Centre for Environment-friendly Energy Research (CEER/FME)
Zero Emission Buildings (ZEB)

WP 3 - Energy supply systems and building services systems

ZEB Konferansen 2012

Oslo, 05.09.2012

Energiforsyning og tekniske installasjoner – hva er valgmulighetene?

Vojislav Novakovic, NTNU

The ZEB research activities

ZEB focuses its work in five areas that interact and influence each other:

- **WP-1: Advanced materials technologies**
- **WP-2: Climate-adapted low-energy envelope technologies**
- **WP-3: Energy supply systems and services**
- **WP-4: Use, operation, and implementation**
- **WP-5: Concepts and strategies**

WP3 - Energy Supply Systems and Building Services

Main goal:

Develop new solutions for energy supply systems and building services systems with reasonable energy and indoor environment performance appropriate for zero emission buildings.

Subtasks:

3.1: Available technologies for renewable energy

Goal: Investigating new solutions for energy supply systems, heating, ventilation, and air conditioning systems, and energy storage systems.

3.2: Interaction between user needs, energy supply, and building services

Goal: To develop new and to improve existing solutions for buildings with extremely low heating and cooling demands.

3.3: Integration of technologies and solutions

Goal: To develop optimal solutions for integration of new building materials, building envelope solutions, local and in-house energy supply systems, and building services systems.

3.4: High performance building services

Goal: Develop optimal solutions for highly efficient building services systems.

3.5: Test and pilot buildings - Follow up

Goal: Give support to building and study of test and pilot buildings.
Evaluate the performance of test and pilot buildings.

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Basert på arbeidet i WP 3:
Energy supply systems and building services systems

1. **Verktøy for valg av energiforsyning (3.1 og 3.2)**
   - **Vojislav Novakovic, NTNU**

2. **Ventilasjon og energigjenvinning i kaldt klima (3.4)**
   - **Hans Martin Mathisen, NTNU**

3. **En teknisk entreprenørs utfordringer i praksis**
   - **Jens Petter Burud, YIT**

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Verktøy for valg av energiforsyning

Vojislav Novakovic, NTNU

WP3 - Selected Research Activities 2009-2012

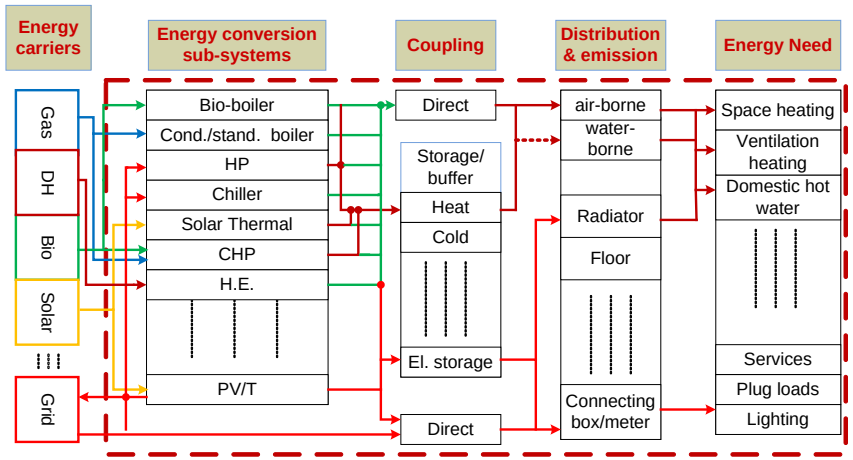
- **Available technologies for renewable energy (3.1)**
  - **A comprehensive state-of-the-art study of available energy supply technologies was accompanied at the beginning of the project and later updated**
    - **The report is frequently used by MSc and PhD students.**
  - **A qualitative survey based study among partners and other relevant players in the building industry discovered need for development of:**
    - **A simple decision support tool focusing on selection of energy supply solutions in an early project design phase, and**
    - **A database on energy supply technologies which are good and robust for the near future under Norwegian conditions**
    - **Development of the tool and the database, that will be linked in use, is planed to be accomplished late 2012**

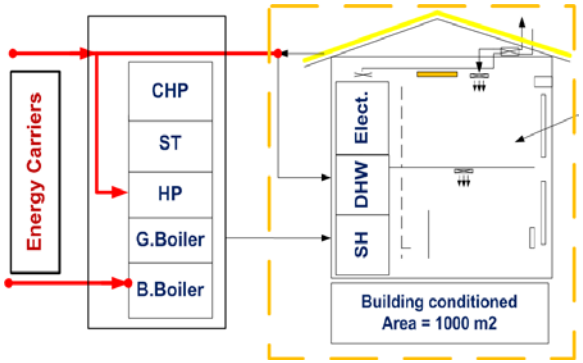
WP3 - Selected Research Activities 2009-2012

- **Interaction between user needs, energy supply, and building services (3.2)**
  - **PhD-study: Optimal solutions for buildings with extremely low heating and cooling demands**
    - **Advanced simulation models for prediction of performance of buildings with extremely low heating and cooling demand. Started April 2010.**
  - **Multi-objective optimization at an early design stage – Introductory case study for a 1000 m^2 building**
    - **Objective functions: Minimum Annual cost and Total primary energy factor**
    - **Constraints: Annual zero CO2 balance and Limited roof area for Solar system (PV&ST)**
    - **Input: Simple - based on average, seasonal, fixed, norm values and simplified calculations**
    - **Output: Different combination possible, Optimal threshold using Pareto Front**
  - **Multi-objective optimization at detail design stage – through the above mentioned PhD study**
    - **Traditional energy systems are designed to cover peak loads and they are over-sized to cover uncertainties**
    - **In low energy building, this leads to system operation at part-loads or stand-by setting for major portion of time. That might lead to increase in auxiliary energy use.**
    - **Input: Precise – based on real values for efficiencies, demand profiles, energy prices, technology costs etc.**
    - **Output: Seasonal performance of different sub-system, Optimal configuration and sizing of system, Net-ZEB strategies may be explored**

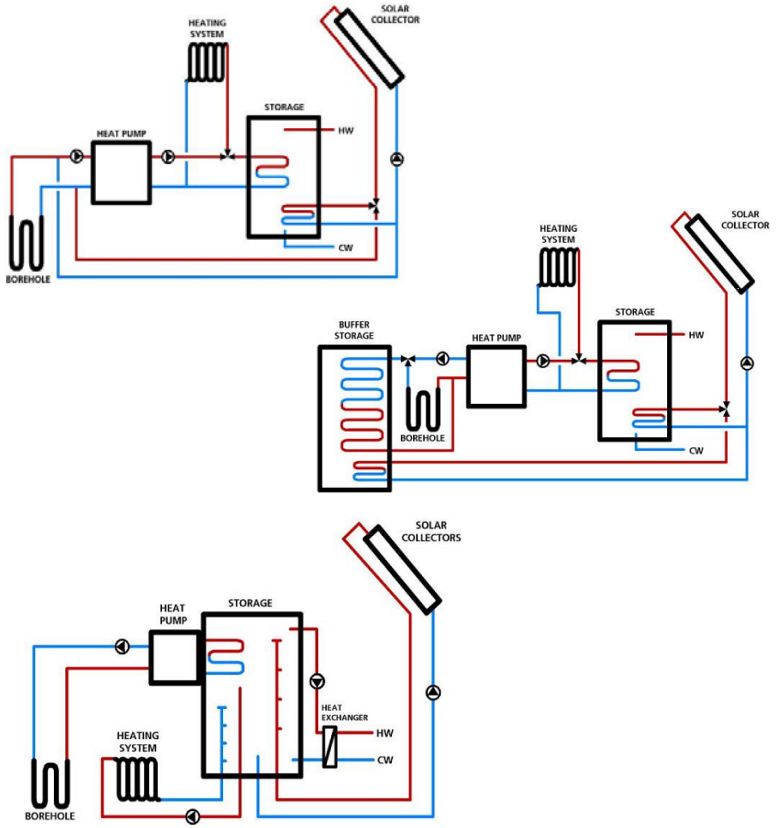
Multi-objective optimization at …

- early design stage





- detailed design stage



Selection of energy supply solutions in an early project design phase

- Today in Norway is based on use of software tools for calculating the building energy need:
  - SIMIEN
  - TEK Sjekk

- Cover the building physics part
- BUT
- the energy system part is oversimplified

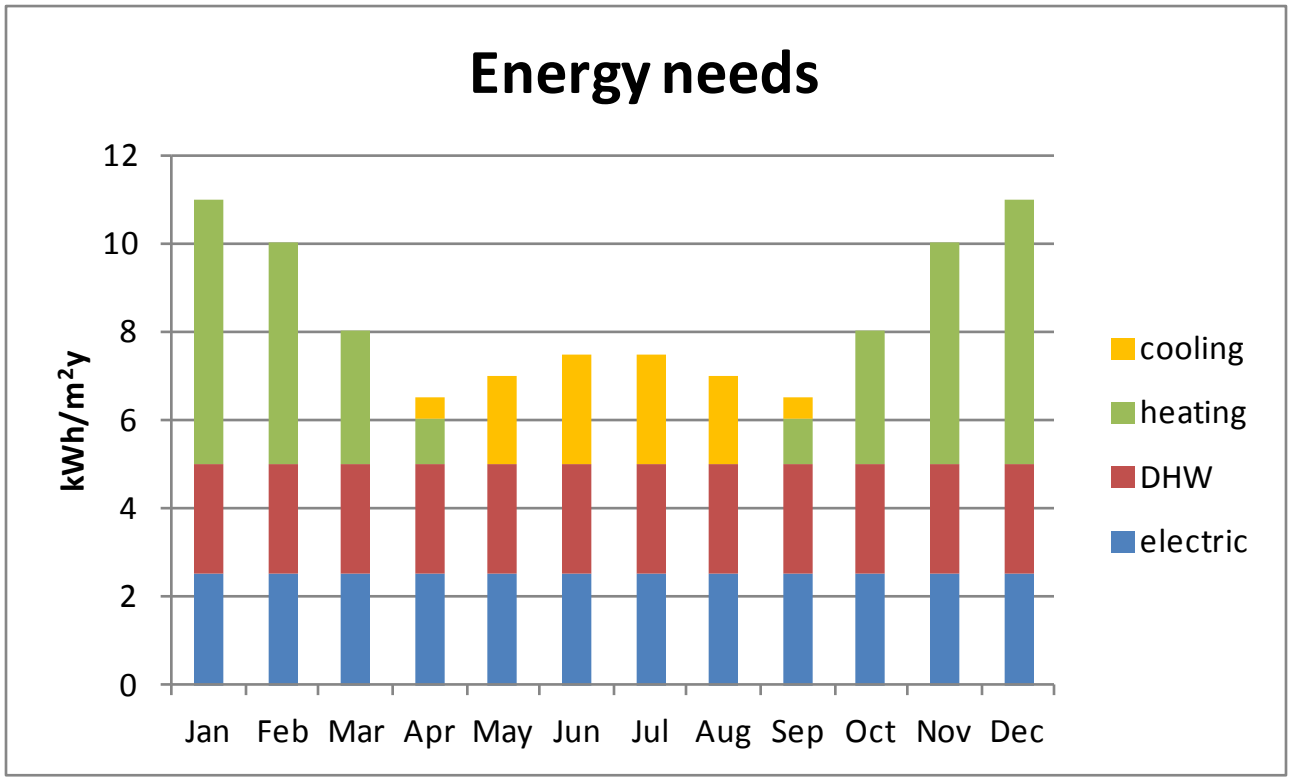
- It is only possible to define:

  - share of total load covered
  - OR
  - max capacity (constant = ideal system)

A simple decision support tool for selection of energy supply solutions in an early project design phase

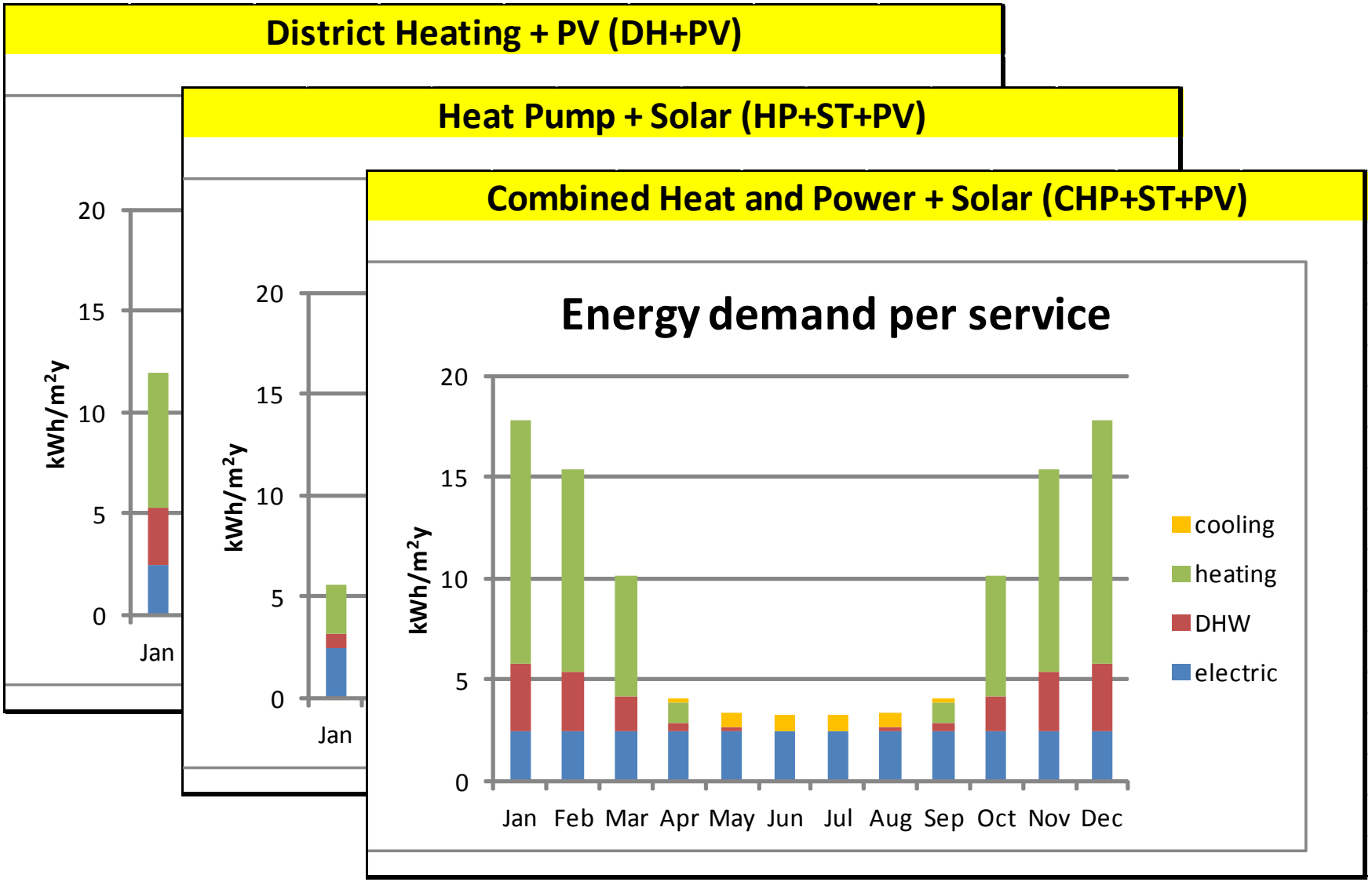
- A simple decision support tool
- for selection of energy supply solutions
- in an early project design phase
- with a database on
- energy supply technologies
- which are good and robust
- for the near future
- under Norwegian conditions

Example energy need in input

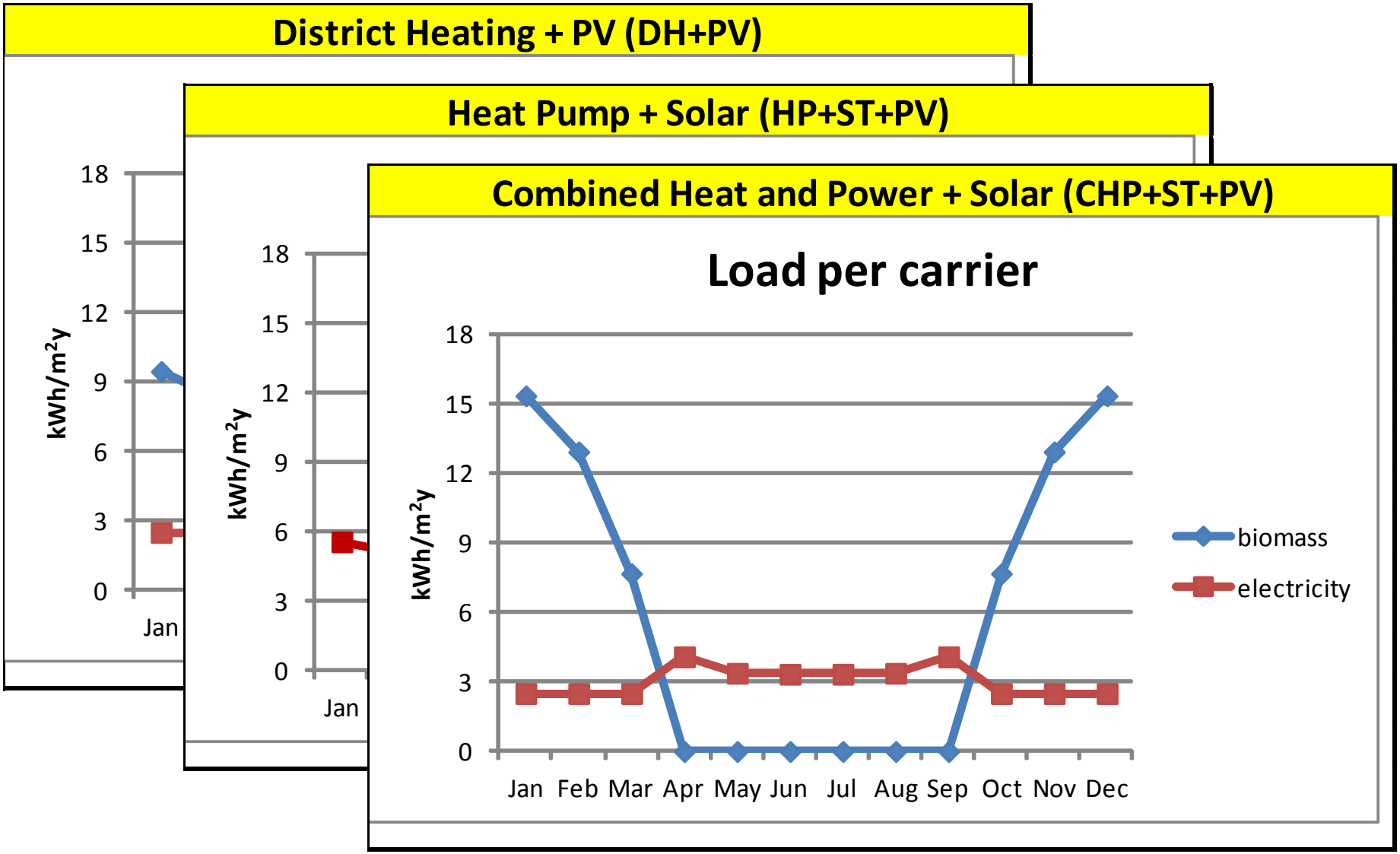


Hypothetical low-energy building in continental climate
Annual energy need = 100 kWh/m²
Insolation data from PVGIS for Paris, ca. 50°N

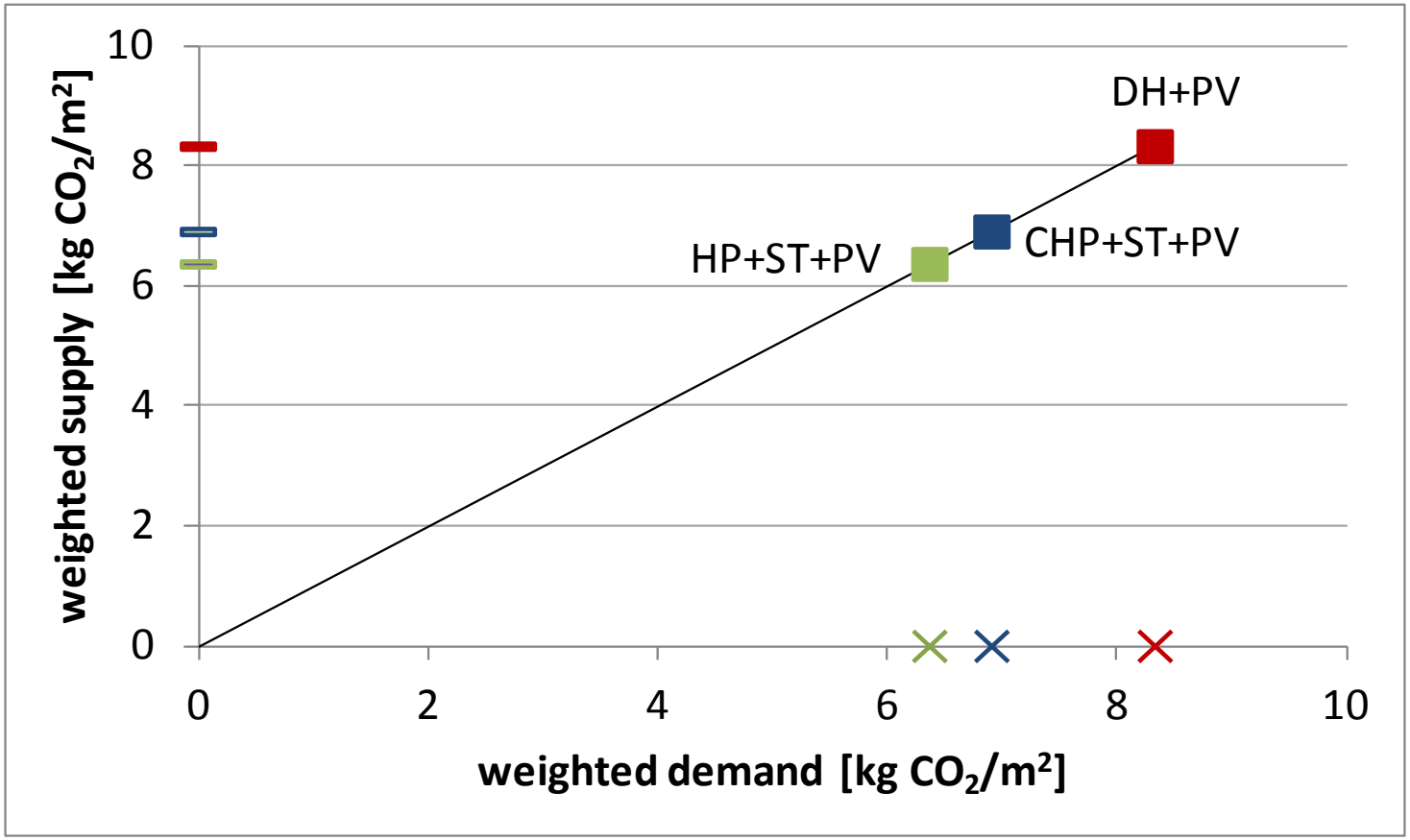
Example outputs: energy demand



Example outputs: load per energy carrier

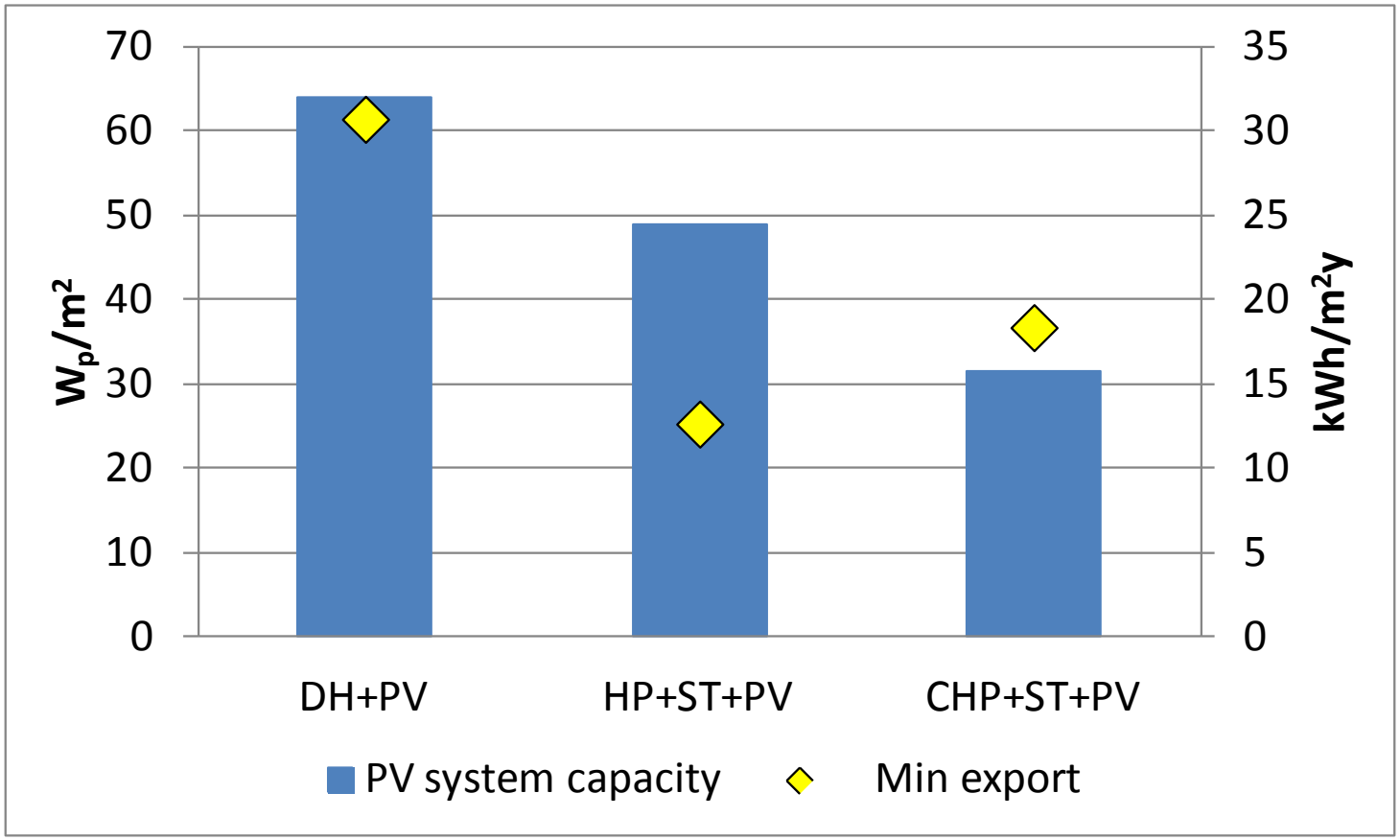


Example output: annual load vs. generation

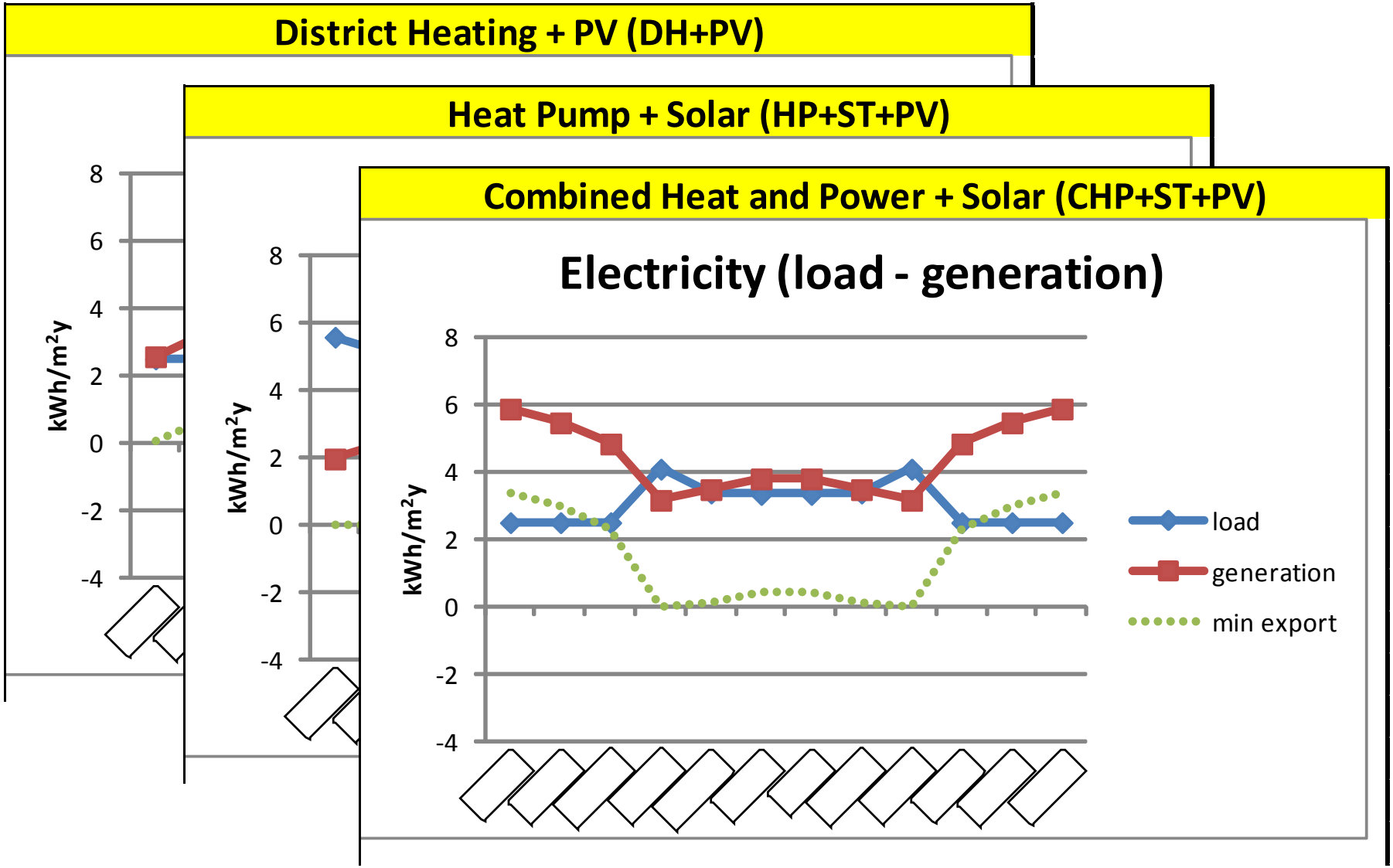


Energy carrier	Weighting [g CO_2/kWh]
Electricity	130
District heating	60
Biomass	30

Example Results: generation capacity, el. export



Example output: monthly load vs. generation



Verktøy for valg av energiforsyning

- A simple decision support tool for selection of energy supply solutions in an early project design phase with a database on energy supply technologies which are good and robust for the near future under Norwegian conditions

- Development of the tool and the database, that will be linked in use, is planed to be accomplished by the end of 2012

Verktøy for valg av energiforsyning

Thank you for the attention!

Questions ???