WP 3
Sustainable Energy Planning
Work-shop 2007-05-29--30

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The REAM presentation

Objectives
General description
Model structure
Calculation algorithm
Result presentation

Objective of WP 3 – Sustainable Energy Planning

- Further development of an existing tool for local energy planning (KRAM) into the REAM system
- Energy analyses and planning in all SEC's
- Active involvement by local communities - energy experts, politicians, planners etc
- Develop "Energia-game"

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The REAM model 1

- Simulation model for local/regional energy planning
- The stationary energy system
- Geographical dimension
- Analyses development of the energy system over time
- Heating, Cooling and Electricity
- Flexible degree of detail

The REAM model 2

- Supply technologies as well as energy efficiency measures
- Large scale conversion technologies and small scale
- Includes costs, technologies and emissions
- Analyses the development on a least cost basis
- ReferensEnergySystem-oriented
- Language flexibility, partly unit flexibility
- File-explorer look-alike

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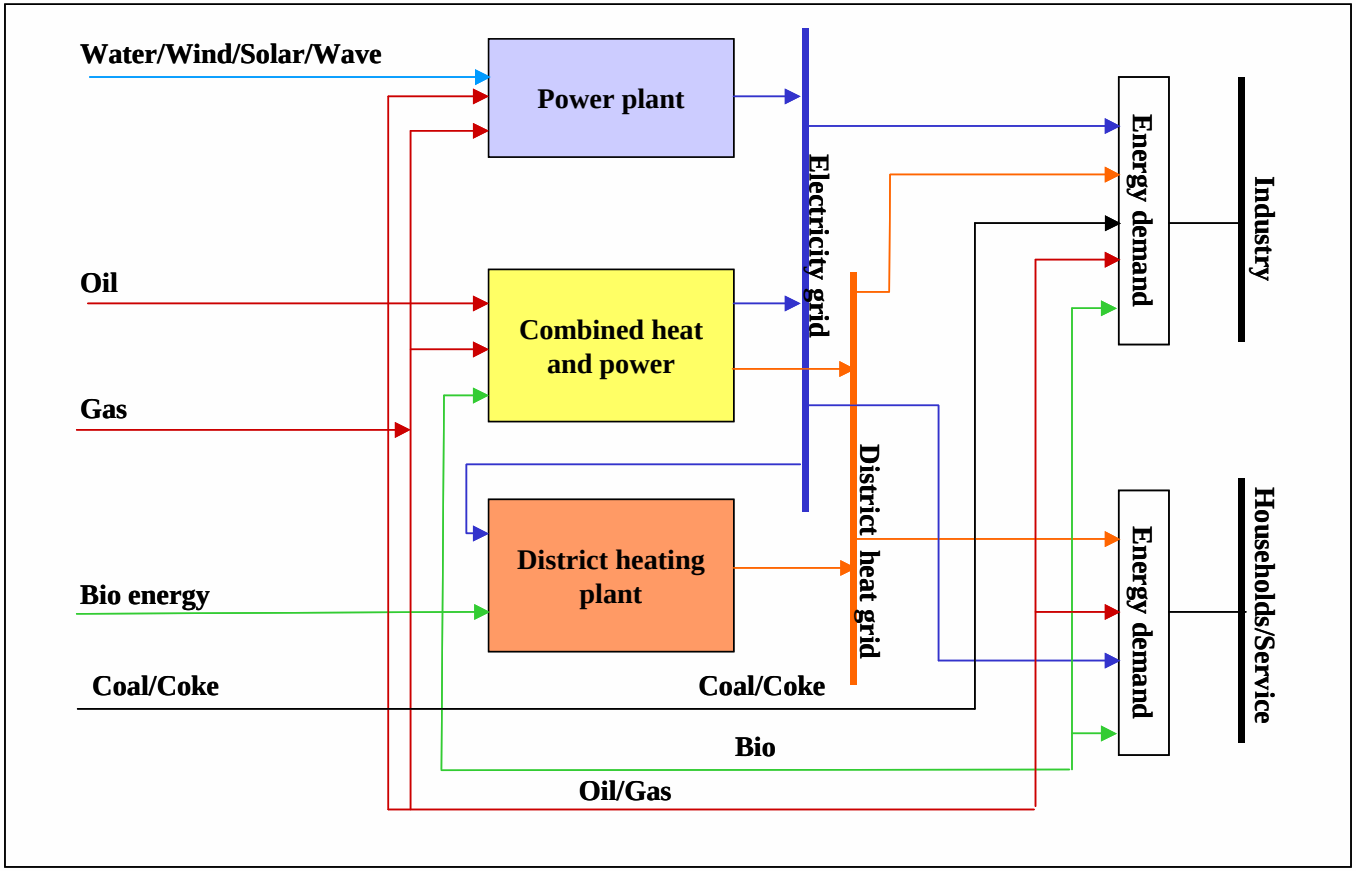
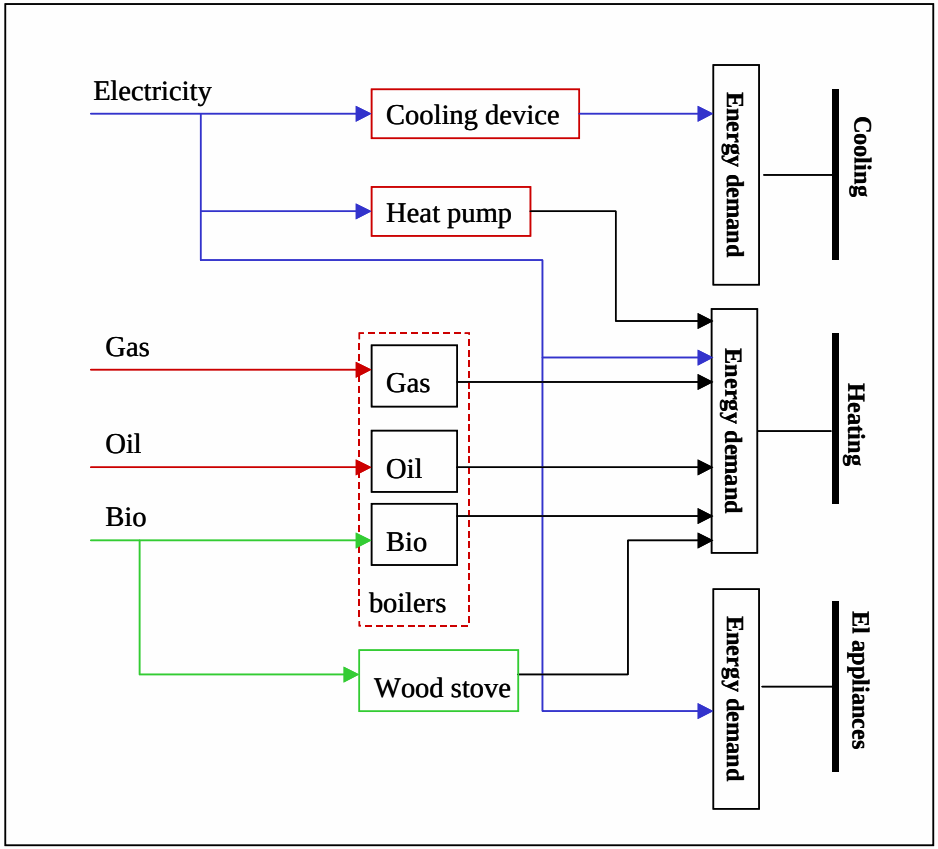
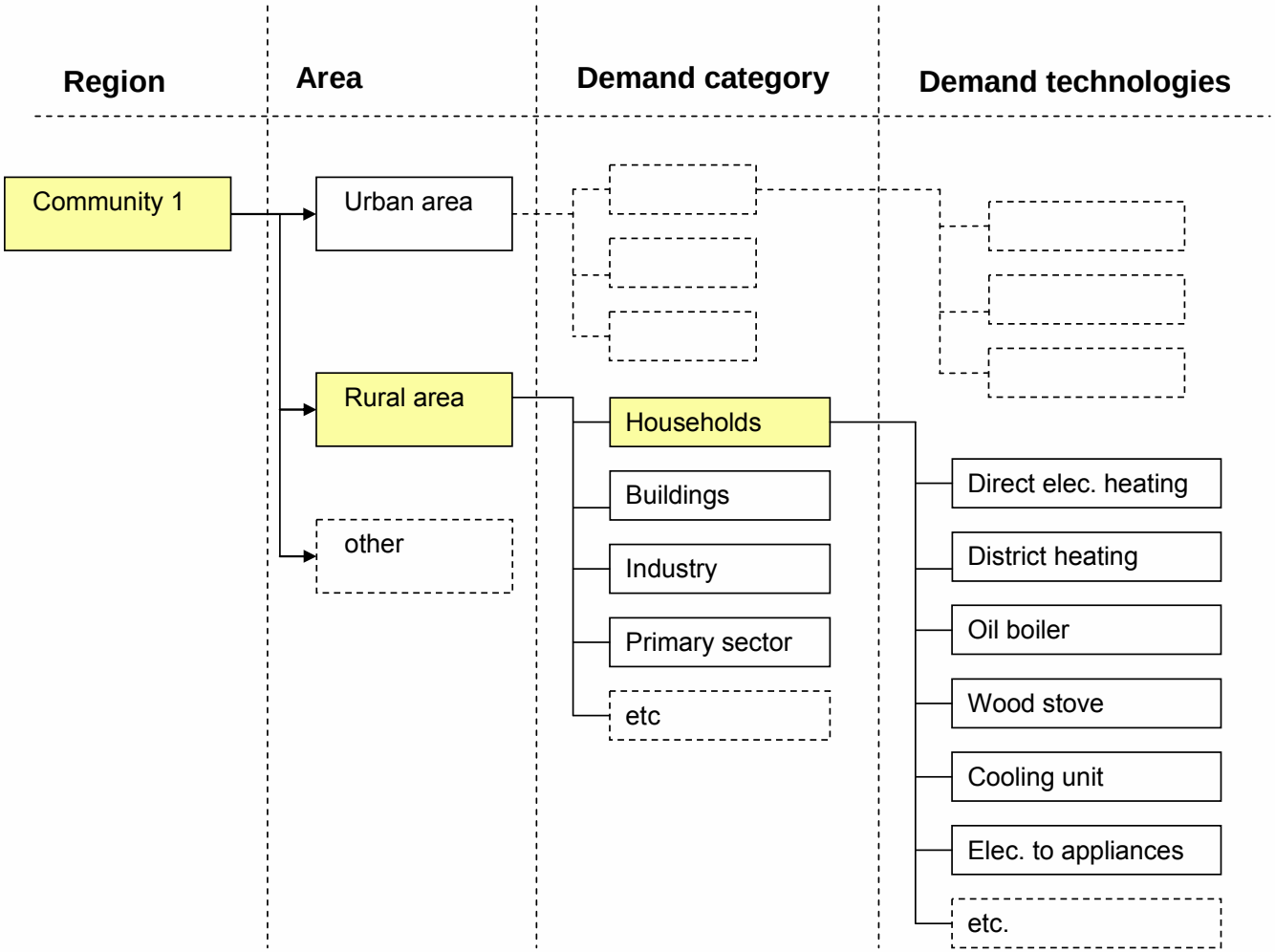
Principal RES – Overview level



Principal RES – Demand category level



Energy system / model structure



Heating – Electricity – Cooling

- Three energy types
- All types handled in the same way
- Supply and efficiency measures
- Large scale and small scale technologies

Demand category

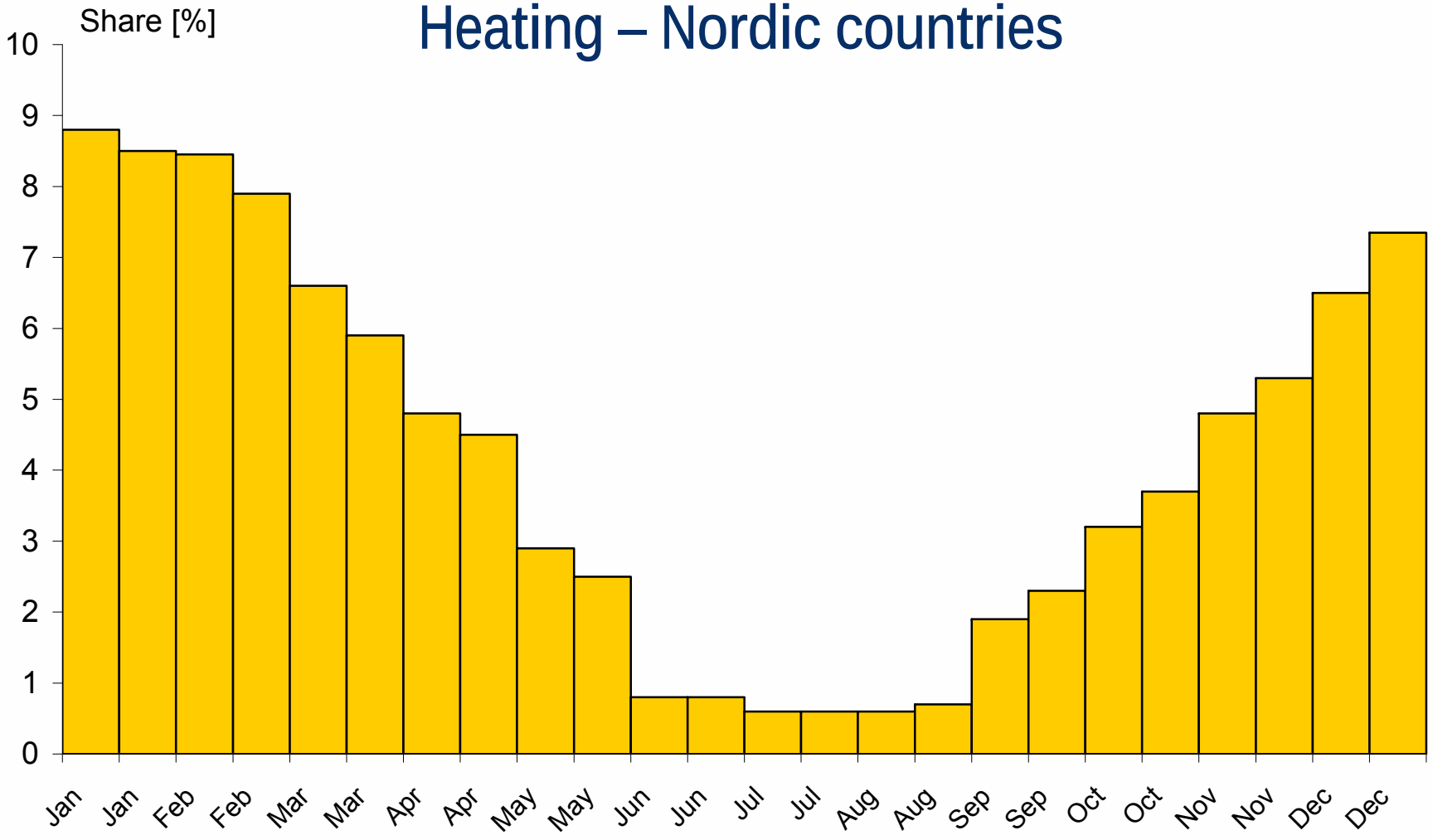
- Homogeneous demand groups
- Small Scale Technologies (demand technology)
- Total energy demand (per type)
- Load curves
- Calculation rate
- VAT
- Extra investments (e.g. central heating and chimney/tank)
- Emission fee share

Small scale / large scale technologies

- Small scale = individual technologies related to the demand categories
- Large scale = centralized common systems related to an area, e.g. district heating and local electricity production

Load curve

Heating – Nordic countries

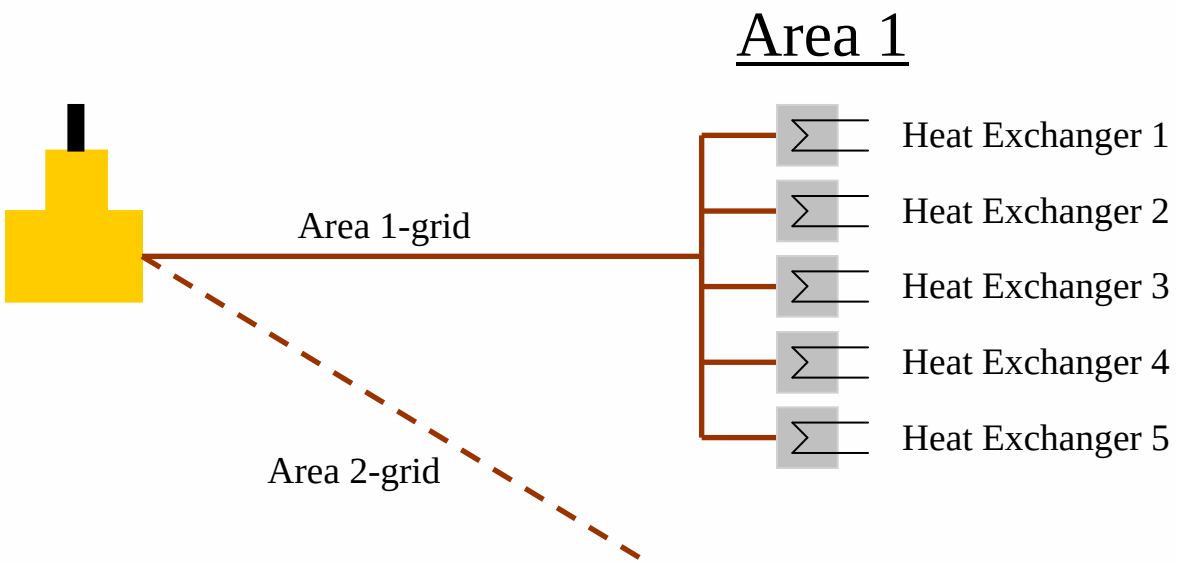


Small scale technologies

- Supply and efficiency technologies
- The technologies are described by:
  - Efficiency (per fuel), [%]
  - Capacities (residual, upper, lower, fix), [EU/year]
  - Fuel(s) with maximal share
  - Grid connections
  - Investment, [MU/EU]
  - Life length, [years]
  - Extra investments, [MU/EU]
  - Fixed costs , [MU/EU]
  - Variable cost (per fuel), [MU/EU]
  - Emission coefficients (per fuel), [µg, mg, g /EU_{fuel}]

Grids

- Connects small scale technologies with large scale technologies
- Area restriction
- Investment and capacities



Large scale technologies

- The technologies are described by:
  - Efficiency (per fuel), [%]
  - Capacities (residual, available), [CU]
  - Fuel(s) with maximal share
  - Secondary output
  - Grid connections
  - Investment, [MU/EU]
  - Life length, [years]
  - Fixed costs , [MU/EU]
  - Variable cost (per fuel), [MU/EU]
  - Emission coefficients (per fuel), [µg, mg, g /EU_{fuel}]

Fuels

- Prices – time resolution 1 / 24, [MU/EU]
- Taxes x 5, e.g. energy tax, [MU/EU]
- Emissions from fuel (outside the analysed system)

Emissions

- Small scale technologies, [µg, mg, g /EU]
- Large scale technologies, [µg, mg, g /EU]
- Fuels, [µg, mg, g /EU]
- Emission fees, [MU/WU]

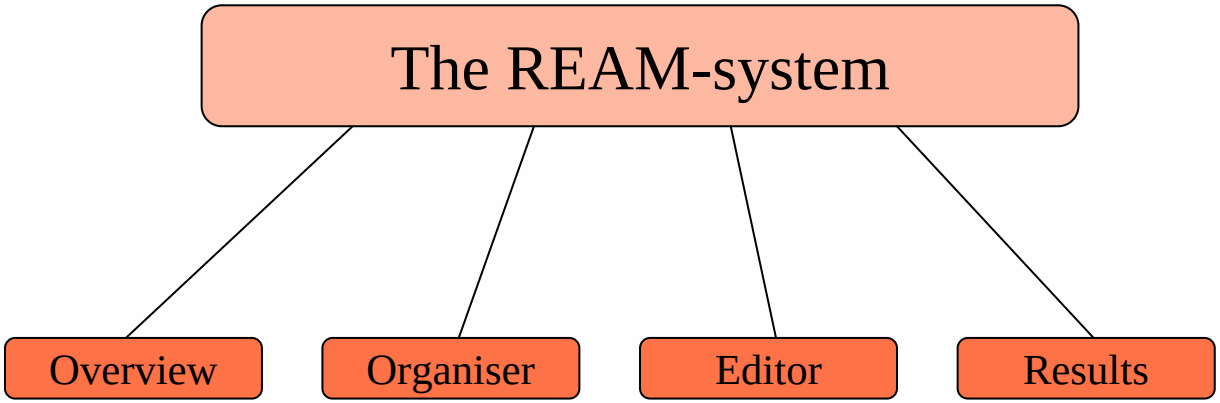
Years

- Numeric values
- Capital cost calculation
- Life length administration

Flexibilities

- Structure
- Detail
- Language
- Monetary units
- Energy units: Watt or Joule

Program structure



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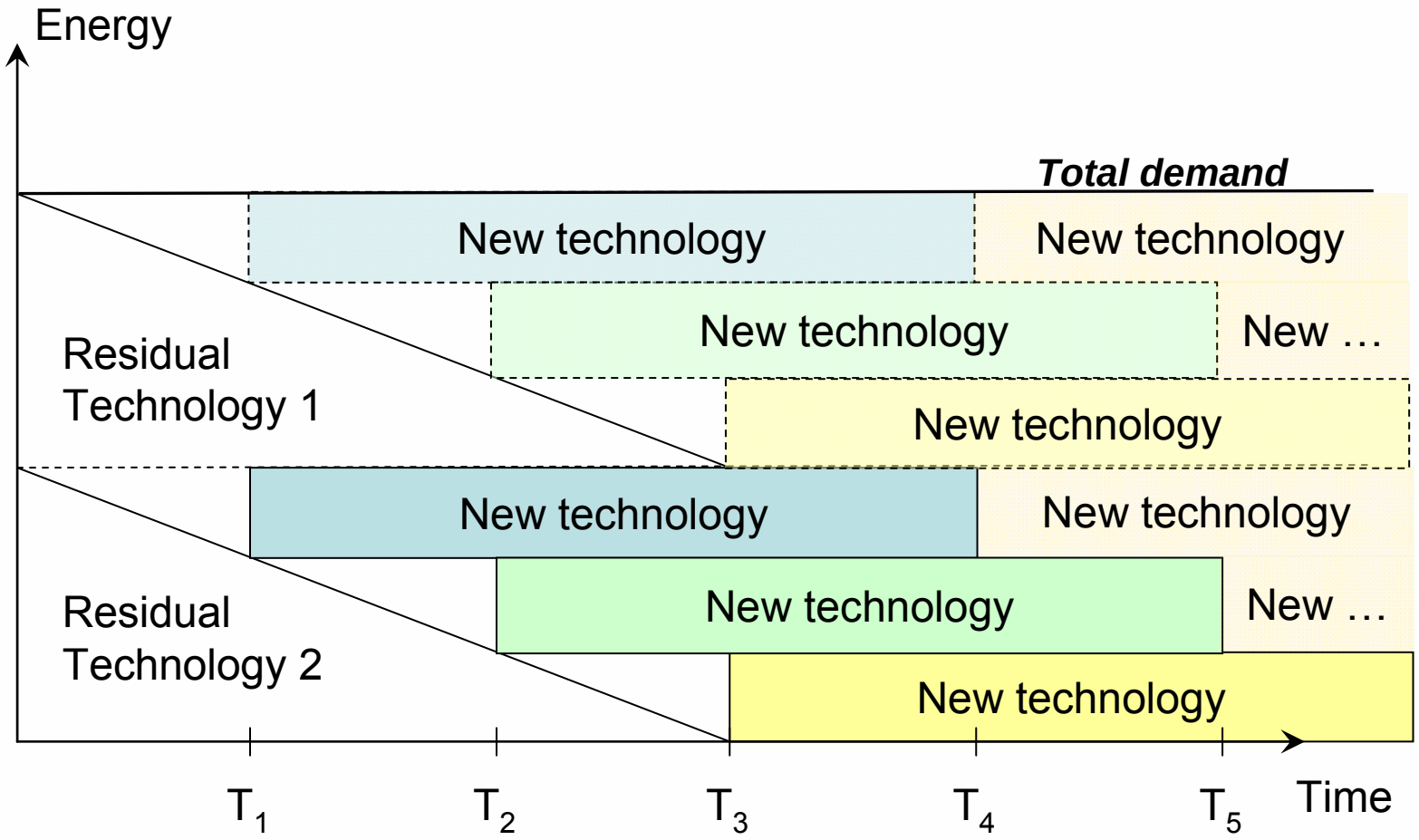
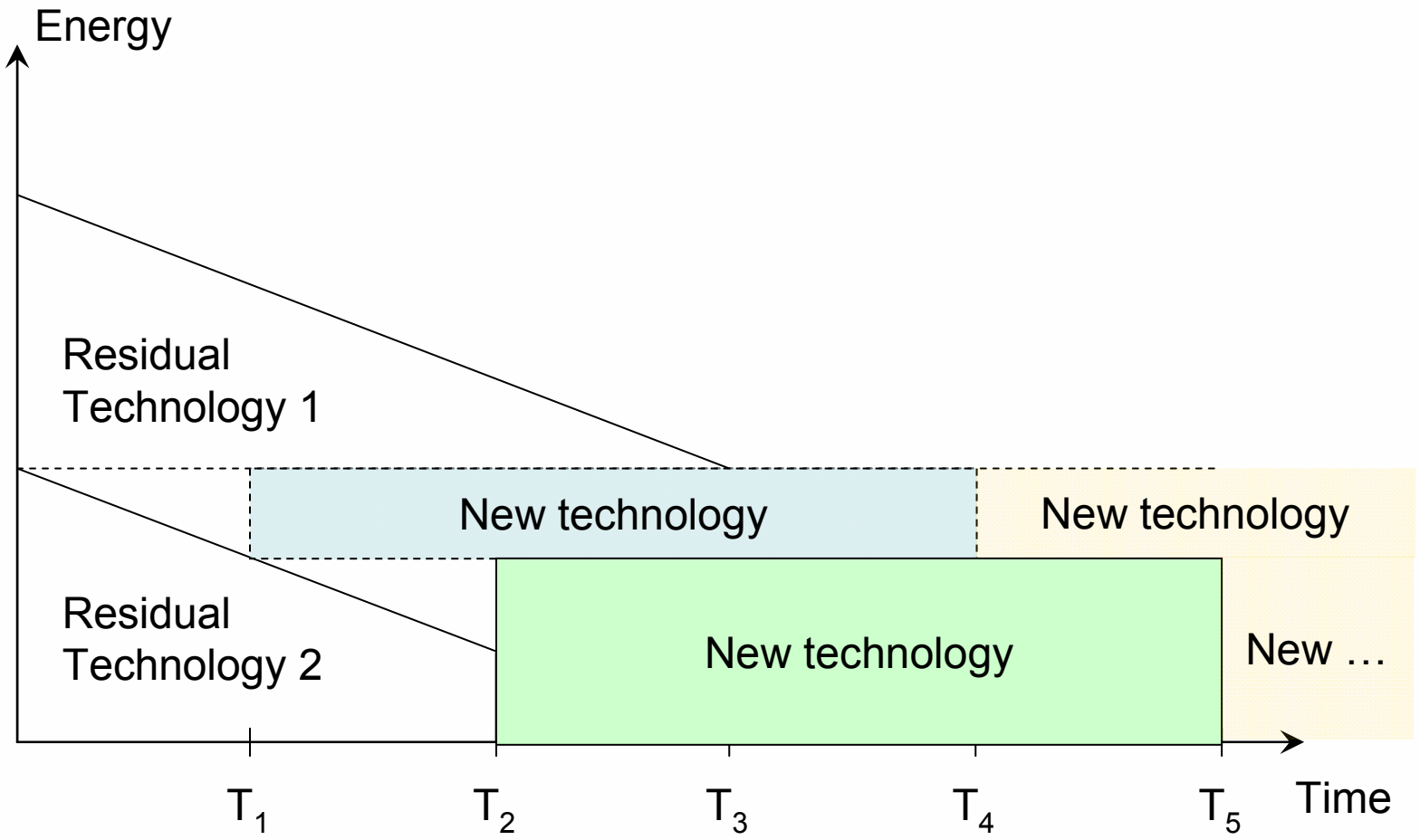
Calculation algorithm – small scale

- The model is driven by the changes in the demand categories (market changes)
- Replacing phased-out capacity, alternative
- Replacing technologies with variable cost > new total cost
- The substitution is made on the basis of lowest total cost
- Alternatively is the development specified by the user
- The calculation of the total cost in a specific period is based on the assumptions **only** in this period → sequential calculations

Substituting phased-out capacity



Existing variable cost > new total cost

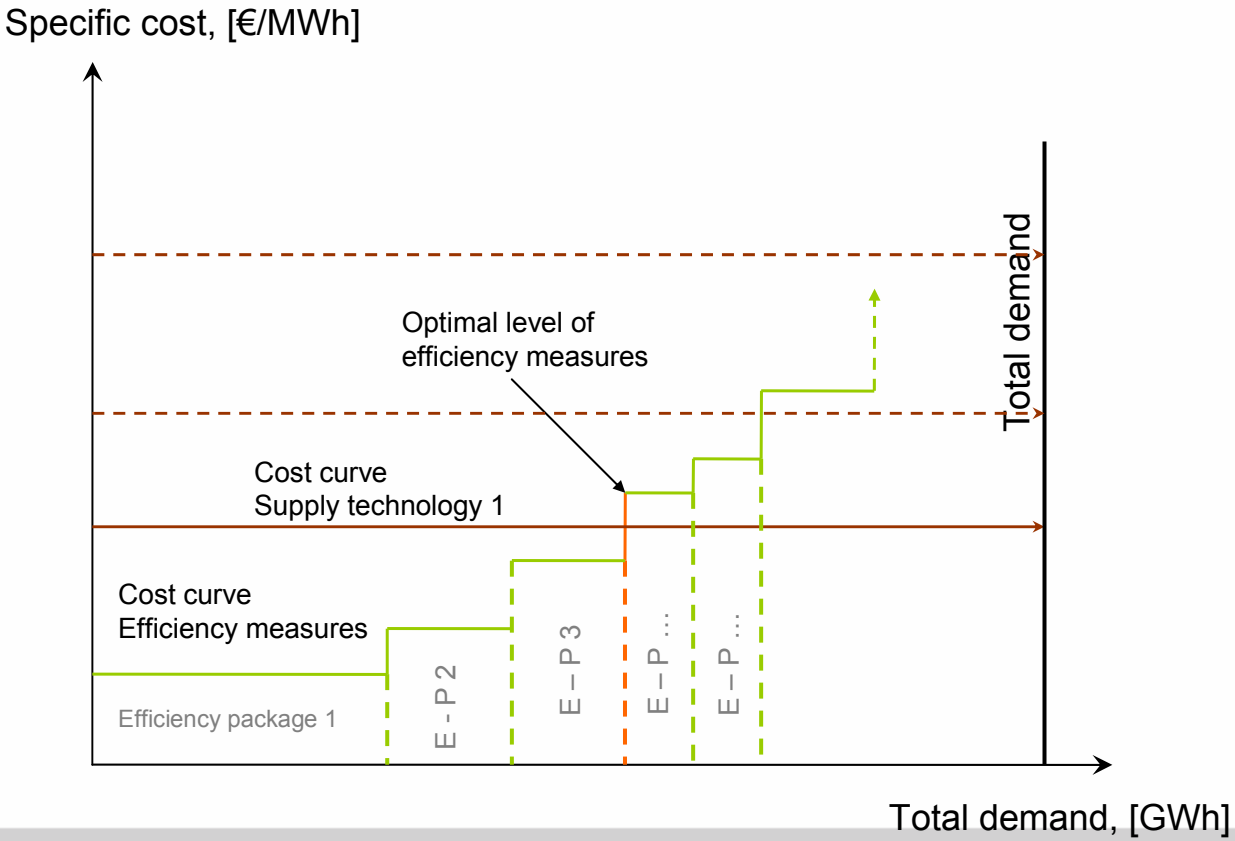


Total cost

- Small scale
  - Fuels price, taxes, emissions fees, variable cost, fixed cost, capital cost (investment + extra investment), efficiency
- Large scale
  - Fuels price, taxes, emissions fees, variable cost, fixed cost, capital cost (investment + extra investment + grid investment), secondary output, efficiency
- However, the large scale output is priced in the demand category by the user

Supply and efficiency measures

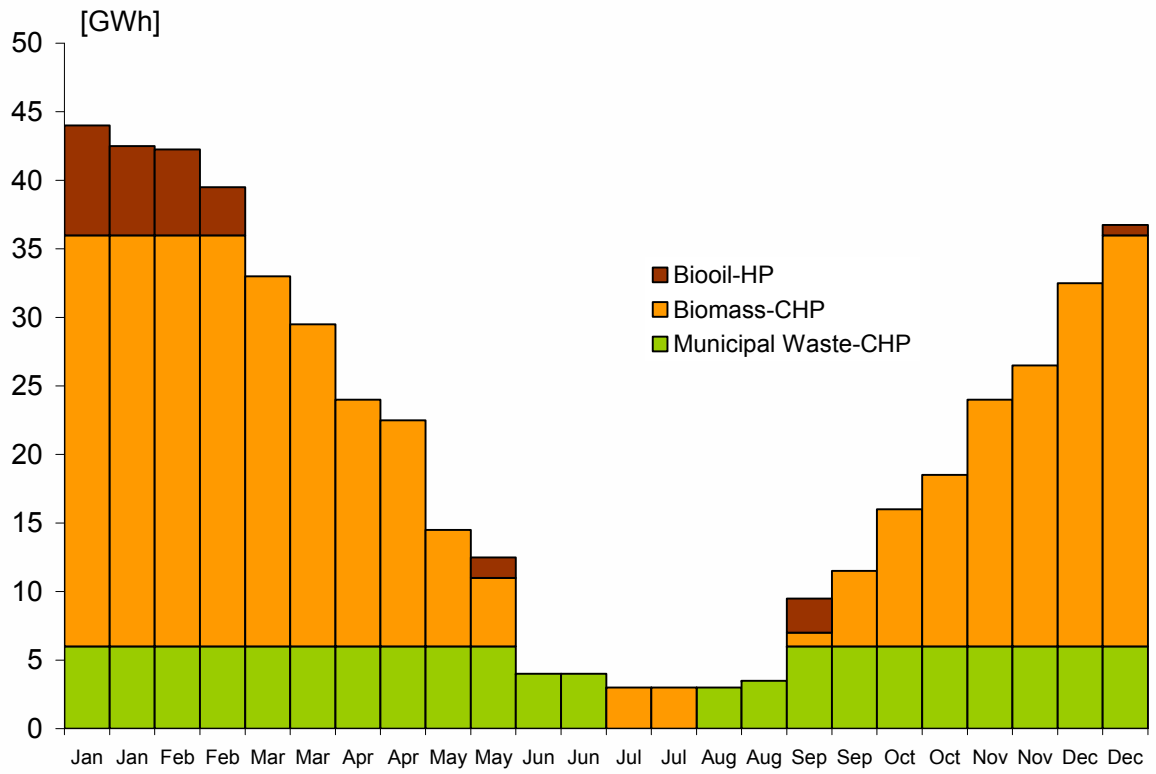
- Optimal level for supply vs. efficiency measures on a cost basis
- Supply and efficiency handles in the same way



Calculation algorithm – large scale

- Dispatch model (total variable cost ranking)
- Alternatively user specified production schedule

Example - District heating production



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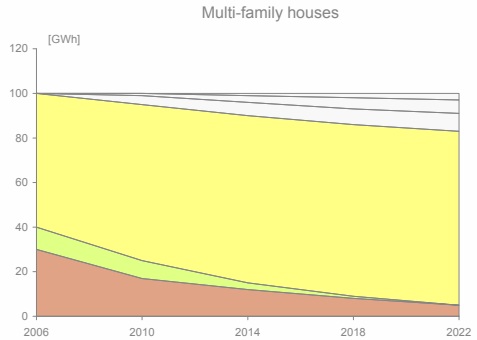
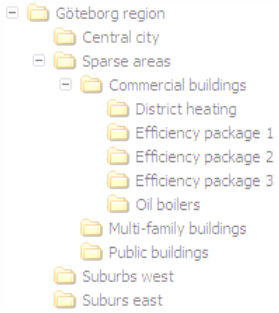
Result presentation

- Flexible presentation system
- File-explorer look-alike structure
- Tables and diagrams
- Possible to export to Excel and pdf-files
- Crystal reports-system

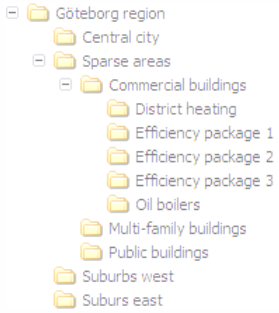
	2006	2010	2014	2018	2022
Oil boiler	30	17	12	8	5
Elc boiler	10	8	3	1	0
District heating	60	70	75	77	78
Eff pack 1		4	6	7	8
Eff pack 2		1	3	5	6
Eff pack 3			1	2	3
Sum	100	100	100	100	100





Results from the model 1

- Results from all levels and geographical areas
  - Energy supply
  - Energy production
  - Emissions (also emissions from fuels)
- Costs (fuel costs, taxes, fee costs, fixed and variable cost and capital cost)
- Region (summarised of all areas):
  - Energy supply (per fuel)
  - Total large scale production (total per area)
  - Emissions (total per area)
  - Costs (total)



Results from the model 2

- Area (summarised of all demand category)
  - Energy supply and efficiency measures (per fuel)
  - Large scale production (per energy type)
  - Emissions (per demand category)
  - Costs (total)
- Demand category (per category)
  - Energy supply and efficiency measures (per fuel)
  - Small scale production and efficiency measures
  - Emissions
  - Costs

What will happened now?

- Possible already now to put in the input data (paste function is missing)
- First complete version will be distributed in the end of August
- Mr. Ottosen from IFE will use REAM in his Master thesis
- SEC will use the model as a tool in the planning process.
- User support from IFE during the project