ENERGY INDEPENDENCE FOR EUROPE

From Smart Electrical Grids to a Smart Energy System

Euro-CASE conference Nov 13, 2012

Bo Normark

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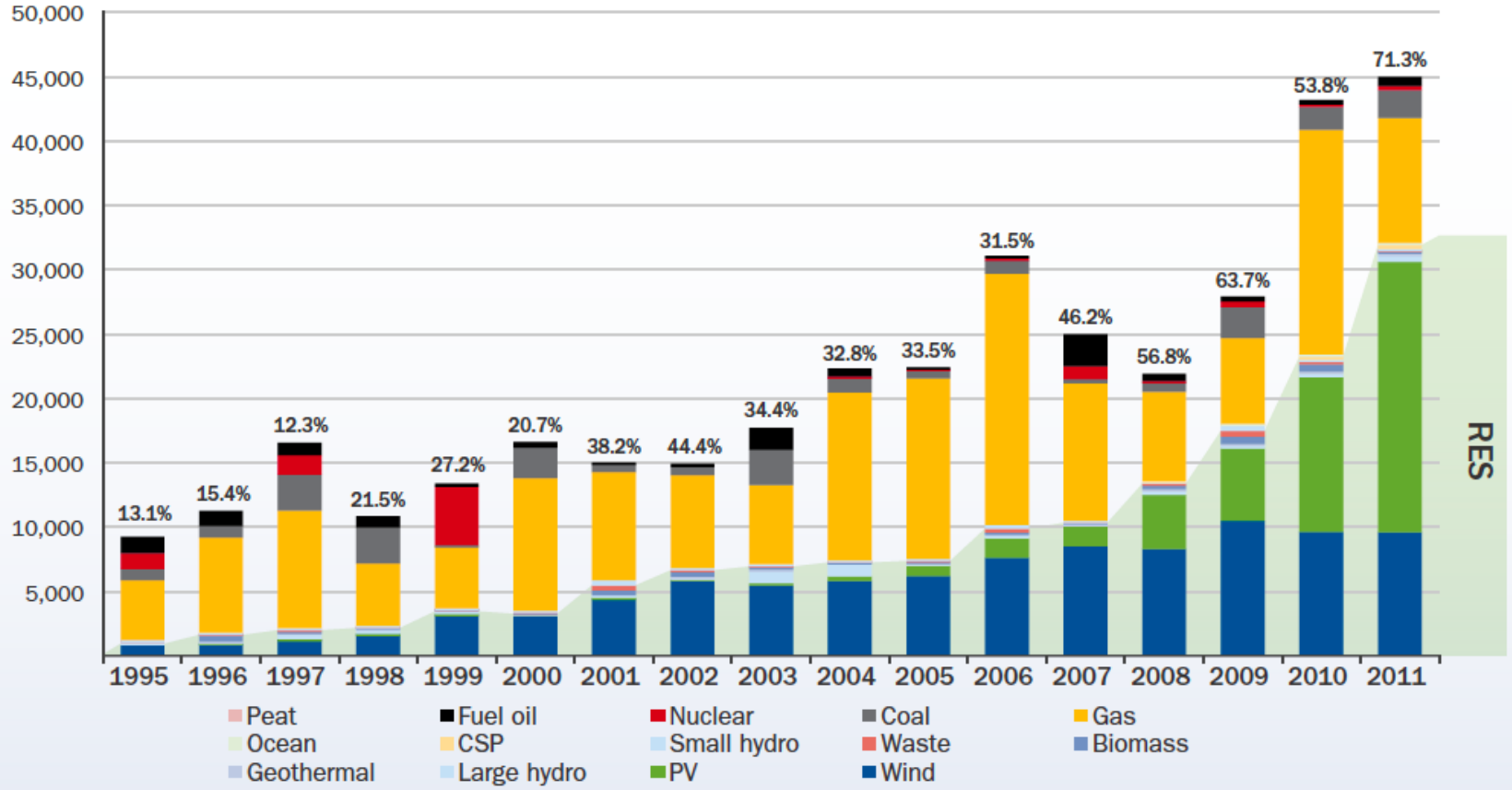
European Energy System under transformation

EU INSTALLED POWER GENERATING CAPACITY PER YEAR IN MW AND RES SHARE (%) FIGURE 2.1



Källa: EWEA 2011

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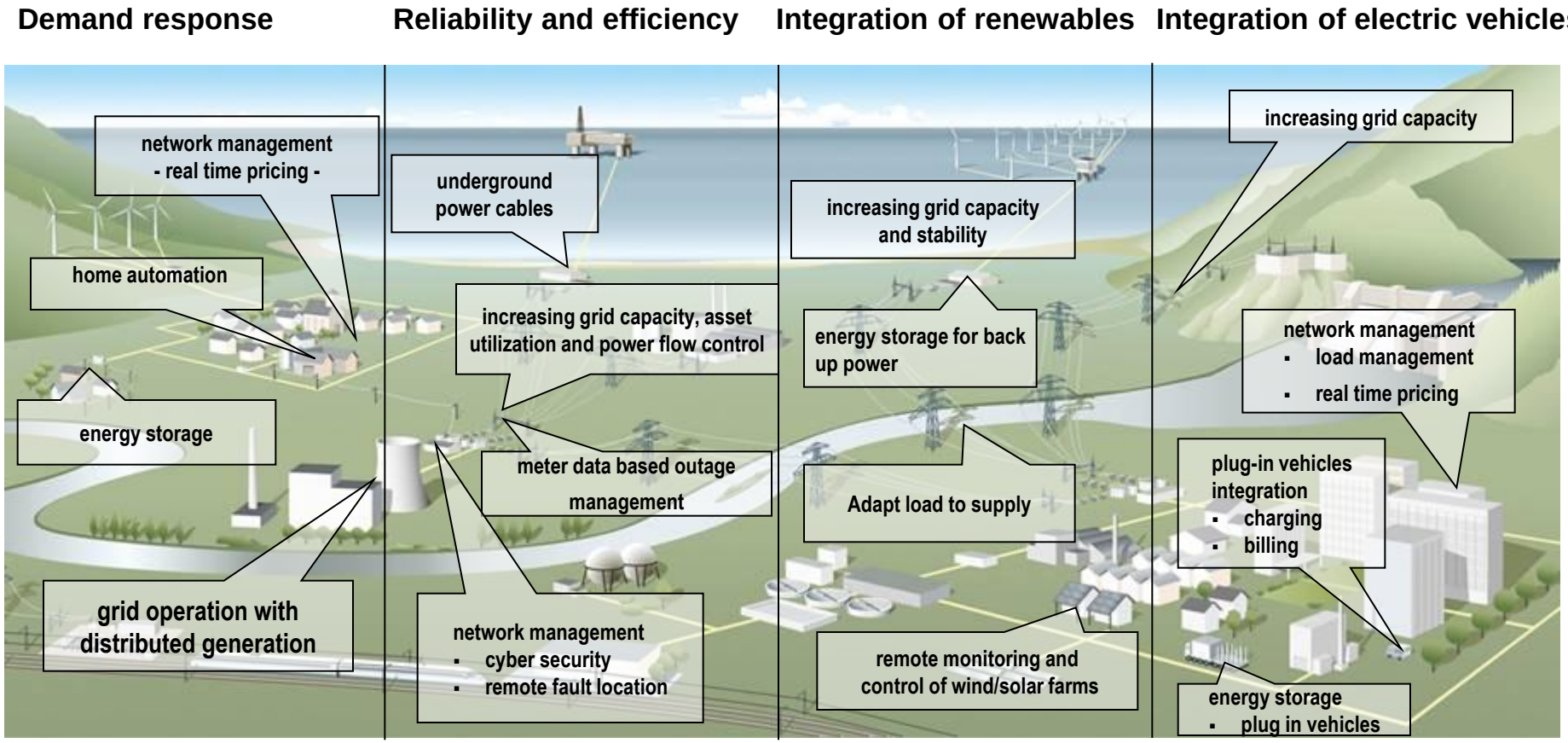
A new Energy Landscape is emerging



Source: ABB

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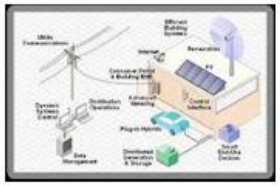
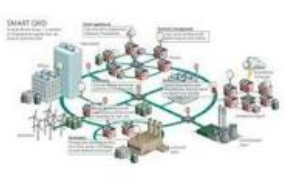
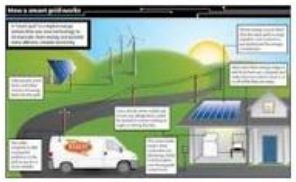
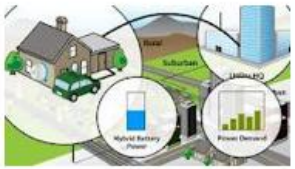
Is Smart Electrical Grids the solution ?





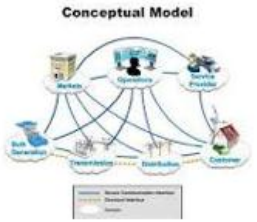










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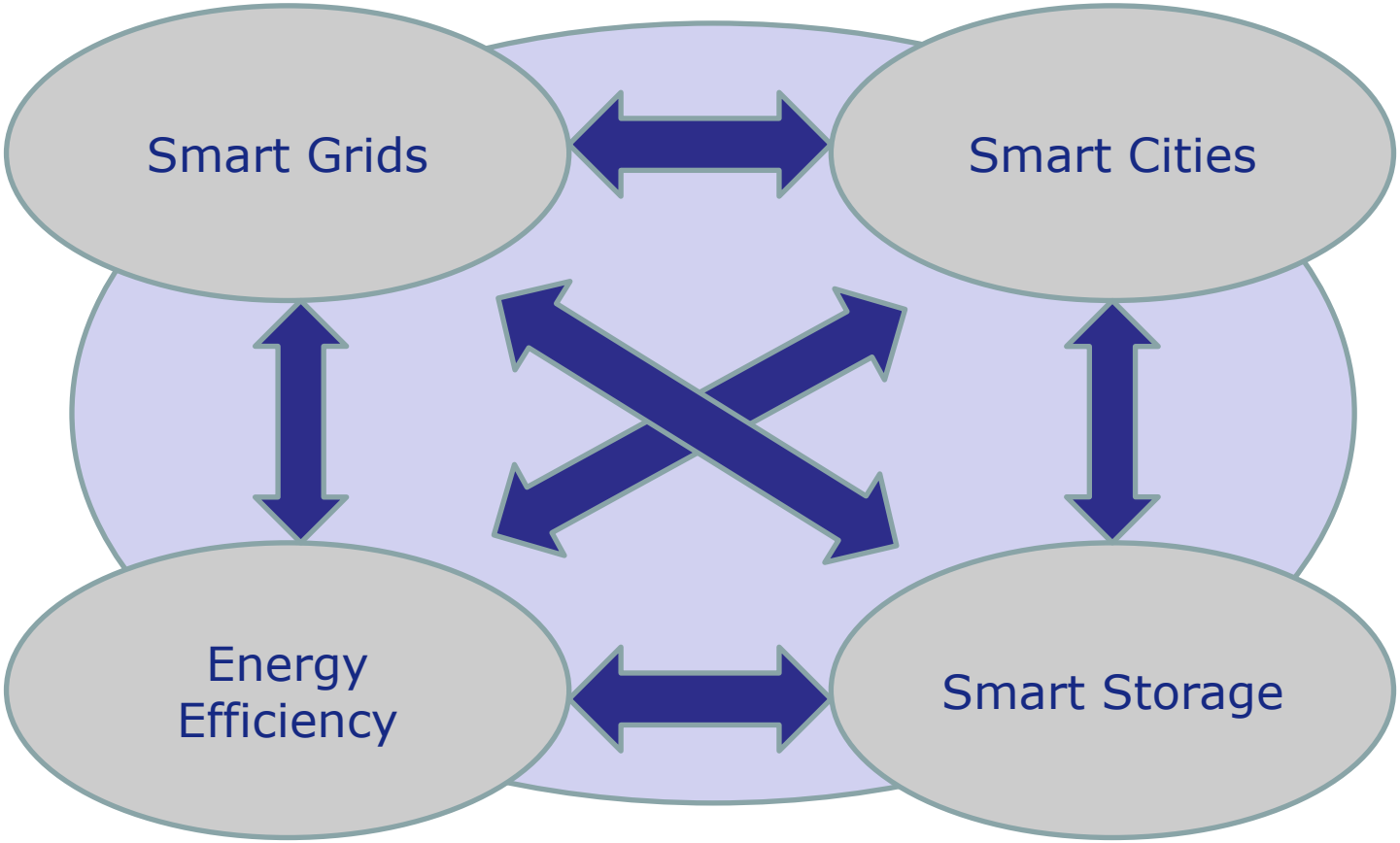
The solution is a Smart Energy System where Smart Grids is one part



Source: KIC InnoEnergy, Ilka von Dalwigk

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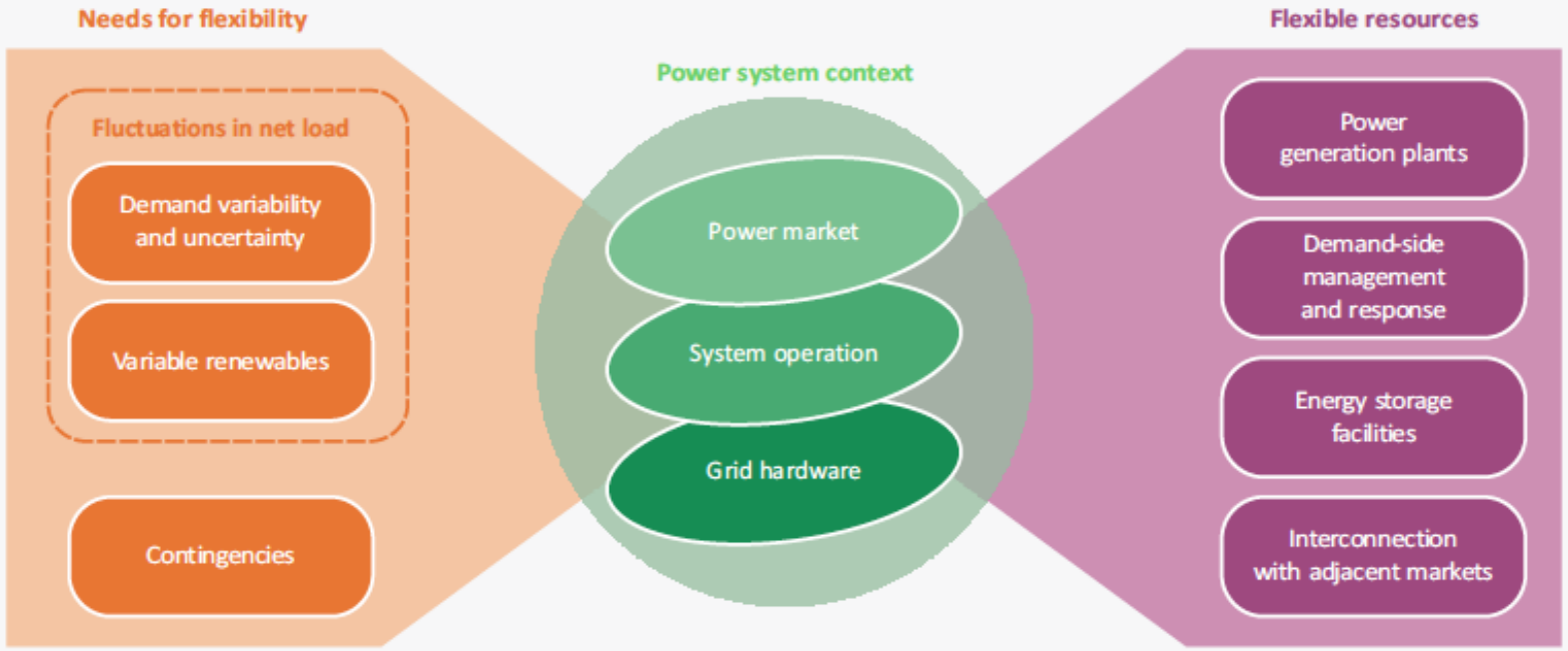
Flexible Electricity Systems

Figure 6.3 Overview of flexibility needs and resources



Source:IEA Energy Technology Perspectives 2012

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Variable generation, Demand management

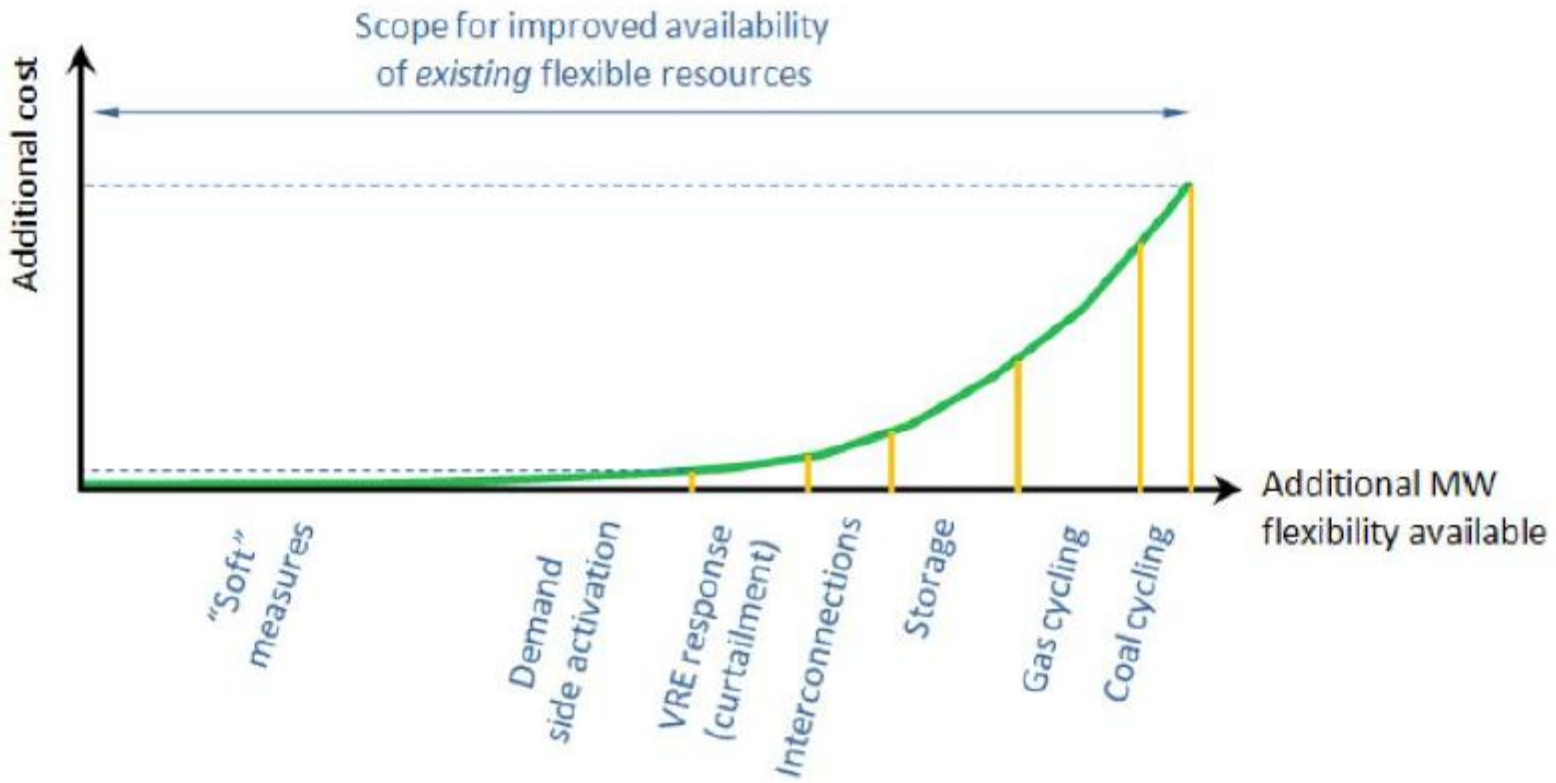

Figure 2: Illustrative "flexibility merit order" of measures to support VRR integration
Source: IEA FAST presentation to IRENA, October 6, 2011

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Storage

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Large scale hydro storage

Storage Hydro Power in Europe:

Rated Power, Storage Capacity and Annual Energy Production

Data of UCTE 1998	Rated Power of Reservoir and mixed pumped Storage [GW]	Storage Capacity of Reservoir and mixed pumped Storage [TWh]	Annual Energy Prod. of Reservoir and mixed pumped Storage [TWh]
Slovenia/Croatia	1.4	1.8	?
Swizerland	8.2	8.4	18.0
Serbia and Montenegro	2.0	2.0	?
Portugal	2.1	2.6	4.2
Austria	5.6	3.2	7.0
Luxemburg	0.0	0.0	0.0
Italy	7.5	7.9	
Greece	1.9	2.4	
France	11.6	9.8	
Germany	1.4	0.3	
Belgium	0.0	0.0	
Spain	7.7	18.4	
Sum of UCTE	**49**	**57**	
Data of NORDEL			
Norway	27.3	84.1	112.6
Finland	2.9	4.9	12.6
Sweden	16.2	33.7	63.6
Sum of NORDEL	**46**	**123**	**189**
Sum of NORDEL + UCTE	**96**	**180**	**275**

NO / FI / SE
70 % or European Storage Capacity

G. Czisch 2000

ISET

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Norway is ready to do more…

Statsminister Jens Stoltenberg flankert av sine kolleger Johanna Sigurdardottir fra Island og Andrius Kubilius fra Litauen under det nordisk baltiske statsministermøtet i London torsdag ettermiddag. Foto: MARK EARTHY / Scanpix.

Vil gjøre Norge til Europas grønne batteri

Want to do Norway to the green battery of Europe

Estimated Capacity in southern Norway (Statkraft study):

- **30.000 MW** **at 50 cm /h change of level**
- **3.200 MW** **at 1 cm / h change of level**

A matter of regulation, can be distributed over five days

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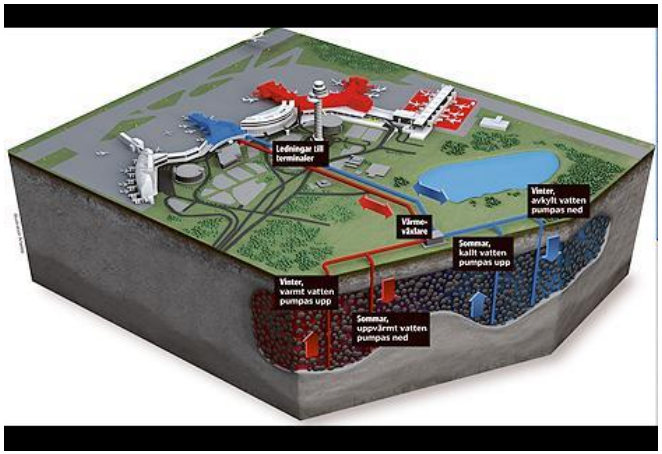
Large scale heat/cold storage

Arlanda Heat / Cold Storage Sweden



- Volume 2.000.000 cubic meter

Heat Storage, Solna Sweden

Heat storage 4300 kbm or 300.000 kWh

Heat Storage, Hvide Sand Denmark

Heat storage 2000 kbm or 130.000 kWh

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Local Energy Storage
22 kWh

250 kg water

With a heat pump electric storage can be multiplied up to five times…

250 kg Li-Ion-Battery

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Smartgrids

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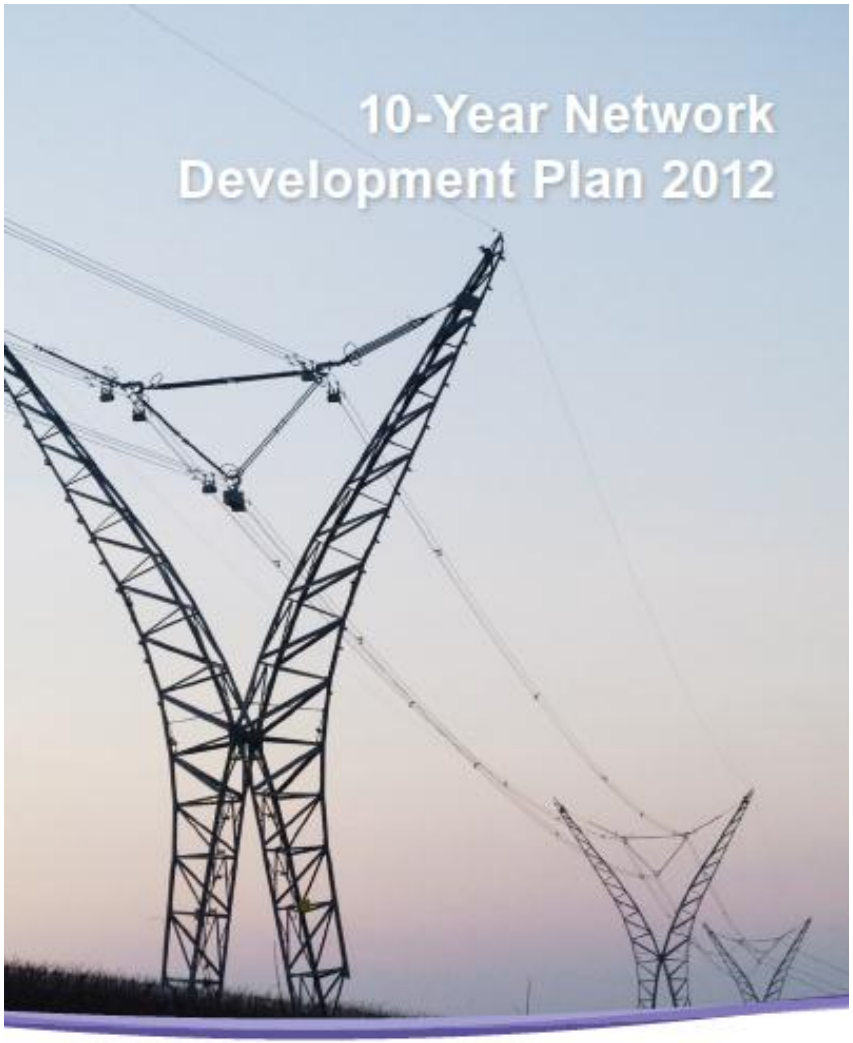
Coordinated European grid initiative



European Network of Transmission System Operators for Electricity

entsoe

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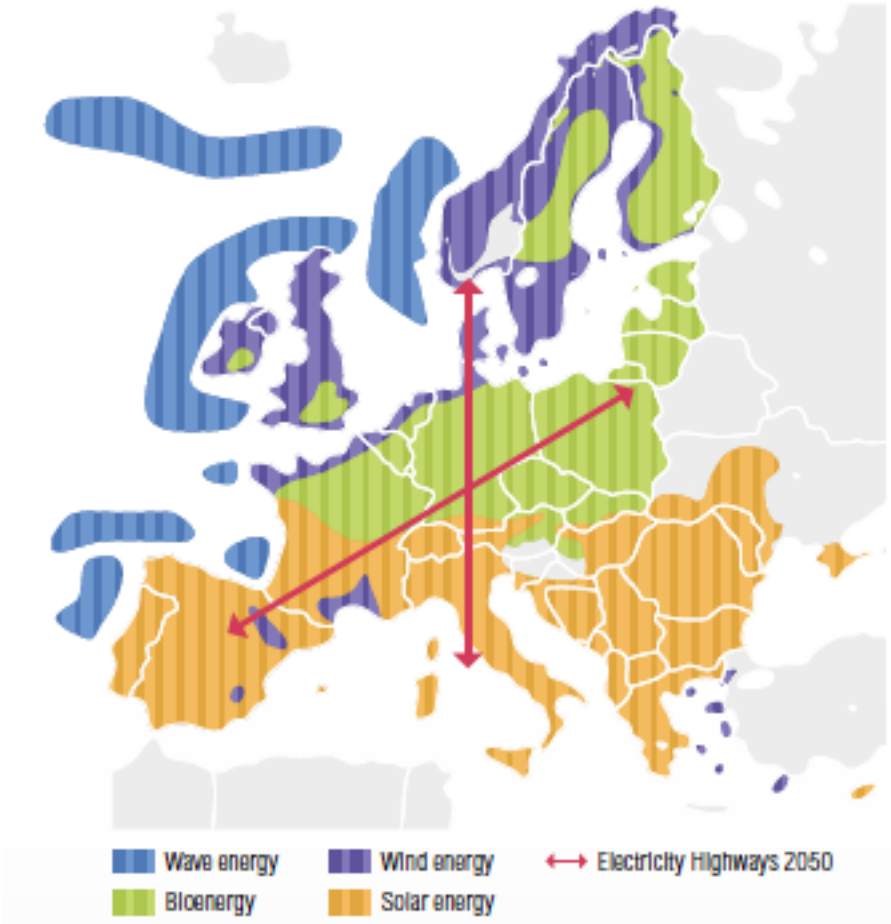
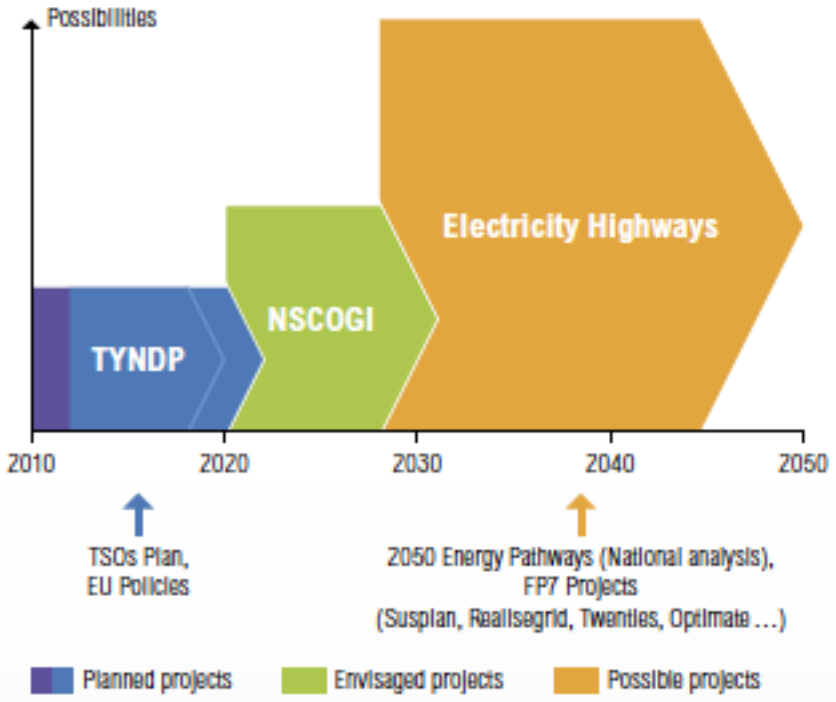
Coordinated European initiative





Source: ENTSO-e

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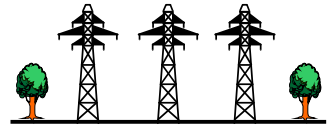
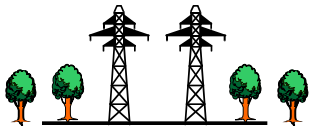
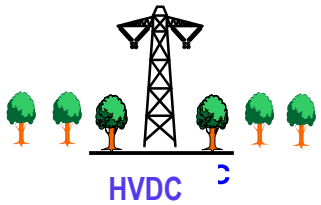
Technology options, power transmission



Conventional HVAC



HVAC with FACTS



HVDC

HVDC Light

Traditional HVAC Transmission

FACTS

⇨ 30-50 % higher capacity and increased control by FACTS (Flexible AC Transmission Systems)

VSC HVDC

⇨ 200 – 300 % higher capacity and more control by HVDC (High Voltage DC Transmission)

⇨ Superior control and underground option

Source: ABB

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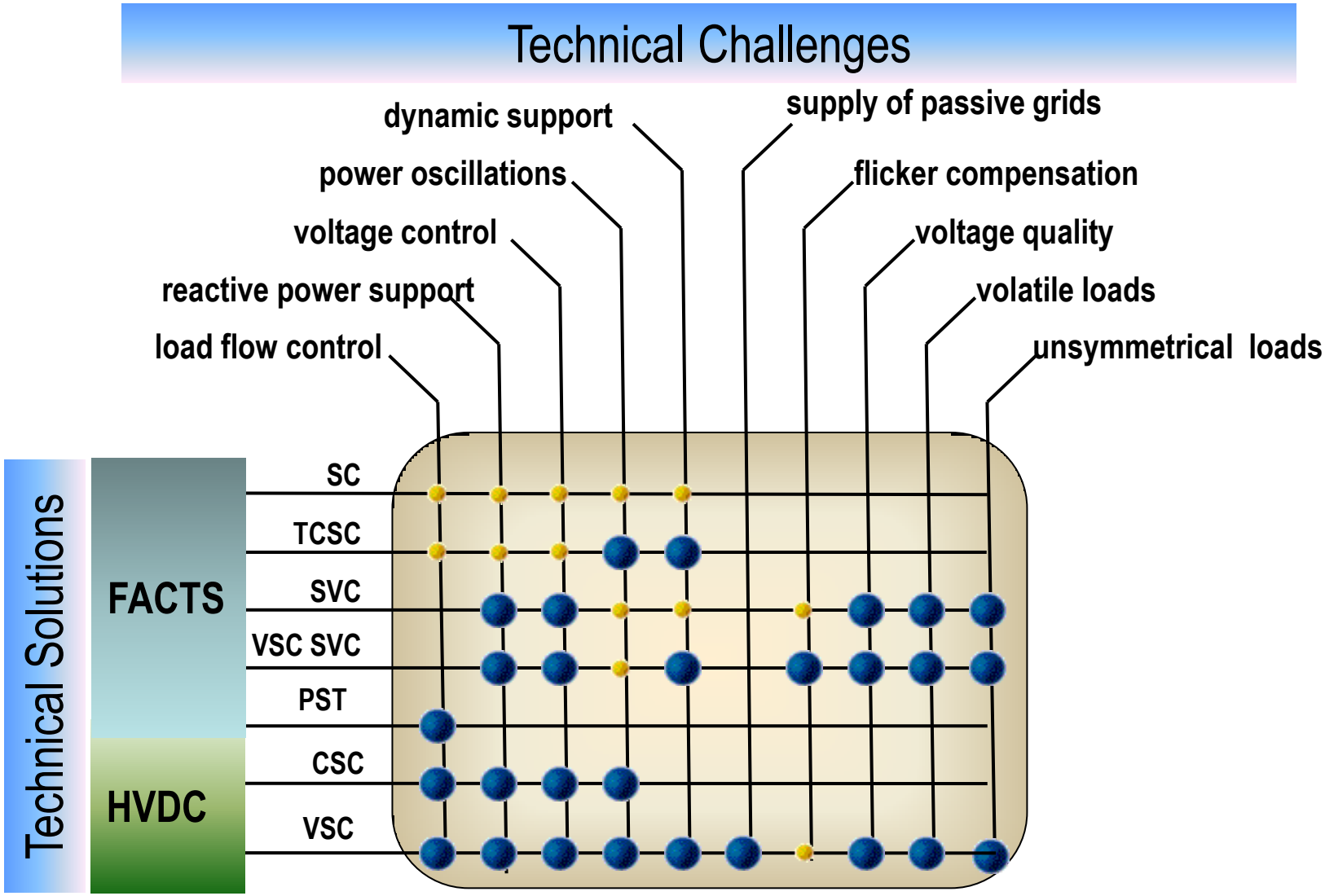
Smartgrid transmission technologies



Source: ABB

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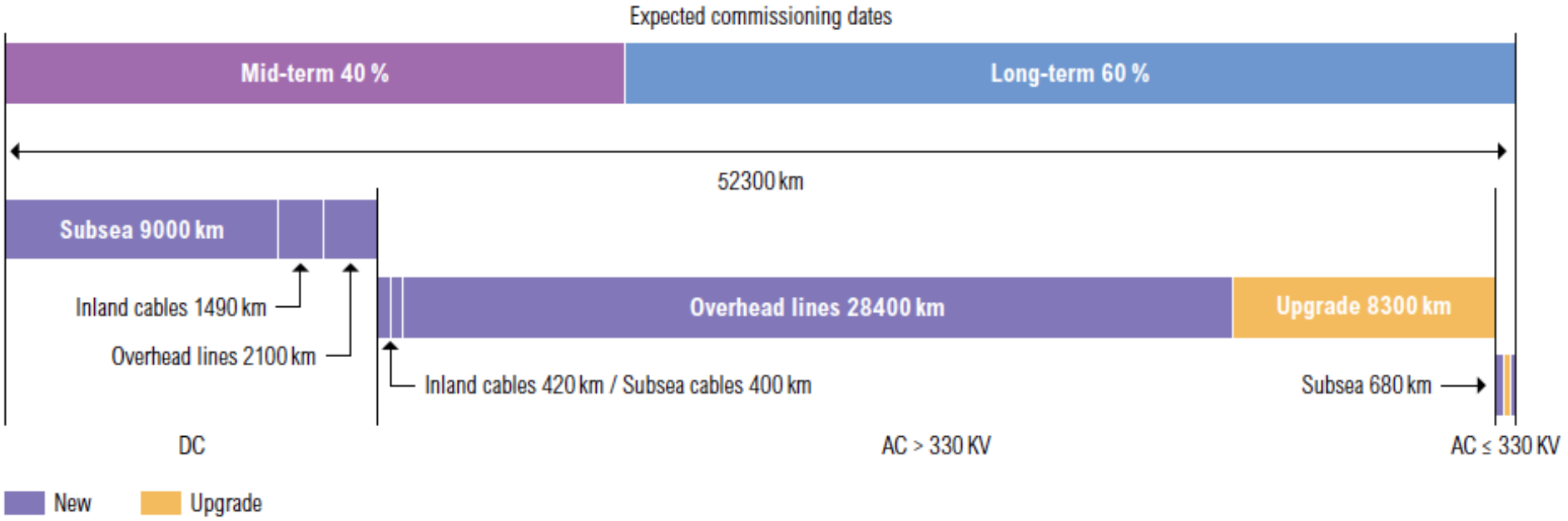
Grid expansion, technology



Source: ENTSO-e

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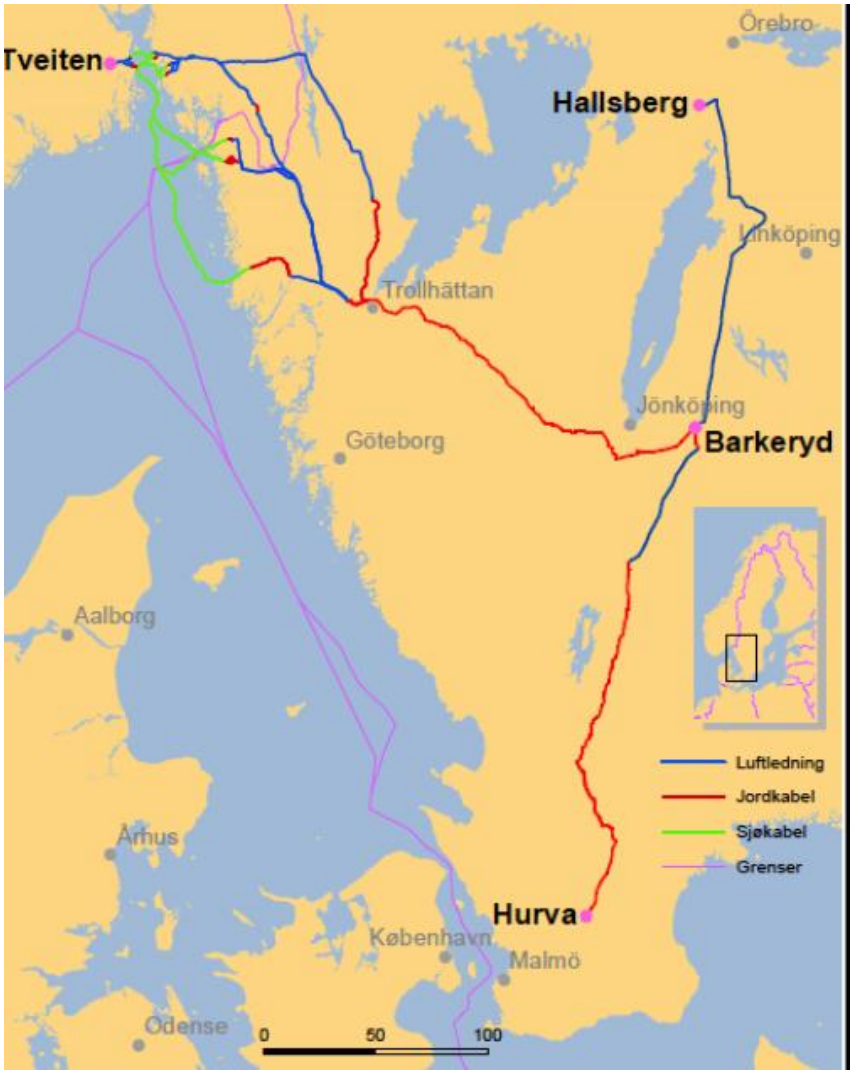
South-West Link Sweden-Norway
New transmission solution



- Technology VSC-HVDC
- 2 x 700 MW
- Combination of
  - AC OHL
  - HVDC OHL
  - HVDC UG Cable

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Randstad Netherland
New transmission solutions

- New environmentally friendly tower design

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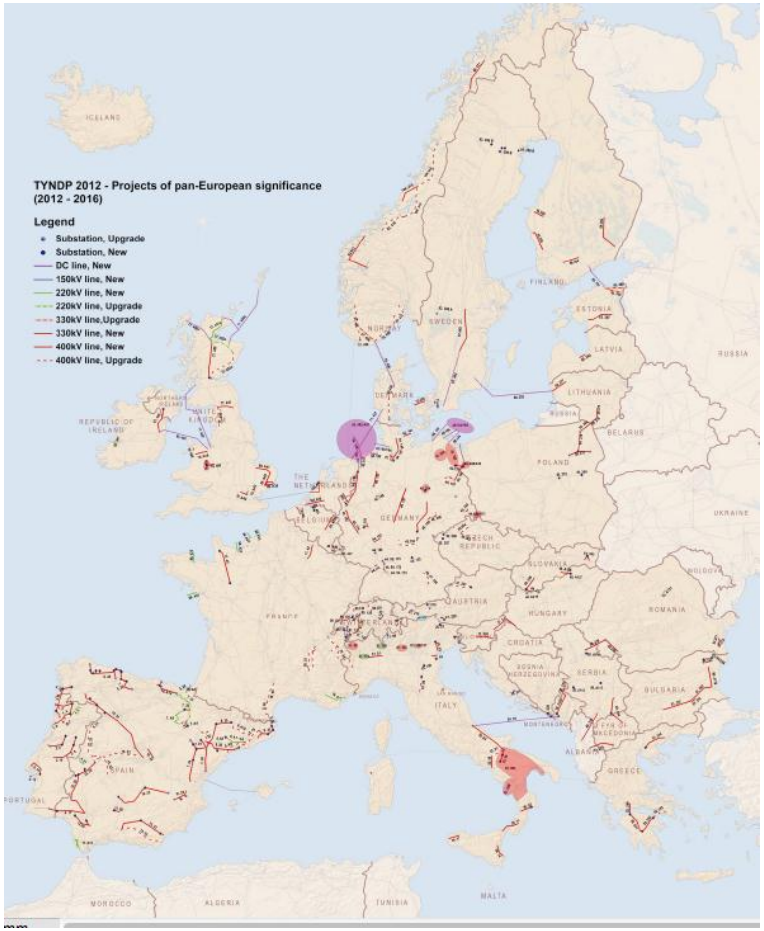
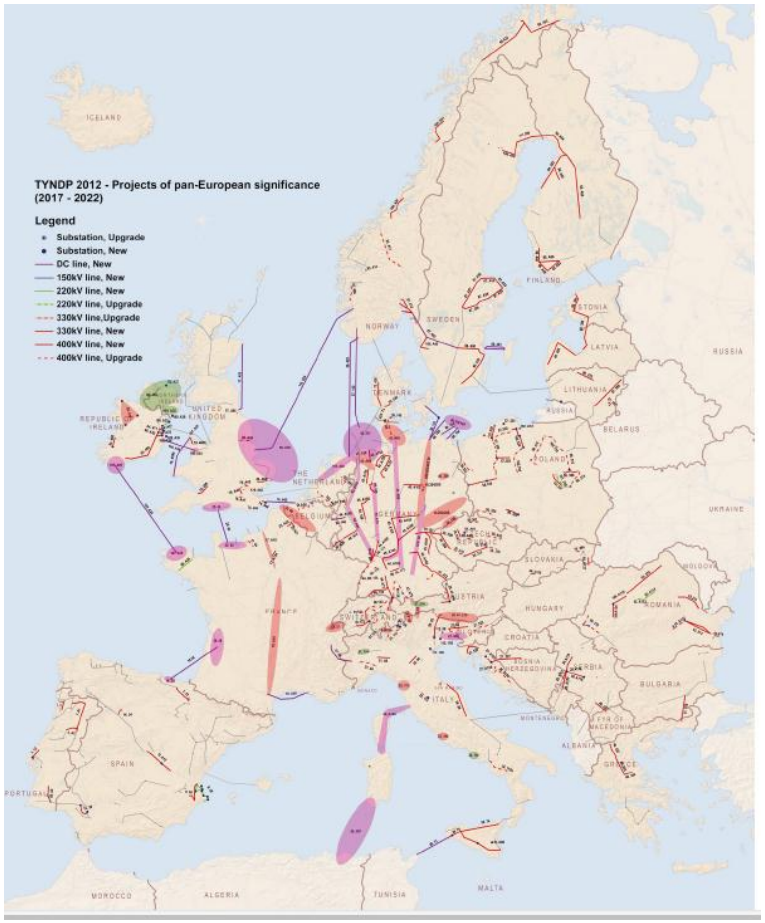
Major grid investments

2017 - 2022



2017 - 2022



Source: ENTSO-e

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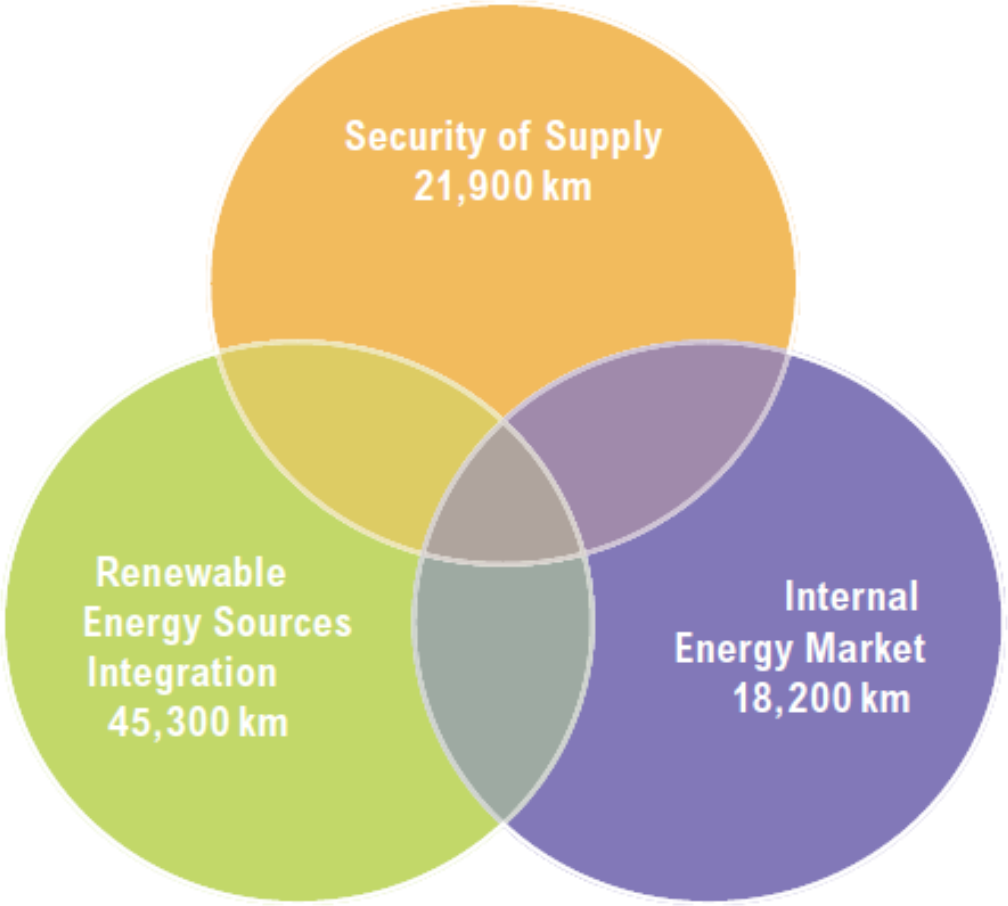
Driving forces for grid expansion, ENTSO-E



Source: ENTSO-e

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Energy Efficeincy

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Efficient TV sets

Plasma LCD LED

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“Best in Class” Fridge

- Energy Class A+++
- Energy 75 kWh/år
- Volume 355 liters
- Average Power 8 W

The Smartness is the low consumption !!

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“Best in Class”, light….

Was 120 W

Is 16 W

Rel 13%

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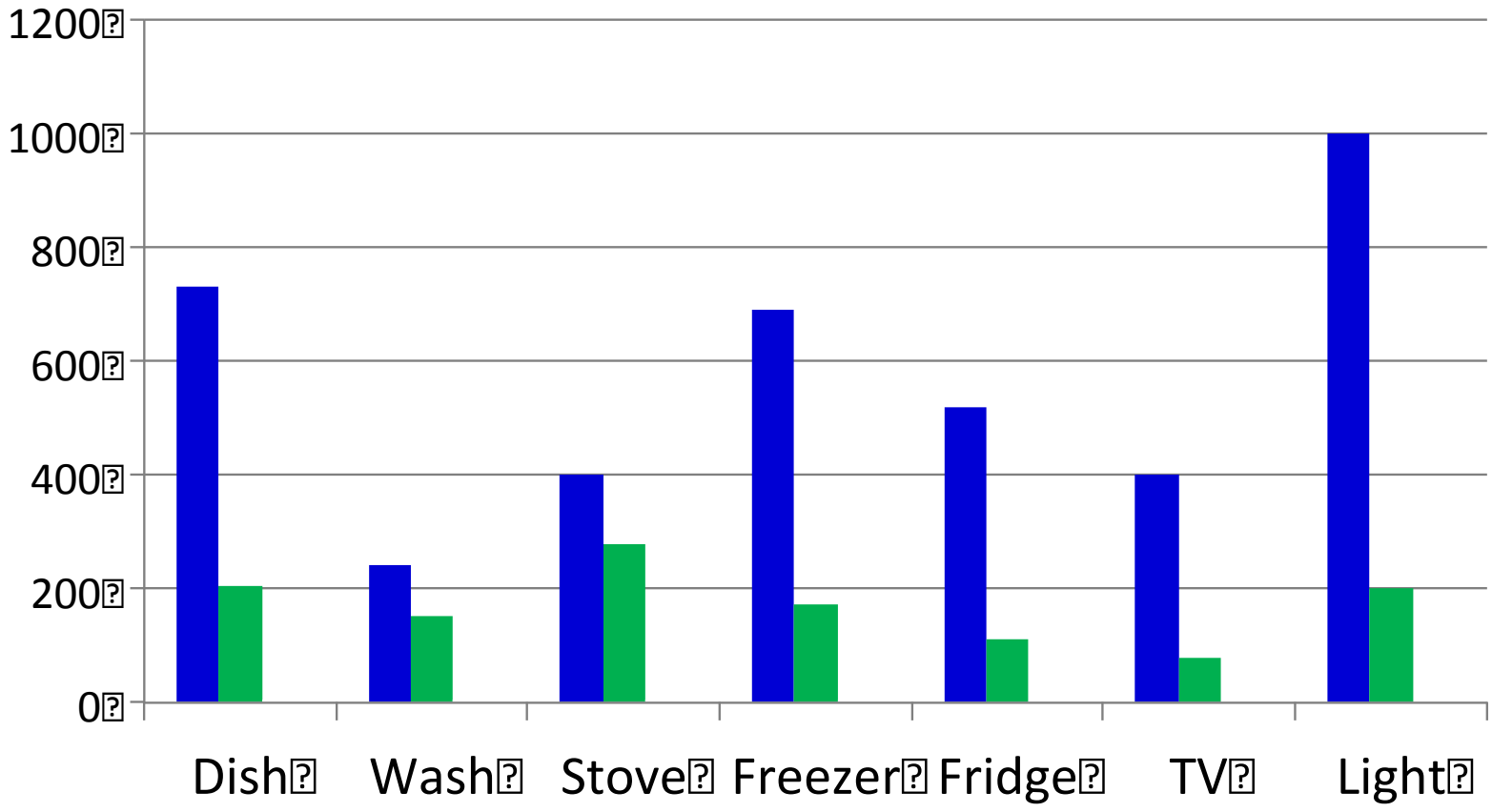
Potential Saving 2012 year technology

Before: 4000 kWh, After: 1200kWh, Saving 2800 kWh



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So what should we control ?
Demand control options Sweden

• Freezer (4 milj / 0,05-0,125 W)	200-500 MW
• Fridge (4 milj/ 0,05-0,125 kW)	200-500 MW
• Dishwasher (3 milj/ 2 kW)	6.000 MW
• Washer (3 milj/ 2 kW)	6.000 MW
• Hot Water (3 milj/ 3kW)	9.000 MW
• Heat Pumps (1,0 milj / 10 kW)	10.000 MW
• Electric Cars (1 milj / 10 kW)	10.000 MW

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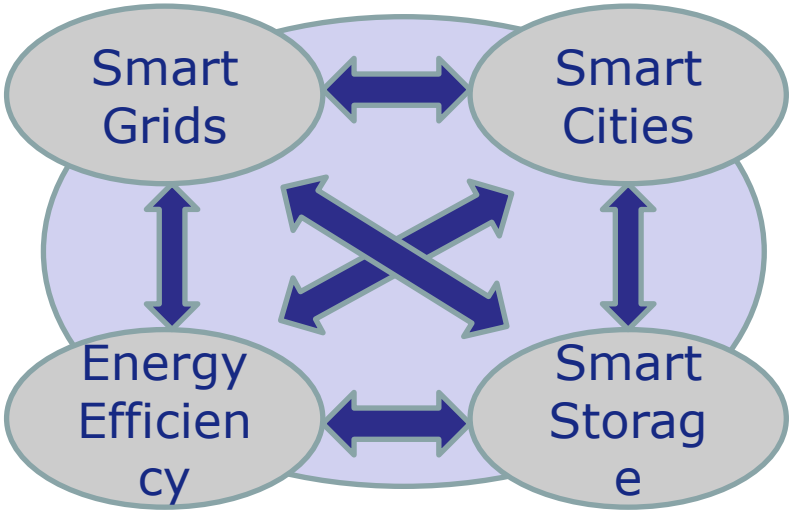
Conclusions

- European energy system under transformation
- Technical solutions are available and under development
- The solution is a system approach where Smartgrids will play a key role



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