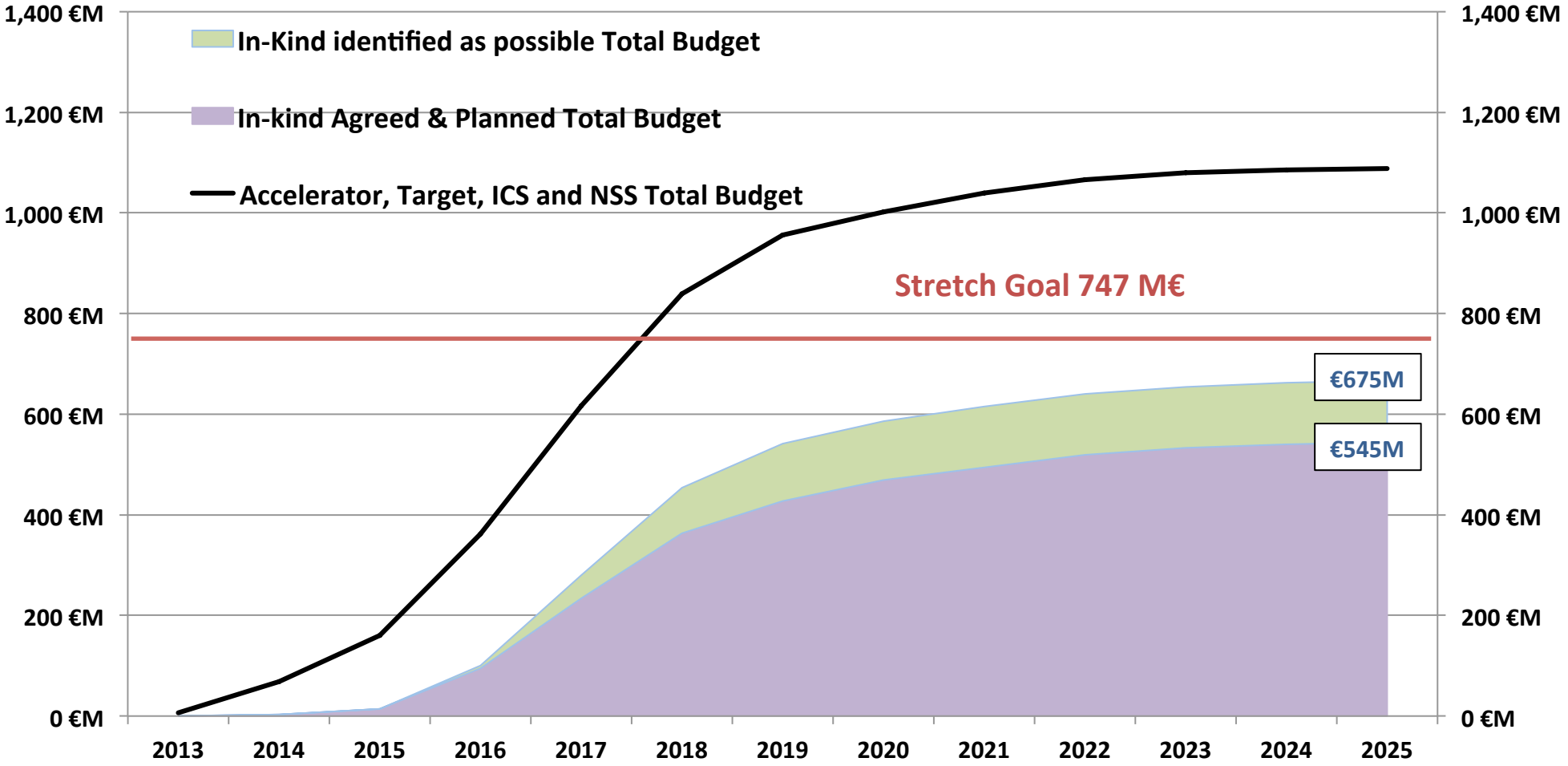
ESS In-kind goals

Construction cost: € 1.84 Billion
In-kind: € 747.5 Million

40.5%



In-kind status and plans



Civil construction groundbreaking

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September 2014


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August 2015

Progress in 18 months…


Schaku &Transport
VOLVO


Cementation
SKANSKA

Summary

- Construction project ~ 23% complete and ~ 35% by end of 2016
- Emphasis on securing in-kind deliverables in a collaborative framework
- Priority on schedule performance – key to success
- Additional work to ensure European Spallation Source ERIC provides the institutional framework needed for long term success
- Working to establishing operations plans consistent facility requirements and supportable by the ESS Council

Core Values are Excellence, Openness, Collaboration, and Sustainability

Mission – design, build, and operate the world's leading research facility using neutrons

2016 priorities

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- Continue emphasis on schedule performance – *key to success!*
- Transition In-kind partners into execution phase – *ongoing*
- 3rd Annual Project Review and Response – *complete*
- Submit application to regulatory authority for license to commission first stages of accelerator systems – *complete*
- Establish a “cash facility” for liquidity gap/hold schedule – *June*
- ESS start installation machine (accelerator) equipment – *Sep*
- Establish operations plans consistent with requirements – *Dec*
- Engage new members – *ongoing!*

Accession procedure

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Written application addressed to the Council Chair describing intended contributions and to comply with European Spallation Source ERIC Statutes

Conditions for accession subject to agreement between Belgium and the Council

Council to approval of the admission of Latvia as a European Spallation Source Member by unanimous vote

Conditions the same as Founding Members if accession completed prior to 31 August 2016

EU Commission informed

Experience from other projects – A few ingredients to success

Facility must be a priority of the science community!

Funding agency commitments and strong host role

Collaboration leadership enables success of others

Establish realistic goals – “Experience over hope”

Credibility through openness with transparency

Collective ownership of problems & solutions

Populate the organization with experience

Success built on energy and enthusiasm!

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Thank you!
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