Implementing energy efficiency in Sweden's existing housing stock

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Focus of presentation

Do currently used policy measures encourage house owners to implement changes in accordance with national goals?

3 perspectives

The societal economic perspective on cost and environment

The house owners' economic situation

The house owners' perception

Methodology

1. Using reference houses
2. Implementing measures to house envelopes
3. Implementing changes to supply systems
4. Including current policy measures

5. Studying effects on resource use, emission and cost
6. Studying effects on the house owners annual heating cost

1 The reference houses

- Built in 1974 and 1976
- Heated area of 100-306 m^2
- Heat demand of 28-47 MWh/year
- Resistance heaters (electric radiators)
- Resistance heaters, hot water boiler and drainage system need to be replaced. Window frames need to be painted.

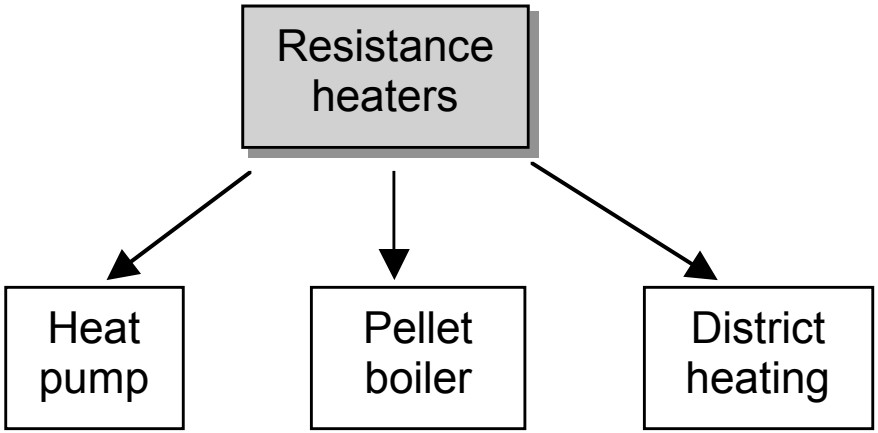
2 Demand side measures

- Extra insulation on the attic floor

- Extra insulation on the outside of the basement walls
- Ground insulation in the foundation

- Replacement of the existing windows

3 End-use supply conversion



Results - Societal economic view

- **House envelope measures** reduced the heat demand by 20-25%
- **District heating** and **heat pumps** reduced the primary energy use by 70 % and 54%, respectively
- …and reduced the CO_2 emission by 93% and 94%
- **Biomass-based** systems gave low CO_2 emission
- Conversions to **district heating, heat pump** and **pellet boiler** reduced the societal economic cost
- **Pellet boilers** and **district heating** less profitable for smaller houses

Swedish energy goals

- Phase out electric heating
- Phase out heating with oil
- Increase energy efficiency
- Increase use of renewable resources
- Reduce CO_2 emission

4 Assumptions

house owners economic situation

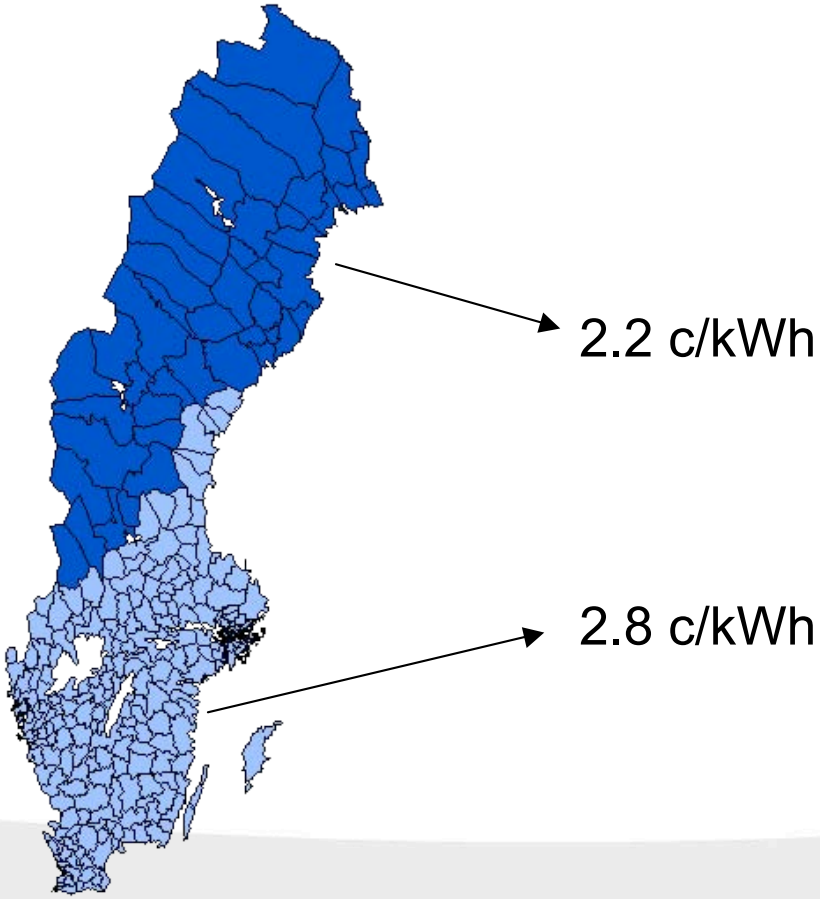
- Annualised investment costs
- 3 % real discount rate
- Remaining lifetime of house: 50 years
- Changes to demand side before supply side
- Comparing purchase of electricity and heat from 2 suppliers
- Including effects from subsidies, electricity tax and real estate tax

Subsidies

- Conversion from resistance heaters
  - Installing heat pump, district heating or biomass based system
  - 30 % of the investment cost, up to €3240
  - Both material and labor included in the cost

- New windows
  - U-value 1.2 or lower
  - 30 % of the investment cost exceeding €1080 up to €1080
  - Both material and labor included in the cost

Swedish customer electricity tax

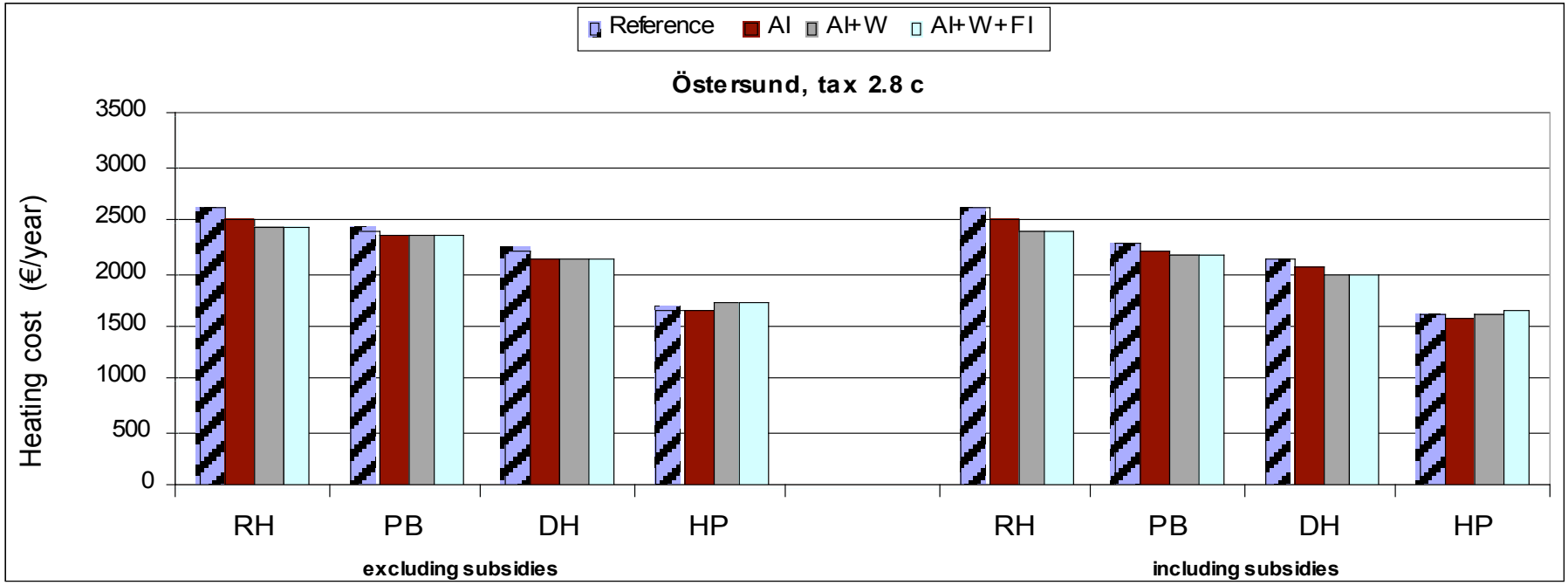


Real estate tax

- Real estate tax of 1% of the assessed value
- Installation of heatpump or new windows increse the assessed value
- Original real estate tax for house B medium size was €1070/year

Annual customer heating cost

Investment subsidies

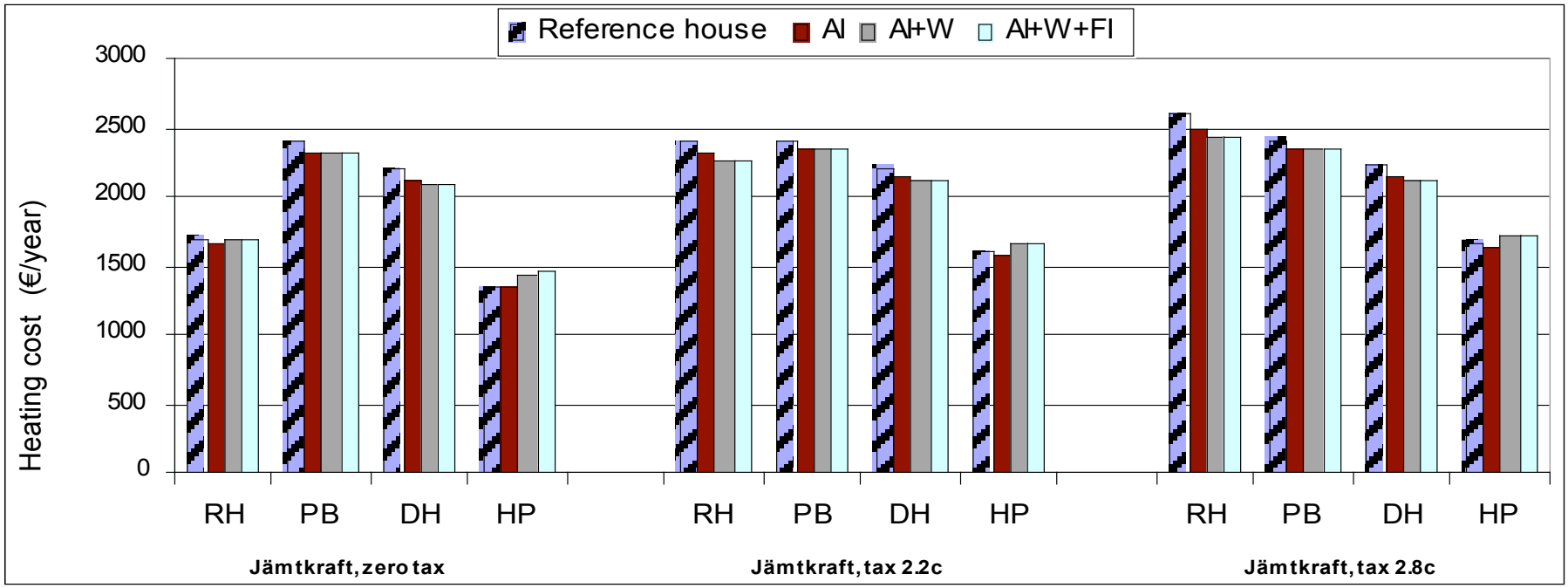


RH=Resistance heaters
PB= Pellet boiler
DH=District heating
HP= Heat pump

AI=Attic insulatio
FI= Foundation insulation
W=New windows

Annual customer heating cost

Electricity tax



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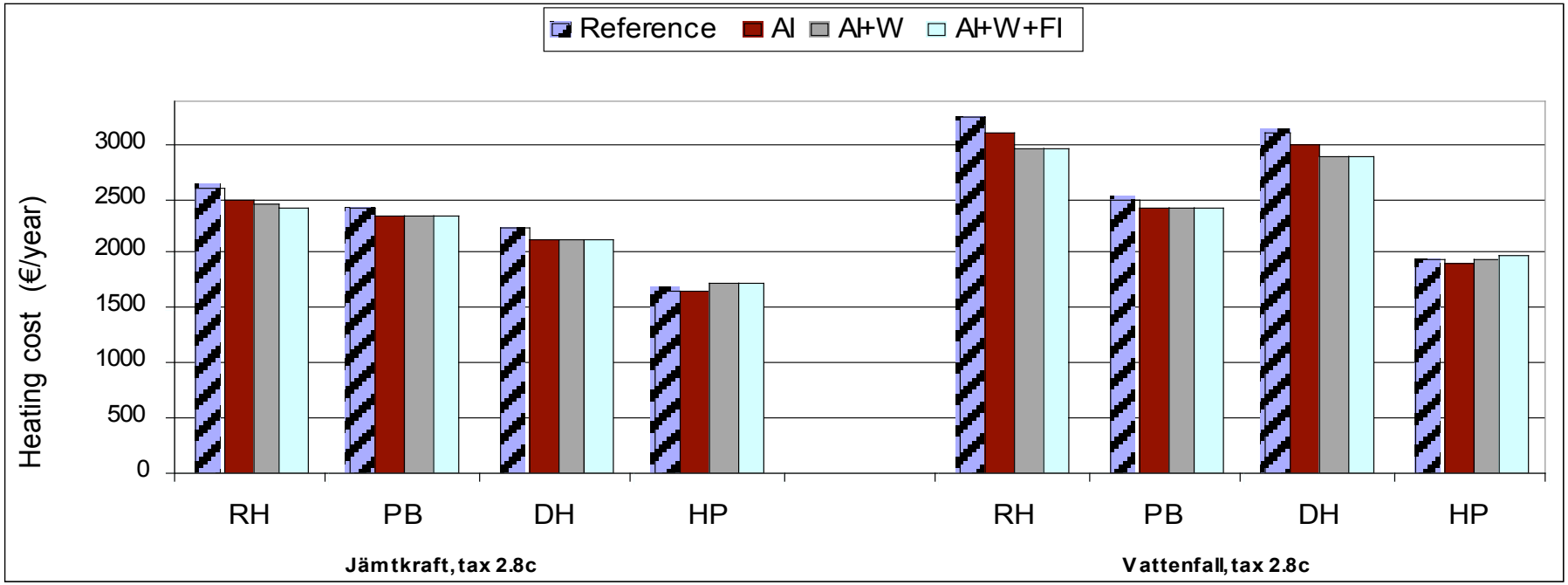
Annual customer heating cost

Energy supplier influence



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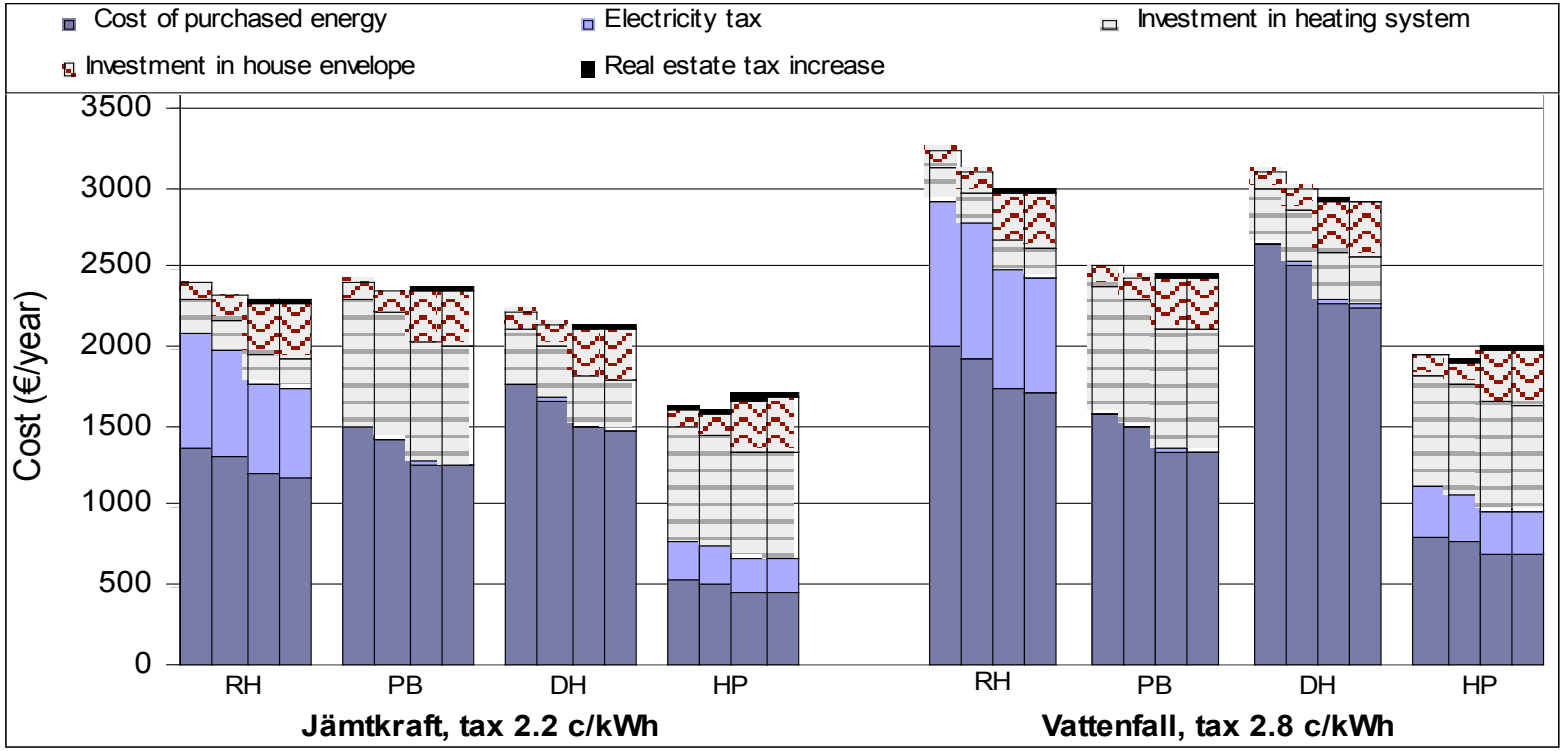
Total customer cost



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DH=District heating
HP= Heat pump

House owners' perception

Results based on surveys by Mahapatra and Gustavsson

1 local survey in area with electric heating
1 national survey

House owners' perception

- **80 % do not plan to change heating system**
  - Do not feel the need

- **House owners with RH are more dissatisfied, but also less likely to change**
  - Lock-in effect due to high investment cost

House owners' perception

Most important performance factors	*"Best" system*
• Annual cost	HP
• Investment cost	PB
• Fuctional reliability	DH
• Indoor air quality	DH

House owners' perception

What system would you recommend to someone else?

Locally

Heat pump	41 %
District heating	38 %
Pellet boiler	2 %

Nationally

Heat pump	54 %
District heating	15 %
Pellet boiler	10 %

Conclusions

- The economic benefits not enough for customers to feel the need of a new heating system
- Subsidies reduced annual cost by less than 7 %
- Subsides affect investment cost – investment cost also important for house owners
- Subsidies can be useful to break lock-in with resistance heaters
- Subsidies might be a trigger to search for information

Conclusions

- Electricity tax encouraged energy efficiency measures and made pellet boilers and district heating competitive
- Reduction of electricity tax in some areas counteracts the national goals
- Increased real estate tax is contradictive
- Reasonable with economic instruments to promote systems in line with environmental goals

Conclusions

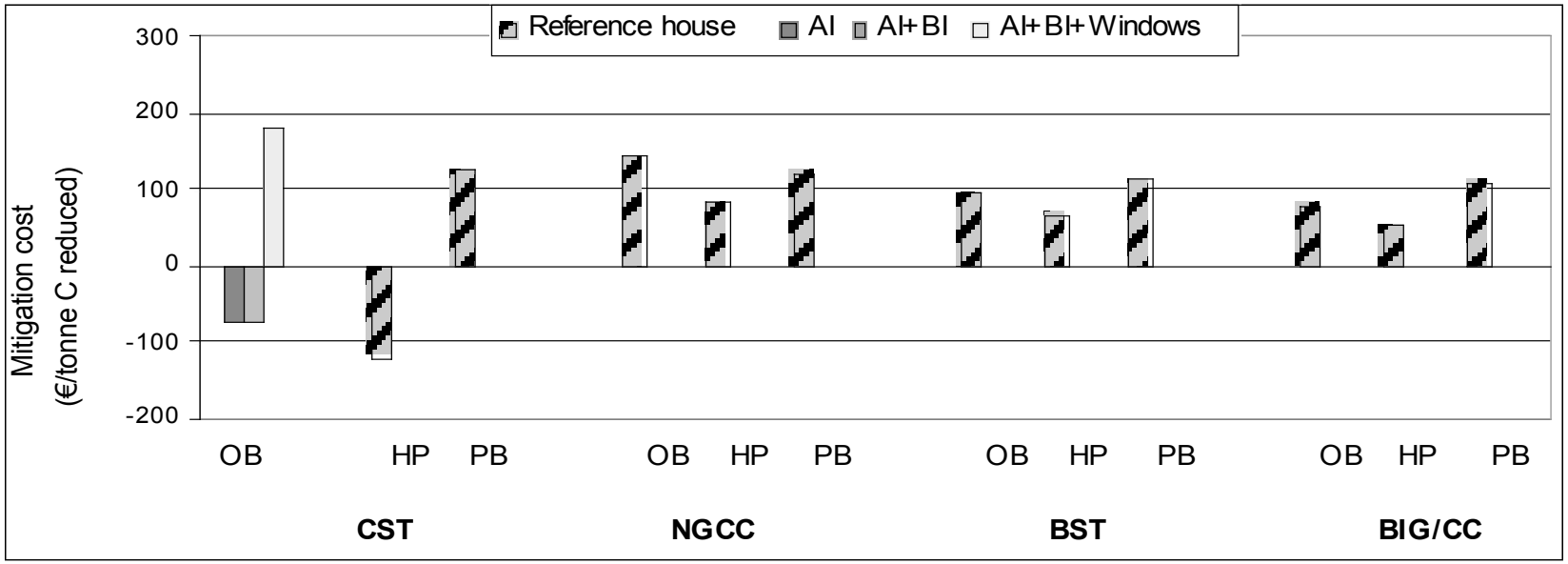
- The energy supplier is important for the customers' economic situation
- The energy supplier may influence the effects of policy measures
- The energy supplier might have the power to influence the customers attitudes towards the systems

Issue for discussion

How to encourage house owners to implement the presented changes that increases energy efficiency and reduces the CO_2 emission?

Conversion from oil boiler

Mitigation cost



Conversion from NG boiler

Mitigation cost