Dealing with uncertainty in the Protocol Monitoring Energy savings for the Netherlands
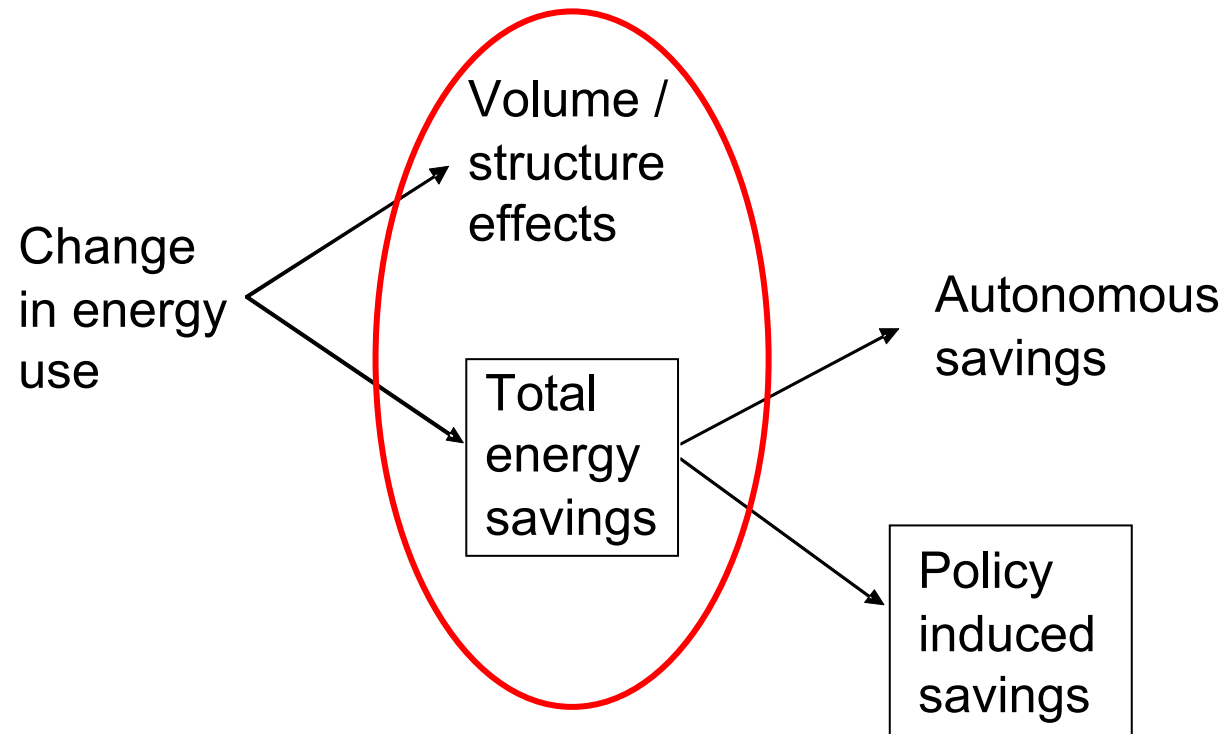
ECN - Policy Studies unit, Piet Boonekamp

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Contents

- Energy savings
- Protocol method
- Uncertainty analysis
- Conclusions

Energy trends and savings

Protocol method general

Main categories on savings:

   a. Final use of heat and electricity

   b. Conversion for end-users (co-generation)

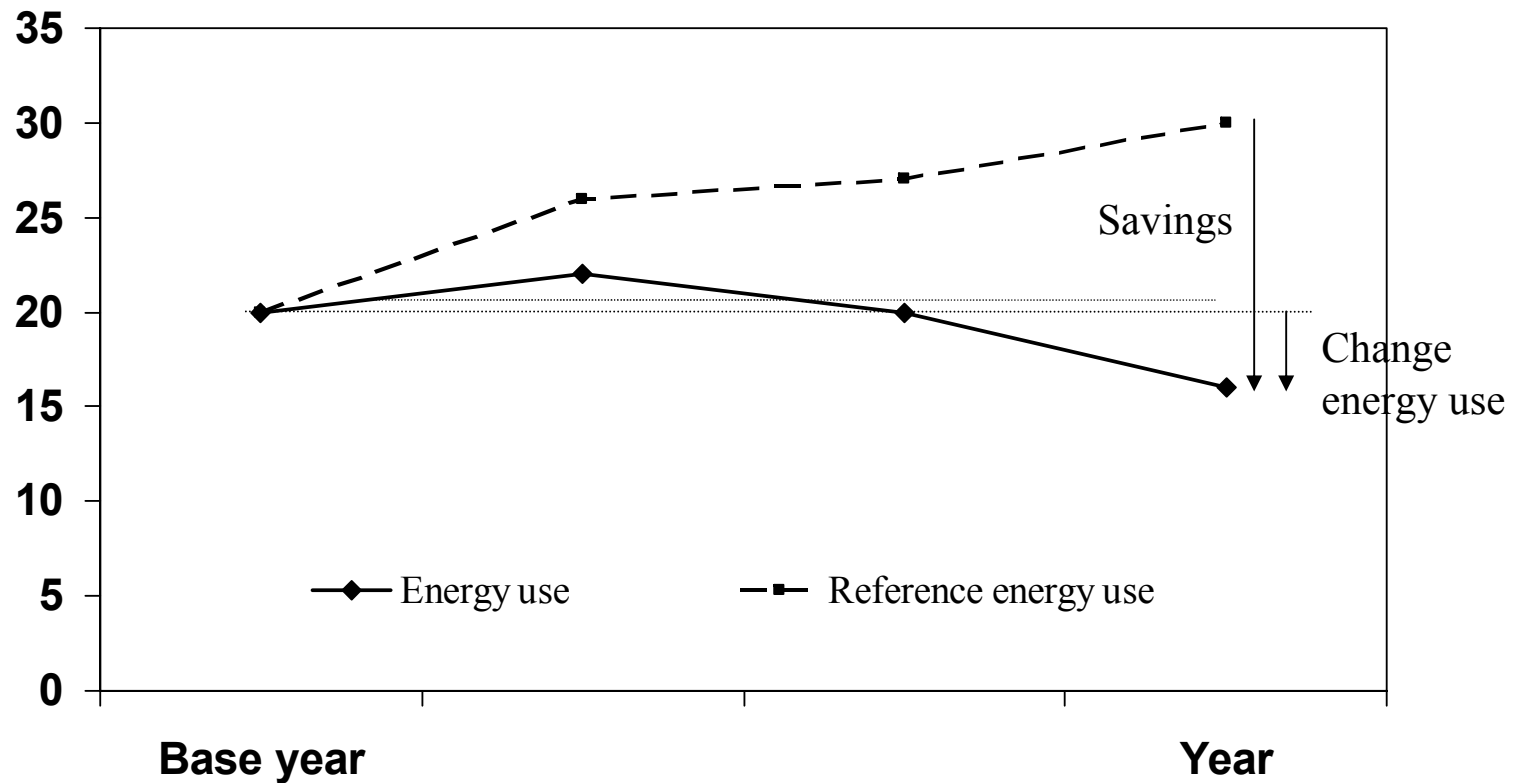   c. Conversion E-sector (power stations)

Calculation of savings:

b. Savings cogeneration = difference with separate production of heat/electricity

c. Savings power stations = effect of higher conversion efficiency per type of fuel

Protocol method final energy use

Calculation of savings on final energy use:

- Final savings = Reference energy use – Actual energy use (realisation)

- Reference energy use = base year energy use * change in energy relevant variable (ERG)

- ERG is the driver for the selected energy use

- Des-aggregation of energy use to find a suitable ERG

Protocol method final energy use (2)

Energy Relevant Variables (drivers)

- Households/space heating: number of dwellings
- Households/electricity use: weighted stock of appliances
- Industry: various physical production quantities
- Services: employees or output in constant prices
- Transport: person-km and ton-km

Protocol results (yearly for 1990- 2001)

	National	Indus-try	Refi-neries	Trans-port	House-holds	Ser-vices	Agri--Cult.
Volume-effect	2.8%	2.2%	2.0%	4.1%	3.0%	3.1%	2.0%
Structure-effect	-0.3%	0.0%	0	-1.6%	-0.4%	-0.2%	1.1%
Saving-effect end use	-0.9%	-1.2%	-1.0%	-0.4%	-1.1%	-0.3%	-1.2%
Savings effect CHP	-0.1%	-0.1%	0.0%	0	0.0%	-0.3%	-0.7%
Savings end users	-1.1%	-1.3%	-1.0%	-0.4%	-1.2%	-0.6%	-2.0%
Energy consumption	1.4%	0.9%	1.0%	2.1%	1.5%	2.3%	1.1%
Savings conversion	-0.1%						
Total Savings	-1.2%						

Margins for Dutch saving results

National savings = 1.2% +/- 0.3%

Lower level compared to national:

- Industry: same
- Services: much worse
- other sectors: worse
- Conversion end use (CHP) : same
- Conversion E-sector (power stations): worse

Calculation of uncertainty from input margins

Final use, sub-category:

- Margin reference use: margin for ERG and margin end-use in base year combined

- Margin actual energy use: margin for statistical data

- Margin energy savings: margins for reference use, actual energy use and appropriateness of ERG combined

Sectoral level: margins for all categories combined

National level: margins for all sectors combined

Uncertainty and length of period

Year-to-year, per sub-category:

- Margin in energy use base year 1%, data on ERG-variable 1%, appropriateness of ERG 0% (assumptions)
- Margin in reference use 2%, margin actual use 1% > margin for difference (savings) equal to 3% of reference/actual use
- Yearly savings 1% of reference/actual use > relative uncertainty in yearly energy savings very large !

Period 7 years:

- Margin for difference 3% reference/actual use
- Period energy savings 7% of reference/actual use > relative uncertainty in energy savings modest

Conclusion: savings over longer period more reliable

Uncertainty and aggregation level

Sub-category:

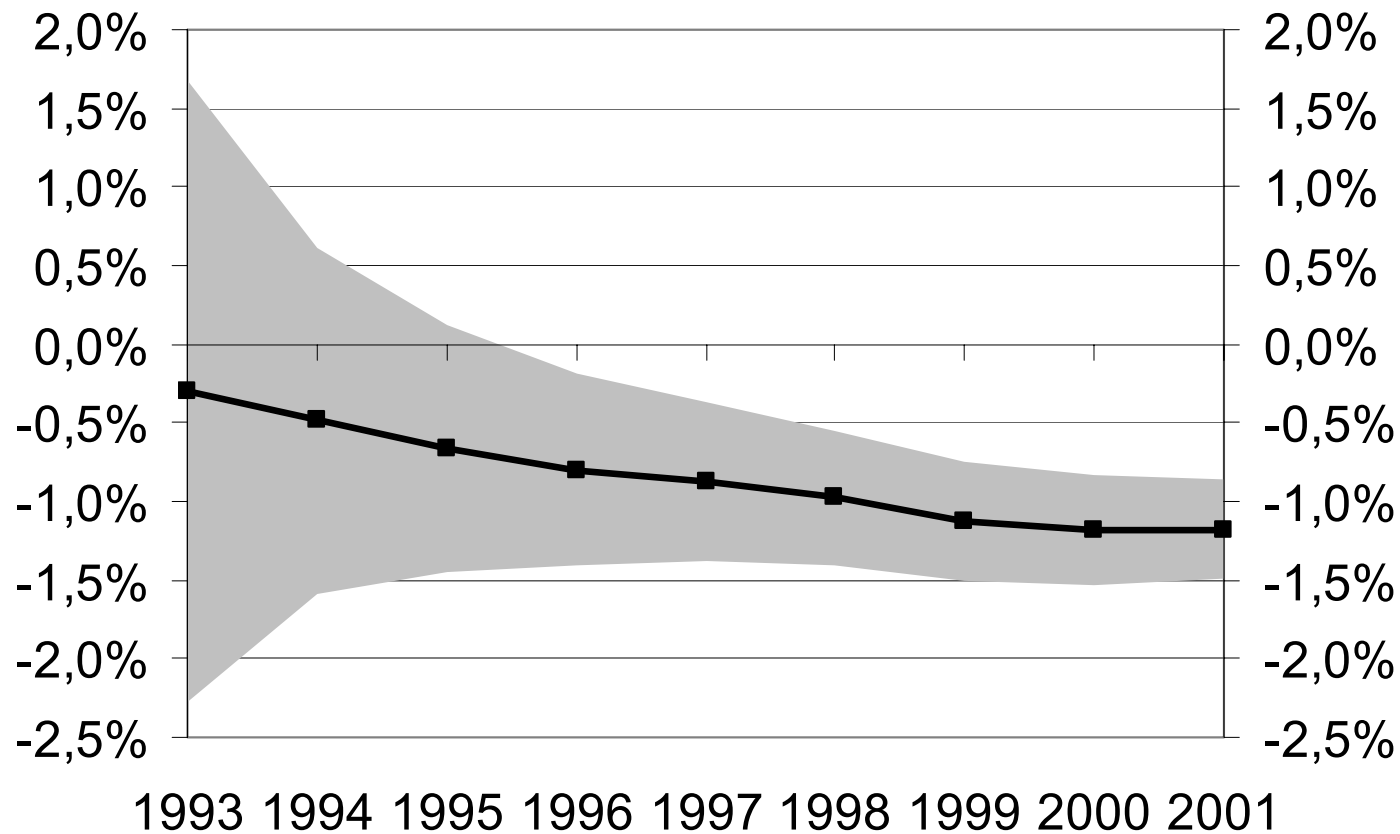- Margin in energy savings figure very large (year-to-year) to modest (period)

Sector level:

- Various sub-categories (3 to 9 per sector)
- Positive and negative deviations in saving figures per sub-category compensate each other (law of large numbers)
- Margin for savings figure at sector level smaller

National level:

- Same mechanism as for sub-category to sector
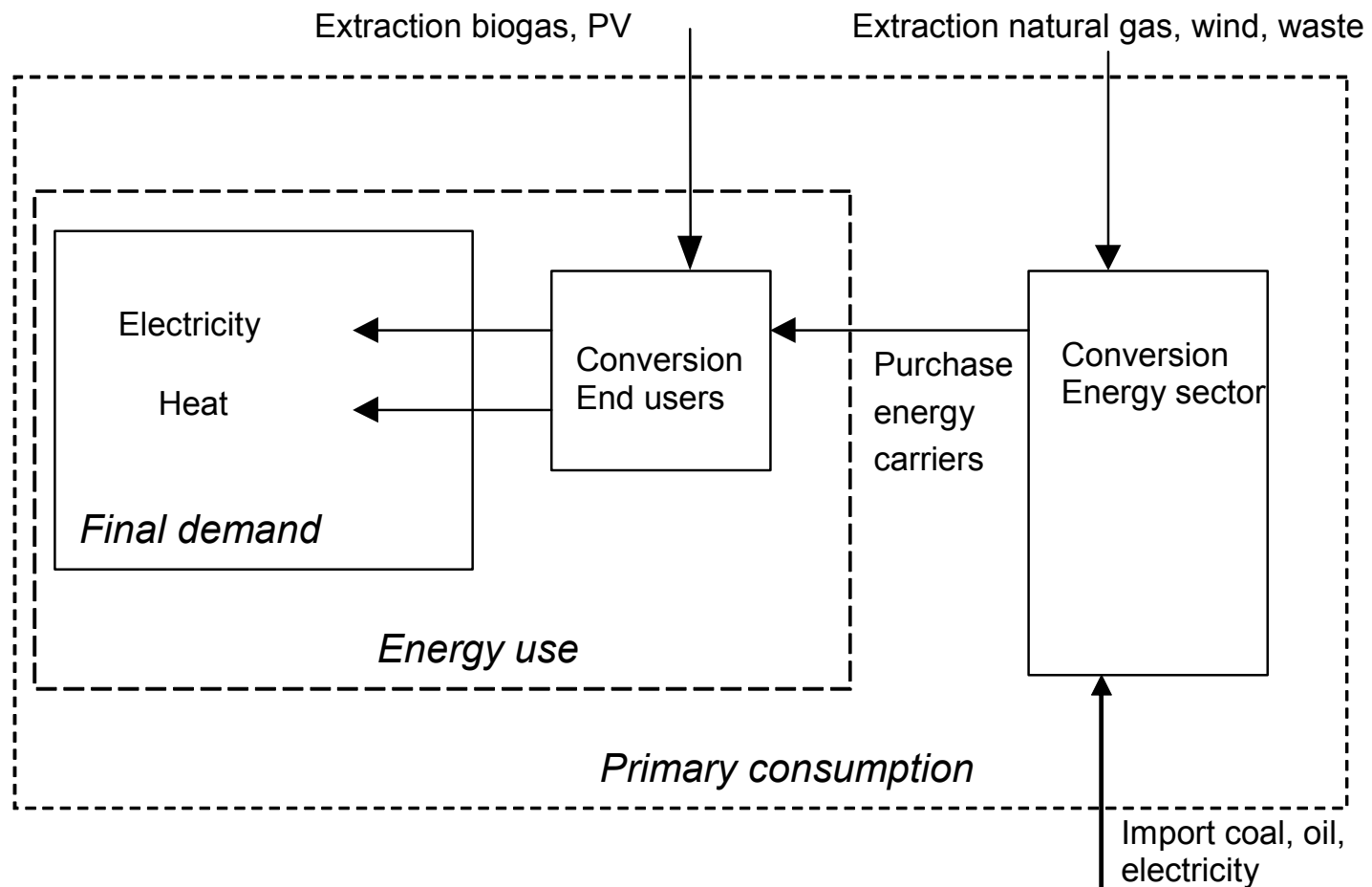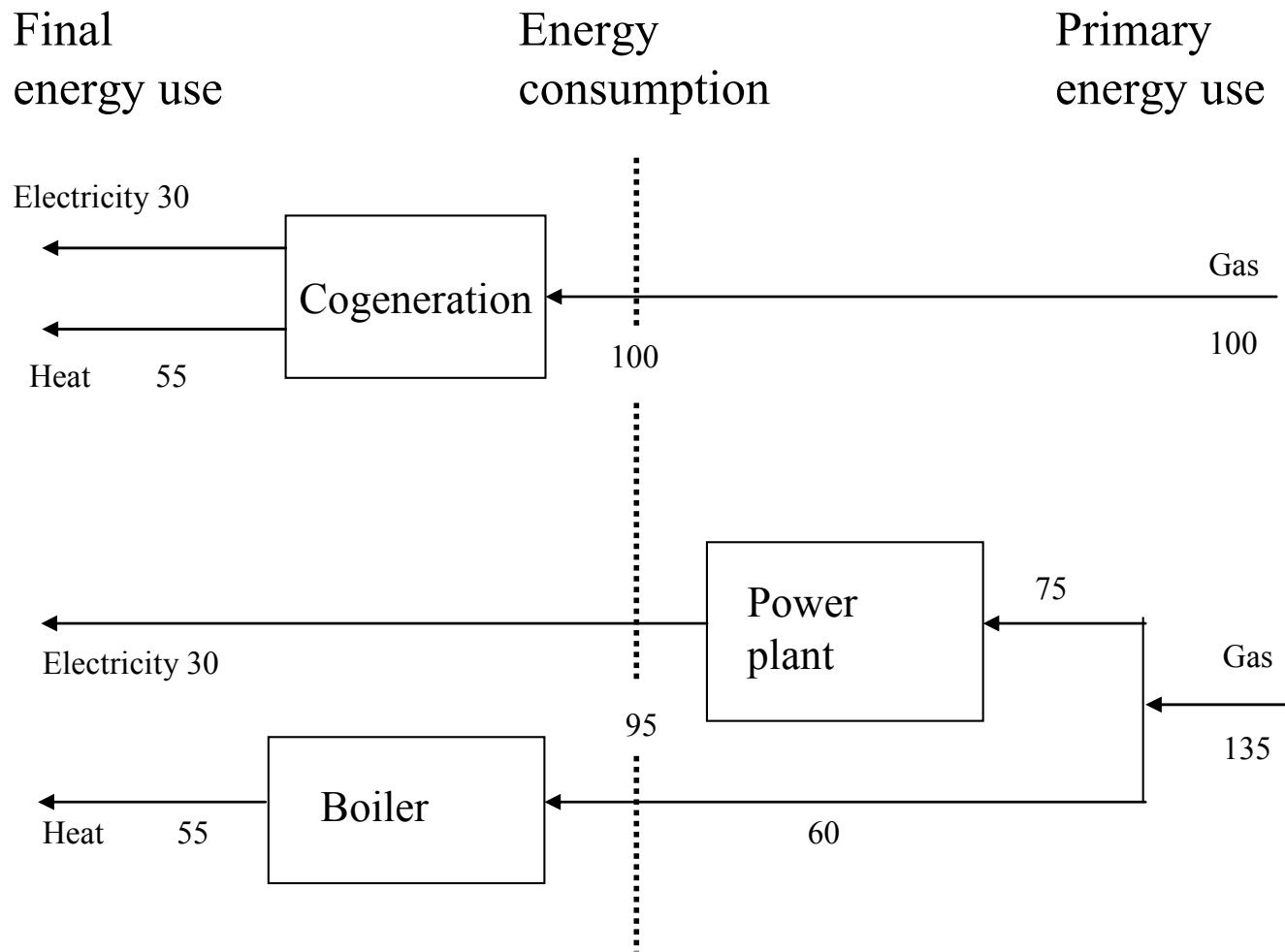- Margin savings figure smaller than at sectoral level

Conclusions

- Year-to-year energy savings for specific energy uses (very) unreliable, due to margins in input data of same magnitude as energy savings

- For longer period and higher aggregation level (much) better savings figures

- Uncertainty analysis prevents ill-defined conclusions

- Uncertainty analysis enables focused improvement of input data

APPENDIX

Primary, energy consumption and final end use

CHP savings and primary energy use

Final energy use

Energy consumption

Primary energy use

Electricity 30

Cogeneration

Gas

100

Heat 55

100

Electricity 30

Power plant

75

Gas

95

135

Boiler

Heat 55

60

Savings due to fuel-substitution

Types of fuel-substitution:

- Autonomous
  - Price induced (e.g. gas vs coal for power plants)
  - Other factors (comfort, risks, availability)
- Policy driven:
  - Saving policy (e.g. electric heat-pumps replacing gas boilers)
  - Environmental policy (e.g. gas replacing coal)
  - Renewable policy (e.g. solar boilers replacing gas)
  - Security of supply policy (e.g. coal replacing oil)
- By-product of saving policy:
  - Auxilliary electricity for heat recuperation unit (gas savings)

Savings due to structure/other policy

Structural changes:

- Dematerialization in manufacturing
- Modal shift (from car to train/bus)
- Different performance for same needs (mobility reduction by internet, less empty lorries)

Other policy:

- Environmental (e.g. lower maximum speed)
- Reliability of networks (e.g. load management)
- Social policy (e.g. energy poverty measures)

Conditions for ascribing measures to ESD-savings:

- policy driven
- Main target of policy = savings
- Consensus between MS