

Roadmap for large-scale balancing from Norwegian hydropower

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CEDREN HydroBalance

WP1 roadmap - The road ahead

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What is a roadmap? (2 min)

- A detailed plan to guide progress from a defined starting point towards a goal
- Where do we have to go?
- Where do we want to go?
- Alignment



Relevant international roadmaps

EU Energy Roadmap 2050 (2011)

IEA Technology Roadmap for Hydropower (2012)

Eurelectric - Flexible Generation: Backing up Renewables. Full Report (2010)

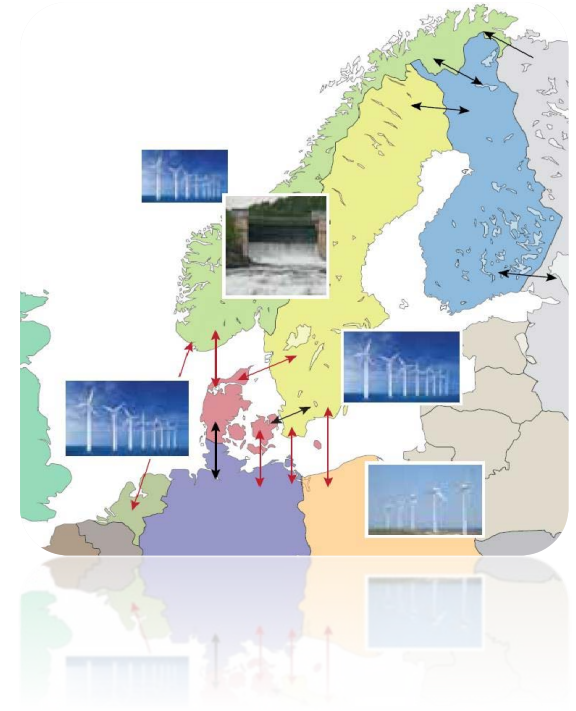


Why?

The HydroBalance roadmap

Goal: *Use Norwegian hydropower to provide flexibility and storage to the European energy system*

- Integrate a large amount of renewable energy sources into the European energy system
- Achieve a low-carbon power system and cut greenhouse gas emissions, respectively
- Needs defined in HydroBalance pilot project (CEDREN 2012)

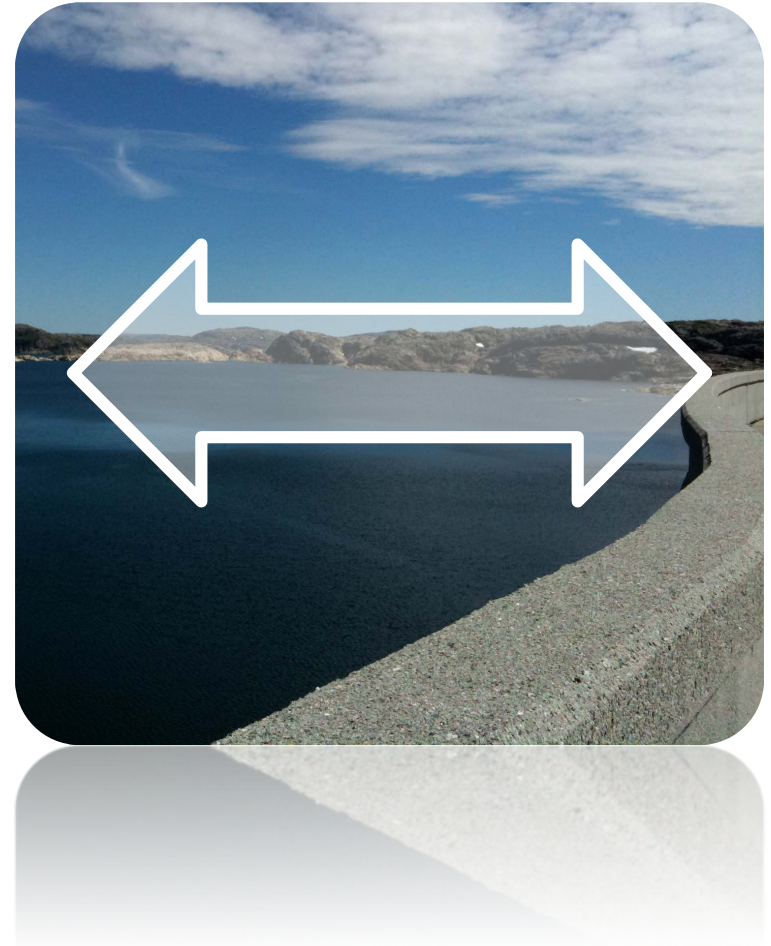


What?

The HydroBalance roadmap

Based on user and research needs the roadmap aims at:

- Pointing out **important steps** in the process of **deploying the flexibility** of Norwegian hydropower with large amounts of **pumped storage**
- Drawing a **time line** for such use of hydropower until the **year 2050**

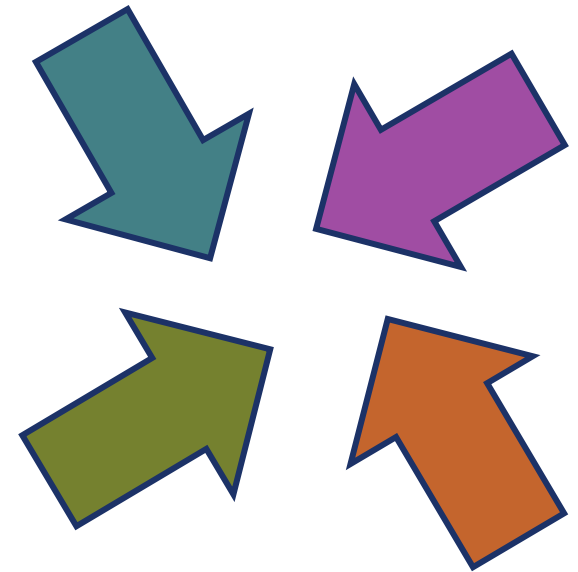


How?

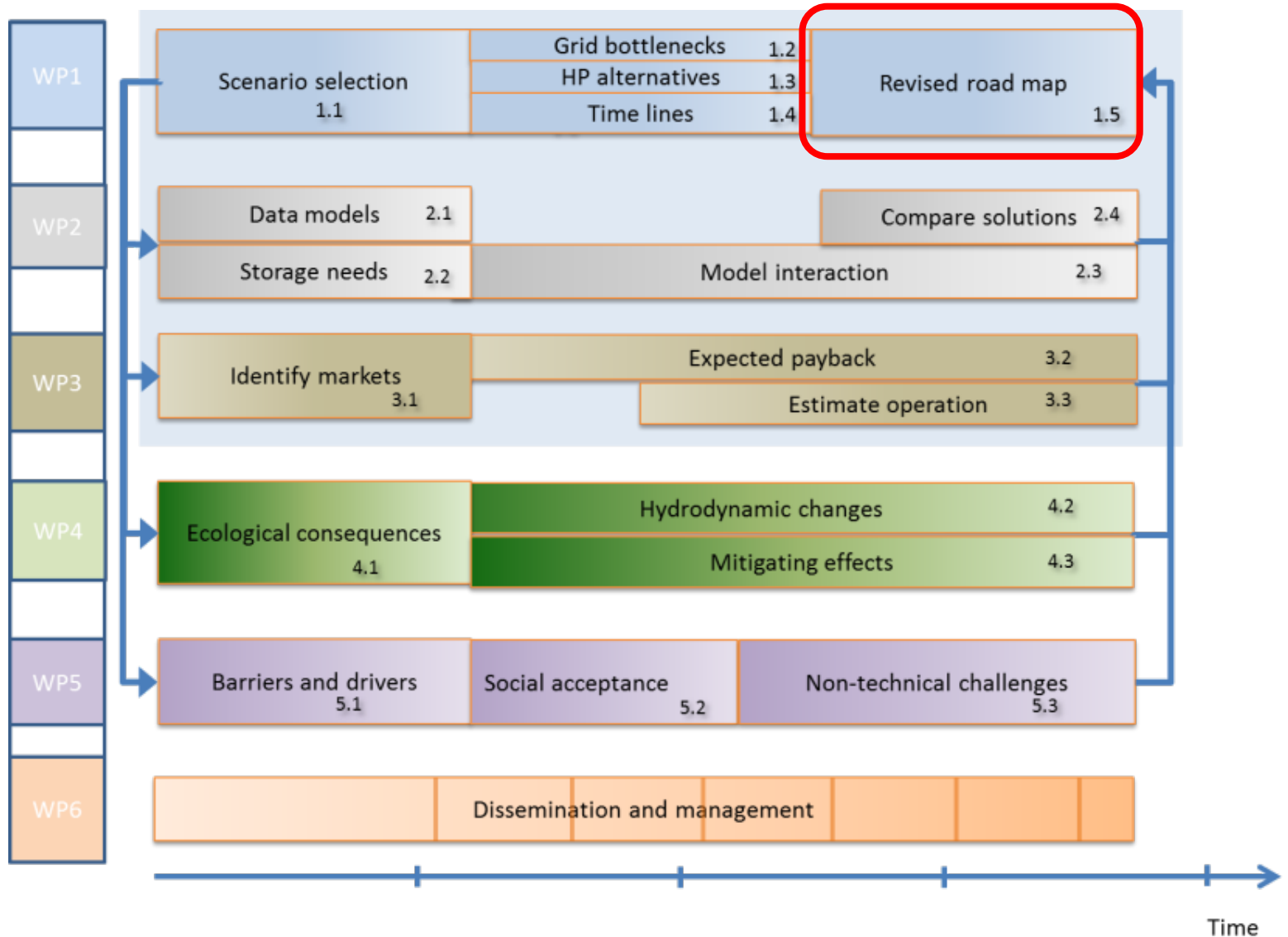
The HydroBalance roadmap

Disseminate findings from research on this topic from different perspectives:

- Energy system and infrastructure
 - Regulatory framework and society
 - Market and economic viability
 - Impacts on aquatic environment
-
- *Conclusions from the different research perspectives*
 - *Look for different pathways to reach goal*
 - *Identify needs, challenges and opportunities along this process*



HydroBalance work plan



Where are we now?

Phase I:

Review of current conditions regarding opportunities for balancing

Phase II:

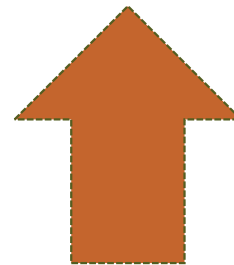
Development and quantification of scenarios to set basis, boundaries and scope for analyses.

Phase III:

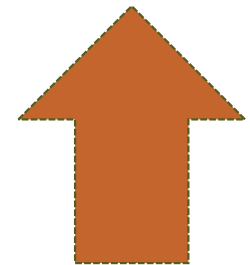
Research activities in the different fields

Phase IV:

Collate results, draw conclusions and identify research needs, policy needs and recommendations to the industry and authorities



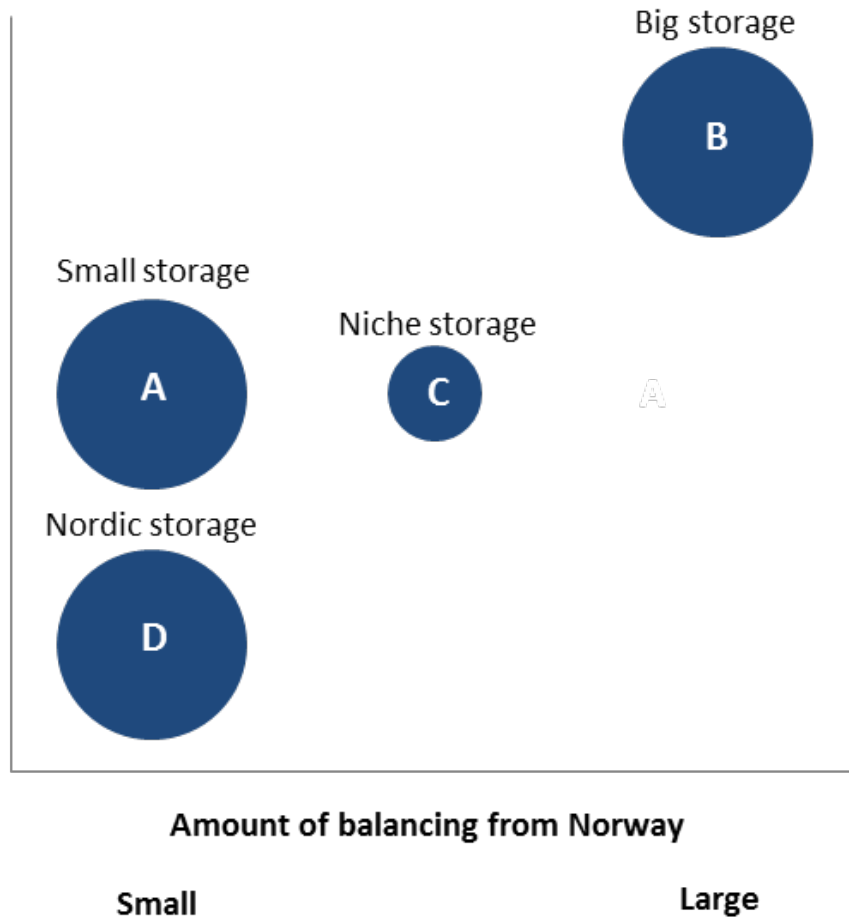
Research activities



User feedback and roadmap revision

The scenarios – WP1 Task 1.1

Main scenario characteristics

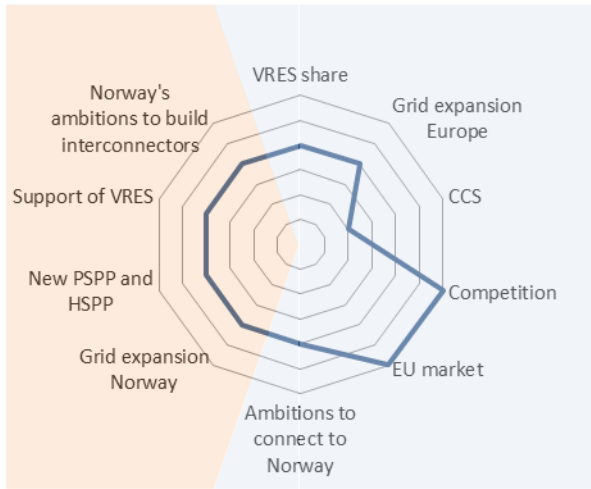


Legend

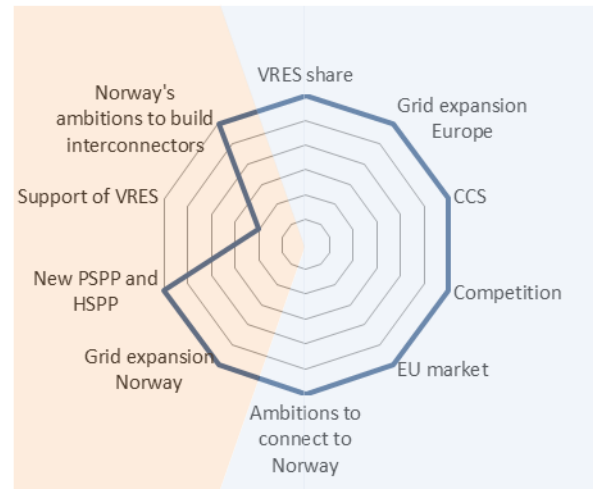
- Bubble size:
- Large bubble: - all time scales
 - Small bubble: - long time horizons only



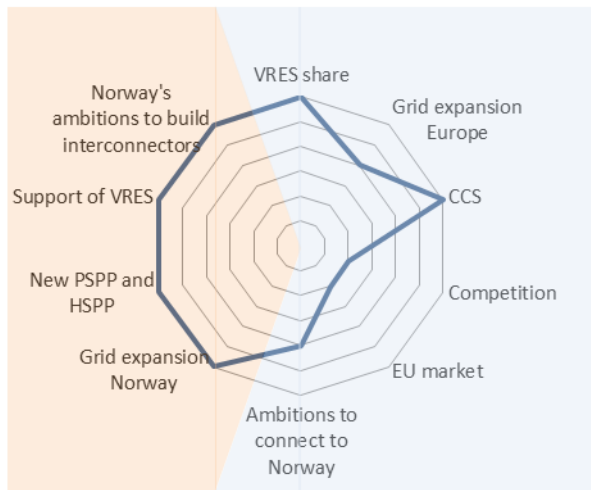
Scenario A - Small storage



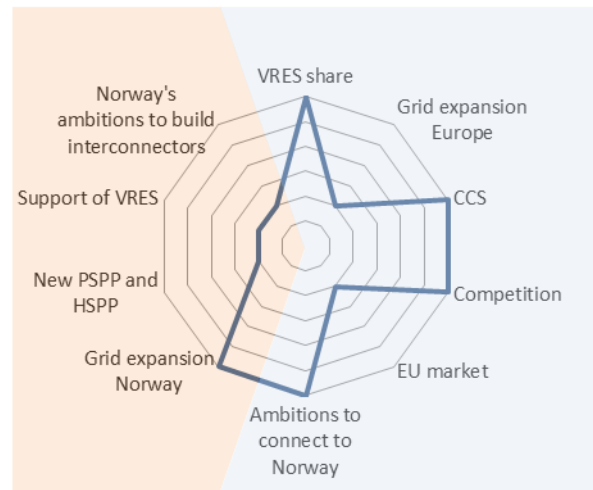
Scenario B - Big storage



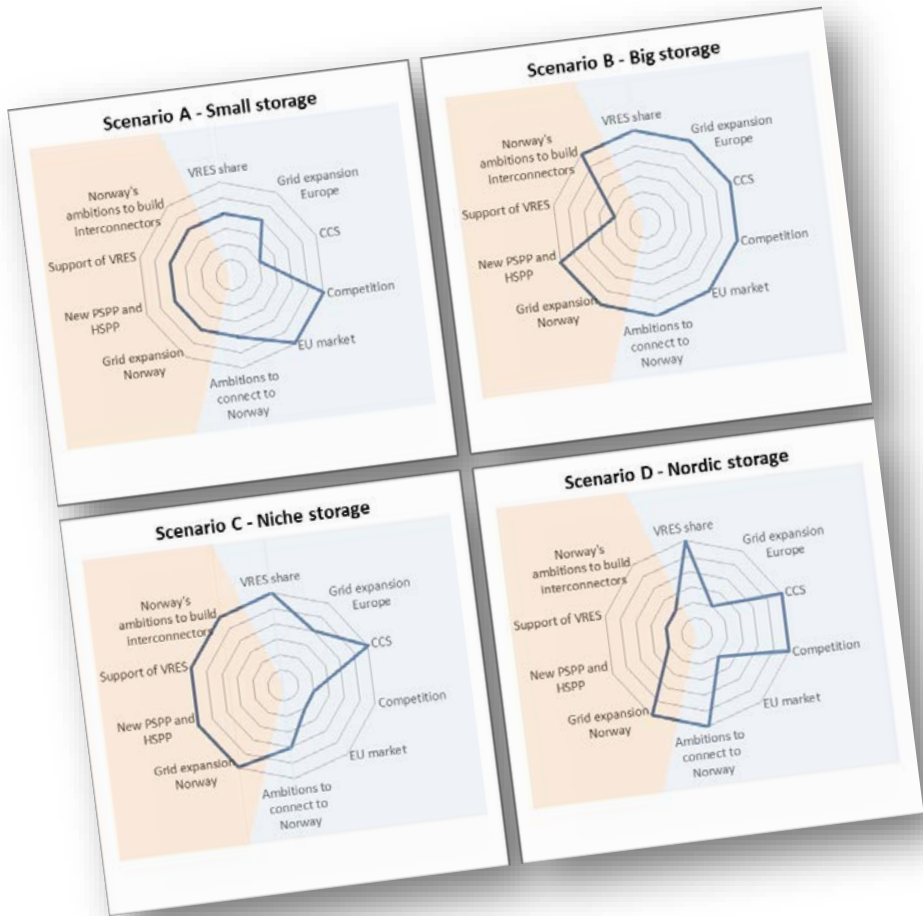
Scenario C - Niche storage



Scenario D - Nordic storage



Scenario input to WPs



- Most relevant scenario(s) chosen
- Not possible to cover all scenarios in each WP
- Adaptation of scenarios to WP

Current status on the roadmap

- Outline proposal
- Preparation for roadmap workshop 26th of October 2016
- Feedback from users and researchers

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Chapter 6 – Starting point

- What do we know today / What are the current conditions regarding opportunities for balancing?



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Norwegian Hydropower system

- Electricity generation
- storage hydropower capacity
- pumped storage capacity
- Total storage capacity
- Total reservoir volume

Power system

- Interconnectors between NO and others countries
- Grid bottlenecks in Europe
- Balancing between DK and NO today

Market

- Market situation, structure, integration
- Price level
- Flexibility options

Regulation of Norwegian reservoirs

- Typical regime of NO reservoirs today?
- Environmental restrictions today?
- Impacts on physical & biological conditions?

Regulatory framework

- Regulatory framework
- Public acceptance
- Policy target

Chapter 6.2 - The current power system

The current situation

The future situation

From WP1:

- Existing bottlenecks in national and international transmission grid
- Today's potential for balancing services and current alternative hydropower development schemes

From WP2:

- What tools are available for balancing service analysis
- How capable are the tools spatially and temporarily

From WP3:

- Describe today's market situation(s)
- Current TSO plans in Norway
- How is wind and solar balanced today

Chapter 6.3 - The regulation and operation of Norwegian reservoirs

The current situation

The future situation

From WP3:

- Describe a "typical" reservoir operation scheme

From WP4:

- What environmental restriction exists today
- What are the key indicators influenced by reservoir operations
- Describe current influence of operations on key indicators

Chapter 6.4 - The existing market situation

The current situation

The future situation

From WP2:

- Describe the different existing market systems
- How are markets connected in the current situation
- How are balancing services handled in today's markets

From WP3:

- What are the current mechanisms for creating payback options for hydropower investors
- Which markets can already today supply increased revenue for hydropower investors
- Describe state-of-the-art planning and operation models currently in use

Chapter 6.5 - The current regulatory framework

The current situation

The future situation

From WP5:

- What barriers and opportunities exist in today's regulatory framework
- How are Norwegian hydropower production currently influenced by European directives being implemented
- How do stakeholders, politicians, management describe today's situation
- What are the challenges hydropower investors are faced with in the current situation
 - Environmental flows
 - Transmission lines
 - License revisions
 - Other
- What is the current practice of handling these challenges in the hydropower sector

Chapter 8 - Insights in conditioning factors / where do we go from here

Possible scenarios



Recommendations

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The HydroBalance **roadmap** work

– *important steps before finalization*

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

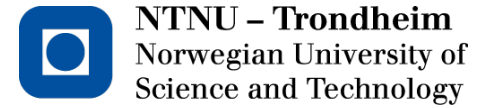
- Be actively involved
- Supply stakeholder views on the different topics
- Access available documents on CEDREN.no

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



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