



Characterisation of European CO₂ storage

January 2011 – December 2013

Overview



SiteChar – 3rd SiteChar Stakeholders Workshop, TNO, Hoofddorp, 24th September 2013

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ENVIRONNEMENT



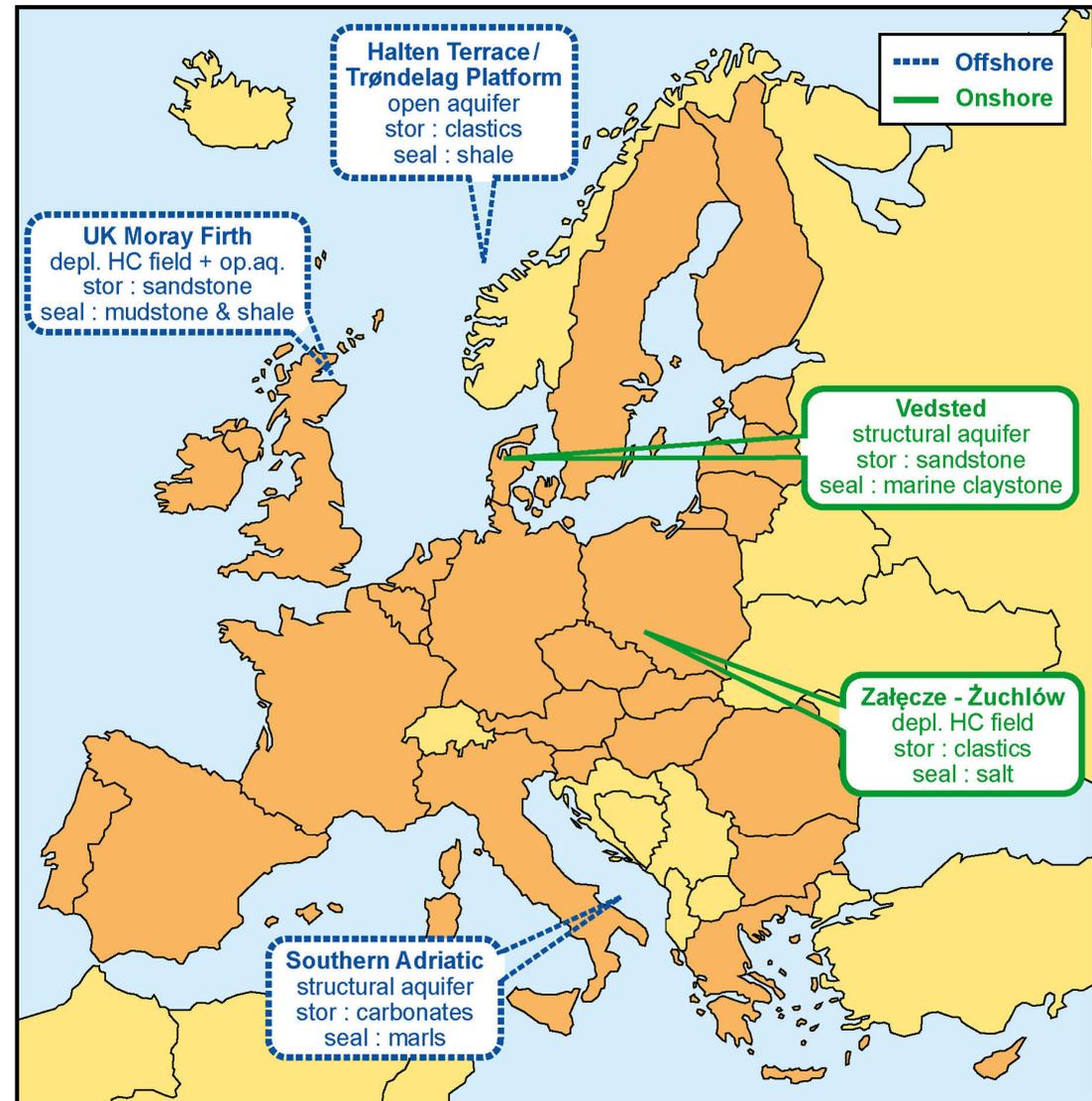
The aim of *SiteChar*

Provide the key steps required to make on-time effective large-scale implementation of CO₂ storage in Europe:

- *Demonstrate the level of geological characterisation and the assessment of long-term storage complex behaviour in accordance with the regulatory requirements (EU Directive)*
- *Develop a methodology for the preparation of exploration permit applications, accounting for all the technical and economic data, as well as the social dimension*
- *Raise public awareness and enable informed opinion formation*

The *SiteChar* sites portfolio

- Representative EU sites where CCS is most likely to develop in the near term
- Allowing to test and improve the *SiteChar* methodology for site characterisation in different geological contexts





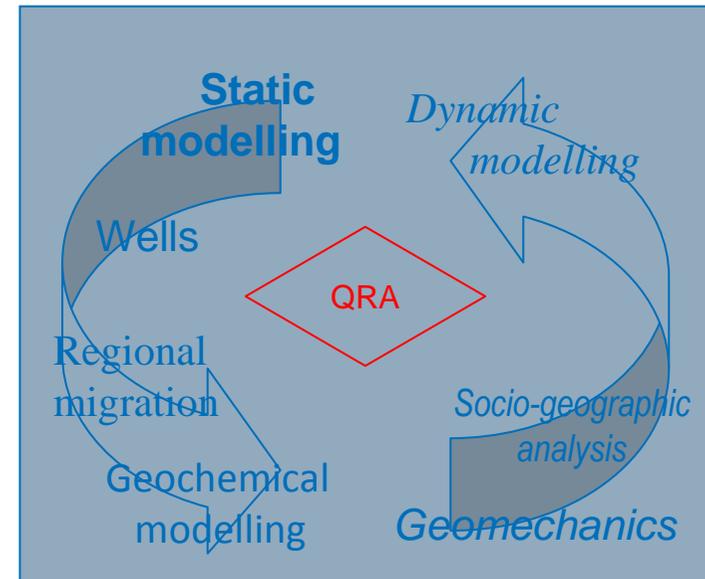
The *SiteChar* workflow

Consolidation of a site characterisation workflow

- In line with EC storage directive 2009/31/EC
- Validated from insight from research on the *SiteChar* sites portfolio

➤ So as to support

- An uniform characterisation of a storage complex
- An assessment of the security of the storage pursuant to the EC CO₂ Storage Directive



Two sites to perform a full-chain characterisation suitable for a storage permit application



■ The North Sea Outer Moray Firth site, UK

■ A multi-store site, comprising

- A hydrocarbon field: near-term storage capability
- The host saline aquifer sandstone: greater storage potential, later in the storage cycle

→ *Relationship between a producing hydrocarbon field and the host saline aquifer*



■ The Vedsted site, Denmark

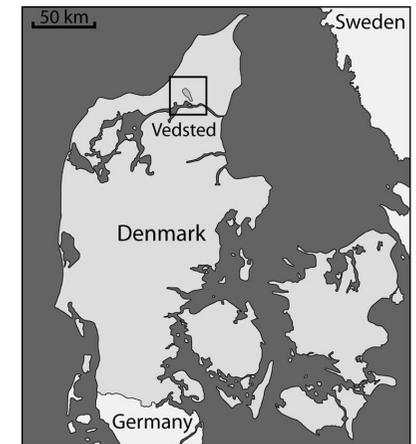
■ An onshore saline aquifer

- Processed by Vattenfall till late 2011 to be an industrial scale CCS demo project

→ *Different ways to supplement sparse data*

→ *Impact on the surrounding region*

→ *A monitoring plan ensuring the best risk management*



Three sites to overcome specific barriers related to the site characterisation methodology



■ The Zalecze & Zuchlow site, Poland

- An onshore gas reservoir

- *Application of the workflow from the first stages*

- *Behaviour of reservoir and caprock during CO₂ injection*

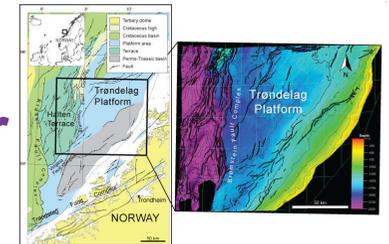


■ The Trøndelag Platform, Mid Norway

- An offshore multi-compartment saline aquifer

- *Approach for basin to individual compartment scale evaluation of performance*

- *Effective injection, monitoring and remediation strategies*

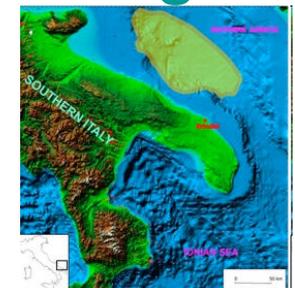


■ The South Adriatic site, Italy

- A structural trap in an offshore saline aquifer

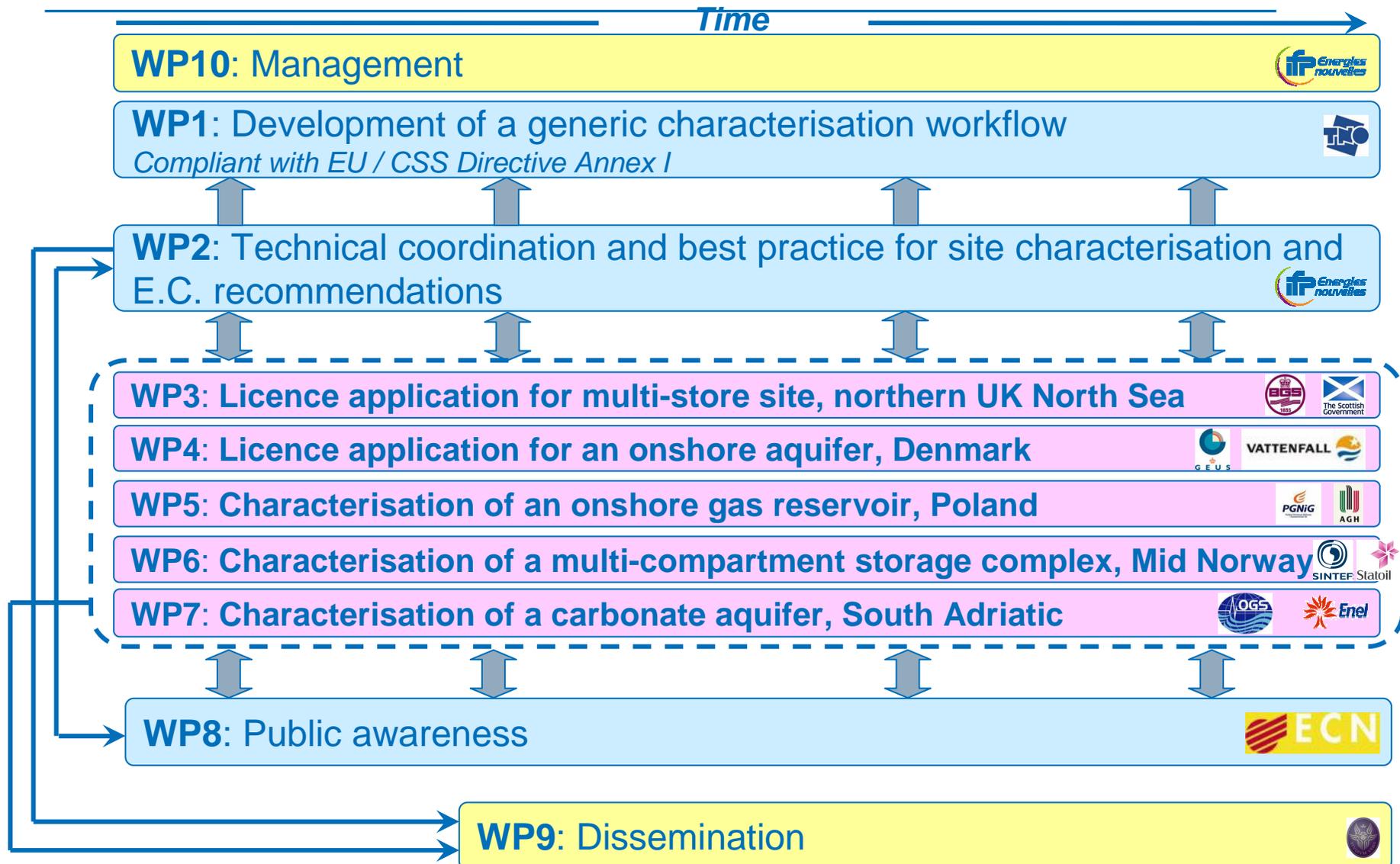
- *Characterisation of carbonate formations*

- *Geomechanical and dynamic behaviour of the complex*





The SiteChar project





The *SiteChar* exemplar permit applications

- Development of internal dry-run permit applications
- Evaluation by a group of independent geological experts and regulators
- A pragmatic and efficient approach to
 - Promote a more realistic licence application process
 - Ensure that key lessons on best practices can be fully applied



The *SiteChar* techno-economic analysis

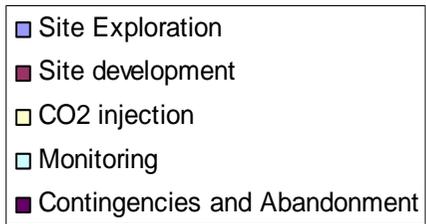
- **Conduct a comparable evaluation approach at four sites (e.g. same hypothesis & same methodology)**
 - UK site / Danish site / Norwegian site / Italian site
 - *Interesting variability of the sites and their characterisation*

- **Address mainly the storage part on the full-life time of the storage site:**
 - Account for all CAPEX and OPEX to be mobilized over the life of the project
 - Provide not only values but also related assumptions
 - Five stages to be considered:
 - Exploration / Development / Injection & Production / Monitoring / Abandonment



The *SiteChar* techno-economic analysis

	Outer Moray Firth <i>UK</i>	Vedsted <i>Denmark</i>	Trøndelag Platf. <i>Norway</i>	South Adriatic <i>Italy</i>
Context	Offshore	Onshore	Offshore	Offshore
Reservoir type	Depl. HC field & Deep Saline Aquifer	Deep Saline Aquifer	Deep Saline Aquifer	Deep Saline Aquifer
Project lifetime (year)	40	70	70	40
CO ₂ stored (Mt)	100	60	40	10
Injection duration (year)	20	40	40	10
Injectivity (Mt/year)	5	1.5	1	1
Nb. injection wells	5	1	1	1
Nb. production wells	1	0	0	0
Estimated costs	599 M€ / 11.4 €/t	29 M€ / 3.2 €/t	159 M€ / 26.6 €/t	97 M€ / 28.8 €/t
Share of estimated costs				





The *SiteChar* techno-economic analysis

No meaningful average cost for CO₂ storage

- **Very heterogeneous structure of costs**
 - Site location (onshore/offshore)
 - Amount of CO₂ injected
 - Well injection rate
 - Number of CO₂ injection wells
 - Need for water production and treatment
 - Variety of monitoring plans
 - ...
- **Site dependent**
- **Choice of economic parameters**

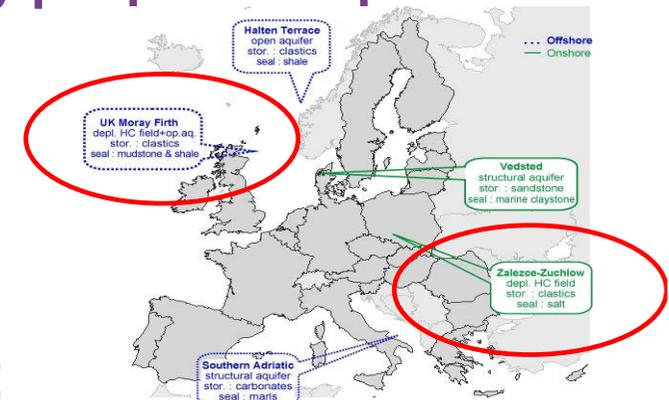


The *SiteChar* public engagement activities

- **Social site characterisation & advancing public awareness**
 - Raising public awareness and enabling informed opinion formation
 - Making available and comprehensive to lay people site-specific information

- **On two sites**

- The *offshore* Scottish site
- The *onshore* Polish site



- **Fieldwork from early 2011 to mid-2012**

Poland		Scotland
Fieldwork first half of 2011; data processing and reporting second half of 2012.	Step 1. Social Site Characterisation: - Desk research - Stakeholder interviews - Media analysis - Survey	Fieldwork first half of 2011; data processing and reporting second half of 2012.
30-31 March & 20-21-22 April 2012	Step 2. Focus conferences	30-31 March & 20-21-22 April 2012
June 25 2012	Step 3. Information meeting	September 6 2012
Continuously	Website information	Continuously
July 2012	Step 4. Second survey	September 2012



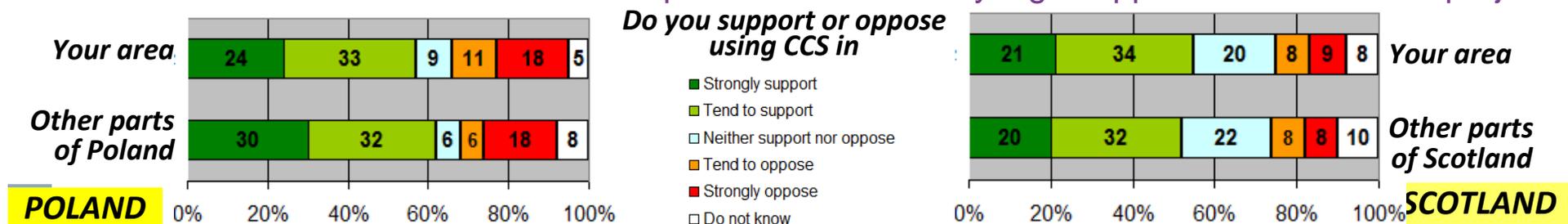
The *SiteChar* public engagement activities

■ Key findings relevant to policy makers

- Agreeing that climate change happens and that measures should be taken does not imply agreement on CCS as a suitable method to curb climate change
- Acceptability of CCS is related to other measures to combat climate change
- Pay attention to national/local advantages and disadvantages, *e.g. unemployment*
- Pay attention to risks and uncertainties, *e.g. CO₂ leakage and its effects*
- National and European governments should clarify their role/position on CCS as part of their emissions reduction strategy
- Citizens (particularly in Scotland) expect public communication and participation activities on EU as well as national level

■ Key findings relevant to site operators

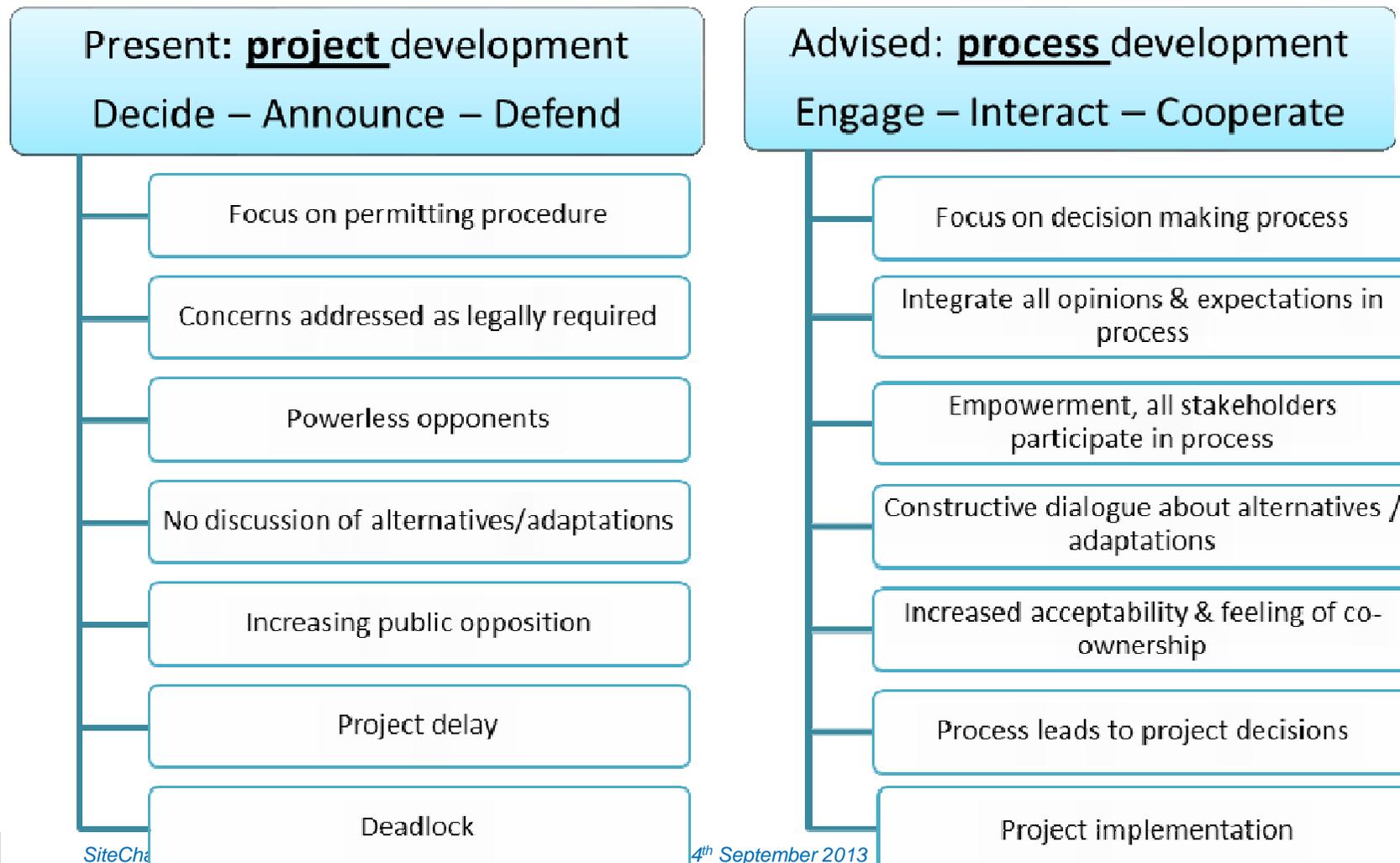
- Awareness and knowledge levels of CO₂ storage remained low
 - End of research: 78% at Polish site and 53% at Scottish site 'never heard about it'
- Misconceptions about CCS at the Polish site, *e.g. 'reduce toxic waste' & 'smog'*
- Prominent local discussion: Environmental risk in Poland / Economic benefits in Scotland
- Nonetheless at both sites about equal and over-all fairly high support for a local CCS project





The *SiteChar* public engagement activities

■ Link to permit application





The *SiteChar* benefits

Technical recommendations for storage site characterisation and best practice guidance for storage licensing from the perspective of both applicant and regulator

For further use by storage site operators and regulatory bodies

www.sitechar-co2.eu



Acknowledgments

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