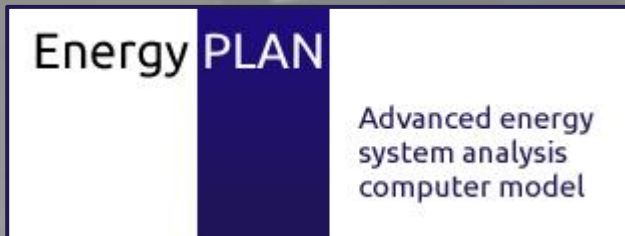# MULTIPLE ENERGY SYSTEM ANALYSIS OF SMART ENERGY SYSTEMS

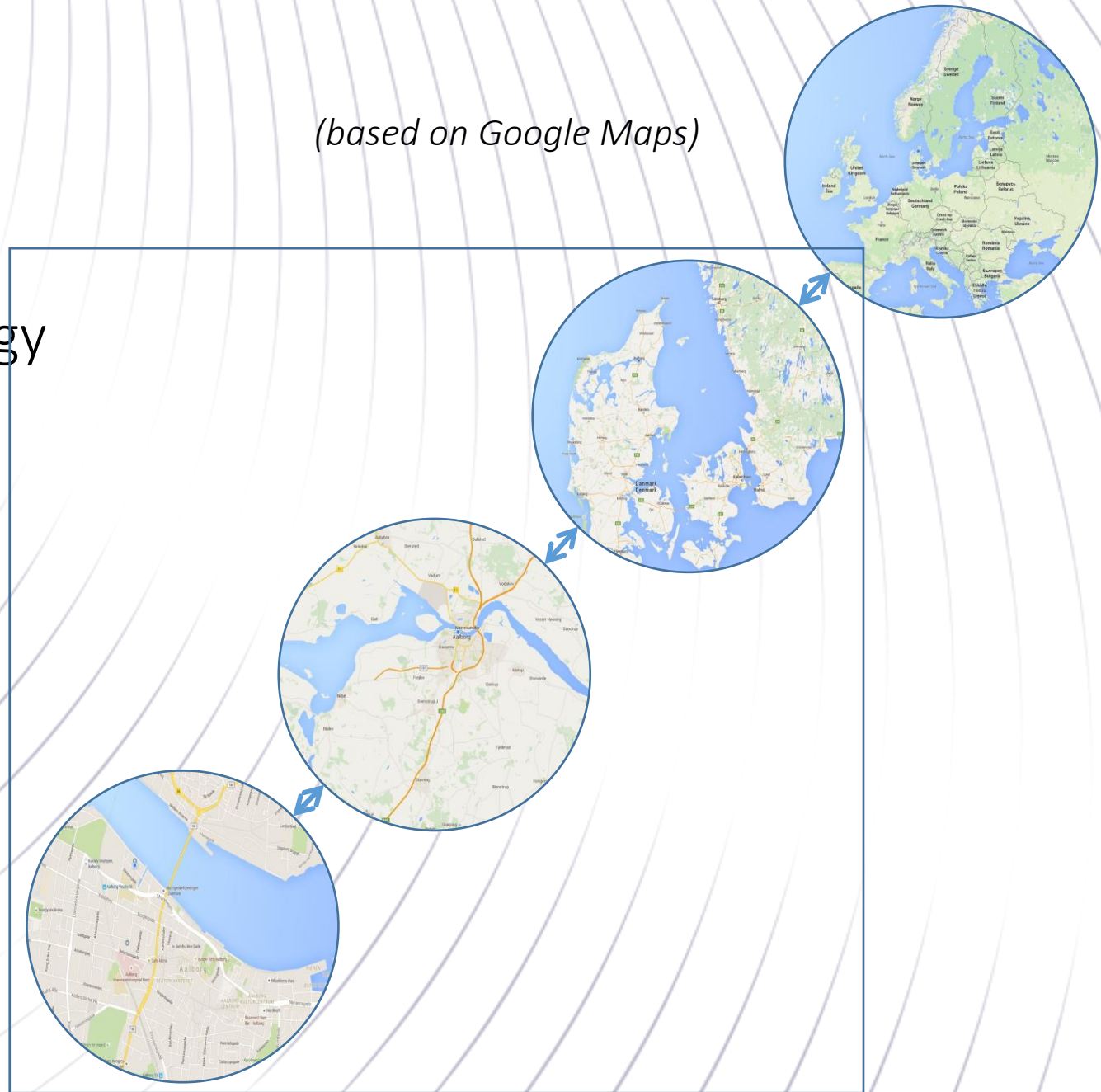Jakob Zinck Thellufsen

PhD Fellow, Aalborg University

INTRODUCTION

(based on Google Maps)

- Transition to future smart energy systems

- Three (four) levels of energy systems

  - City (Local)
  - (Regional)
  - National
  - Transnational

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LINKING LOCAL AND NATIONAL ENERGY SYSTEMS

- Allocation based on national averages

- Upscaling local models

- Transmission between levels and systems

- Developing a tool to handle local <-> national energy systems
  - Country as regions
 - Cities and Municipalities as part of regions and Countries

Municipality as part of countries
(based on Google Maps)
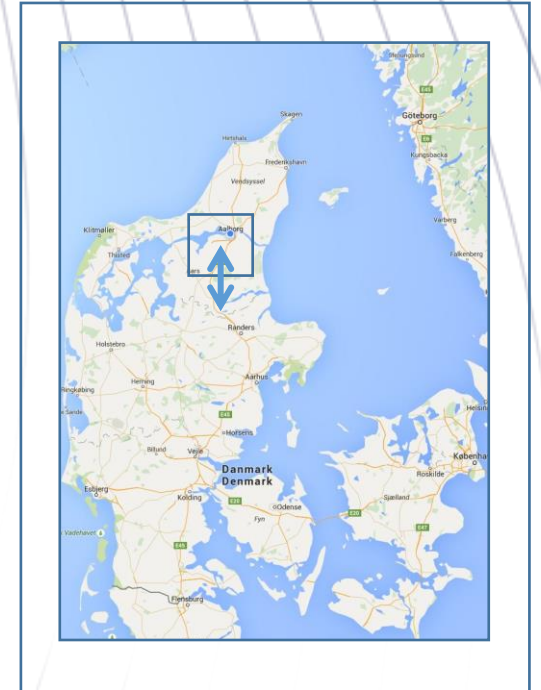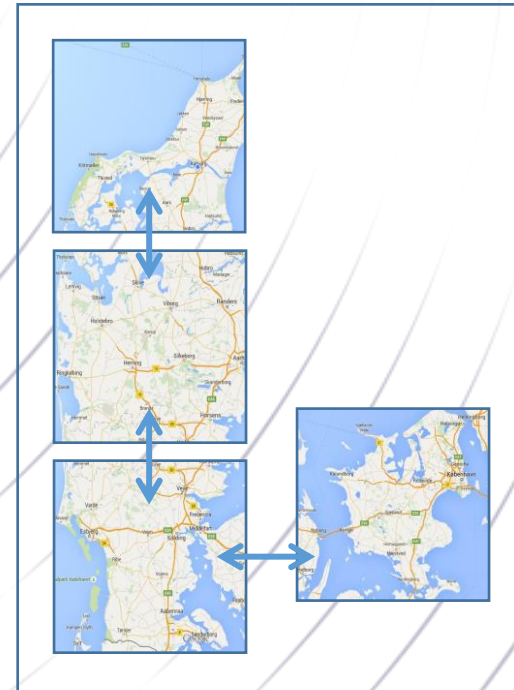
Country as regions
(based on Google Maps)

CURRENT MODELING IN ENERGYPLAN

- One system limitation
  - Municipality
  - Region
  - Country
  - …

- External electricity market
  - Interconnector Capacity

- Separate analyses of individual regions.

- Creating a tool that can link multiple energy plan models.
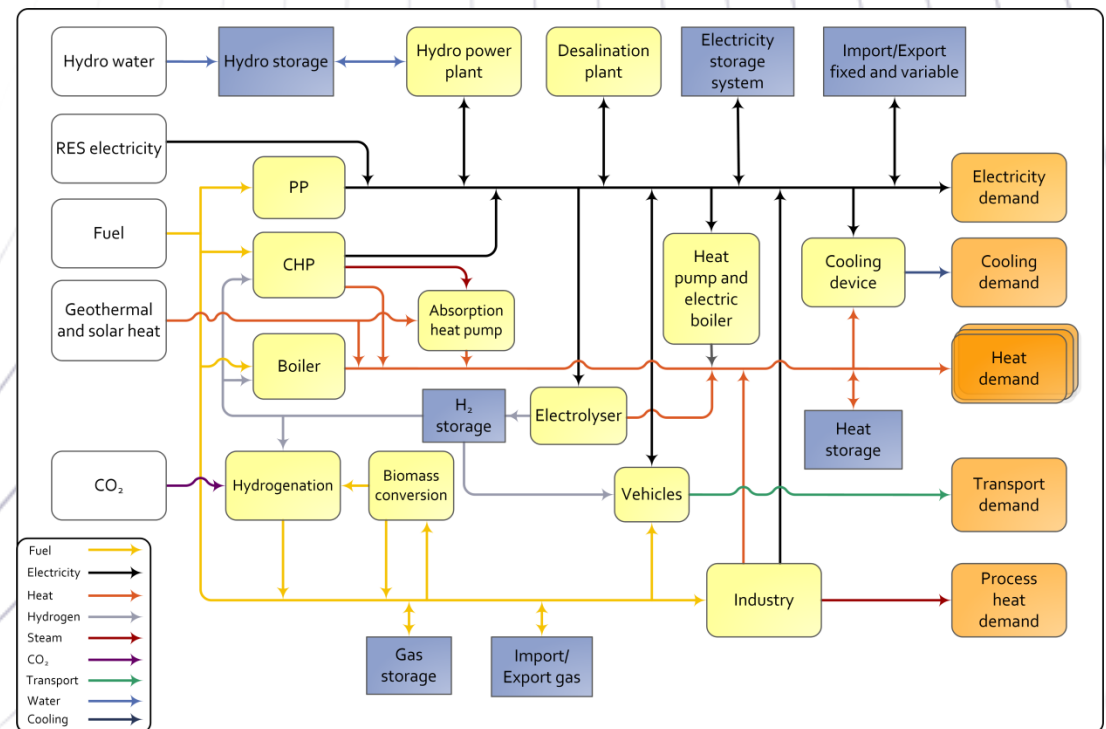
(energyplan.eu 2015)

CREATING A MODEL FOR ANALYSING MULTIPLE ENERGY SYSTEMS IN ENERGYPLAN

Transmission

- Model all scales of energy systems
- Difference in linking cities to countries and linking countries to each other

Current Assumptions in EnergyPLAN

- Analytical programming
- Based on technical simulation
  - Fuel based optimisation
  - Most efficient units
  - Utilise "local" production units

A MULTIPLE EXECUTION TOOL FOR ENERGYPLAN – TWO MAIN APPROACHES

Iterative

- Run each individual system in island mode

- Analyse import/export data and production units and transmission capacity

- Add potential export to the systems

- Run and repeat.

Share based

- Define an overall system

- Define subsystems

- Program calculates the shares of the subsystem in the overall system

- Analyse the overall system, use shares to get subsystem output.

- Assumes copper-plate

EXAMPLE OF CITY TO COUNTY

- Copenhagen and Denmark
  - Larger city with central CHP
  - Iterative

- Sønderborg and Denmark
  - Smaller city with decentral CHP
  - Iterative and share based
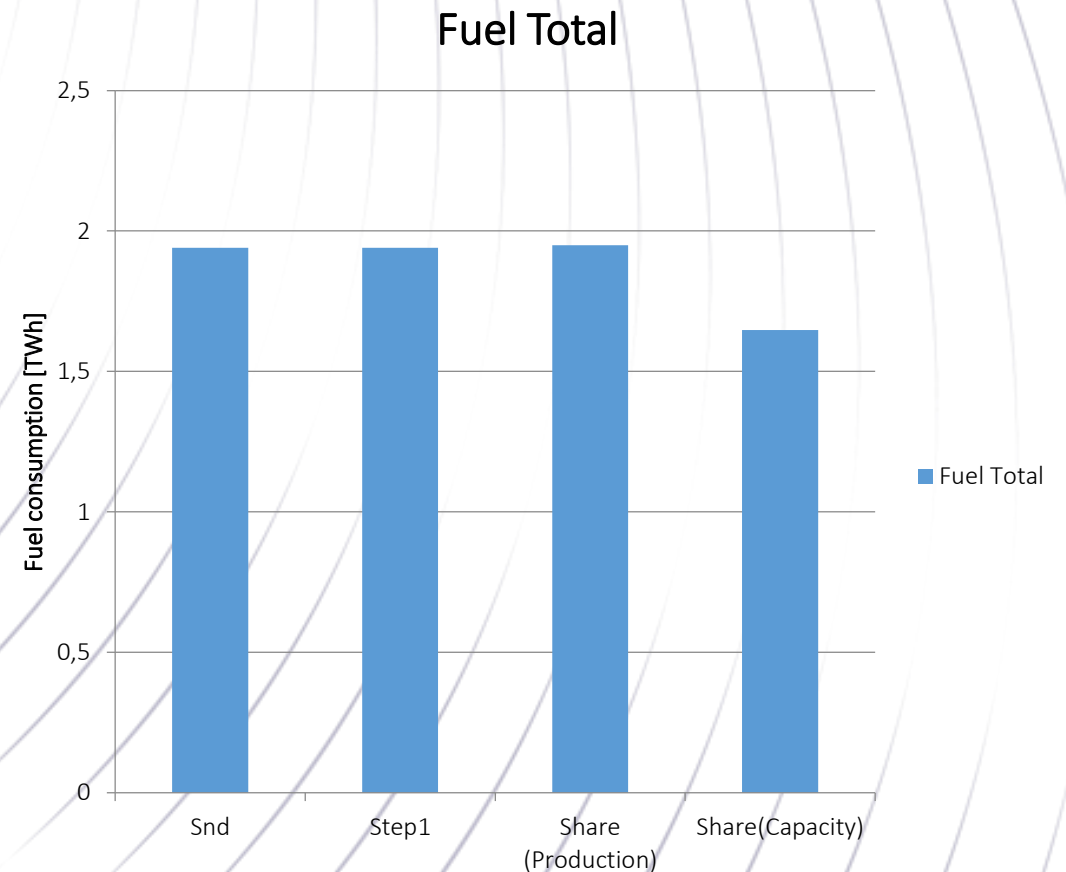
RESULTS: ITERATIVE ANALYSIS FOR DK
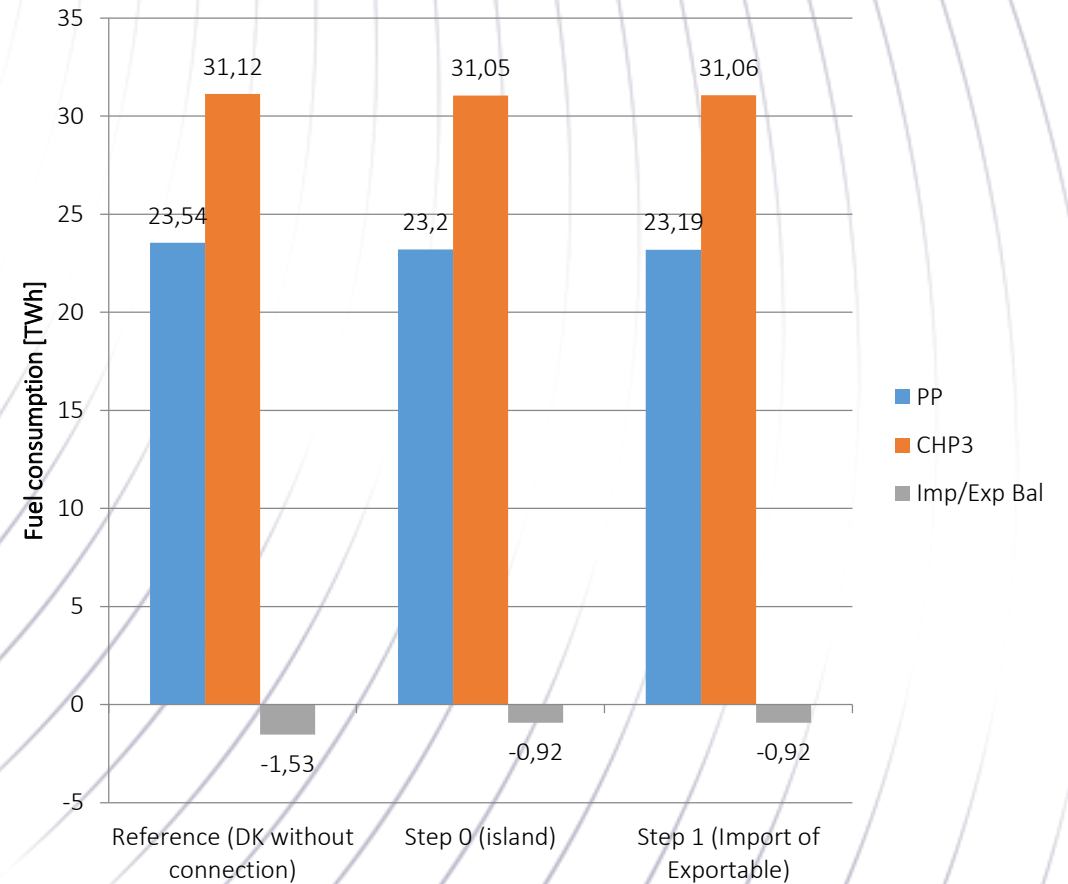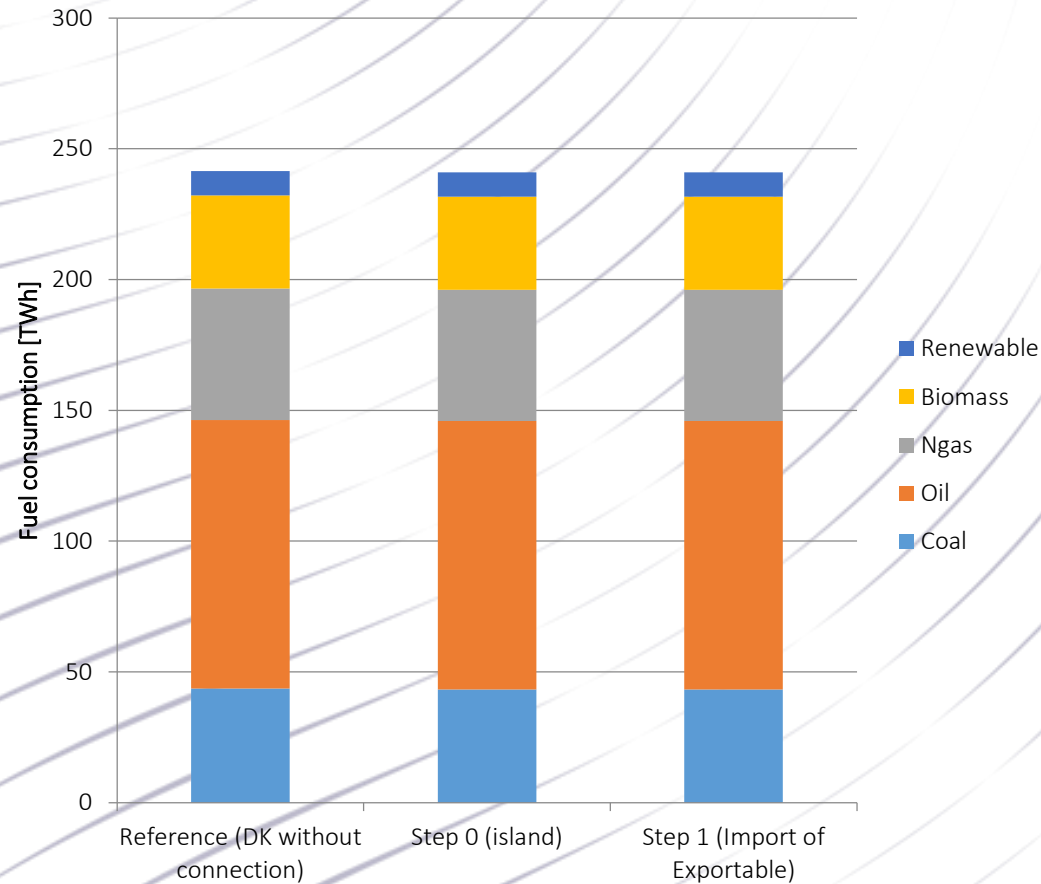
Analysis based on data from CEESA and PlanEnergi

PERFORMANCE OF LOCAL SYSTEM: COMPARING SHARE BASED ANALYSIS

- Capacity or Production?
  - Production strategies

- Production based is more similar to the iterative approach

Fuel Total

Analysis based on data from CEESA and PlanEnergi

CONCLUSIONS

- That the iterative process works in terms of reducing fuel consumption
  - However, some import demand might still exist.

- No difference if the share is calculated on production.

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QUESTIONS?

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