

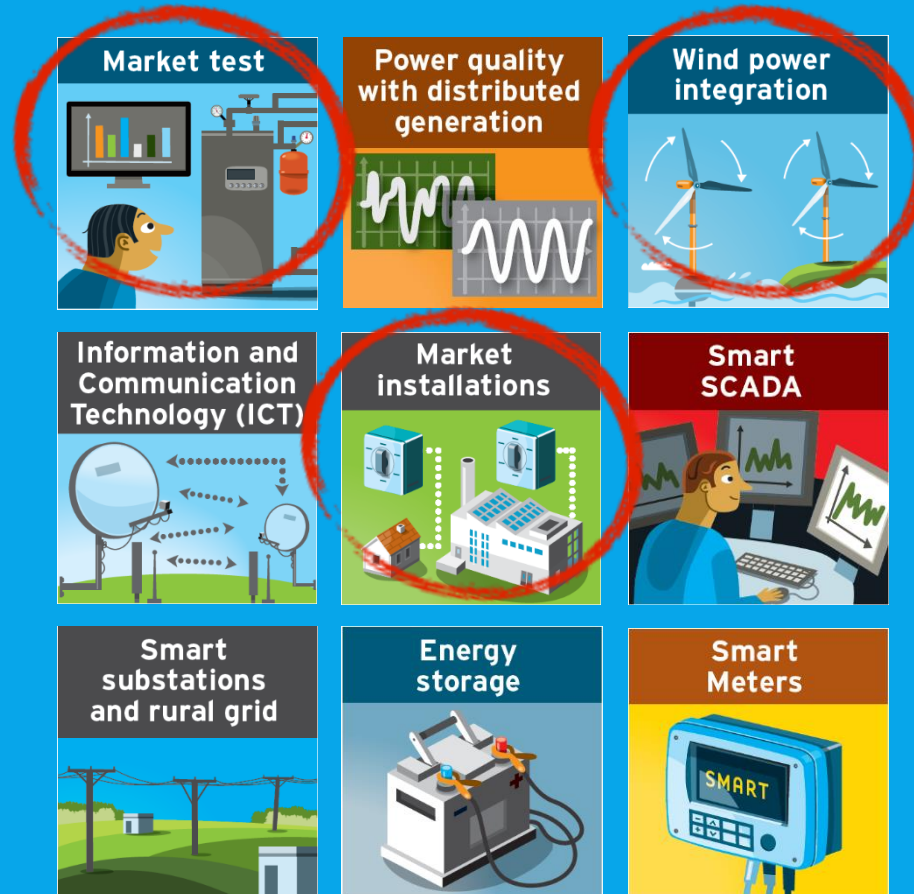


Demand-Response in the Smart Grid Gotland project

PowerTech, Eindhoven, 2015-06-29

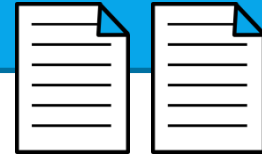
Daniel A. Brodén, danbro@kth.se

Subprojects



Subproject: wind power integration

Thesis Paper



Highlights:

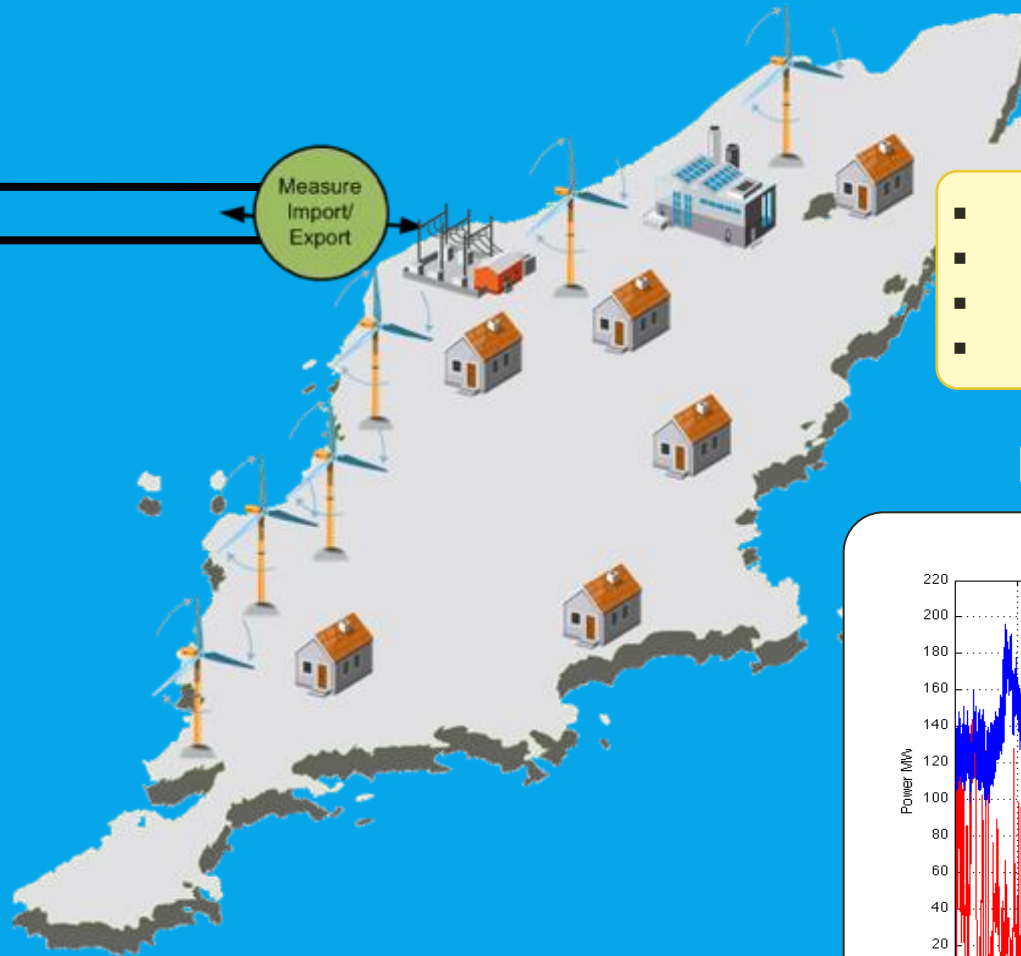
- Master Thesis Results (2013),
"Analysis of Demand-Response Solutions for Congestion Management in Distribution Networks",
Daniel A. Brodén
- Master Thesis Results (2015),
"Analysis of Demand-Response Participation Strategies for Congestion Management in an Island Distribution Network",
Gaëlle Ryckebusch



Thesis Paper

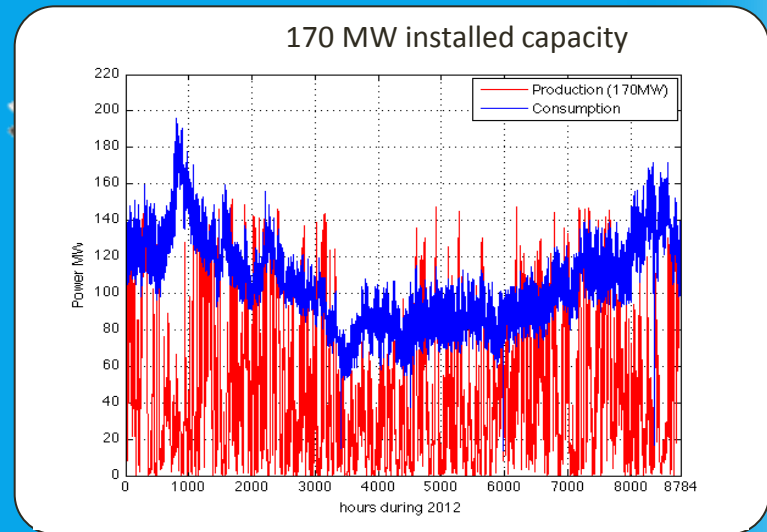
Gotland Today

≈ 170 MW wind power



- Max grid capacity 195 MW
- HVDC capacity 2x130 MW
- 21,000 detached houses
- 3 major industries

Prod & Cons 2012



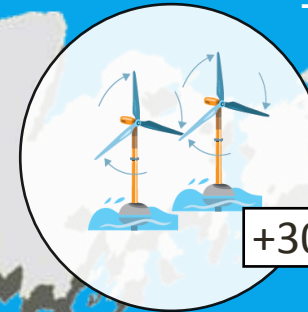
Integrating 5 MW Beyond Hosting Capacity

170→200 MW



Measure Import/Export

Peak Prod – Min load > 130 MW

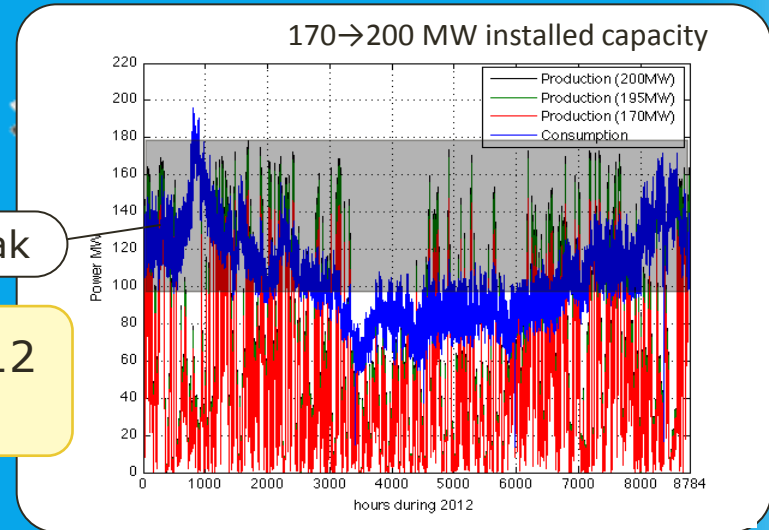


+30 MW

Prod & Cons 2012

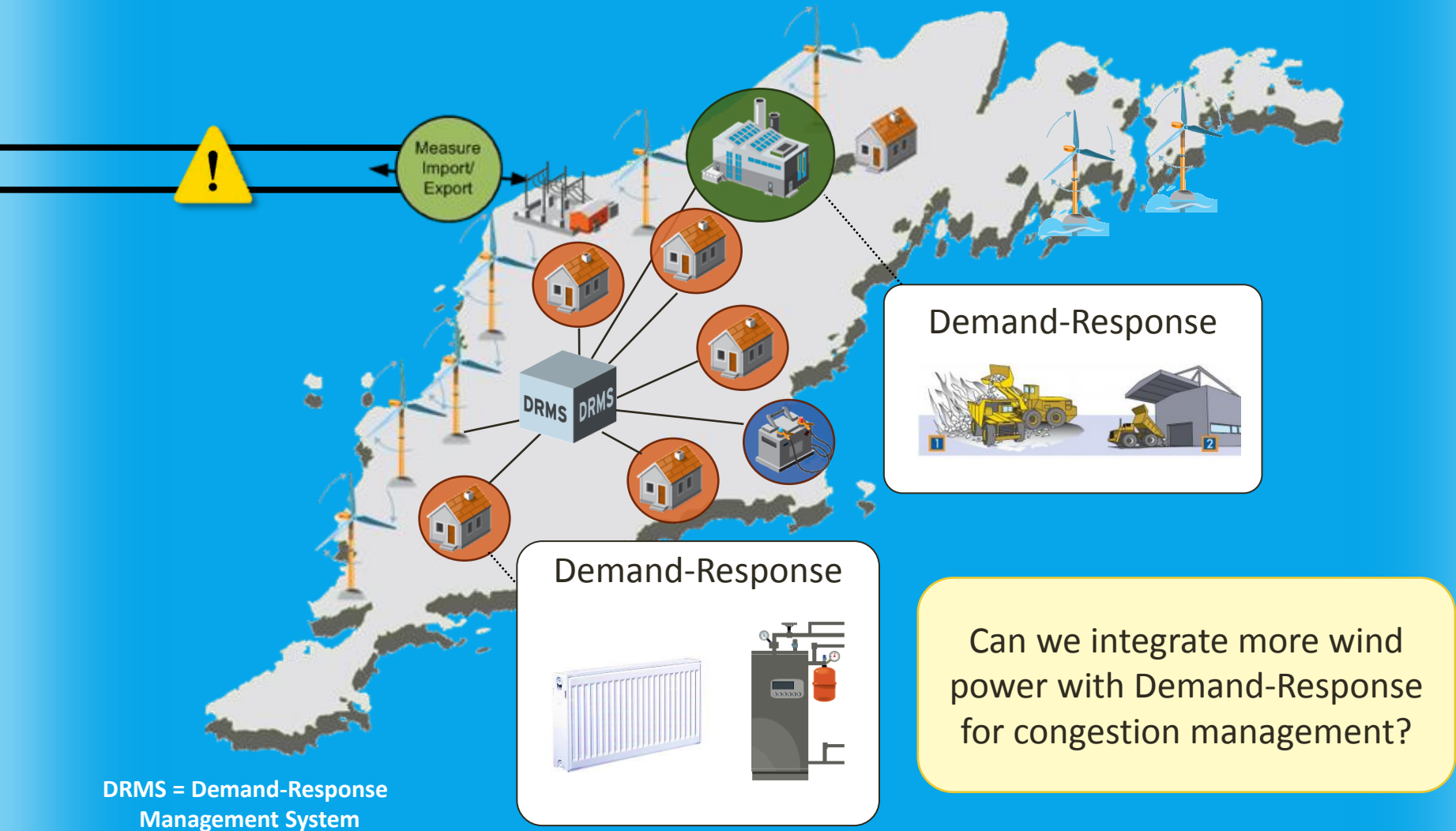
80→95 MW Export Peak

No overloads in 2012
Export < 130 MW



Congestion Management

200 MW wind power



DRMS = Demand-Response Management System

Can we integrate more wind power with Demand-Response for congestion management?

Simulation Results (MS Thesis 2013)



≈ 2000 detached houses required to manage a set of worst-case congestion scenarios while satisfying comfort constraints



Reducing participation of up to 700 detached houses when including demand-response activity from a large industry



Battery with 280 kWh capacity absorbs most of the prognosis errors. A few wind curtailment events were required.

More information: <http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-138575>

Simulation Results (MS Thesis 2015)



Little variation in number of required DR participants when integrating participation strategies:

- Dynamic Network Tariff
- Spot Price Optimization

Cost analysis for a three-day simulation period:

- Total of 200 - 10 000 € in compensation cost for the DSO depending on the simulated scenario
- Savings of DR participants are negligible

More information: <http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-169220>

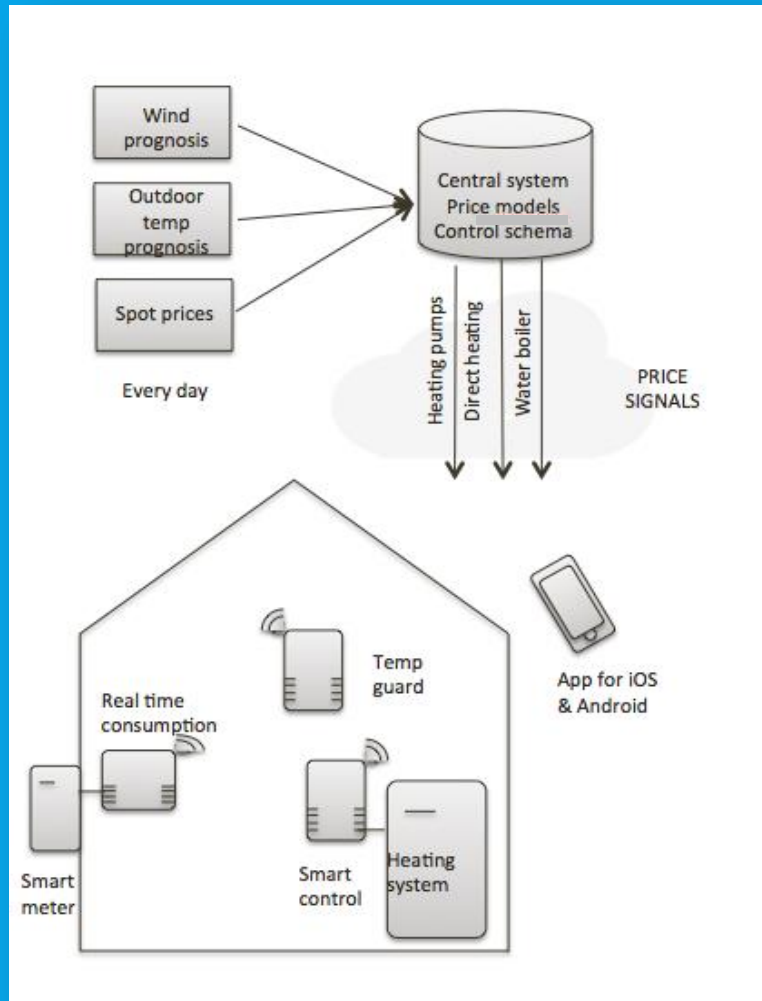
Subproject: market test & installations



Highlights

- Demand-response control systems installed and running for approx. 260 detached houses - optimizing on market price signals
- Customer surveys results

Installation Overview



- 260 units installed today
- Optimizing on spot price and time of use tariff
- Different heating systems

Type of heating	#
Electrical heater	54
Hot water boiler	87
Electrical radiator systems	29
Heat Pump (water based)	66
Electrical floor heating	4
Heat pump (air)	2

Application View

Mina enheter +

Just nu **På**

Idag Imorgon

golvvärme >

Just nu **På**

Idag Imorgon

Temp-vit >

20,9 °C 5,8 °C

Översikt Just nu Historik Enheter Mer

Overview
components

Tillbaka golvvärme

Styrning Lista Inställningar

Morgondagens styrschema

24:00 03 06 09 12:00 15 18 21

Översikt Just nu Historik Enheter Mer

Price
signals

Tillbaka Temp-vit

Temperatur Inställningar

Namn: Temp-vit

Tillgänglig: Ansluten

Typ: Temp

ID: 1200040958934582

Signalkvalitet: 36

Programversion: 1.0.10

Batterinivå: [Battery level indicator]

Temperaturvakt för styrenheter: På 17 °C

Omkonfigurera

Ta bort enhet

Översikt Just nu Historik Enheter Mer

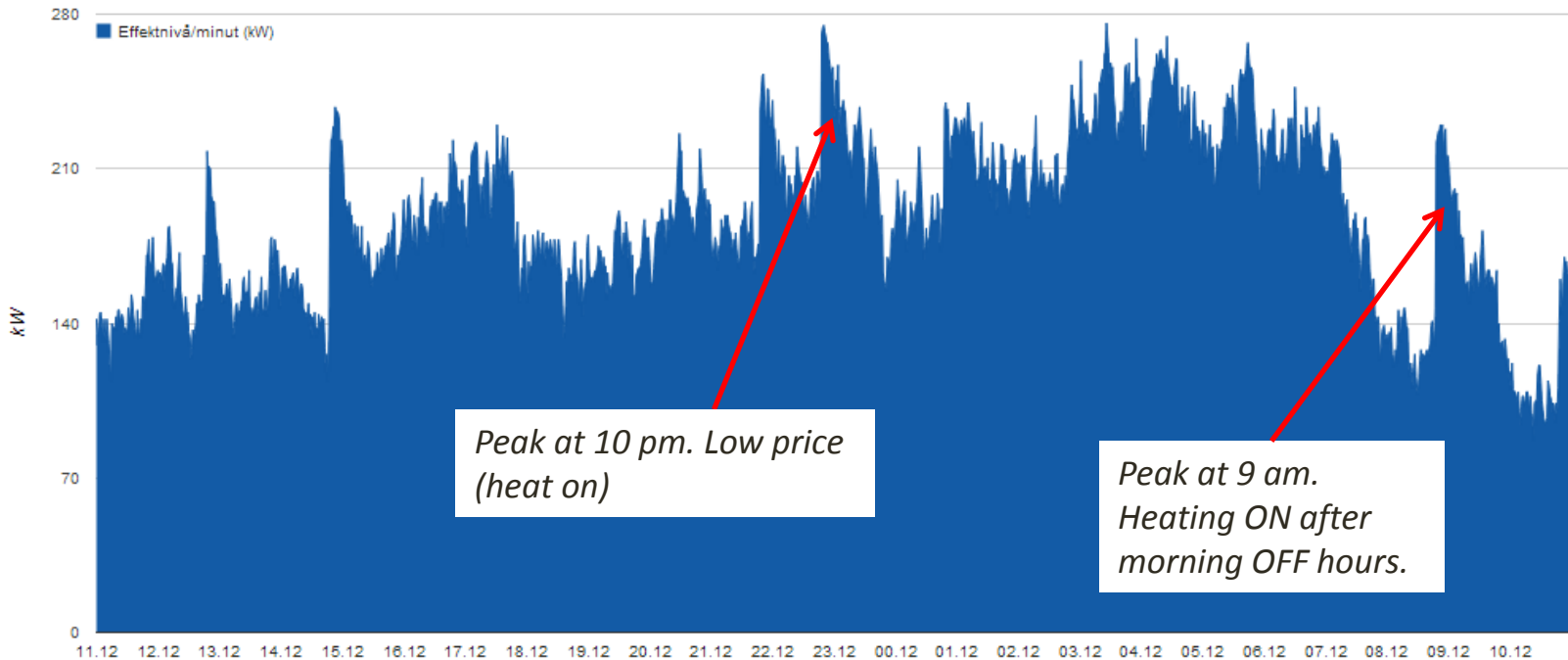
Temperature
override

Aggregated Consumption of Customers



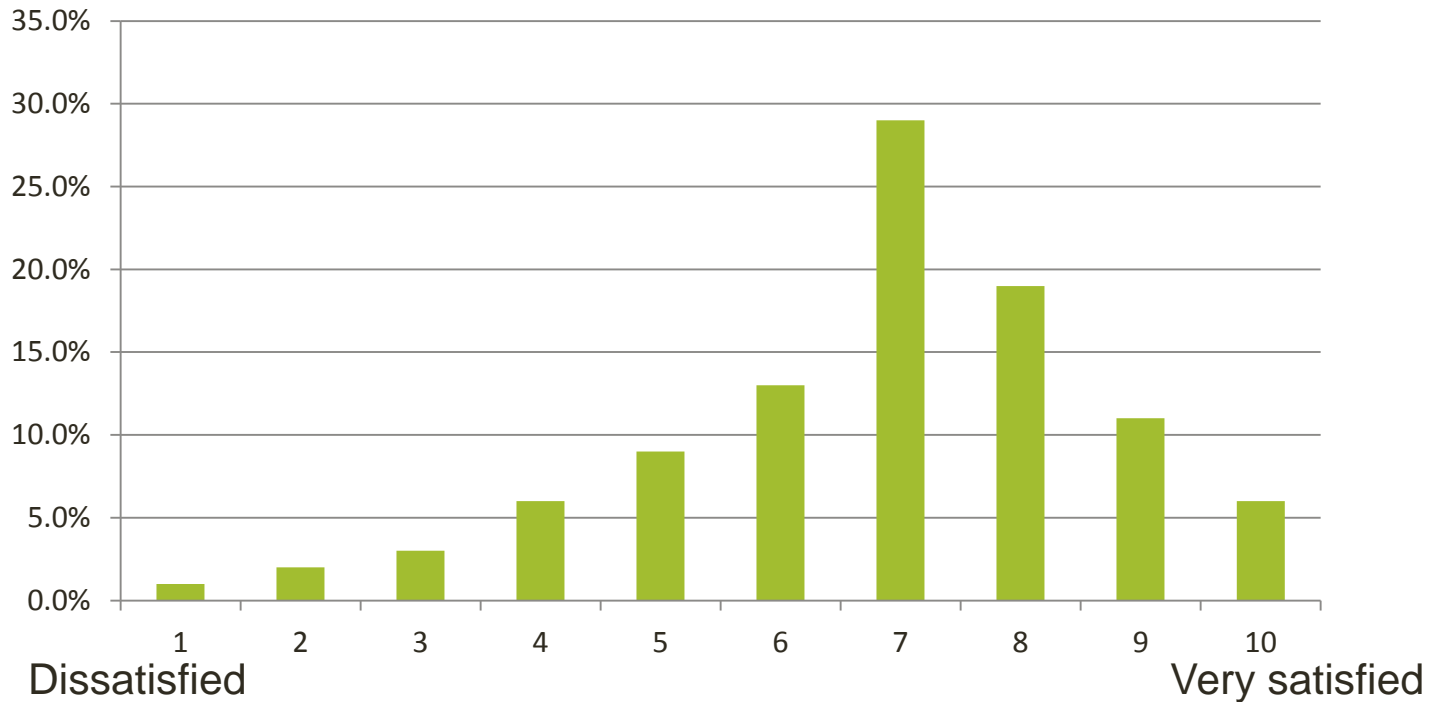
sgg.energywatch.se/TotalChart

Effektuttag just nu: 298,6 kW Antal enheter: 217



“Smart” Energy Customer Survey

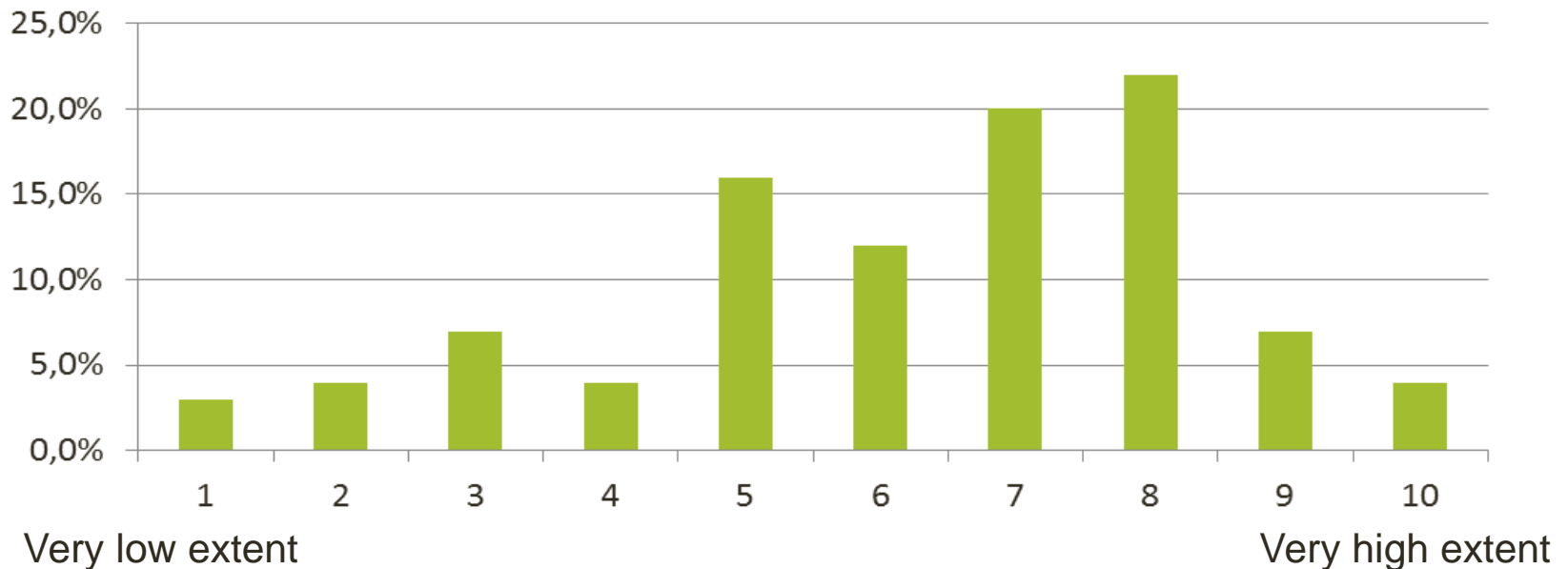
How do you rate your experience as a “Smart” Energy Customer?



Based on the answers of approximately 200 participants

“Smart” Energy Customer Survey

To what extent has participants changed their consumption habits?



Based on the answers of approximately 200 participants

More results..

- Data is collected until Spring 2016
- Data is being analyzed for
 - Consumer behavior
 - Comfort variations
 - Electricity bill savings
 - And more



Tack för din uppmärksamhet!

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Smart Grid Gotland

