# System and scenario choices in the life cycle assessment of a building – Changing impacts of the environmental profile


Freja Nygaard Rasmussen, AAU

**Morten Birkved, DTU**

Harpa Birgisdóttir, AAU

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## Main results from LCA case study of an office building :

- Life cycle stage contributions to toxicological impact potentials do not follow the same trend as contributions to environmental impact potentials
- Extending study period from 50 to 100 years changes results in environmental impact potentials by 8-18 %
- Use of national energy data instead of regional energy data changes results by up to 175 %
- Use of a dynamic approach to national energy data changes results by up to 320 %

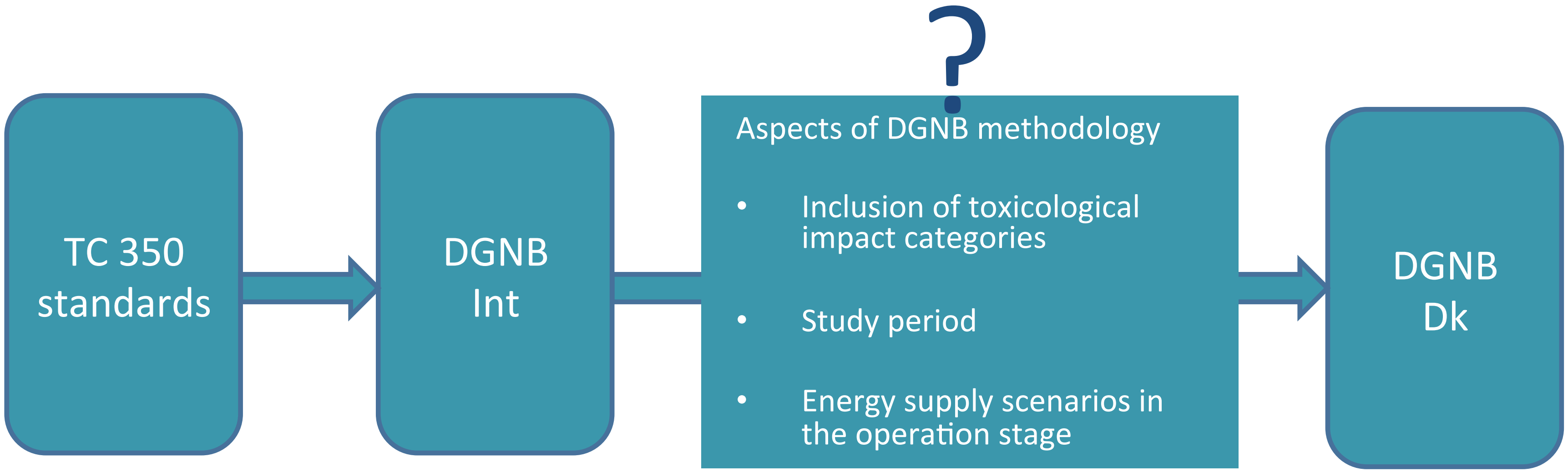
BACKGROUND

# DGNB – Danish adaptation

TC 350 as a standard framework for sustainable buildings

National adaptation of international certification scheme

GREEN BUILDING COUNCIL DENMARK



Investigated through modelling of a case study building and application of 3 scenarios

[Henning Larsen Architects]

**Office building**

NN1 Headquarters of Novo Nordisk medical company

**Low energy building** (Dk building regulation 2015):

Annual electricity consumption 13.8 kWh/m$^2$

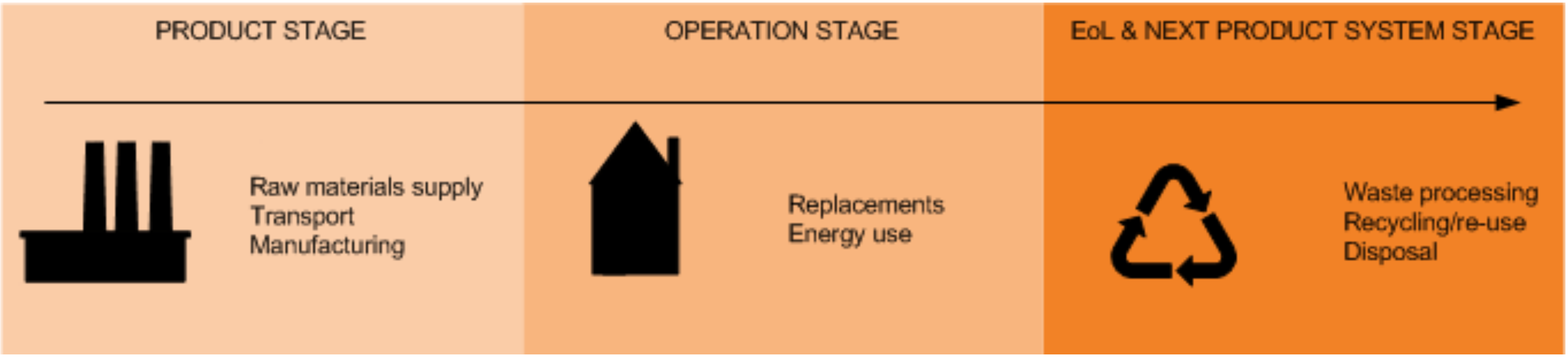
Annual heat consumption 12.3 kWh/m$^2$

**GFA:** 32,742 m$^2$

**Structural elements**: Concrete and steel

**Facade:** Glazed white tile, glass

## Product system




## Impact categories

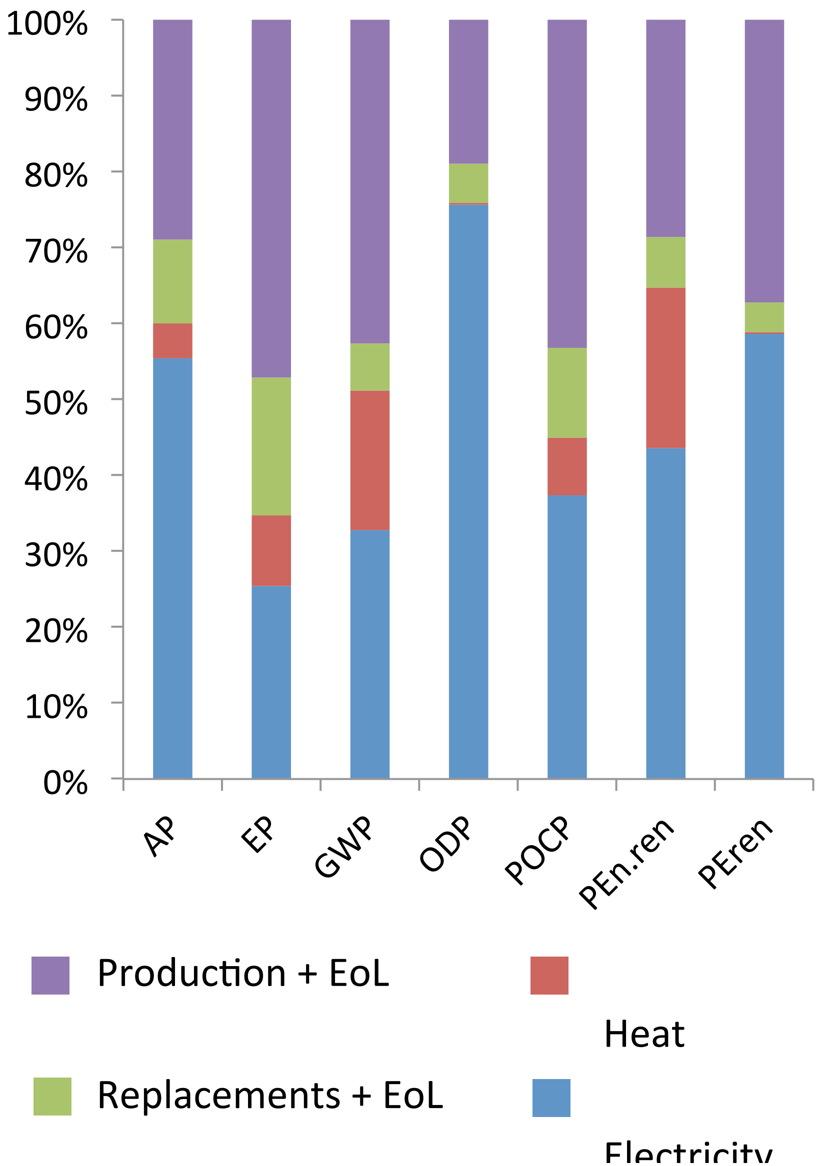
| Potential environmental impacts | | |
|---|---|---|
| Acidification potential | AP | kg $SO_2$-eq/$m^2$/year |
| Eutrophication potential | EP | kg $PO_4$-eq/$m^2$/year |
| Global warming potential | GWP | kg $CO_2$-eq/$m^2$/year |
| Ozone depletion potential | ODP | kg R11-eq/$m^2$/year |
| Photochemical ozone creation potential | POCP | kg Ethene-eq/$m^2$/year |
| **Resource use** | | |
| Primary energy use, non-renewable | PEn.ren | MJ/$m^2$/year |
| Primary energy use, renewable | PEren | MJ/$m^2$/year |

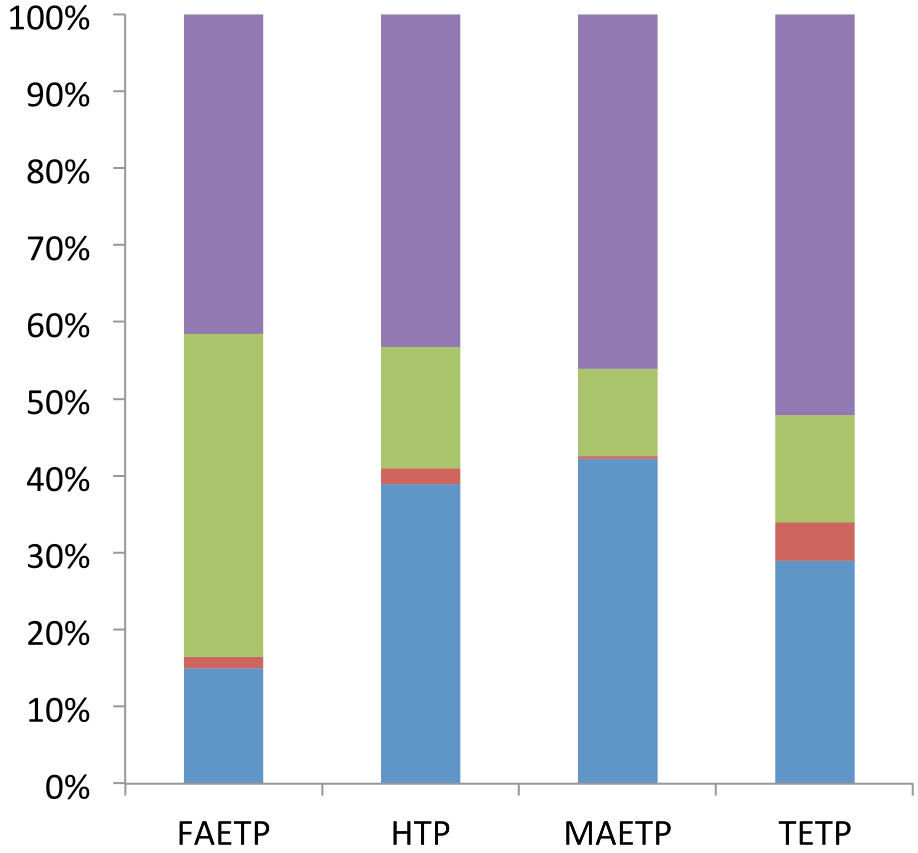
| Scenario | Electricity | Heating | Reference Study Period |
|---|---|---|---|
| 1. DGNB Reference | EU-25 grid mix | District heating (100 % natural gas) | 50 years |
| 2. Long study period | EU-25 grid mix | District heating (100 % natural gas) | 100 years |
| 3. Dk mixes 2011 | Dk grid mix 2011 | Dk district heating mix 2011 | 50 years |
| 4. Dk mixes 2011-2061 | Dk grid mix average 2011-2061 | Dk district heating mix average 2011-2061 | 50 years |

RESULTS

Scenario 1 – DGNB reference

## Contributions to total results



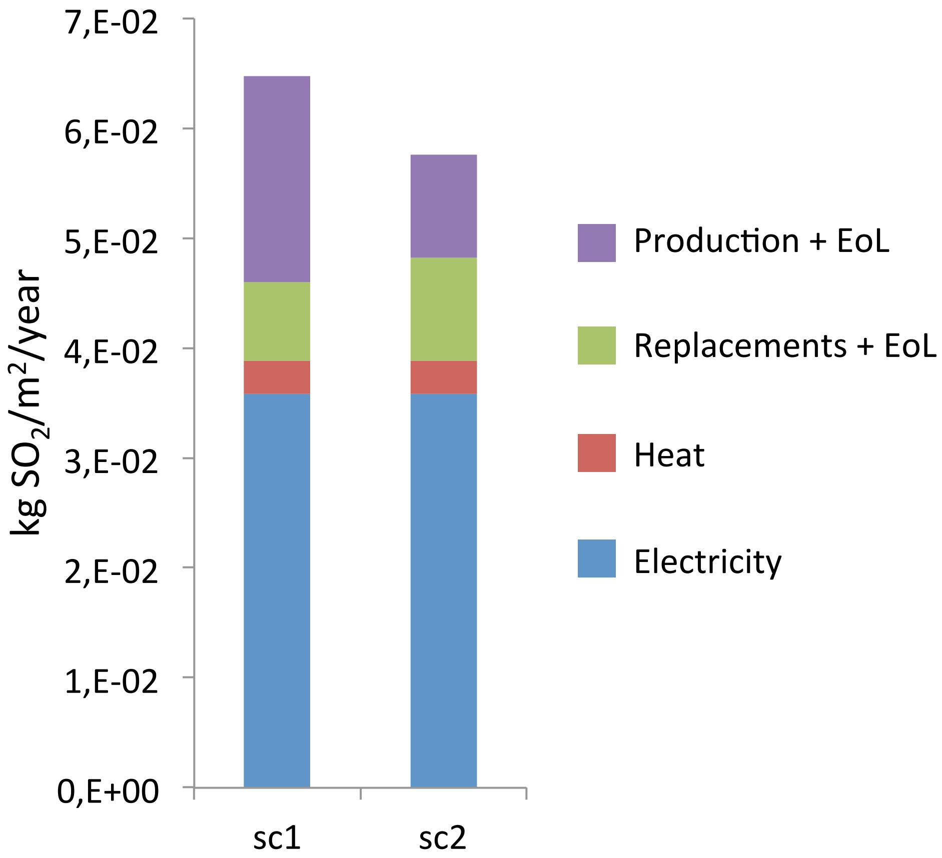




FAETP: Freshwater Aquatic Ecotoxicity Potential
HTP: Human Toxicity Potential
MAETP: Marine Aquatic Ecotoxicity Potential
TETP: Terrestric Ecotoxicity Potential

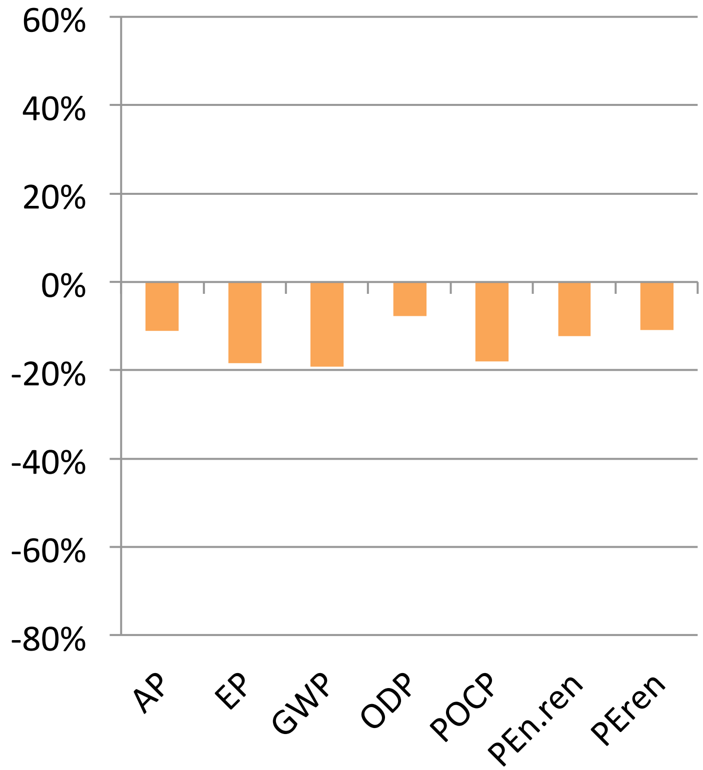
## Scenario 1 → 2
## Adjusted parameter

Study period 50 years
→
Study period 100 years

### Acidification potential



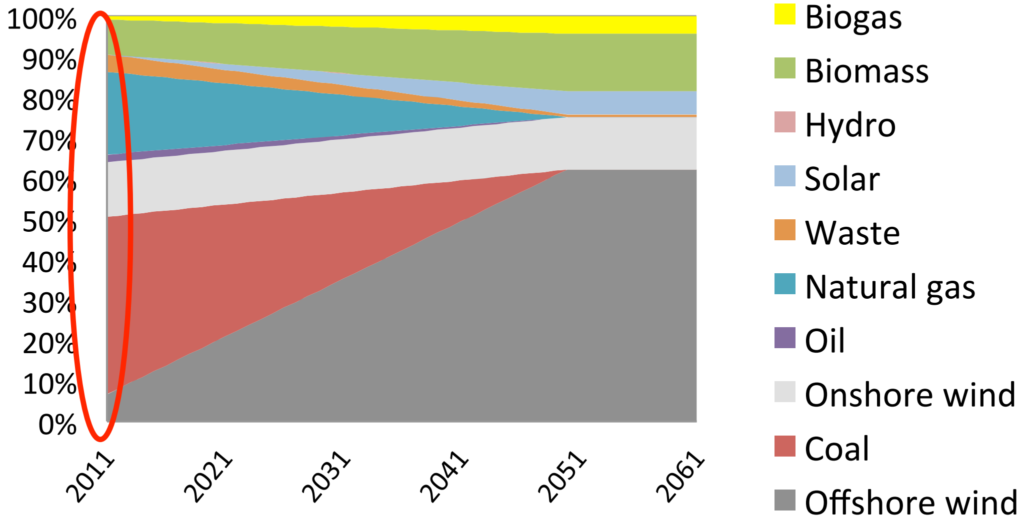

### Difference from reference results



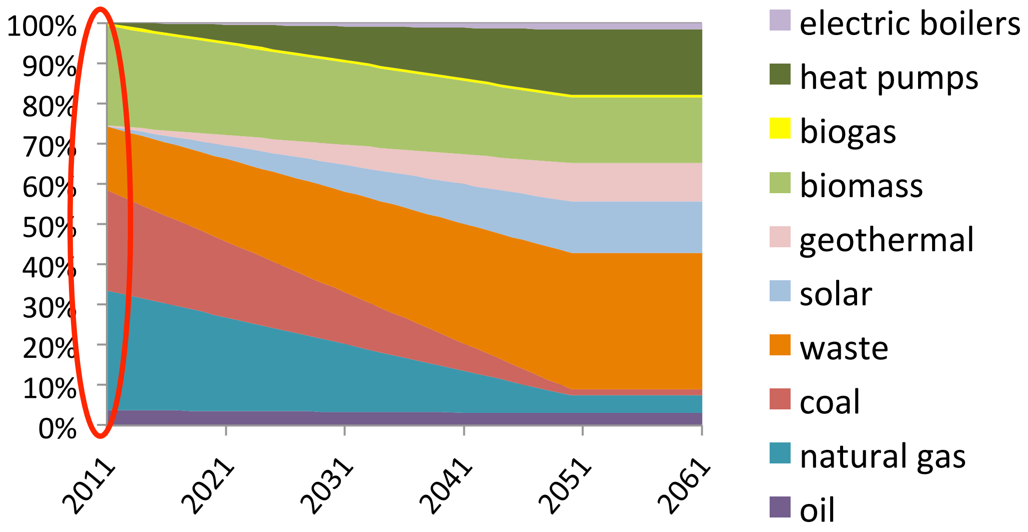
# RESULTS

## Scenario 3 – DK energy mixes 2011

### Dk electricity mix 2011




### Dk district heating mix 2011

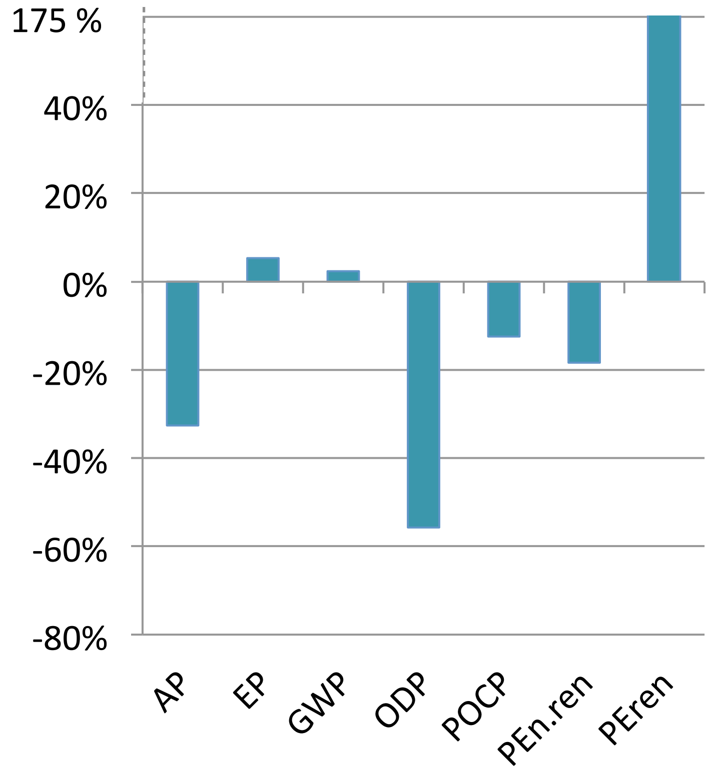



### Scenario 1 → 3

### Adjusted parameter

Average European grid mix,
District heating from natural gas
→
DK energy mixes 2011

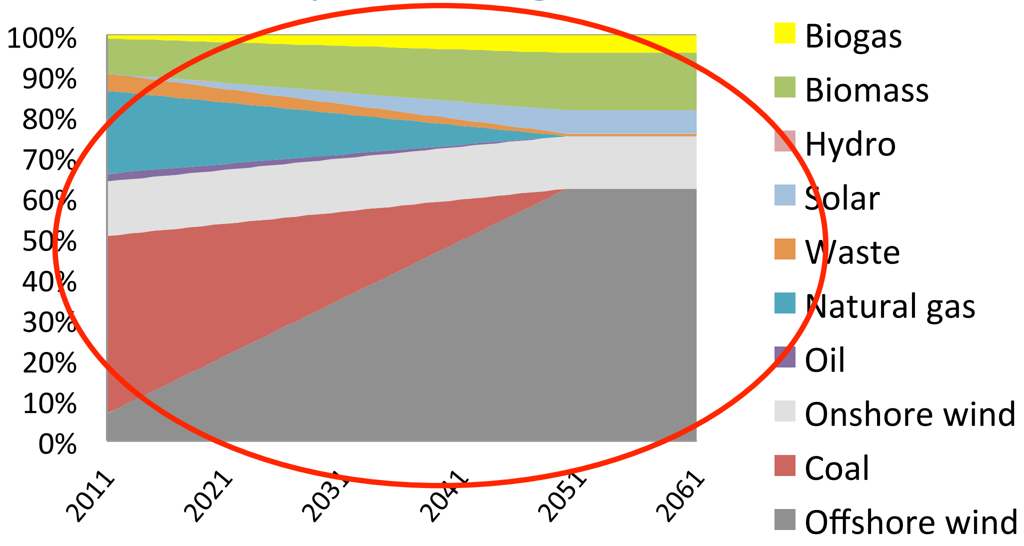
### Difference from reference results



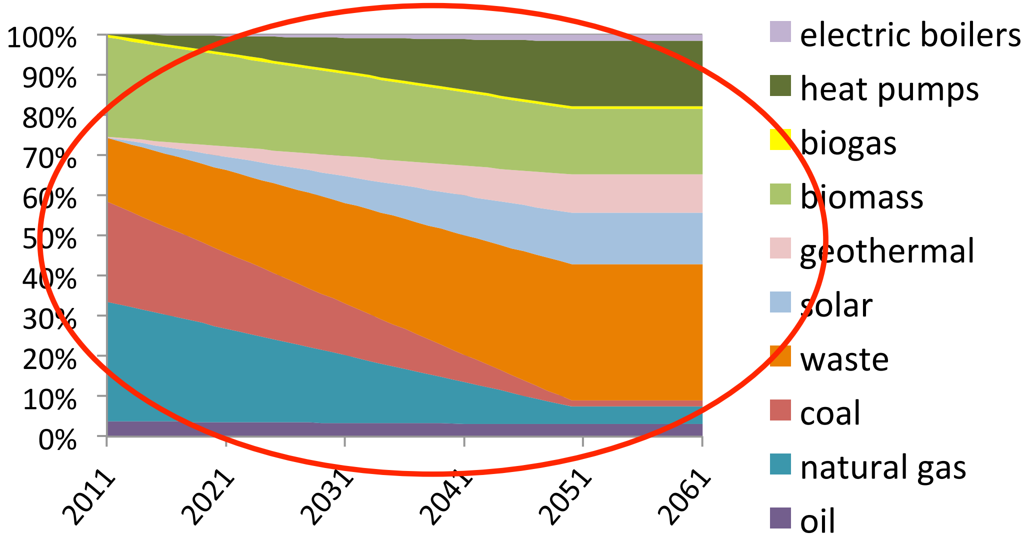
RESULTS

# Scenario 4 – DK energy mixes 2011-2061

## Dk electricity mix average 2011-2061




## Dk district heating mix average 2011-2061




## Scenario 1 → 4

## Adjusted parameter

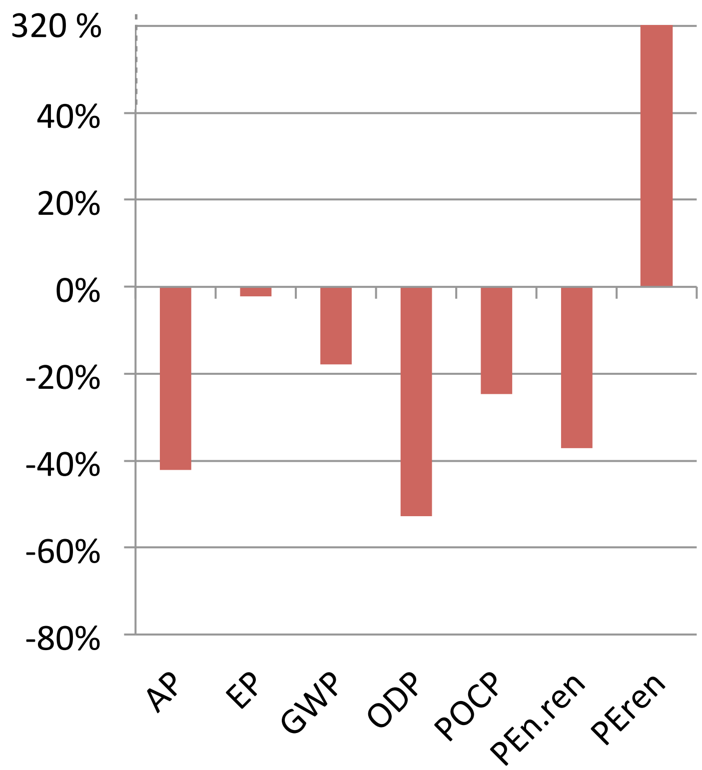
Average European grid mix

District heating from natural gas

→

DK energy mixes average 2011-2061

## Difference from reference results



Sum-up

## Main findings of case study

Life cycle stage contributions to toxicological impact potentials do not follow the same trend as contributions to environmental impact potentials

*Materials used in the building life cycle contributes most to toxicological impact potentials*

Extending study period from 50 to 100 years changes results in annual environmental impact potentials by 8-18 %

*But the approach increases the uncertainty of the energy consumption/supply scenarios, which mean most to total results*

Use of national (instead of regional) energy data changes results by up to 175 %

*With a large variation depending on impact category*

Use of a dynamic approach to national energy data changes results by up to 320 %

*Again with a large variation depending on impact category*

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