Improve Grid Capacities and Secure Grid Operation
The Problem

- Increased electricity demand
- Penetration of distributed energy resources
- Problems of erecting new power lines
- Increase in transit power flows

Congestions in power grid
Solutions

How to relieve congestions?

Long term (5-10 years)
- Build new power lines
- Build new generation capacities*
- Decrease load/demand*

Mid-term (3-5 years)
- Upgrade/uprate power lines
- SUMO with Dynamic Thermal Rating - DTR

Short term (1-3 years)
- Re-dispatch
- SUMO with Dynamic Thermal Rating - DTR

* (out of TSO scope)
## Comparison of Solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Implementation time</th>
<th>Cost</th>
<th>Impact on capacities</th>
</tr>
</thead>
<tbody>
<tr>
<td>New power lines</td>
<td>5-10 years</td>
<td>€€€€€€</td>
<td>High</td>
</tr>
<tr>
<td>Upgrade or uprate</td>
<td>3-5 years</td>
<td>€€€</td>
<td>Medium</td>
</tr>
<tr>
<td>SUMO (DTR)</td>
<td>1-2 years</td>
<td>€€</td>
<td>Medium</td>
</tr>
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SUMO as a Solution

- **DTR**
- **Weather Measurements & Models**
- **Forecast of Weather & Power flows**
- **Network analyses for real-time & near future**
- **Visualization and alerts**
- **SCADA/EMS integration**
Sumo Features

- Visualization
- Critical power lines identification
- Load Forecast
- SCADA/EMS Integration
- N-1 contingency analyses
- Alarms and notifications of weather conditions
- DTR - Dynamic thermal ratings, based on Weather Conditions
Sumo Functions

- Weather Measurements
- Weather Forecast
- Network Model, State & Data
- DTR - Dynamic Thermal Rating
- Weather Alarms and Notifications
- Load Forecast
- N-1 contingency analyses
- Visualization
- Critical Power Lines Identification
- SCADA Integration
### Sumo Advantages

<table>
<thead>
<tr>
<th>Local weather data</th>
<th>Limit assessments are calculated based on <strong>local weather data</strong> (measurements and models)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTR algorithm</td>
<td>Improved DTR algorithm is tested on an open-air test site with actual conductors used on power lines</td>
</tr>
<tr>
<td>Non invasive installation</td>
<td>Installation and DTR calculations are non-invasive (no need for switching off the power line)</td>
</tr>
<tr>
<td>Experience</td>
<td><strong>Experience</strong> gained from everyday use of SUMO is used for <strong>new and improved functionalities</strong></td>
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</table>
USE CASE: Avoiding N-1 Overload

**Static operating limit:** 1200 A  
**N-1 calculated load:** 1300 A  
**DTR calculated limit:** 1600 A

- N-1 load / static limit = 108%  
- N-1 load / DTR limit = 81%

If static limit was considered, the N-1 overload would trigger a process for re-dispatching the loads or activate generation to relieve congestion.
Calculation of Ratings With Real Weather Conditions

Short term – operational phase avoiding re-dispatching and switching maneuvers
Sumo Building Blocks

- **NETWORK ANALYSES**
  - N-1, Load Forecast

- **SUMOBUS**
  - Integration platform

- **WEATHER**
  - Measuring, Modelling & Forecast

- **VISUALIZATION**

- **ALARMS & NOTIFICATIONS**
  - Exceptional weather events

- **DTR**
  - Ratings Calculation
Example Of Implementation

ELES, Slovenian Transmission System Operator.

- 2013 – Pilot
- 2015 – Full implementation
- Implemented on 23 powerlines
  - 12 @ 110 kV
  - 6 @ 220 kV
  - 5 @ 400 kV
- One 400 kV Phase-shifting transformer
SUMO enables the Transmission System Operator to

- Better utilize the existing power grid
- Secure and remedy operation in changing environment
- Improve awareness of the situation in power grid.
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