The Energy transition meets the Digital transformation: The Perfect Storm

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- Challenges for the system operators
- The EU action plan on digitalization of the Energy System
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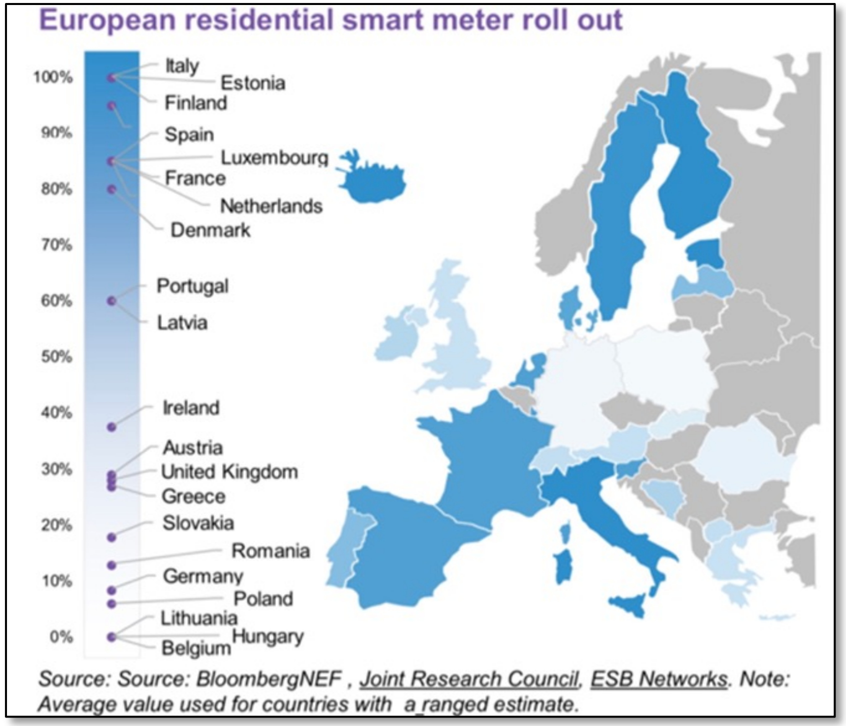
- The Digital transformation:
  - Smart metering
  - Flexibility
  - Data exchange
  - Local Energy sharing

The context of the Energy Sector



The energy transition accelerates

The Russian-Ukrain conflict drives acceleration of the Energy transition (RePowerEU):

Accelerating electrification and decentralisation

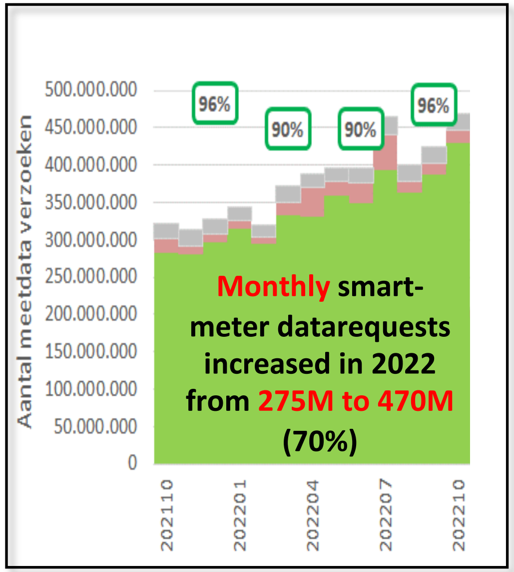
- Decentralized electricity generation (PV and Wind)
- Heat (full electric/ hybrid heat pumps)
- Transport (EV charging)

Smart appliances becoming part of the system

- Interoperability urgently needed

Data from the edge:

- Exploding volume, from appliances and smart (sub)meters
- Emerging real time data needs



Building an urgent case for change: **How to deal with massive relevant grid edge data ?**
How does this impact existing smart meter roll outs ?

Challenges System Operators in NL

- Shortage of grid capacity (due to misalignment between national subsidy schemes and grid expansion programmes)

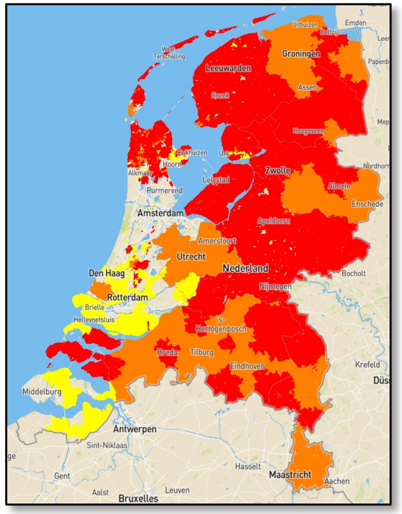
- Transforming energy infrastructures:
- From E (20%) / G(80%) → E(50%) / H2&H(50%)

- DER integration in LV grids, originally not designed & engineered for bi directional energy flows, create PQ issues

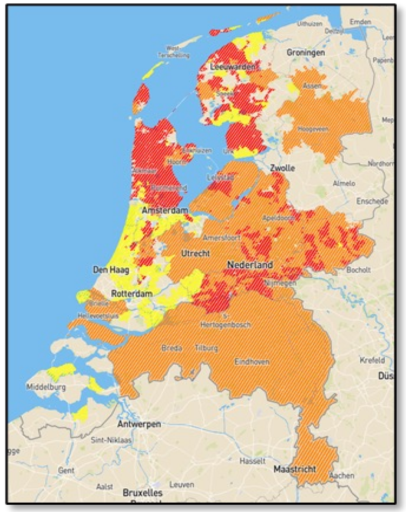
- Low voltage grid LV with a low level of digitalization

- Lacking adequate Day Ahead load forecasting and predictive loadflow analysis capabilities on all DSO grid levels

- Lack of grid capacity 37% (cables, transformers, space)
- Lack of capital (>100 Billion euro CAPEX up to 2050)
- Lack of technical staff (17.500 fte)
- Lack of time….



Production



Consumption

The EU actionplan of digitalisation of the Energy System

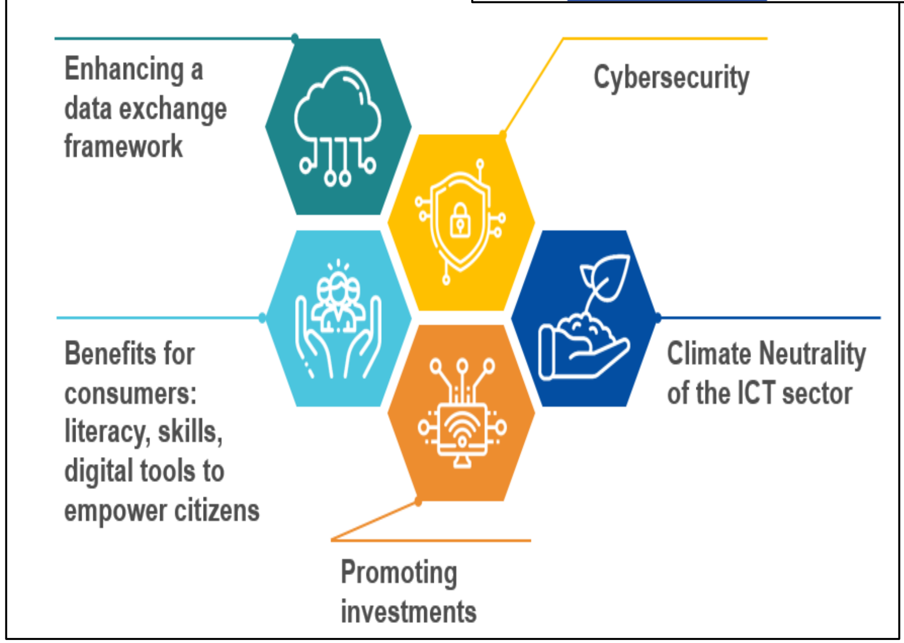
Published 18-10-2022

- European and National legislation addressing digitalisation of the Energy System directly

- De European themes:
  1. Data exchange
  2. Empowering citizens
  3. Investments in smart grids
  4. Cyber security
  5. Climate neutrality of the ICT sector

- Strongly enabling the on 14-3-2023 published EU proposals on the Electricity Market Design (EMD)

European Commission



General insights & learnings

Effectiveness = Quality X Acceptance

New connections are needed

"The Energy System of the future will not be built on the silo's of the past"

"Technology, markets and regulation are strongly intertwined. We will be only successful if their vision & strategies are consistently aligned"

"Systems will only work together, if the people who built them do"

Access to Energy is a basic human right

"The market works for society and its citizens, and not they other way around"

Focus on transition strategies & change management (HR) is needed

"Living in the world of A (today) we will only arrive in the world of B (tomorrow) if we apply the principles of the world of B"

"The creation of the world of B next to the world of A, is a more effective route then trying to modify the world of A"

General insights & learnings on digitalization

Business IT integration

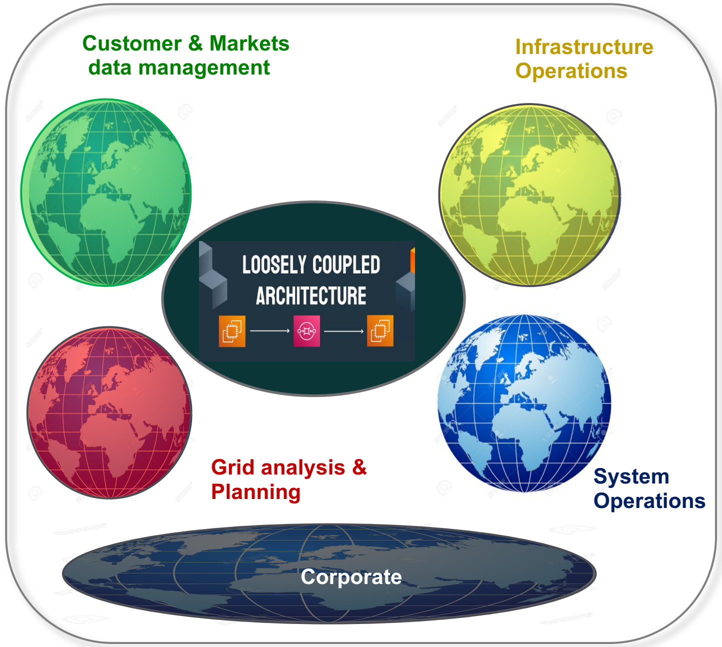
"Transforming a business ecosystem into a <u>digital</u> business ecosystem requires the adoption of an outside-in mindset and integration of the IT function in the business"

Data exchange is a Business transaction

" Exchange of data is more then defining a data format & protocol. In the <u>digital</u> business ecosystem it is a business transaction, defined by business, legal, technical and operational parameters"

Business agility through a loosely coupled IT architecture

" The speed and direction of change of the 4 core functions of a DSO (planning, infra-operations, system-operations, market facilitation) differ, which requires a loosely coupled IT architecture, to accommodate business agility in the business <u>digital</u> ecosystem"



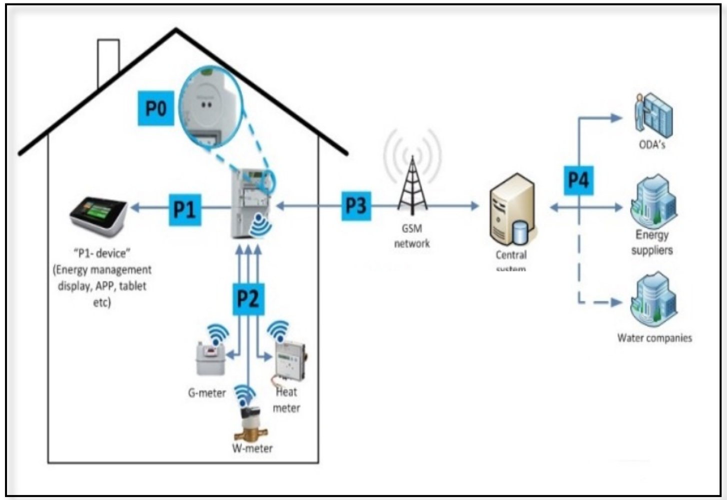
Smart metering: insights & learnings

Definition of a smart meter
" a real smart meter is more then a dumb meter with software in it. It is a smart component (sensor & computing platform) in the business digital ecosystem"

Rolling out smart meters =/= Operating smart meters
"a data collection performance of 99% still equals 84.000 meters in failure (installed base = 8.4 Mio smart meters, = 90%)

Privacy
"Smart meter data reflects personal behaviours. This requires data handing which respects privacy (GDPR).To earn trust from citizens this should be safeguarded in an independent way"

Decentralizing data processing
"To accommodate processes using massive data, originating at the grid edge", data processing is also needed in the edge (IoT edge computing),.



Smart metering in the Netherlands

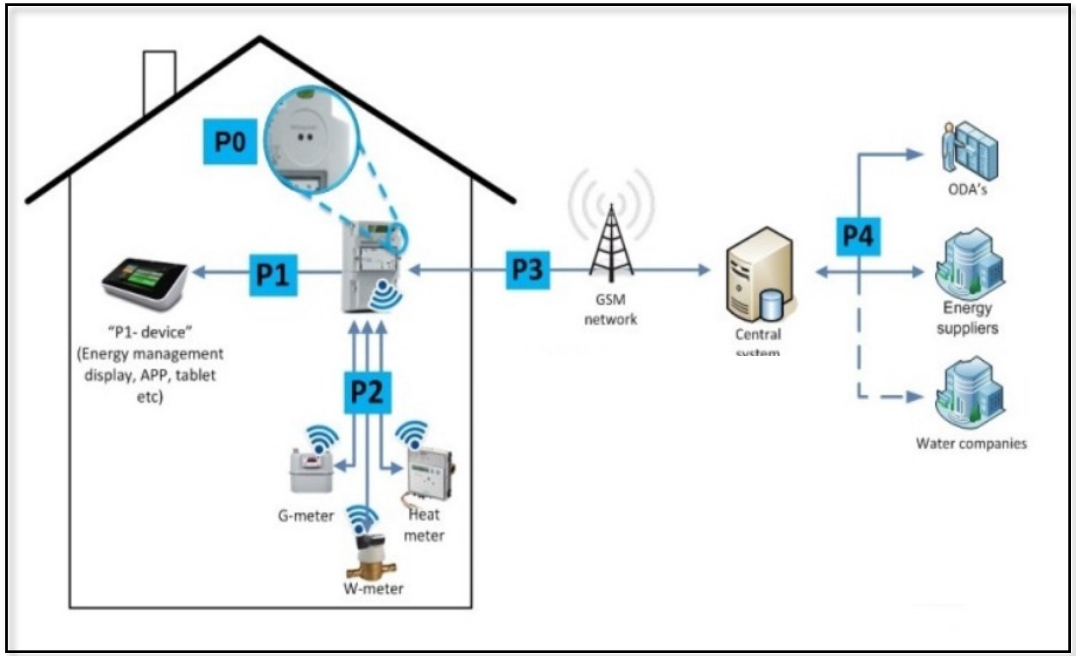
Roll out

- 8,4 Mio Residential connections
- Roll out period: 2015-2020
- Clear customer communication (customer journey)
- Smart Meter installed end 2021: 7,48 Mio (89%)
- 2% of the smart meters not accessible:
  - 0,9% technical issue
  - 1,1 % automatically reading switched off
- Evolving generation meters: 1.x(2012) – 5.x(2017)

Smart meter operations

- Monthly performance (sept. 2022):
  - *Completeness daily values:* *99,3%*
  - *First Time Right:* *98%*
  - *Timely data delivery:* *96,1% (n=97%)*

- **Monthly data requests increase 2022:** **275M -> 470M (70%)**



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Example: LV grid management & system operations

- Smart meter data for LV grid managing and planning and system operations purposes is needed.

- In 2022 the DUTCH Data Protection Authority approved DSOs code of conduct on privacy on EU GDPR compliancy

<u>Future</u>

- Access to all relevant grid edge data (smart inverters, CHP's, EV CP's): only on a legal basis or customer consent

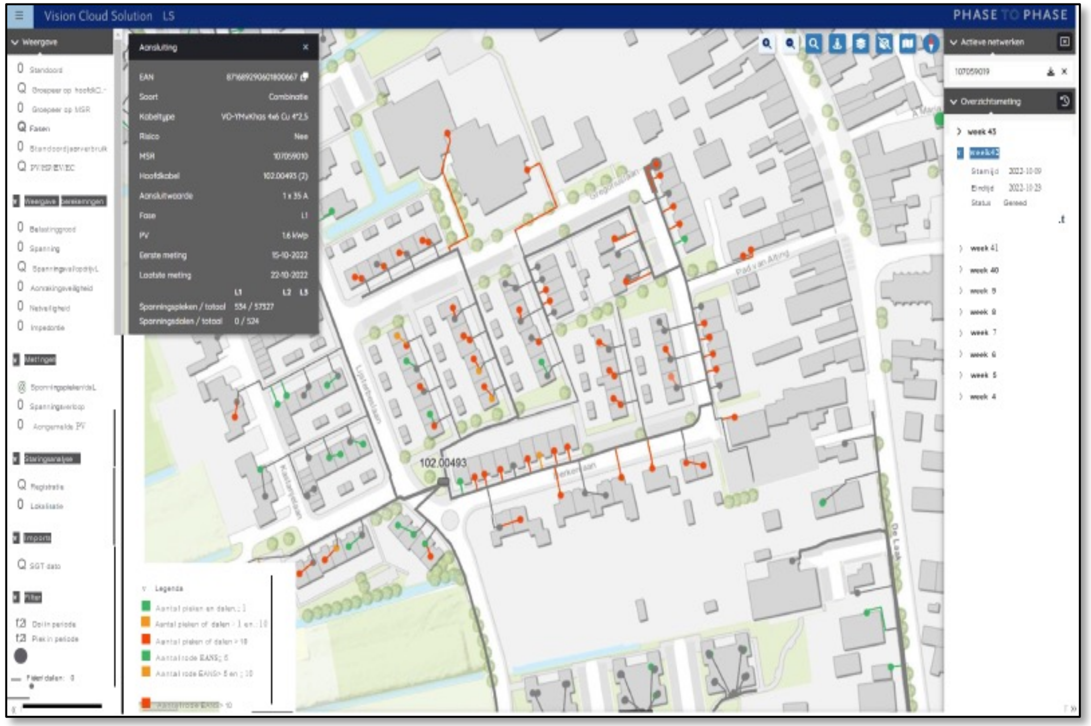
- Creating a roadmap NEXTGEN smart meter towards an IOT grid edge computing architecture

USE CASES

- 2021 Voltage level monitoring at LV customers V1
- 2022-1 PQ monitoring at LV grid
- 2022-2 Fault detection and lokalisation
- 2022-10 Extreme usage
- 2022-3 Customer compensation after outage
- 2022-7 Grid Capacity planning
- 2022-8 Reducing grid losses
- 2022-9 Congestion management icm 2022-7
- 2022-11 PV panels
- 2022-12 EV charging
- 2022-14 Voltage level monitoring at LV customers V2 icm 2022-1
- 2022-4 Capacity gas grid

Example: LV grid management using smart meter data

Use Case: Monitoring voltage levels at all grid connection points



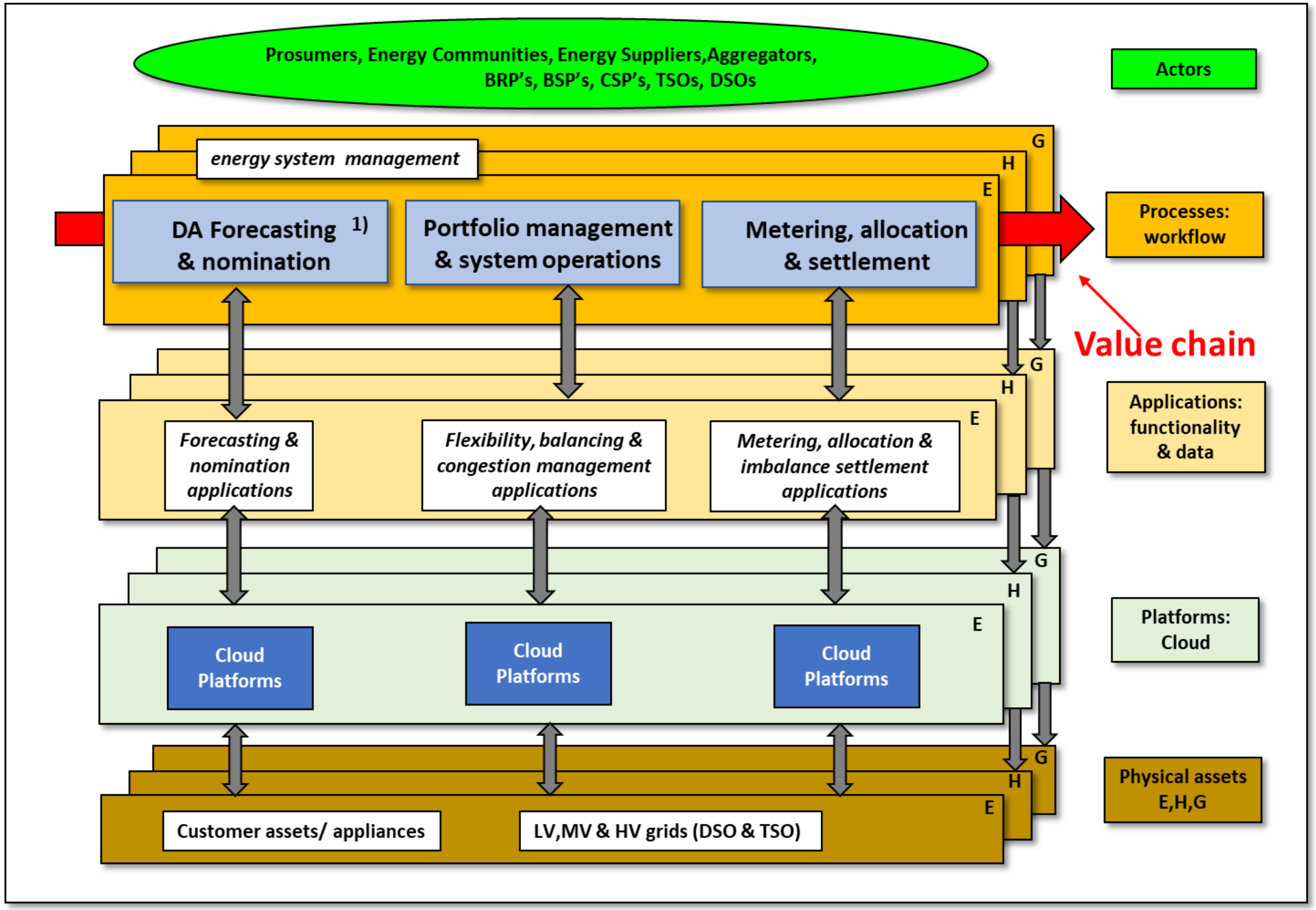
Some characteristics of operating the Energy System in the past

Traditional mindset
- Centralized energy generation
- Centralized data processing
- Unidirectional Energy flows
- Strong asset focus

No integration focus
- on E,H and G energy carriers

Digital fragmented
- no optimization over the value chain
- No architectural framework

Low level of digitalisation
- LV grids monitoring & control
- DSO system operations



1) Forecasting: Energy & transport prognoses

Some characteristics of operating the Energy System in the future

E,H,G Integrated

- Via minimum Interoperability mechanisms (MIMS)

Data processing also decentralized

- Federated open architecture
- Edge - Cloud
- Edge – Edge

Open standard API's:

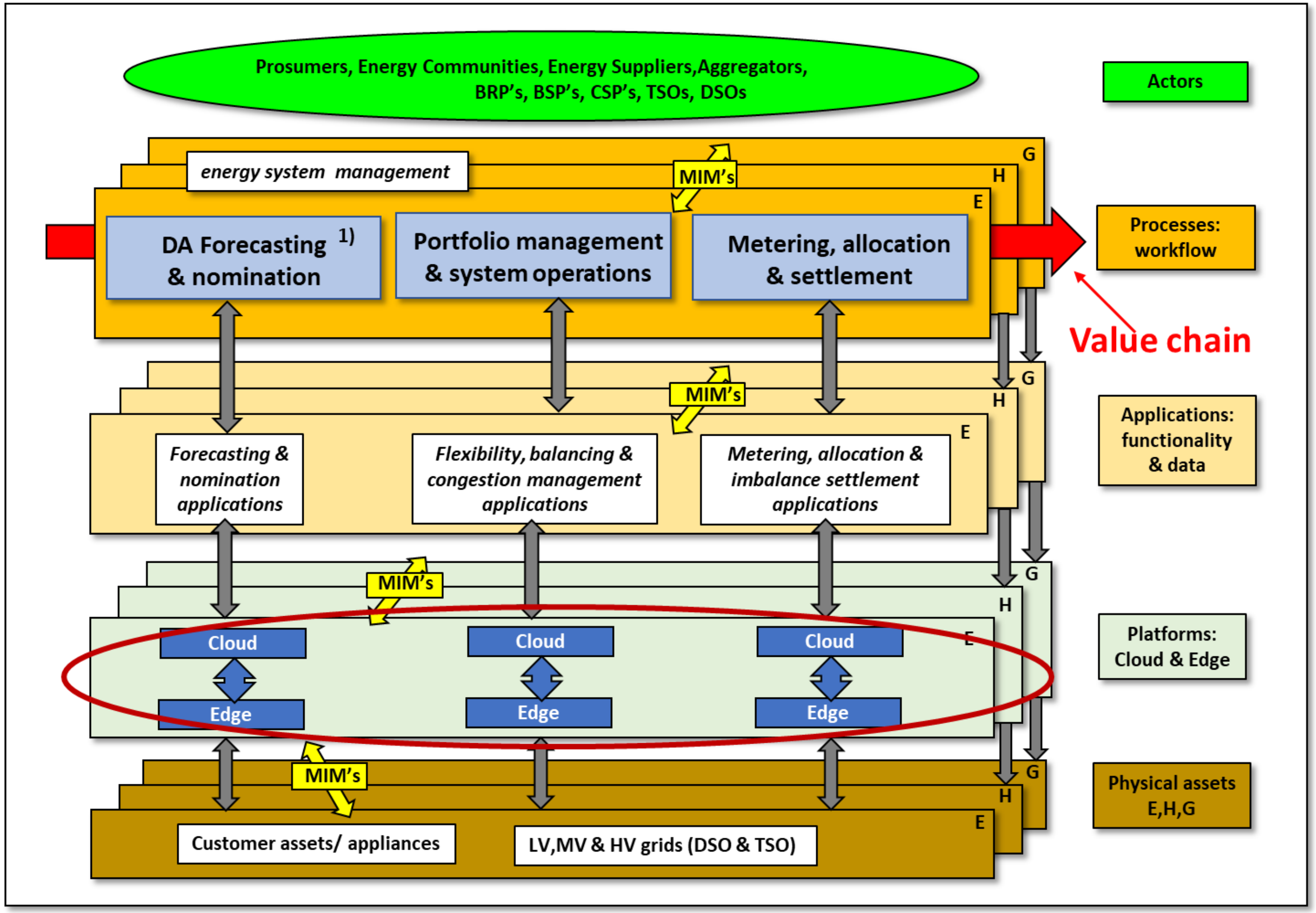
- Enabling transformation of the value chain

Focus on data for also:

- Grid Resiliency
- Privacy (GDPR)

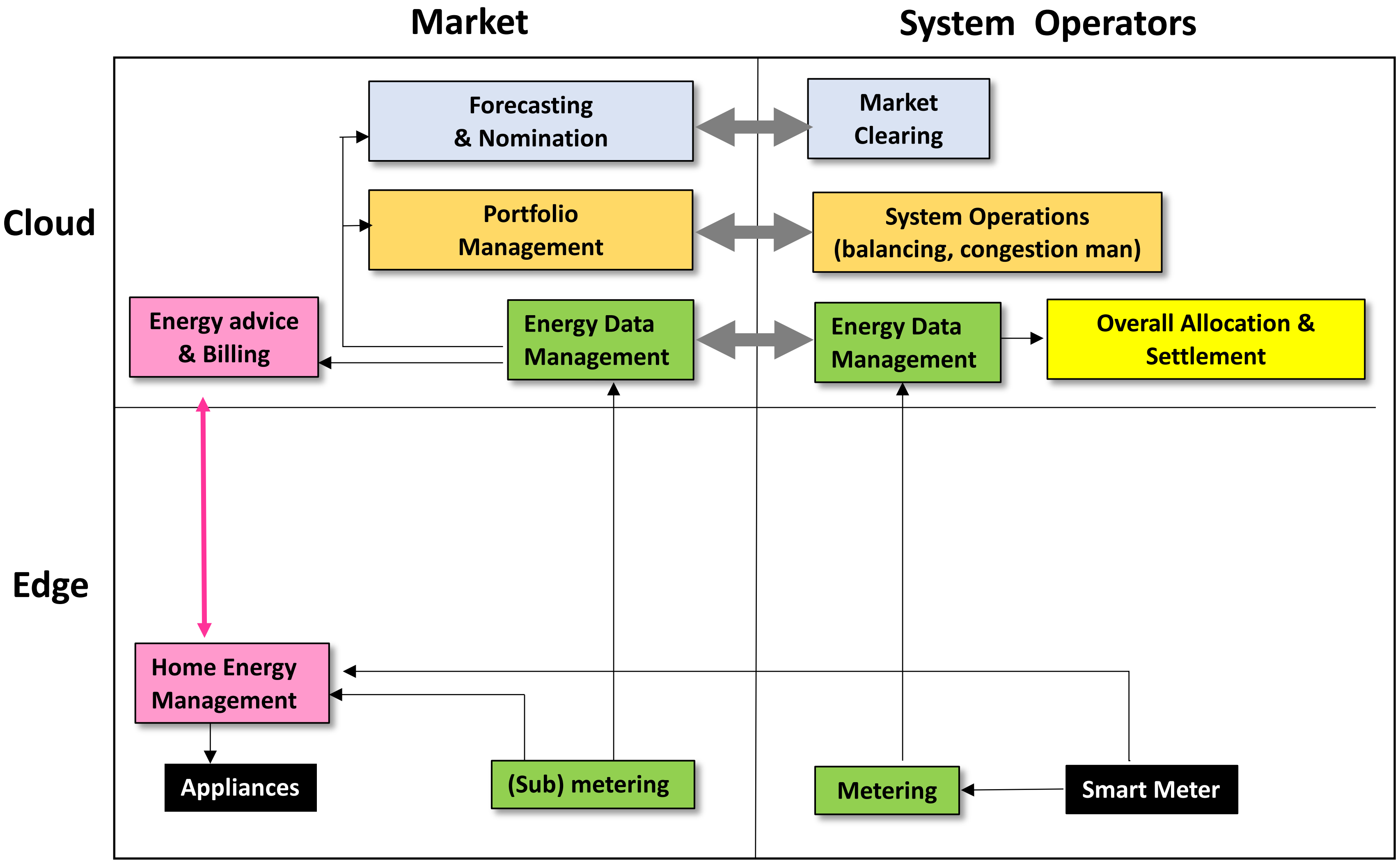
Clear benefits for:

- Consumers
- All market actors
- System operators



1) Forecasting: Energy & transport prognoses

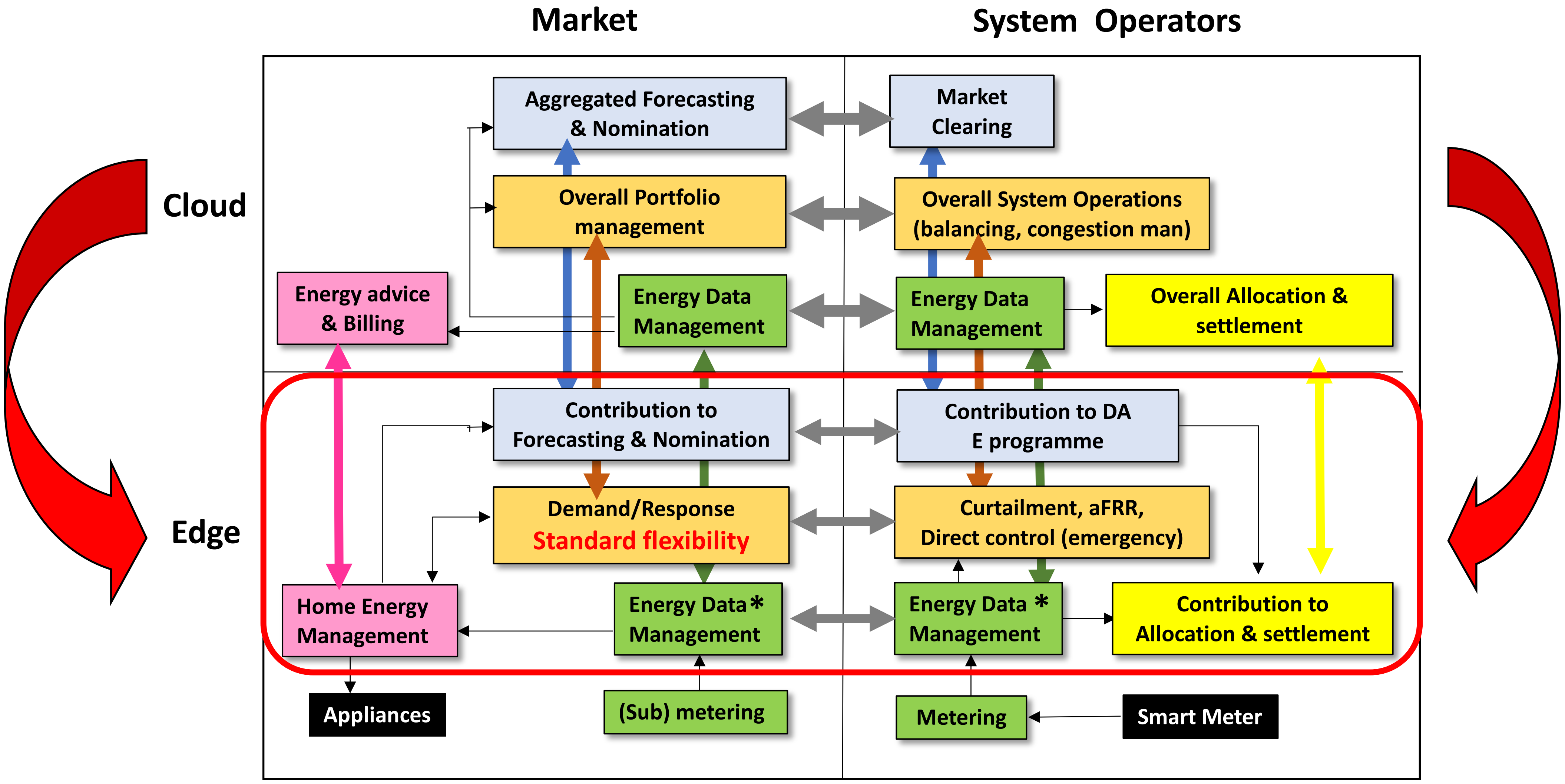
Departing from centralized data processing…



non exhaustive

To also decentralized data processing

Candidates for edge applications… ?

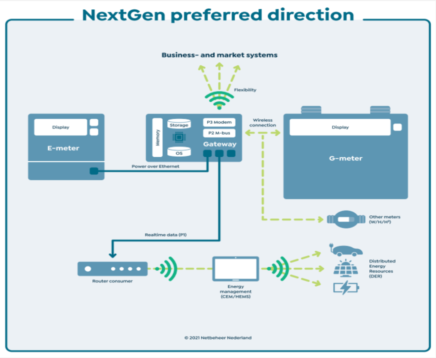


** Including privacy (GDPR) & cyber security*

non exhaustive

Next generation smart meters development

NextGen architecture

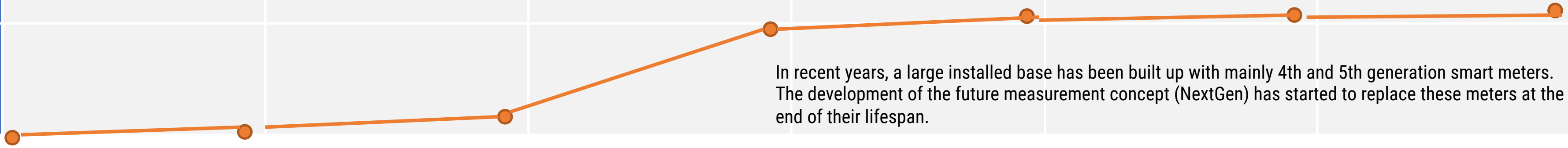


Features

- Basic meters with long lifetime
- IoT Edge Gateway (low cost) with open API's
- Applications to be downloaded from an AppStore
- Enhanced local consumer interface
- Roll out only when needed

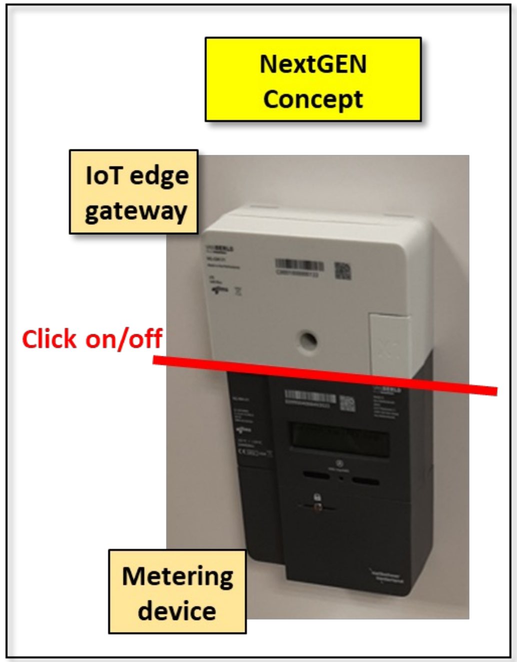
Modular design

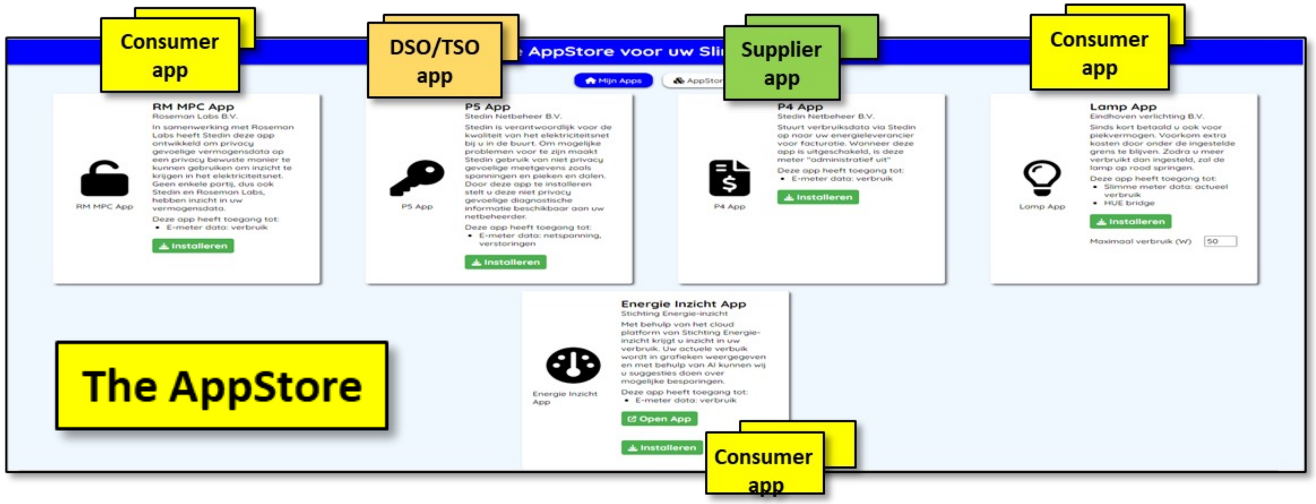
	2006-2012	2012-2015	2015 – 2020	Horizon 1 (2021 – 2025) Manufacturability, affordability and reliability	Horizon 2 (2025 – 2030) Impact of changing environment	Horizon 3 (2025 – 2040) New requirements due to the energy transition
Phase	Pilots	KSA	GSA	Transition	Replacement	
Generations (installation period)	1.x meters ~2006-2012	2.2 meters ~ 2012-2014	4.x meters ~ 2014-2016	5.x meters ~ 2017>	NextGen	
Installed base smart meters (indicative)						

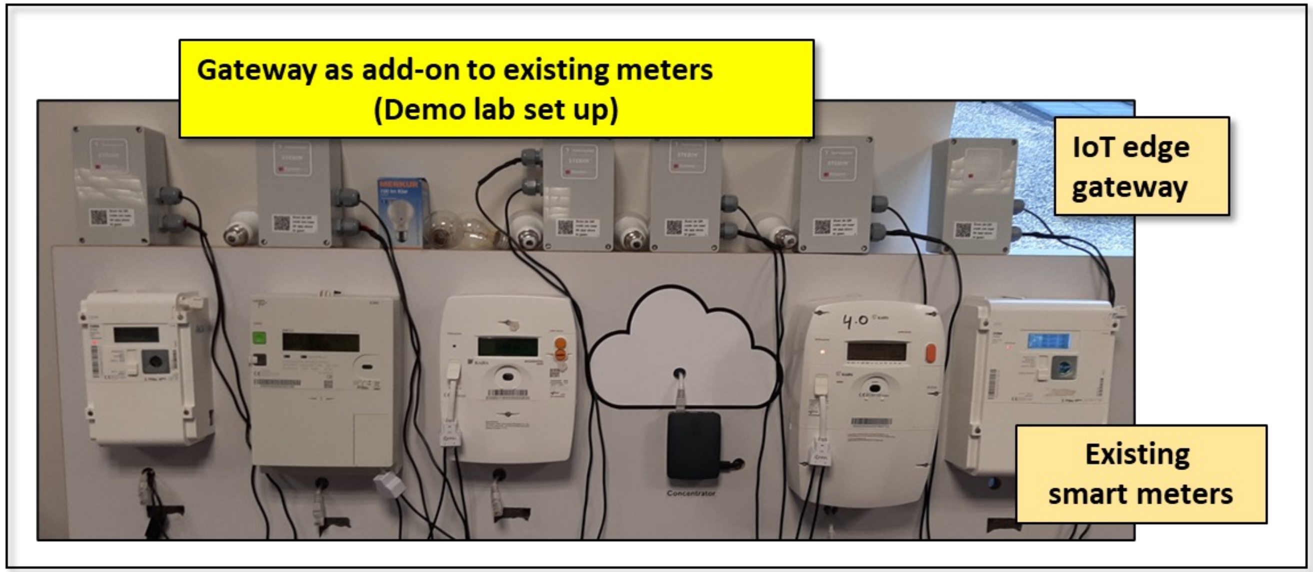


In recent years, a large installed base has been built up with mainly 4th and 5th generation smart meters. The development of the future measurement concept (NextGen) has started to replace these meters at the end of their lifespan.

Example: Demonstrator project







Flexibility: insights & learnings

A toolbox with instruments

A different mindset is required operating the system

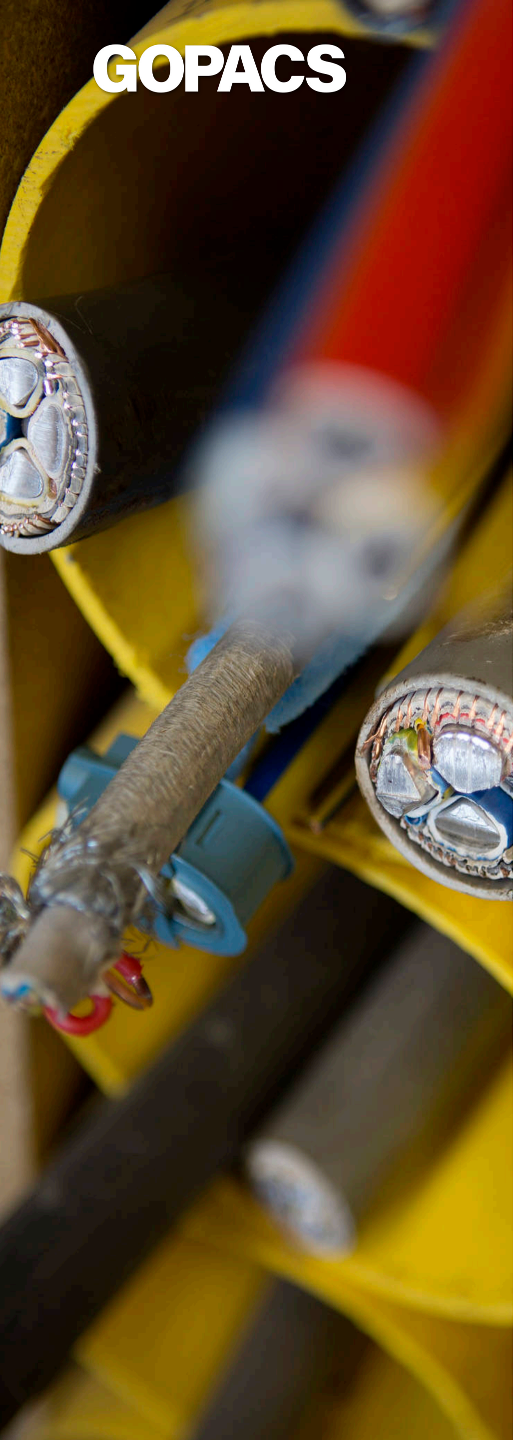
" We transform from '<u>Supply follows Demand</u>' system to a system in which '<u>Demand follows Supply</u>' : the last mile is turning into the first mile'.

Adopt an "ONE system approach"

" We have multiple grids, but within a balancing zone only ONE system. So in intervening on system level (balancing & congestion management), <u>TSO's and DSOs should cooperate</u>: Any action invoked by a system operator on system level should not harm any other system operator"

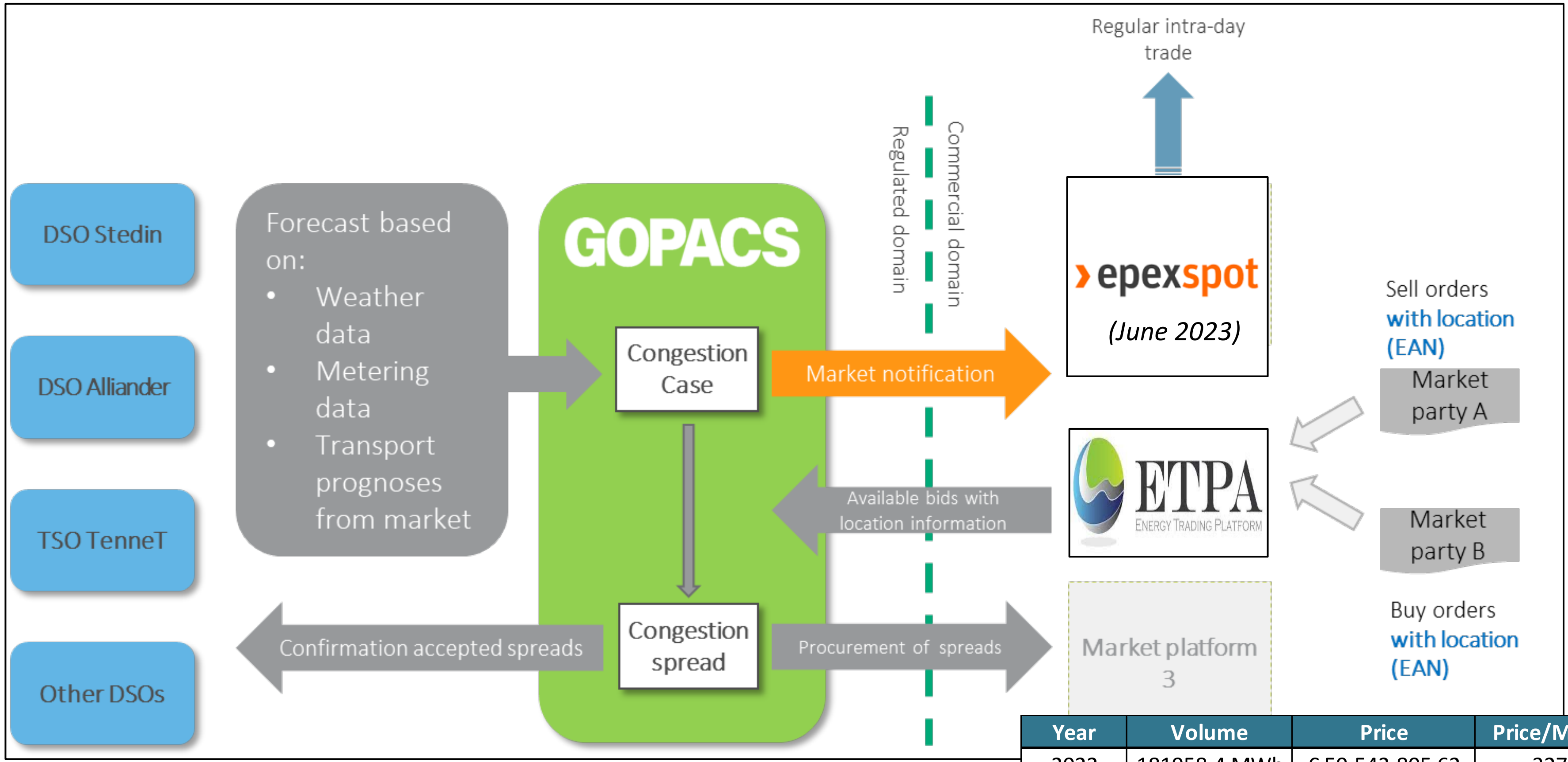
New Capabilities required at distribution level

" Continuing a "copperplate investment strategy" for grids is no longer affordable for society. This requires '<u>Day Ahead Load Forecast</u> and <u>Predictive Loadflow Analysis'</u> capabilities for <u>all grid levels</u> for DSO's"



Example: Joint TSO/DSO Platform GOPACS in the Netherlands for market based congestion solutions

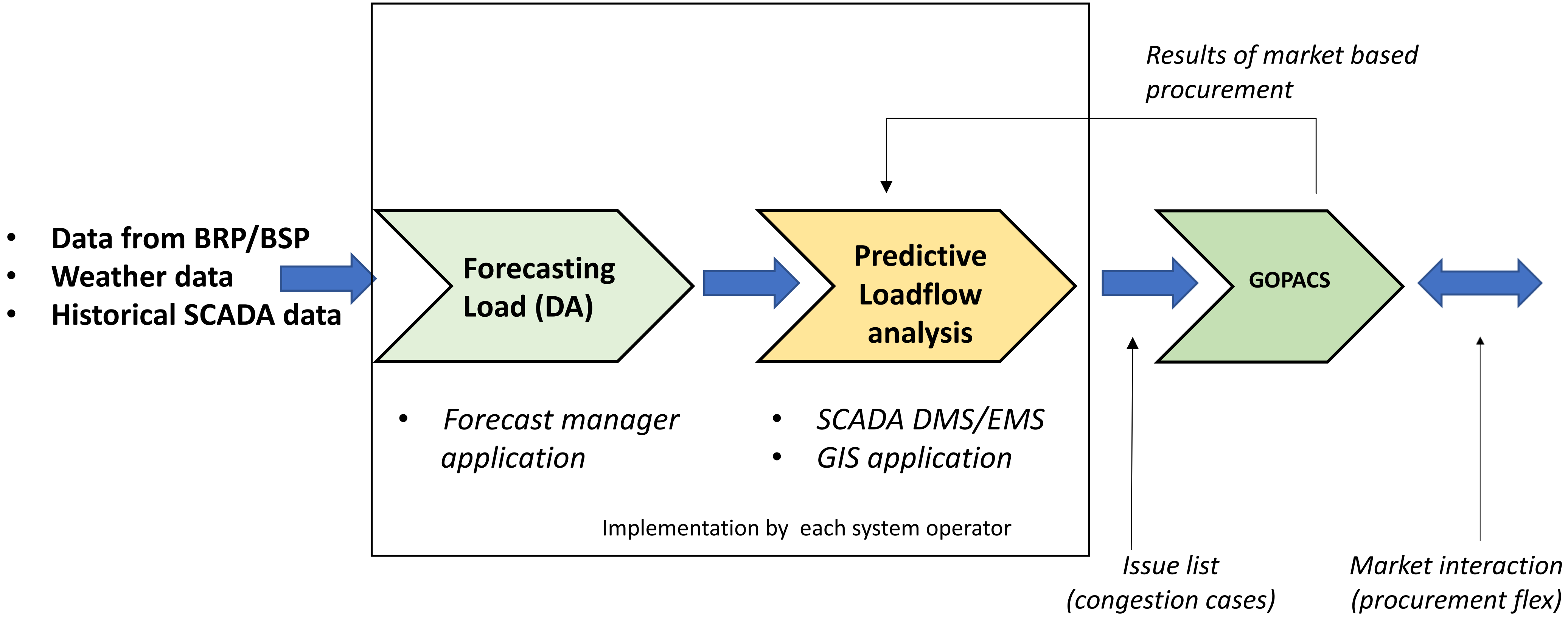
Operational since 2019



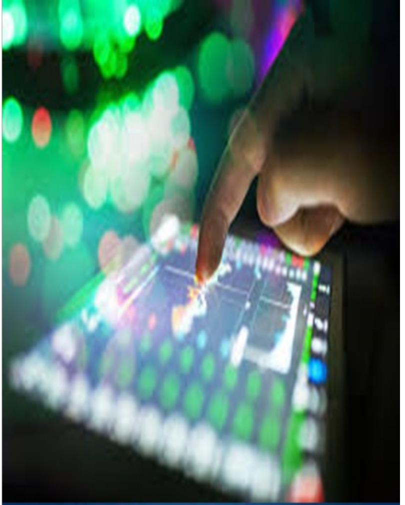
Year	Volume	Price	Price/MWh
2022	181958.4 MWh	€ 59.542.805,62	327
2021	144035.6 MWh	€ 45.221.897,61	314
2020	53965.5 MWh	€ 6.165.575,43	114
2019	36552.1 MWh	€ 4.464.483,75	122

But when & where is flexibility needed?

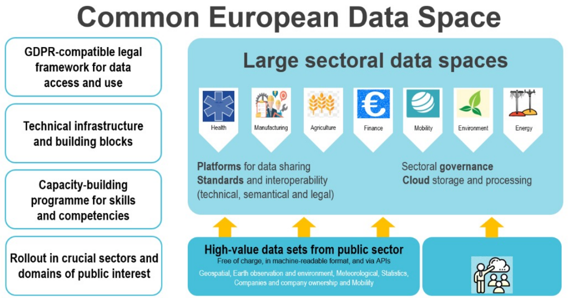
- In Day Ahead and Intraday timeframe at 15 min granularity ?
- at HV, MV and LV grid levels



New Capabilities for DSO's needed :Loadforecasting & predictive loadflow analysis



Data exchange: insights & learnings



Data is the new money
"Access to data should accommodate a level playing field in society and the market"

Cross sectoral exchange of Energy Data
"For a successful energy transition, energy data is relevant for also other sectors, such as the building, transportation, financial and public sectors"

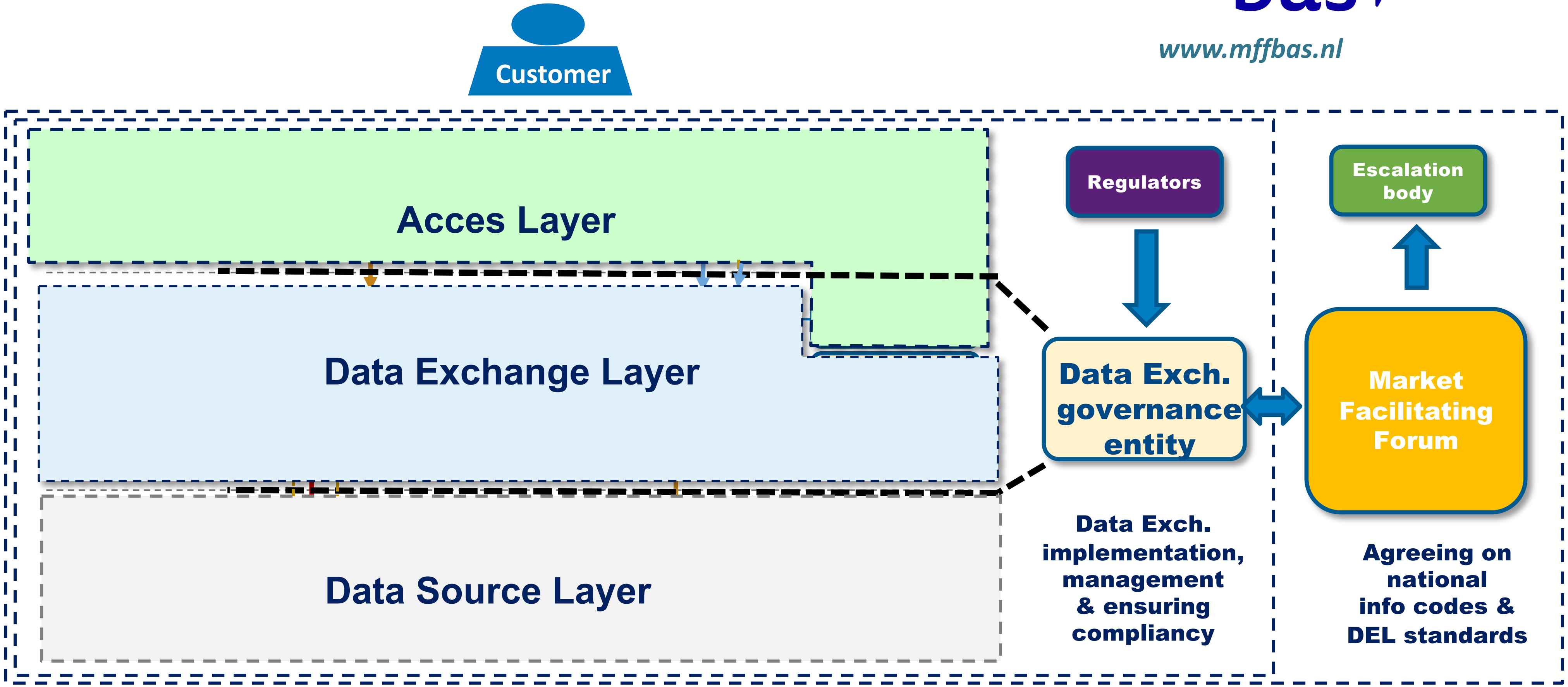
A separate Data Exchange layer is needed
"Implement re-usable functionality (like IAA services) between all data requesters and all data sources"

Start with the governance issue first
With data kept at the source as much as possible, we should strive for interoperable Data Spaces, with each its <u>own governance</u>, including how data can be shared between these Data Spaces"

Example: Implementation Netherlands (2022)

To date: 73 cross sectoral members of MFF

www.mffbas.nl



Energy Sharing & Collective Self Consumption:

insights & learnings

The customer is in the heart of the Energy Transition'
"The commitment of the customer will be essential for success: Statement EU commission"

Use local what you produce local ("Local4Local")
"With enabling Sharing of energy and Collective Self-Consumption, we will arrive at 3 wins:

- *<u>Citizens</u>: Cheaper and affordable energy, social commitment*
- *<u>System Operators</u>: "reduces stress at DSOs on congested grids, CAPEX expenditure and workforce challenges (needed for grid expansion projects)*
- *<u>Government: </u>it accelerates an affordable energy transition, as citizens become co-investors of parts of the Energy System, and accelerate the uptake of decentralized electricity generation and the decrease of fossil fuel usage"*

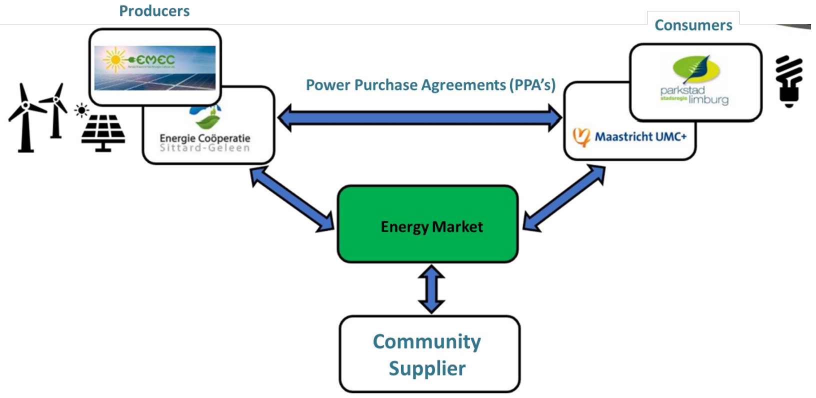
A fundamental market model change is ahead
"From '<u>Supply of Energy</u>' to <u>facilitating Producer - Consumer energy transactions,</u> in all timeframes"

Energy Sharing & Collective Self Consumption
use Local what you produce Local"

Emerging hot topic:

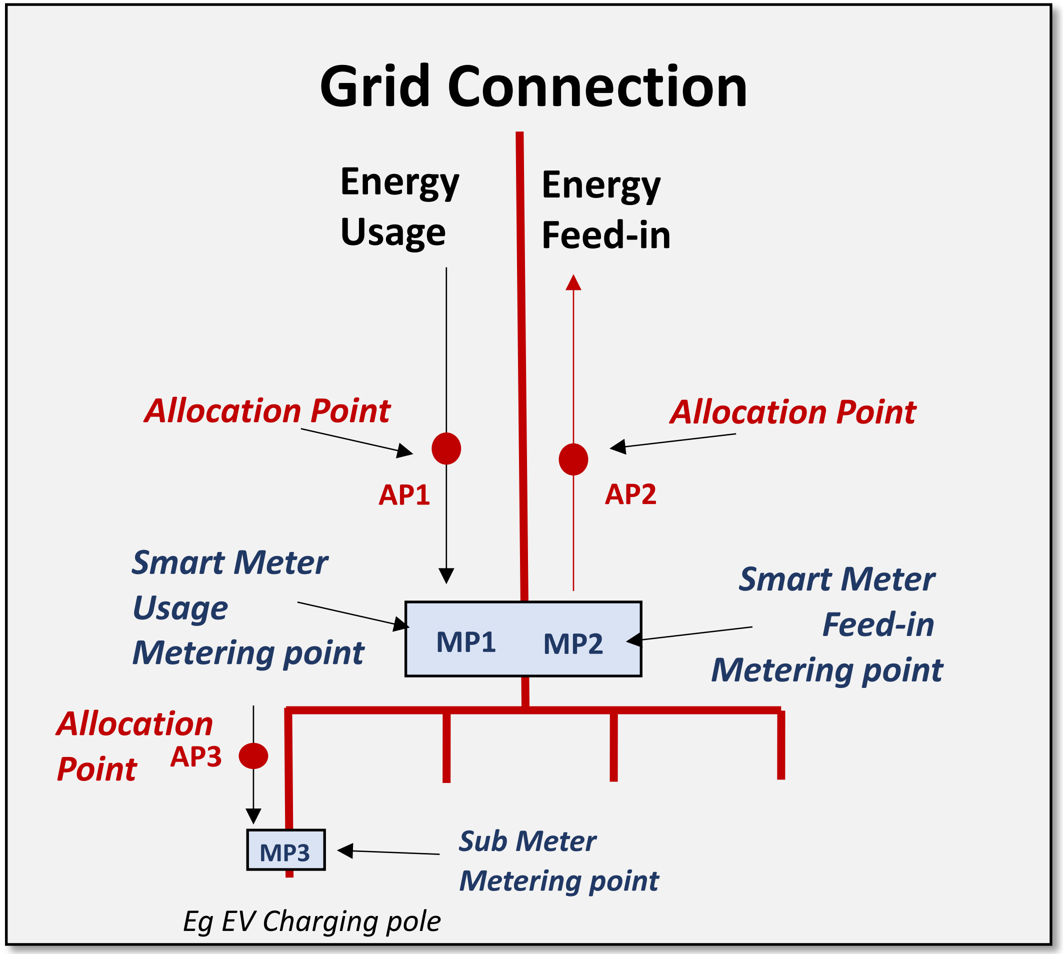
- In Europe: EMD update Directive 2019/944 (art.15a)
- In the Netherlands:
  - Today >600 energy cooperatives active
  - National programme "Local4Local" by LEC's
- Perimeter: Municipality or MV grid level
- Local markets (peer2peer trading) connected to the wholesale market
- Local prices decoupled from wholesale market prices
- Multiple market actors active simultaneously on one connection
- Allocation data derived from multiple metering points

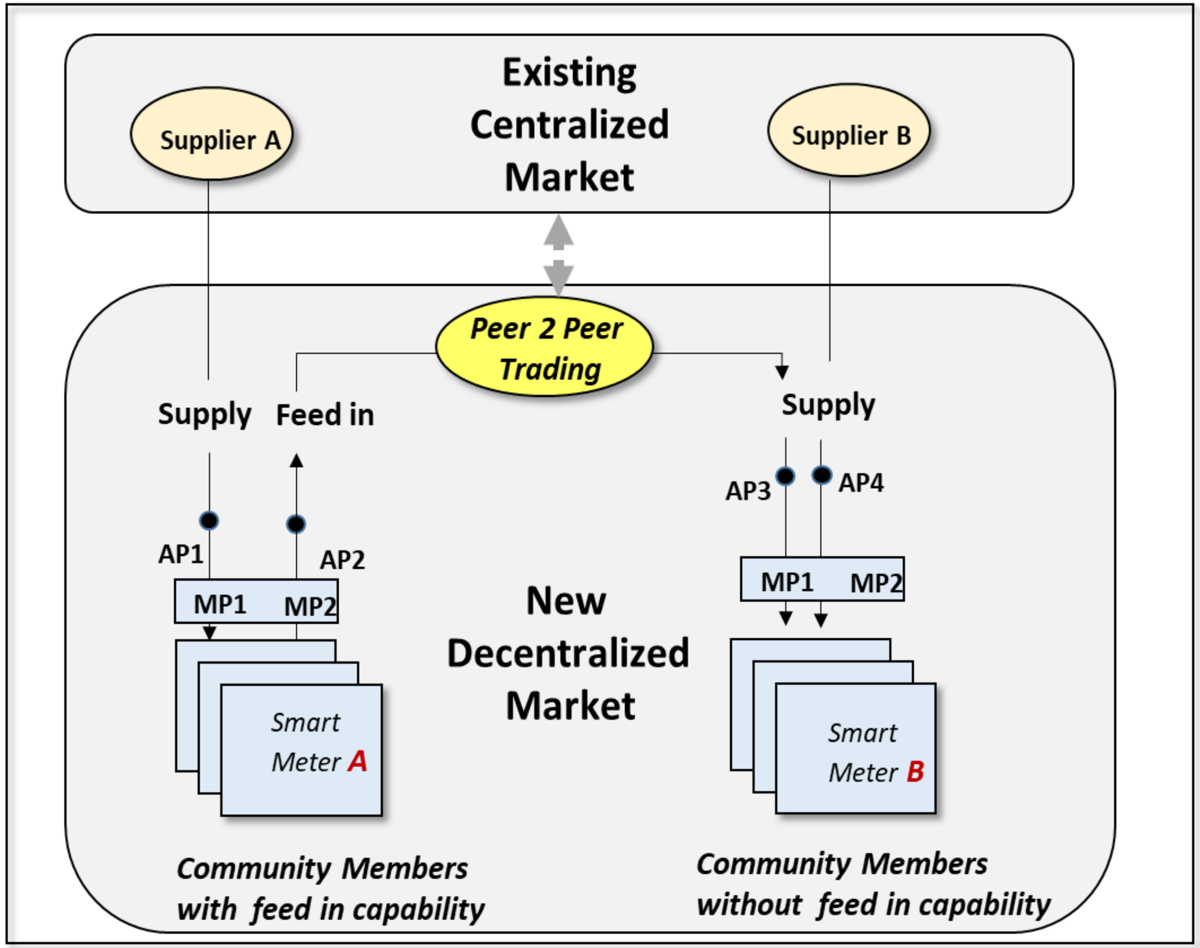

European Commission
NEWS ARTICLE | 13 December 2022 | Directorate-General for Energy
In focus: Energy communities to transform the EU's energy system



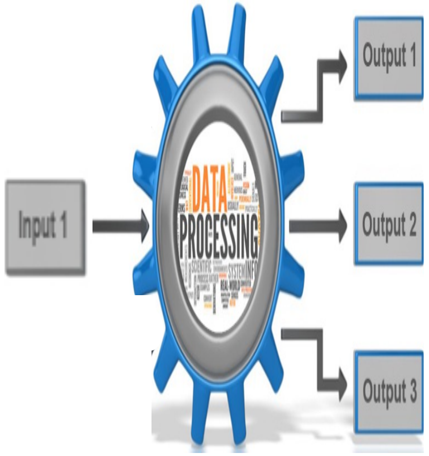
Differentiating between Metering Points and Allocation Points:

Enabling Collective Self Consumption, Energy Sharing, Peer2Peer trading and Local Markets





MP= Meterregister Point *AP= Virtual Allocation Point*



Data as a market design enabler (1)

Existing process:
Collecting, storing and distributing metering data

Datasources: Smartmeter registers

AMI head end)

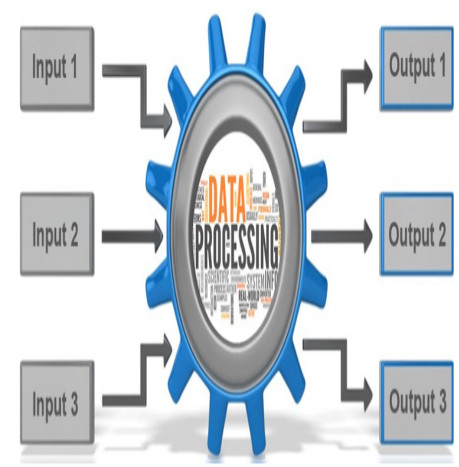
Distribution to market parties

Allocation and imbalance settlement of Energy

Metering data

Characteristics:

- Metering data from the source of the value chain is forwarded **1 to 1** to processes at the end of the value chain (possible temporary stored in the AMI Head End)
- Allocation data equals metering data from one metering point (MP)



Data as a market design enabler (2)

Future process:
collecting, storing, processing and distributing allocation data

Datasources:
Smart meter registers

Other meters
registers (behind the meter)

Metering data

AMI
(head end)

Processing metering data into allocation data

Distribution to market parties

Allocation, and imbalance settlement of Energy

Allocation data

Characteristics :

- Allocation data is unambiguously calculated from metering data coming from **one ore more metering points of one or more connections**
- Make a distinction between metering points (MP) and virtual allocation points (AP), representing points of measured metering data and calculated allocation data

To conclude

Thank You

Questions ?

References/ relevant URLs

Netherlands

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- Flexibility: www.gopacs.nl
- Data exchange: www.mffbas.nl
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European Commission

- EU action plan on digitalisation of the Energy System: https://ec.europa.eu/commission/presscorner/api/files/document/print/en/qanda_22_6229/QANDA_22_6229_EN.pdf
- EU proposals on the electricity market design (EMD):Reform of the EU electricity market design (europa.eu)

E.DSO for smart grids

White paper on digitalization:
https://www.edsoforsmartgrids.eu/images/E.DSO_White_Paper_digitalised_energy_system_FINAL.pdf

SolarPowerEurope

White paper on collective self consumption
Final_collective_self_consumption_report_133b88bb28.pdf (solarpowereurope.org).