



Energy research Centre of the Netherlands

Using simulation models to evaluate realized energy savings

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Outline

Evaluation in the Netherlands

Problems with current evaluation tools

Simulation models for ex-ante evaluations

Examples of results obtained

Observations for evaluation

Evaluation in the Netherlands

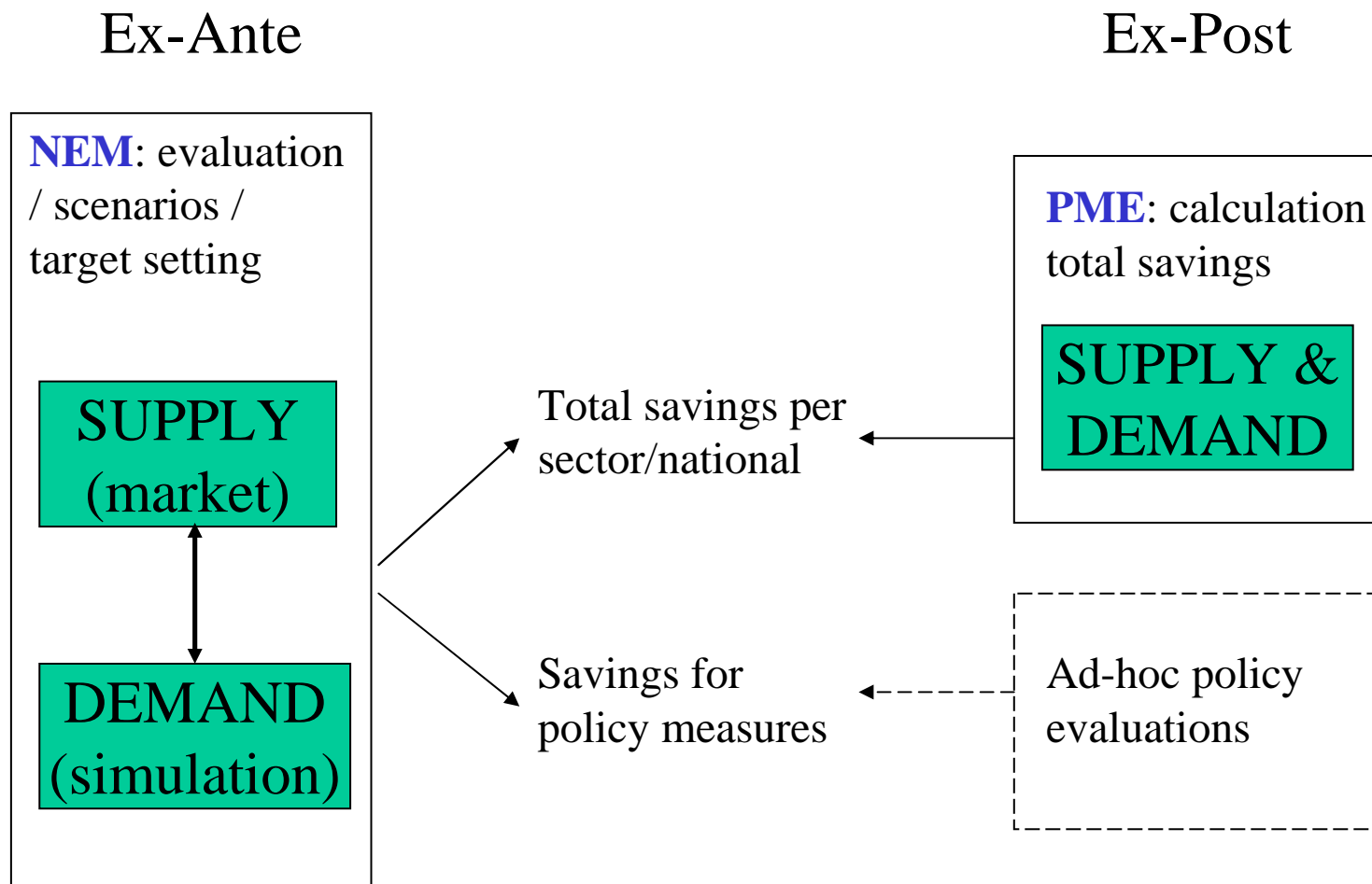
ECN contribution:

- Independent evaluations of trends and policy on energy savings
- **Ex-ante** scenarios, using modeling system **NEM**
- **Ex-post** calculation of savings, using **PME**

Available tools:

- **NEM** = National Energy Modeling system with simulation of demand and market models for supply
- **PME** = Protocol Monitoring Energy savings based on statistical data > indicators > total savings per sector and national

Existing M & E system



Problems with ex-post evaluation tools

Type of savings

- PME savings per sector and national > only total savings
- Policy savings > only ad-hoc studies
- Relation total savings and policy savings unclear

Timing

- Total savings only available after two years

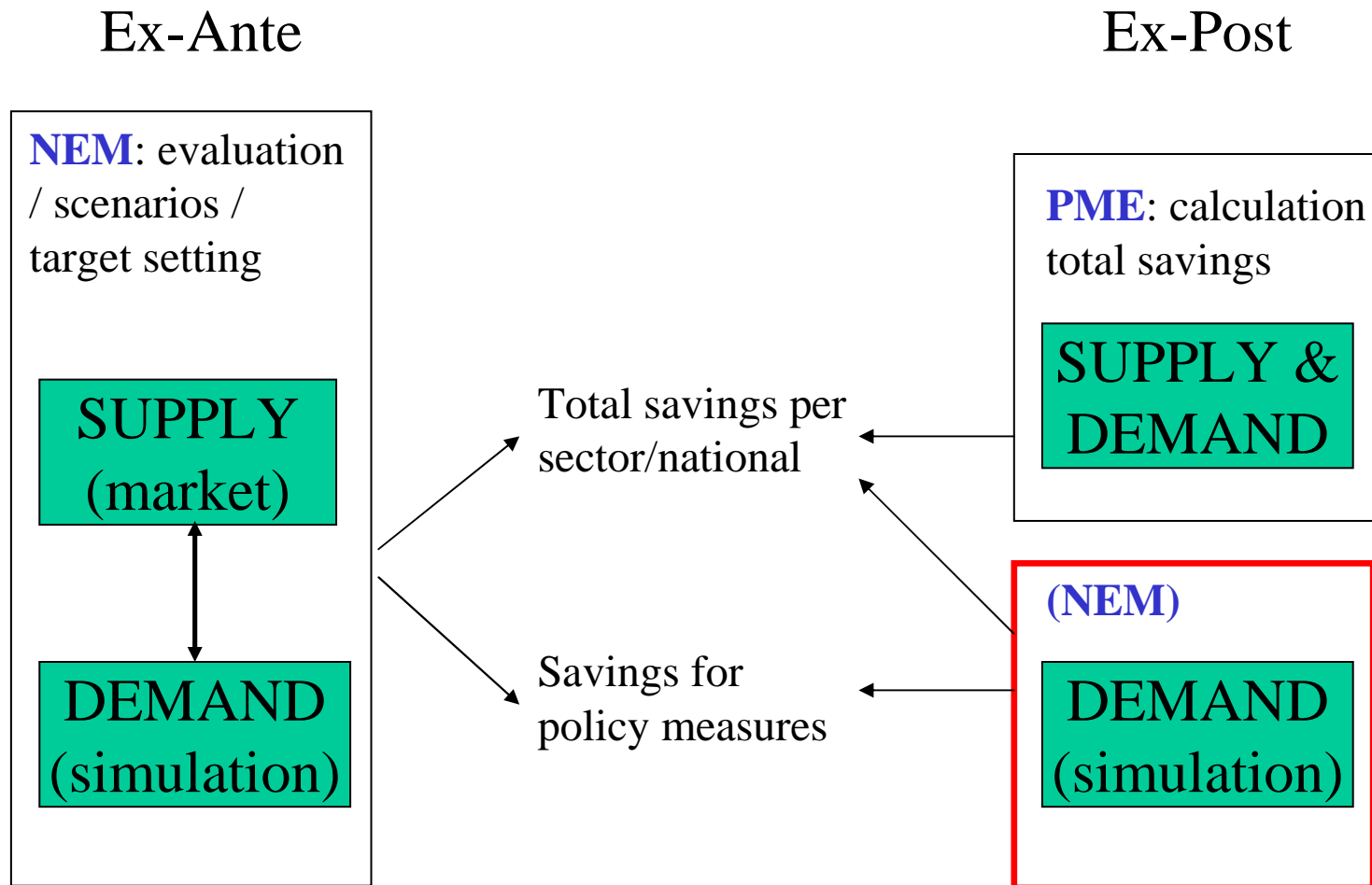
Quality

- Total savings year-to-year very uncertain
- Policy savings calculated differently

Comparison with target

- Ex-ante savings for target not comparable with ex-post savings

New M & E system



NEM Simulation of energy demand

Sector models

- Households (dwellings and appliances)
- Tertiary sectors
- Industry & Agriculture (incl. CHP)
- Transport (external input)

Model characteristics

- Detailed modeling of targeted energy uses and all saving options
- Socio-economic drivers define energy demand for targeted uses
- Energy prices and investment costs define CBR for saving options
- Modelling of investment behaviour > penetration of options > achieved savings > costs and benefits

Adaptation models for ex-post evaluations

Model structure

- Actual values next to calculated values, for relevant quantities
- Flexible parameters for investment behaviour

Inputs:

- Expected socio-economic trends > realised trends
- Expected stock of energy using devices > observed stocks
- Expected prices > actual prices
- Intended policies > actual policy measures

Fit of model results to actual trends:

- For penetration of saving options
- For energy consumption trend

Result: simulated historic trend for penetration, energy use, savings, costs, etc.

Results obtained with simulation model

Simulations with fitted model:

- Base case: historic trend
- Variant 1: frozen technology (without penetration of saving options)
- Variant 2a, 2b, 2c,: without policy measure a, b, c, ...
- Variant 3: without all (extra) policy

Results from simulations:

- Total savings = Base case - variant 1
- Effect of specific policy measure x = base case - variant 2x
- Total policy effect = Base case - variant 3
- Interaction between policy measures = Variant 3 - sum (variant 2a, 2b, ...)

Examples of evaluation through simulation

1. Correcting statistical trend breaks
2. Policy interaction for households
3. Evaluation second NEEAP

Example 1: Correction trend breaks in energy use

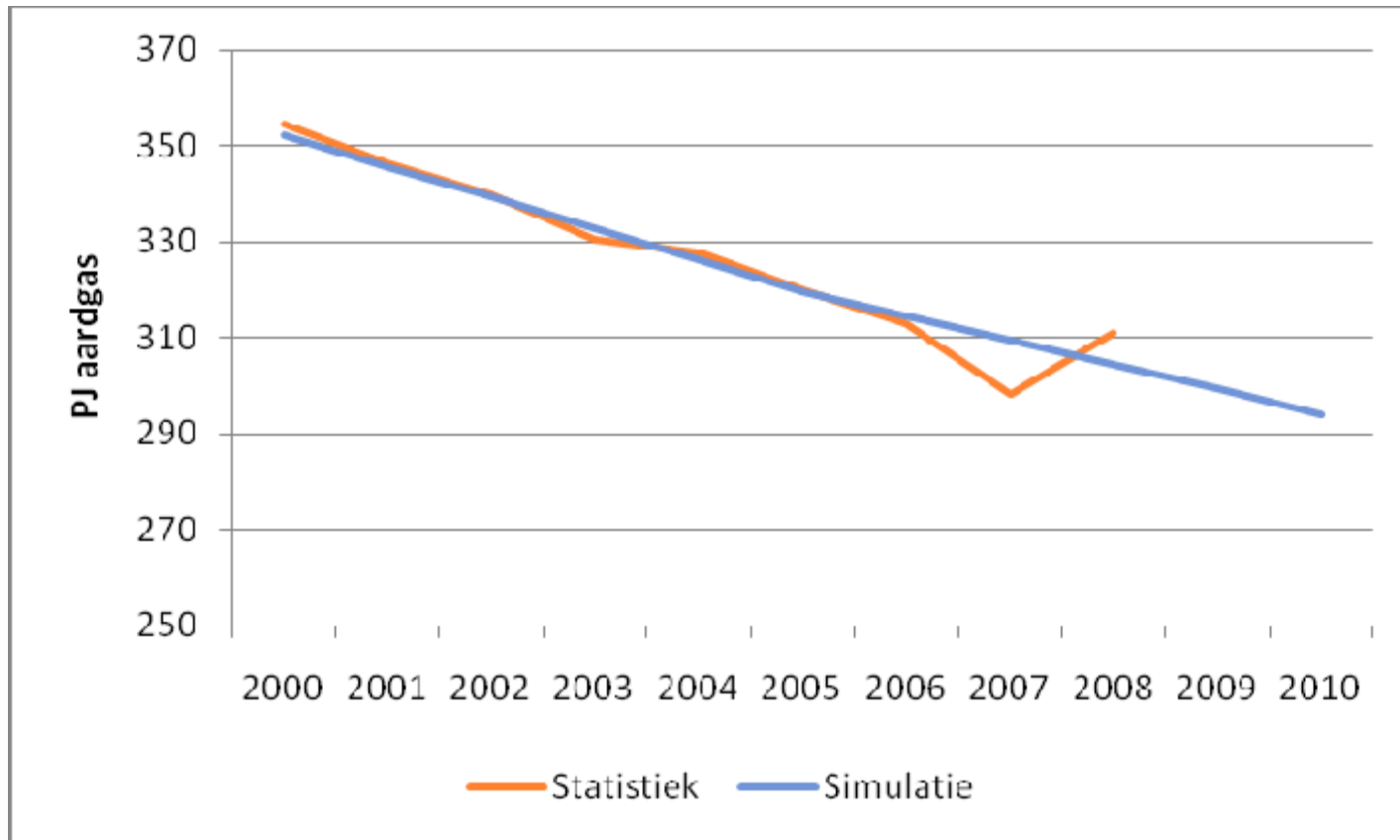
Standard calculation of savings:

- Based on indicators, using energy statistics
- Statistics Household energy consumption based on survey
- Change in survey set-up > trend break in statistical data > energy indicators erratic > calculated savings unrealistic

Simulation approach:

- Energy consumption trend based on many bottom-up trends
- Total energy consumption fitted to statistical trend
- Trend based on observed bottom-up trends for trend-break
- Indicators based on simulated trend > realistic savings

Correcting statistical errors for household gas use



Example 2: Policy interaction for households

- Bottom-up simulation of energy trends for 1990-2000
- Variants with/without:
 - Regulatory energy **tax**
 - Investment **subsidies** on saving options
 - **Regulation** of space heating demand
- Sum of separate effects is higher than combined effect:
 - 13% for gas
 - 4% for electricity
- Longer term interaction: 30%

Savings per policy measure and overlap for Households (1995-2000)

Energy savings due to a regulatory tax, investment subsidies, regulation, and the combination for 1995 and 2000

	1995		2000	
	Gas [PJ]	Electricity [PJe]	Gas [PJ]	Electricity [PJe]
Policy measures:				
Tax only	0.0	0.0	8.5	1.6
Subsidies only	10.1	1.5	18.1	2.7
Regulation only	6.1	0.0	19.3	0.0
(sum)	(16.2)	(1.5)	(45.9)	(4.3)
Tax & subsidies & regulation	15.3	1.5	41.5	4.2

Example 3: Evaluation second NEEAP for EU

National Energy Efficiency Action Plan 2:

- End-use savings period 2008-2016 (excl. ETS)
- Top-down (total) savings and bottom-up (additional) savings
- Second evaluation for 2011:
 - Ex-ante 2011-2016 (2020)
 - Ex-post 2008-2010

Expectation:

- Less savings due to crisis (less investments)

Problems:

- No/few statistical data for 2010 and 2009 > no total savings
- Inconsistencies top-down (total) and bottom-up (policy) savings

Simulation results for second NEEAP

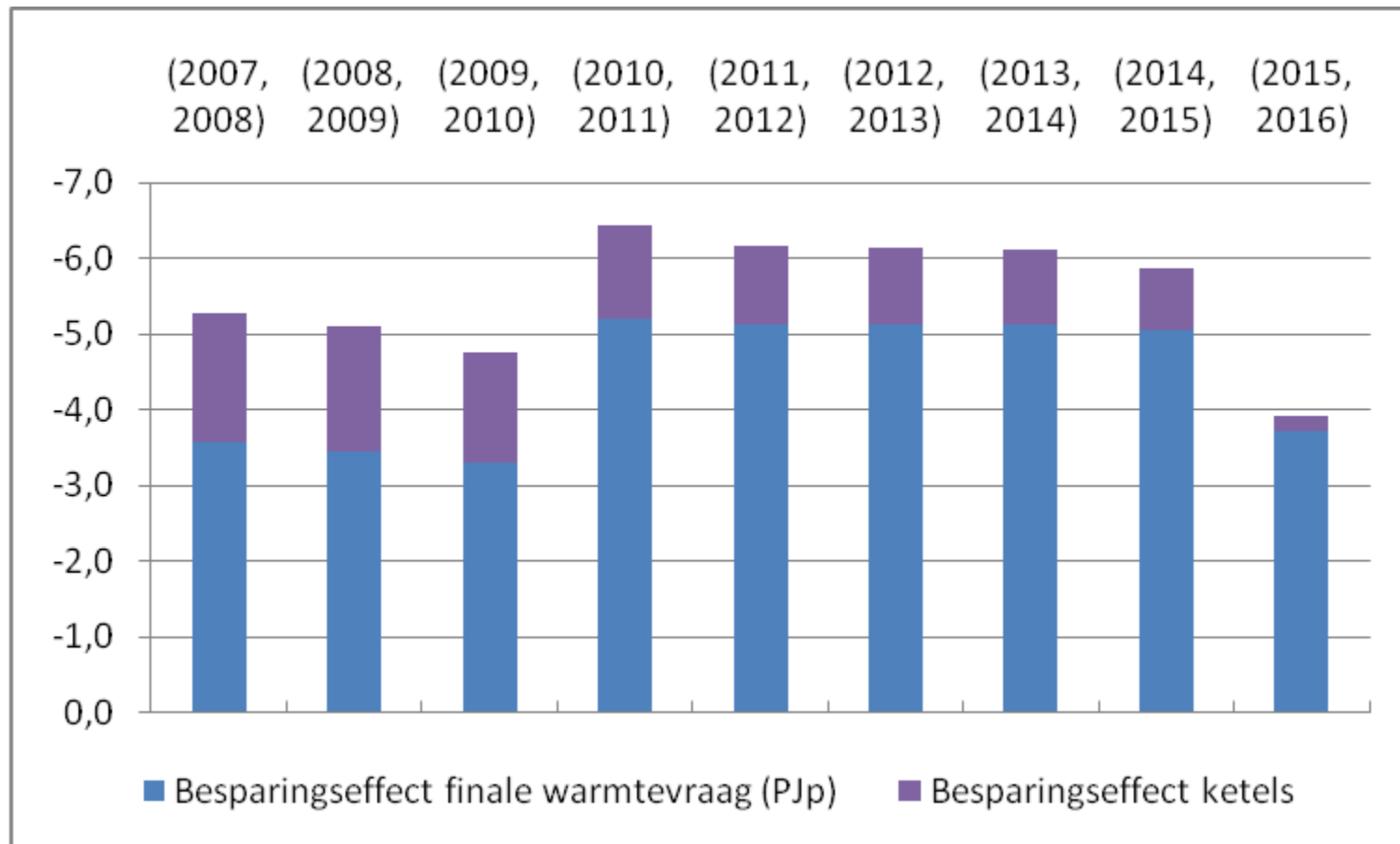
Simulation inputs:

- Newly built dwellings (stimulated against crisis)
- Replacement of boilers (follow stock renewal)
- After 2011 new savings program (assumed)

Simulation results:

- Savings do NOT decrease for 2008-10
- Savings increase by 2012 IF recovery and new programme
- Savings decrease in 2016 due to exhaustion of potential

Realized/expected gas savings households



Observations on new approach

Consistent picture of energy consumption and underlying trends

Integrated picture of energy consumption trends and savings

Consistent results for total savings and policy savings

Interaction between policy measures can be quantified

Same format for expected savings (target) and realised savings

Comparison possible between target and savings when situation has changed

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Literature:

ECN evaluatiesysteem voor energiebesparing in Nederland - Op basis van energiemodellen, P.G.M. Boonekamp et al, ECN-E-10-114, August 2010

Tweede Nationale Energie Efficiëntie Actie Plan voor Nederland, ECN/Agentschap NL, 30 Juni 2011

Actual interaction effects between policy measures for energy efficiency - A qualitative matrix method and quantitative simulation results for households, P.G.M. Boonekamp , ECN, 2005.

Scope for energy savings

