ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

Electricity grids and the energy transition

ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

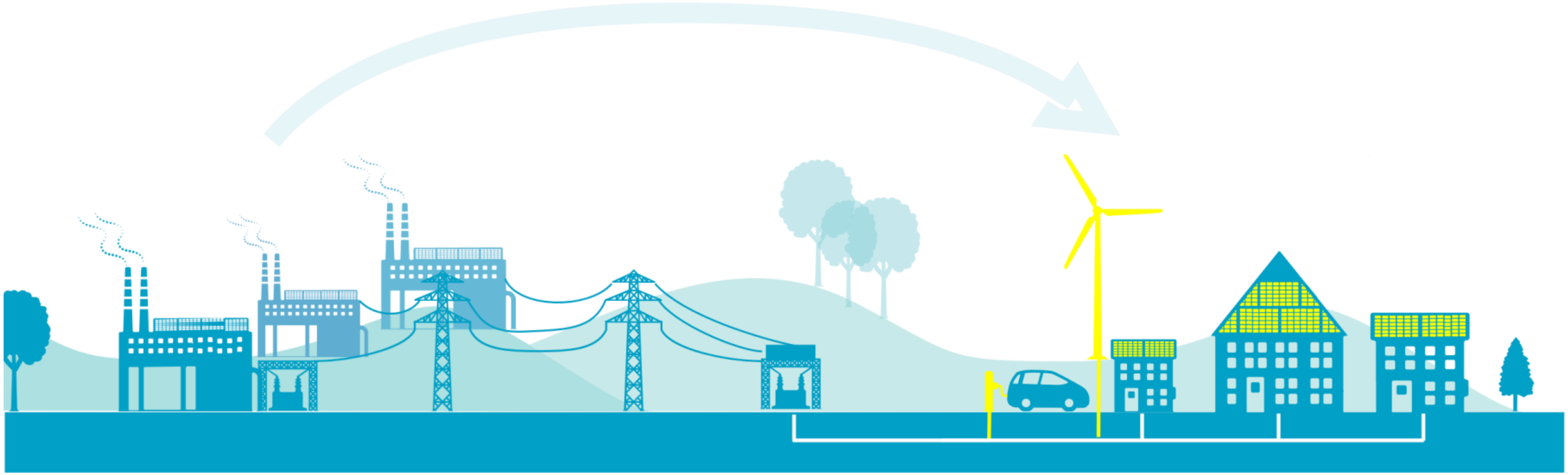
creos


DIESEL


DIESEL


DIESEL


DIESEL




GREEN
PRODUCTION
& LOCAL
SHARING

ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

The Energy Transition

The Luxembourg Grid

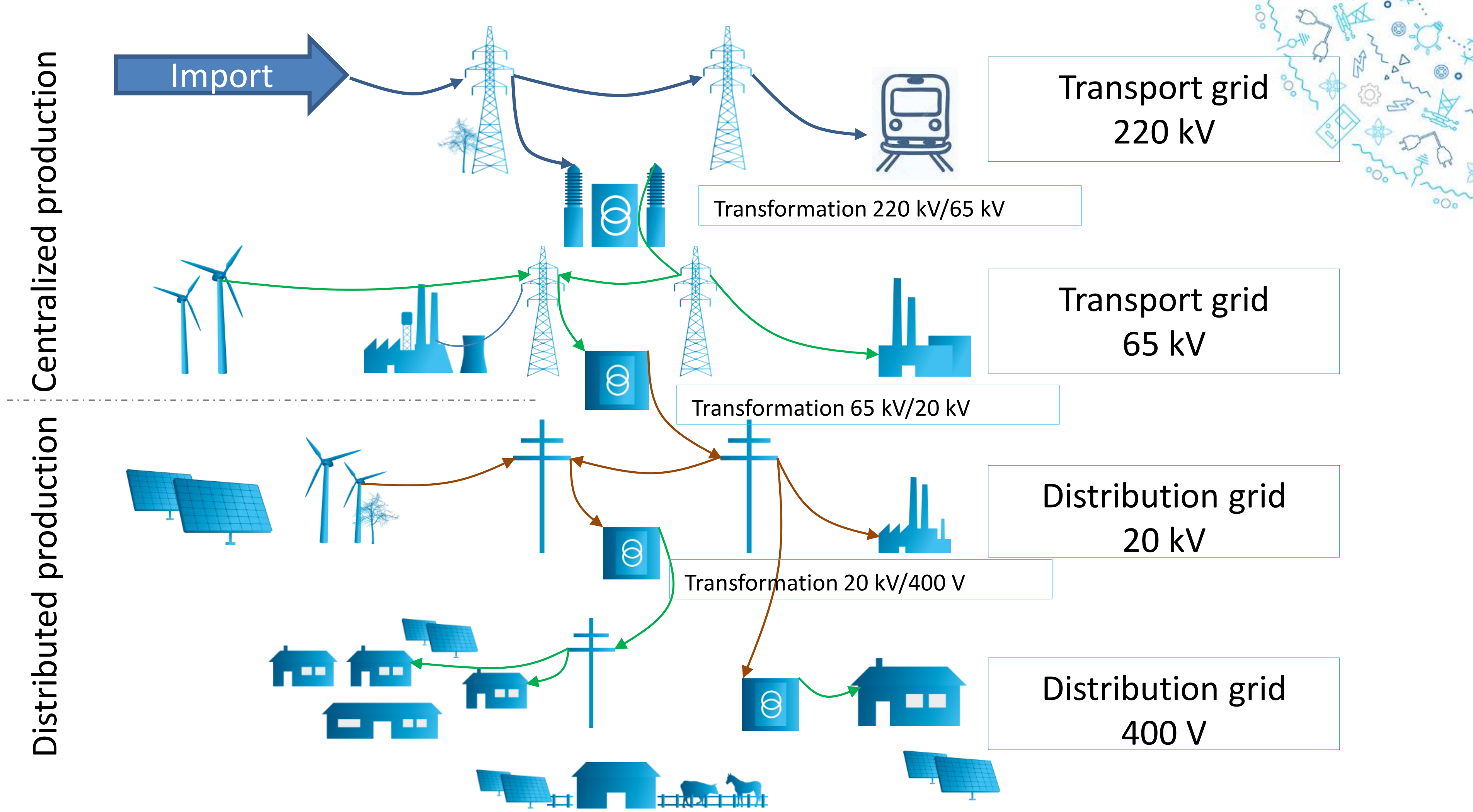
- The Role of the TSO and DSO
- 220 kV (HT)
- 65 kV (HT)
- 20 KV (MT)
- 400 V (LT)

Domestic Electricity Production

Energy Communities

The challenge of the Energy Transition

The Smart Grid


Centralized production
Distributed production
Import
Transport grid
220 kV
Transformation 220 kV/65 kV
Transport grid
65 kV
Transformation 65 kV/20 kV
Distribution grid
20 kV
Transformation 20 kV/400 V
Distribution grid
400 V

ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

- The Energy Transition
- The Luxembourg Grid
  - The Role of the TSO and DSO
  - 220 kV (HT)
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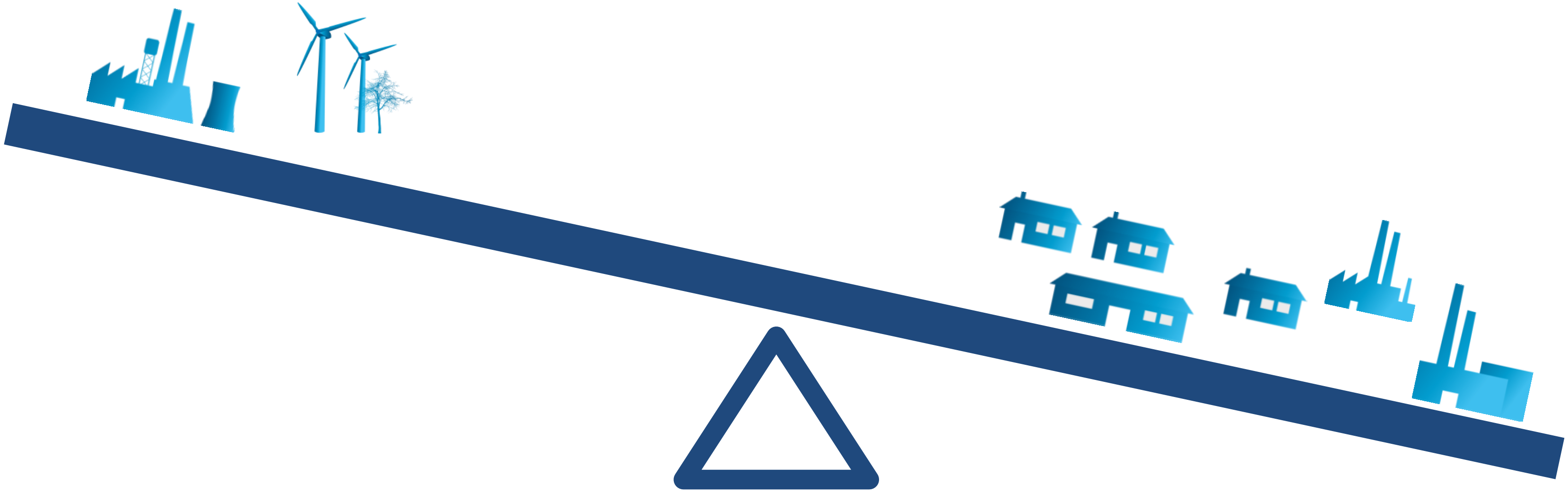
- Energy Communities
- The challenge of the Energy Transition
- The Smart Grid

Frequency control

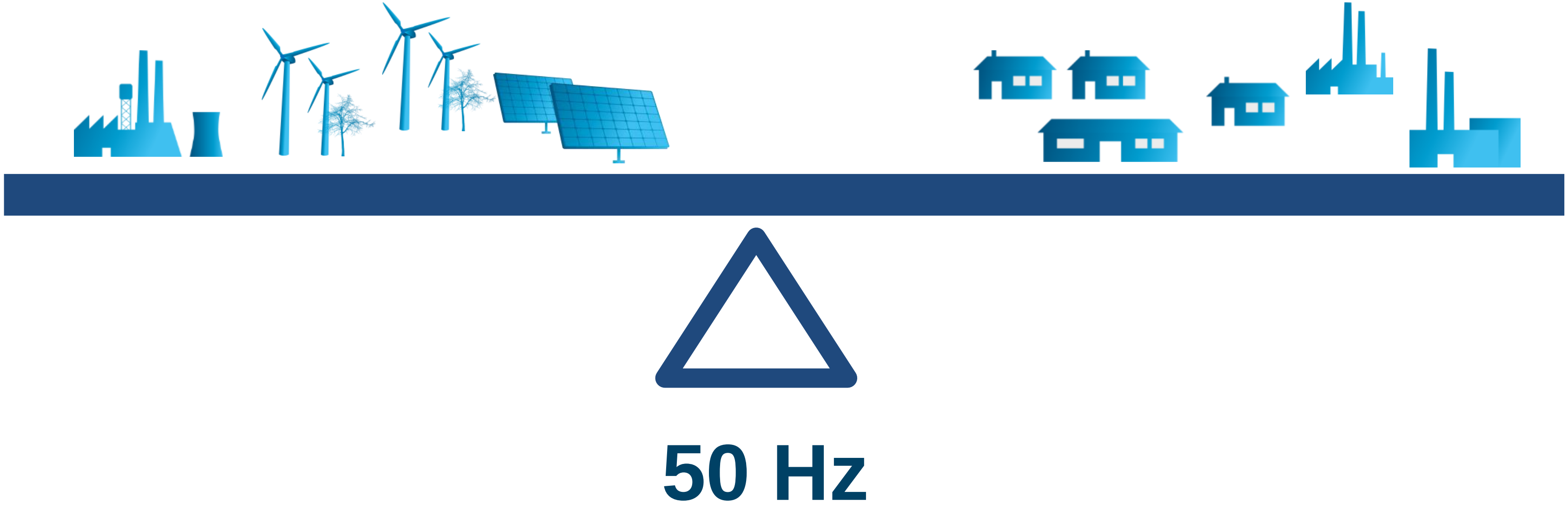
50 Hz

Frequency control

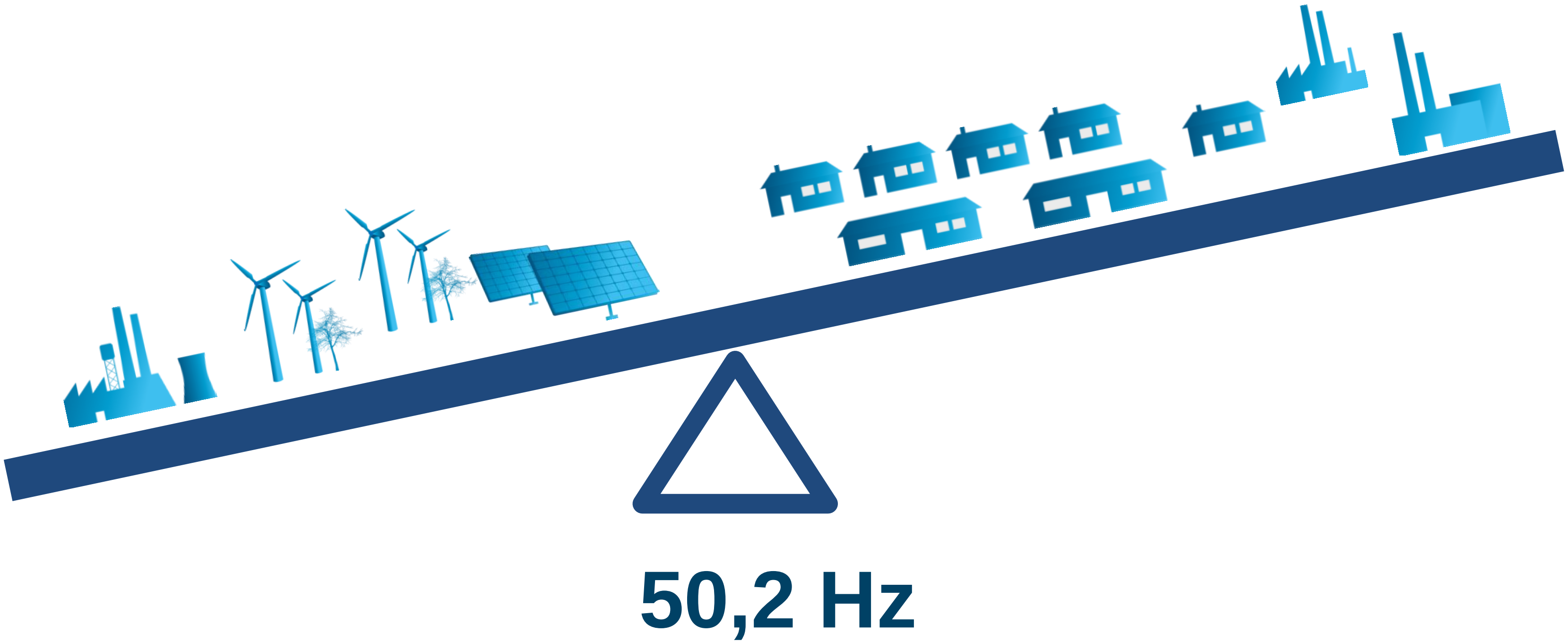


49,8 Hz

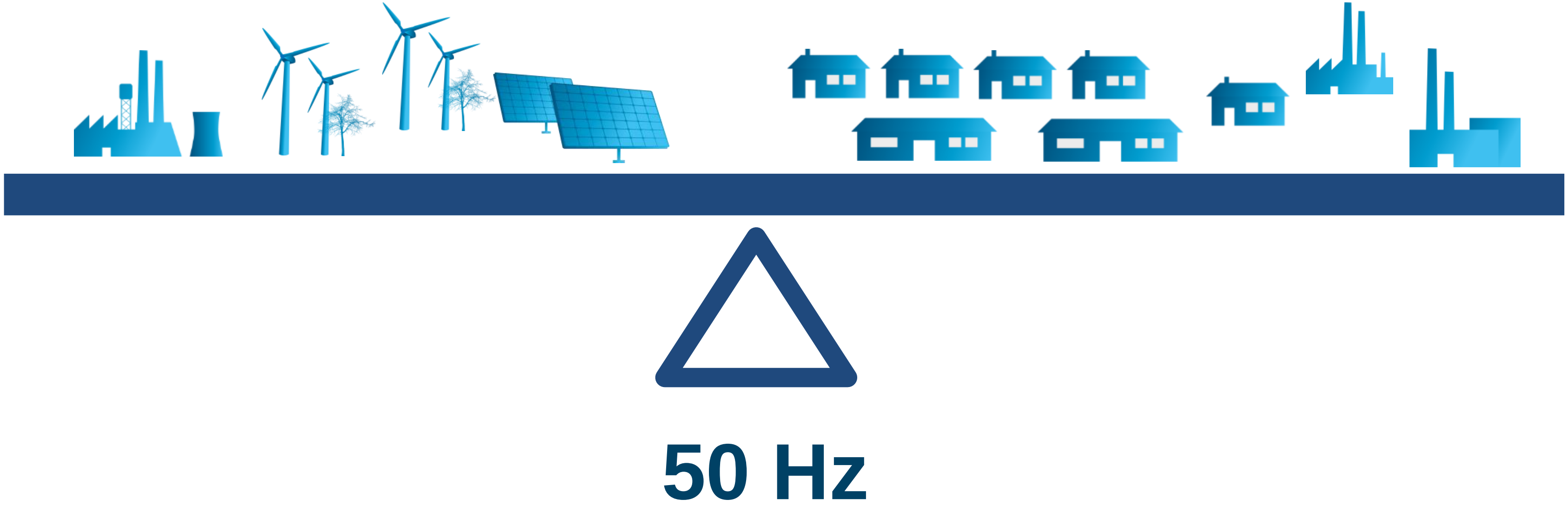
Frequency control



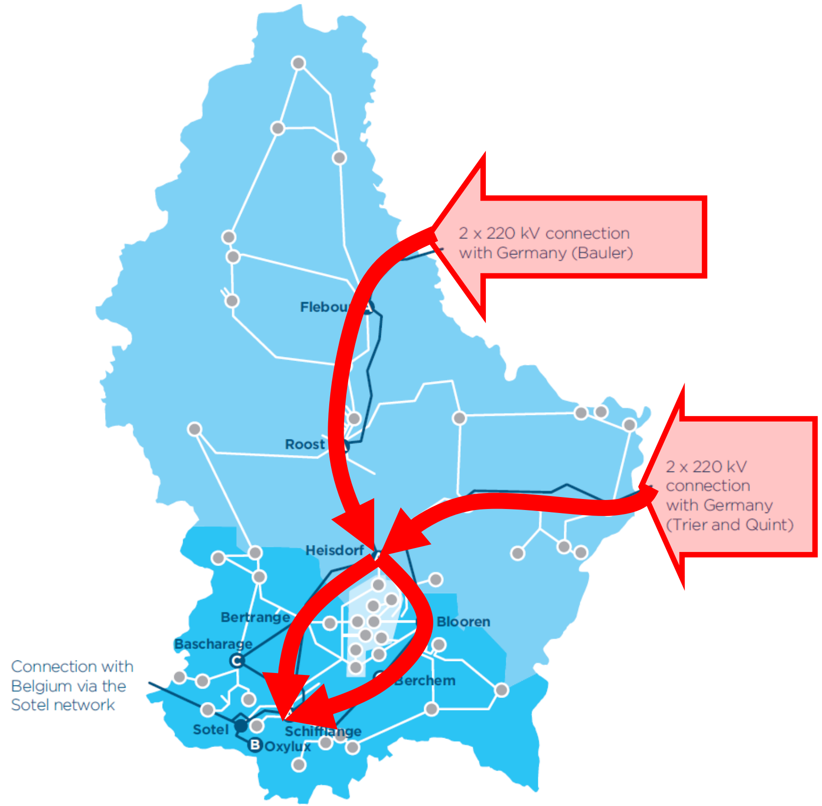
Frequency control



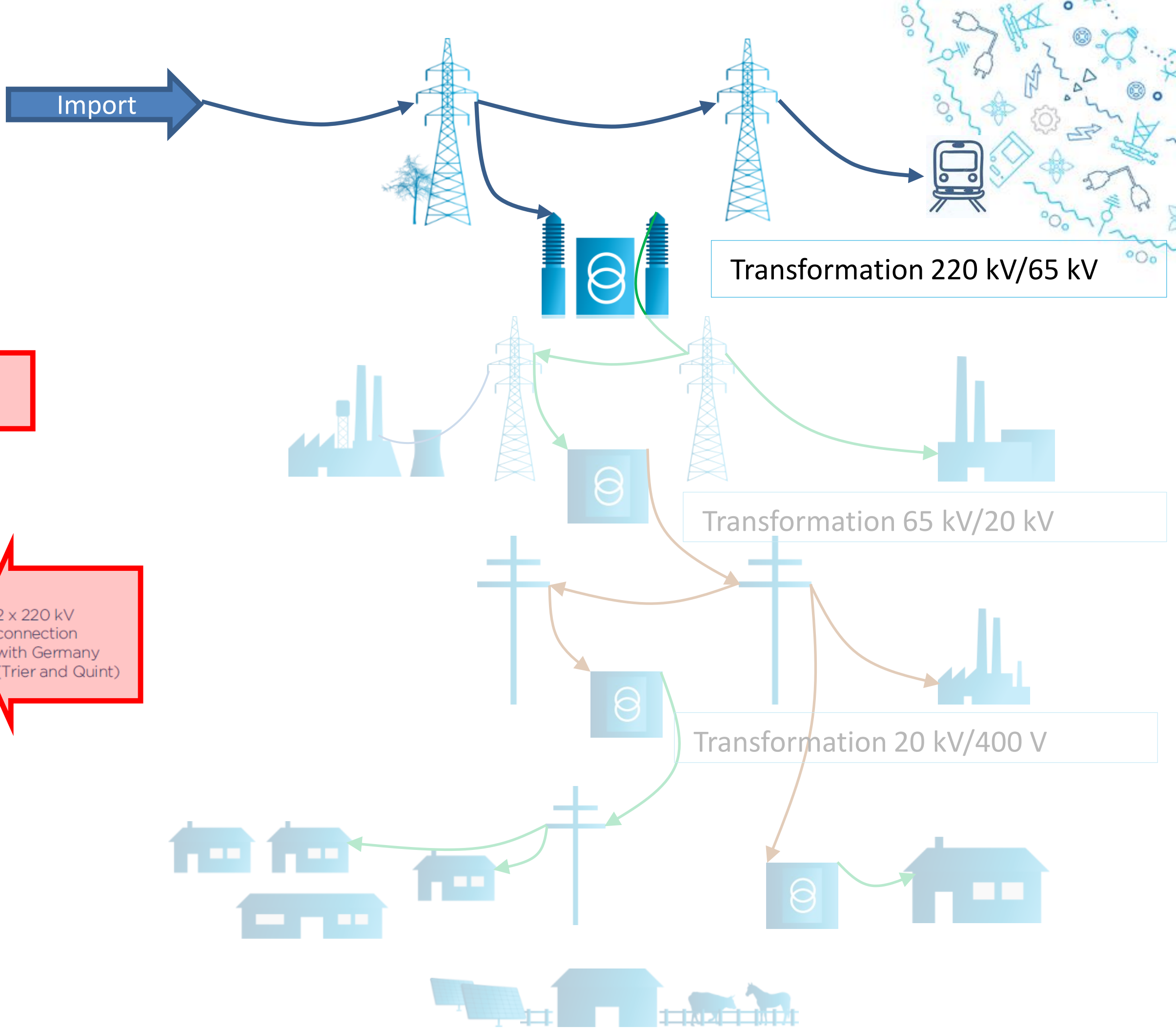
Frequency control



ENERGY TRANSITION DIALOGUE IN LUXEMBOURG



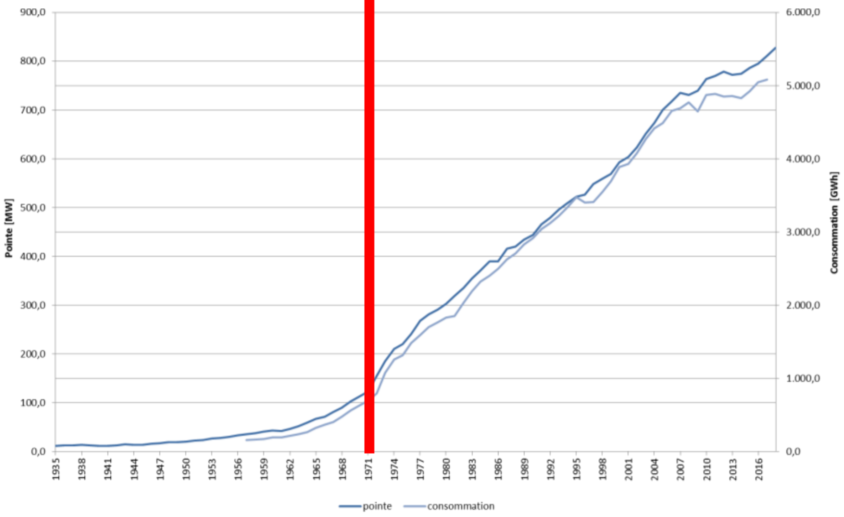
2 x 220 kV connection
with Germany (Bauler)
2 x 220 kV
connection
with Germany
(Trier and Quint)
Connection with
Belgium via the
Sotel network
Flebour
Roost
Heisdorf
Bertrange
Bascharage
Blooren
Berchem
Sotel
Schifflange
Oxylux

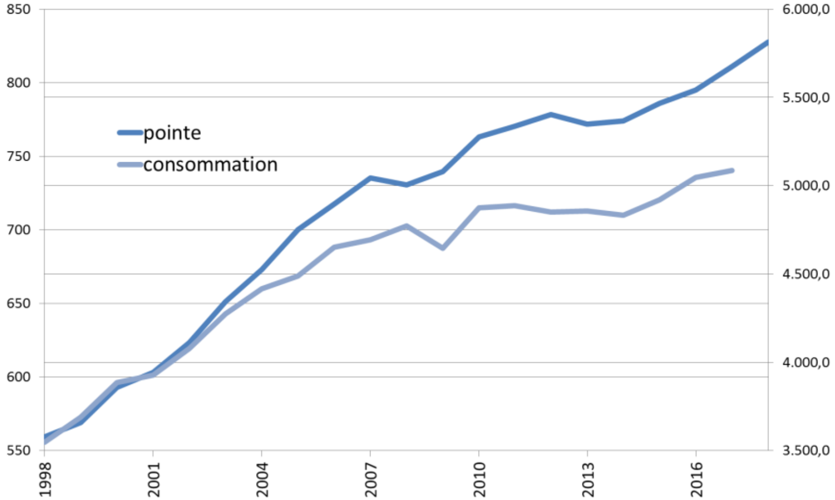


Import
Transformation 220 kV/65 kV
Transformation 65 kV/20 kV
Transformation 20 kV/400 V

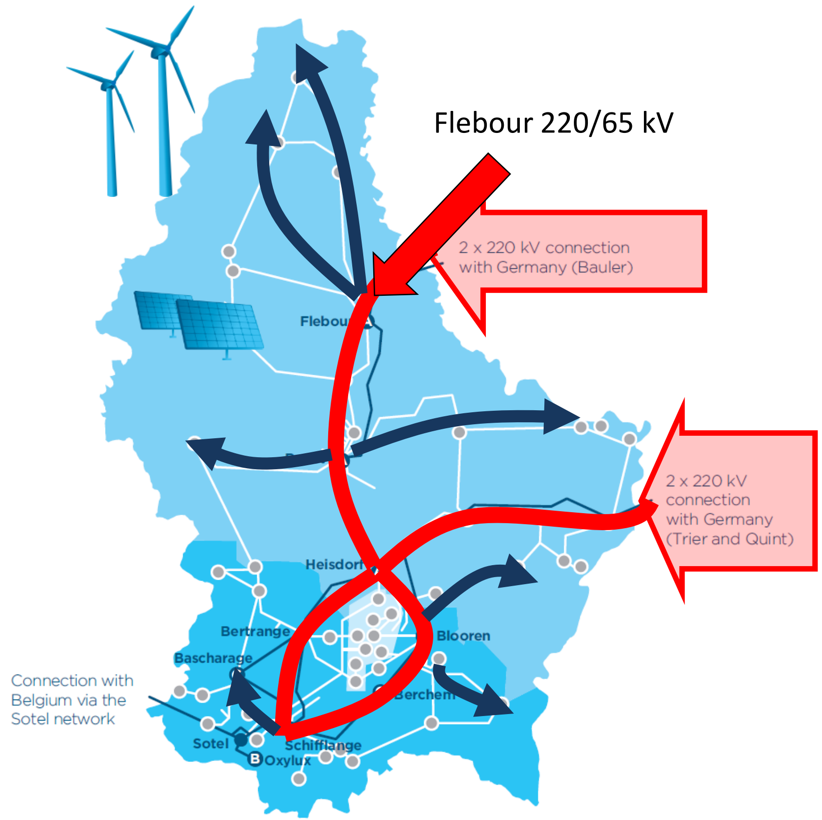
Peak Consumption Increase

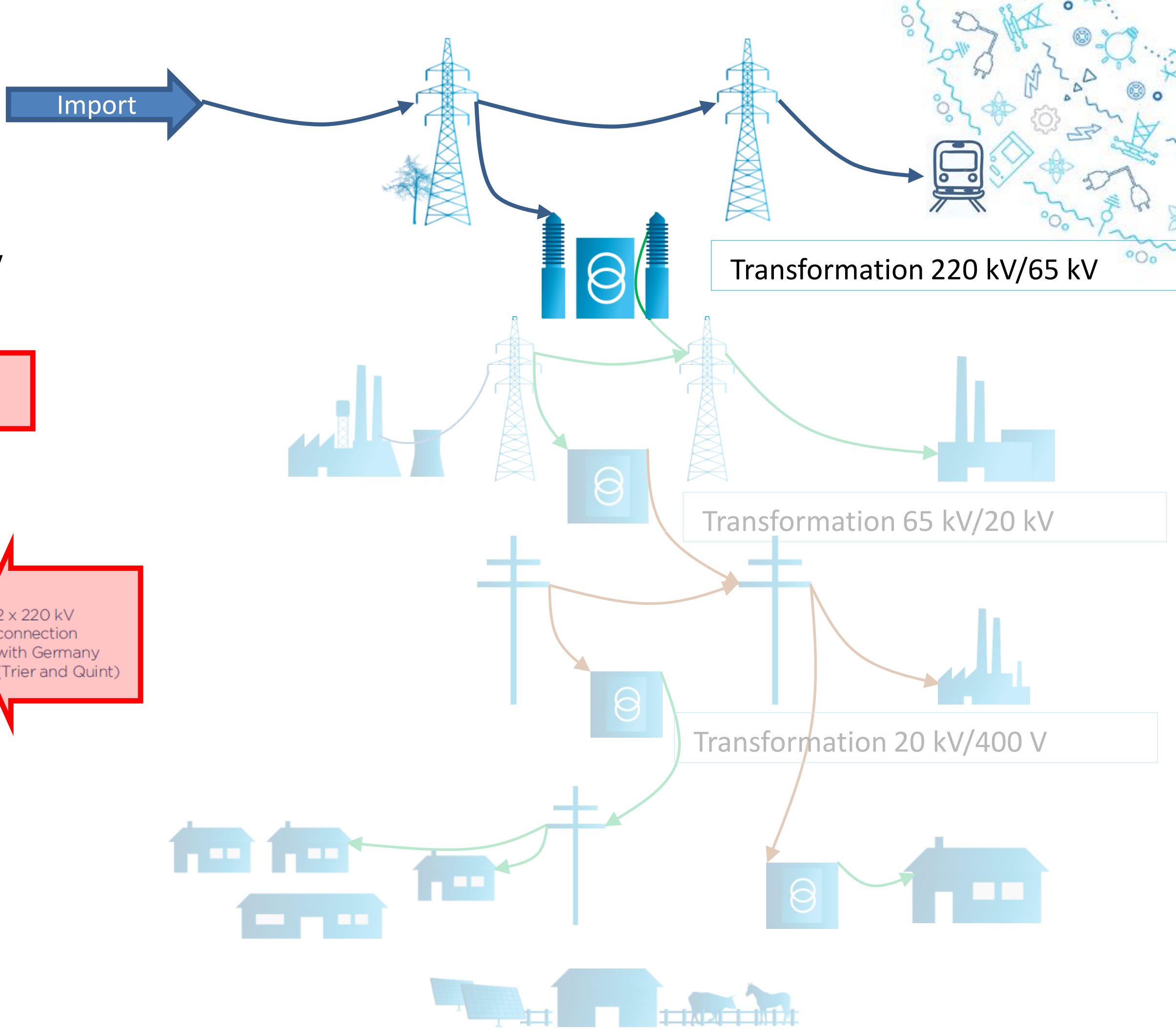
Design for the 2 inter-connectors to Germany beginning ‘70s

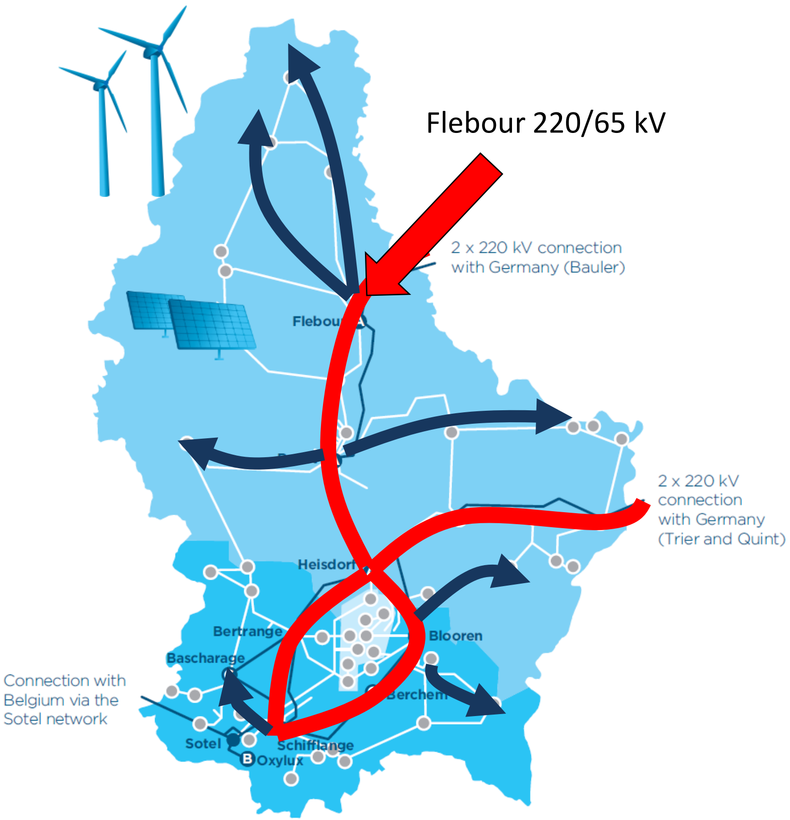




ENERGY TRANSITION DIALOGUE IN LUXEMBOURG


Flebour 220/65 kV
2 x 220 kV connection with Germany (Bauler)
2 x 220 kV connection with Germany (Trier and Quint)
Flebour
Heisdorf
Bertrange
Bascharage
Blooren
Berchem
Schifflange
Sotel
Oxylux
Connection with Belgium via the Sotel network


Import
Transformation 220 kV/65 kV
Transformation 65 kV/20 kV
Transformation 20 kV/400 V


Flebour 220/65 kV
2 x 220 kV connection
with Germany (Bauler)
Flebour
2 x 220 kV
connection
with Germany
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Heisdorf
Bertrange
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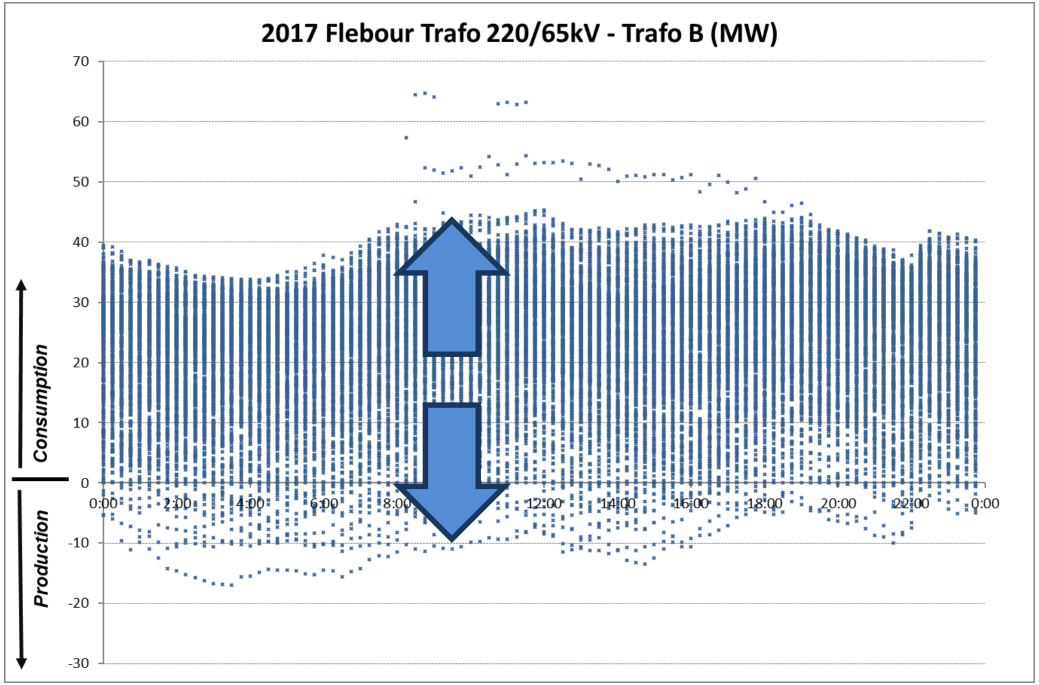
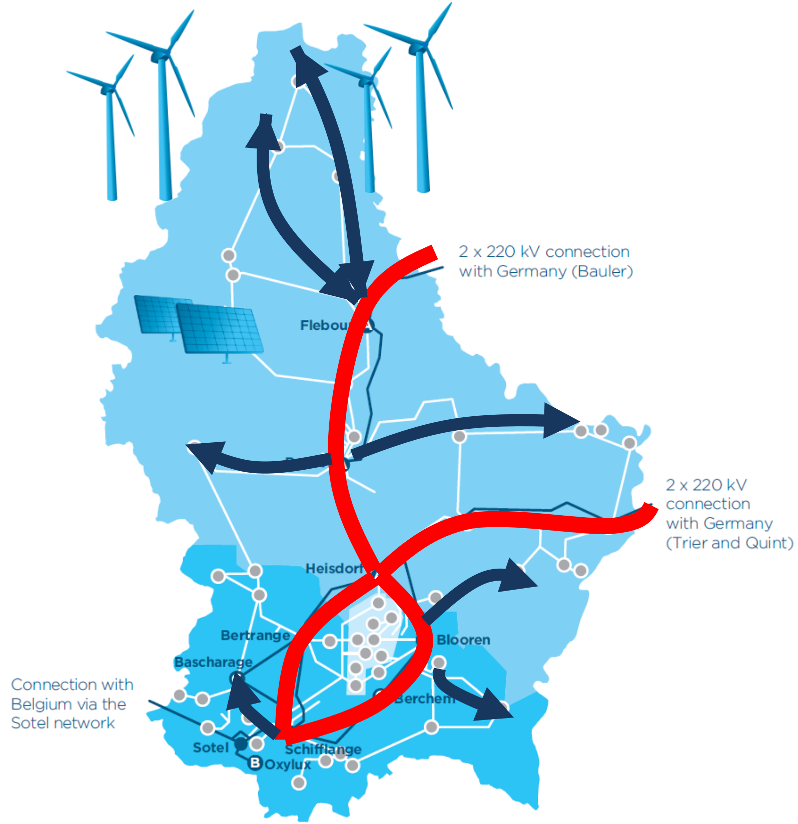
Blooren
Berchem
Connection with
Belgium via the
Sotel network
Sotel
Schifflange
Oxylux


2017 Flebour Trafo 220/65kV - Trafo B (MW)
70
60
50
40
30
20
10
0
-10
-20
-30
Consumption
Production
0:00
2:00
4:00
6:00
8:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00



2 x 220 kV connection with Germany (Bauler)
2 x 220 kV connection with Germany (Trier and Quint)
Connection with Belgium via the Sotel network
Flebour
Heisdorf
Bertrange
Bascharage
Blooren
Berchem
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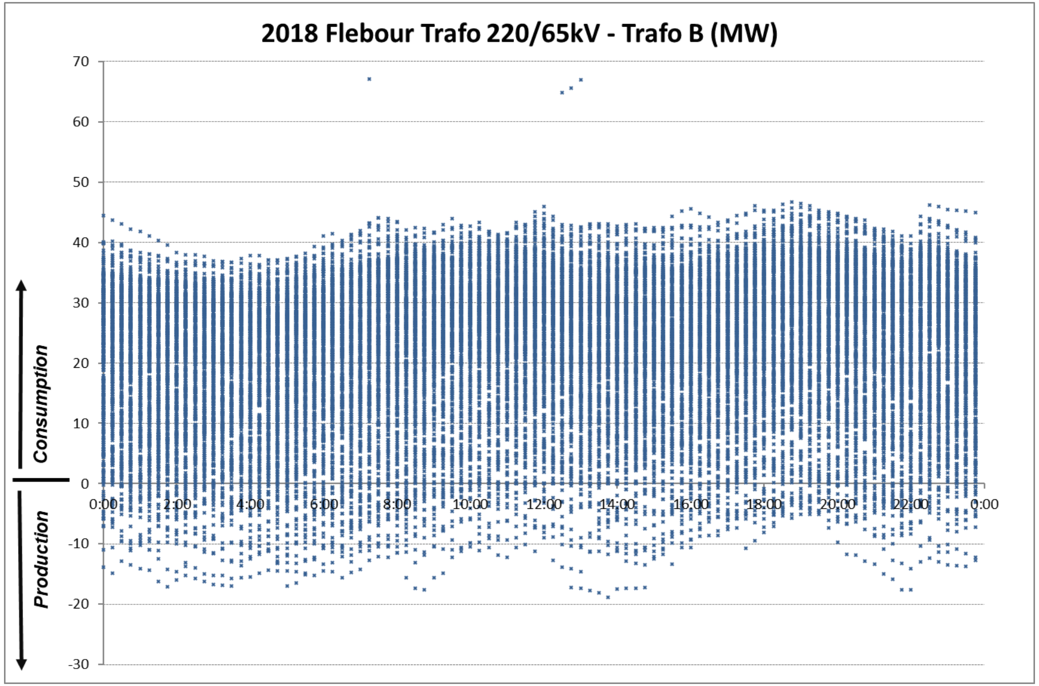
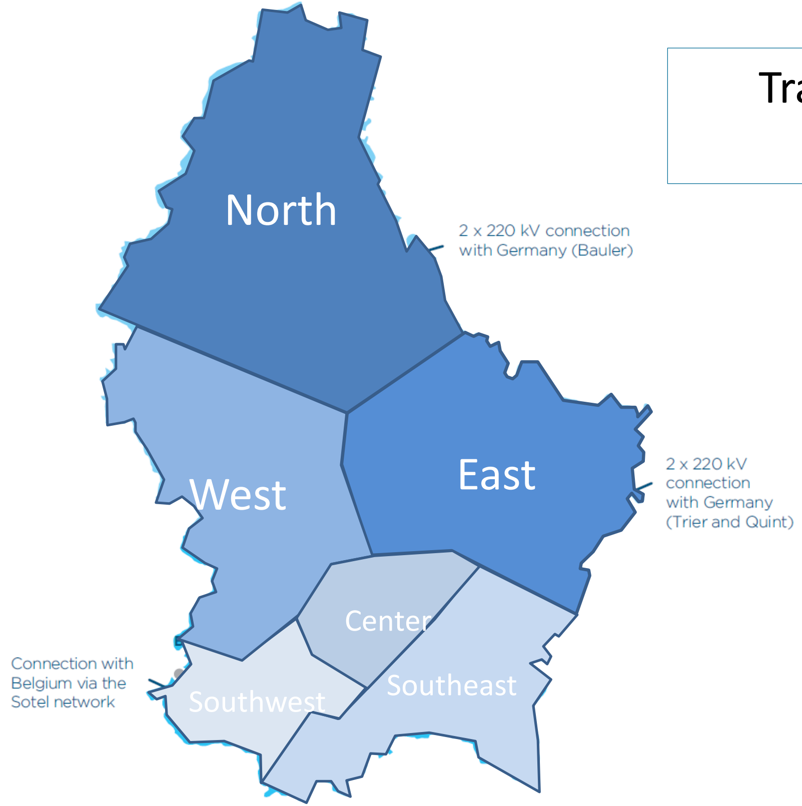
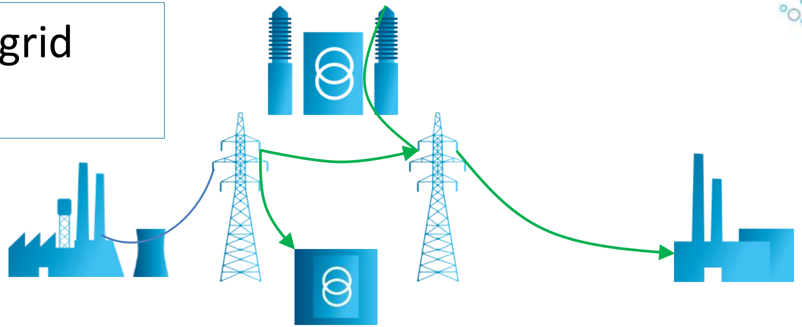


2018 Flebour Trafo 220/65kV - Trafo B (MW)
Consumption
Production
70
60
50
40
30
20
10
0
-10
-20
-30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

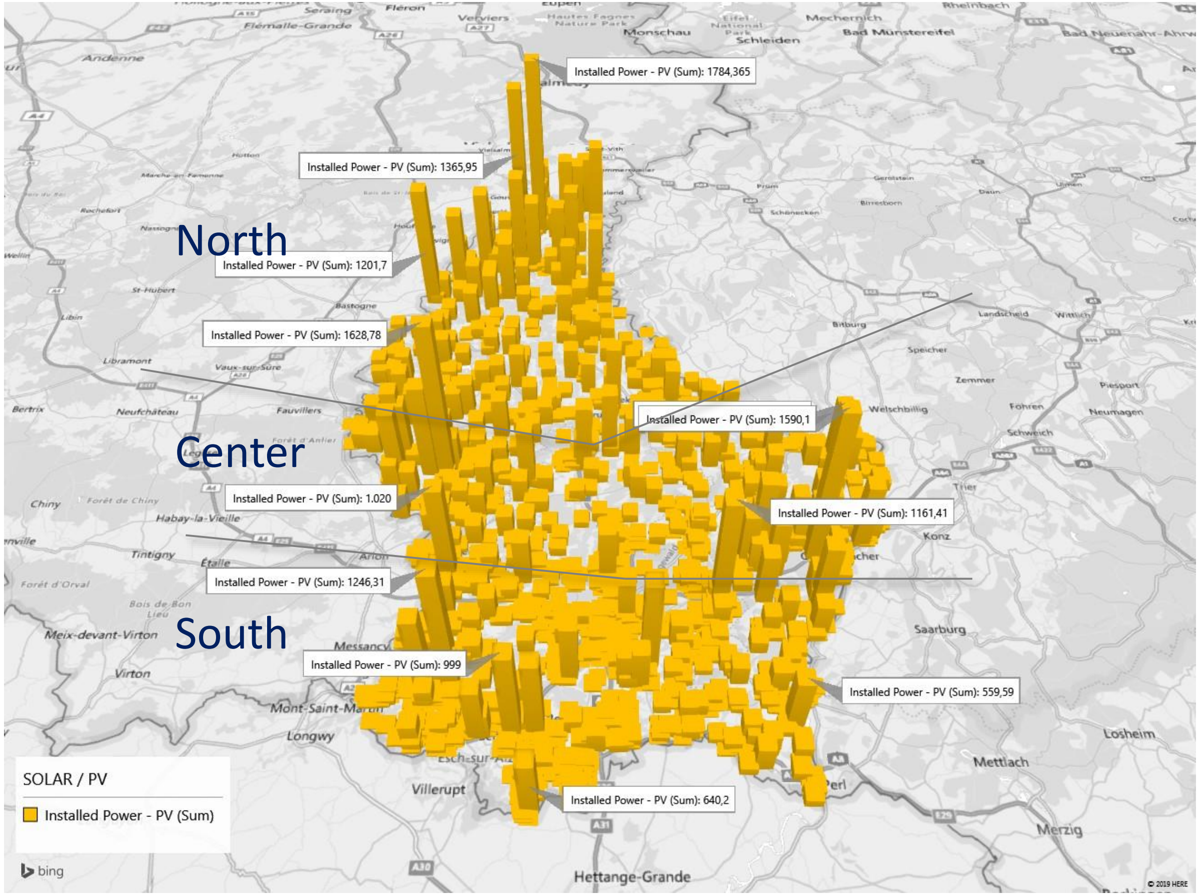


Transport grid
65 kV

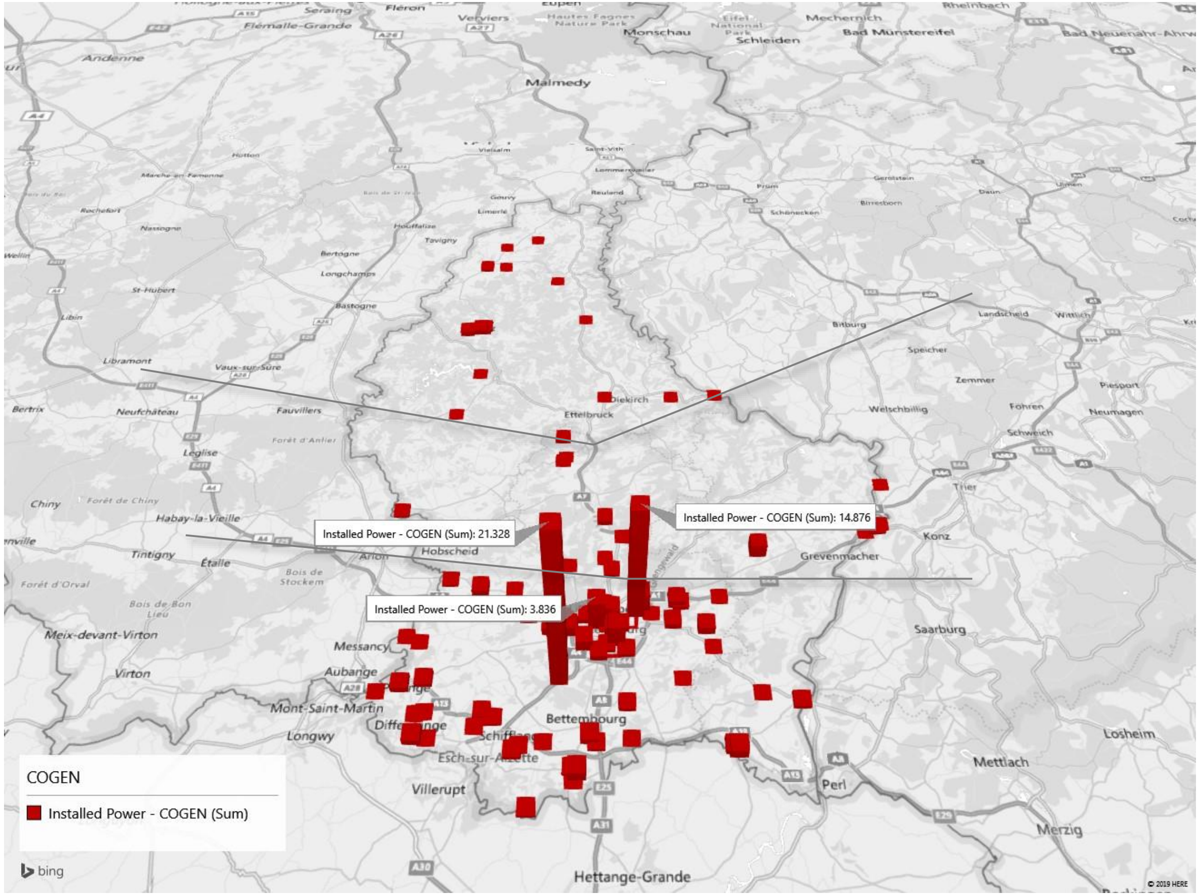


ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

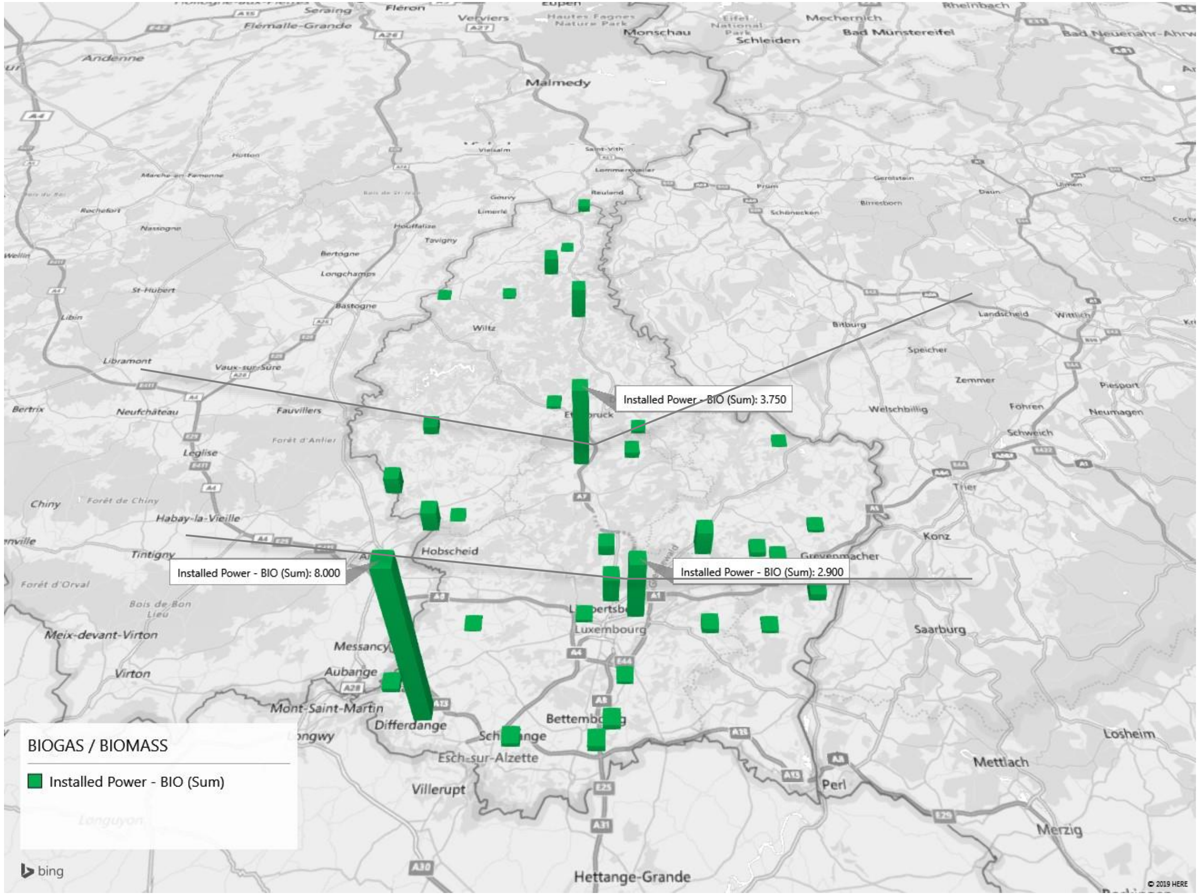
Installed PV production capacities



Installed CoGen production capacities



Installed Biomass production capacities



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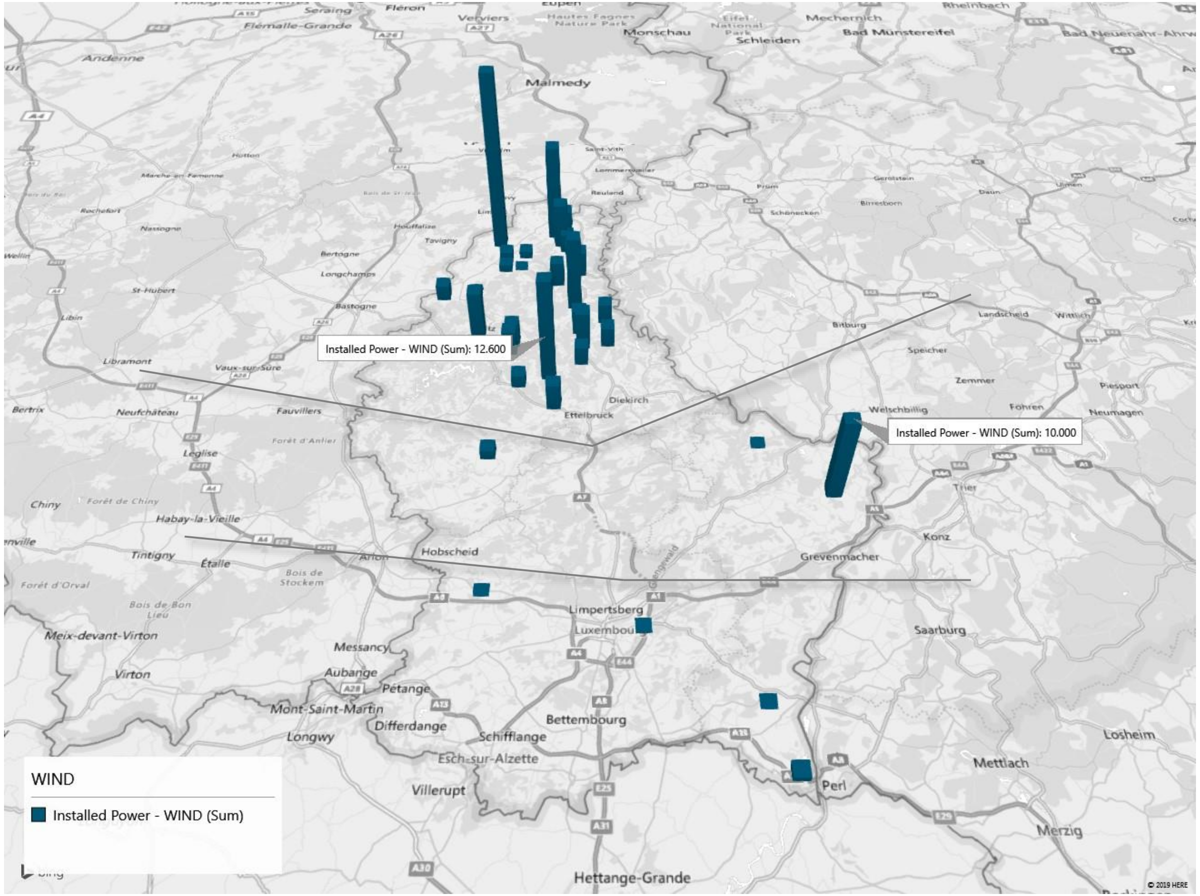
Installed Wind production capacities



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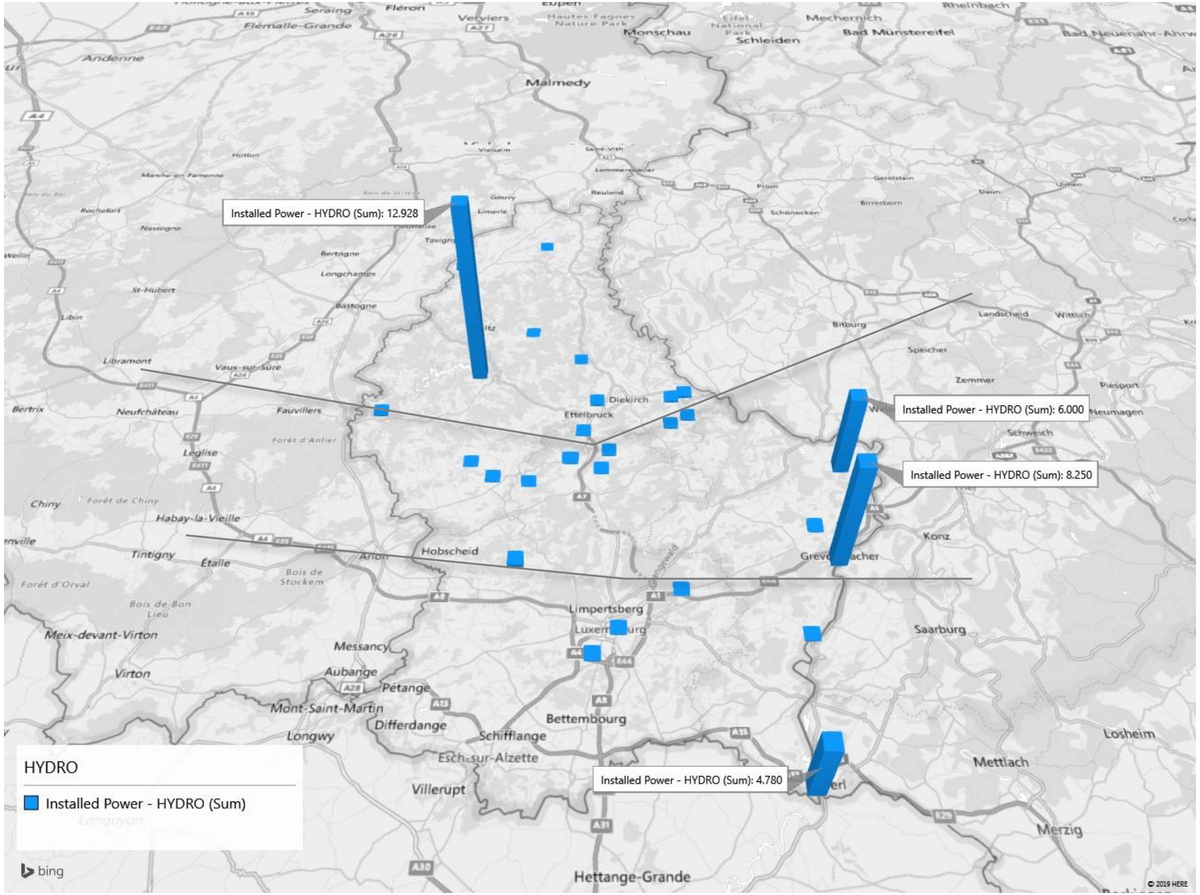
Installed Hydro production capacities



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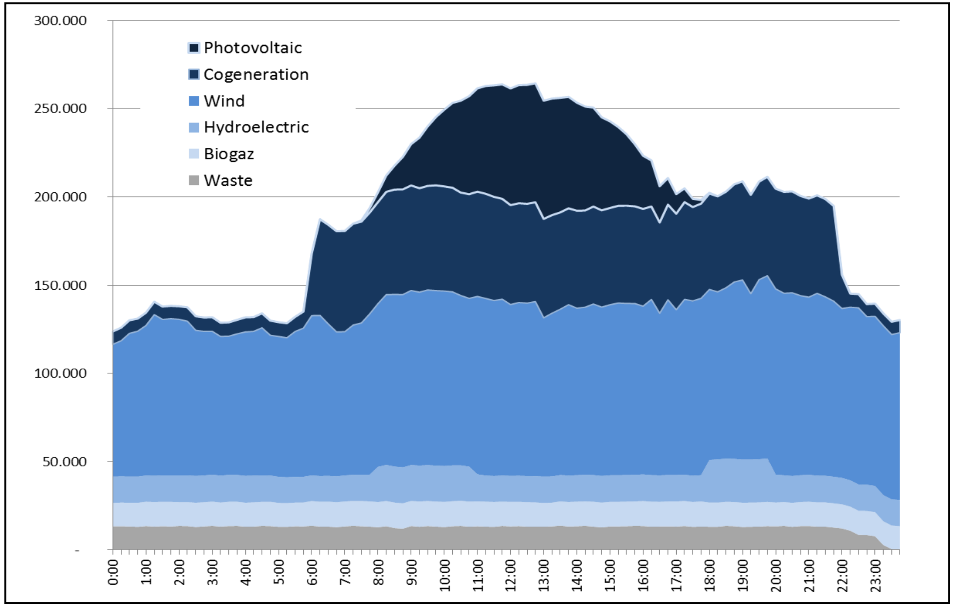
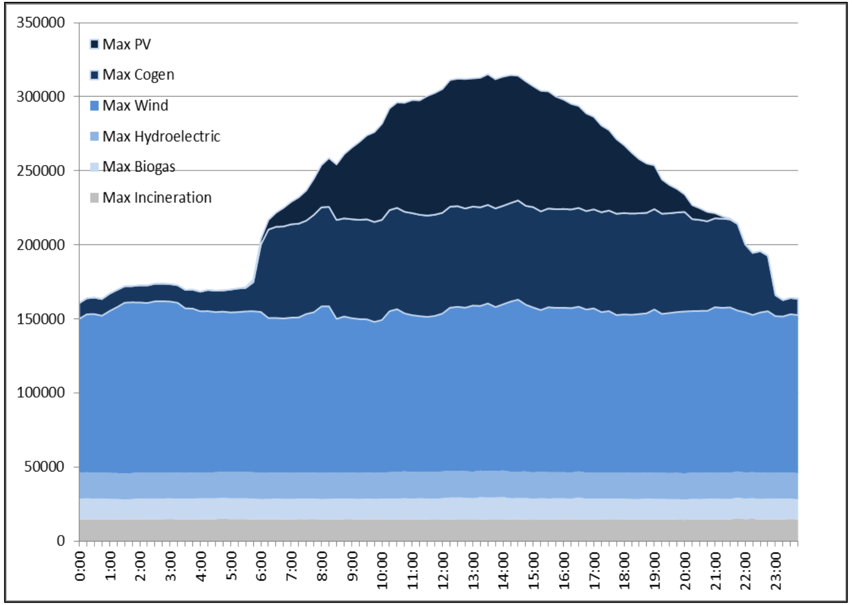
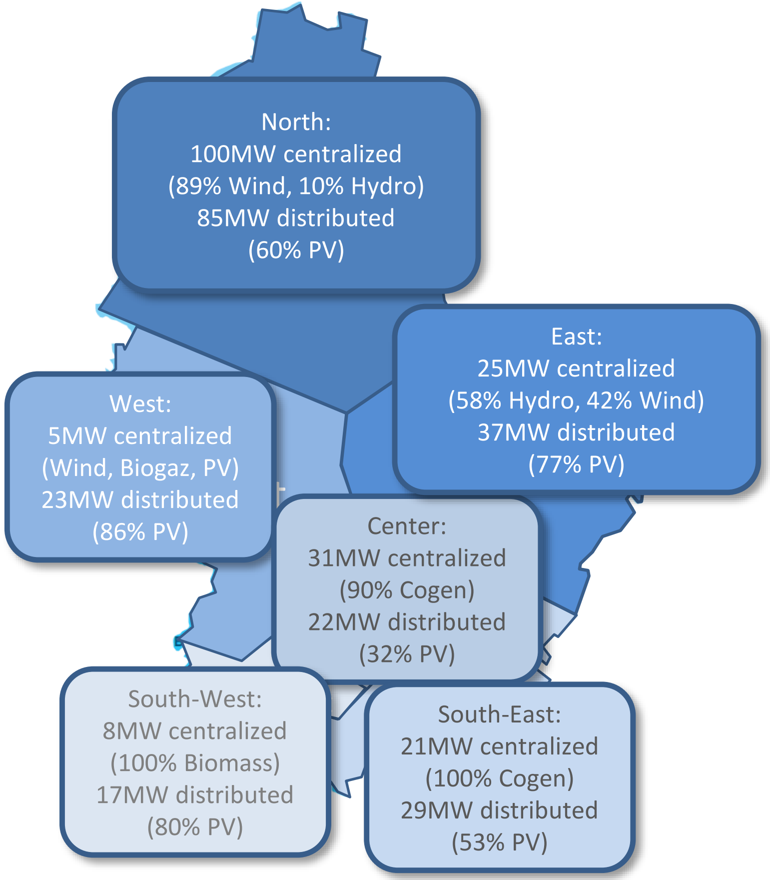
Luxembourg domestic production (KWh/h)



The day with the maximum production in winter 2018



All maximas of each 1/4h each type 2018



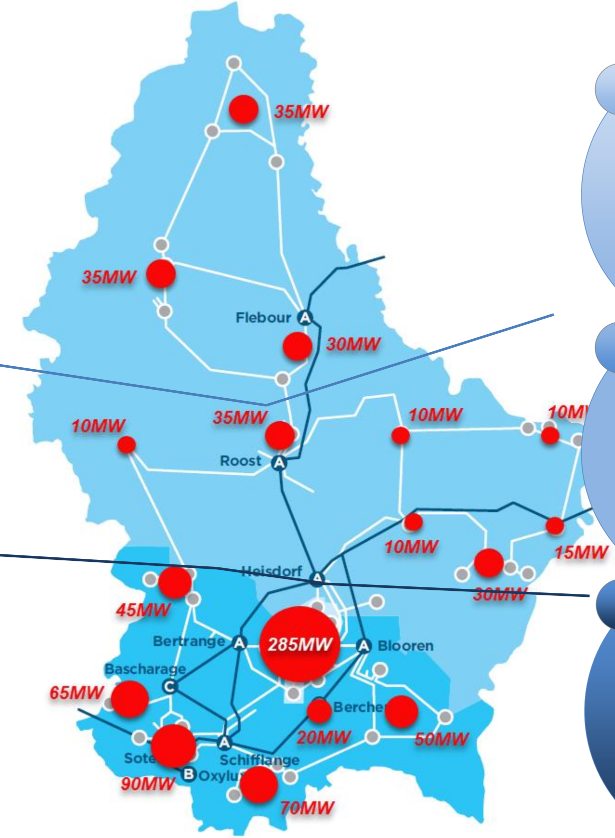
Total installed Generation in 2018: by technology:

PV:	135 MW
Wind:	123 MW
Cogen:	84 MW
Hydro:	34 MW
Bio:	27 MW
Total:	**403 MW**

Total installed Generation in 2018: by region:

North:	185 MW
Center:	53 MW
East:	52 MW
South-East:	50 MW
West:	28 MW
South-West:	25 MW
Total:	**403 MW**

Load / Production distribution (2018)



North

~ 120MW

Center

~ 165MW

South & VDL

~585MW

(285MW VDL)

(300MW South)

Load (peak)

North

~170 MW

120MW Wind

40 MW PV

10 MW Gogen

Center

~110 MW

30 MW Hydro

60 MW PV

20 MW Cogen

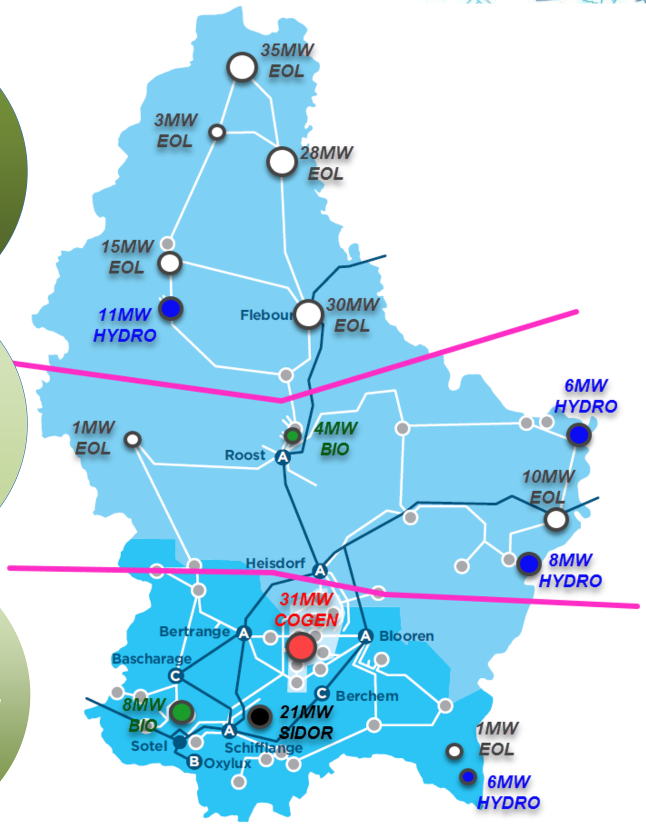
South & VDL

~ 140 MW

105 MW Wind

35 MW PV

> 400MW installed capacity



* Only biggest generation units shown

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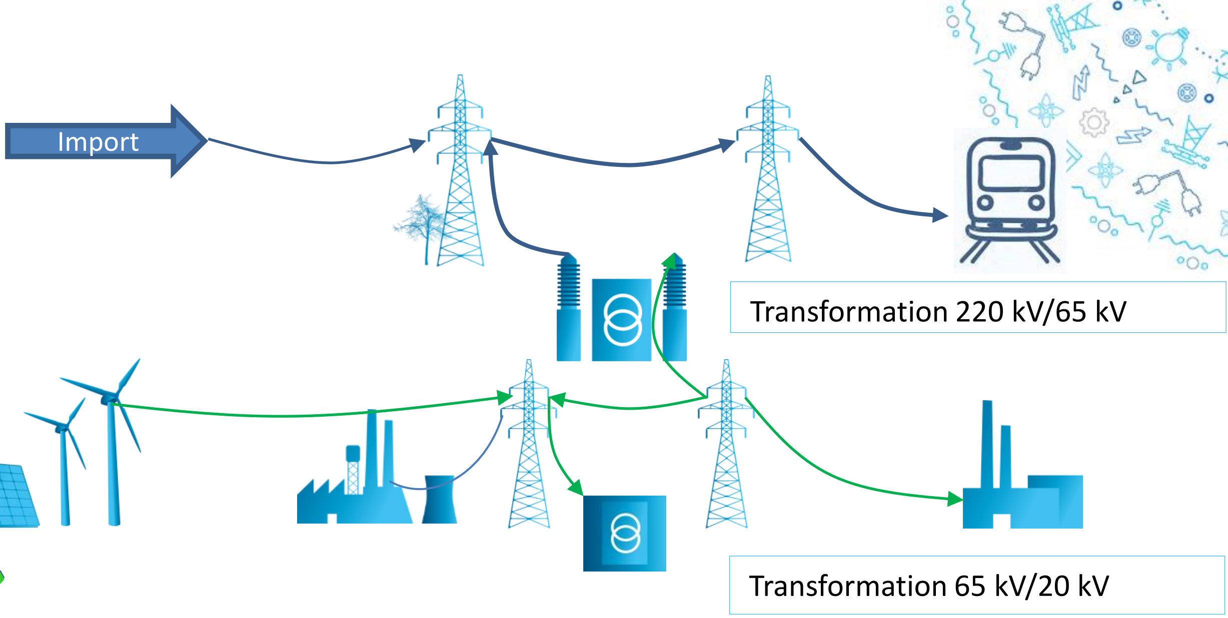
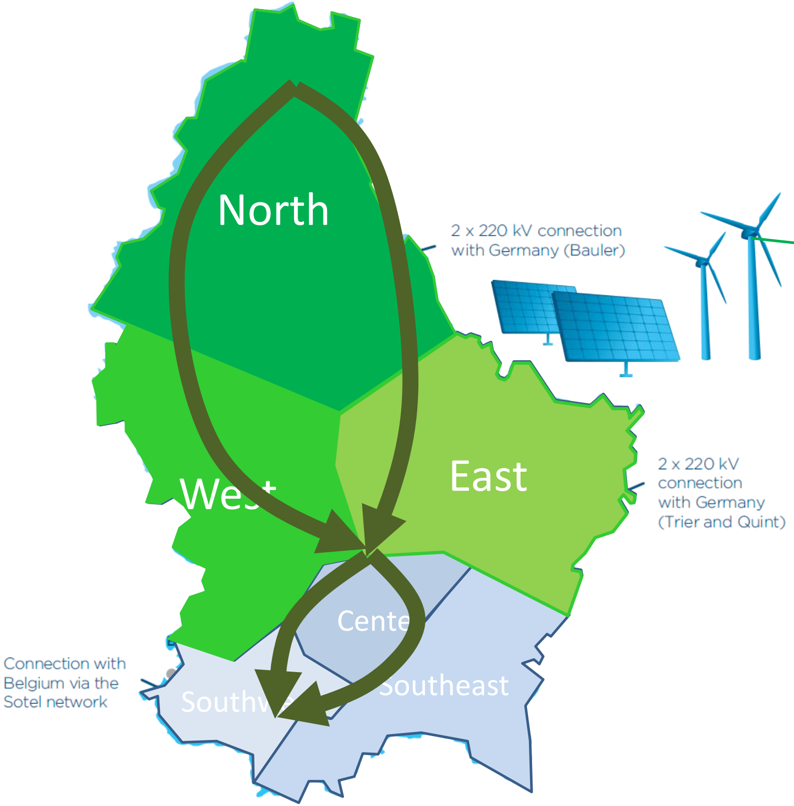
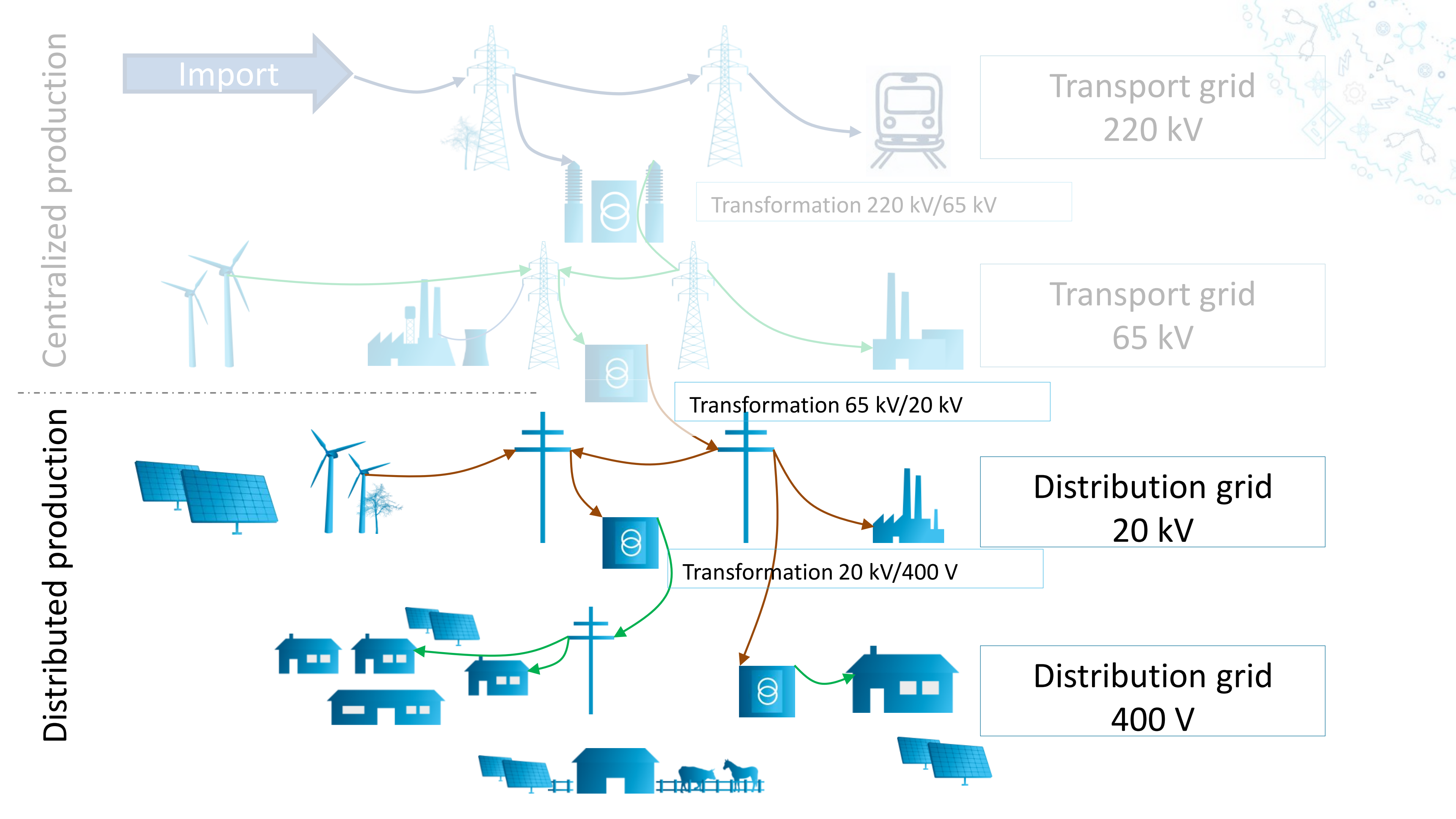
ENERGY TRANSITION DIALOGUE IN LUXEMBOURG





A high renewable penetration requires a strong HT Grid including 65/20kv transformer stations!

ENERGY TRANSITION DIALOGUE IN LUXEMBOURG



Centralized production
Distributed production
Import
Transport grid
220 kV
Transformation 220 kV/65 kV
Transport grid
65 kV
Transformation 65 kV/20 kV
Distribution grid
20 kV
Transformation 20 kV/400 V
Distribution grid
400 V

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- Energy Communities
- The challenge of the Energy Transition
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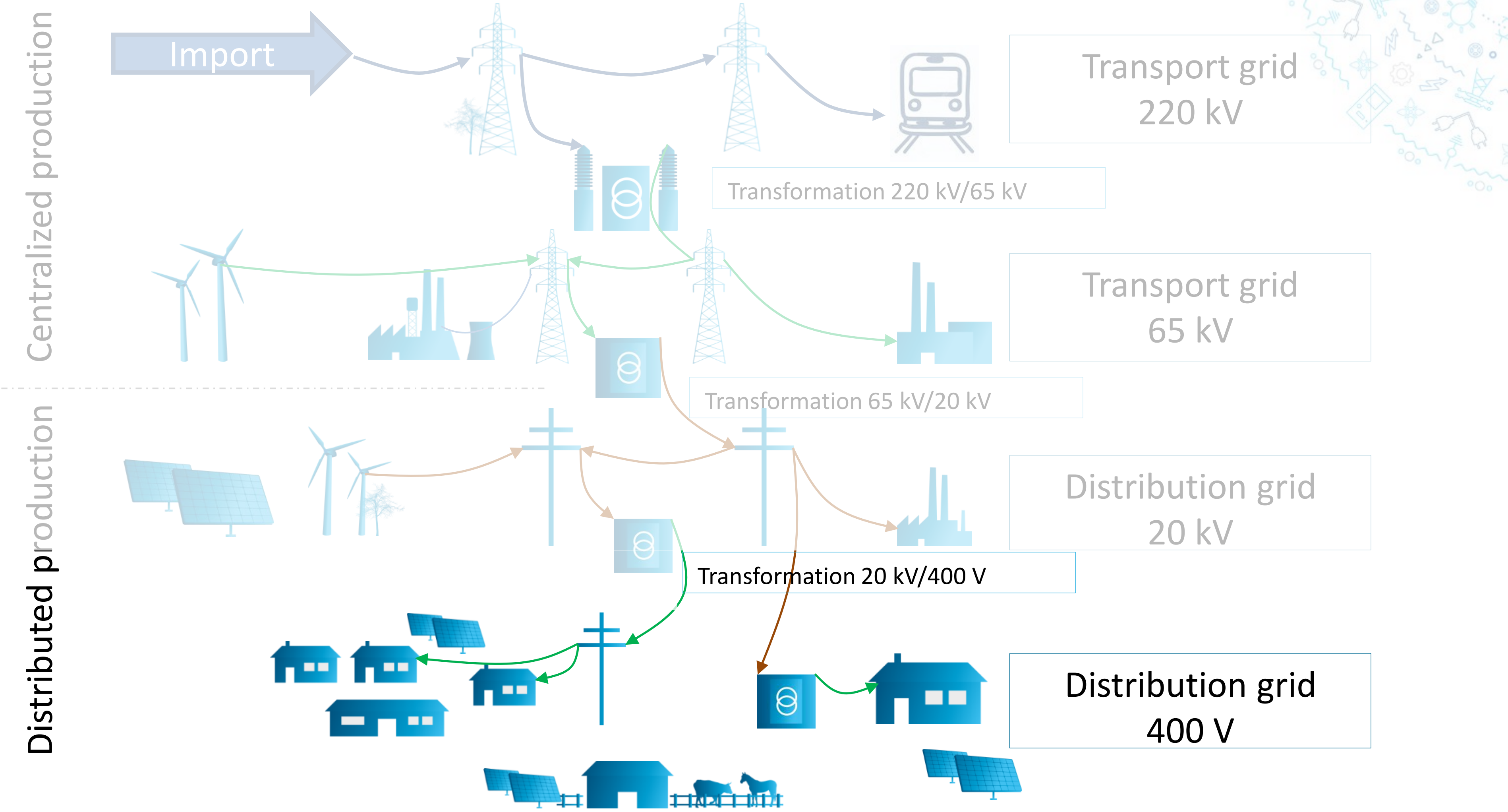
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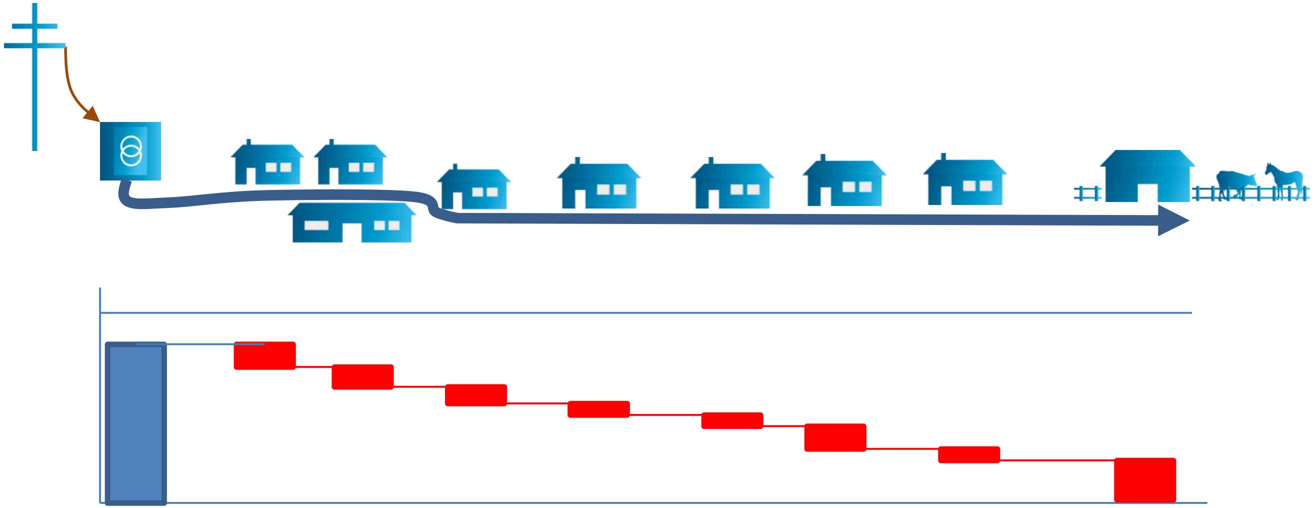
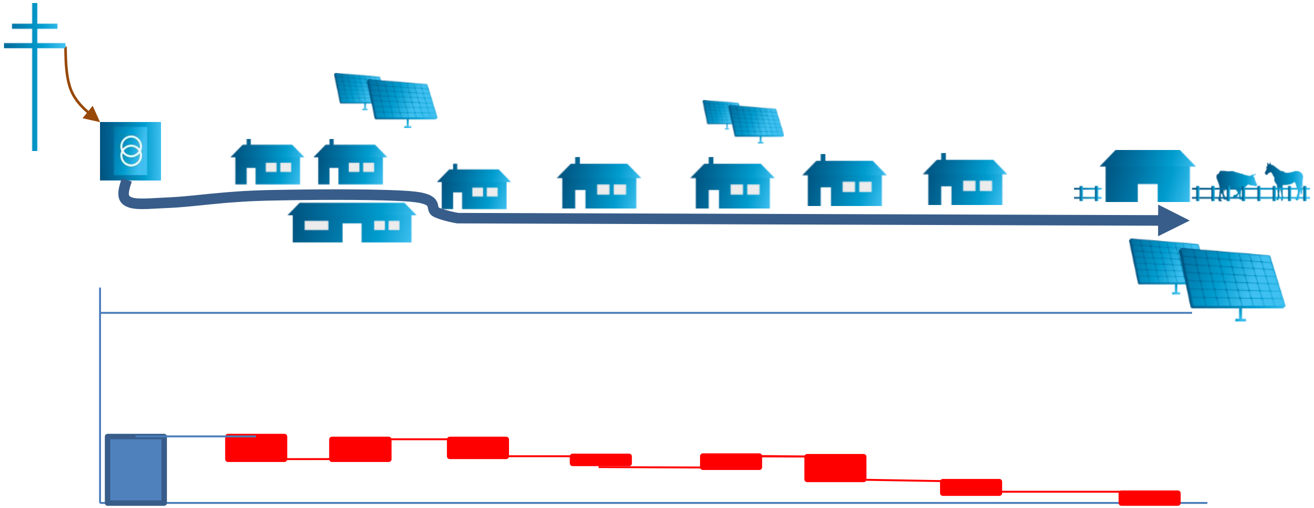
20 kV
Transformation 20 kV/400 V
Distribution grid
400 V

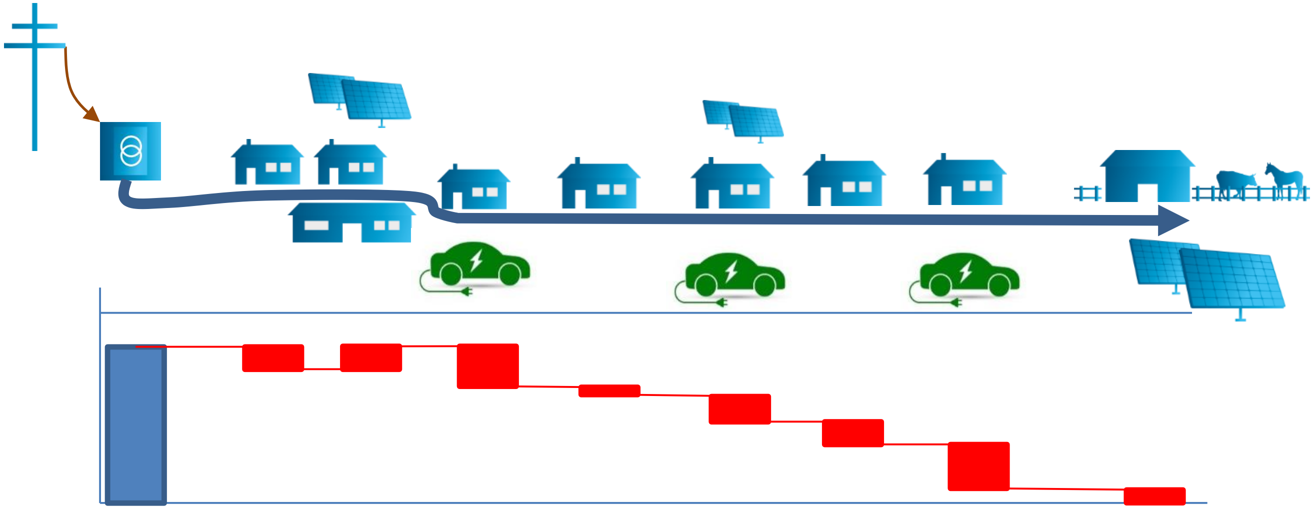
Routing to the consumer 400 V



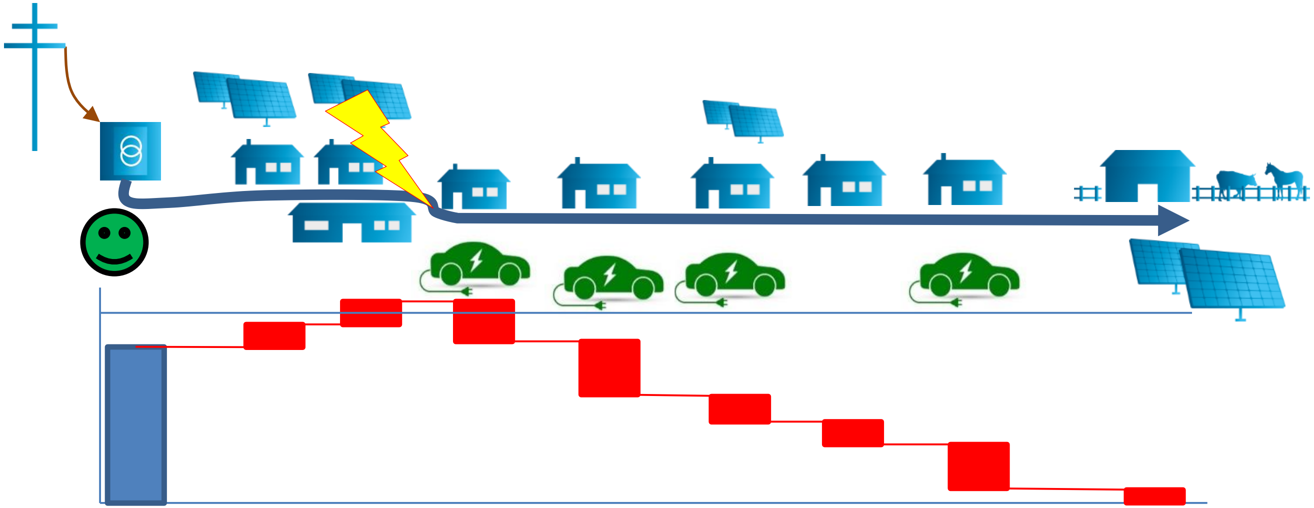
Routing to the consumer 400 V



Routing to the consumer 400 V

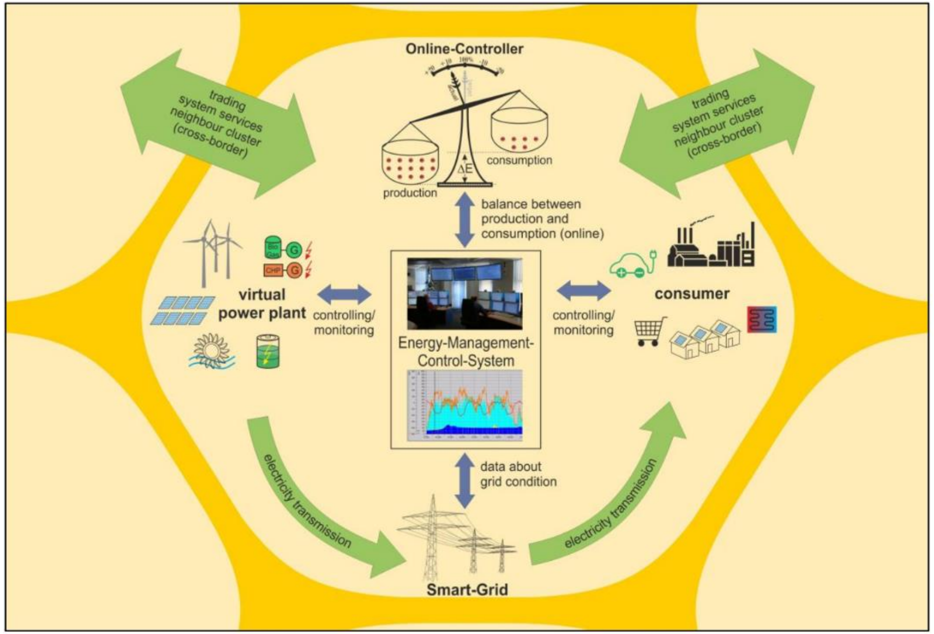


Routing to the consumer 400 V



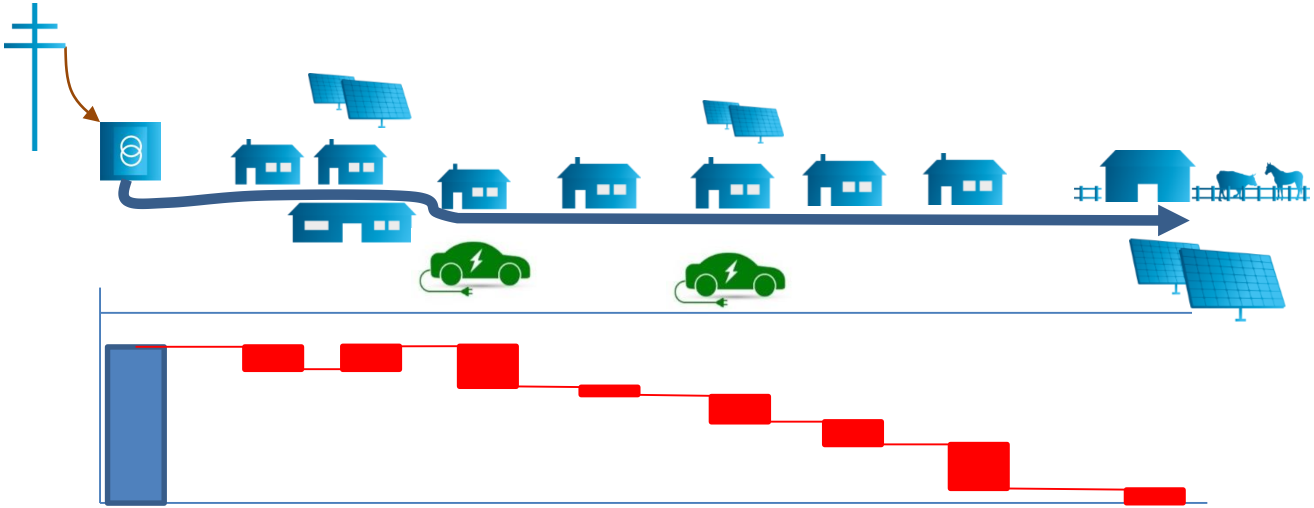
ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

Local Energy Community

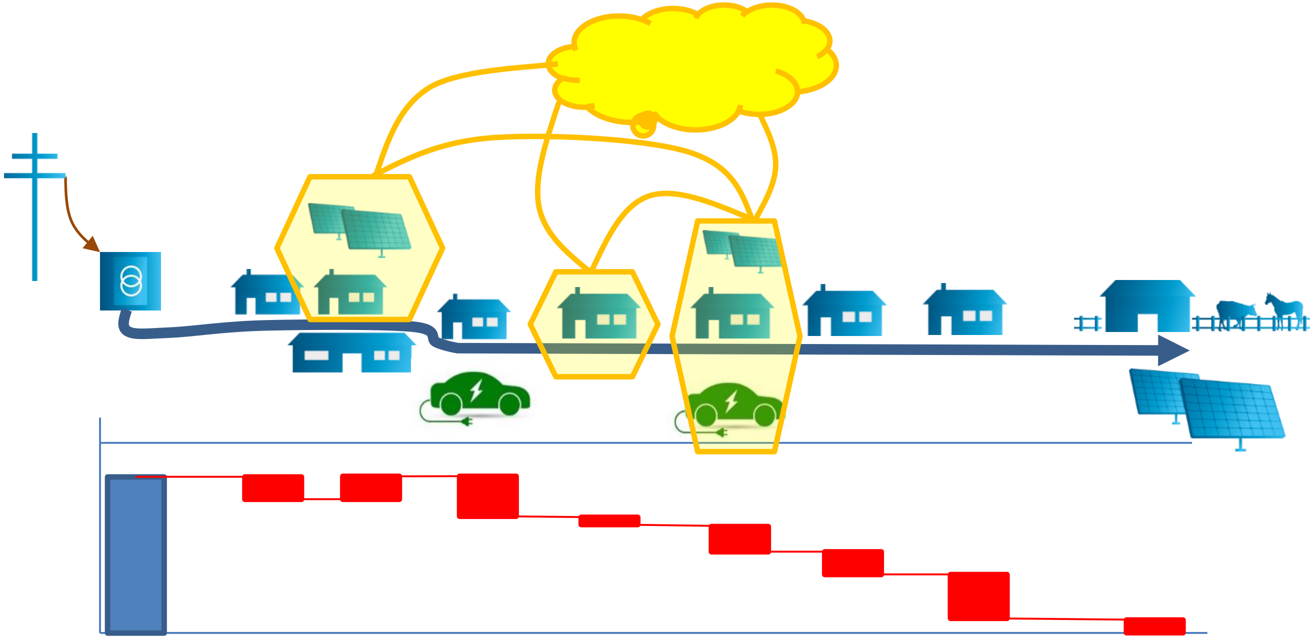


The basic idea of a local energy community is to ensure electricity supply from regional renewable energy production and to regulate this at distribution grid level if possible. This concerns a spatially limited area, which contains all components for electricity supply (generation, transmission, storage and consumption). They should be flexibly adapted to each other, so that no shortages arise, the volatile supply of renewable energy is easier to predict and curtailment of energy is prevented as far as possible.

Local Energy Community

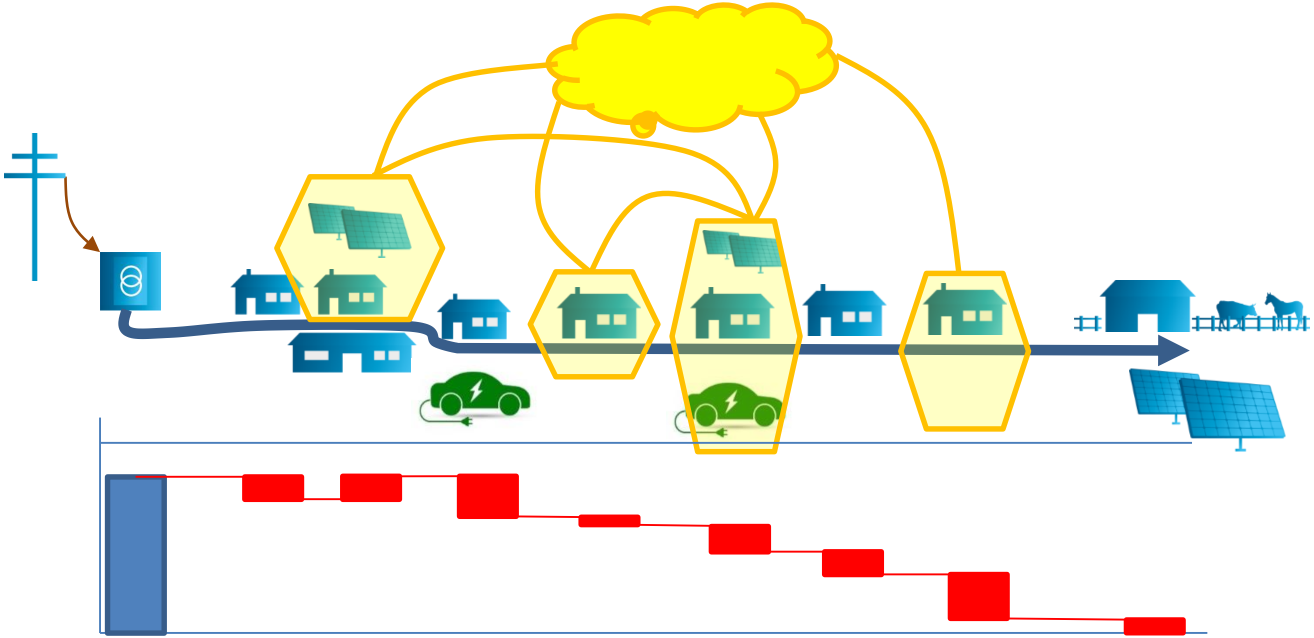


Local Energy Community

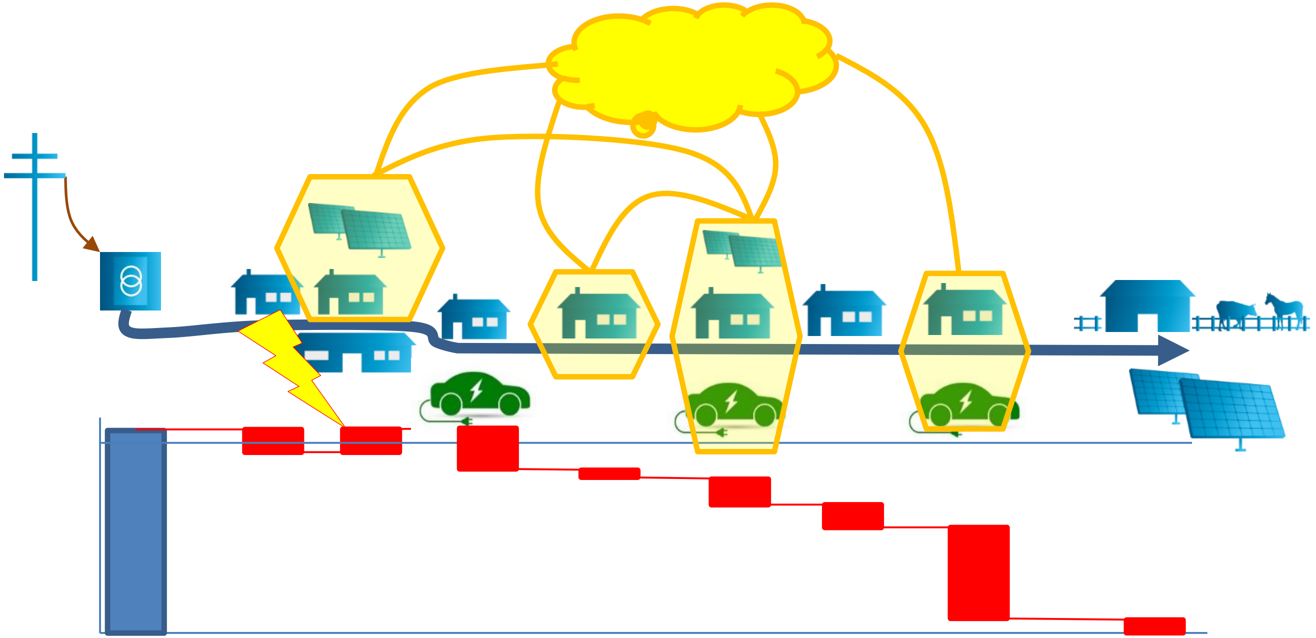


There will be an optimisation of the energy cell or energy cluster, but not an optimisation of the electricity grid!

Local Energy Community



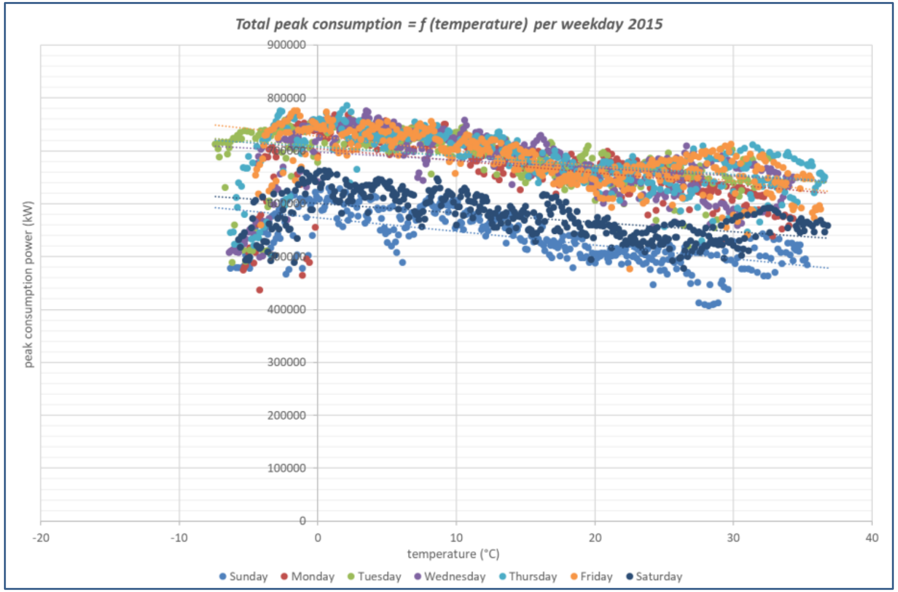
Local Energy Community



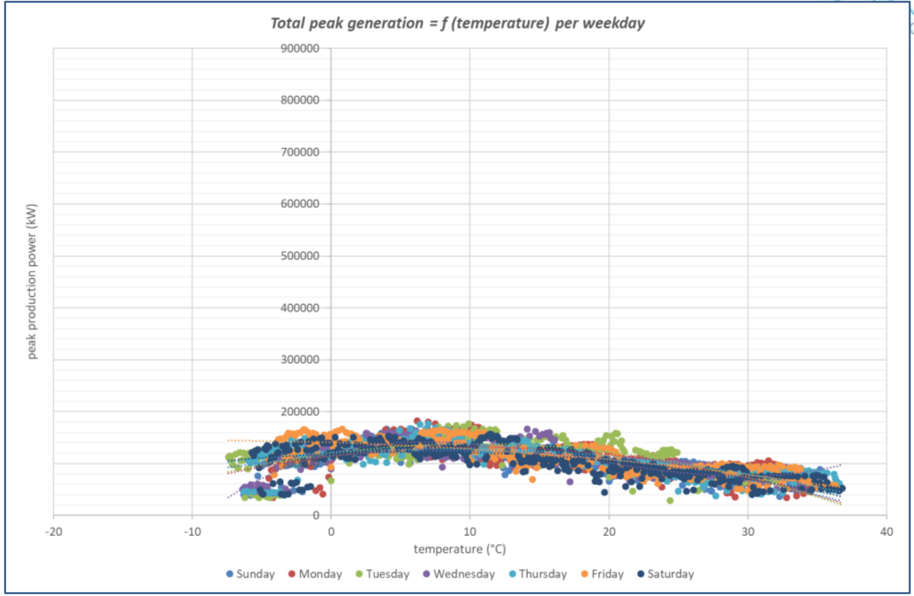
The situation of the electricity grid could even become worse!

ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

2015

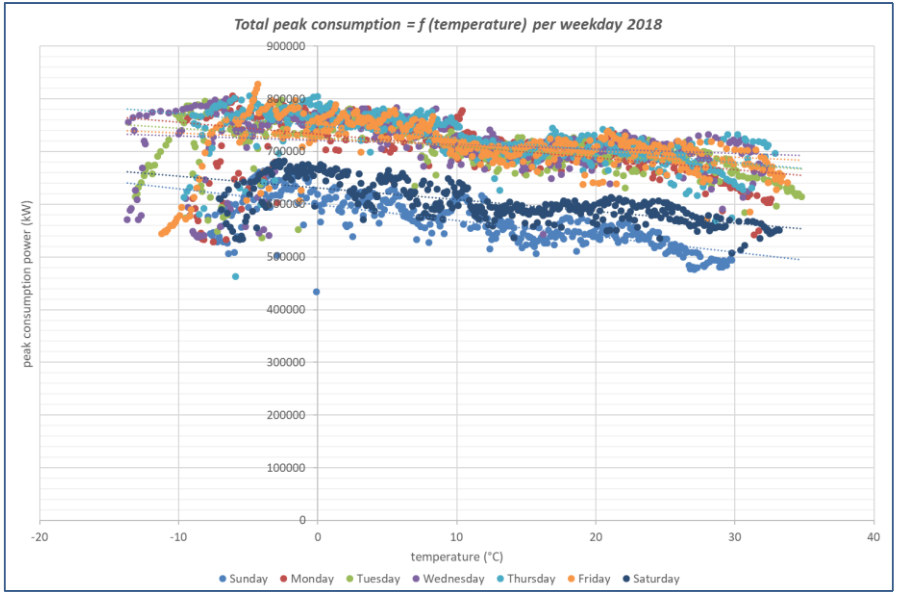


Total peak consumption = f (temperature) per weekday 2015
peak consumption power (kW)
temperature (°C)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

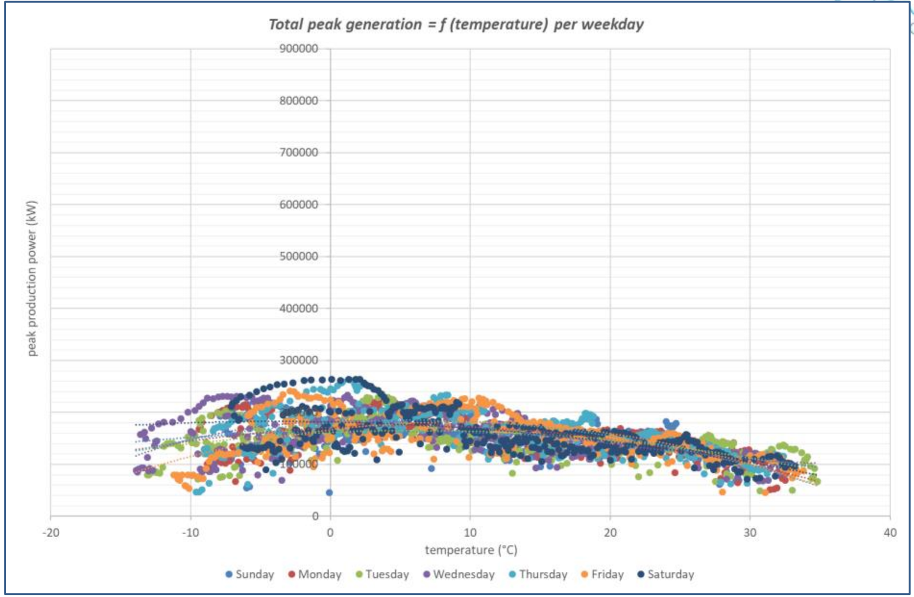


Total peak generation = f (temperature) per weekday
peak production power (kW)
temperature (°C)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

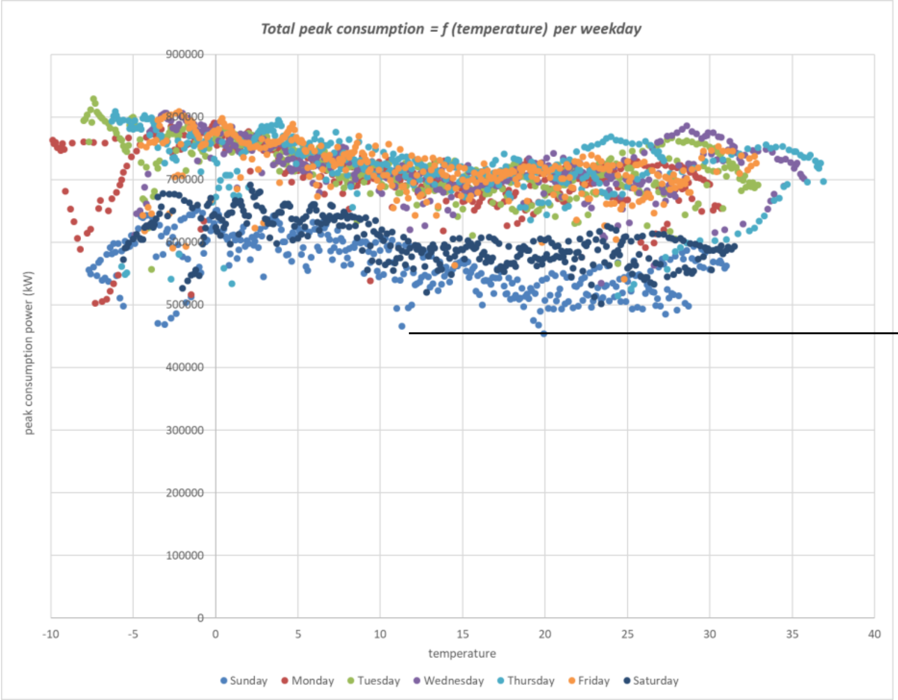
2018



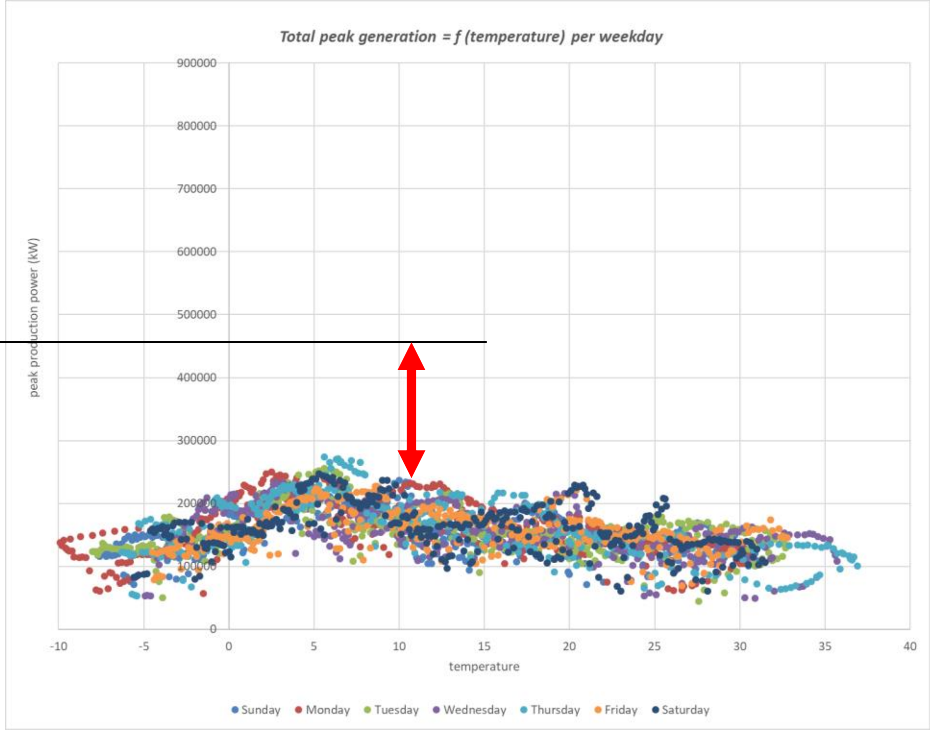
Total peak consumption = f (temperature) per weekday 2018
peak consumption power (kW)
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-20
-10
0
10
20
30
40
temperature (°C)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday



Total peak generation = f (temperature) per weekday
peak production power (kW)
900000
800000
700000
600000
500000
400000
300000
100000
0
-20
-10
0
10
20
30
40
temperature (°C)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday



Total peak consumption = f (temperature) per weekday
peak consumption power (kW)
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-10
-5
0
5
10
15
20
25
30
35
40
temperature
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday



Total peak generation = f (temperature) per weekday
peak production power (kW)
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-10
-5
0
5
10
15
20
25
30
35
40
temperature
Sunday
Monday
Tuesday
Wednesday
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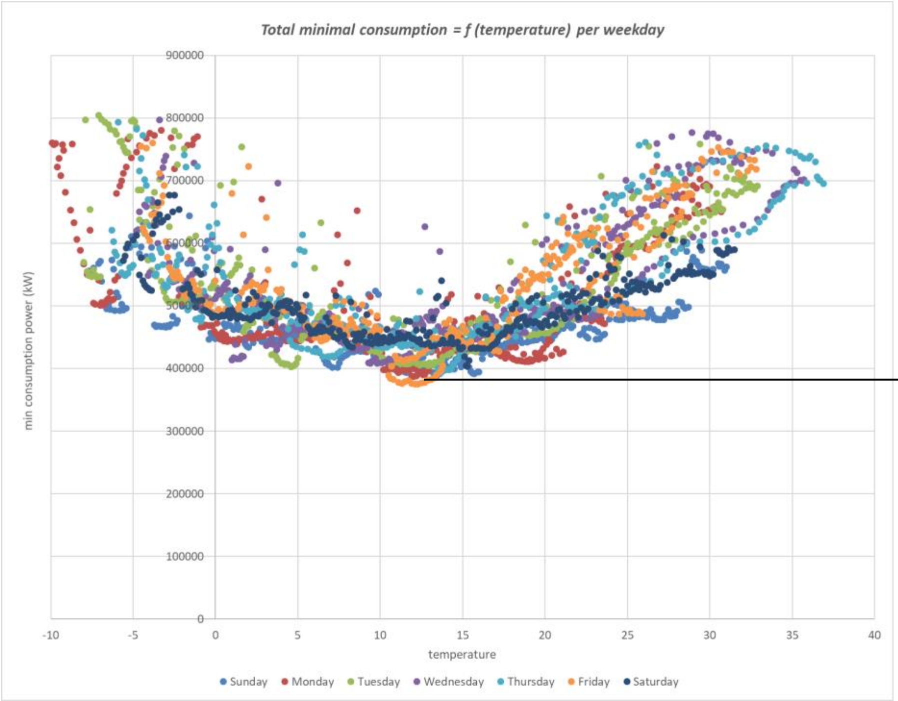
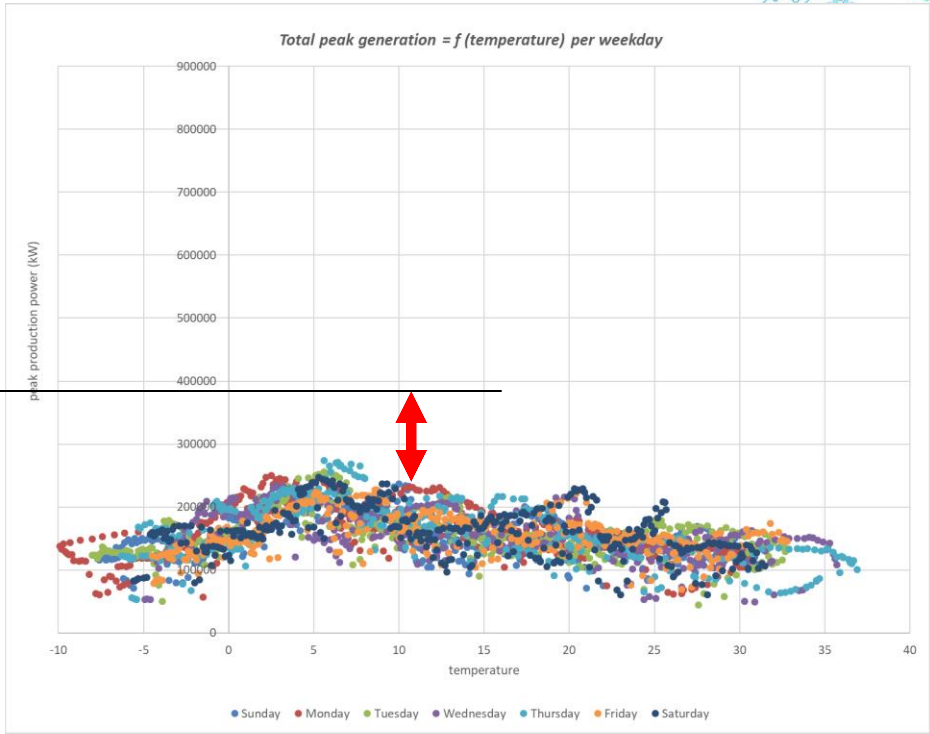
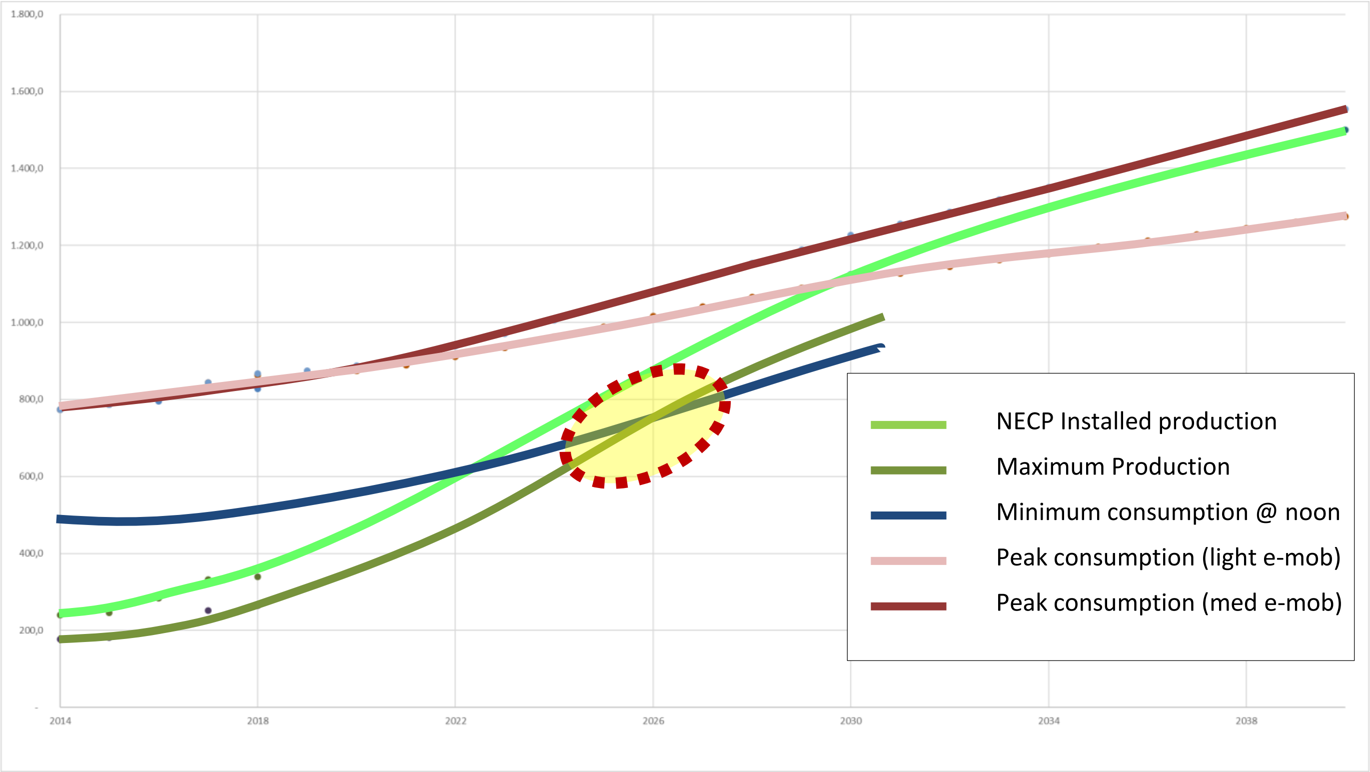
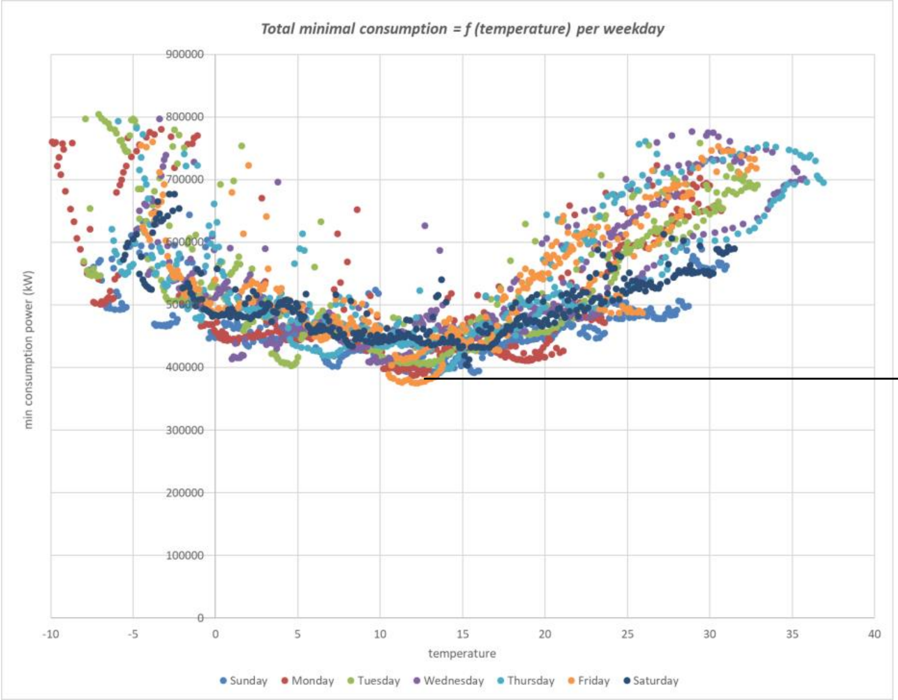


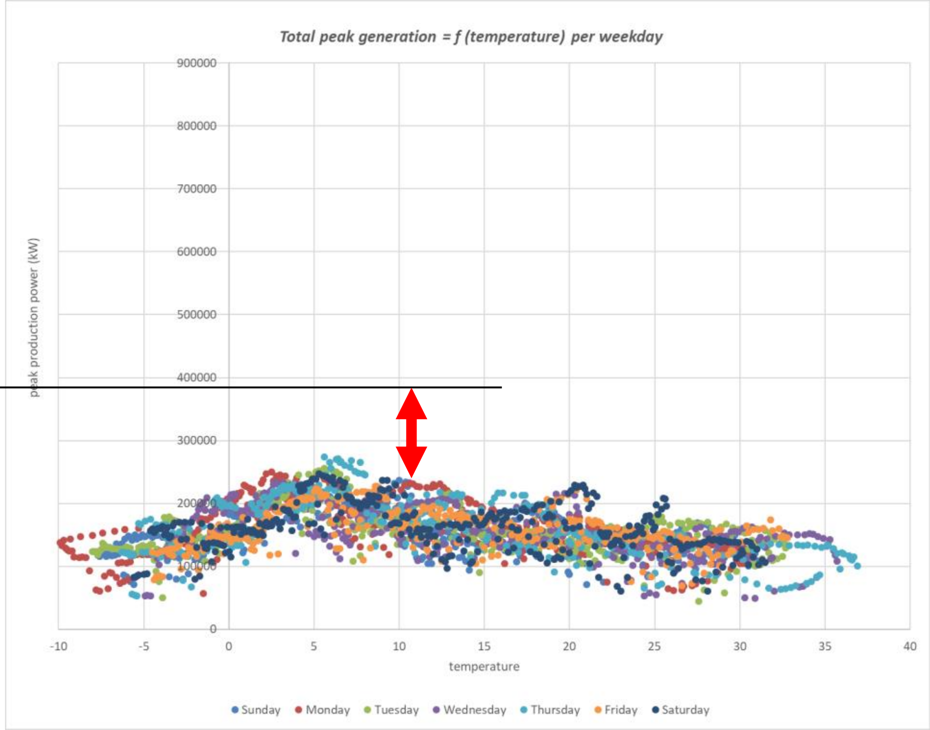
Total minimal consumption = f (temperature) per weekday
min consumption power (kW)
temperature
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

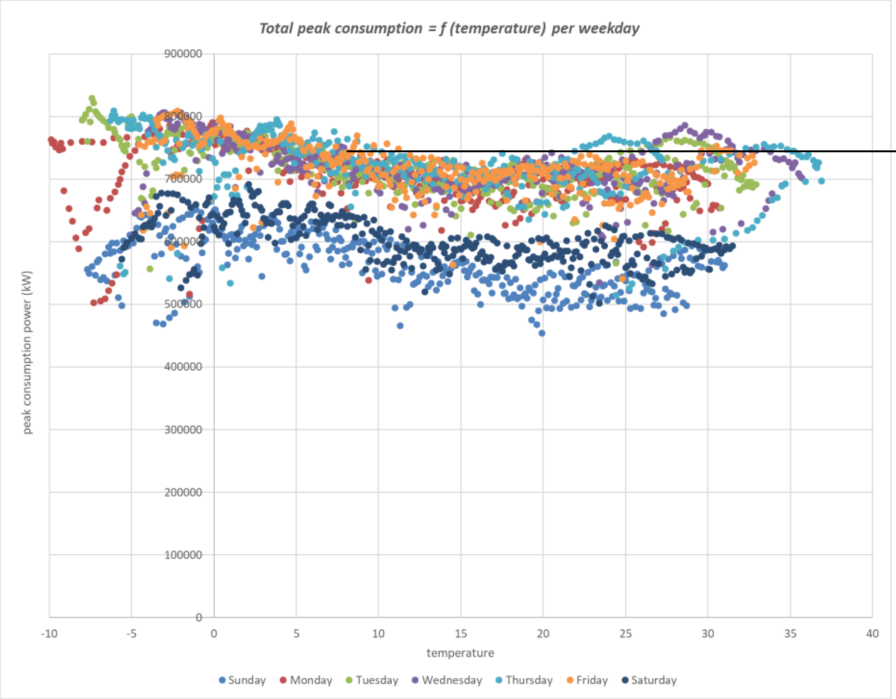


Total peak generation = f (temperature) per weekday
peak production power (kW)
temperature
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

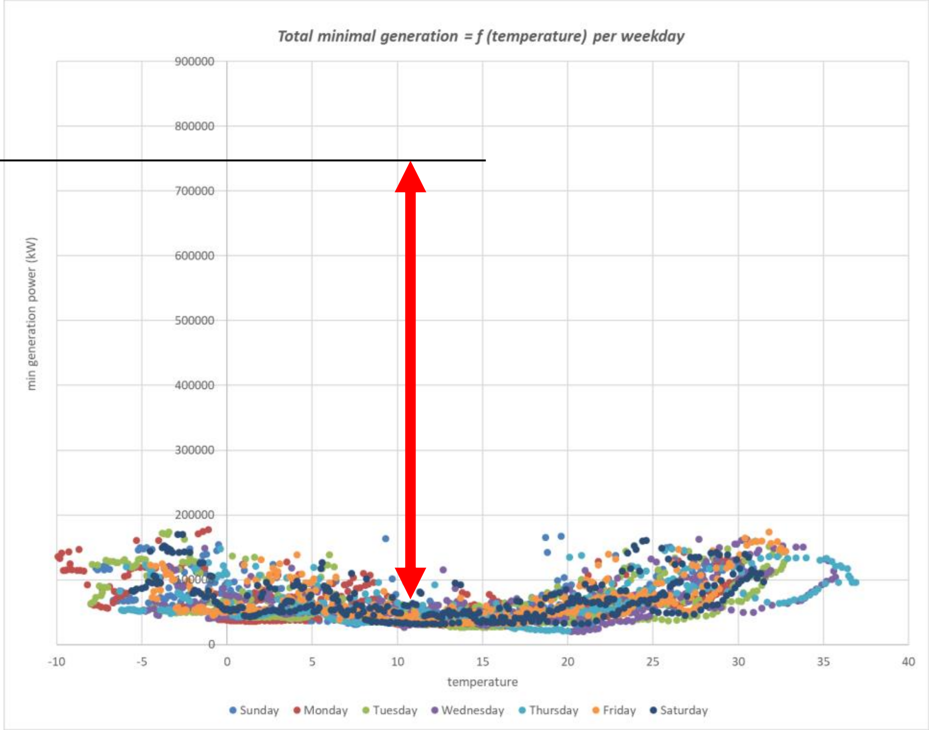

1.800,0
1.600,0
1.400,0
1.200,0
1.000,0
800,0
600,0
400,0
200,0
2014
2018
2022
2026
2030
2034
2038
NECP Installed production
Maximum Production
Minimum consumption @ noon
Peak consumption (light e-mob)
Peak consumption (med e-mob)


Total minimal consumption = f (temperature) per weekday
min consumption power (kW)
temperature
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday


Total peak generation = f (temperature) per weekday
peak production power (kW)
temperature
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday



Total peak consumption = f (temperature) per weekday
peak consumption power (kW)
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-10 -5 0 5 10 15 20 25 30 35 40
temperature
Sunday Monday Tuesday Wednesday Thursday Friday Saturday



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-10 -5 0 5 10 15 20 25 30 35 40
temperature
Sunday Monday Tuesday Wednesday Thursday Friday Saturday

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ENERGY TRANSITION DIALOGUE IN LUXEMBOURG

- The Energy Transition
- The Luxembourg Grid
  - The Role of the TSO and DSO
  - 220 kV (HT)
  - 65 kV (HT)
  - 20 KV (MT)
  - 400 V (LT)
- Domestic Electricity Production
- Energy Communities
- The challenge of the Energy Transition
- **The Smart Grid**

Detect

What has to be done where?

Transport grid
220 kV

Transport grid
65 kV

Distribution grid
20 kV

Distribution grid
400 V

Demand Side Mgt

Pump Water Storage

Open Cycle GT

Demand Side Mgt

Peak Load Shaving

P2G

Help

Local grid batteries

Bus Opportunity Charging

P2

BEV Superchargers

BEV Fast Charging

Demand Side Mgt

Bus Charging

Peak Load Shaving

P2X

Local grid batteries

Home Batteries

BEV Smart Charging

Demand Side Mgt

P2H

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Transport grid
220 kV

Transport grid
65 kV

Distribution grid
20 kV

Distribution grid
400 V

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Peak Load Shaving

P2G

Local grid batteries

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Transport grid
220 kV

Transport grid
65 kV

Distribution grid
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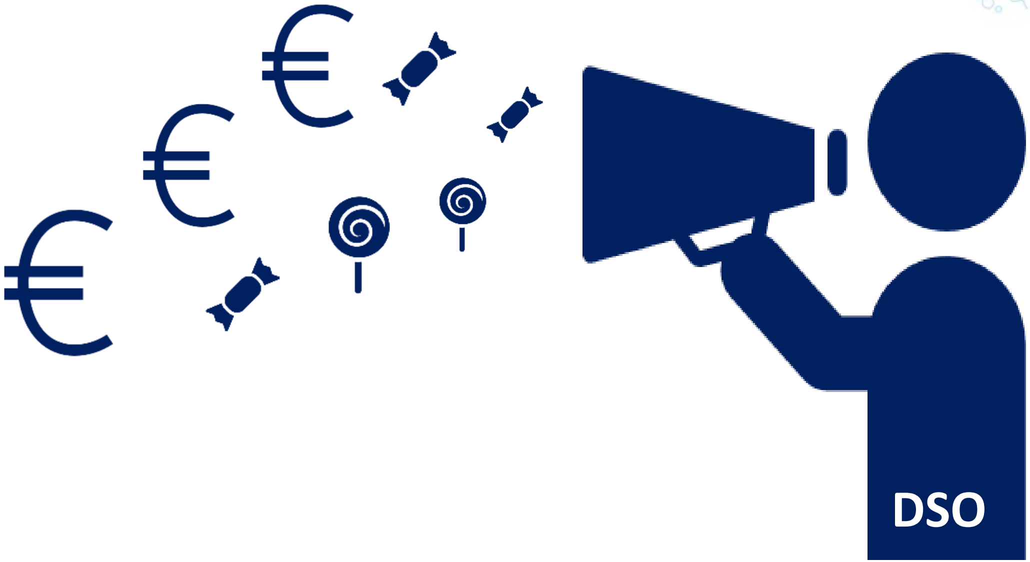
Distribution grid
400 V



Smart Grid Deployment Planning

0 No Control

- No Online-Measurement in the grid, but Ex-Post -Smart-Meter Data available
- **No Grid Control by DSO possible**

1 Offline „Control“

- Ex-Post Data available
- Simulations based on Ex-Post Smart-Meter Datas

2 Control of local stations

- Online-Measurement in local stations
- Grid Control by DSO **possible and reasonable** (increased efficiency)

3 Complete Grid Control

- Online-Smart-Meter read-out and utilisation
- Grid Control by DSO **reasonable** (maximum efficiency)


GREEN
PRODUCTION
& LOCAL
SHARING

Thank you very much for your attention!

About the speaker

Last name:	**Michels**
First name:	**Alex**
Job title / Function:	**Head of Asset Management / Regulation / Special Projects**
Organisation / Company:	**Creos Luxembourg S.A. (TSO & DSO for Power & Gas)**
Country:	Luxembourg
Studied:	Mechanical Engineer at the University of Kaiserslautern
Work Experience:	8 years as Project Manager in the Area of Blast Furnace 16 years in the Energy business with: 8 years as CEO in a gas DSO and utility company 4 years as Head of conventional Power production 4 years as Head of Asset Management, Regulation and Special Projects Vice-President of NEXXTLAB, an innovation platform in the field of e-mobility and energy-management