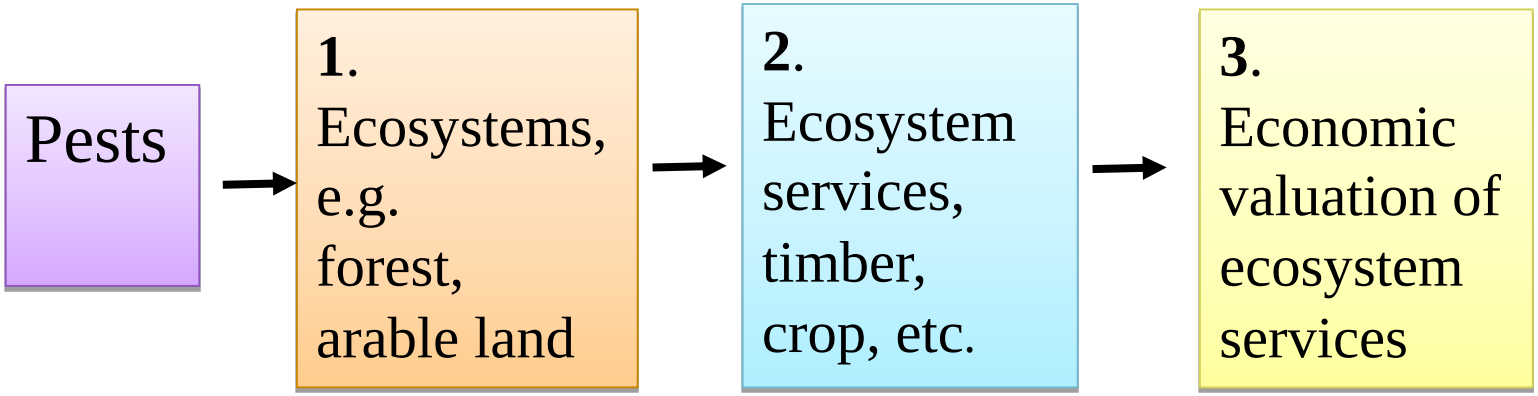
Challenges in estimating economic effects of plant pest: costs of invasive pathogens in forests in EU

Ing-Marie Gren

Department of Economics, Swedish University of Agricultural Sciences

General approach: the production function method



General approach. Production function method, cont.

- Step 1: description of the pest and ecological/hydrological modeling of the affected ecosystem
- Step 2: quantification of effects on provision of ecosystem services with and without the pest
- Step 3: economic effects of changes in provision of ecosystem services

Step 3: economic valuation of ecosystem services

- **Market ecosystem services (**timber, crops, etc.),
  - market prices
- **Non-market ecosystem services**, (carbon sequestration, recreational values, etc)
  - indirect markets (travel cost method, hedonic method)
  - hypothetical markets (contingent valuation)
  - cost based methods (cost of pest mitigation and adaptation, replacement cost)

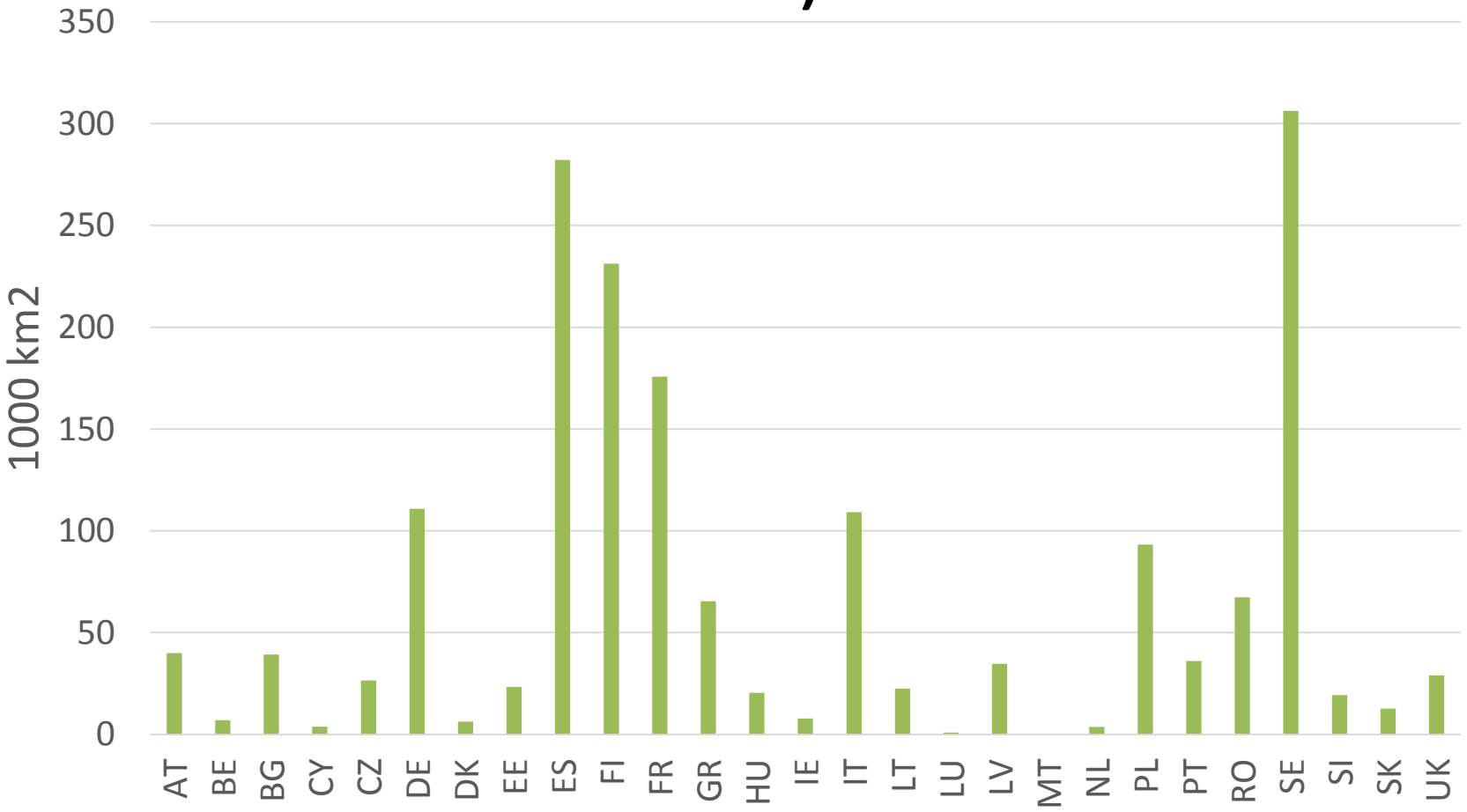
Example: cost of pathogens in EU forest

Step 1: simple model of area dispersal of pathogen
impacts on forest quality, logistic forest growth model

Step 2: impacts on provision of above ground carbon sink and timber outputs,

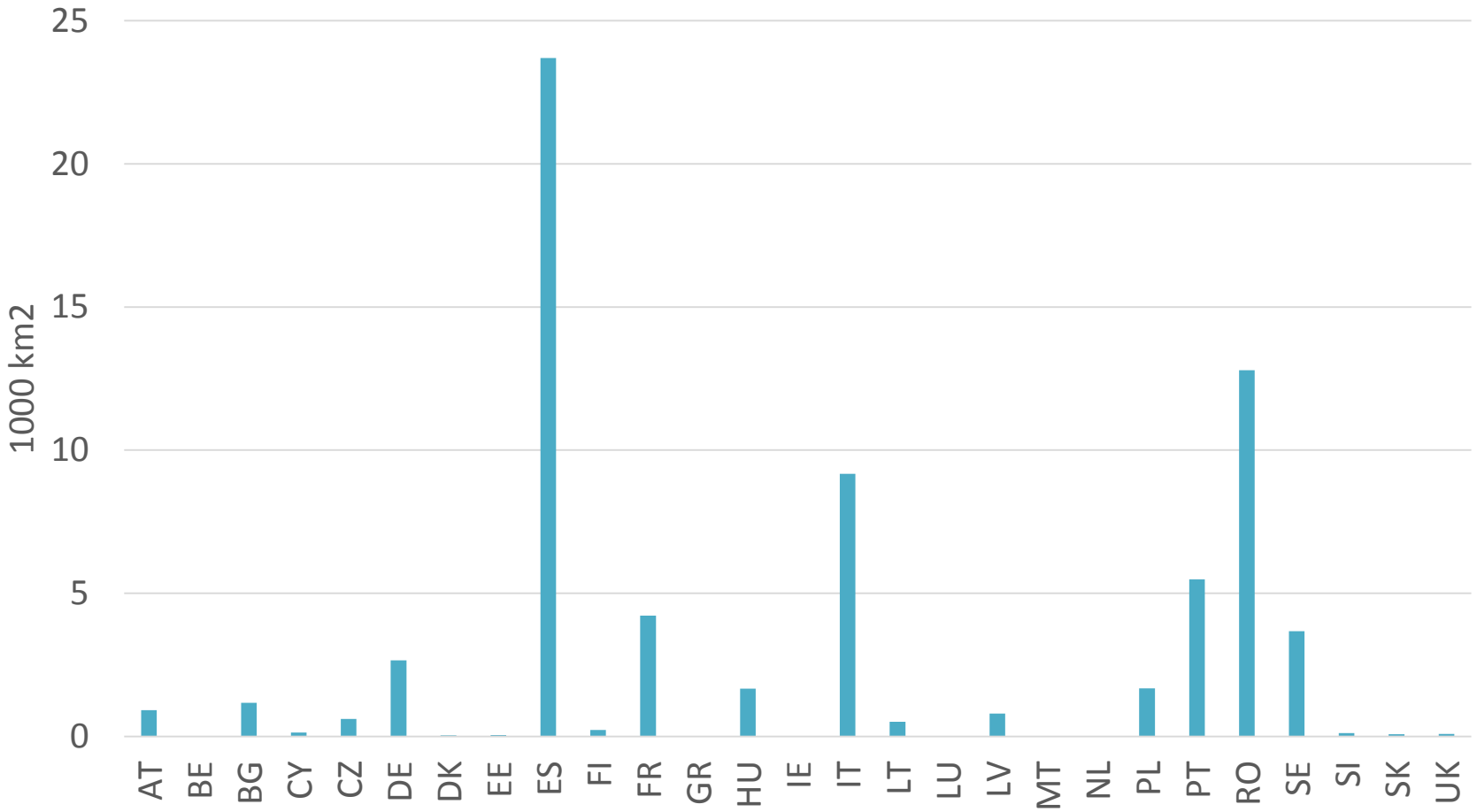
Step 3: Timber; market prices
carbon sequestration; increase in cost of reaching EU 2050 climate target (replacement cost method)

Forest areas in EU countries, 1770 kkm2 in total (European Forest Institute, 2016)



Areas with disease, 70 kkm2 in total

(European Forest Institute, 2016)



Step 1-3: Numerical dynamic optimisation model over 35 years

- Model objectives:
  - Minimizing costs of reaching 2050 climate target of 80% reduction in CO2e emissions
  - Maximizing profits from forestry
- CO2e reduction options:
  - reductions in use of fossil fuel
  - carbon sink enhancement by management and afforestation

Step 1-2: Numerical dynamic optimisation model, cont.

- **Step 1**:
  - 50% decrease in quality of affected forest area,
  - 2.2% annual rate of area dispersal of disease
- **Step 2:**

Logistic forest growth functions calculated by Leslie matrices based on data on forest volume, growth and harvest of different tree species and ages

Numerical dynamic optimisation model, cont.

- **Step 3:**

  - Value of timber from market prices

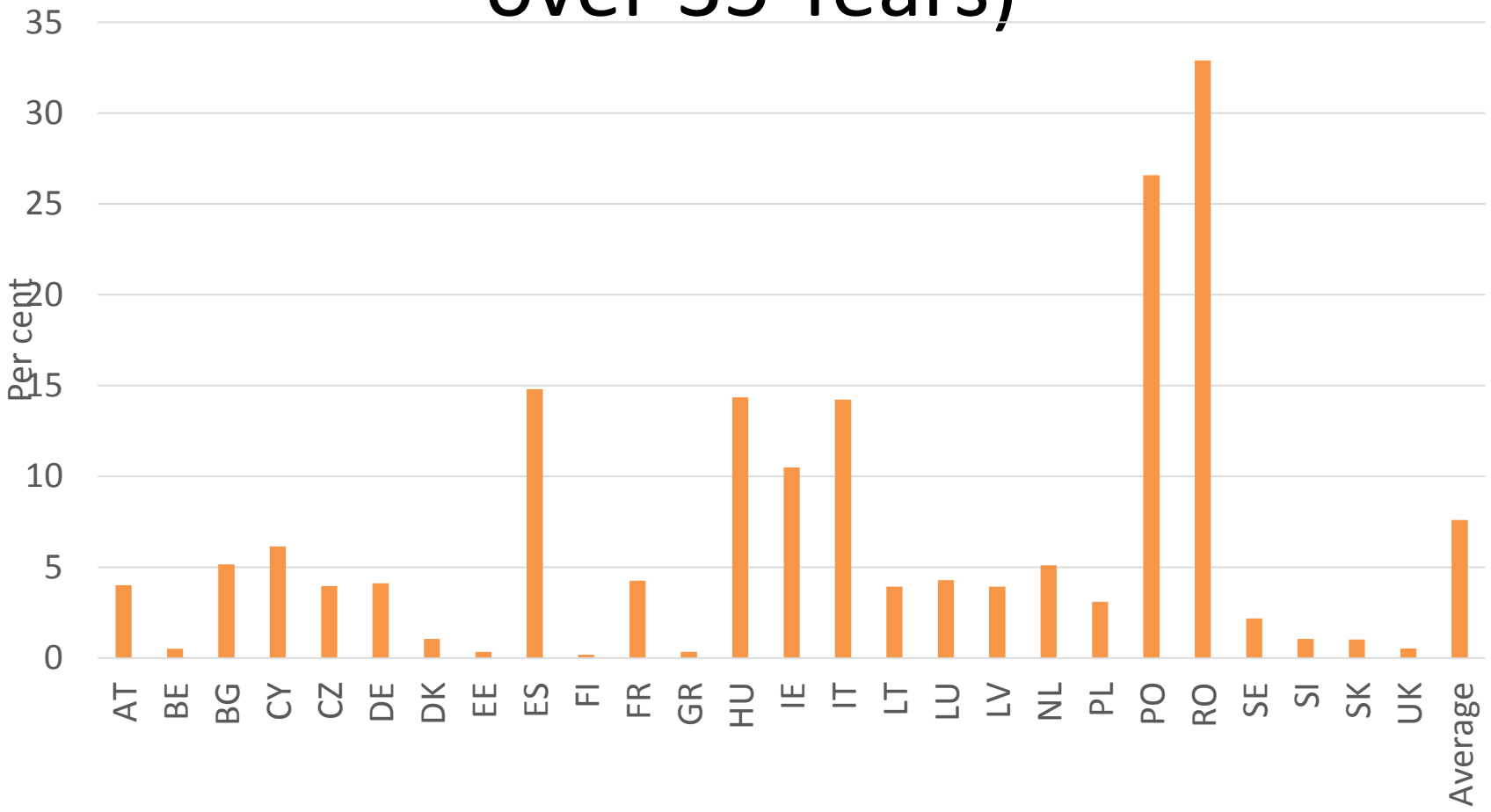
  - Value of carbon sequestration as savings in costs for reaching 2050 target from avoiding more expensive fossil fuel reductions

  - Discount rate of 1.5%

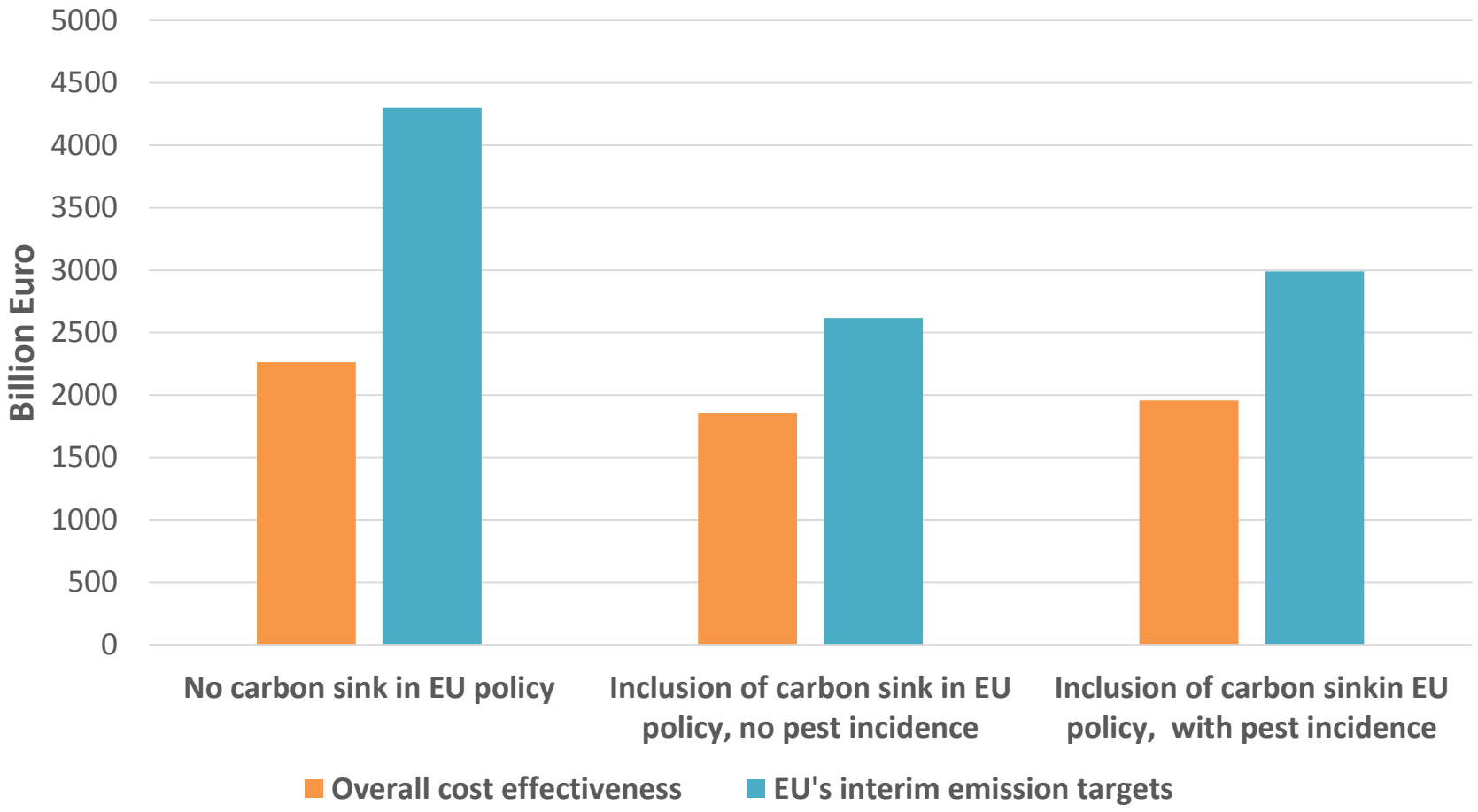
Results: Economic effects on timber and carbon sequestration value of pests

- Two pest scenarios:
  - values without pest incidence
  - values with pest incidence
- Two target setting scenarios for valuation of carbon sink:
  - overall cost effectiveness
  - EU's targets of 40% reduction of CO2e in 2030, 60% in 2040, and 80% in 2050

Results: Effects of pests on timber profits, per cent decrease from profits without pest (total of 1405 bill Euro over 35 Years)

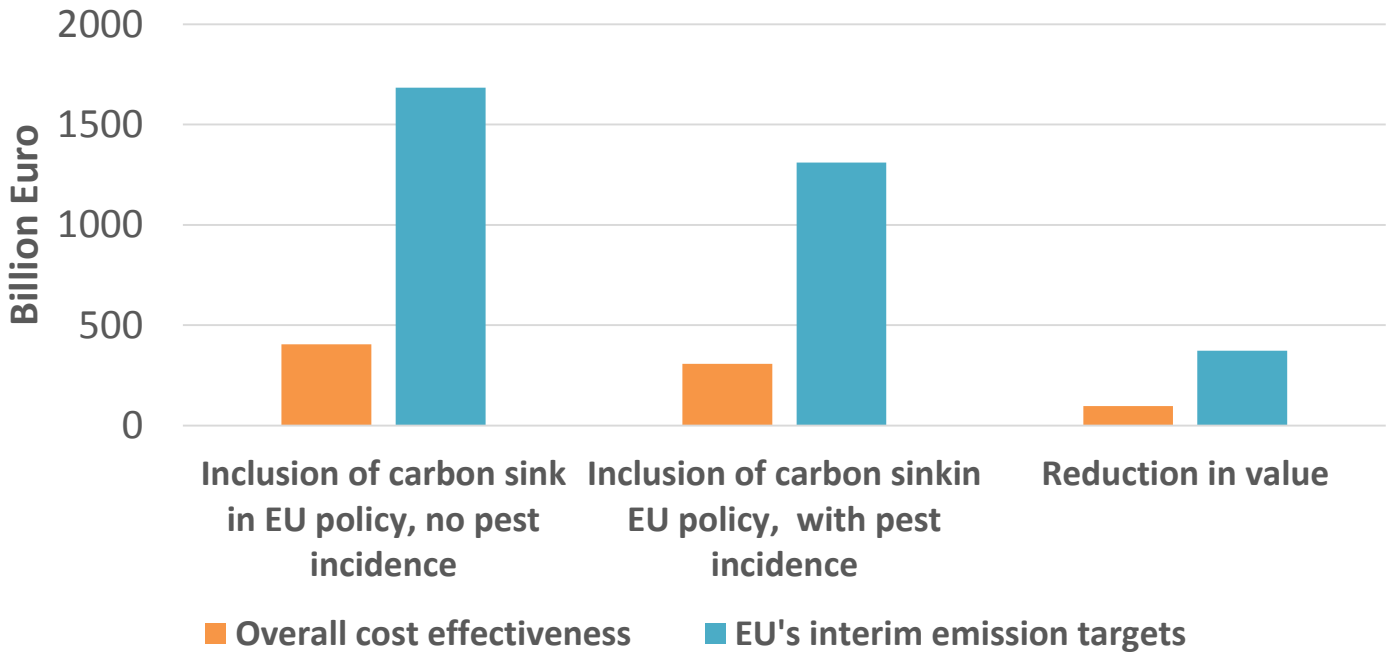


Results: effects of pests on costs of reaching 2050 climate targets

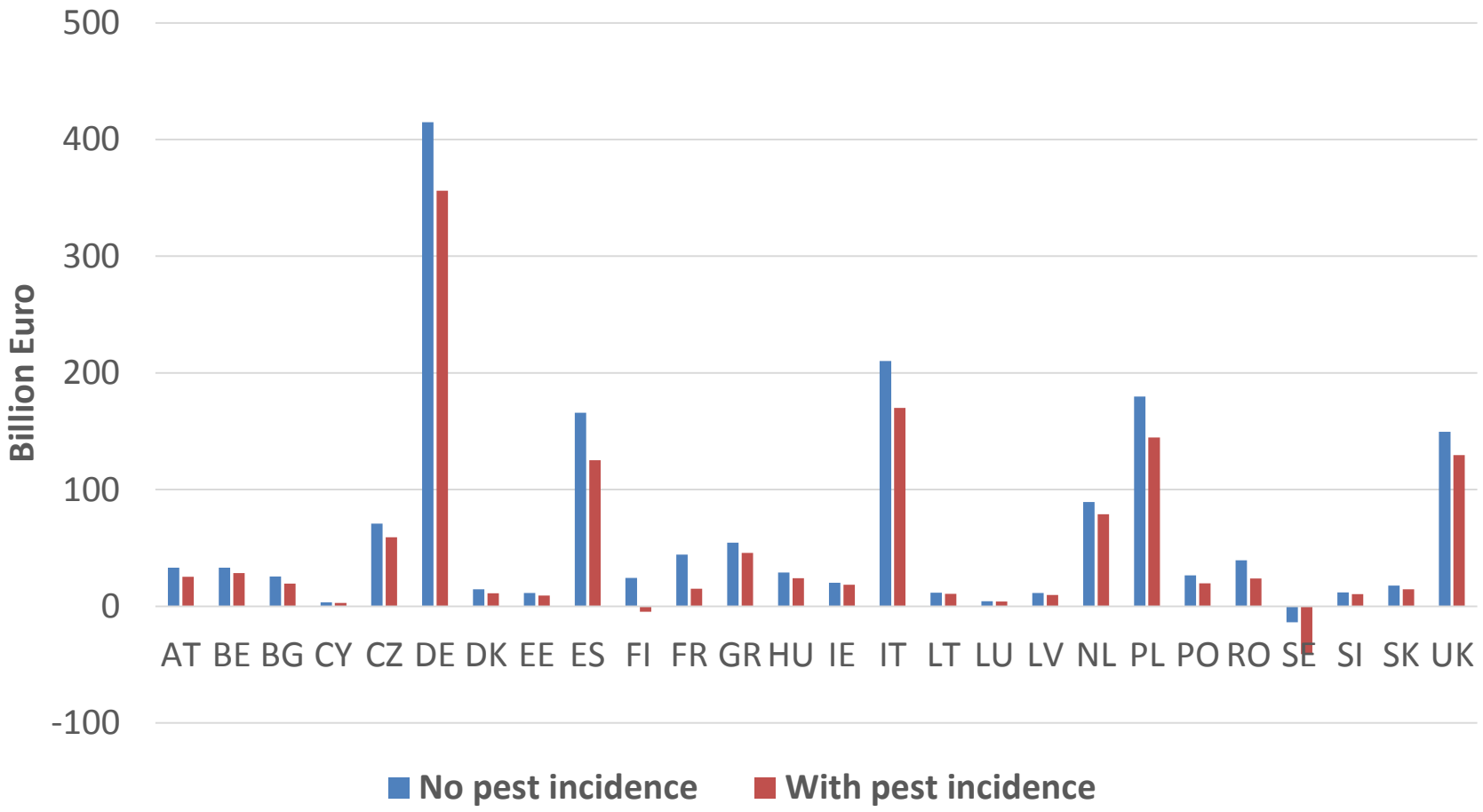


Results: effects of pests on the value of forest carbon sink in EU climate policy

Value = total cost without carbon sink – total cost with carbon sink



Values of carbon sink in different countries with alternative pest incidences



Conclusions

- Main challenge:

quantifying links between pest abundance and quantity of ecosystem services

- Application to pests on EU forests:
  - numerical dynamic optimisation model with pest impacts on ecosystem services and values

Preliminary results: decrease in value of timber and forest carbon sink of approx. 100 and up 370 billion Euro (13 billion/year wich is 0.1% of EU GDP)