MaxLimit Programme

Which assets are causing congestion?

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WINDKRACHT5
Beweging in transitie

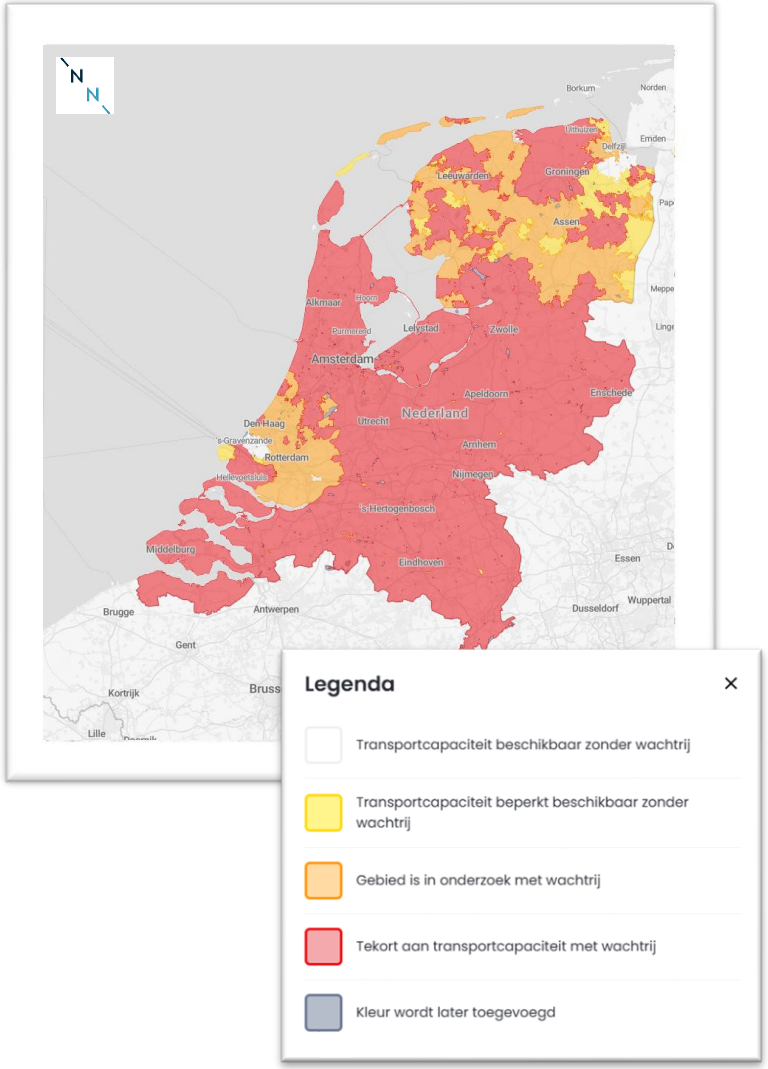
TenneT

Content / Storyline

- Wat are we doing?
- Explanation of Process, Insights, Data quality.
- Where are we now?
- Main Challenges
- Discussion

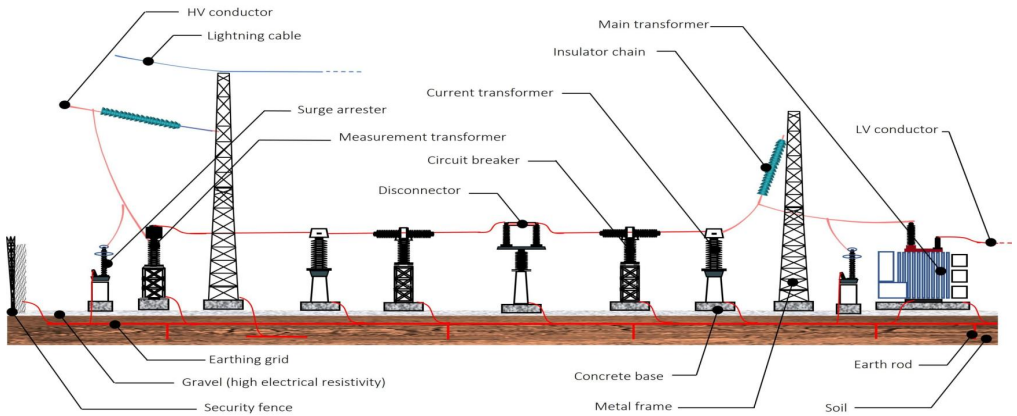
Situation

- The energy transition is placing a great burden on the Dutch electricity grid. This means shortage of transport capacity and new companies cannot be connected in parts of the country, which is also known as **net congestion.**
- The **Maximum capacity** of (connections in) the grid is determined based on various variables such as material type and **load capacity**, but also based on **environmental variables.** This is ultimately determined by assigning a **MaxLimit value** to a whole grid connection.
- The Dutch energy grid is known for its high safety and reliability, power rarely goes out, especially if you compare it with neighbouring countries.



Complication

- TenneT is making **major investments** to strengthen the grid, but these investments will only ensure that there is more space on the grid in the **long term (5-10 years),** but space is needed more quickly.
- Due to **missing or limited** data and knowledge about the existing network, it is unclear what the exact capacity of the current network is. The risk profile of the grid regarding reliability and security of supply has also been determined in a time of abundance.
- Security of supply and reliability are important, but we may maintain (stack) (too) large margins for the reliability and security of supply of the grid, which may be at the expense of the required capacity of the grid, **we don't exactly know.**



MaxLimit of grid **connection** → Yes

MaxLimit on **separate assets** → (91.000 values to investigate)

Question

To what extent can we increase the MaxLimit values of connections so that existing connections have a higher capacity, and we can combat grid congestion problems in parts of the country?

Answer

= *MaxLimit Programm*

1. Take the necessary steps to raise the MaxLimit **(start!)**

   By taking the next step instead of overthinking all steps, we get towards an approach for all promising connections within the Grid.

2. Apply new insights

   Apply new insights like windspeed and load capacity of assets towards the connections and calculate the new MaxLimit value.

3. Improve Data Quality

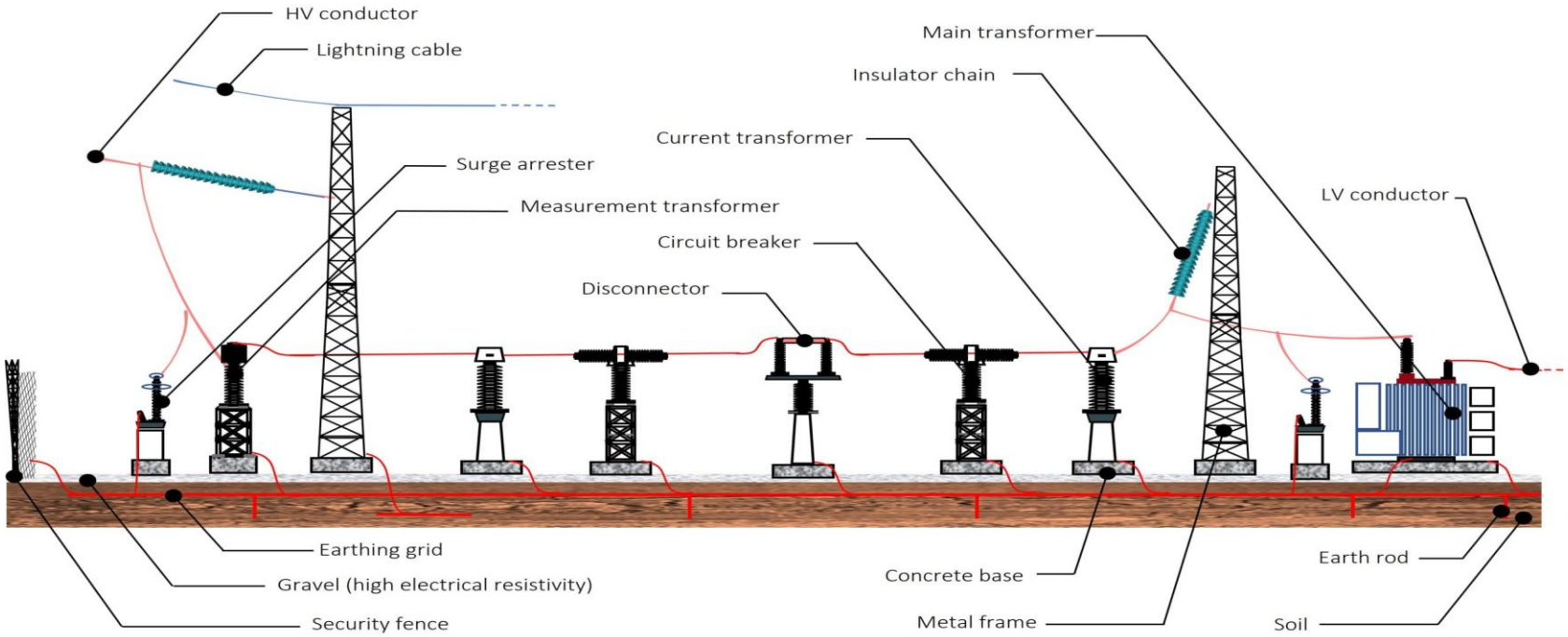
   There are at least 91.000 assets with uncertain MaxLimit values. We must find them to know the MaxLimit value of a Connection (attachment)

4. Take away Bottlenecks

   Detecting bottlenecks in grid connections and removing them through smart applications or replacing an asset.

Raise MaxLimit

Lets dive into this….



800	1000	X	X	1100	5	X	X	1200	X

MaxLimit =

600

Detective work

- Use a scala of resources to find missing values
  - Verifacta photos
  - Documentum
  - Single Line diagrams
  - Protection Database (SEDB)
  - Ask OIVers

- Verify findings with subject experts
- Request change in SAP

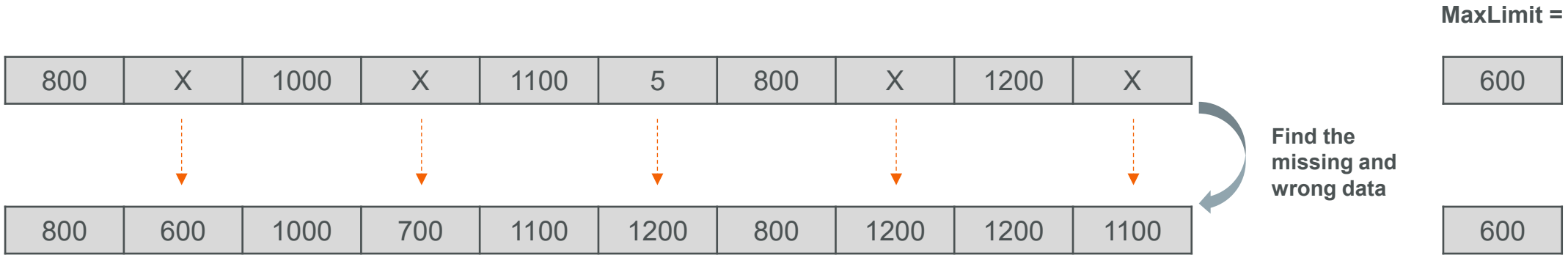
Step 1: Find the Missing data

800	X	1200	X	1100	5	X	X	1200	X

MaxLimit =

600

Step 2: Look for new insights…



Variables that determine the MaxLimit value

Ampacity calculation

IEC 61597

Generic parameters			
System Frequency	f	50	Hz
Conductor Data / Installation Data:			
Outer diameter	D	27,93	mm
Core diameter	D	7,83	mm
Maximum Temperature	T_2	75	°C
Emissivity coefficient in respect to black body	K_e	0,6	--
Solar radiation absorption coefficient	γ	0,6	--
Temperature for DC_resistance		20	°C
The value of DC resistance at 20°C	R_{T1}	6,92E-05	Ω/m
Temperature co-efficient of electrical resistance	α_1	0,00384	--
Relative permeability of conductor	μ_r	1	--
Environmental factors			
Design Ambient Temperature	T_1	30	°C
Intensity of solar radiation	S_i	1000	W/m^2
Minimum wind speed	v	0,6	m/s

Heat gain and losses

Heat gain due to dissipation	P_j	74,4	W/m
Heat gain due to solar radation	P_s	16,8	W/m
Heat loss by radiation	P_r	18,6	W/m
Heat loss by convection	P_c	63,6	W/m
	I_{max}	880	**A**

Windspeed analysis

- 12 Years of ERA5 data
- Circuits with line components
- 3 locations on the circuit (start-middle-end)

- Count of hours:
  - Winter (November – March)
    - Windspeed ≤ 0.6-1.2 m/s and temperature ≥ 15 ℃
  - Summer (April – October)
    - Windspeed ≤ 0.6-1.2 m/s and temperature ≥ 30 ℃

Windspeed Results

Windspeed per Netschakel with line component

Netschakel

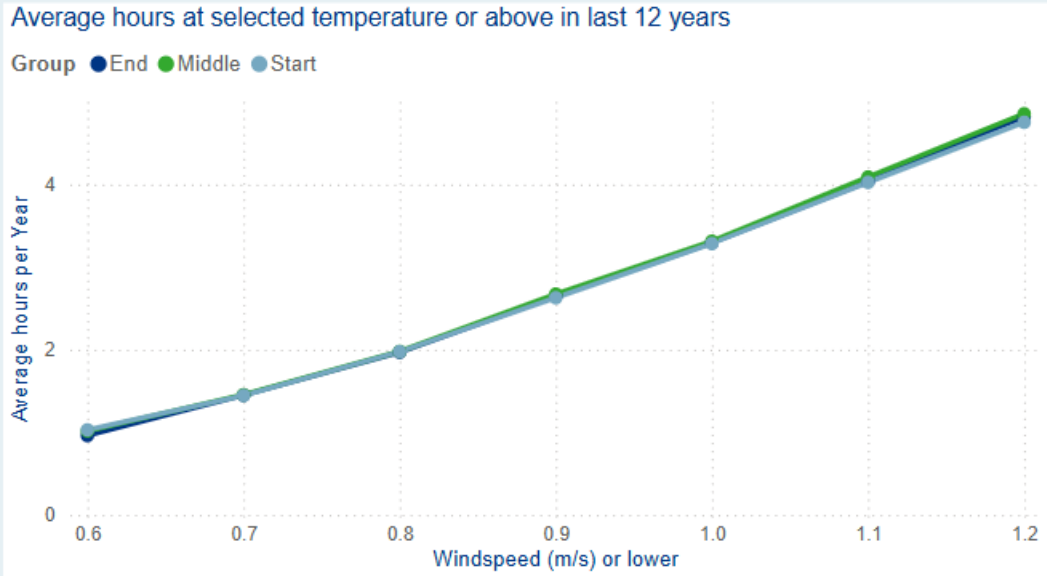
Search

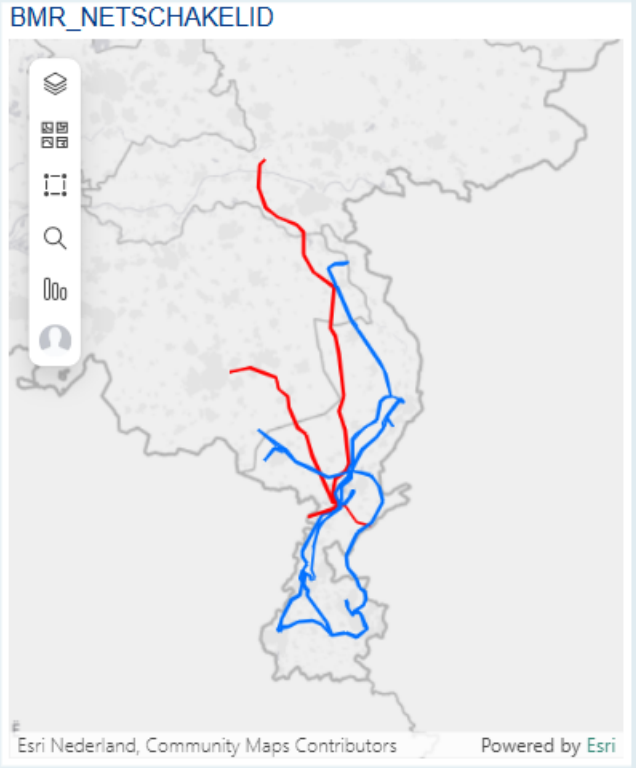
Period

Summer (30C)

Netschakel

- BMR-GENN150
- BMR-VENR150
- BOEK-BLER150
- BOEK-CLF150
- BSDL-TERW150
- BSDL-TRBK150
- BUGG-KELP150
- BUGG-MLBK150
- GRTH-LIMM150
- HELD-BOEK150
- HRST-VENR150





Variables that determine the MaxLimit value

Ampacity calculation

IEC 61597

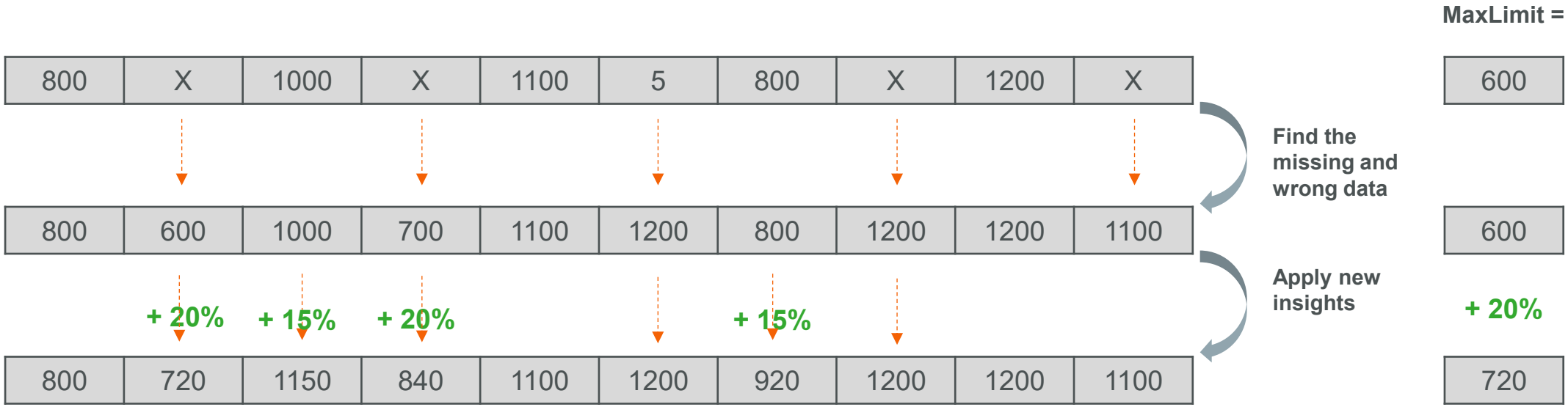
Generic parameters			
System Frequency	f	50	Hz
Conductor Data / Installation Data:			
Outer diameter	D	27,93	mm
Core diameter	D	7,83	mm
Maximum Temperature	T_2	75	°C
Emissivity coefficient in respect to black body	K_e	0,6	--
Solar radiation absorption coefficient	γ	0,6	--
Temperature for DC_resistance		20	°C
The value of DC resistance at 20°C	R_{T1}	6,92E-05	Ω/m
Temperature co-efficient of electrical resistance	α_1	0,00384	--
Relative permeability of conductor	μ_r	1	--
Environmental factors			
Design Ambient Temperature	T_1	30	°C
Intensity of solar radiation	S	1000	W/m^2
Minimum wind speed	v	1	m/s

Heat gain and losses

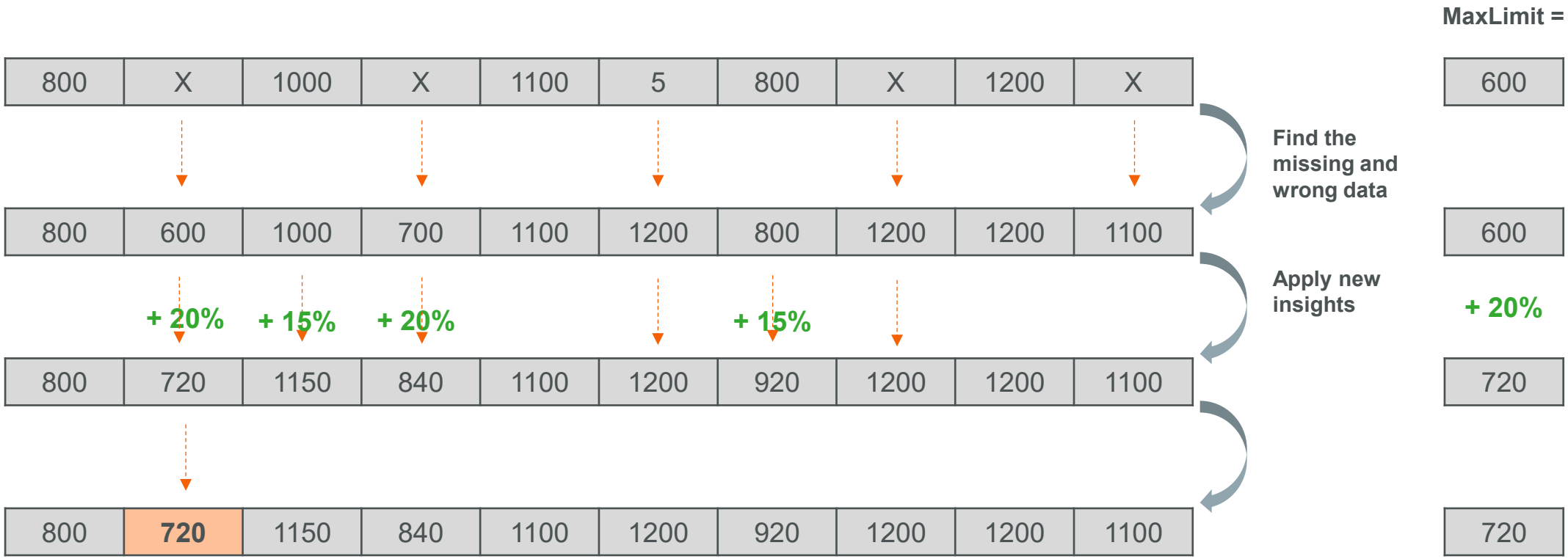
Heat gain due to dissipation	P_j	85,4	W/m
Heat gain due to solar radation	P_s	16,8	W/m
Heat loss by radiation	P_r	18,6	W/m
Heat loss by convection	P_c	84,5	W/m
	I_{max}	1011	**A**

+15%

Step 3: Apply new insights…



Step 4: Identify the bottleneck…



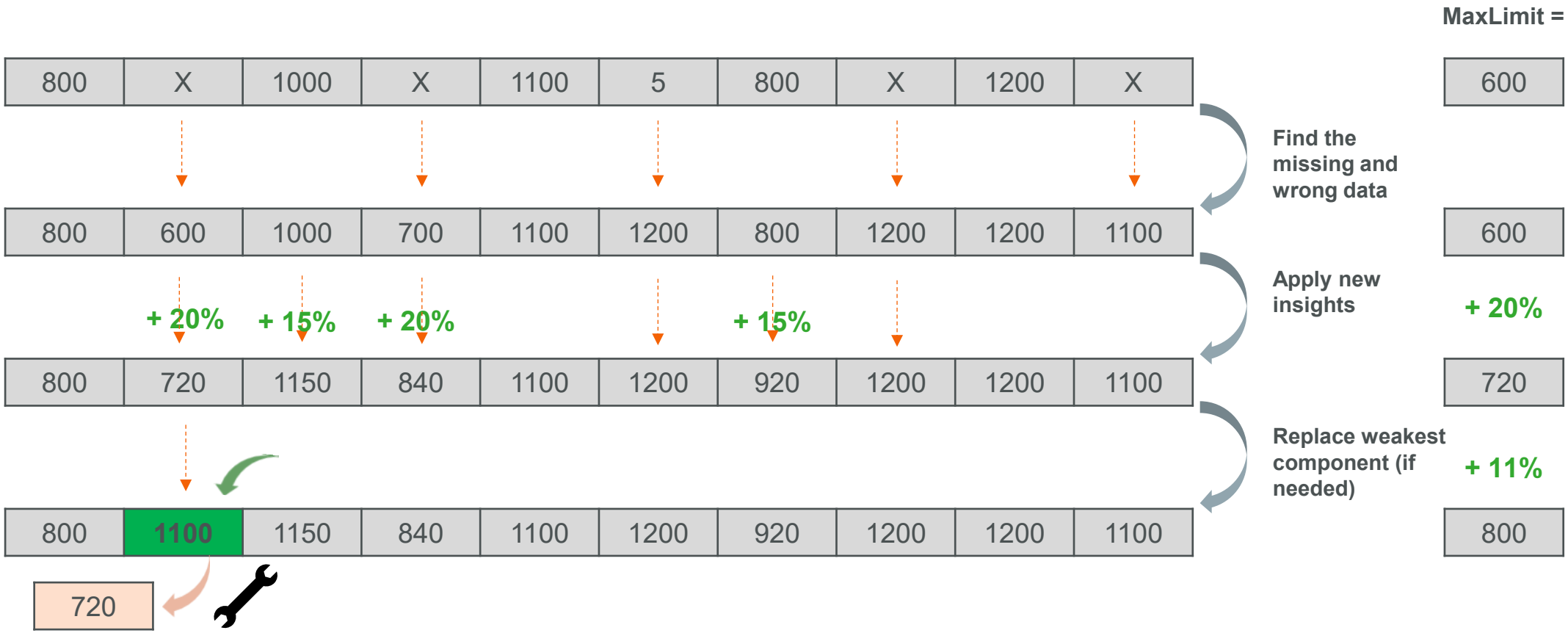
Main challenge ahead: Bottlenecks

- We see different new and innovative ways of solving bottlenecks, but these are not all (yet) applicable.

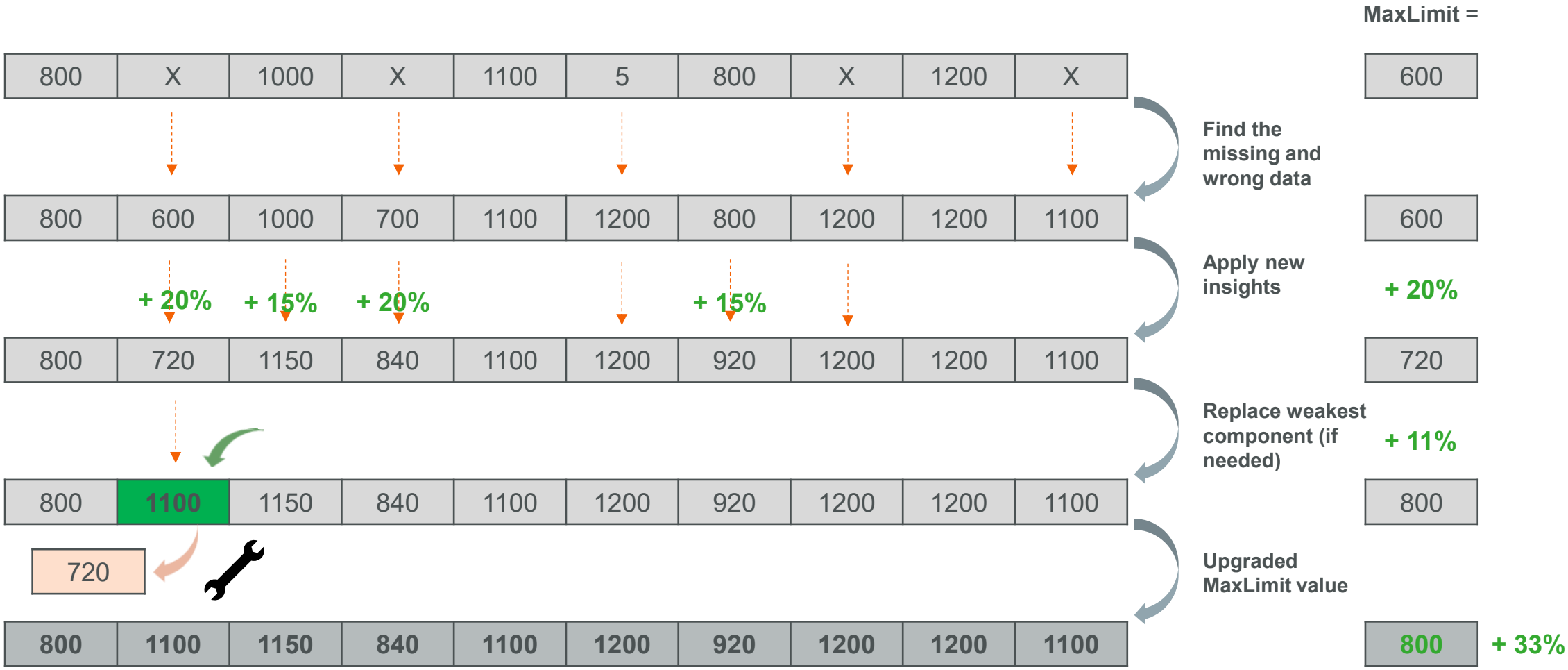
- Switch asset to other settings (Current transformer)
- Dynamic Line Rating (DLR)
- Dynamic Cable Rating (DCR)
- Replacement

Bottleneck	Possible Technique	Applicable?	What do we need?
Current transformer	Switch settings	Sometimes	Prio over other work (Riskmodel)
HS leidingdeel (Line)	DLR	Probably	Pilot ➔ Tender sept ’25
HS kabeldeel (Cable)	DCR	Work in Progress	Pilot ➔ Scale up
Other	Replacement	Yes	Prio over other work (Riskmodel)

Step 5: Replace or Upgrade Bottleneck



Step 6: Upgrade MaxLimit value…



Where are we now?

1. Take the necessary steps to raise the MaxLimit **(start!)**

2. Improve Data Quality

3. Apply new insights

4. Take away Bottlenecks

We found a (pragmatic) solution for a lot of difficult steps during the process, Missing values, Wrong values, Sag, Security, EMC, etc.

	Start	Now	filling level
Values to investigate	91.000	6.916	**92,3%**
Incomplete connections	3.097	1.271	**59,1%**

Insight	Recalculate
Windspeed	**0,6 → 1.0 m/s**
Disconnectors & Circuit breakers	**+ 15%**
Current/Combi Transformers	**+ 20%**

Connections
10-20% (113)

Bottleneck	Possible Solution	Applicable?
Line	Dynamic Line Rating	**Yes (sept '25)**
Cable	Dynamic Cable Rating	**Maybe**
Current transformer	Switch to other settings	**Sometimes**
Other	Replace (KVI)	**Yes**

Main challenge ahead: EMC

- All MaxLimit raises on connections close to a.o. ProRail assets should be investigated on EMC.
- The current EMC investigation process takes 5-8 years and delays update of limits.

- We are working on a pragmatic approach with ProRail a.o.
- Quick Scan → 1, 2 or 3.

1. No Problem
2. Possible Risk → Pragmatic Approach
3. Probably Risky → Full EMC research (takes years)

Discussion