SciGRID – Status Quo of an Open Transmission Grid Modelling

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2nd Open Energy Modelling Workshop
14.04.2015
SciGRID - Overview

**Aims:**

» Building an open topologically network (transmission grid with 220kV and above)

» Scientific approach, developing (and publishing) of methods for an automated evaluation (and abstraction) e.g. from openstreetmap data

» Evaluating and developing of strategies of comparing network models

» Organizing an expert workshop and an international conference (at the end of the project)

**Scope:**

» Two funded positions at NEXT ENERGY for 3 years

**Status:**

» Project start: 1st of October 2014
SciGRID - Project Plan

AP1: Network Development

AP2: Validation

AP3: Interfaces

AP4: Publications

Short term  4 work packages  Long term
## OSM – Data Quantity and Data Quality

<table>
<thead>
<tr>
<th>mm/yyyy</th>
<th>#OSM User</th>
<th>#circuits</th>
<th>Length of AC 220kV circuits (km)</th>
<th>Length of AC 380kV circuits (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/2010</td>
<td>15</td>
<td>68</td>
<td>820</td>
<td>1536</td>
</tr>
<tr>
<td>08/2012</td>
<td>36</td>
<td>476</td>
<td>5295</td>
<td>6686</td>
</tr>
<tr>
<td>06/2013</td>
<td>47</td>
<td>497</td>
<td>5302</td>
<td>7122</td>
</tr>
<tr>
<td>12/2013</td>
<td>51</td>
<td>520</td>
<td>5464</td>
<td>7274</td>
</tr>
<tr>
<td>06/2014</td>
<td>40</td>
<td>664</td>
<td>7169</td>
<td>10303</td>
</tr>
<tr>
<td>12/2014</td>
<td>27</td>
<td>771</td>
<td>9987</td>
<td>13890</td>
</tr>
<tr>
<td>03/2015</td>
<td>30</td>
<td>773</td>
<td>9997</td>
<td>13915</td>
</tr>
</tbody>
</table>

12/2012 ENTSO-E for Germany:
- Length of AC 220kV circuits: 14053 km
- Length of AC 380kV circuits: 20455 km

Source: [https://www.entsoe.eu/publications/statistics/](https://www.entsoe.eu/publications/statistics/)
OSM – Data Quantity and Data Quality

12/2012 ENTSO-E for Germany:
Length of AC 220kV circuits: 14053 km
Length of AC 380kV circuits: 20455 km

Source: https://www.entsoe.eu/publications/statistics/
OSM - Data Structure

relation

- `<relation id="1560977"
member type="way"
ref="156960646" role="plant"/>
member type="way"
ref="58417796" role="line"/>
member type="way"
ref="23025610" role="substation"/>
tag k="route" v="power"/>
tag k="type" v="route"/>
tag k="voltage" v="380000"/>
tag k="cables" v="3"/>
tag k="wires" v="quad"/>
</relation>`

way

- `<way id="58417796"
<nd ref="2923456189"/>
<nd ref="2923456185"/>
<nd ref="724245909"/>
<nd ref="724245923"/>
<nd ref="1691982847"/>
tag k="power" v="line"/>
tag k="voltage" v="380000"/>
</way>`

node

- `<node id="724245909"
lat="51.8898354"
lon="14.4283962">
tag k="power" v="tower"/>
</node>`
OSM - Data Structure

relation

• <relation id="1560977"
  <member type="way"
    ref="156960646" role="plant"/>
  <member type="way"
    ref="58417796" role="line"/>
  <member type="way"
    ref="23025610" role="substation"/>
  <tag k="route" v="power"/>
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  <tag k="voltage" v="380000"/>
  <tag k="cables" v="3"/>
  <tag k="wires" v="quad"/>
</relation>

way

• <way id="58417796"
  <nd ref="2923456189"/>
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  <nd ref="724245909"/>
  <nd ref="724245923"/>
  <nd ref="1691982847"/>
  <tag k="power" v="line"/>
  <tag k="voltage" v="380000"/>
</way>

node

• <node id="724245909"
  lat="51.8898354"
  lon="14.4283962">
  <tag k="power" v="tower"/>
</node>
OSM - Data Structure: Most important „power“ tags

- power=plant, station, substation, sub_station, generator, transformer
  » vertices

- power=line, cable
  » links

- route=power, cables=*, frequency=*, wires=*, voltage=*
  » circuits
SciGRID - Abstraction to Topologically Grid Model

Relation: 302 Marzahn - Thyrow (241441)

(kein Kommentar)
Bearbeitet vor etwa ein Monat von Thomas Plischka
Version #18 - Änderungssatz #29306841

Tags

<table>
<thead>
<tr>
<th>Tag</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>cables</td>
<td>3</td>
</tr>
<tr>
<td>frequency</td>
<td>50</td>
</tr>
<tr>
<td>from</td>
<td>Marzahn</td>
</tr>
<tr>
<td>name</td>
<td>302 Marzahn - Thyrow</td>
</tr>
<tr>
<td>operator</td>
<td>50-Hertz</td>
</tr>
<tr>
<td>ref</td>
<td>302</td>
</tr>
<tr>
<td>route</td>
<td>power</td>
</tr>
<tr>
<td>to</td>
<td>Thyrow</td>
</tr>
<tr>
<td>type</td>
<td>route</td>
</tr>
<tr>
<td>via</td>
<td>Wuhlheide</td>
</tr>
<tr>
<td>voltage</td>
<td>220000</td>
</tr>
<tr>
<td>wires</td>
<td>double</td>
</tr>
</tbody>
</table>
### SciGRID - Transmission Grid Model

<table>
<thead>
<tr>
<th>Total number of relations with voltage &gt;= 220kV</th>
<th>779</th>
</tr>
</thead>
<tbody>
<tr>
<td>→ relations to be fixed</td>
<td>34</td>
</tr>
<tr>
<td>→ relations with 0 substations</td>
<td>6</td>
</tr>
<tr>
<td>→ relations with 1 substation</td>
<td>41</td>
</tr>
<tr>
<td>→ relations with 2 substations</td>
<td>623</td>
</tr>
<tr>
<td>→ relations with 3 substations</td>
<td>67</td>
</tr>
<tr>
<td>→ relations with 4 substations</td>
<td>3</td>
</tr>
<tr>
<td>→ relations planned/construction</td>
<td>5</td>
</tr>
</tbody>
</table>

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14.04.2015  
C. Matke / SciGRID
Summary - Building a Topologically Grid Model

- Download planet-latest.osm.pbf (27GB)
- Extraction of Power Data with Osmosis (3-4h, ca. 100MB)
- Export Power Data with osm2pgsql (Germany, <2min, ca. 500 MB in Database)
- Abstraction of relations with route=power and voltage >= 220kV and exactly 2 substations to Topological Network (<2min)

For Topologically Analysis, Electricity Flow Model, etc.
Outlook

- First release at the end of April
  www.scigrid.de
Thank you for your attention
OSM Data Structure: Example

```
node
node id = 724245909
lat = 51.8898354
lon = 14.4283962
power = tower
user = *
timestamp = *
...

way
way id = 58417796
nd ref = 724245909
...power = line
user = *
timestamp = *
...

relation
relation id 1560977
Member type=way id=58417796
role=line
...
route = power
user = *
timestamp = *
...
```

2...2000
OSM Data Structure: Distribution of „power“ tags

- power=plant
- power=line
- power=generator
  - anything that converts energy of one source to electrical energy

238 different values → not all of them are relevant
- „tower;substation“, “1“, “grounding_electrode“, “2x400“...