# The Effect of Temperature on Electricity Consumption in Sweden

- Cooperation between Department of Mathematical Sciences at AAU and Nordjysk Elhandel, winter term 2010/2011

Aalborg, September 15th, Michael Bartels, Head of Analysis

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# Terms and Definitions

- Electricity consumption = Load = Demand
- TSO (Transmission System Operator)
  = company that ensures reliable electricity network operation
- Day-Ahead forecast = 24 hours of the next day
- Peak = hours from Monday to Friday from 8 am to 8 pm
- Offpeak = remaining hours (night time, weekends)

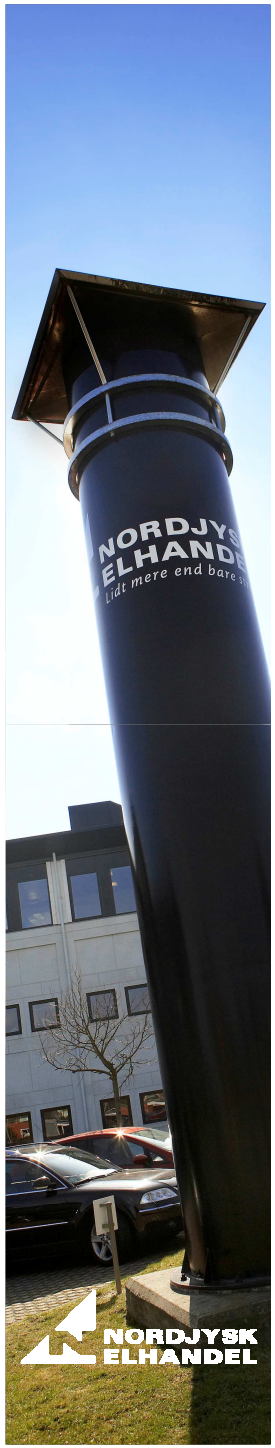

# Some Business Activities at NEAS and their Analytical Support

## Activities

- Pricing of electricity (monthly prices by type of business)
- Supply of electricity (load scheduling)
- Selling of electricity on behalf of power stations
- Balancing of sell and buy activities
- Cross-border-trading (hourly import and export)

## Tools

- Matlab
  - Large matrix calculations
  - Example: portfolio management
- R
  - Statistical toolbox
  - Example: load and price forecasting
- GAMS
  - Linear optimization toolbox
  - Example: price forecasting and scenario simulations



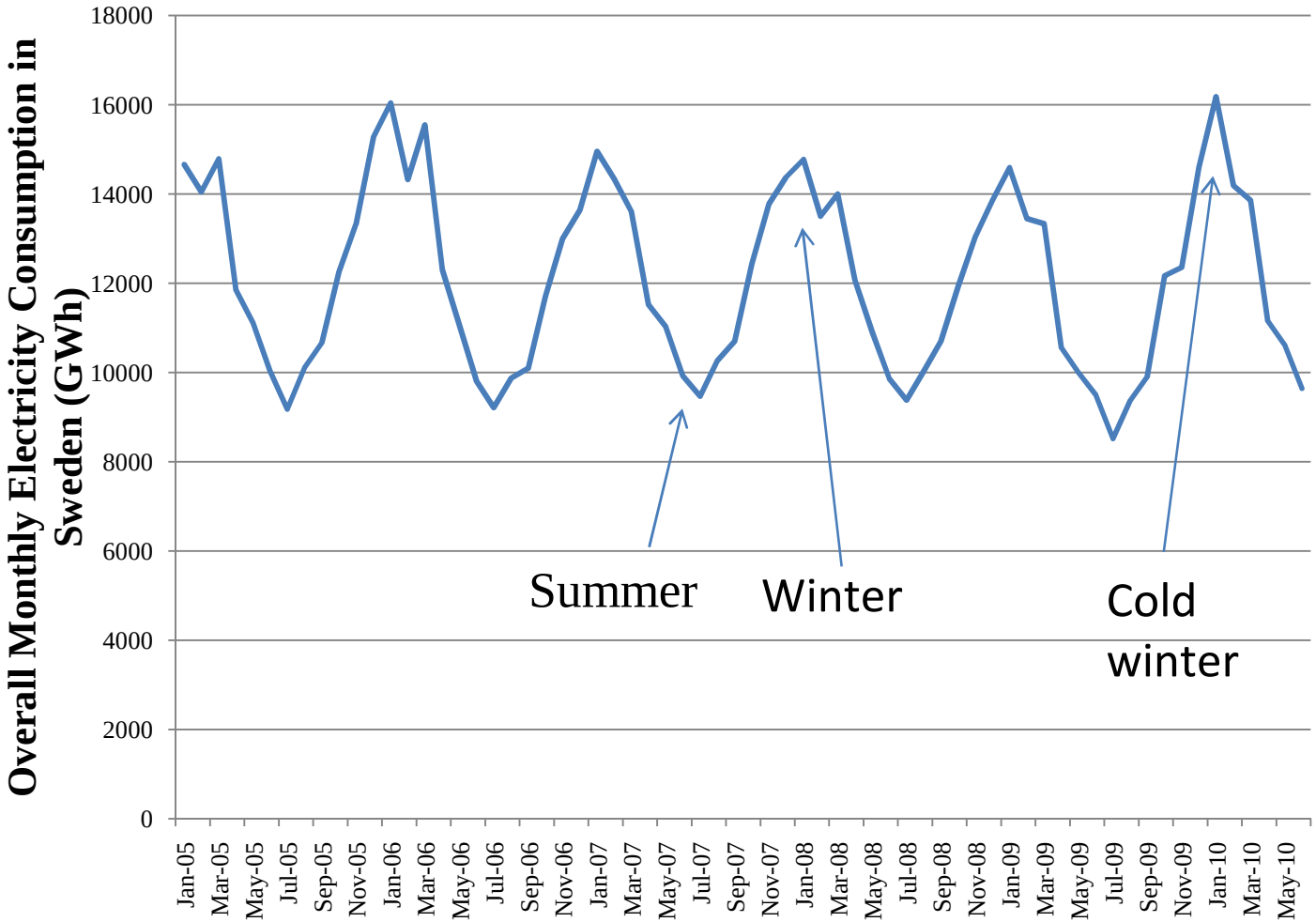

# The Case of Sweden

- Today there is a single price area in SE
  (actually 24 different prices, one for each hour of the day)
- From December 2010 subdivision into four areas (financial trading starts)
- First physical delivery from December 2011
- What will prices be after the subdivision?


# On Electricity Consumption Patterns in General

- Seasonal fluctuations
- Daily fluctuations: working days, weekends, bank holidays, vacations
- Hourly fluctuations: working hours, peoples habits, effect of “large devices” like in the industry or night storage heaters in households
- Consequences of the recent economic downturn
- …

# Seasonal load fluctuations

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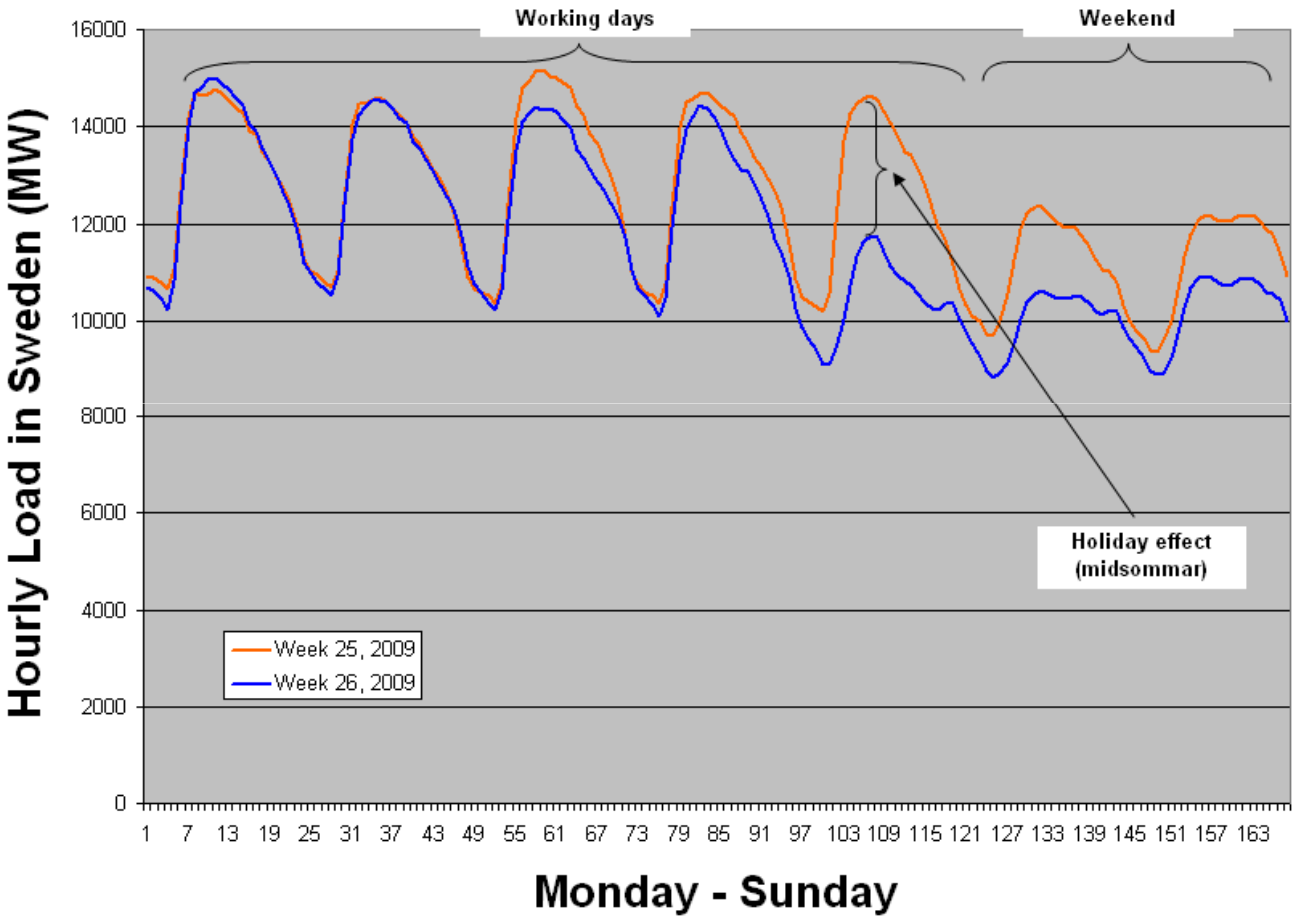
Lidt mere end bare strøm

# Daily load fluctuations

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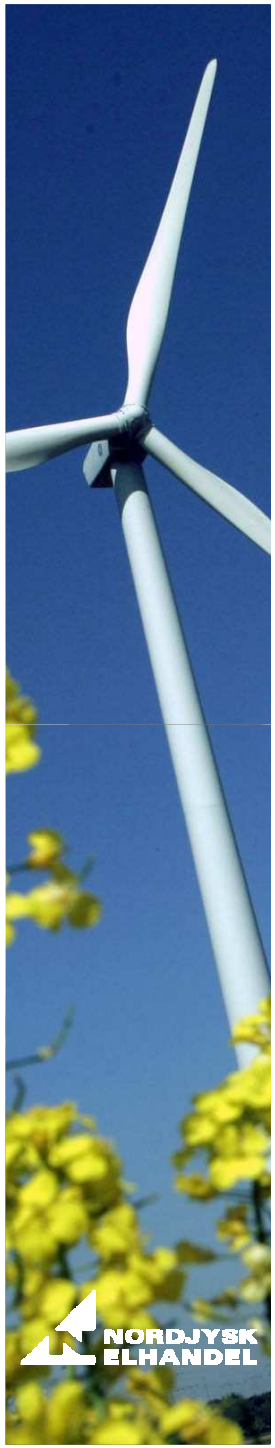
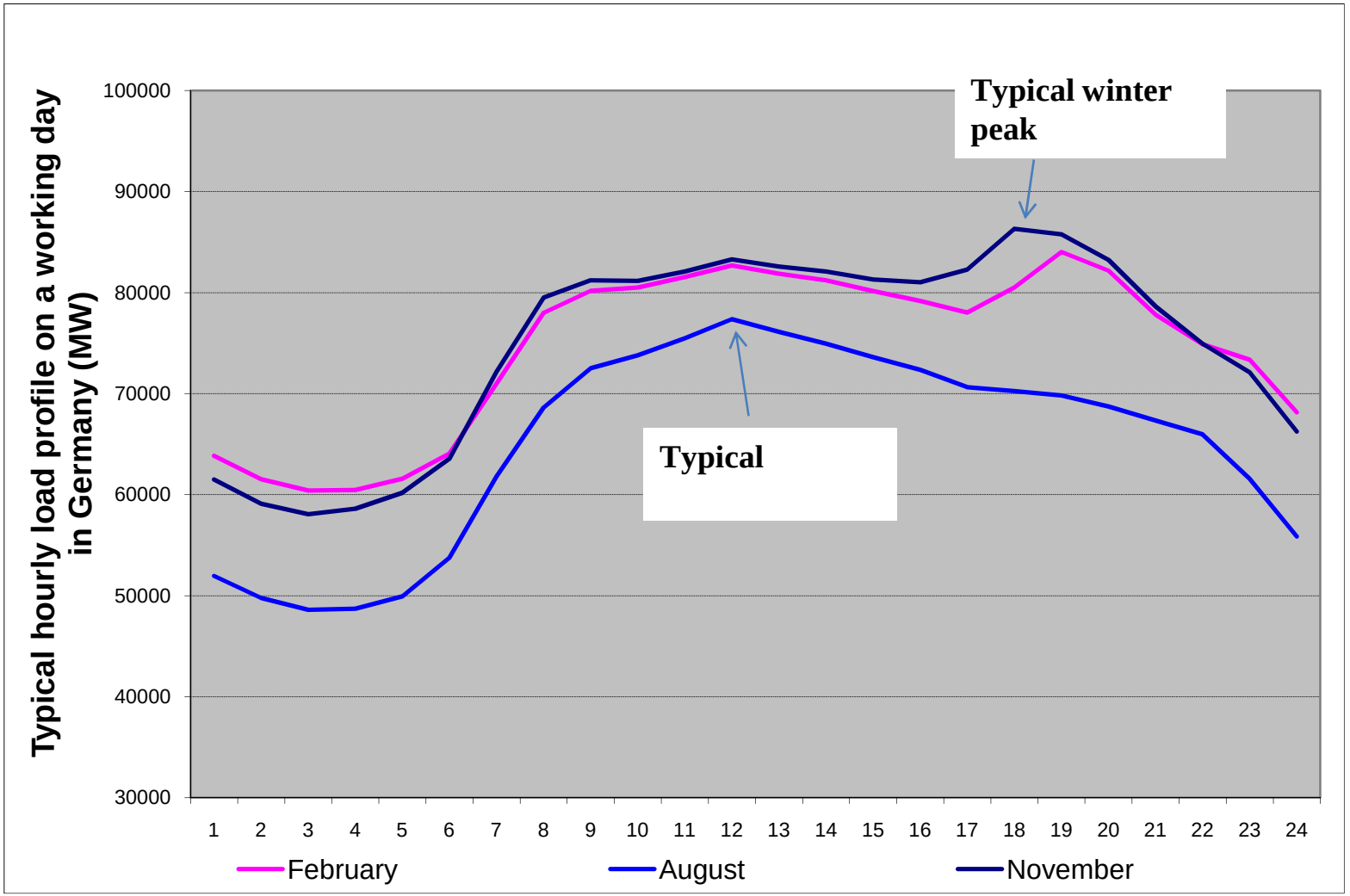
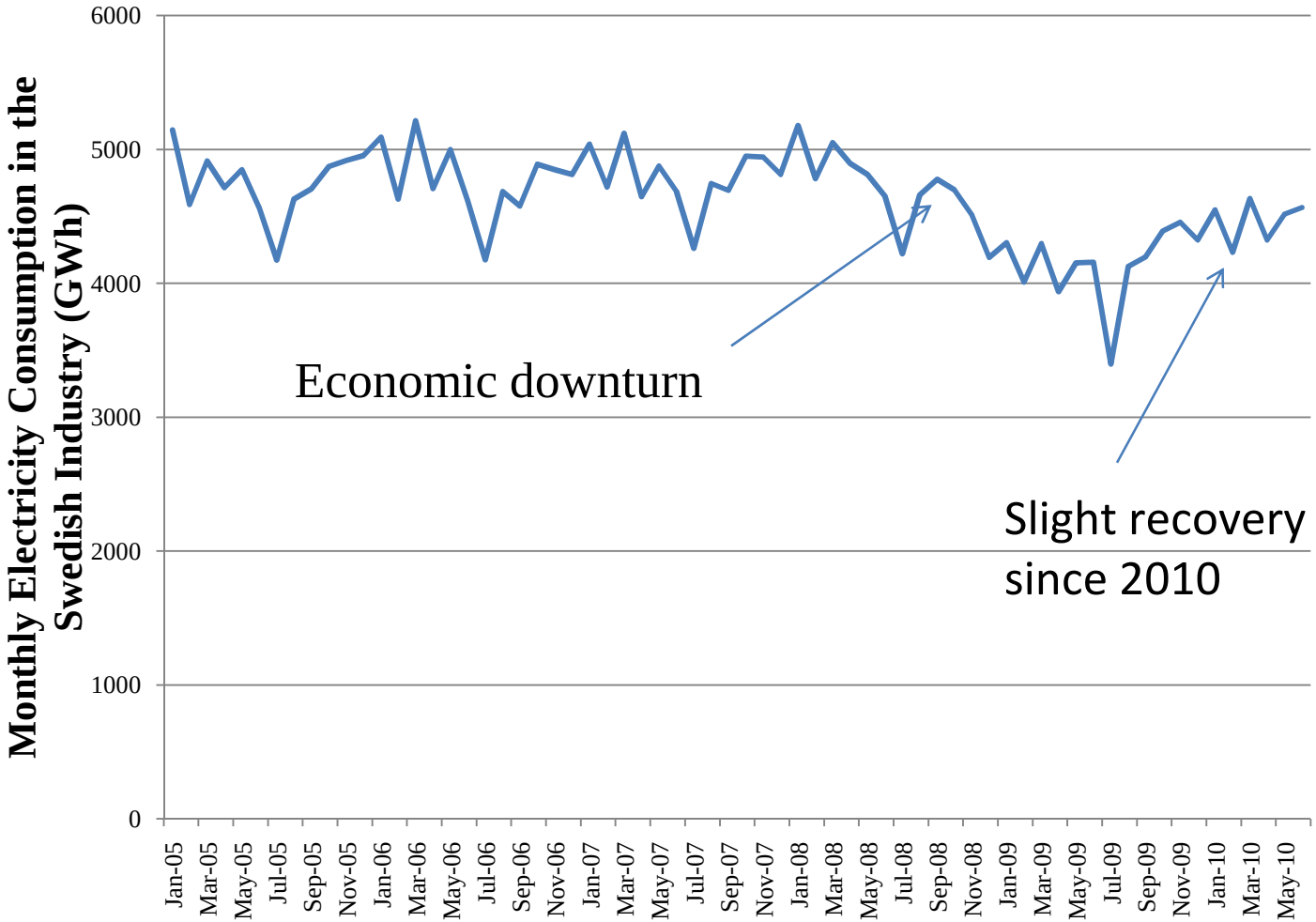



# Changes in the Daily Load Structure




# Consumption in the Industry Hit by Global Crisis




# Available Data

- Hourly load for 4 Swedish regions
- Daily average temperature for 21 weather stations
- Data available for period January 2007 – April 2010
- Data available in Excel file format
- Other data on request (if available)


# The concept of ”heating degree days”

- Response of consumption to temperature levels is usually strongest during winter time

- Heating degree days (HDD) could be used to replace temperature as explanatory variable

"Heating Degree-Days are the number of degrees per day that the daily average temperature is below a given temperature (18℃ or 6 5℉). The given temperature is the point below which the consumer is assumed to use fuels for space heating and varies from country to country.“ (International Energy Agency)

The Swedish Meteorological Institute SMHI uses 17℃ as “the given temperature”, instead of 18℃.

# What we are interested in

- NEAS would like to develop a forecast tool for hourly consumption in the 4 Swedish areas
- It will be one input to a price forecast (day-ahead)
- Try different ways to model electricity consumption
  - Recommended to focus on daily consumption first
  - Advance the model by considering hourly load profiles as a second step
- Test how the model fits with actual data by applying some sorts of backtesting and error measure
- All outcomes, “positive” and “negative”, are of interest!

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# Thank you!

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