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Eidgenössische Technische Hochschule Zürich
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Impact of climate change on energy demand in the Swiss service sector – and application to Europe

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IEECB'06, Frankfurt, April 26-27, 2006

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Thanks

Co-authors

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Swiss Federal Office of Energy

- The Swiss case study was done as part of the ongoing long term energy perspective exercise of SFOE

Content

Impact of climate change in Switzerland on

- Energy demand for heating
- Electricity demand for room cooling (air conditioning)

Application to Europe

- Impact of climate change on relative CO_2-emissions in function of
  - Heating degree days (cooling degree days)
  - Fuel mix of heating (electric heating)
  - CO_2-content of electricity

Service sector only!

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Assumptions „climate change scenario“

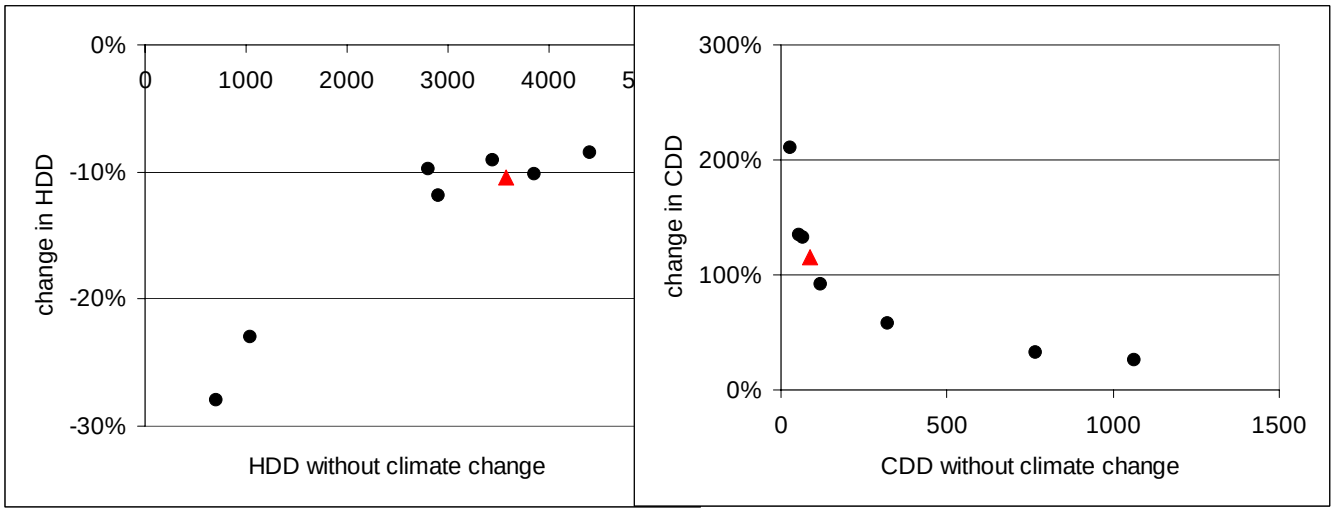
Change of mean temperature (2035)

- +1 °C in the months from September to May
- +2 °C from June through August
- → Change of heating degree days (HDD)
- → Change of cooling degree days (CDD)

“Business as usual” improvement of buildings, heating and air conditioning systems,

but no specific adaptation measures! (→ next presentation by C.U. Brunner et al.)

Relative variation of HDD and CDD due to the assumed climate change in 2035 in function of HDD and CDD without climate change (typical locations in EU)



Impact on heating energy demand

Apply formula used for correction of annual variation of heating degree days (HDD) to variation of HDD due to climate change:

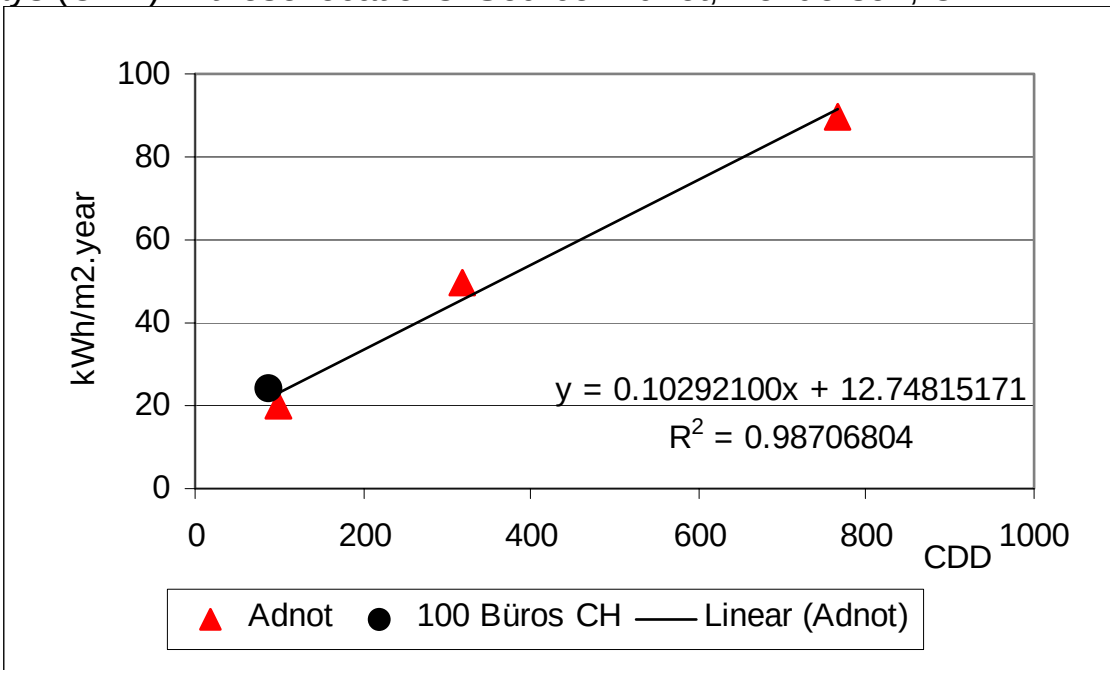
- $H_{\_CC} - H_{\_2005} = H_{\_2005} * a * (HDD_{\_CC} / HDD_{\_2005} - 1)$

Impact on cooling energy demand (1)

Two factors:

1. Increase of floor area with air conditioning (cooling)
   - → ad-hoc assumptions (no second summer 2003!)
   - CH: 50% of no cooling → partial cooling
     50% of partial cooling → fully air conditioned
   - Other countries → see paper
2. Increase of specific electricity demand
   - $El_{\_CC} - El_{\_2005} = 0.102921 * (CDD_{\_CC} - CDD_{\_2005})$, in kWh/ m_c^2.a

Electricity demand for cooling, in kWh/m2.year, of office buildings in London, Milano and Sevilla (= Adnot) in function of the Cooling Degree Days (CDD) in these locations. Source: Adnot, Henderson, CEPE



Impact on cooling energy demand (2)

In Switzerland in the year 2035, increase due to climate change relative to reference scenario (no temperature increase): + 115% (EU regions see paper)

Relative importance of the two factors in Switzerland:

- Increase of cooled floor area = 60%
- Increase of specific electricity demand = 40%

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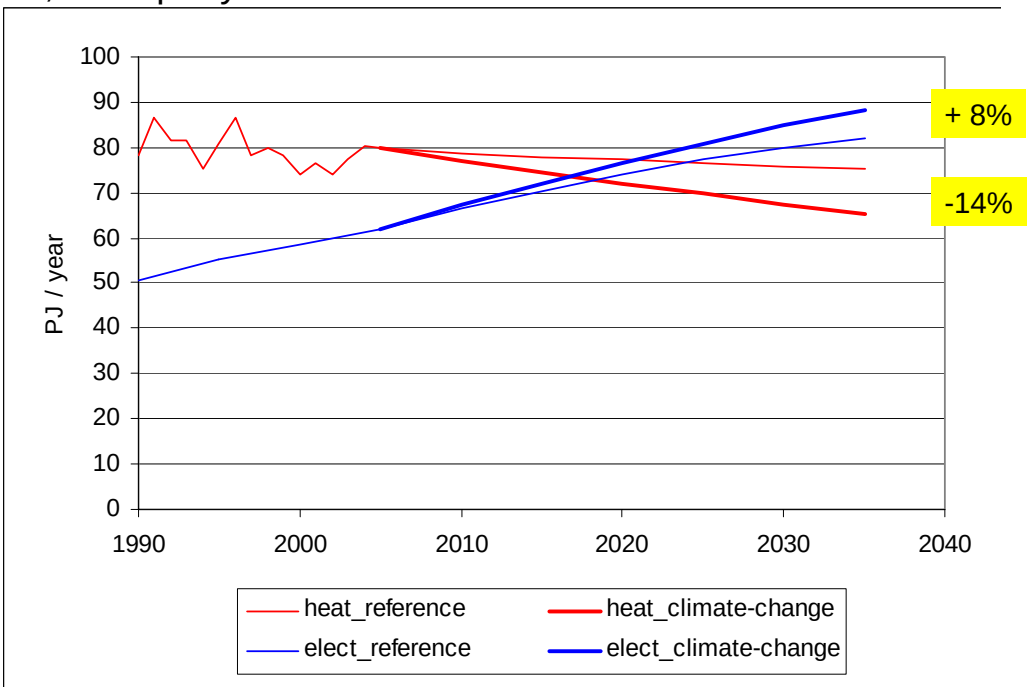
Heating energy demand and total electricity demand in the reference scenario with constant mean temperatures and in the climate change scenario, in PJ per year. Source: CEPE



Application to some regions in the EU

Impact of climate change on relative CO_2-emissions in the service sector in function of (very simplified sensitivity exercise):

- Heating degree days (cooling degree days)
- Fuel mix of heating
  - 10% electric resistance/ohmic heating = **little**
  - 50% electric resitance/ohmic heating = **much**
- CO_2-content of electricity
  - 100% coal fired power plants = **high**
  - 90% CO_2-free power plants = **low**

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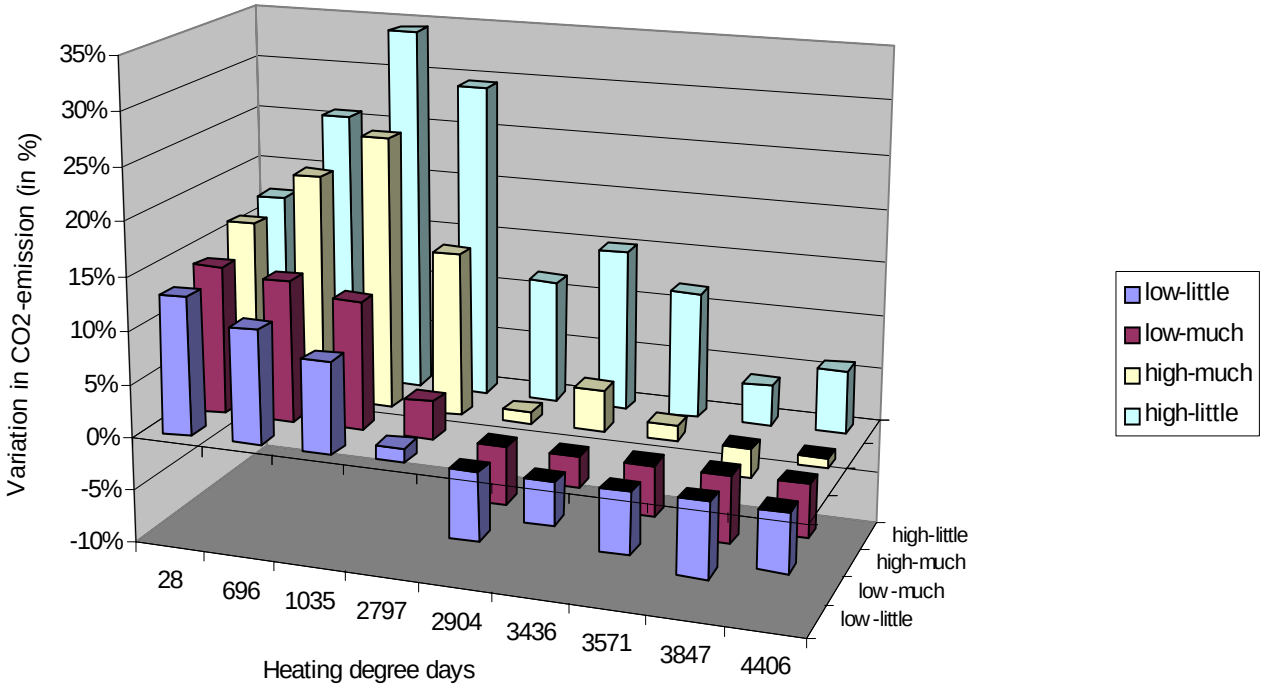
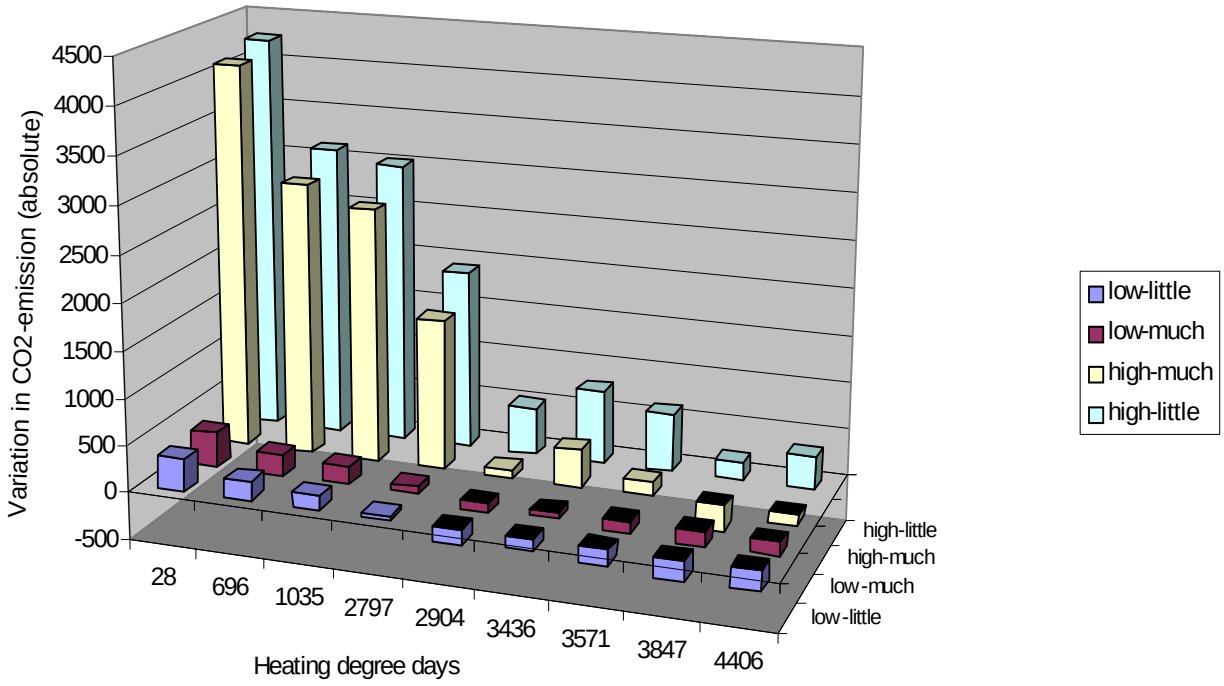
Changes in relative CO2 emission from heating and cooling due to climate change in different locations (characterised by HDD), in percent



Changes in absolute CO2 emission from heating and cooling due to climate change in different locations (characterised by HDD), in arbitrary units



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Discussion and conclusions

Temperature increase → increase in cooling- and decrease in heating-energy.

Net effect in final energy: decrease in cold climate, increase in warm climate.

Net effect on CO_2 is much more complicated. Largest increase in warm climate with high CO_2-intensity of electricity.

In temperate and cold climate +100% (and more) energy for cooling → (more and new) policy measures needed:

- Planning of new buildings (and refurbishment) considering future temperature increase
- Double strategy: avoid mechanical cooling (if possible) and improve mechanical cooling
- But, don't forget heating demand!