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Energy research Centre of the Netherlands

Investment behaviour for the adaptation of energy efficient technology

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Investment behaviour for the adaptation of energy efficient technology

Overview:

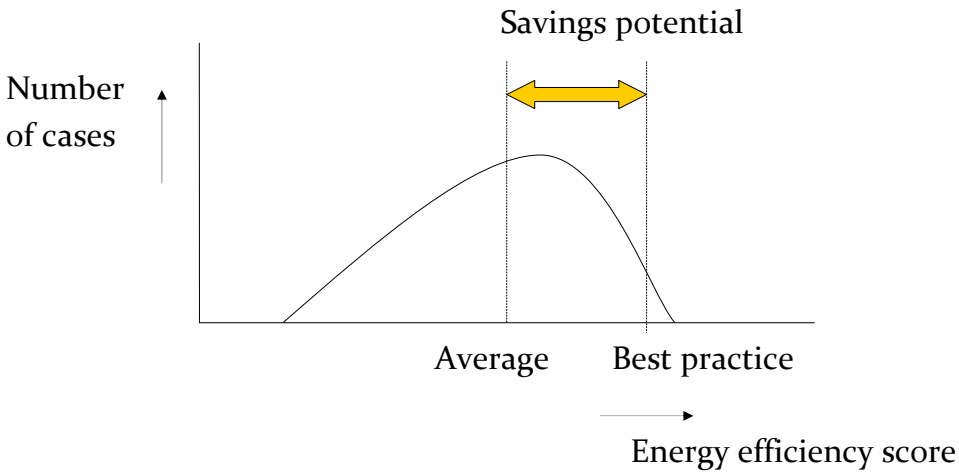
- Which are the key barriers for realization of unused energy efficiency potential?

National Energy Outlook Modeling System (NEOMS)

- How is investment behaviour modeled?
- Model application: Intermediate assessment of the Dutch policy program for energy and climate

I) Barriers

The energy efficiency gap



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Investments in energy saving technologies

Rational economic decision making:

- Payback period
- Net present value
- Internal rate of return

Companies use a critical payback period or hurdle rate for internal rate of return (which may be high)

Still many possibilities to save energy with positive pay-off: deviations occur through **hidden costs** or **market failures**.

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Hidden costs

1) Cost variations due to specific situations

E.g. Business case does not apply in all situations

2) Loss of comfort and additional efforts

E.g. "Good housekeeping" measures require little material purchases, but do take time

3) Premature capital losses

Existing equipment may have to be depreciated

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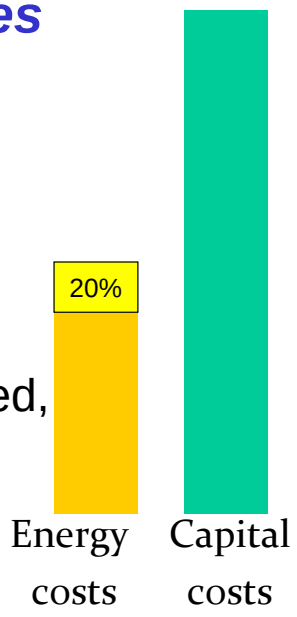
Example: premature capital losses

The ratio of annual capital depreciation to energy costs in industry ranges from 2-10.

→ Even if 20% of the energy costs are saved, the cost of one year earlier replacement is 10 times the savings



Hidden costs (continued)

4) Avoidance of uncertainties and opportunity cost of waiting

Technology, market and policy uncertainties

5) Transaction costs

E.g. Information costs and costs for negotiating agreements

6) Neglected features and preferences

Investment decision involves more aspects than energy efficiency

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Market failures

1) Environmental externalities
E.g. Damage and health risks from emissions

2) Public good aspects of information
E.g. Consumers often not well-informed

3) Positive aspects of technology development
E.g. Investments are too high or uncertain to be borne by private parties

4) Non-rational behaviour in private situations
E.g. Organizational aspects

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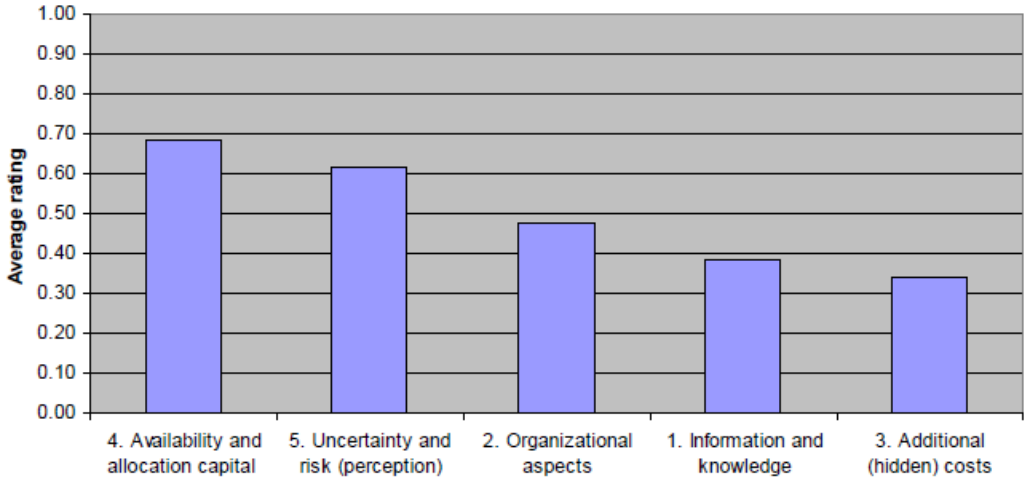
Relevance of barriers in the industrial sector

- Rated by experts



D.J. Masselink, ECN (2008)

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Most important barriers in the industrial sector

Rank	Barrier	Score
1.	Current machines not depreciated	0.44
2.	Other investments priorities	0.41
3.	Economic and market trends	0.39
4.	Uncertainties about fitting in current process	0.38
5.	Limited availability external capital	0.34
6.	Limited budget for (energy-saving)investments	0.33
7.	Focus on the short term	0.31
8.	Company structure blocks energy saving investments	0.30
9.	Costs for production disruptions	0.30
10.	Limited availability internal capital	0.30

There are many barriers that are considered relevant

D.J. Masselink, ECN (2008)

II) National Energy Outlook Modeling System (NEOMS)

How is investment behaviour modeled?

Energy research Center of the Netherlands (ECN)

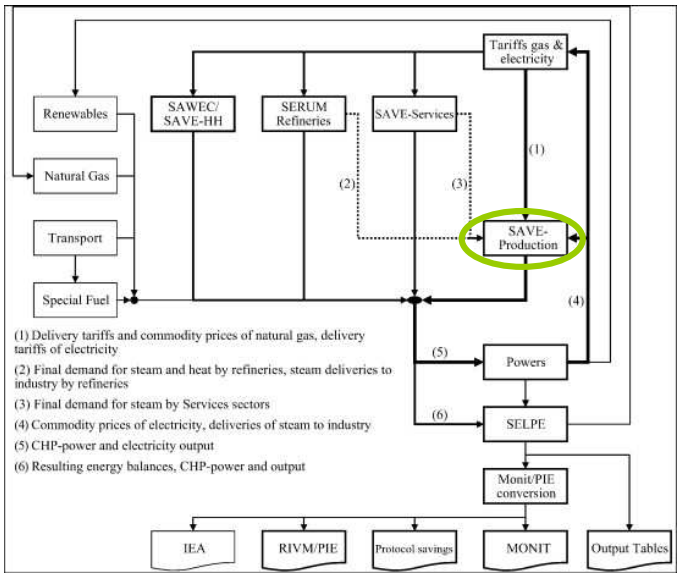
ECN Policy Studies

- Evaluation of energy and environmental policies
- Development of scenario's
- Analyses of energy markets
- Socio-economic analyses of innovation and transitions

National Energy Outlook Modeling System (NEOMS)

Model system used for:

- Projections
- Policy evaluations
- Monitoring



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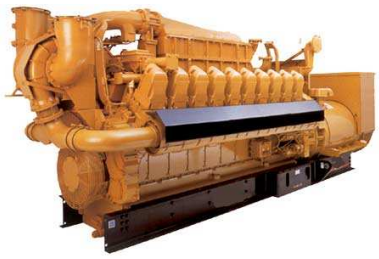
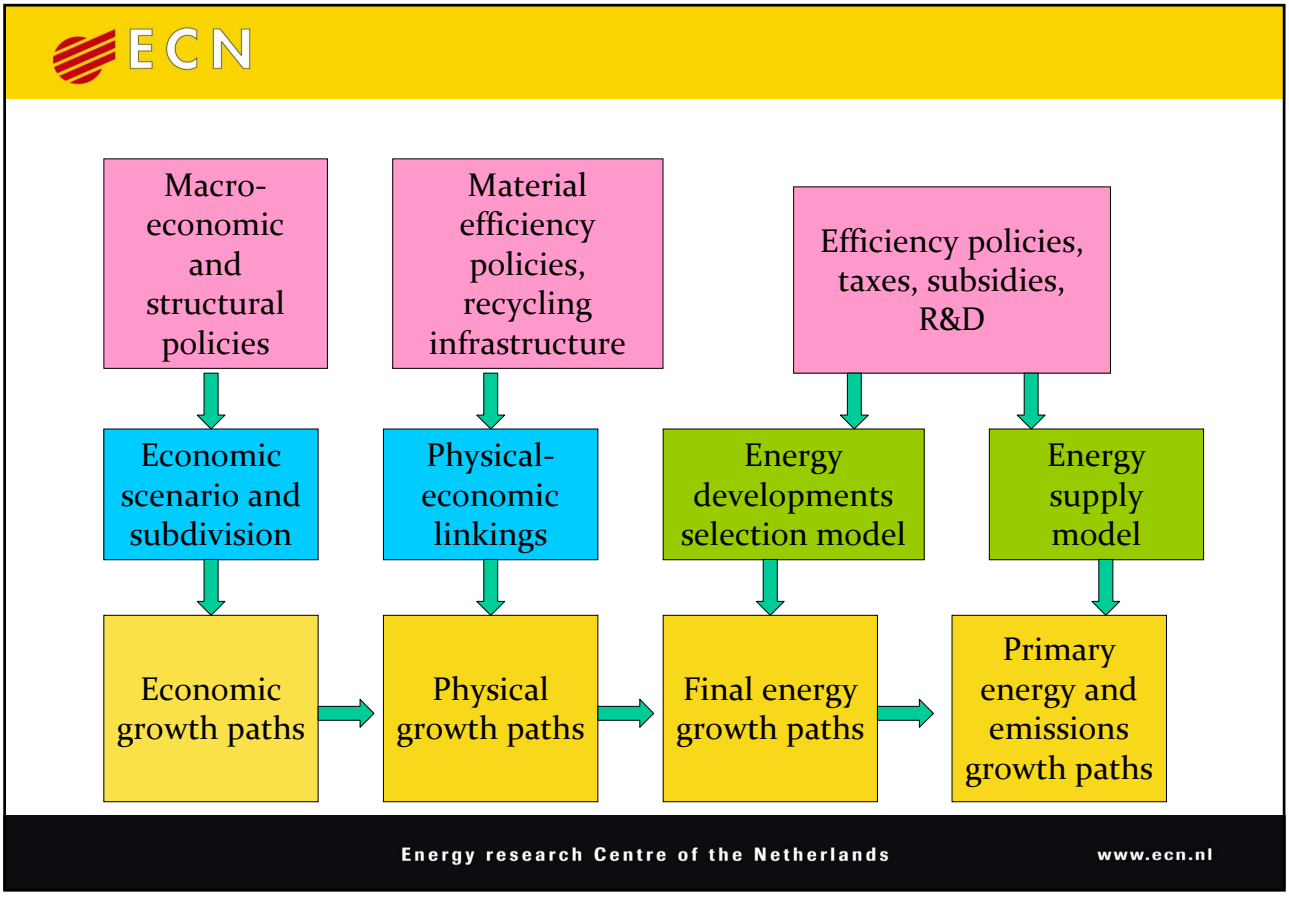
The ‘Save production’ model

- Detailed bottom-up model for energy use in industry and agriculture
- Year by year simulations driven by economic growth
- Combined Heat and Power modeled on the level of individual installations

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Macro-economic and structural policies
Material efficiency policies, recycling infrastructure
Efficiency policies, taxes, subsidies, R&D
Economic scenario and subdivision
Physical-economic linkings
Energy developments selection model
Energy supply model
Economic growth paths
Physical growth paths
Final energy growth paths
Primary energy and emissions growth paths
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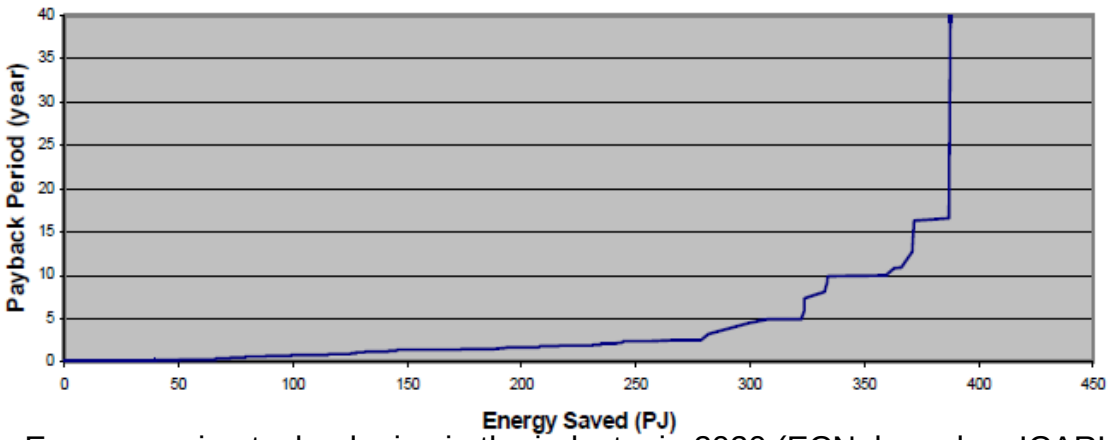
Technology database

- Decision maker is presented with a set of technologies
- Technology performance is standardized



Energy saving technologies in the industry in 2020 (ECN, based on ICARUS 4)

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Modeling of investment decisions (1/4)

Starting point: Rational economic decisions

Calculate IRR for each technology investment

- IRR is compared to sector hurdle criterion
- Technologies compete with reference technologies

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Modeling of investment decisions (2/4)

Hidden costs are integrated in the economic investment decision mechanism

- Costs of extra efforts, information, contracting and risk raise the hurdle rate

- Capacity replacement moments are fixed

- Cost variations: normal distribution

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Modeling of investment decisions (3/4)

Micro economic **market failures** are added as additional restrictions

- Instantaneous switches are inhibited
- The introduction speed is limited in initial stages
- Share that considers an investment can be controlled

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Modeling of investment decisions (4/4)

The effect of **policies** can be included

- Subsidies and fiscal benefits are included in economic evaluation

- Effects of awareness and information can be included by removing restrictions and lowering the hurdle rate

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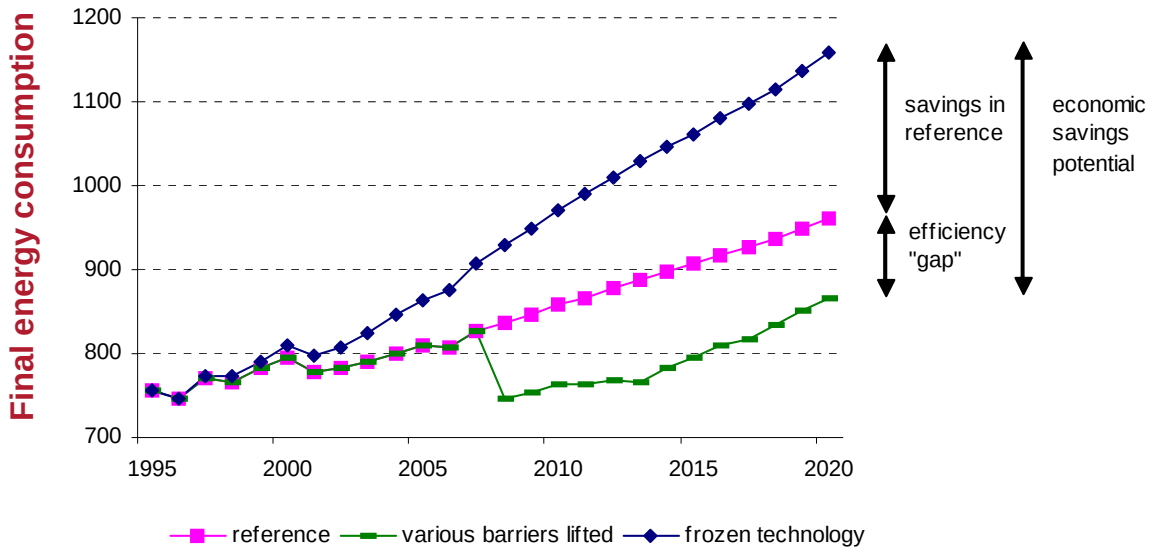
Effect of lifting barriers in 2008



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III) Application of the NEOMS model system:

Assessment of the Dutch energy and climate policy program

- Monitoring
- Policy evaluation
- Projections

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The ‘Clean and Efficient’ program

Targets:

- to cut emissions of greenhouse gases by 30 % in 2020 compared to 1990 levels

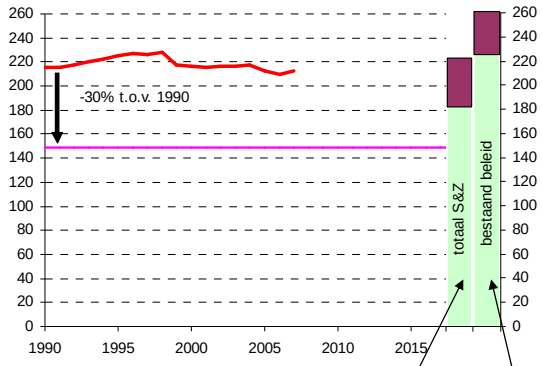
- to double the rate of yearly energy efficiency improvement from 1 to 2 % in the coming years

- to reach a share of renewable energy of 20 % by 2020

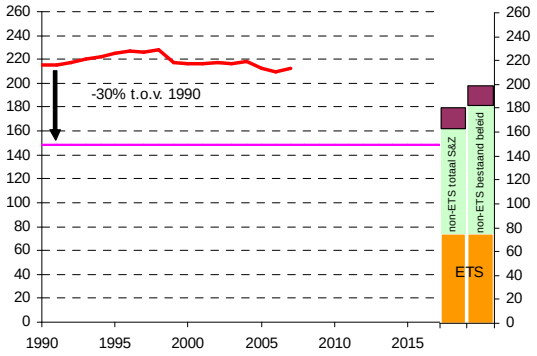
Developments and policies

- Netherlands rapidly becomes net exporter of electricity
- New financing method renewables subsidies
- Strong growth of CHP in greenhouse agriculture
- Covenant for savings in built environment

Greenhouse gas emissions [Mton CO_2 eq.]



Total national



After EU reduction allotment

'Clean and efficient' program

Existing policies

Energy savings

Historical energy efficiency improvements 1995-2007

- End use + CHP + Supply side → National
  0,9% 0,1% 0,1% 1,1%

Assessment: rises to 1,4%-1,8% in 2011-2020
(definition excluding feedstocks)

Protocol Monitoring Energy Savings

Conclusions

- Many barriers prevent realization of energy efficiency potential

- In the NEOMS models hidden costs and market failures are taken into account.

- The current Dutch policy instruments have substantial effects, but the targets for 2020 will not be met. For this, additional, possibly more obligatory policy is needed.

A.W.N. van Dril, (coörd.), *Verkenning Schoon en Zuinig, Stand van zaken 2009*, ECN-E-09-022, 2009.

C.B. Hanschke (coörd.), *Monitor Schoon en Zuinig, Actuele stand van zaken – 2008*, ECN-E—09-030, 2009

B.W. Daniëls, A.W.N. van Dril, *Save production: A bottom-up energy model for Dutch industry and agriculture*, Energy Economics, Volume 29, 847-867, 2007

D.J. Masselink, *Barriers to investments in energy saving technologies, case study for the industry*, ECN-I—08-057, Petten, 2007

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