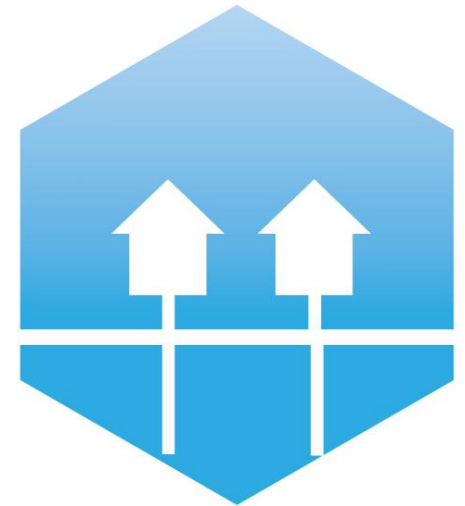
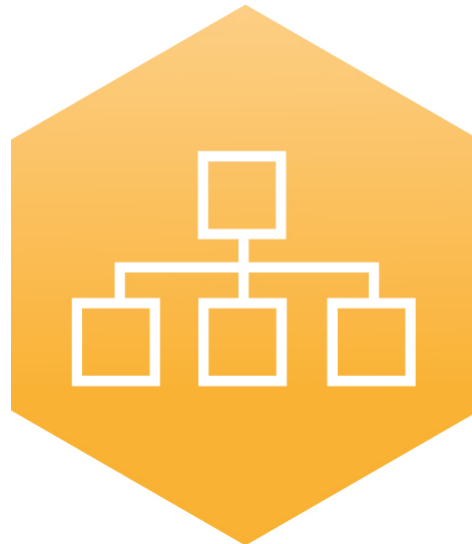


**100% renewable municipal  
energy supply:  
Chances and restrictions  
of solar thermal district heating**



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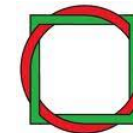
## Research project

“The municipal efficiency revolution for climate protection in German cities – requirements, transformation paths and effects” (KomRev)

Supported by:



Federal Ministry for the  
Environment, Nature Conservation,  
Building and Nuclear Safety



**Wuppertal Institut**  
für Klima, Umwelt, Energie  
GmbH



**Deutsches Zentrum**  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft

based on a decision of the German Bundestag



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International Conference on Smart Energy Systems and  
4th Generation District Heating, Copenhagen, 25-26 August 2015



# Questions & models



- **Level of energy supply from local potentials and from the outside: heat (yearly amount), electricity (effective power levels, yearly amount), fuel (yearly amount)?**
- **Effects on electricity residual loads by different options for supply and interconnection?**
- **Spatial modelling of network based solar heat supply via geographical information system (demand, roof area)**
- **Hourly based simulation of heat, traffic and electricity (demand and supply)**



# Demand reduction as basic assumption



## Private household

- Today's high efficiency appliances
- Slight decrease of energy hungry components

## Industry

- Realization of energy savings in cross-sectional and process technologies

**20% to 90% demand reduction**

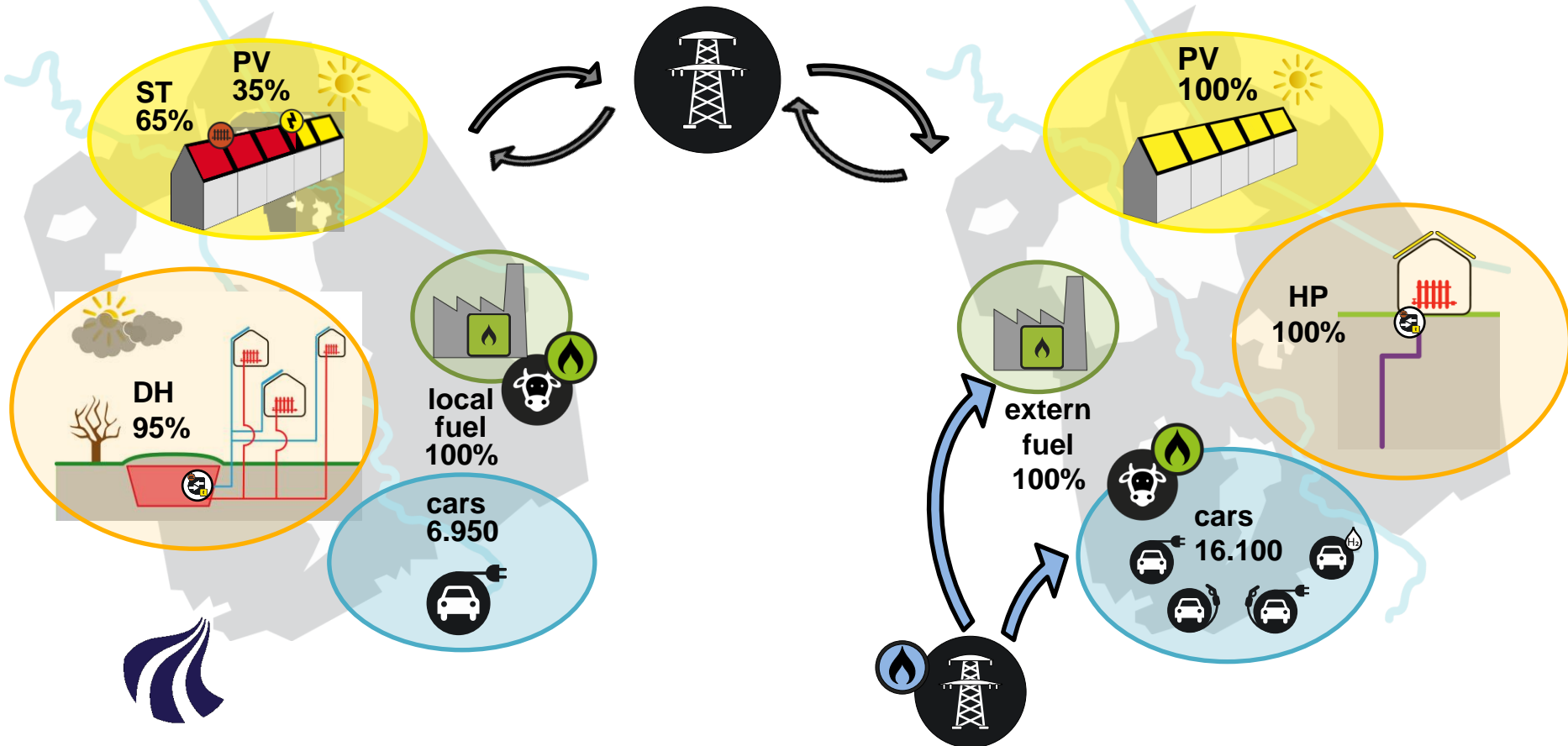
- Energetic renovation of all existing buildings
- Decrease of warm water demand per person



# System boundaries and concept guard rails

## Maximum Decentralized

## Moderate Decentralized



# Results Maximum Decentralized

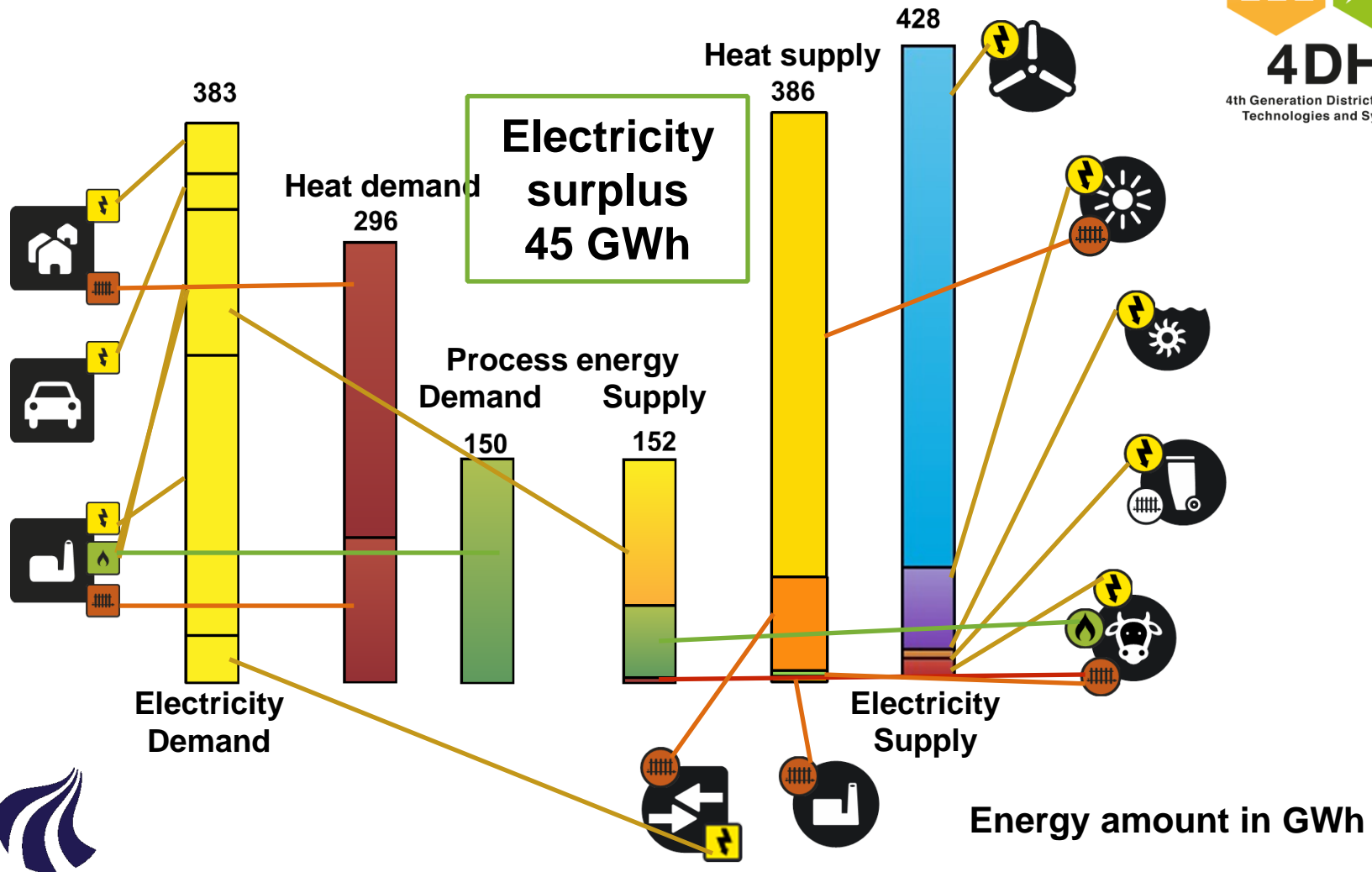


**Energy amounts per year**

**➔ locally met demand and energy export for:**



# Results MaxDec – Energy Export



# Results Moderate Decentralized



## Energy Amounts per Year

➔ locally met demand and energy import

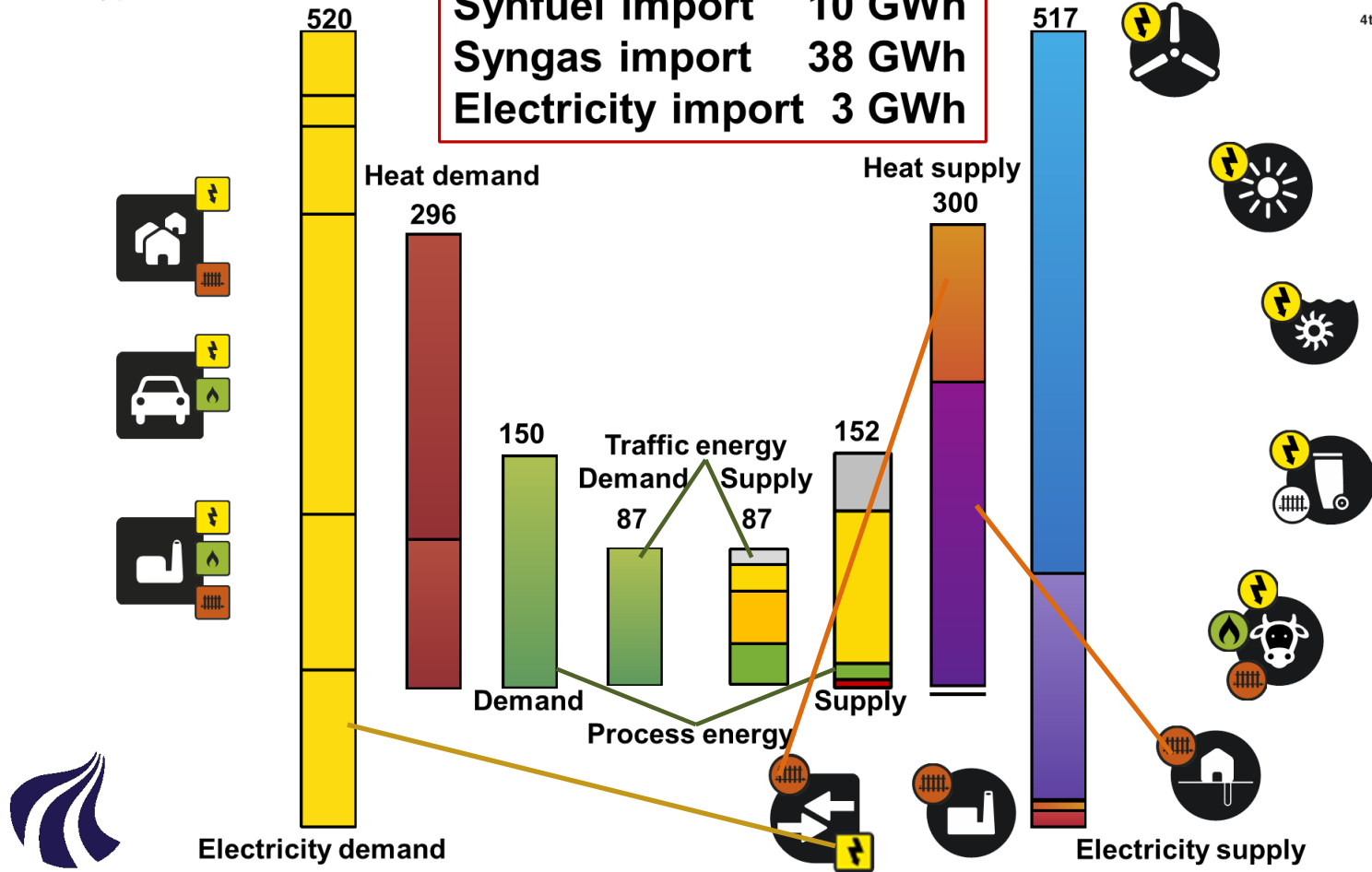




# Results ModDec – Energy Imports

Energy amount in GWh

Synfuel import	10 GWh
Syngas import	38 GWh
Electricity import	3 GWh



# Heating System Choice



## Effects on the residual load curve results

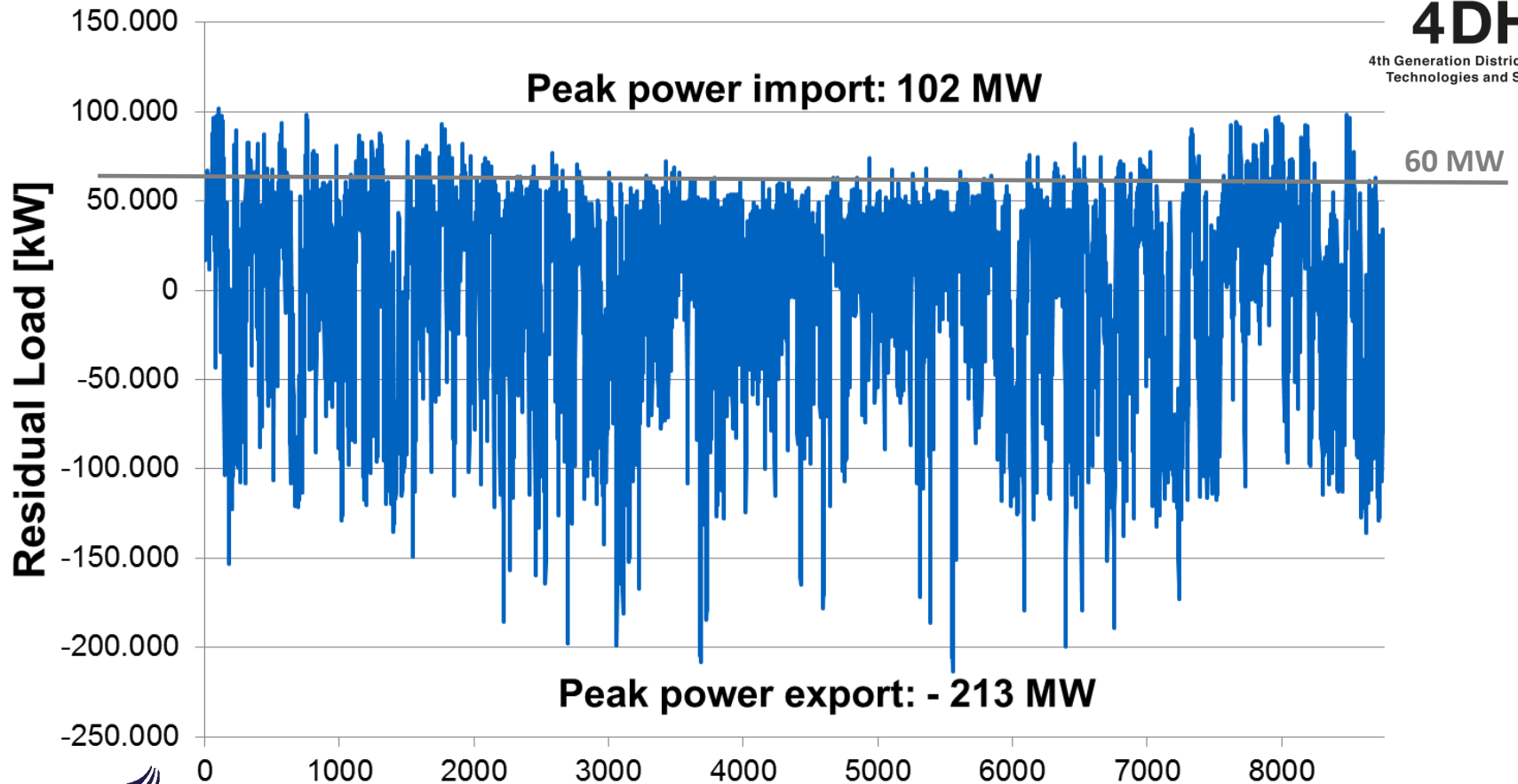


# Results ModDec – Residual Load Curve



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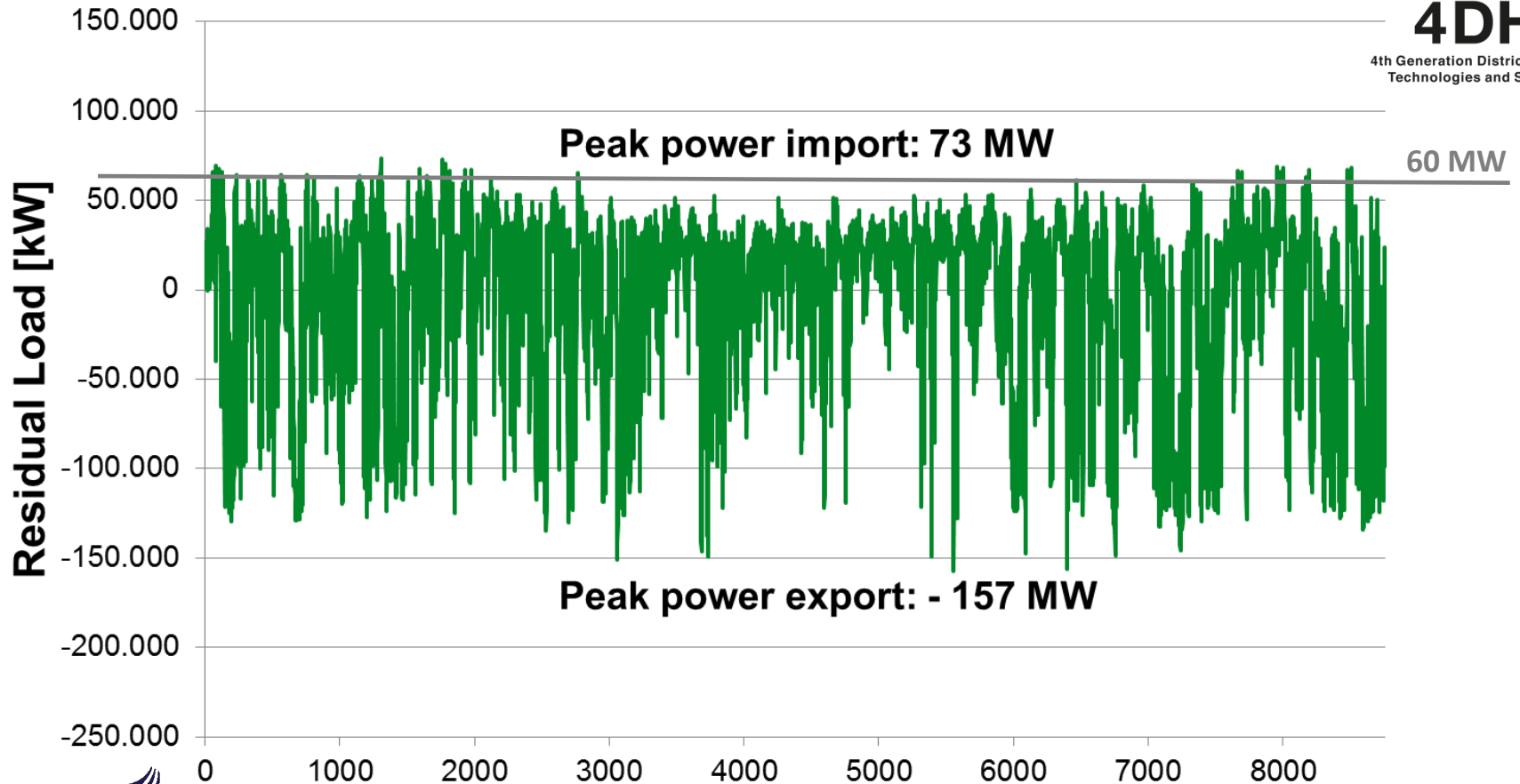


# Results MaxDec – Residual Load Curve



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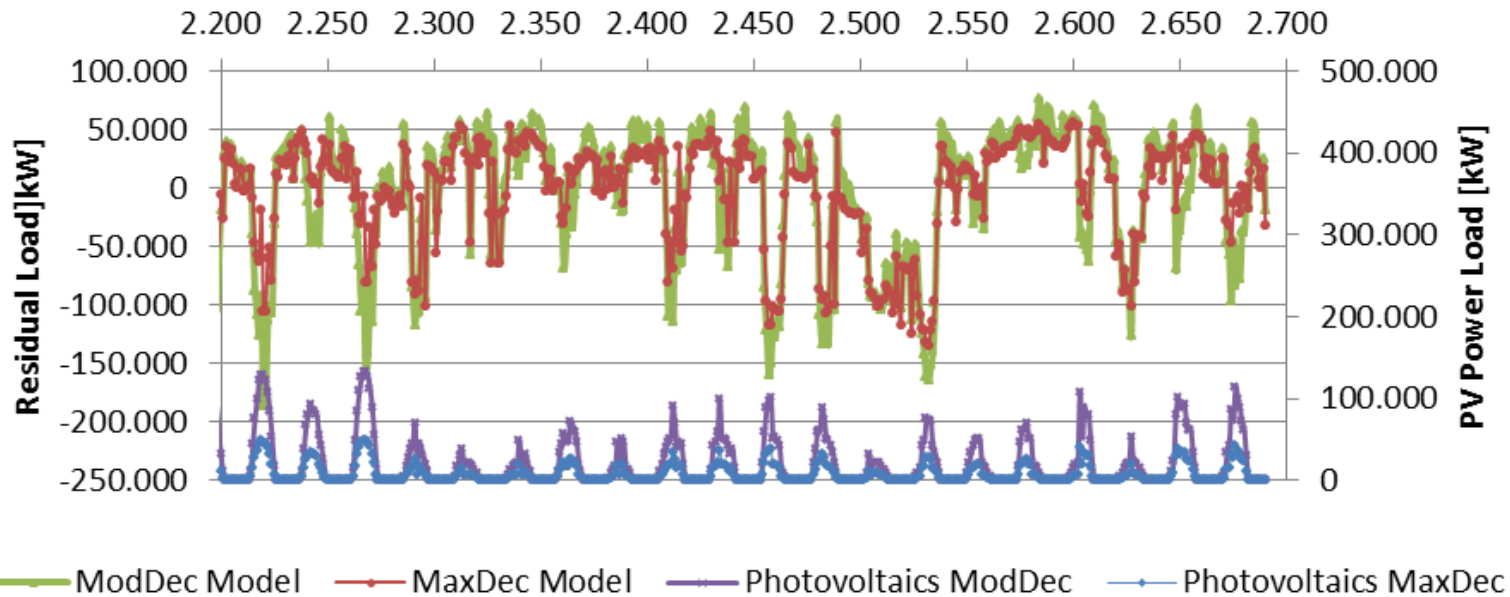
# Residual Load Curve - Effects of DH & Seasonal Storage



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## Residual Load Curve Section with High Export Values



# Residual Load Curve - Effects of DH & Seasonal Storage

