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Facilitating energy storage to allow high penetration of intermittent renewable energy



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Project Summary & Objectives

stoRE aims to facilitate the high penetration of variable renewable energies in the European grid by unblocking the potential for energy storage infrastructure, through:

- Analysis of the energy storage status and potential
- Assessment of the environmental considerations for the development and operation of energy storage facilities
- Identification, assessment and reviewing together with key stakeholders of the regulatory and market framework conditions
 - at European level
 - in the 6 target countries
- Dissemination activities for improving the understanding of the benefits of energy storage for the energy systems of Europe.





Results (1)

- □ Current Status, Role and Costs of Energy Storage Technologies
- □ The Role of Bulk Energy Storage in Facilitating Renewable Energy Expansion
- Environmental Performance of Existing Energy Storage Installations
- Recommendations for furthering the Sustainable Development of Bulk Energy Storage Facilities – consultation process closed









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Results (2)

- Guidelines for the development of PHES in environmentally sensitive sites –
 ongoing consultation process
- European Regulatory & Market Framework for Electricity Storage Infrastructure consultation process closed
- □ Energy Storage Needs in Austria, Denmark, Germany, Greece, Ireland and Spain
- Regulatory & Market Framework for Electricity Storage Infrastructure ongoing consultation process









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What are the requirements for energy storage in Europe?





Calculation of

total energy

storage needs

Development of renewable energy sources Calculation of residual load

Seperation of long and short term energy storage needs

















100% 90% 80% 70% 60% **RES-E share** 50% 40% 30% 20% 10% 0% 2010 2020 2030 2040 2050 Year

DG Energy Roadmap - Current Policy DG Energy Roadmap - Delayed CCS DG Energy Roadmap - Energy efficiency DG Energy Roadmap - High RES DG Energy Roadmap - Low Nuclear DG Energy Roadmap - Reference DG Energy Roadmap - Diversified Supply ECF Roadmap 2050 - 40% RES ECF Roadmap 2050 - 60% RES ECF Roadmap 2050 - 80% RES ECF Roadmap 2050 - Baseline Eurelectric - Power choices - Baseline Eurelectric - Power choices - Power choices Greenpeace - Energy [R]evolution - Advanced Energy [R]evolution -Greenpeace - Energy [R]evolution - Energy [R]evolution Greenpeace - Energy [R]evolution - Reference EEG - stoRE - Green EEG - stoRE - BAU











stoRE Target Countries





Development scenarios in stoRE

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Target country	40% RE	80% RE	Import/Export	Heating sector			
Austria	Already more than 40% RE →2020 scenarios A,B,C	2050 scenarios GREEN, BAU	Yes, combined system Germany - Austria	No			
Denmark	Scenarios 2020 A,B,C Different wind development	One scenario	Yes, import/export via AC to Germany	Yes, for 80% RE			
Germany	3 scenarios A,B,C Different RE development	3 scenarios A,B,C Different RE development	No	No			
Greece	2 Scenarios A,B Strong PV, strong Wind	3 scenarios A,B,C Different RE development	No	No			
Ireland	Scenarios 2020 A,B,C Different wind development	One scenario	Yes, import/export via HVDC to GB	No			
Spain	2 Scenarios A,B Strong PV, strong Wind	2 Scenarios A,B Strong PV, strong Wind	No	No			





Calculation of total energy storage needs

Calculation of residual load

Development of renewable energies





Calculation of residual load

Calculation of residual load in Greece – 80% RES scenario







Calculation of residual load

Calculation of residual load in Greece – 80% RES scenario









Calculation of

total energy

storage needs

Seperation of long and short term energy storage needs

Calculation of residual load

Development of renewable energies



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Storage needs for 80% RES Zero curtailment & Unlimited Transmission

Countries	Additional Neo [GN		Additional Needed Stored Energy		
	Charging	Discharging	[GWh]		
Austria	0 - 2,98	0	0		
Germany	31,85 - 55,16	25,17 - 29,04	950 - 1.534		
Denmark	4,85	3,25	660,75		
Ireland	6.8	4.3	2.700		
Spain	34,2 - 46,8	30,4 - 36,8	640 - 6.340		
Greece	10,6 - 15,1	8 - 8,3	340 - 1.550		

Storage needs for 80% RES Zero curtailment & Unlimited Transmission

Countries	Additior	Additional Needed Capacity [GW]				Additional Needed Stored Energy		
	Chargi	Charging		harging		[GWh]		
Austria	0 - 2,9	0 - 2,98		0		0		
Germany	31,85 - 5	5,16	25,1	.7 - 29,04		950 - 1.534		
Denmark	Scenario 80% RE	Scenario		ionally Needed Capacity (GW)		Additionally Needed Stored Energy (GWh)		
Ireland		Charging		Discharging				
Spain	Equal	38	.79	25.17	,	1,308		
	Wind	31.85		25.74		1,534		
Greece	PV	55	.16	29.04		950		

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Storage needs for 80% RES Zero curtailment & Unlimited Transmission

Countries	Additio	Additional Needed Capacity [GW]				Additional Needed Stored Energy		
	Scenario	Additionally Needed Capacit (GW)		ity	Additionally Needed			
Austria	80% RE	Charg	ging	Dischargin	g	Stored Energy (GWh)		
Austria	Equal	35.	3	36.5		2240		
Germany	Wind	34.2		36.8		1290		
Germany	PV	36.	8	30.4		640		
Denmark		Nuclear scenarios						
Definitark	Equal-n	45.3		33.6		6340		
Ireland	Wind-n	44.	2	33.6		5000		
Irelaliu	PV-n	46.8		34.9		4300		
Spain	34,2 -	34,2 - 46,8		30,4 - 36,8		640 - 6.340		
Greece	10,6 -	10,6 - 15,1		8 - 8,3		340 - 1.550		

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Regulatory & Market Framework

What is the effect of the regulatory and market framework conditions on the development of new and operation of existing energy storage facilities?

Aim: Identify possible barriers

Wide consultation process + Questionnaire + Workshop

Recommendations for improvements





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