Berlin University of Technology
Department of Energy Systems
www.ensys.tu-berlin.de

Effectiveness and Efficiency of Renewable Energy Promotion Schemes in the German Space Heating Market

Energy, Economy, Environment: The Global View
32nd IAEE International Conference San Francisco
22.06.2009

Johannes Henkel

Outline

- The German “renewable heat law”
- Effectiveness and efficiency
- Model description
- Model results and discussion
- Conclusions

The German Renewable Heat Law at Federal Level

- Goal: Increase share of renewables in the heating market to 14% until 2020 (today: 6-7%)
- The use of renewable energy is mandatory for new buildings
- Possible technological choices:
  - combination of oil/gas with solar thermal heat (share of 15% solar thermal energy)
  - wood pellet heating
  - electric heat pumps (min. COP 4.0/3.5)
  - natural gas (micro-)CHP with min. 30% biomethane
  - fuel oil boilers with 50% bio oil (e.g. rapeseed oil)
  - district heating
- Entered into force at the beginning of 2009
- Moreover: Subsidies and low-interest loans

Policy Instruments

- Investment Subsidies
- Low-interest Loans
- Obligation of Use
- Tradable Certificate Systems
- Bonus/Incentive System
- “Boiler Scrapping Bonus” (“Cash-for-Old-Boilers”)

Effectiveness and Efficiency

- Effectiveness:
  - A policy instrument is effective, if the goals set are reached
  - Basic “regulatory policy” instruments like obligations or prohibitions therefore can be 100% effective, if the obligation is high enough (depending on level of compliance)
  - Here: *efficiency* = n goal reached / n total
    (% of how many monte carlo cases reach the goal)

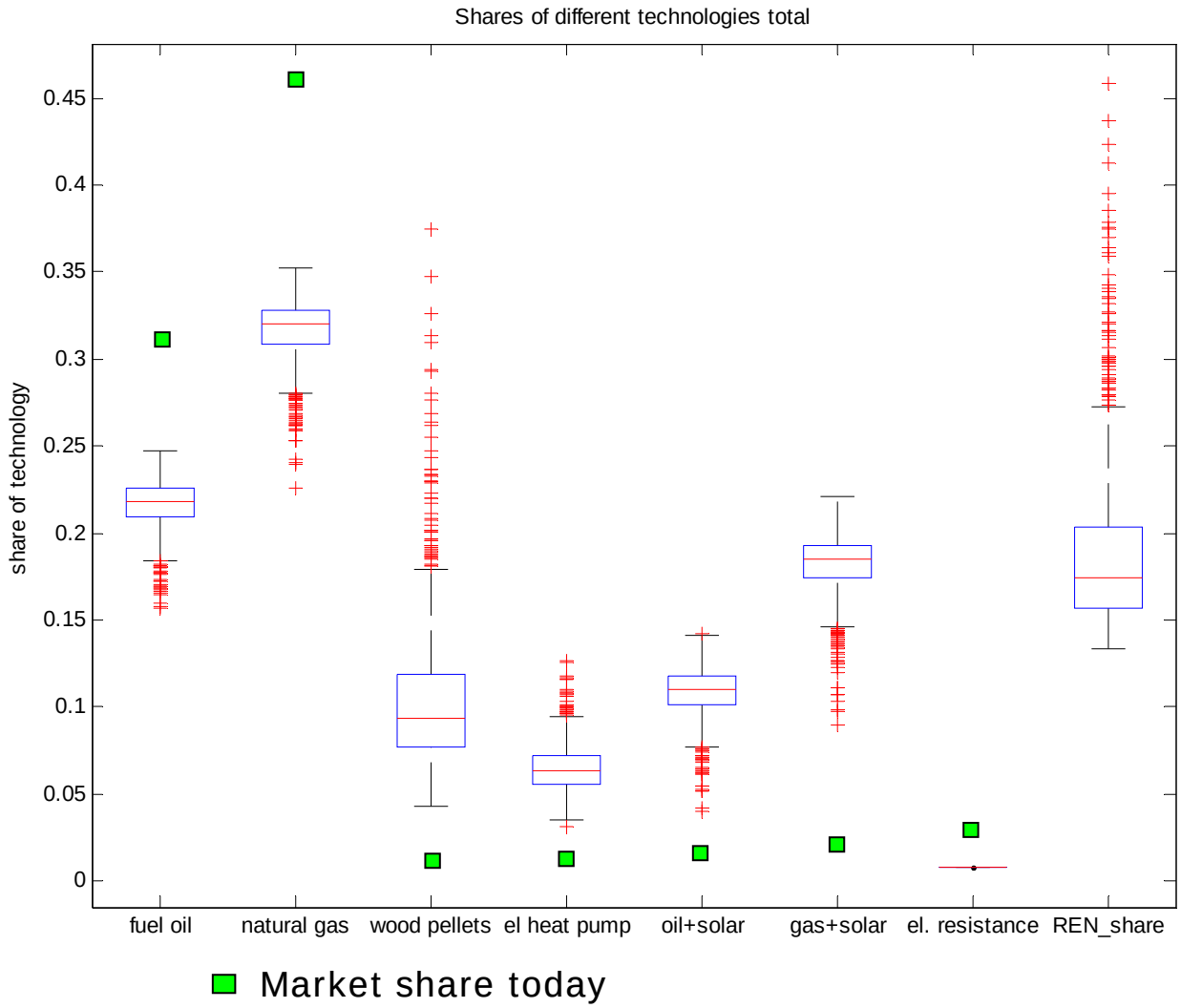
- Efficiency:
  - Efficiency = cost-efficiency
  - A policy instrument is the more efficient the lower the cost of the instrument divided by the effect
  - Here: CO_2 mitigation cost (Alternative: Cost per 1%-point of increase of renewables)

Model Description

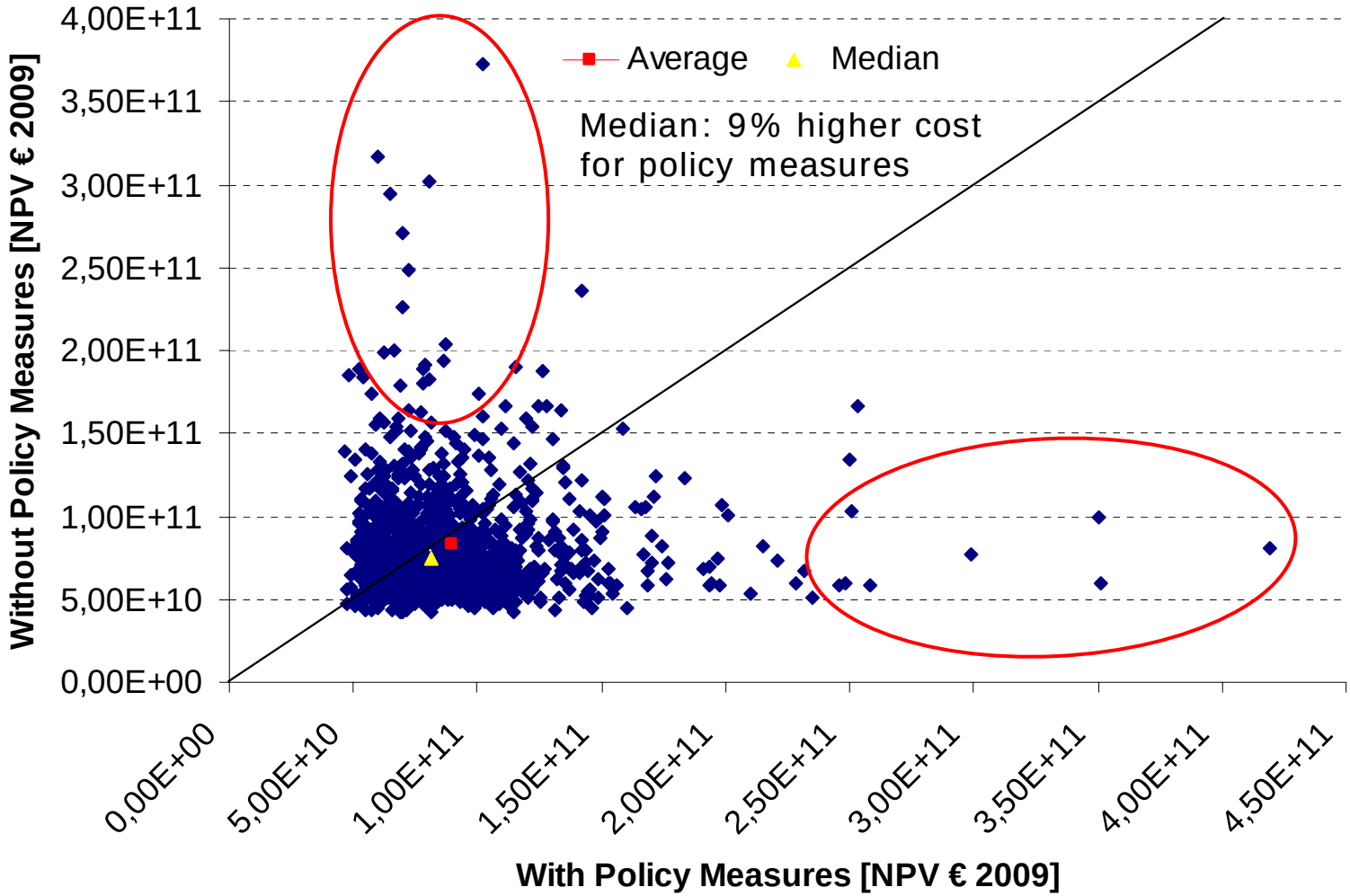
- Logistic regression model
- Focus on different heating technologies
- Fuel oil prices are modelled by a random walk with a drift (average increase of 2% per year)
- Natural gas and electricity prices are correlated to price for fuel oil
- Wood pellet prices are calculated fundamentally according to cost-resource-curve

  ⟹ Monte-Carlo-Analysis of scenarios
- Consumer decision is made based on economic as well as other criteria (comfort, ecology, investment barrier etc.)
- Consumer expectations for future fuel prices are considered in the decision process
- Learning curves for heat pumps, wood pellets and solar thermal
- Model was fitted to 2004-2008 sales data

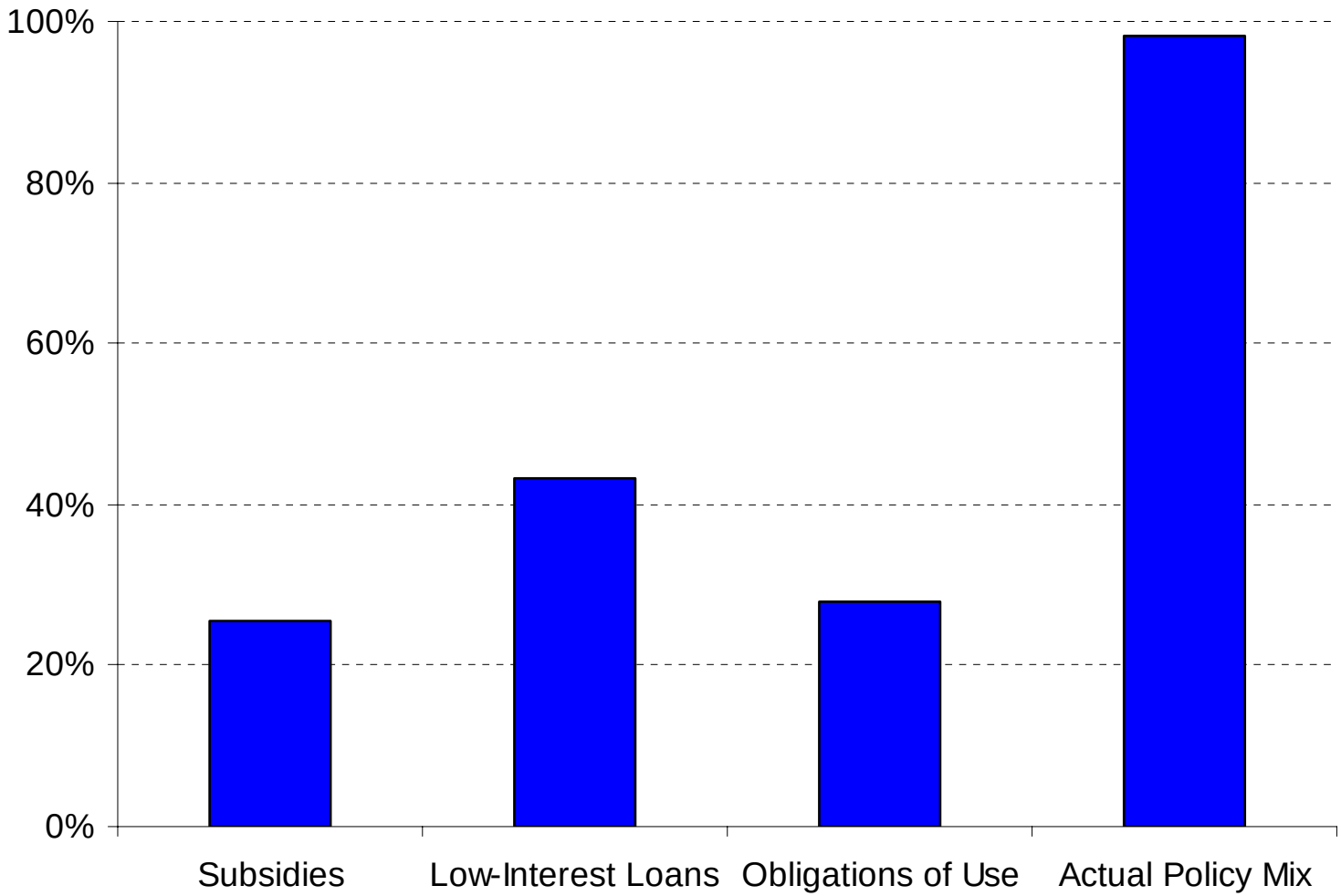
Results I: Shares of Different Technologies in 2020 (Actual Policy Mix)



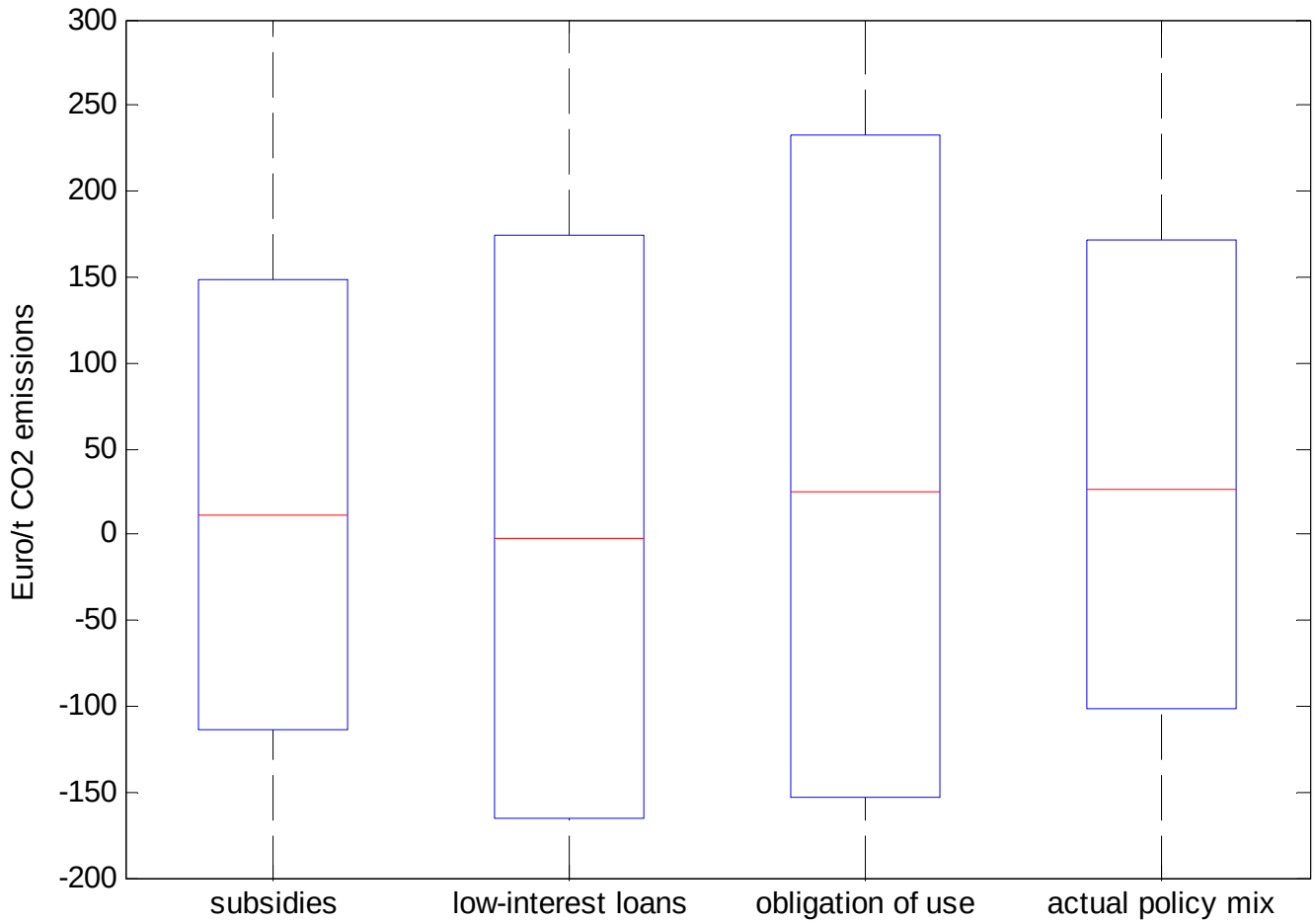
Results II: Comparison of Cost with and without Policy Measures



Results III: Effectiveness of Different Policy Measures



Results IV: Efficiency
CO_2 Mitigation Cost



Conclusions

Concerning effectiveness:

- Generally, regulatory policy can be effective, but is unpopular
- The low-interest loans used in Germany are quite effective

Concerning efficiency:

- Policy measures in the average lead to higher macro-economic cost but in many scenarios cost are reduced (e.g. through learning effects)
- Obligations of use are the least efficient
- Low-interest loans are very efficient (because of double effect)
- Right mix of policy instruments in order to achieve acceptability, effectiveness and efficiency

Thank you for your attention!

- Berlin University of Technology
  Department of Energy Systems
  Dipl.-Ing. Johannes Henkel
  Einsteinufer 25 (TA 8)
  D-10587 Berlin
  Germany
- johannes.henkel@tu-berlin.de
  www.ensys.tu-berlin.de
  Tel: +49 30 314-21710
  Fax: +49 30 314-26908