Introduction to CEDREN HydroBalance

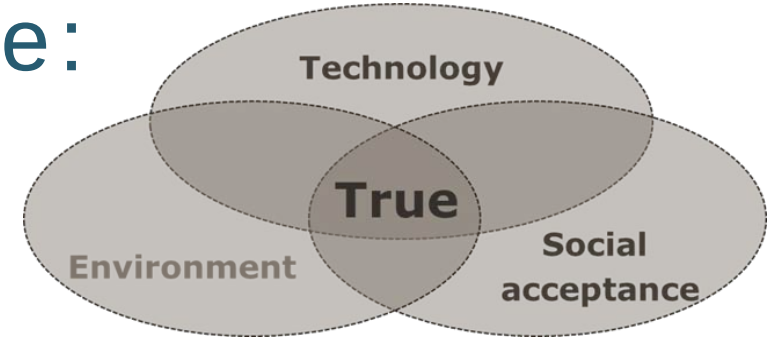
User Meeting 2016

By: Research Manager Michael M. Belsnes & WP-leaders

CEDREN HydroBalance: Facts

- Budget: ~25 MNOK, (~18 MNOK from NFR)
- Duration: 4 years, (From autumn 2013)
- Research partners (11)
  - SINTEF Energy Research, NTNU: Norwegian university of Science and Technology, NINA: Norwegian Institute for Nature Research, UIO: University of Oslo, University of Waterloo, ECN: Energy Research Centre of the Netherlands, University of Exeter, UMB: Norwegian University of Life Science, NIVA: Norwegian Institute for Water Research, Technical University of Madrid, University of architecture, Civil Eng. and Geodesy, Bulgaria, Univercity of Aachen (E.ON)
- Funding (10):
  - EnergiNorge, Agder Energi, BKK, Sira Kvina kraftselskap, Statkraft, Listerrådet, EdF: Electricite de France, E.ON, RCN: Research Council of Norway

CEDREN HydroBalance:



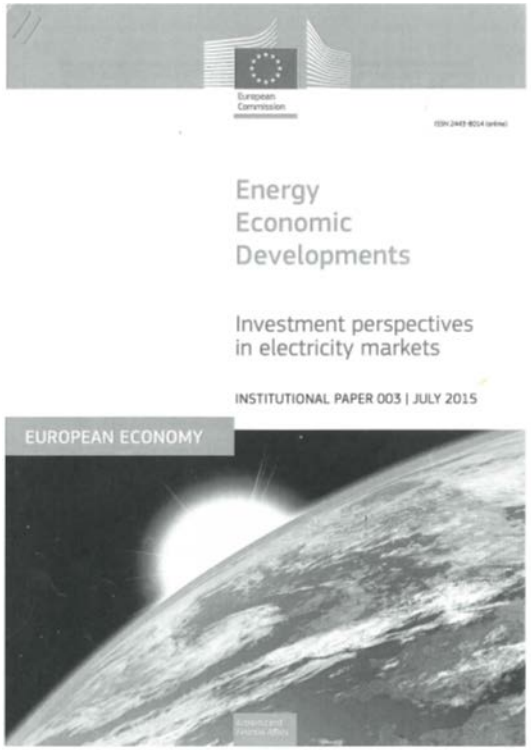
Objectives

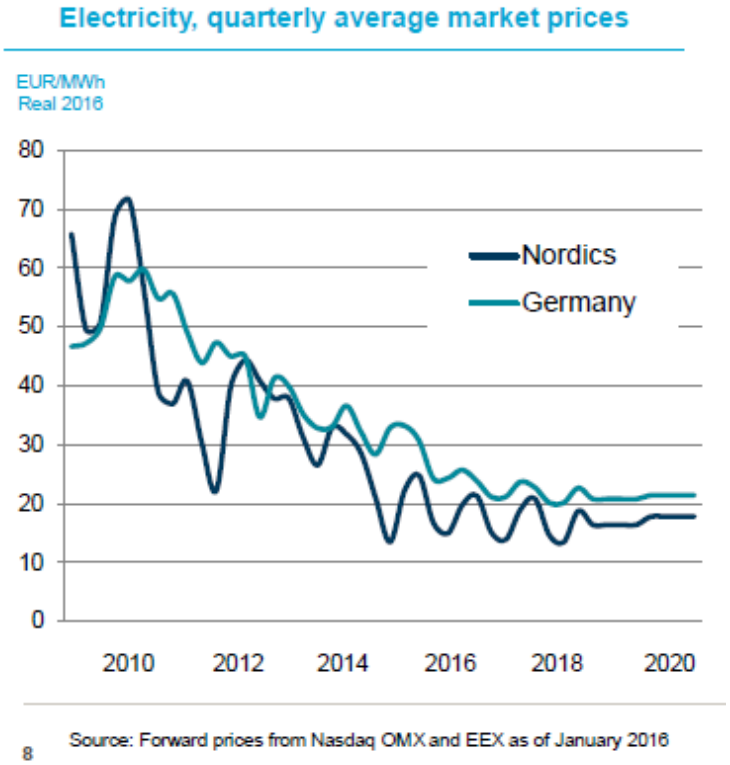
The project will address key questions regarding use of hydropower flexibility and expansion of such flexibility including pump storage development between reservoirs.

The project will draw a picture of the future for hydropower flexibility towards 2050 and assess needs for flexibility, alternatives to hydropower and required transmission capacity. How can and should the hydropower sector respond to the power system development in Europe? The project will assess and suggest business models in a Norwegian-European perspective.

Use of hydropower flexibility must go hand in hand with environmental concerns and the project will in particular contribute with new knowledge about consequences of reservoir level changes.

News:





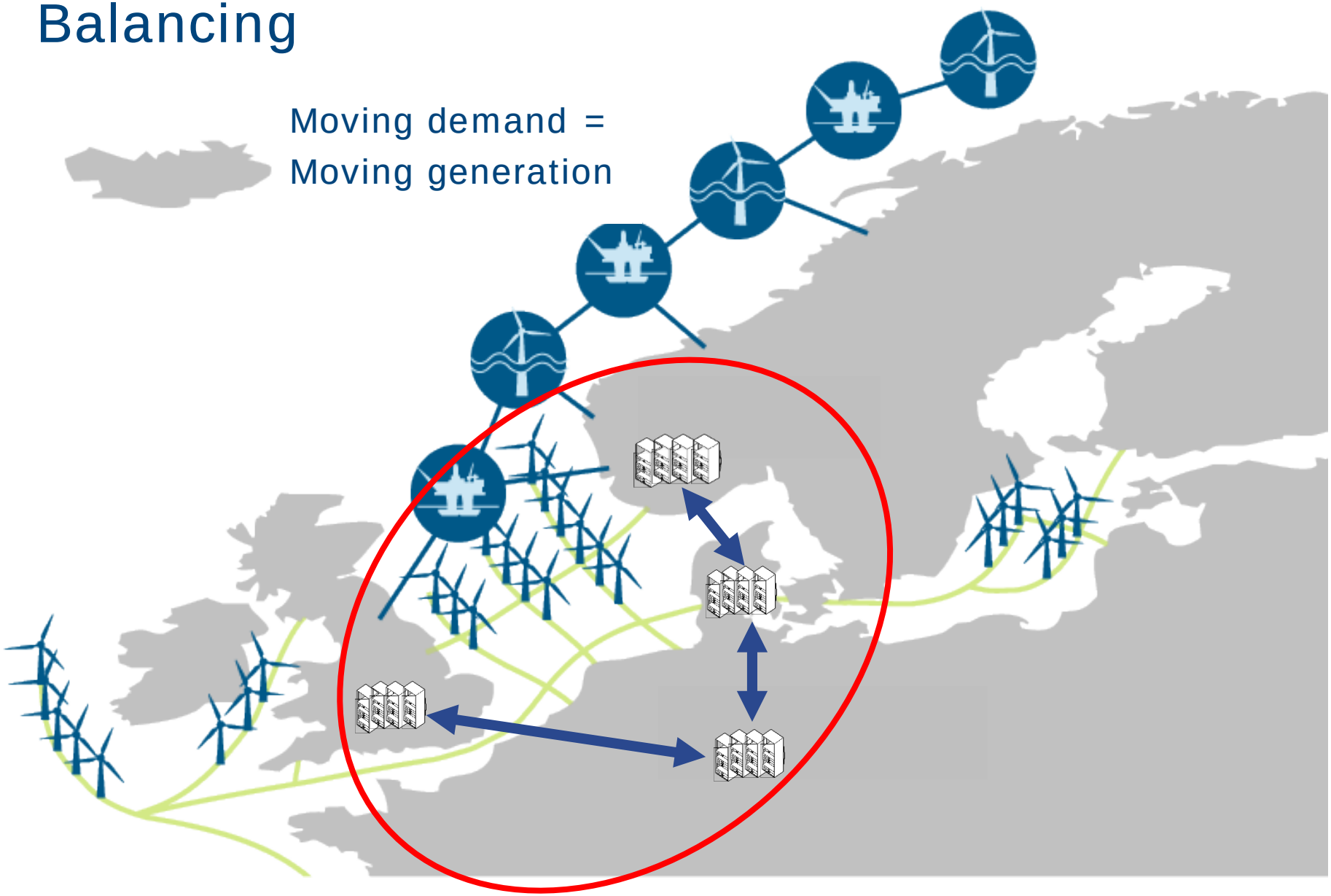
Tidligere Statoil-topp tror strømprisene dobles

- Nye kabler til utlandet skaper debatt
- Mener norske strømkunder blir lurt

VG 2016-09-12

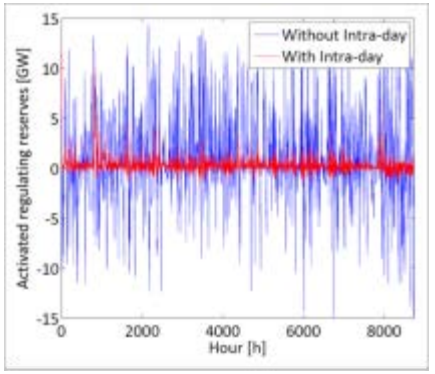
Balancing

Moving demand =
Moving generation



CEDREN HydroBalance: Technology

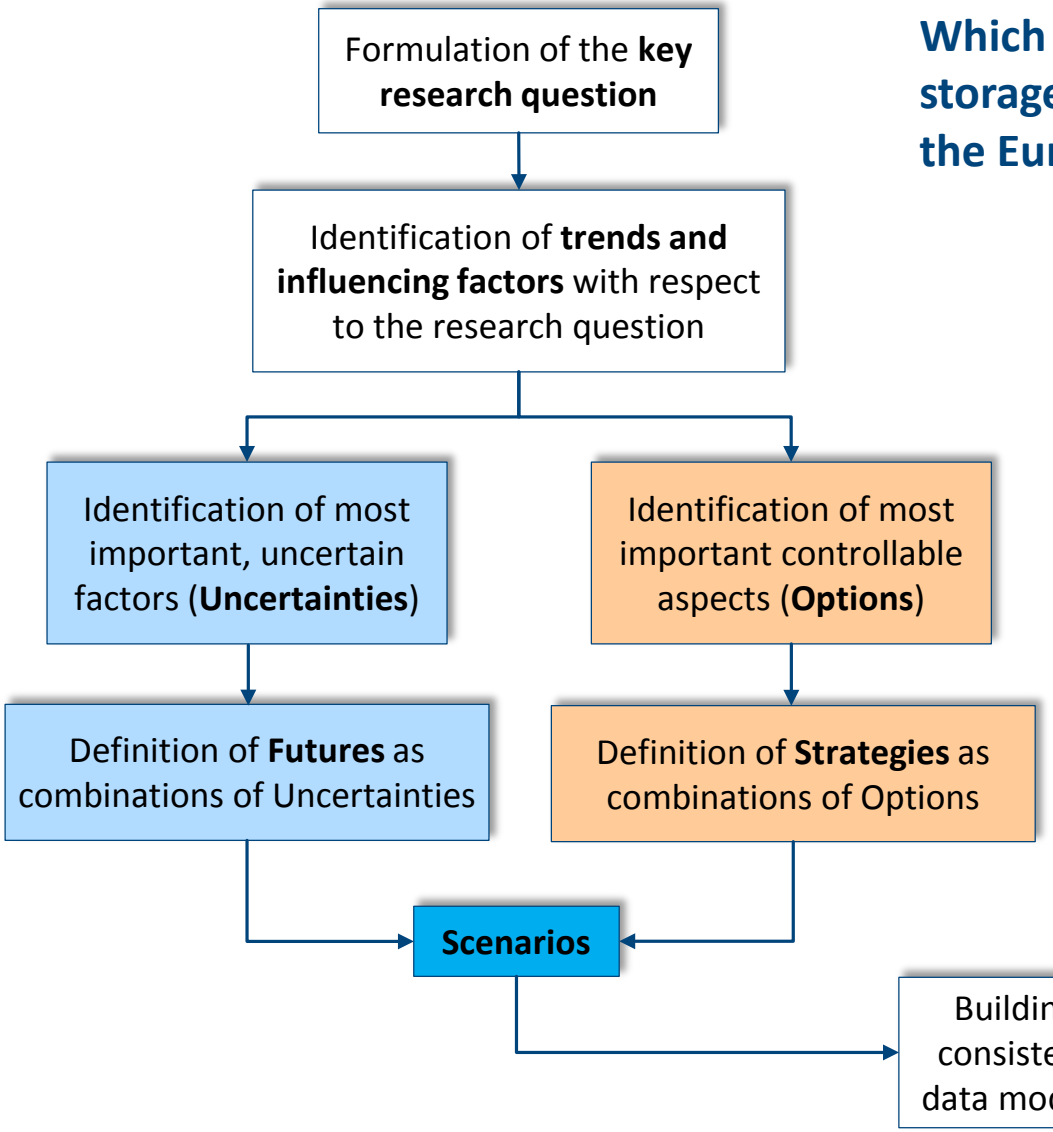
- WP 1:Roadmaps for balancing from Norwegian hydropower (Julie Charmasson/Håkon Sundt)
  - Assess the possibility space for balancing power from Norway towards Europe
  - Timeline for when, how and where Norwegian hydropower should respond



- WP 2:Demand for energy balancing storage (NTNU: Prof. Magnus Korpås)
  - Establish data models with
  - Short- long-term storage, interaction between markets
  - PhD: Ingeborg Gråbak

- WP 3: Analyses to develop relevant business models (Ove Wolfgang)
  - Possible business models for operation in different markets for balancing, including cross border possibilities.
  - Analyses of possible capacity projects, profitability and operation
  - Includes a substantial research cooperation with ECN and EON

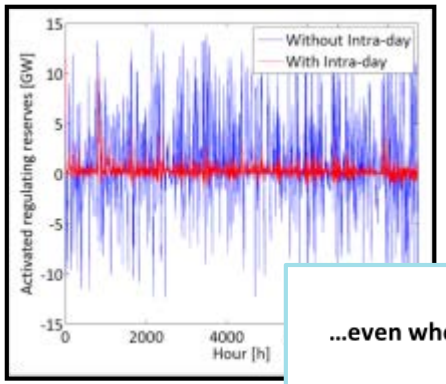
WP 1 Scenario building approach



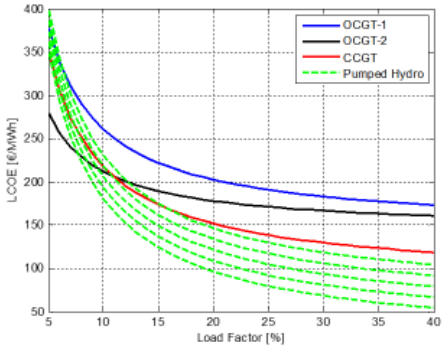
Which role can energy balancing and storage by Norwegian hydropower play in the European electricity market in 2050?

= Combination of *Options* which Norwegian decision makers have control on

WP 2 Macro sense check



...even when grid and cable costs are included



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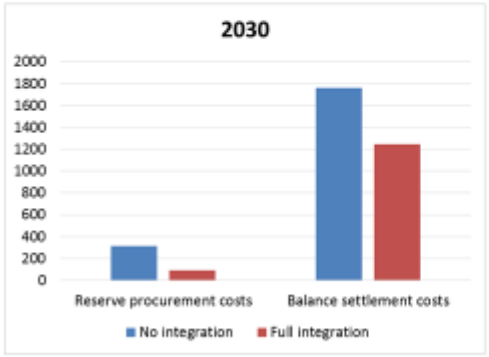
Large benefits of integrating the Northern and continental balancing markets

Total annual balancing cost savings (Mill.EURO)



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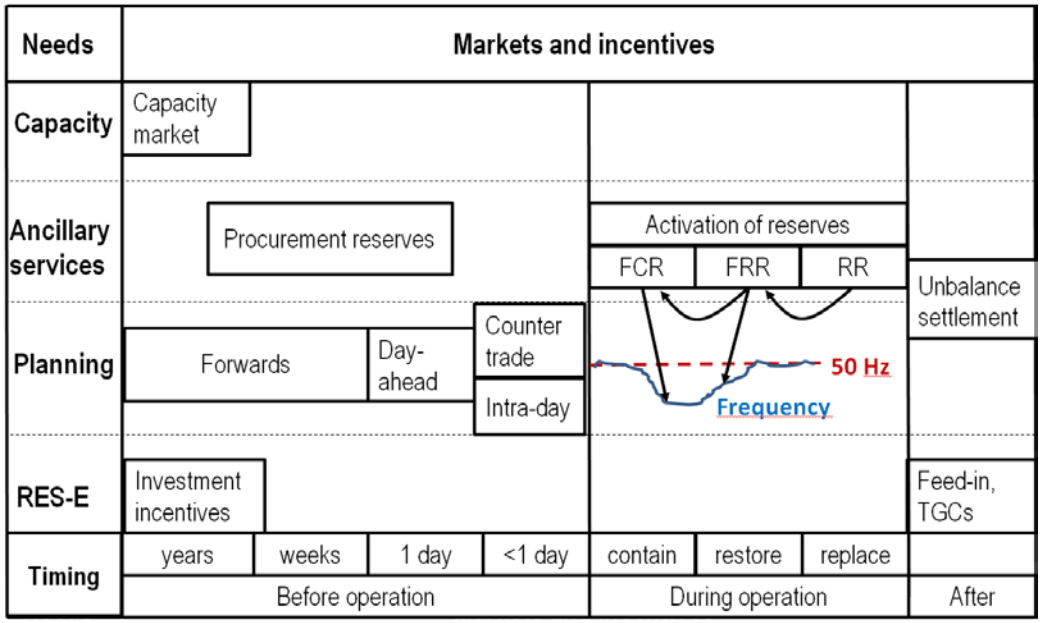
Source: Farahmand (NTNU/SINTEF)

Balancing makes sense from a levelized cost perspective

Balancing makes sense from a energy system perspective

How much sense?

WP 3 Micro sense check



Spot income

Intra-day income

Reserve income

Activation income

+

Sum income

CEDREN HydroBalance: WP's

- WP4: Environmental impact of operation schemes for balancing (NINA: Ingeborg Helland)
  - Research task regarding environmental impact on reservoirs, size and type
  - Use CEDREN results for broad analyses of environmental impact and mitigation.
  - Postdoc: Antti Eloranta

- WP 5: Social acceptance and regulatory framework (Marte Qvenild)
  - Political barriers and success criteria for balancing power
  - Income distribution and socialization of cost, non technical challenges.

WP 4 Environmental (micro) sense check

Expected final outcome WP4

Combine ecological models with hydro-dynamic models

- Predict how future operational regimes influence ecological communities
- Identify mitigation measures

Main link to other WPs

- WP1 roadmaps
- WP3 business models
- WP 5 social acceptance

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WP 4: Connecting environmental impact and economy

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WP 5 Social acceptance sense check

General concerns about environmental, visual and economic impacts locally

- "If the water level in Tyin is regulated more rapid up and down, the sources of food for the fish stock will be washed away along the shore" (Local informant, NGO)
- "If this happen it will be dangerous and impossible to travel on Tyin during winter time" (Local informant, Landowner)
- "In Tyin the water is completely clean. If you start pumping water into Tyin it will be polluted" (Local informant, Landowner)
- "People come here because of nature. Many already comments that a low water level make the shore look ugly" (Local informant, tourist entrepreneur)

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How can Hydrobalancing be locally accepted?

- Measures should be done with least possible environmental impact
- Electronic warning system (security issue)
- Early involvement and information about possible social and environmental impacts
- Improve/maintain local infrastructure (ski tracks, keeping roads open over the winter, maintaining boat piers, roads, internet access)

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WP 1 The HydroBalance **roadmap** work *– important steps before finalization*

How do we ensure a roadmap of relevance for all stakeholders?

- Be actively involved
- Supply stakeholder views on the different topics
- Access available documents on CEDREN.no

For feedback, notify WP leaders or roadmap management

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Milestone activities:

1. Workshop 26th of October – First feedback from users and WP leaders
2. Revision of roadmap
3. Workshop spring 2017 – Second feedback from users and WP leaders
4. Finalization of roadmap in 2017