

FinEst Centre
for Smart Cities

Measures and Applications for Managing Electricity Demand in Estonia

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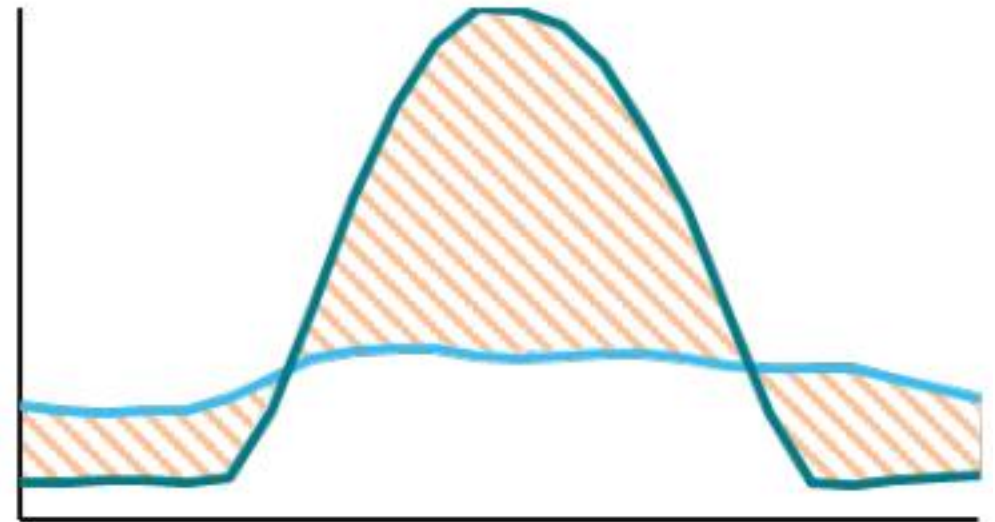


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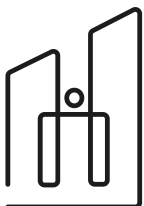
Demand Side Management

- Demand Side Management refers to **initiatives** and **technologies** that encourage **consumers** to **optimise** their **energy use**¹.
- Demand side management enables to **increase** energy **efficiency** and **match** electricity **supply** with **demand**



European Commission, Directorate-General for Energy, Antretter, M., Klobasa, M., Kühnbach, M., et al., Digitalisation of energy flexibility, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2833/113770>

¹„Demand Side Management,“Energy Market Authority of Singapore. Available online at: https://www.ema.gov.sg/Demand_Side_Management.aspx accessed on 19.20.2022.



Static Demand Side Management

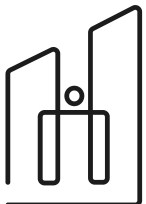
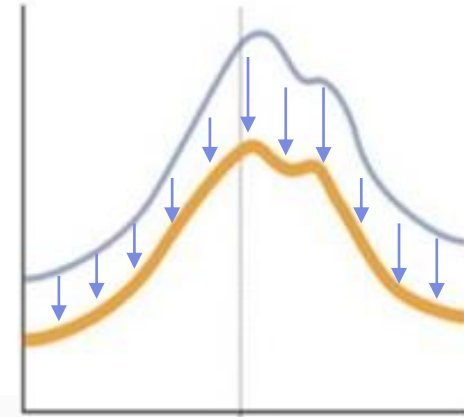
Active end-user involvement

- Consumer investments to increase energy efficiency

Passive end-user involvement

- Regulations on regional, national and/or trans-national levels

Improves **overall** energy **efficiency**



Dynamic Demand Side Management

Also known as **Demand Response**.

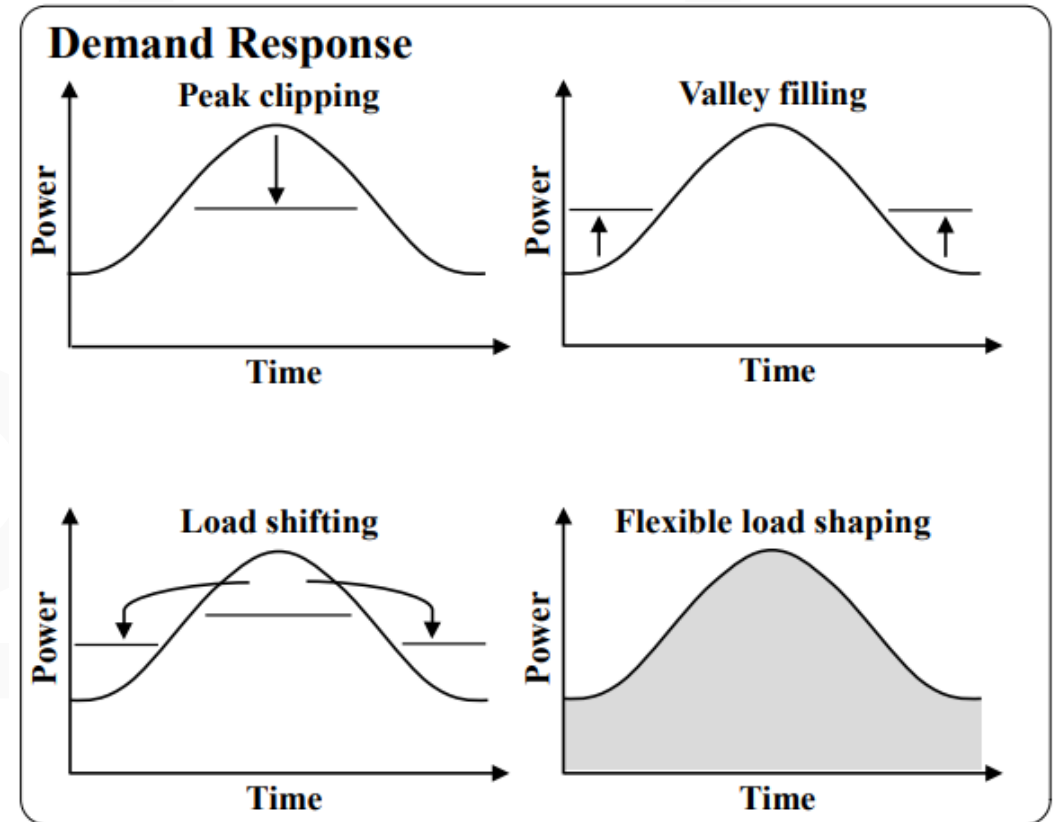
Active end-user involvement

- Transactive measures to guide consumption

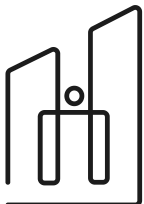
Passive end-user involvement

- Automated systems to control loads

Aim to **shape load** profile to **match** electricity **consumption** with **production**

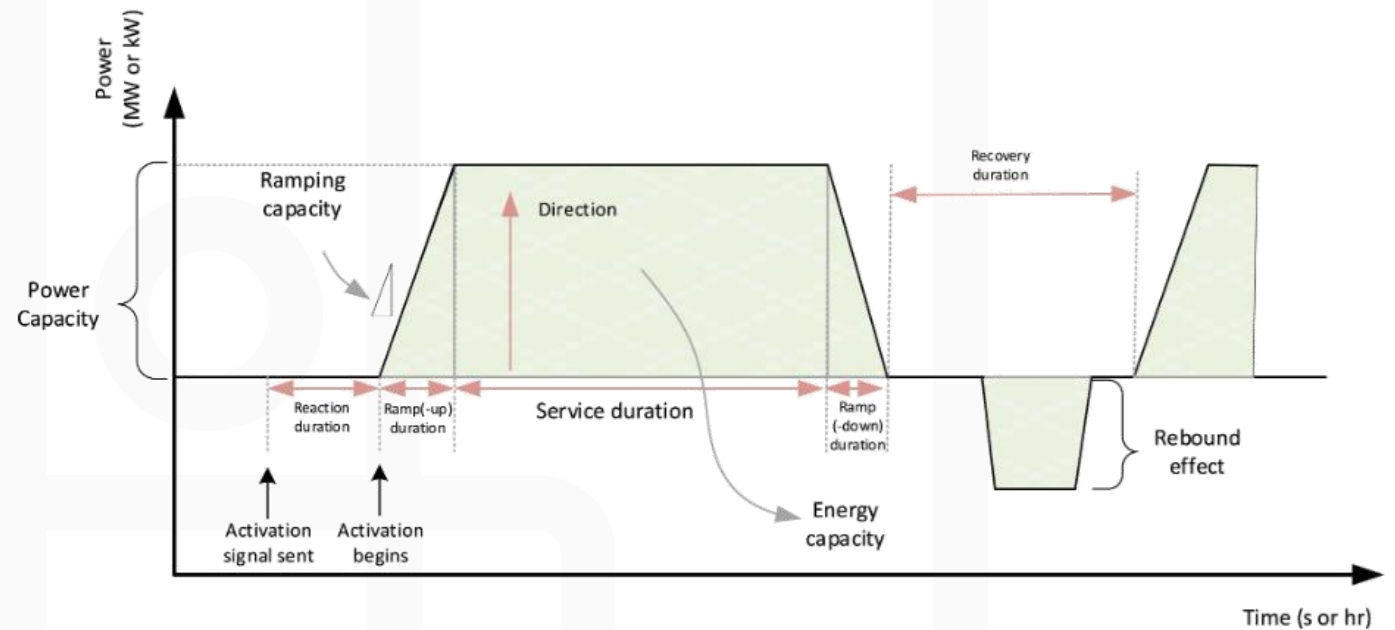


Lampropoulos, Ioannis C, Wil L. Kling, Paulo Fernando Ribeiro and Jan van den Berg. "History of demand side management and classification of demand response control schemes." 2013 IEEE Power & Energy Society General Meeting (2013): 1-5.

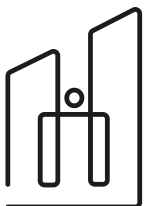


Power System Flexibility

- Power system flexibility can be defined as the systems ability to react to differences between energy consumption and production
- Power system flexibility is characterised through:
 - Power capacity,
 - Service duration (energy capacity),
 - Reaction duration,
 - Ramp duration and slope,
 - Recovery duration,
 - Rebound effect.



Merkebu Zenebe Degefa, Iver Bakken Sperstad, Hanne Sæle, Comprehensive classifications and characterizations of power system flexibility resources, Electric Power Systems Research, Volume 194, 2021, 107022, ISSN 0378-7796, <https://doi.org/10.1016/j.epr.2021.107022>.

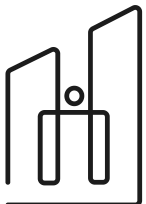


Demand Response

- Attractive source of power system flexibility since power system assets already present
- Relevant aspects to consider for Demand Response implementation
 - Load flexibility characteristics
 - User comfort,
 - Control signal delivery,
 - Verification of action execution

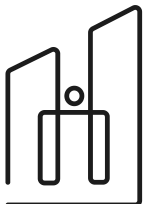
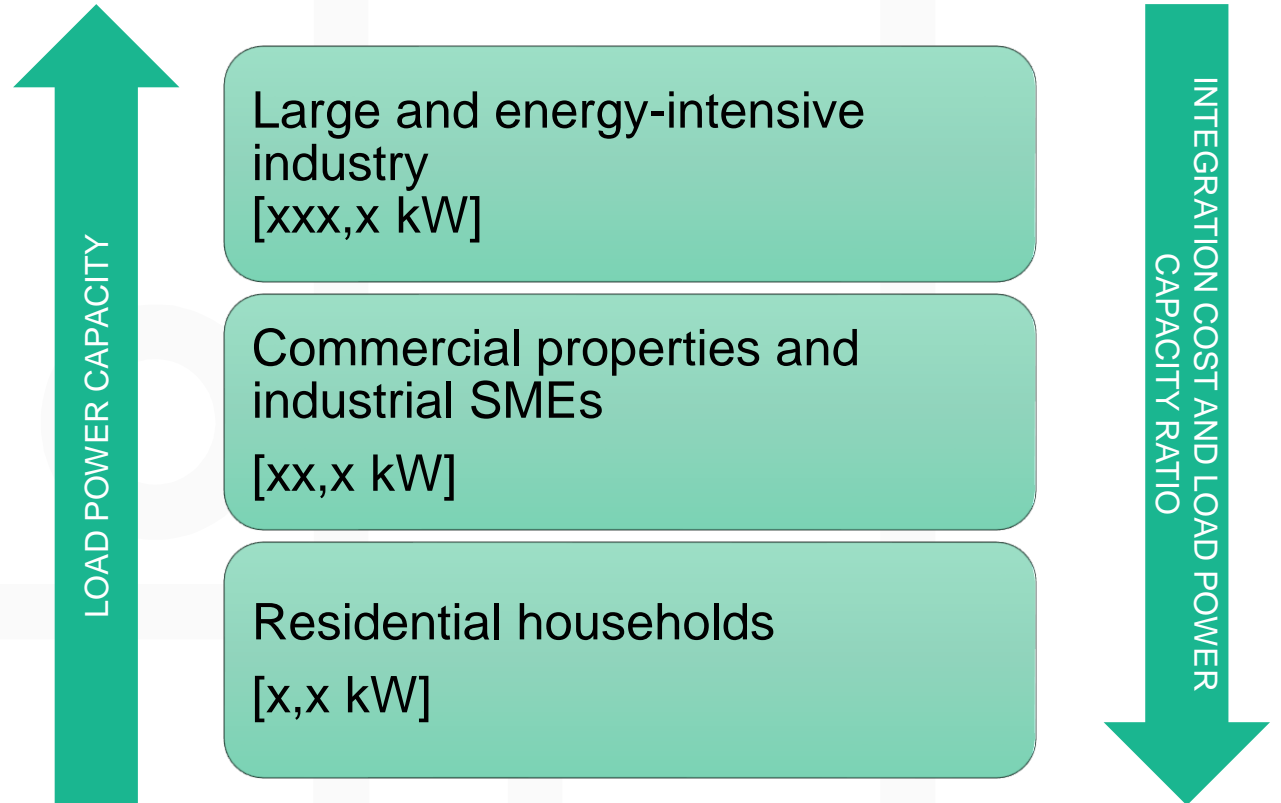


Michael Tobias, „How Energy Efficiency and Demand Response Help the Grid During Summer,“Nearby Engineers. [Vörgumaterjal] Link: <https://www.ny-engineers.com/blog/how-energy-efficiency-and-demand-response-help-the-grid-during-summer> Refereeritud: 07.10.2022



Application of Demand Response

- Established business models and market players
- Scaling business models and developing market players
- Developing and unvalidated business models and exploring market players



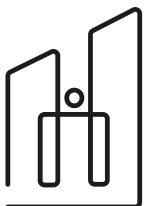
Potential of Demand Response in the Estonian Power Grid

- Largely untapped potential.
- Households are largest source of flexibility.
- Easiest source of flexibility is Industry.
- Lack of feasible business models and dominant market players for the large-scale integration of households into **Virtual Power Plants**.

Estimated Estonian Demand Response potential for one hour (2014)

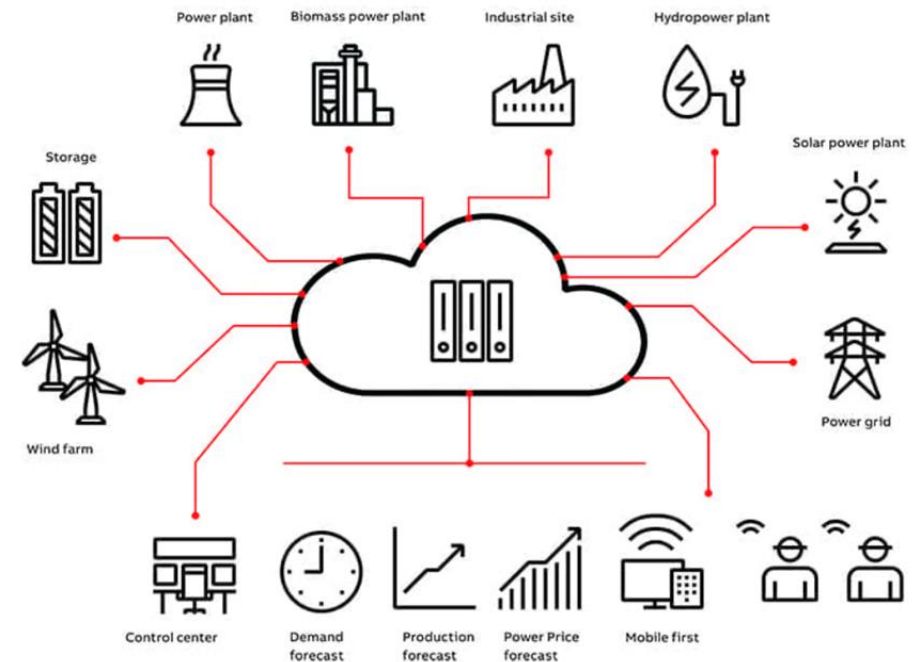
Sector	Average controllable hourly load, MW
Industry	65
Office buildings 24/7	14
Office buildings 8/5	72
Commercial properties	7 ... 26
Residential Households	55 ... 230
TOTAL	213 ... 407

Rosin, A., Drovtar I., Link S., Hõimoja H., Mölder H., Möller T., "Tarbimise juhtimine – Suurtarbijate koormusgraafikute salvestamine ning analüüs tarbimise juhtimise rakendamise võimaluste tuvastamiseks," Elering toimetised nr 3/2014 (8), 2014.

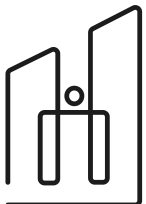


Virtual Power Plant (VPP)

- A VPP is a **technological system**, which is comprised of a large number of small and medium size **generation** units, energy **storages** and controllable **loads**.
- The VPP aggregates individual devices into one (virtual) system that is (logically) connected to a larger power system.
- A VPP enables to Control and optimize the energy flows of connected devices.
- From a legal perspective, a VPP is an aggregator that participates in different electricity markets and/or offers services to system operators.

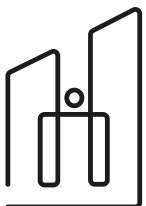
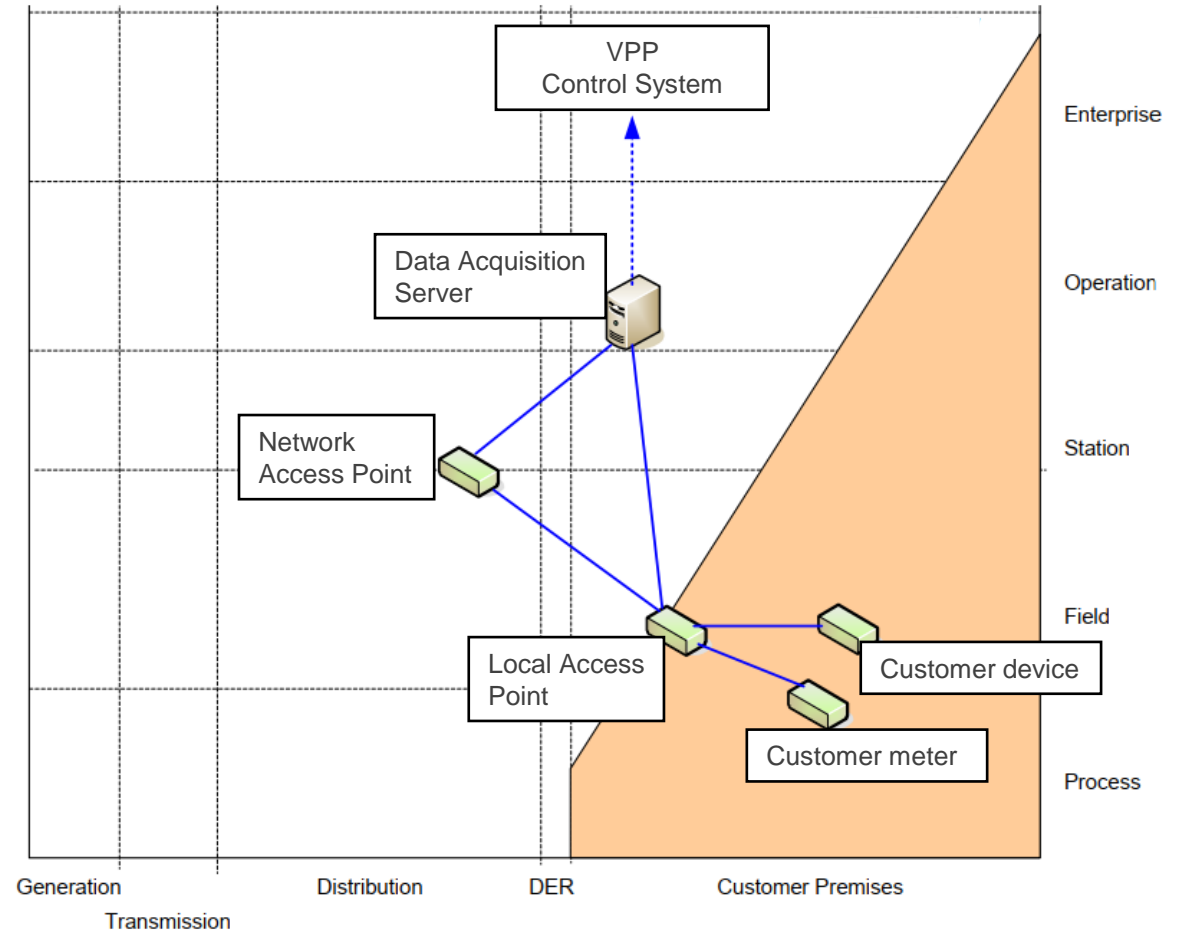


Alliance to Save Energy, „Virtual Power Plants: Implications For An Active Efficiency Future “.
[Võrgumaterjal] Link: <https://www.ase.org/blog/virtual-power-plants-implications-active-efficiency-future> .
Refereeritud: 07.10.2022



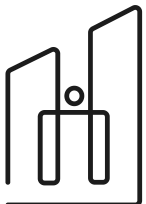
Virtual Power Plant Components

- Central Control system
- System for communication and data acquisition
- Customer devices



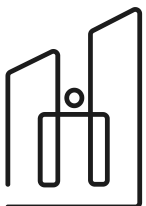
Glossary of terms

- **Demand Response** – altering the operation of electric loads with the conscious aim to change the shape of the load profile.
- **Virtual Power Plant** – a technological system comprised of numerous generation units, energy storages and controllable loads.
- **Power system flexibility** – the systems ability to react to differences between energy consumption and production.



Matters to be addressed for increased uptake of demand response

- Raising of awareness
- End-user engagement
- Development and implementation of sustainable business models
- Standardization plays an integral role
- Provision of privacy and (cyber)security





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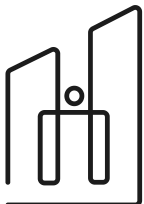
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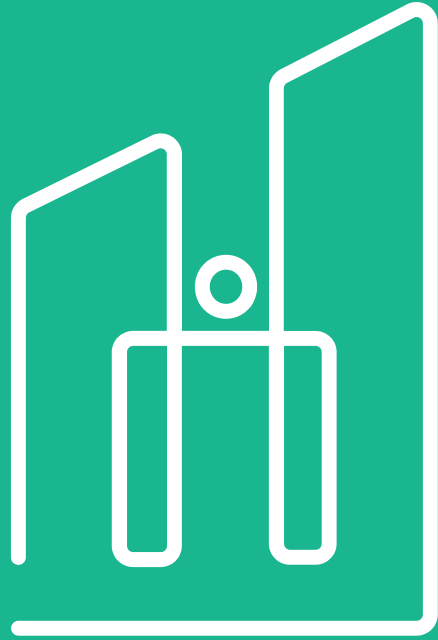
Aalto University



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Thank you!

Questions?

