GIS in a nutshell

“A geographic information system (GIS) integrates hardware, software and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.” – ESRI

- Vectors
  - lines
    • corridors, distribution networks
  - points
    • sites, plants
  - polygons
    • regions, areas in general
- Rasters
  - potentials, climate, POP, GDP, ...
- ArcGIS, MapInfo, Manifold, QGIS...
“Spatializing” TIMES models

Spatial data in energy system models

Example: Global nuclear power plant database (EFDA TIMES)
- flexible regional aggregation of processes and related parameters (type, CAP, RESID, ...)

construction suspended
not operating
operating
planned / under construction
shut down / suspended
Spatial data in energy system models

Example: Global wind power potential (EFDA TIMES)
- flexible regional aggregation of potentials (capacity bounds, efficiency levels ...)
- feedback loops to (spatial) climate models (RES in general)

Spatial model’s structure

Example: “Developing a Roadmap for the Future Energy Infrastructure in Salzburg”
- TIMES-based model, geo-referencing via regions
Spatial model's structure

Example: Project „RECO2NWK“, Regional optimization of heat supply promoting renewables
- GAMS model with geo-referenced processes and commodity flows

RESULTS
Cell as granular spatial unit (250 x 250 m):
• optimized energy infrastructure
• optimized mix of energy sources

Whole region (aggregated results):
• explicit costs, scenario-dependant
• emissions

Spatial model’s structure

Objectives
• costs
• emissions

GRIDS
- gas
- DH
Spatial topology of energy system models

A) SPATIAL TOPOLOGY REPRESENTED BY REGIONS

In GIS / GDB: all regional levels represented
In TIMES: lowest level (finest granularity) implemented (aggregation by attribution)

Spatial topology of energy system models

B) SPATIAL TOPOLOGY REPRESENTED BY PROCESSES AND COMMODITIES

In GIS / GDB: representation of georeferenced processes and regions
In TIMES: regional attribution, georeferencing by process / commodity splitting
Implementation of spatial TIMES models in GDB

model's data

/ TIMES

VEDA

GDB

model's data & model's setup

/ TIMES

GIS

VEDA

Implementation of TIMES in open source GDB
Conclusion & Outlook

Actual state
- review on existing applications and implementations
- Investigation of implementation pathways (direct integration / lose coupling ...)
- implementation of TIMES in GDB (current topic)

Tasks to be completed
- finalizing implementation of TIMES in GDB
- implementation of GDB interfaces (GDB2DD and GDX2GDB)
- benchmark of spatial model frameworks
- report to ETSAP

General remarks
- participation of community welcome / necessary -> discussion form (?)
- open source database scheme and interfaces provided for download

DISKUSSION
Spatial data in energy system models

Example REACESS
- spatial visualization of energy corridors / results

Spatial data in energy system models

EFDA TIMES IRE processes and national uranium resources in GDB
Spatial model's structure

GIS and TIMES

<table>
<thead>
<tr>
<th>TIMES models</th>
<th>GIS models</th>
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<tbody>
<tr>
<td>partial equilibrium model</td>
<td>static, data driven real world model</td>
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<tr>
<td>forecast of the energy system development for the next decades</td>
<td>georeferenced datasets are processed and interpreted (snapshot)</td>
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<tr>
<td>bottom-up (technology based) model</td>
<td>spatial snap-shot scenarios at a certain moment</td>
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<tr>
<td>development of REGIONS in the context of the entire energy system regarding the share of certain technologies at certain future timesteps to meet the prospected demand</td>
<td>spatial correlations between locations, areas, corridor trails are investigated based on indicator datasets linked together by a common geo-index (geo-referenced)</td>
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