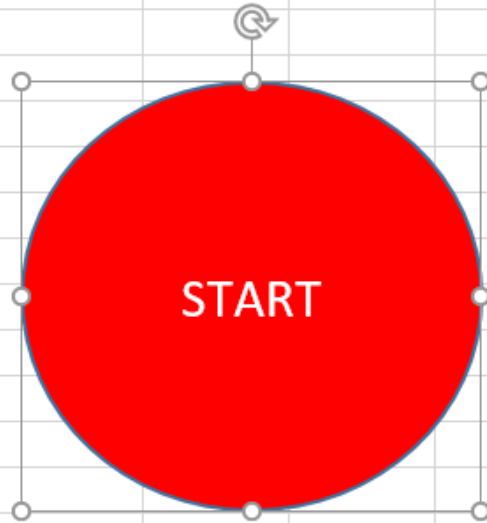


E-GRIDMAP

The tool to simplify connection process



Assign Macro ? X

Macro name: E-GRIDMAP

New

Record...

Macros in: All Open Workbooks

Description

OK Cancel

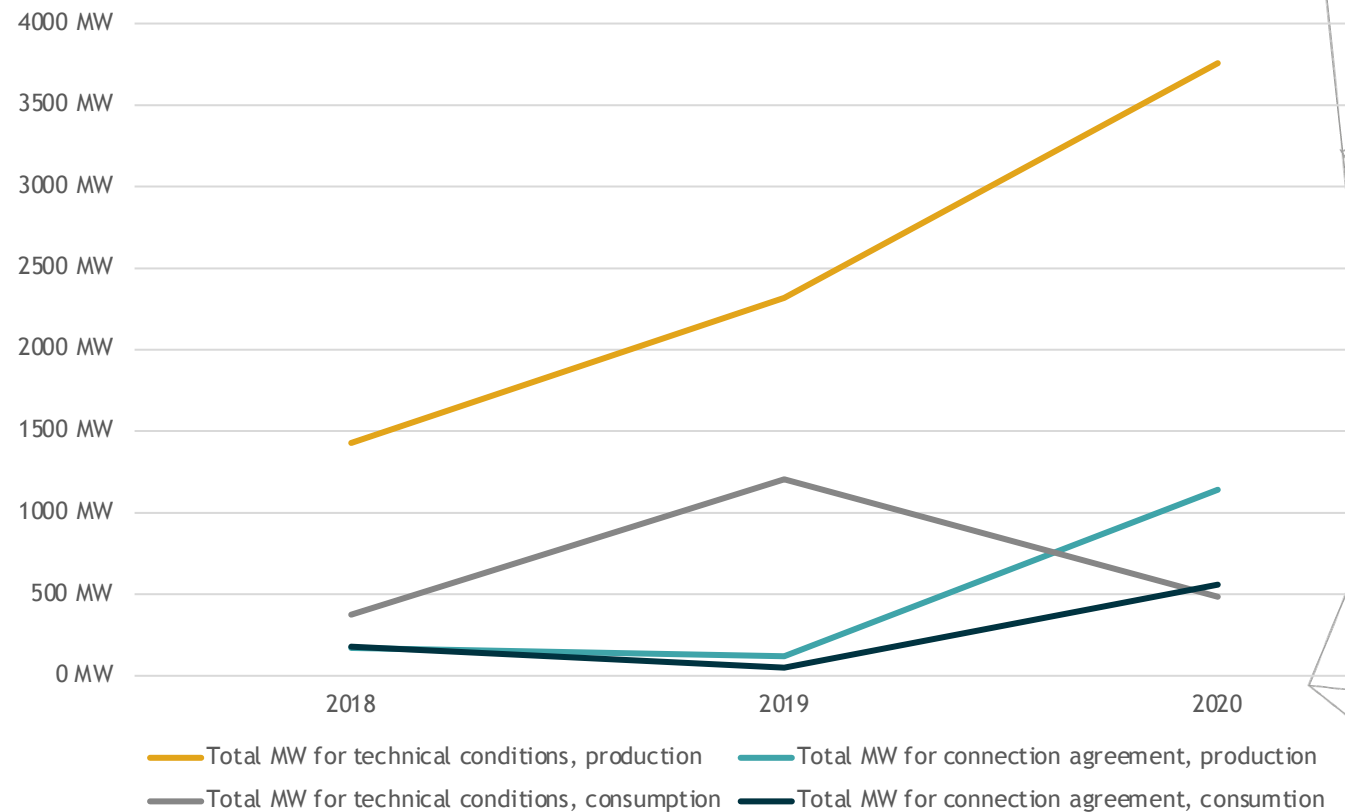
Main topics

- Why E-GRIDMAP was created?
- The algorithms behind the webtool
- Live demo
- Discussion , Q&A

why E-GRIDMAP?

- To help potential developers to assess their business plans
- To be able to cope with significant increase in connection requests (HR limits)
- To make the in-house procedure more efficient and quicker
- To standardise the methodology and to increase the quality of the analysis.

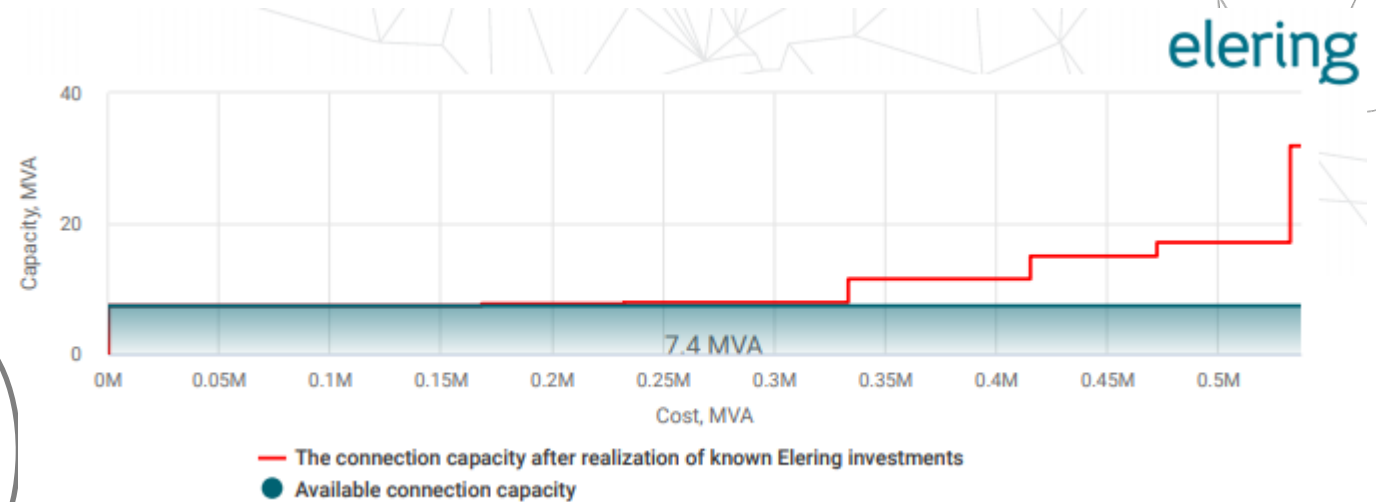
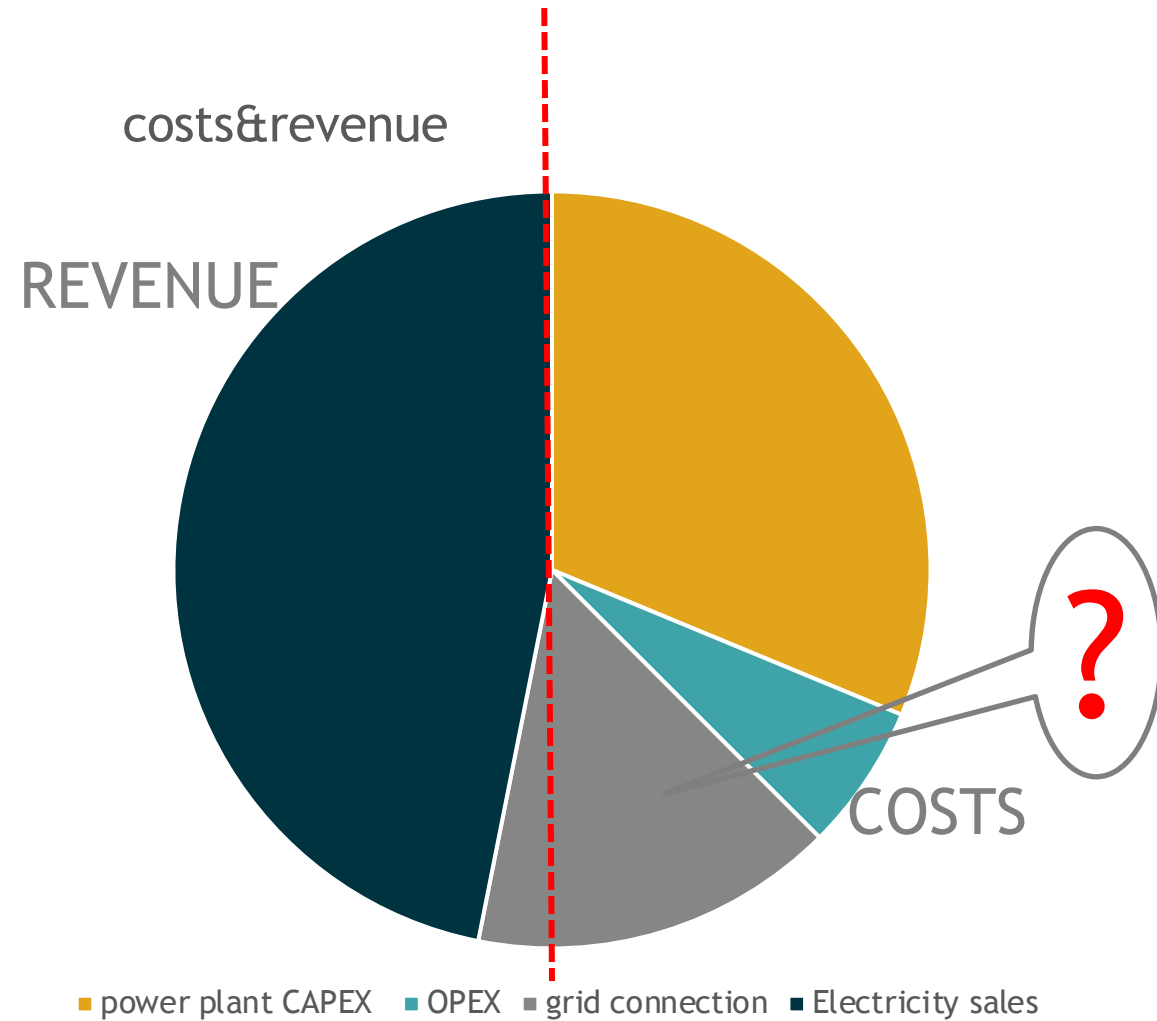
Technical conditions and Connection contract proposals in last 3 years



New connection principles in EE

- It is possible to connect anywhere and any size - it's the question of costs.
- If additional connection capacity causes overloadings the client has to cover the costs of the investments necessary to eliminate these overloadings.
- Set of measures with minimum costs is proposed, however it has to be consistent with the minimum technical policy requirements.
- The impact of the new connection capacity is analysed with power system model with N-1 principle - deterministic approach.
- The impact is comparing Base scenario vs. Base+New connection scenario with the same background conditions.
- Also flexible connection conditions are possible - the connection contract will be bounded with the certain overloading conditions coming from the analysis.

Investment planning



The grid connection assessment process

before (several weeks)

- Client to submit technical conditions request to Elering (client service)
- Elering internal communication process to address the client need to the analyst - if necessary to specify the connection details.
- Analyst running the necessary calculations and to draft an internal report. *Significant manual work setting up the model and writing the report.*
- Internal verification of the results (meetings)
- Communication to the client regarding with information of the necessary grid reinforcements
- *(previous process usually takes few weeks)*
- If everything is clear client will submit the official connection application

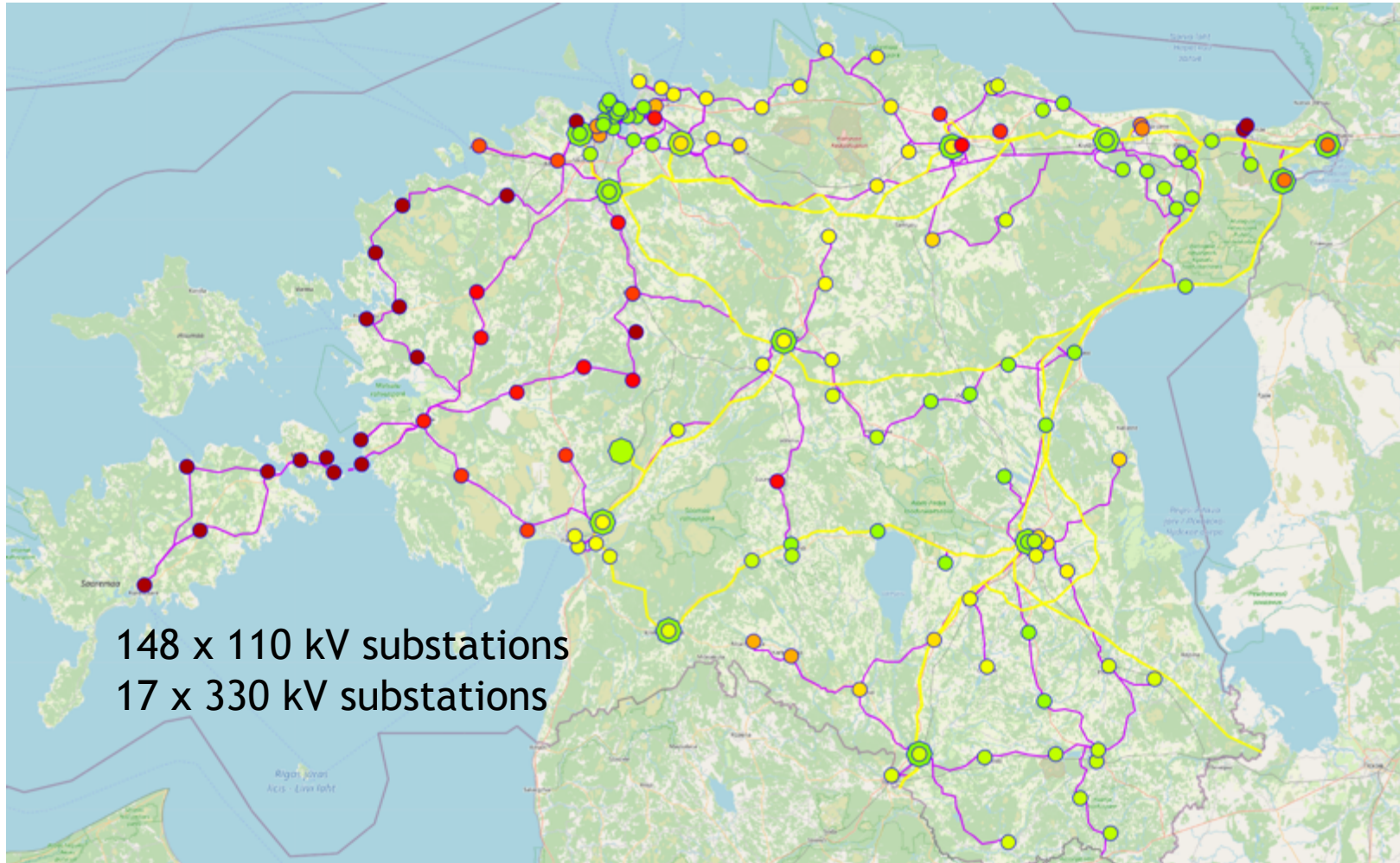
Now (instant)

- client can assess the possible connection points and estimated costs directly on E-GRIDMAP
- *(assessment from E-Gridmap is instant)*
- When business plan seems to be acceptable Client will submit official application for the grid connection.
- For bigger connection capacities (eg. Offshore wind parks) there Elering will run separate analysis.

The experience of E-Gridmap has been successful

- Positive feedback from clients
- more efficient and focused connection applications - level of completion rate is higher, number of new contracts increased.
- Increased efficiency of internal analysis - duration of analysis has decreased significantly with the same human resource.

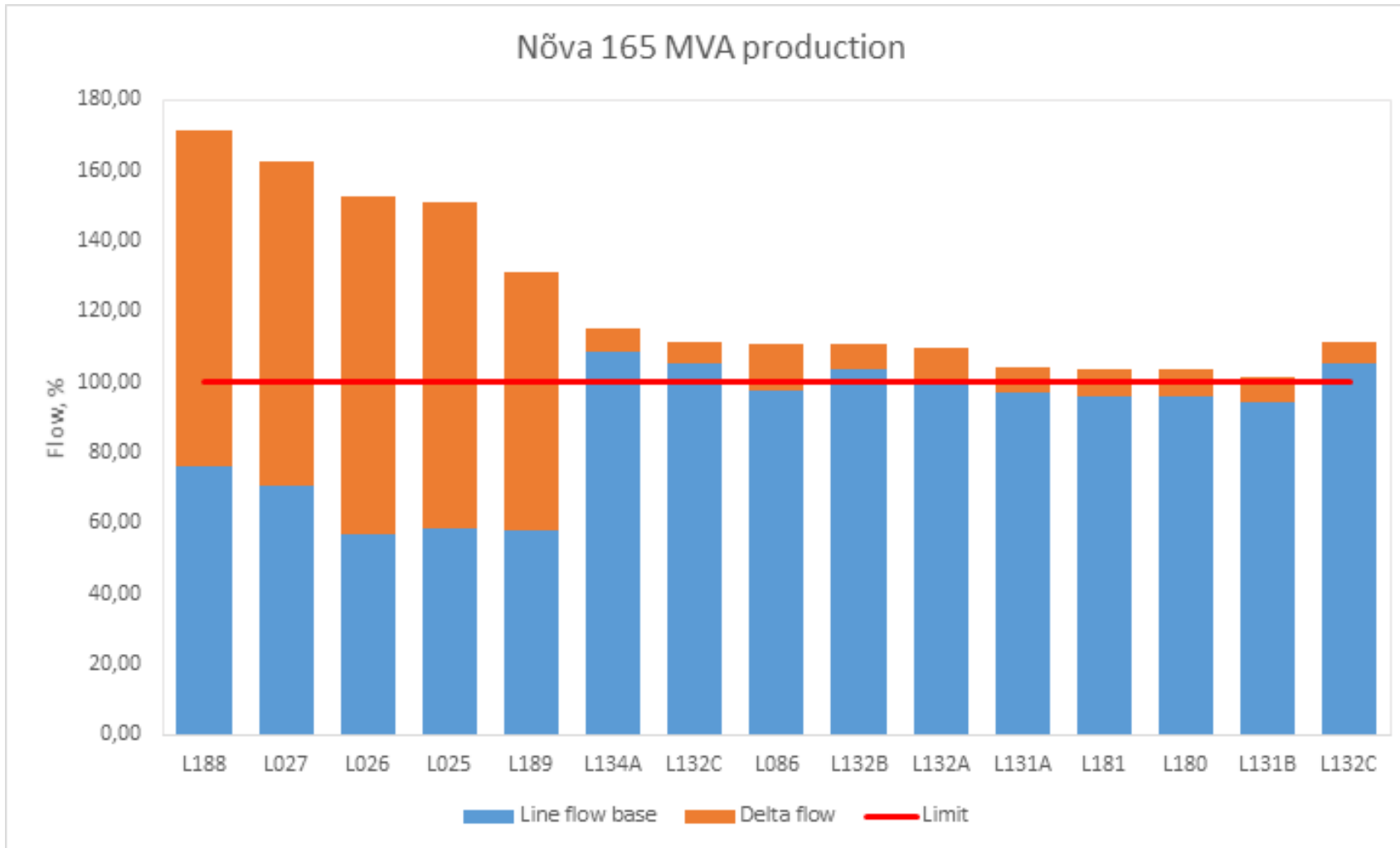
into the details and algorithms of E-Gridmap



N-1 Contingency analysis

- Connection impact for all Elering substations will be calculated
 - 148 x 110 kV and 13 x 330 kV substations
- Contingencies
 - ca. 300 lines
 - 17 transformers 330/110 kV
- 2 directions for each substation - Production and consumption capacities
- 28 boundary scenarios (The mixture of loading patterns, generation patterns and import/export patterns)
- the calculations are completed for 5+1 years in future (taking into account Elering's planned future investments)
- In deterministic analysis the worst case loading of any element is compared between Base scenario and Base+New connection scenario.
- Calculation amount:
 - $(148 + 13) \times 2 \times 28 \times (5 + 1) = 54\ 096$ cases to run N-1 analysis
 - 2,6 GHz and 8 core computer calculates about **48 hours**

Comparison of line flows BAU vs. new connecton scenario with impact more than 5%

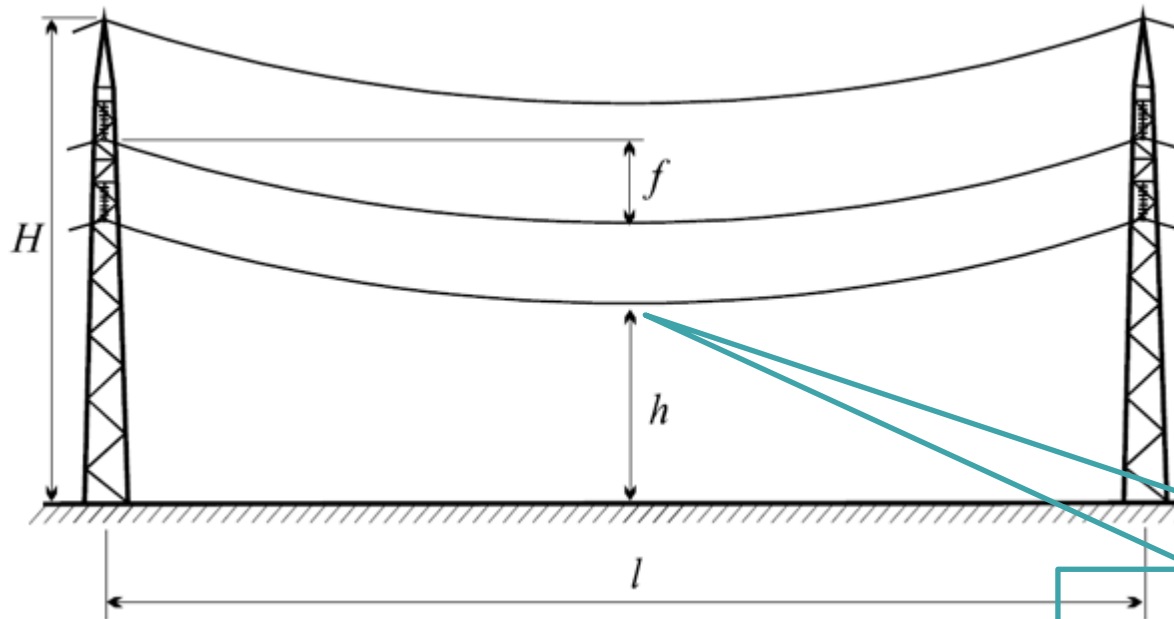


The automated calculation - cost of Network reinforcement

Capacity increasing activities (for each activity there is an estimated unit cost):

- Replacement of the limiting line current transformer
- Upgrade thermal rate of the existing line and wire:
 - Tightening the line ($h \leq 0,5 \text{ m}$)
 - Lifting towers ($0,5\text{m} < h \leq 1 \text{ m}$)
 - Replacement towers ($h > 1 \text{ m}$)
- Replacing the wire of the existing line
- Full replacement of the existing line with new one (the thermal capacity designed for 80 degrees Celsius)
- Adding 330/110 kV transformers (usually related to new consumption side connections close to bigger loading centers)

Permissible line power flow (current)



110 kV:

ground $h \geq 6 \text{ m}$

road $h \geq 7 \text{ m}$

330 kV:

ground $h \geq 7,5 \text{ m}$

road $h \geq 8,5 \text{ m}$

The standard thermal conditions for existing lines:

- 35°C (older soviet time lines)
- 45°C
- 60°C (usually the maximum that can be achieved for existing lines)

Elering has the laser scanning information database that is updated in every 5 years and the condition assessment data is updated annually for all 110 kV and 330 kV lines.

The results

- The automated calculations run capacities up to:
 - 100 MW at 110 kV level
 - 300 MW at 330 kV level
 - Bigger capacities are usually related to change in grid topology - this feature is not integrated today - maybe in future.
- The results will be shown in EUR/MW curve
 - each breaking point represents the capacity in the calculations where the next overloading condition occurs.
- For each breaking point the automated calculation finds the cost to overcome this limit with least amount of expenses. Double investments for the same element are eliminated.

BACK TO MAP

PDF

XLSX

Kolga 110 kV substation

English

Capacity, MVA:

100

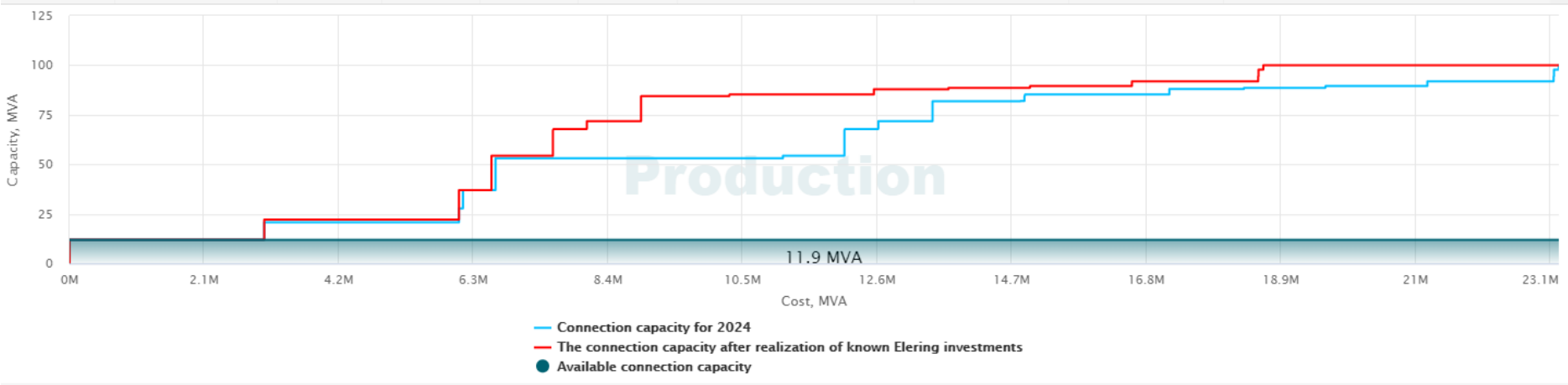
Cost, €:

23 236 000

2024

2025+

Activities necessary for strengthening power grid									
Line	Line name	Voltage, kV	Length, km	Type	Max capacity, MVA	Activity to increase capacity	Cost	Cumulative cost	Comment
Rakvere A1T	Rakvere trafo	330		Transformer	11.9	Adding Rakvere transformer	3 038 000 €	3 038 000 €	
Püssi A4T	Püssi trafo	330		Transformer	20.8	Adding Püssi transformer	3 038 000 €	6 076 000 €	
L103	Püssi - Rakvere	110	50.4	Overhead line	27.8	Thermal upgrade to 45°C	63 000 €	6 139 000 €	Renovated by 2029
L506	Rakvere - Kiisa	330	107.8	Overhead line	37	Thermal upgrade to 45°C	507 000 €	6 646 000 €	
L353	Viru AJ - Tsiguliina	330	243.3	Overhead line	53.1	Thermal upgrade to 45°C	4 485 000 €	11 131 000 €	Renovated by 2026
L357	Paide - Kiisa	330	70	Overhead line	54.3	Thermal upgrade to 45°C	959 000 €	12 090 000 €	
L061	Kadrina - Viitna	110	14.3	Overhead line	67.3	Replacement of Kadrina current tra...	5000 €	12 095 000 €	
L199B	Kolga - Loksa	110	14.9	Overhead line	67.5	Replacement of Kolga current trans...	5000 €	12 100 000 €	
L347	SOPI - SINDI	330	22.7	Overhead line	67.8	Thermal upgrade to 45°C	515 000 €	12 615 000 €	
L060	Rakvere - Kadrina	110	15.5	Overhead line	67.9	Replacement of Kadrina current tra...	5000 €	12 620 000 €	
L346	Paide - SOPI	330	66.4	Overhead line	71.8	Thermal upgrade to 45°C	845 000 €	13 465 000 €	
L169	Iru - Kallavere	110	7.4	Overhead line	81	Thermal upgrade to 45°C	0 €	13 465 000 €	
L126	Püssi - Aseri	110	16.7	Overhead line	81.8	New 1x240 line	1 372 000 €	14 837 000 €	
L103	Püssi - Rakvere	110	50.4	Overhead line	81.9	Thermal upgrade to 60°C	125 000 €	14 992 000 €	Renovated by 2029
L199A	Kuusalu - Kolga	110	14.1	Overhead line	84.3	Replacement of Kolga current trans...	5000 €	14 997 000 €	
L061	Kadrina - Viitna	110	14.3	Overhead line	84.9	Replacement of Viitna current trans...	5000 €	14 997 000 €	
L198	Kallavere - Kuusalu	110	27.5	Overhead line	85.3	New 1x240 line	2 251 000 €	17 248 000 €	
L061	Kadrina - Viitna	110	14.3	Overhead line	88	New 1x240 line	1 174 000 €	18 422 000 €	
L060	Rakvere - Kadrina	110	15.5	Overhead line	88.6	New 1x240 line	1 274 000 €	19 696 000 €	
L062	Viitna - Võsu	110	24.1	Overhead line	89	Replacement of Viitna current trans...	5000 €	19 701 000 €	
L063	Võsu - Loksa	110	19.4	Overhead line	89.5	New 1x240 line	1 588 000 €	21 289 000 €	
L062	Viitna - Võsu	110	24.1	Overhead line	91.9	New 1x240 line	1 975 000 €	23 264 000 €	



Production

Available connection capacity, MVA

11.9

11.9

11.9

11.9

11.9

11.9

2020 2021 2022 2023 2024 2025+

Year:

2024

Voltage:

110 kV

Substation:

Kolga

Direction:

Production

Consumption

Interruption duration:

120 hours

2 hours

Capacity: 100 MVA

Cost of substation connection point: 290 000 €

Strengthening power grid 2024: 23 236 000 €

Total cost 2024: **23 526 000 €**

Strengthening power grid 2025: 18 626 000 €

Total cost 2025+: **18 916 000 €**

Live demo

<https://vla.elering.ee/?lang=en>

Thank YOU!

oleg.Tsernobrovkin@elering.ee

<https://youtu.be/NFuXzu-GIPo>