What do customers want?

- Awareness of flexibility and willingness to participate

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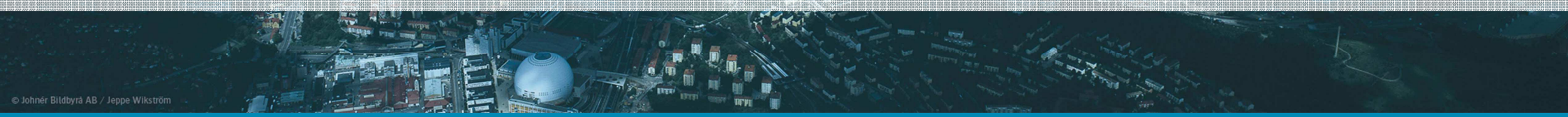


Outline of presentation

1. Background
2. Household customers
    1. Method, results and conculsions
3. Other customer segments
    1. NEPP
4. Sweco study
    1. Method, results and conclusions

1. Background

- Ei decided to fund customer research
  - Study in 2014; En elmarknad i förändring - Är kundernas flexibilitet till salu eller ens verklig?
  - Study in 2015; An electricity market in transition - demand flexibility and preference heterogeneity
- Government task – flexibility
  - Look into how to enhance the flexibility in the electricity system
  - All areas; network, supply-contracts, balancing markets, information etc

2. Looking at demand response – customer segments

- Houses (hus)
- Housing (fastigheter)
  - Apartments (lägenheter)
  - Businesses (lokaler)
- Servicearea (serviceverksamhet)
- Industry (other than electricity intensive)
- Electricity intensive industry

2. Household customers

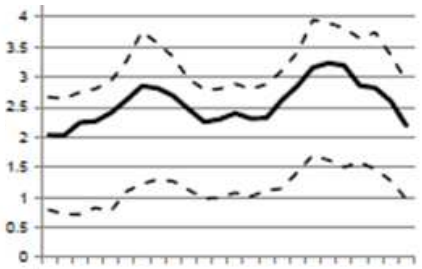
2. Method

- Analysis of *En elmarknad i förändring* (2014) CERE, Umeå Universitet: Ei
  - Choice experiments with hypothetical supply-contracts, 900 respondents
  - Household customers' attitude towards allowing the electricity consumtion to be controlled
  - Household customers' demand for compensation for allowing the electricity consumtion to be controlled
- Analysis of how much and when over the day/year household customers' use elctricity
  - Household electricity
  - Electrical heating

2. How does the household consumtion vary?

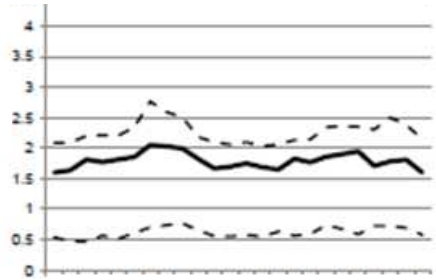
- During the day:
  - Electricity for heating ~ constant
  - Household electricity varies
- During the year:
  - Household electricity ~ constant
  - Electricity for heating varies

Total elförbrukning, medianhushåll [kWh]



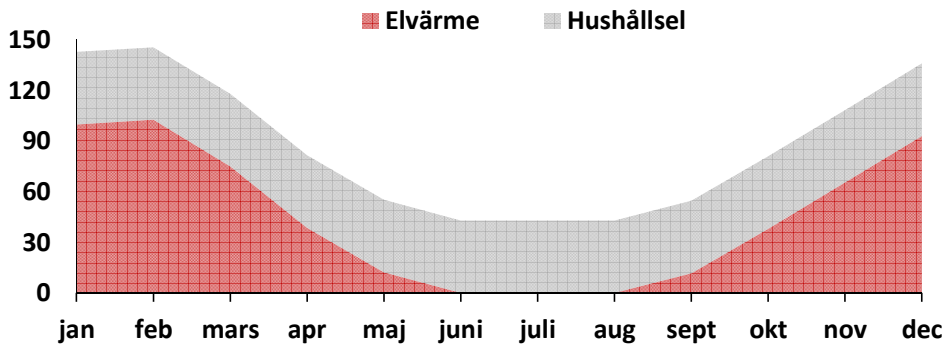
24 h

Elvärme, medianhushåll [kWh]



24 h

Total elanvändning i småhus & lägenheter under ett genomsnittligt dygn [GWh]



Results

- Load shift of heating electricity during weekdays
- Load shift of household electricity during weekdays
- Load shift of heating and household electricity in extreme situations

2. Control of heating

- Loadshift of heating electricity: heating turned off 7-10 or 17-20
- Potential power reductions, shift 7-10
  - Median household: 1.9 kW
  - 1 million households: 1900 MW

Annual compensation:
0 kr per household

- Potential power reductions, shift 17-20
  - Median household: 1.9 kW
  - 1 million households: 1900 MW

Annual compensation :
630 kr per household

IVA has estimated the potential to 2000-2400 MW (2015) & NEPP has estimated it to 2000 MW (2016)

2. Control of household electricity

- Shifting household electricity: electricity usage limited 7-10 or17-20
  - The limitation means it is not possible to use dish washer, washing machine, dryer, comfort floor heating or electricity heated towel hangers
- Potential power reductions, shift 7-10
  - Median household: 0.45 kW
  - All households: 2 100 MW

Annual compensation:
830 kr per household

- Potential power reductions, shift 17-20
  - Median household: 0.60 kW
  - All households: 2 900 MW

Annual compensation:
1 440 kr per household

2. Control in extreme situations

- Customers are informed one day in advance that their heating and household electricity can be shifted some time between 7.00–20.00
- Household customers can consider agreeing to the shift 3 times per year in exchange of a 44 kr compensation every time
- If 1 million households agree to their load being shifted, the potential is:
  - Morning: 4 000 MW
  - Evening: 4 800 MW

2. How much does it cost to control/steer 1 MW?

- Steering heating electricity
  - 7-10: 0 kr
  - 17-20: 500 kr
- Steering household electricity
  - 7-10: 2400 kr
  - 17-20: 3000 kr
- Steering both heating and household electricity (extreme situations)
  - Steering 2 hours during morning: 4500 kr
  - Steering 2 hours during evening: 5400 kr

3. How does it look in the other customer segments?

3. North European Power Perspectives (NEPP)

1. Heating electricity: ca 500 000 households à 1 kW, 500-900 MW
2. Heating electricity: ca 330 000 households à 4-5 kW at high temp., 1 500 MW
3. Shopping centre: 320 à 140 kW, 45 MW
4. Offices: 0,004kW/m2 à 35 million m2, 150 MW
5. Schools: 0,0004kW/m2 à 37 million m2, 15 MW
6. Industry (excl. electricity intensive): 300 MW
7. Electricity intensive industry: 2 600 – 3 600MW

4. Sweco’s study

4. Electricity intensive industry

- 684 recipients, response rate: 8 % companies with 1-19 employees, 11 % companies with 20+ employees – a total of 66 answers
- Out of the 15 companies that were interviewed, 6 are active on Elspot, 1 on Elbas and 6 participate either in regulating power market or the effect reserve
- Knowledge about own usage:
  - 32 % know the meaning of demand response
  - 83 % consider electricity to be a substantial cost
  - 48% know their maximal power consumption

4. Other industries

- 1531 recipients with a response rate of 7 % companies with 1-19 employees, 8 % companies with 20+ employees – a total of 107 answers
- None of the seven interviewed companies participate in NordPool or the regulating power market
- Knowledge about own usage
  - 20 % know the meaning of demand response
  - 44 % consider electricity to be a substantial cost
  - 62 % know their maximal power consumption

4. Real estate/Fastigheter

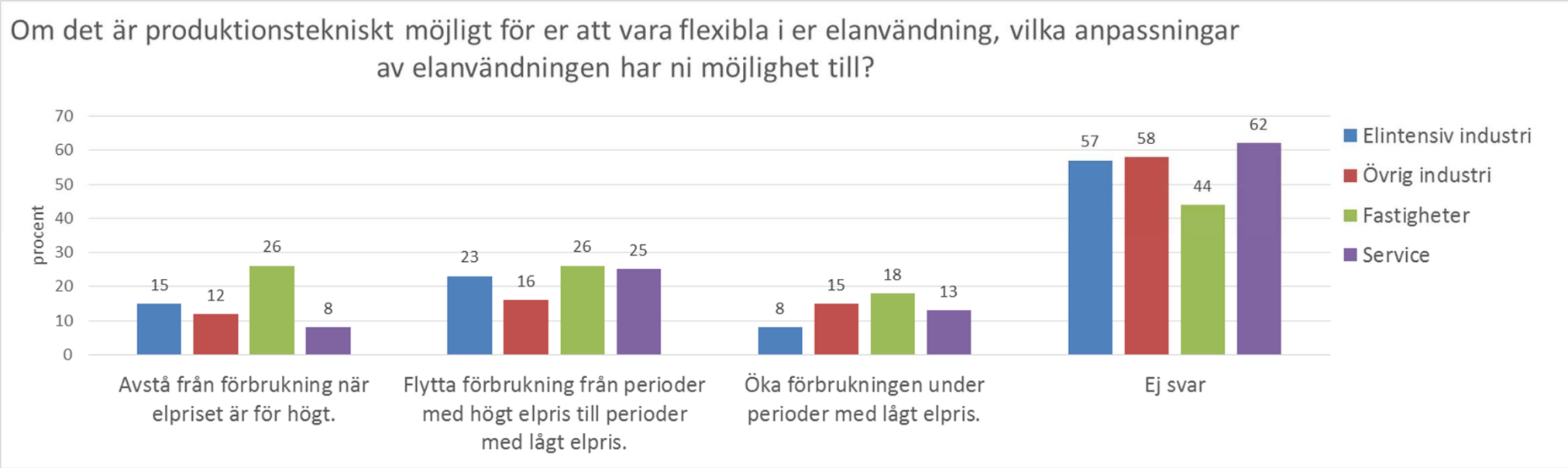
- 269 recipients with a response rate of 12 % all companies. 17 % companies with 20+ employees – a total of 34 answers
- One of the five interviewed companies participates in NordPool
- Knowledge about own usage
  - 29 % know the meaning of demand response
  - 76 % consider electricity to be a substantial cost
  - 18 % know their maximal power consumption

4. Service

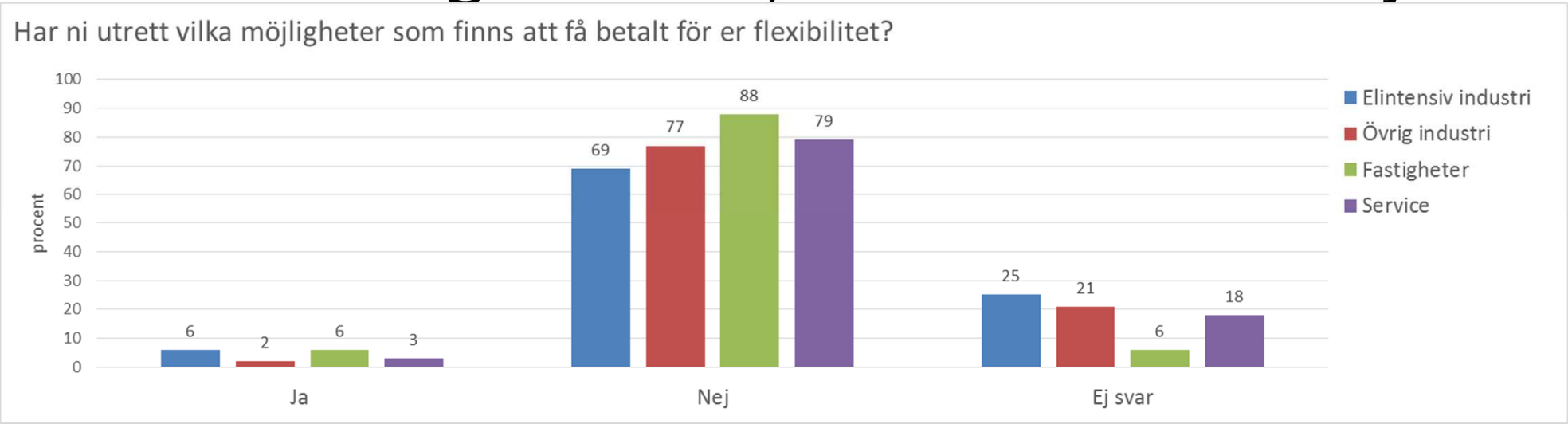
- 1 819 recipients with a response rate of 6 % for all companies and companies with 20+ employees – a total of 103 answers
- Seven in-depth interviews were undertaken
- Knowledge about own usage
  - 28 % know the meaning of demand response
  - 42 % consider electricity to be a substantial cost
  - 21 % know their maximal power consumption

4. About the possibility to be flexible

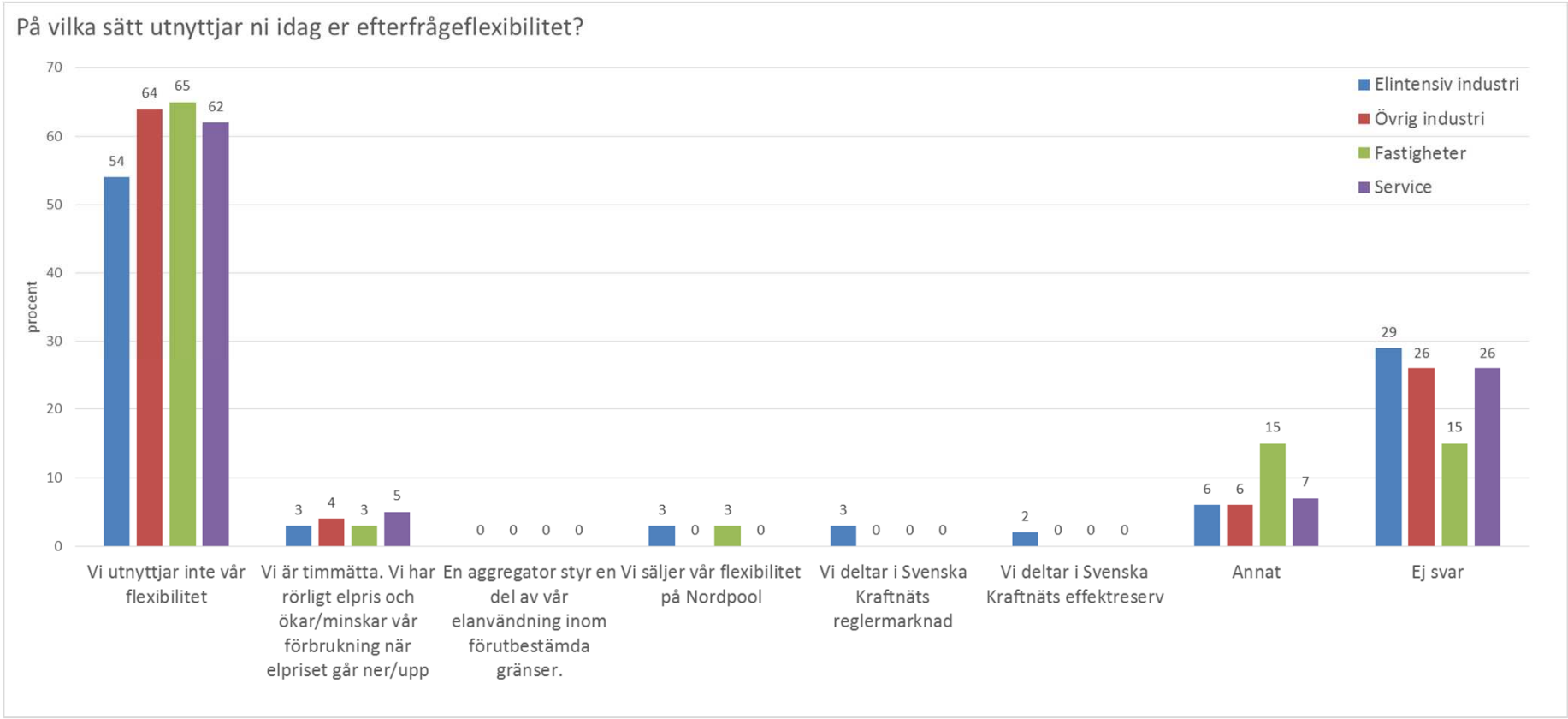
4. About possible adjustments



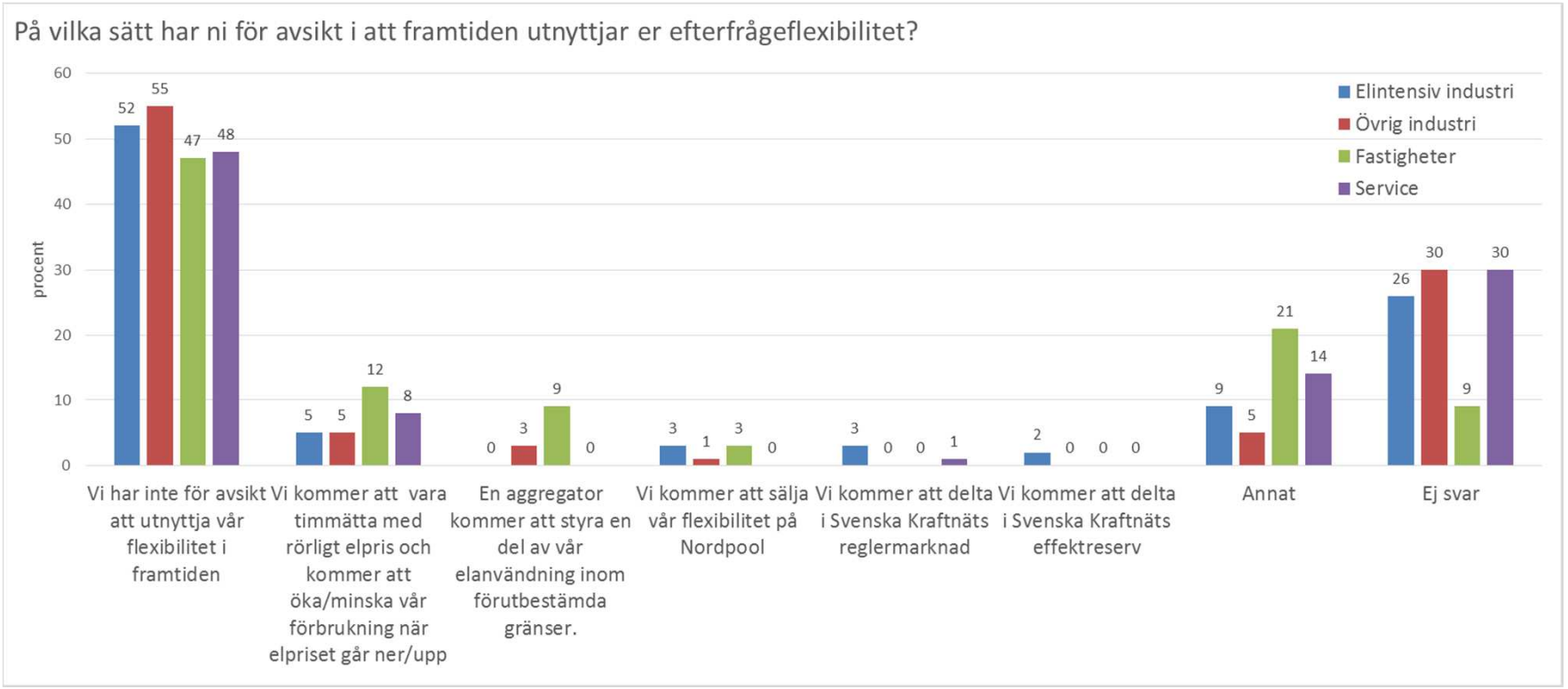
4. About realising the worth/value of the flexibility



4. About today's situation



4. About the future



4. Conclusion

- 310 survey resonses and 34 in-depth interviews provide coherent view
- Low interest, large information shortage
- Barriers: Too high costs for lost production/lost market shares, too low compensation today, too high requirements to participate in markets to sell flexibility, difficulties to estimate the operational costs of demand respones, difficulties to estimate the savings of demand response, internal organisational barriers…

Reports

- En elmarknad i förändring - Är kundernas flexibilitet till salu eller ens verklig?
- An electricity market in transition - demand flexibility and preference heterogeneity

Thank you for your attention!