SciGRID_gas Input data

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Institute of Networked Energy Systems
Workshop agenda

• Introduction
• Overview and Data Structure
• Input Data
• Merging data sets
• Attribute generation heuristics
• Final Network Model & Data Visualisation
• Users Feedback
• Questions
1. **Loading data sets**
   (Many raw data sets)

2. **Converting into SciGRID_gas structures**
   (Many component data sets)

3. **Combining**
   (Single component data set)

4. **Generation of missing attributes**
   (Single filled component data set)

5. **Simplifying data set**
   (Single network data set 4 modelling)
Data overview

- Sparse # of points
- Topological precise / non-precise
- Mighty
  - Gas pipeline diameter
  - Gas pipeline pressure
  - Storage capacity
  - Gas power plants
  - Compressors
- Time Series
  - Gas flow
  - Storage
  - LNG
  - Production
  - End user

precise

BUT

sparse
Possible data sets

- **INET data** (additional data)
- **GIE** (Gas Infrast. Europ: LNG, storages)
- **GSE** (Gas Storage Europe: storages)
- **IGU** (Intern. Gas Union: storages)
- **EntsoG map** (TSO: pipelines)
- **LKD-EU** (DWI: pipelines, storages)
- **GB** (govt: pipelines, compressors)
- **NO** (govt: pipelines)
- **Cons** (modelled data: consumers)
- **GEM** (Global Energy Monitor)

- **FNB** (Fernleitung Netz Betreiber)
- **GasLib** (Zuse & Open Grid Europe)
- **EntsoG** (TSOs: time series)

- **OSM** (Open Street Map: pipelines)
## Ideal data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
<td>1500</td>
</tr>
<tr>
<td>LNGs</td>
<td>33</td>
</tr>
<tr>
<td>Storages</td>
<td>300</td>
</tr>
<tr>
<td>Productions</td>
<td>500</td>
</tr>
<tr>
<td>Compressors</td>
<td>300</td>
</tr>
<tr>
<td>BorderPoints</td>
<td>111</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>200,000</td>
</tr>
</tbody>
</table>
## INET data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
<td>556</td>
</tr>
<tr>
<td>LNGs</td>
<td>33</td>
</tr>
<tr>
<td>Storages</td>
<td>199</td>
</tr>
<tr>
<td>Compressors</td>
<td>249</td>
</tr>
<tr>
<td>BorderPoints</td>
<td>111</td>
</tr>
<tr>
<td>PipeSegments</td>
<td>1049</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>86,000</td>
</tr>
<tr>
<td>Nodes</td>
<td>1391</td>
</tr>
</tbody>
</table>
INET data density

PipeSegments

- MAX PRESSURE: 74%
- MAX CAP: 88%
- BI DIRECTIONAL: 92%
- IS_H_GAS: 4%
- DIAMETER: 51%

Compressors

- TURBINE POWER 1..6: 85%
- TURBINE FUEL ISGAS 1..6: 86%
- IS_H_GAS: 93%
- MAX PRESSURE: 93%
- PAS POWER: 84%
- MAX CAP: 93%
GIE data set

Component | #
--- | ---
LNGs | 21
Storages | 107
Pipe [km] | 0
Nodes | 113
GIE data density

LNGs

% missing

MEDIAN CAP STORE -> PIPE
MAX WORKING GAS
MAX CAP STORE -> PIPE

0 20 40 60 80 100

Storages

% missing

MEDIAN CAP STORE -> PIPE
MAX WORKING GAS
MAX CAP PIPE -> STORE
MAX CAP STORE -> PIPE

0 20 40 60 80 100
GSE data set

Component | #
---|---
Storages | 207
Pipe [km] | 0
Nodes | 165
GSE data density

Storages

% missing

- MAX WORKING GAS: 23
- MAX CAP STORE -> PIPE: 26
- MAX CAP PIPE -> STORE: 34

SciGRID_gas input data > J.C. Diettrich > 20.05.2021
IGU data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storages</td>
<td>140</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>0</td>
</tr>
<tr>
<td>Nodes</td>
<td>135</td>
</tr>
</tbody>
</table>

International Gas Union, c/o Naturgy, BTB-03, Plaça del Gas, 1, 08003 Barcelona, Spain
IGU data density

Storages

% missing

- MAX POWER: 26%
- MIN STORAGE PRESSURE: 32%
- MAX STORAGE PRESSURE: 14%
- MAX CUSHION GAS: 1%
- MAX WORKING GAS: 2%
- MAX CAP STORE -> PIPE: 9%
- MAX CAP PIPE -> STORE: 0%
EMAP data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productions</td>
<td>103</td>
</tr>
<tr>
<td>Storages</td>
<td>177</td>
</tr>
<tr>
<td>PipeSegments</td>
<td>7126</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>221,000</td>
</tr>
<tr>
<td>Nodes</td>
<td>6019</td>
</tr>
</tbody>
</table>

European Network of Transmission System Operators for Gas, Avenue de Cortenbergh 100 - 2nd floor, B-1000 Brussels - Belgium
EMAP data density

- Topological accuracy < 50 km (exact = 3)

- 3 classes of pipes (except Germany)
  - Small
  - Medium
  - Large

- Parallel pipelines not well represented
LKD data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressors</td>
<td>13</td>
</tr>
<tr>
<td>Productions</td>
<td>6</td>
</tr>
<tr>
<td>Storages</td>
<td>14</td>
</tr>
<tr>
<td>PipeSegments</td>
<td>1085</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>27,000</td>
</tr>
<tr>
<td>Nodes</td>
<td>721</td>
</tr>
</tbody>
</table>

Kunz et al. 2017, Data Documentation: Electricity, Heat, and Gas Sector Data for Modeling the German System
LKD data density

PipeSegments

% missing

- MAX PRESSURE: 17
- MAX CAP: 100
- IS_H_GAS: 13
- DIAMETER

SciGRID_gas input data > J.C. Dietrich > 20.05.2021
GB data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressors</td>
<td>21</td>
</tr>
<tr>
<td>PipeSegments</td>
<td>386</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>8,000</td>
</tr>
<tr>
<td>Nodes</td>
<td>297</td>
</tr>
</tbody>
</table>

© National Grid UK
GB data density

PipeSegments

• diameter: 4% missing
NO data set

![Map of Norway with pipeline segments and nodes]

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>PipeSegments</td>
<td>43</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>9,300</td>
</tr>
<tr>
<td>Nodes</td>
<td>59</td>
</tr>
</tbody>
</table>

NO data density

PipeSegments
### OSM data set

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>PipeSegments</td>
<td>3893</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>180,500</td>
</tr>
<tr>
<td>Nodes</td>
<td>7338</td>
</tr>
</tbody>
</table>
OSM data density

PipeSegments

% missing

MAX PRESSURE  95
DIAMETER  85
CONS data set (coming soon)

<table>
<thead>
<tr>
<th>Component</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
<td>1506</td>
</tr>
<tr>
<td>Pipe [km]</td>
<td>0</td>
</tr>
<tr>
<td>Nodes</td>
<td>1506</td>
</tr>
</tbody>
</table>
CONS data density (coming soon)

Consumers summary

- Time span: 2010-2019
- Temporal resolution: daily

- Consumer categories
  - Household
  - Commercial
  - Industrial

Spatial resolution of input

- GDP (annual, NUTS 3)
- Population (annual, NUTS 3)
- Temperature (daily, NUTS 3)
- Country consumption (annual, country)
- Number of households (annual, NUTS 2)
- Average size of living area (NUTS 0)
- Number of employs (annual, NUTS 2)
- Typology (rural, urban, intermediate) (NUTS 3)
- User type (space heating, water heating, cooking) (NUTS 0)