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**sgem**

Smart Grids and Energy Markets

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# Smart Grids and Energy Markets

A Finnish perspective, ready for the next level

Jan Segerstam, Development Director, Empower IM Oy

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## **Smart Grid Platform in Finland “What’s available?”**

- Historical development
- Smart meter enabled change 2008-2014
- Products out now

## **Finnish Smart Grid Development “What’s next?”**

- Demand Response as a research vehicle
- Demand Response concept
- Future research topics from SGEM

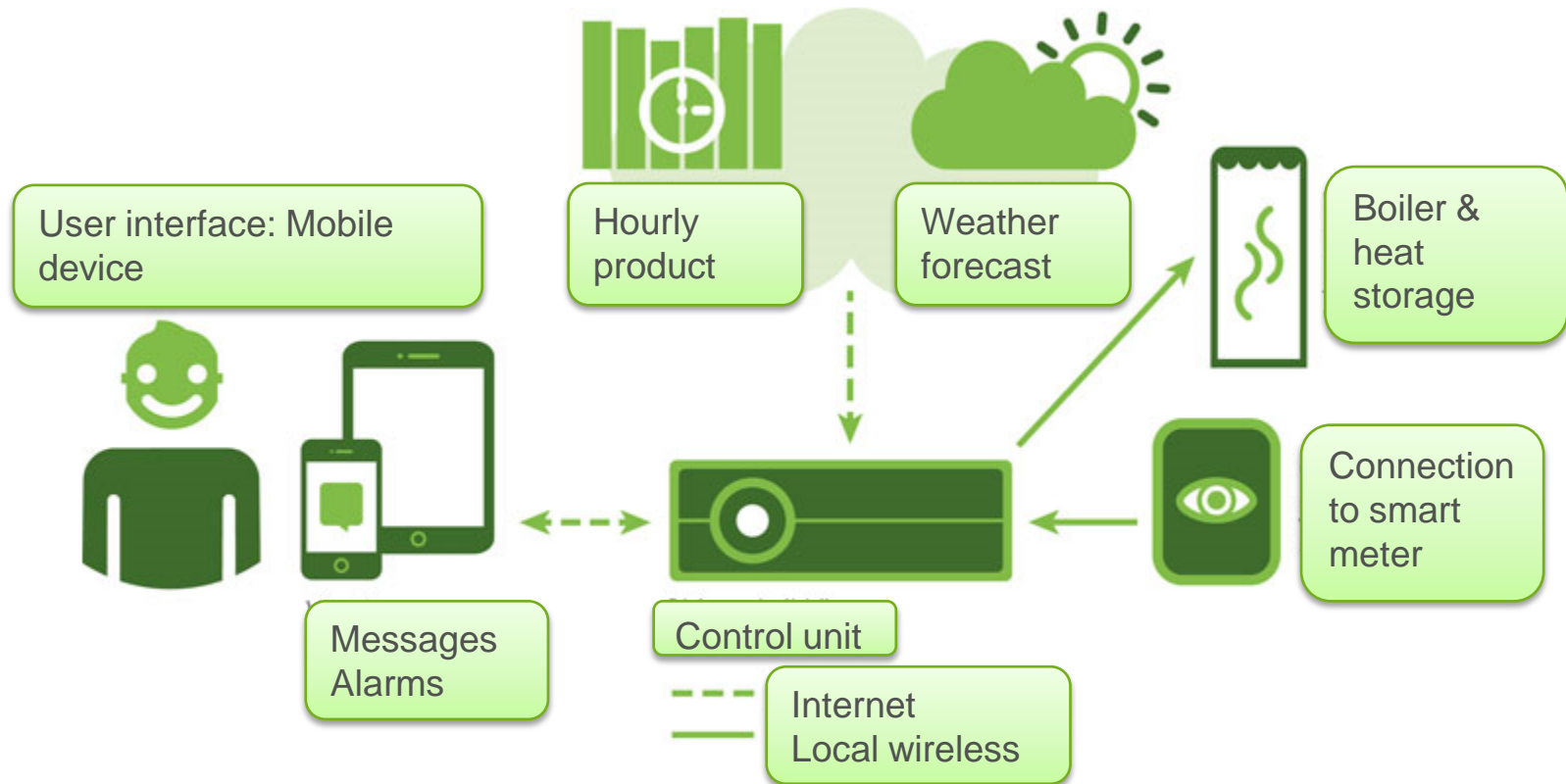
# Smart Grid & Market Development in Finland

- 1970s
  - New Generation
  - Need for load shifts to maximize plant usage
- 1980s
  - Implementation of remote controllable loads
  - CHP scaling for efficiency
- 1990s
  - New energy market rules
  - Usage of controllable loads to optimize energy market contract positions
  - Remote disconnectors
  - Retail Market Opening
- 2000s
  - Implementation of intraday commodity trading on hourly basis, continued market development
  - Legal unbundling of distribution
  - Automated Network Control
  - Automated meter infrastructure design
- 2010s
  - Automated meter roll out
  - Hourly balancing and settlement
  - Hourly customer reporting
  - Distribution Grid connected production (PV/Wind)
  - Market based Demand Response Products

# Smart Grid & Market Development 2008-2014

- New legislation (2008)
  - Measurement
  - Information Exchange
- After deadlines were set, implementation
  - Roll out plans for every company
  - Procurement of AMM solutions
  - Delivery of AMM solutions
- Market process change
  - Streamlining and certifying information exchange without major change
  - Change of balance settlement
- Minimum requirements for installation
  - Controllability
  - 3<sup>rd</sup> party information access
  - Transfer of installed remote controllable load base
- Reporting requirements set for suppliers
  - Base data to be provided by DSO
- Data access implementation by DSOs
- Completion of smart meter roll out and initial process changes by the end of 2013
- Focus shift from technology to utilization and market model development

# Smart Grid Development, products: Fortum



# Smart Grid Development, products: Helen



# Smart Grid Development: services, Empower IM

The screenshot displays the EMP Message Transmission application. The main window shows a message flow diagram with several nodes and transitions. A green callout box highlights the text: "Demand Response Load / Generation Control Service".

The diagram includes the following nodes and transitions:

- LC request -> Out** (Assort) transitions to **LC\_Ella\_to\_IEC-61968** (ExecuteGeneric).
- LC\_Ella\_to\_IEC-61968** transitions to **Send to HKE000** (SendToDirectory).
- Send to HKE000** transitions to **Archive LC request** (Archive).
- LC\_Ella\_to\_There** (SendToDirectory) transitions to **Send request** (SendEmail).
- Send request** transitions to **Archive LC request**.
- LC response -> In** (Assort) transitions to **LC\_IEC-61968\_to\_Ella** (ExecuteGeneric).
- LC\_IEC-61968\_to\_Ella** transitions to **LC\_There\_to\_Ella** (ExecuteGeneric).
- LC\_There\_to\_Ella** transitions to **LC response -> EDM** (SendToDirectory).
- LC response -> EDM** transitions to **Archive LC response** (Archive).

The Log window on the right shows a table of message events:

Status	Start Time	End Time	Error Message
Older than 1 day 29 messages			
OK	9/18/2012 2:10:12 PM	9/18/2012 2:10:12 PM	
OK	9/18/2012 8:48:20 AM	9/18/2012 8:48:21 AM	
OK	9/18/2012 7:47:22 AM	9/18/2012 7:47:23 AM	
OK	9/7/2012 7:40:55 AM	9/7/2012 7:40:56 AM	
OK	9/6/2012 2:41:29 PM	9/6/2012 2:41:29 PM	
OK	9/6/2012 12:30:06 PM	9/6/2012 12:30:06 PM	

The Message Path window shows the following details:

Process Name	Status	Start Time	End Time
EDM LC request -> Out	OK	9/18/2012 2:10:11 PM	9/18/2012 2:10:11 PM
LC_Ella_to_IEC-61968	OK	9/18/2012 2:10:12 PM	9/18/2012 2:10:12 PM
Send BIS/HKE000	OK	9/18/2012 2:10:12 PM	9/18/2012 2:10:12 PM
Archive LC request	OK	9/18/2012 2:10:12 PM	9/18/2012 2:10:12 PM

The Properties window shows Log Details for the selected message:

- Status: OK
- Error Message:
- Input Path: E:\MsgTransmit\internal\IN\_580
- Process Name: LC\_Ella\_to\_IEC-61968
- Process Type: EMPTY
- Detail**
  - Begin time: 9/18/2012 2:10:12 PM
  - End time: 9/18/2012 2:10:12 PM
  - TimeCategory: Older than 1 day
- File**
  - Message Size: 4207
  - Original name: OSM\_HKE000\_LOADCTRL1002572713.xml
  - Start time: 9/18/2012 2:10:11 PM
- Process execution parameters**

Key	Value
id	4e2dbe10-3a55-4caa-a550-8f578d314dc1
loadcontrolmessageid	1ad48123-a246-4916-a203-3be9739240f1
loadcontrolorganization	HKE000
loadcontroluserid	OSM
msgreceiver	HKE000
msgsender	OSM
msgsize	4207

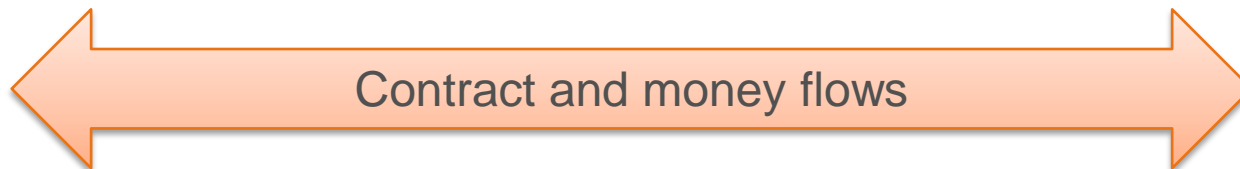
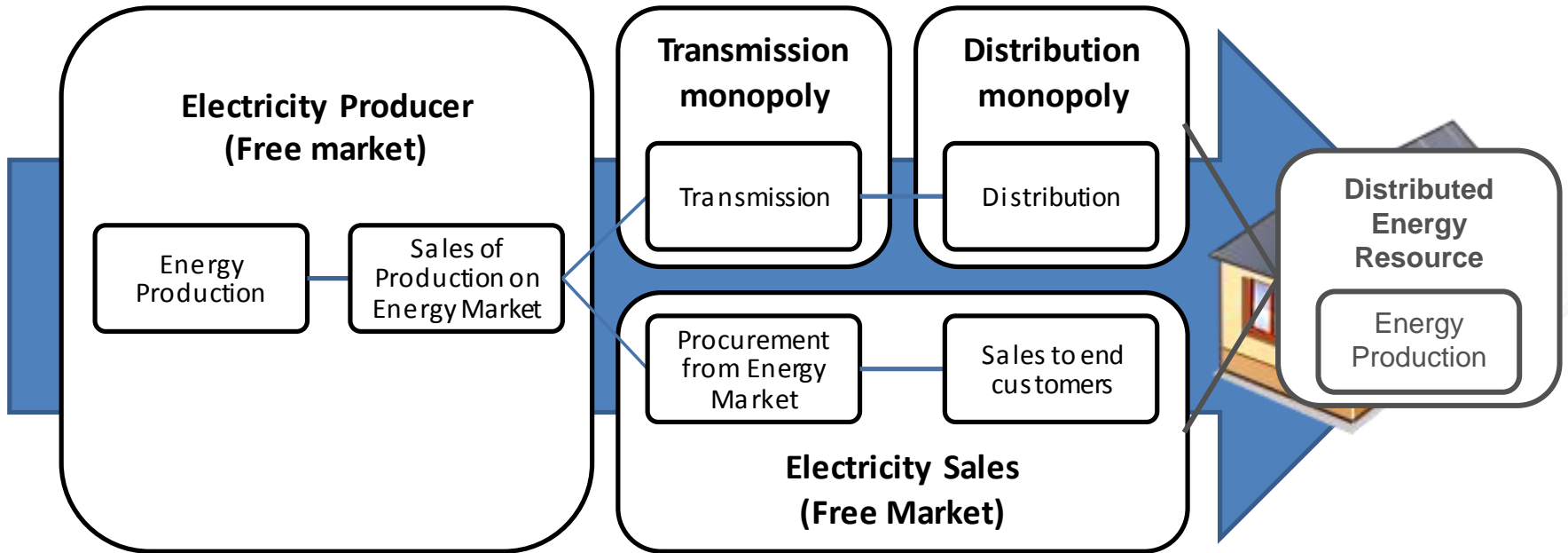


# Demand Response

- Holistic concept embracing change
  - Includes distributed generation processes
  - Includes dynamic market trading models
  - Includes smart technology enablers
  - Includes smart metering leverage
- Research context that enables iterative learning
  - Connects directly to end customer behaviour
  - Multiple players
  - Technology interfaces
  - Market process challenges
  - Regulation incentive evaluation

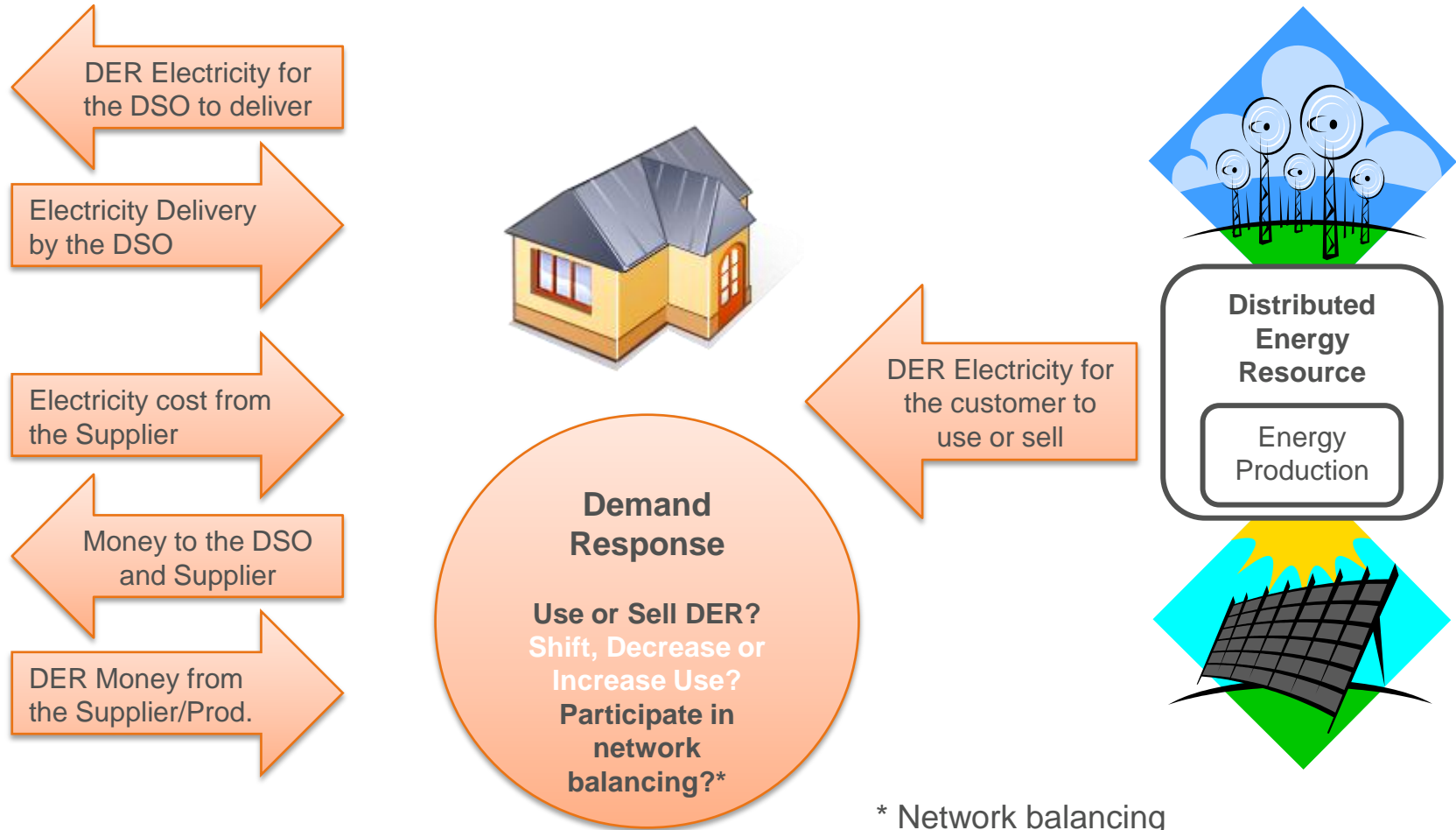


# The Retail Energy Market with DER



DER = Distributed Energy Resources

# Demand Response in the Retail Energy Market



**DER = Distributed Energy Resources**

\* Network balancing flows left out for clarity

# Major Driving Trends for Demand Response

## Demand by Production

Production must equal demand at all times

Marginal cost of renewable production is zero

Limiting production brings no fuel savings

Demand Response maximizes production

## From direct sums to aggregates

Market Processes based on dissecting total volumes

Smart Grids enable building processes on information of discrete site measurements

Availability of site specific information enables

# Future Research Agenda from SGEM

- Marketwide ICT and process architecture enabling “smart customer functions”
- Enabling Distributed Generation impact on market price and on management of power balance
- Enabling optimal use of active resources in demand response, energy optimization across resources
- Tools to introduce significant portion of customers to use a demand response service and home energy management systems
- Achieving European level electricity market structures and interoperability

