

EMPOWER

A Network Market Approach for Local Energy Trade and Renewable Electricity System Integration

7th Solar Integration Workshop

Session 4C: Regulatory and Market Aspects

Berlin, 24.10.2017

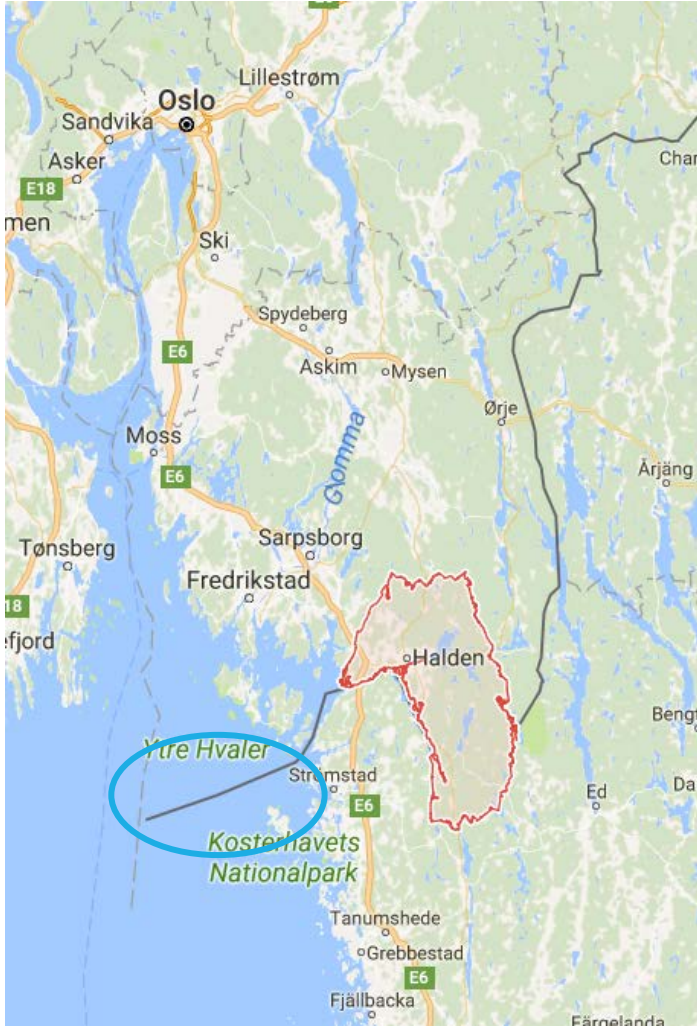
Dr. Christian Kunze, Smart Innovation Norway

Background: Halden Research and Innovation Cluster

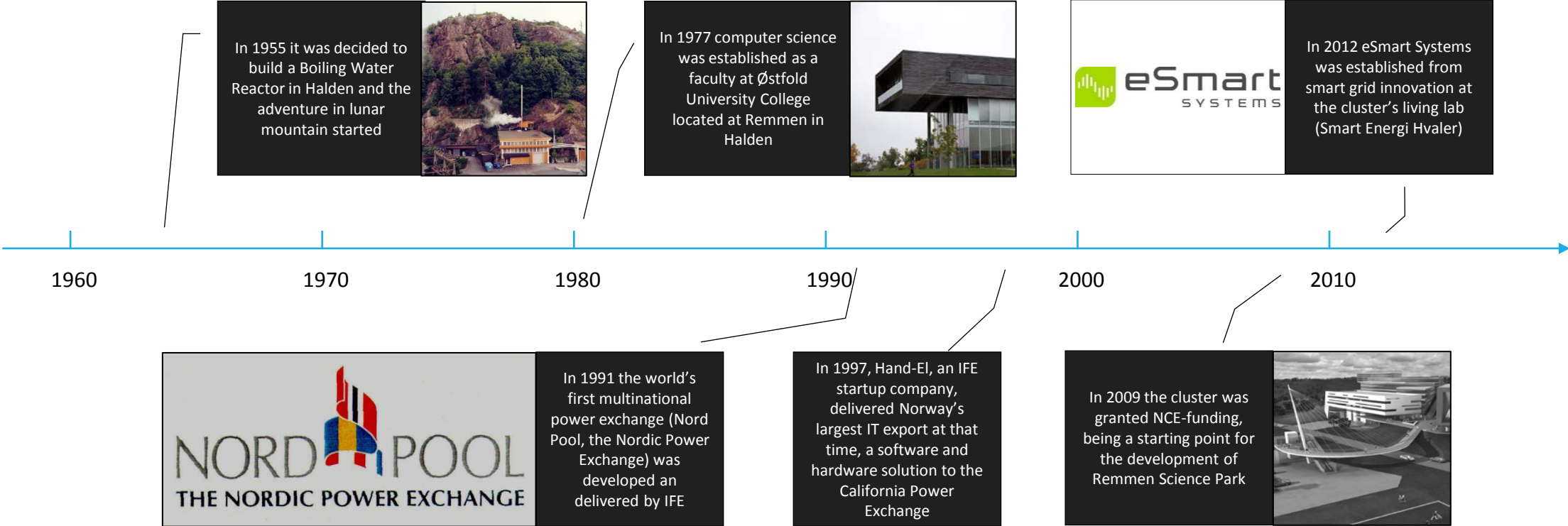
The EU Horizon 2020 EMPOWER Research and Innovation Project

Market & Regulatory Challenges for an Extended EMPOWER Roll-Out

Halden/Norway



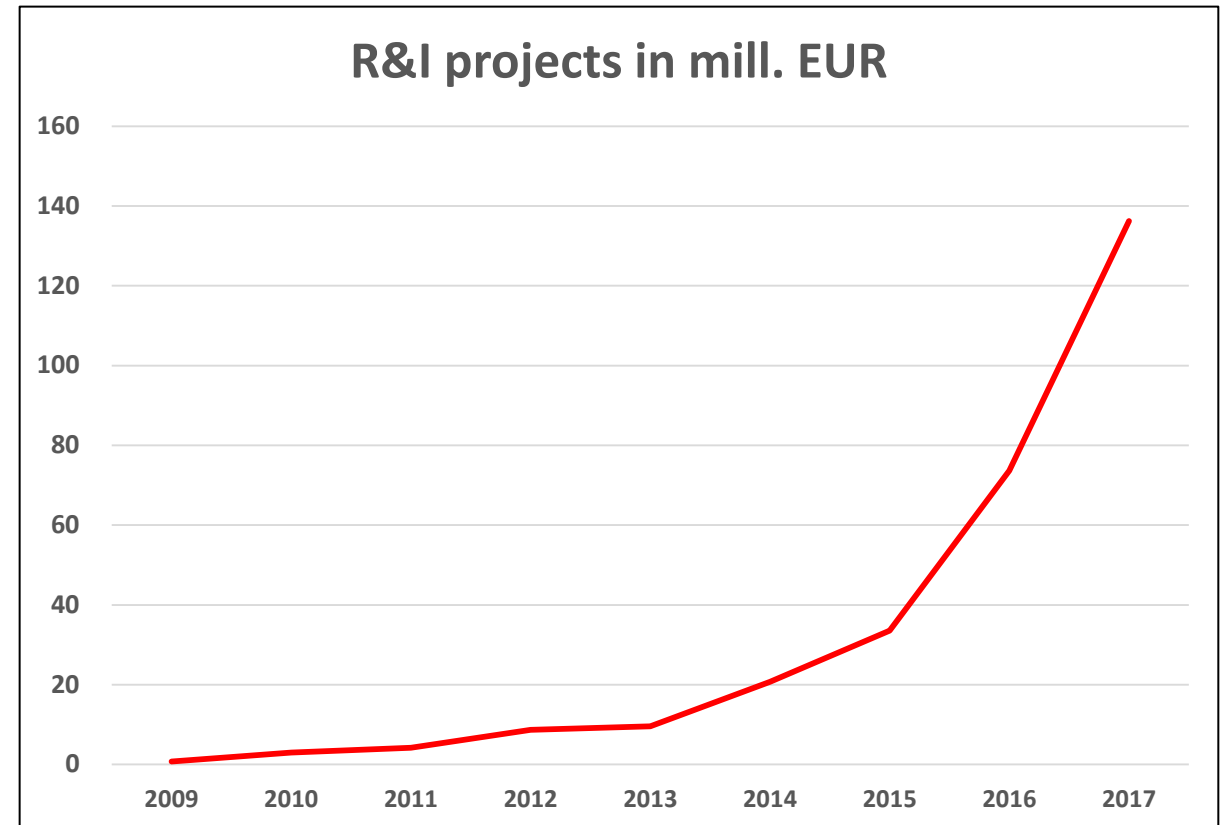
Energy & IT Cluster Development Process in Halden



Smart Innovation Norway: R&I Projects 2009 - 2017

- (1) **Energy Trade and Environment 2020** (2009-2011) (RCN RENERGI)
- (2) **Manage Smart in SmartGrid** (2010-2012) (RCN RENERGI)
- (3) **IMPROSUME** (2010-2012) (EU ERA Net)
- (4) **DeVID** (2012-2014) (RCN ENERGIX)
- (5) **VRI-2 Østfold** (2011-2013) (RCN VRI)
- (6) **Smarter Remmen I** (2011-2013) (Statsbygg)
- (7) **Smart energy optimization of municipal buildings** (2013) (RCN Oslofjord fund)
- (8) **The future of smart energy prosumers** (2013) (RCN Oslofjord fund)
- (9) **Klimareg** (2013-2015) (RCN Oslofjord fund)
- (10) **VRI-3 Østfold** (2014-2016) (RCN VRI)
- (11) **Smarter Remmen II** (2014-2016) (Statsbygg)
- (12) **Smart Rural Grid** (2014-2016) (EU FP7)
- (13) **Smart Energy Hvaler** (2014-2016) (Hvaler kommune, Fredrikstad Energi, NCE Smart)
- (14) **National Smart Grid Laboratory** (2014-2018) (RCN RESEARCH INFRASTRUCTURE)
- (15) **ChargeFlex** (2015-2017) (RCN ENERGIX)
- (16) **EMPOWER** (2015-2017) (EU Horizon 2020)
- (17) **FlexNett** (2015-2017) (RCN IPN ENERGIX)
- (18) **IoTSec** (2015-2020) (RCN Forskerprosjekt IKTPLUSS)
- (19) **MATCH** (2016-2018) (EU - Horizon 2020)
- (20) **PERMIDES** (2016-2018) (EU Horizon 2020)
- (21) **INVADE** (2017 – 2019) (EU Horizon 2020)
- (22) **INJECT** (2016 – 2018) (Innovation Norway)
- (23) **CINELDI** (2016-2024) (RCN Centres for Environment-friendly Energy Research FME)
- (24) **SCOTT** (2017-2020) (JU ECSEL)
- (25) **E-REGIO** (2017-2019) (ERA-Net)
- (26) **RESOLVD** (2017 – 2020) (EU Horizon 2020)

135 M€



Agenda

Background: Halden Research and Innovation Cluster

The EU Horizon 2020 EMPOWER Research and Innovation Project

Market & Regulatory Challenges for an Extended EMPOWER Roll-Out

Horizon 2020 - EMPOWER

EMPOWER (2015-2017) (EU Horizon 2020)

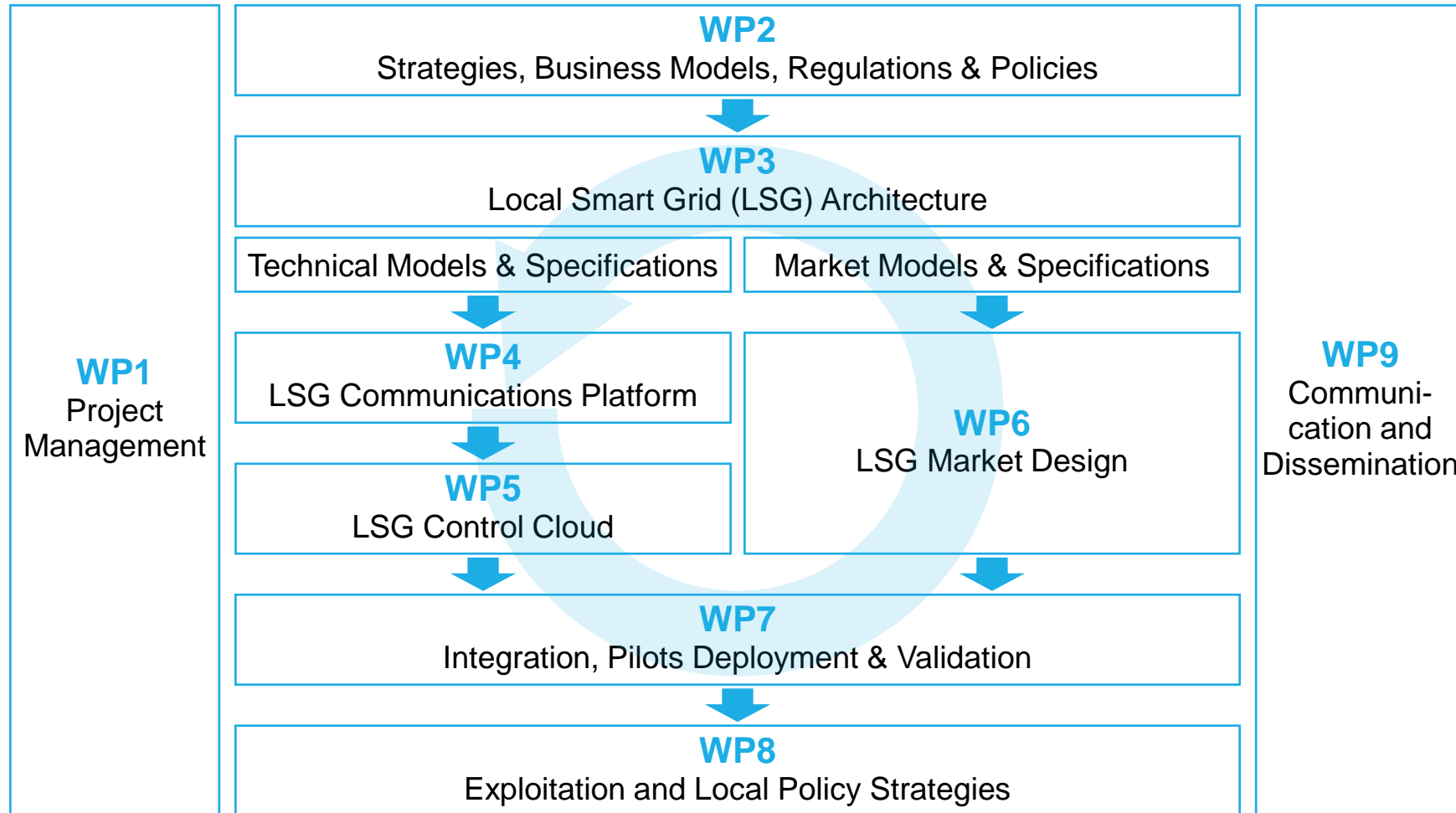
Develop a complete new energy market where consumers can buy and sell «neighborhood energy» which is produced locally by solar panels, micro wind turbines and other de-central energy production, new market design and new business models will be tested in Malta, Germany and Norway.

- *Relieve the central and regional grid, balance distribution grid locally*
- *Increase local electricity production and cheap renewable electricity to the customers*
- *Store electricity locally in battery stations and electrical vehicles*

Coordinator for Horizon 2020 project - total budget of € 6.1 mill.

- Smart Innovation Østfold AS (NO)
- Schneider Electric Norge AS (NO)
- eSmart Systems AS (NO)
- Fredrikstad Energi Nett AS (NO)
- University of St. Gallen (CH)
- Universitat Politècnica de Catalunya – CITCEA (ES),
- Malta Intelligent Energy Management Agency (MT),
- NewEn Projects GmbH (DE)

EMPOWER: Work Packages and Partners



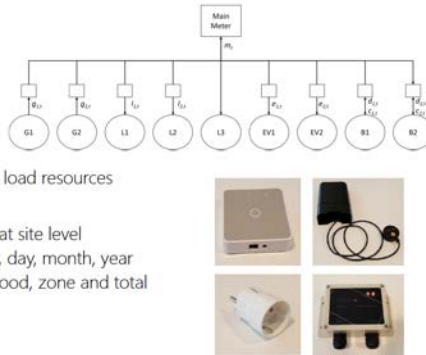
WP	Partner
WP1	Schneider/SmartIO
WP2	UNISG
WP3	UPC
WP4	Schneider
WP5	eSmart
WP6	SmartIO
WP7	Schneider
Wp8	SmartIO
WP9	UPC

EMPOWER: Project Results

Meter values and calculations



- Meter values collected every 10 s
 - Net production and net consumption from main meter
 - Production from generation resources
 - Charging and discharging from batteries
 - Consumption from EV chargers and some load resources
- Calculations
 - Gross production and gross consumption at site level
 - Aggregations (in time) to 15 minutes, hour, day, month, year
 - Aggregations (in space) to site, neighbourhood, zone and total

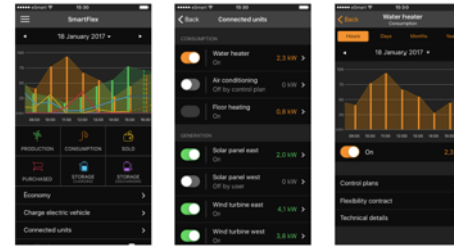


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Meter values and calculations



- Predictions
 - By machine learning, predictions are made for all resources that are metered
- Metered, calculated and predicted values are stored in the cloud and presented at three solutions:
 - For the prosumer:
 - The SmartFlex app
 - A web interface
 - For the SESP operator:
 - The iEMS system



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Meter values and calculations



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Time	Production	Consumption	Net Production	Net Consumption	Net Production	Net Consumption	Net Production	Net Consumption	Net Production	Net Consumption	Net Production	Net Consumption
15:00:00	0.27	0.28	0.01	0.27	0.27	0.28	0.01	0.27	0.27	0.28	0.01	0.27
15:00:10	0.46	0.47	0.01	0.46	0.46	0.47	0.01	0.46	0.46	0.47	0.01	0.46
15:00:20	0.33	0.34	0.01	0.33	0.33	0.34	0.01	0.33	0.33	0.34	0.01	0.33
15:00:30	0.36	0.37	0.01	0.36	0.36	0.37	0.01	0.36	0.36	0.37	0.01	0.36
15:00:40	0.41	0.42	0.01	0.41	0.41	0.42	0.01	0.41	0.41	0.42	0.01	0.41
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15:01:40	0.61	0.62	0.01	0.61	0.61	0.62	0.01	0.61	0.61	0.62	0.01	0.61
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15:08:40	1.87	1.88	0.01	1.87	1.87	1.88	0.01	1.87	1.87	1.88	0.01	1.87
15:08:50	1.90	1.91	0.01	1.90	1.90	1.91	0.01	1.90	1.90	1.91	0.01	1.90
15:09:00	1.93	1.94	0.01	1.93	1.93	1.94	0.01	1.93	1.93	1.94	0.01	1.93
15:09:10	1.96	1.97	0.01	1.96	1.96	1.97	0.01	1.96	1.96	1.97	0.01	1.96
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15:09:50	2.08	2.09	0.01	2.08	2.08	2.09	0.01	2.08	2.08	2.09	0.01	2.08
15:10:00	2.11	2.12	0.01	2.11	2.11	2.12	0.01	2.11	2.11	2.12	0.01	2.11
15:10:10	2.14	2.15	0.01	2.14	2.14	2.15	0.01	2.14	2.14	2.15	0.01	2.14
15:10:20	2.17	2.18	0.01	2.17	2.17	2.18	0.01	2.17	2.17	2.18	0.01	2.17
15:10:30	2.20	2.21	0.01	2.20	2.20	2.21	0.01	2.20	2.20	2.21	0.01	2.20
15:10:40	2.23	2.24	0.01	2.23	2.23	2.24	0.01	2.23	2.23	2.24	0.01	2.23
15:10:50	2.26	2.27	0.01	2.26	2.26	2.27	0.01	2.26	2.26	2.27	0.01	2.26
15:11:00	2.29	2.30	0.01	2.29	2.29	2.30	0.01	2.29	2.29	2.30	0.01	2.29
15:11:10	2.32	2.33	0.01	2.32	2.32	2.33	0.01	2.32	2.32	2.33	0.01	2.32
15:11:20	2.35	2.36	0.01	2.35	2.35	2.36	0.01	2.35	2.35	2.36	0.01	2.35
15:11:30	2.38	2.39	0.01	2.38	2.38	2.39	0.01	2.38	2.38	2.39	0.01	2.38
15:11:40	2.41	2.42	0.01	2.41	2.41	2.42	0.01	2.41	2.41	2.42	0.01	2.41
15:11:50	2.44	2.45	0.01	2.44	2.44	2.45	0.01	2.44	2.44	2.45	0.01	2.44
15:12:00	2.47	2.48	0.01	2.47	2.47	2.48	0.01	2.47	2.47	2.48	0.01	2.47
15:12:10	2.50	2.51	0.01	2.50	2.50	2.51	0.01	2.50	2.50	2.51	0.01	2.50
15:12:20	2.53	2.54	0.01	2.53	2.53	2.54	0.01	2.53	2.53	2.54	0.01	2.53
15:12:30	2.56	2.57	0.01	2.56	2.56	2.57	0.01	2.56	2.56	2.57	0.01	2.56
15:12:40	2.59	2.60	0.01	2.59	2.59	2.60	0.01	2.59	2.59	2.60	0.01	2.59
15:12:50	2.62	2.63	0.01	2.62	2.62	2.63	0.01	2.62	2.62	2.63	0.01	2.62
15:13:00	2											

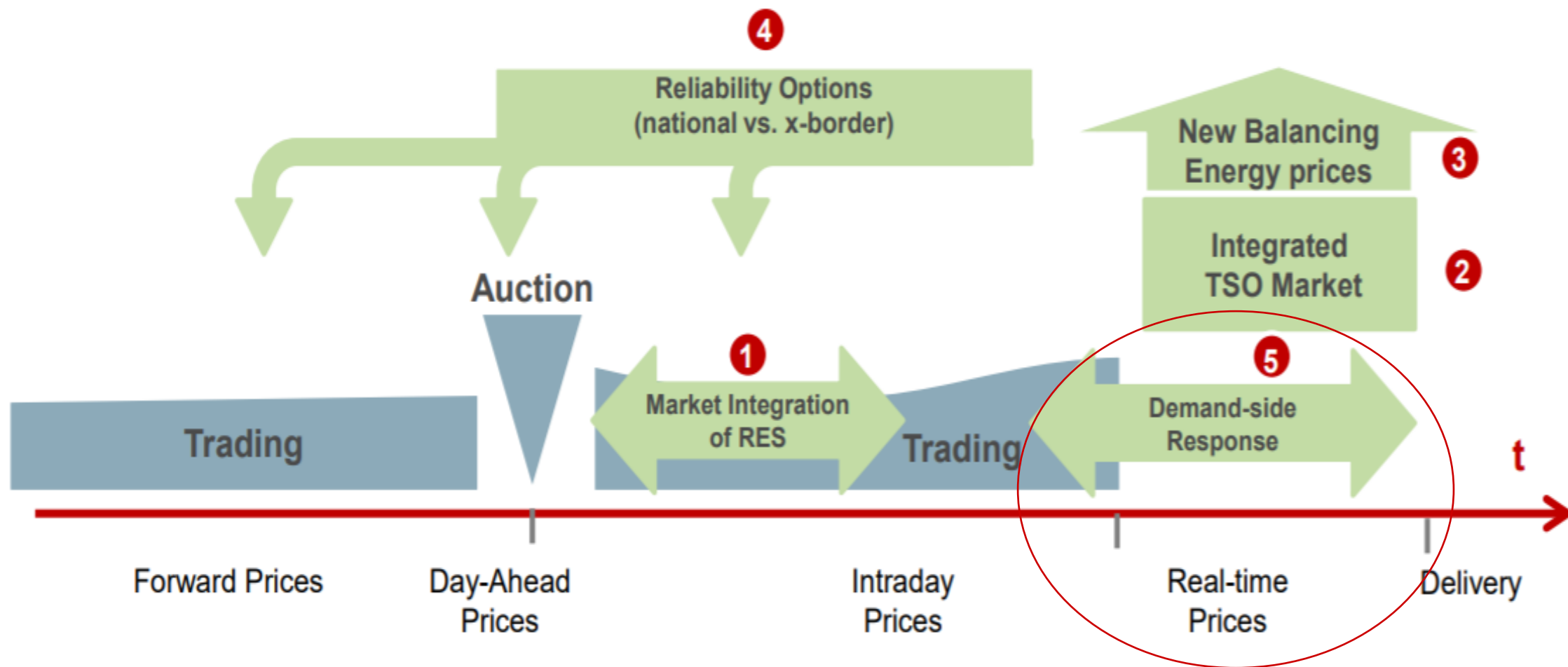
Agenda

Background: Halden Research and Innovation Cluster

The EU Horizon 2020 EMPOWER Research and Innovation Project

Market & Regulatory Challenges for an Extended EMPOWER Roll-Out

Real-Time Price Signal Challenge



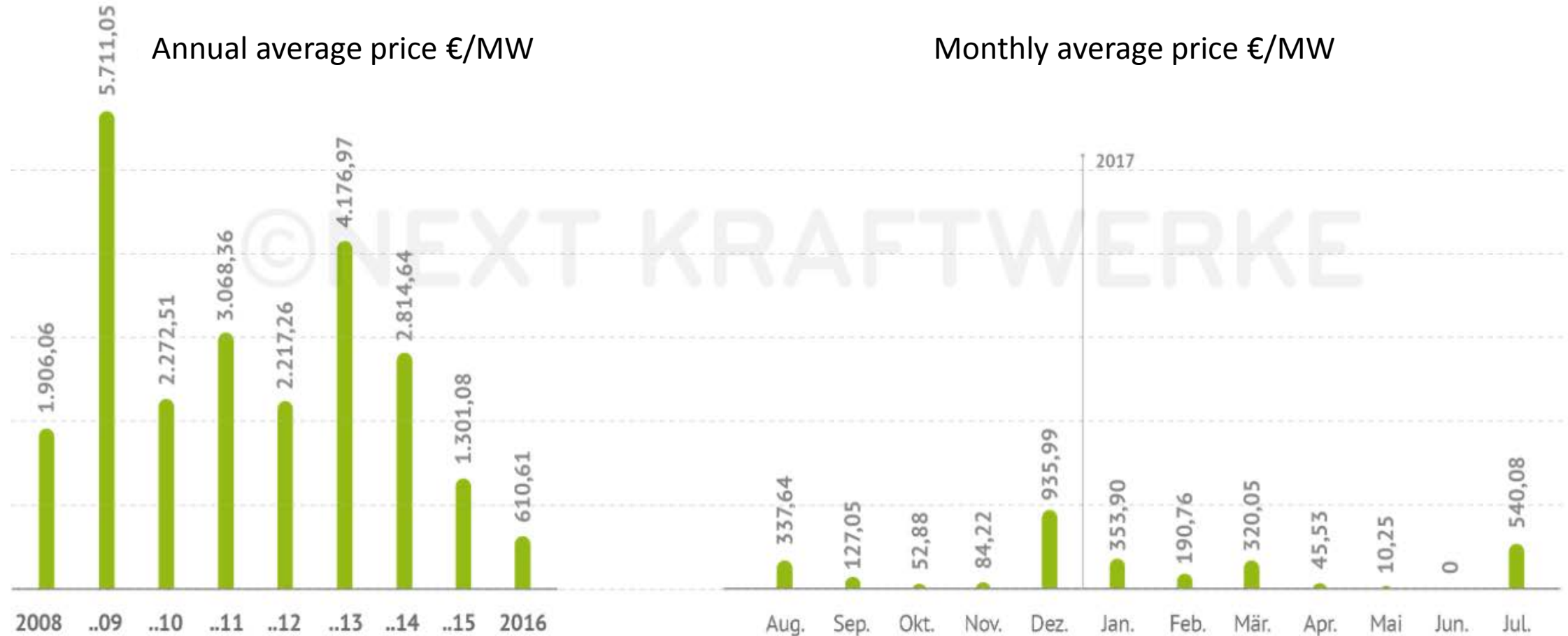
Source: Swissgrid (2016)

Challenges for an EMPOWER Roll-Out

Economics

- High opportunity cost for DSM implementation – low balancing market returns
→ DSM subsidy schemes (i.e. subsidize services for subsidized renewable generation)?

Medium demand charge for negative tertiary control in Germany

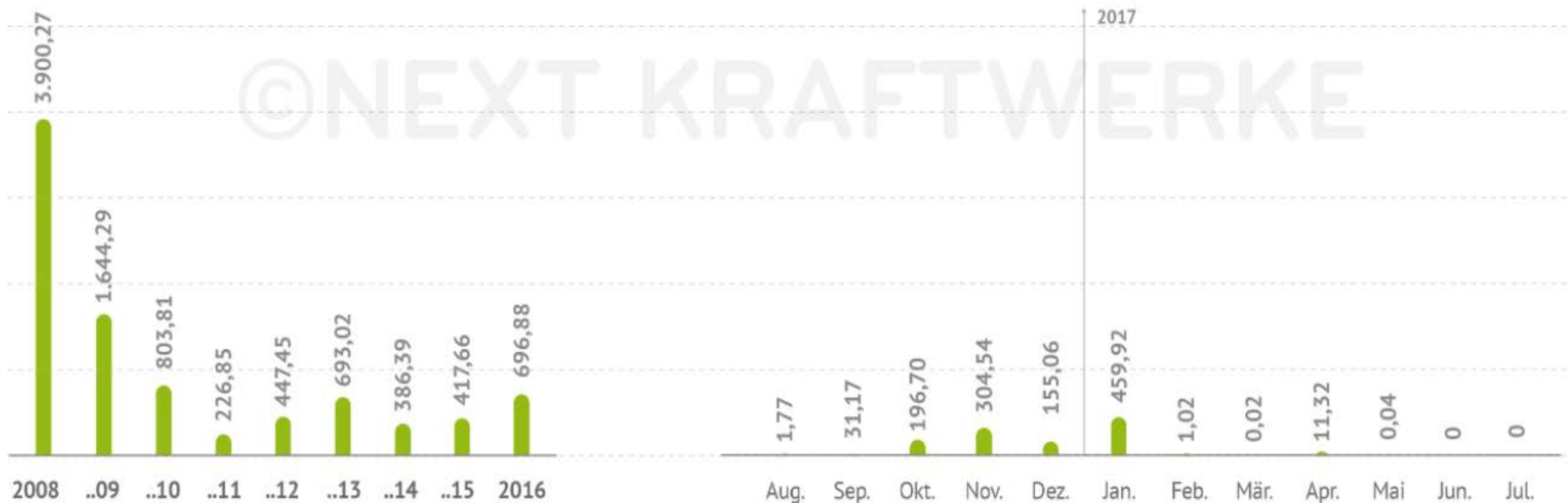


Source: www.next-kraftwerke.de

Medium demand charge for positive tertiary control in Germany

Annual average price €/MW

Monthly average price €/MW



Source: www.next-kraftwerke.de

Balancing market products

- Reduction of required bid volume during the previous years (tertiary control = 5 MW)
- Balancing market design is historically related to centralized generation units
- Adjustment in terms of minimum bid volume, long balancing energy call windows, restrictions for the pooling of processes, short lead time in case of calls, very low variations of load are required

Pre-qualification process for balancing markets

- Pre-qualification process is long, time consuming and not always transparent
- Process simplification and standardization required

Challenges for an EMPOWER Roll-Out

Role distribution balancing group responsible party (BGRP) and flexibility operator

- Central market role of BGRP: intermediary between consumer, supplier, grid operator
- Flexibility operator requires the permission of the BGRP to conduct DSM activities
- Standardized short-term consumer schedule adjustment processes and prices are required

Grid tariffs

- Savings of up to 90% of grid tariffs for companies, if:
 - Peak consumption occurs outside the peak load periods of the local grid
 - Demand is relatively flat and characterized by a high number of grid utilization hours
 - Adjustments required as higher grid tariffs exceed in many cases flexibilisation revenues

Interruptible load decree («Abschaltbare Lasten Verordnung (AbLaV)»)

- Tenders for interruptible loads of large consumers that are connected to the high or highest voltage grid
 - Relatively high compensation for a limited target group of bidders (initially min. 50 MW (now 10 MW) monthly (now weekly) bid size
- Opening of this market segment to smaller, flexible loads is required

Integration of flexibility provisions into energy management measures

- Continuous energy efficiency measures and energy audits in German companies
 - Flexibility / DSM potential and effect is not yet integrated into audits
- Integrate flexibility potential into energy audit DIN EN ISO 50001 bzw. DIN EN 16247-1 a

Project Status and Next Steps

- Stable IT system at pilot sites implemented that passed factory acceptance test
- Project finalization until December, 2017
- Parallel start of the commercialization of EMPOWER results
- Commitment of a group of German «Stadtwerke» for the EMPOWER roll-out
- Detailed analysis of market design aspects and their influence on EMPOWER implementation in additional countries

Thank you for your attention!



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