HEIMTSA

INTARESE

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National Institute
for Public Health
and the Environment

Impact Calculation Tool

Anne Knol (RIVM), Virpi Kollanus (THL)
and Intarese partners

Workshop **“**Quantifying the health impacts of policies - principles, methods, and models”

16 - 17 March 2010, Düsseldorf

Background of the Impact Calculation Tool

- Modelling tool for quantification of health impacts from environmental exposures

- Affiliated projects:
  - International INTARESE project
  - International EBoDE project (Environmental Burden of Disease in Europe)
  - Finnish national projects Seturi and CLAIH
  - Dutch national projects IQARUS, VAMPHIRE and KIP

- Developed by THL in collaboration with RIVM and PBL

- (Intended) date of completion: nov 2010

- Availability:
  - Part of INTARESE toolbox
  - downloadable freely from the internet (in the future)

INTARESE project

- Integrated Risk Assessment of Health Risks from Environmental Stressors in Europe
- International project with scientists in the areas of epidemiology, environmental science, toxicology, ethics, biosciences, etc
- Integrated environmental health impact assessment:

  “a means of assessing health-related problems deriving from the environment, and health-related impacts of policies that affect the environment, in ways that take account of the complexities, interdependencies and uncertainties of the real world”
- Development of methodology (e.g. problem framing, uncertainty analysis, exposure assessment, stakeholder consultation, etc), case studies and toolbox
- Now: Final year of the project

EBoDE project

- Environmental burden of disease in Europe
- Six countries: Belgium, Finland, France, Germany, Italy, and the Netherlands
- Nine environmental stressors:
  - Particulate matter air pollution
  - Environmental noise
  - Radon
  - Passive smoking
  - Lead
  - Dioxins
  - Ozone
  - Formaldehyde
  - Benzene
- WHO environmental burden of disease methodology
- Pilot study finished – presented at Parma conference

Objectives

Primary target group:

- Environmental health scientists carrying out an environmental health impact assessment

Aims and features:

- Harmonized burden of disease calculations
- Developed in Analytica: a licensed software, but models can be run with a free Analytica player (those with Analytica software can also edit the model)
- Openly available on the internet in the future (only web browser needed)
- Simple user interface (no need for advanced knowledge of Analytica)
- Extensive user guidance (to be developed)
- Flexible inputs and outputs
- Options for advanced uncertainty and sensitivity analyses
- Dynamic life tables
- ***Not*** a database (but links to data sources to be provided)

Thanks!

(any questions…?)

NATIONAL INSTITUTE FOR HEALTH AND WELFARE

The Impact Calculation Tool (ICT) – Model specifics

Virpi Kollanus
National Institute for Health and Welfare (THL)

Workshop: Quantifying the Health Impacts of Policies – Principles, methods, and models

Düsseldorf 17.3.2010

Contents

- Model boundaries and outputs
- Quantification methods
- Input requirements
- Uncertainty and sensitivity analyses
- Demonstration 1
  - Health impacts of PM2.5 in Finland
- Demonstration 2
  - Predefined case study

Impact Calculation Tool (ICT)

- For quantifying:

  What is the BoD caused by a given environmental exposure?

  How much does BoD change if the exposure changes?

- Suitable for different types of exposures / risk factors
  - Continuous, categorical
  - Chronic, acute

- Developed with Analytica-software
  → Allows probabilistic modeling
  → Can be added to other Analytica-models
  → Compatible with Excel (transfer of inputs and outputs)

Model

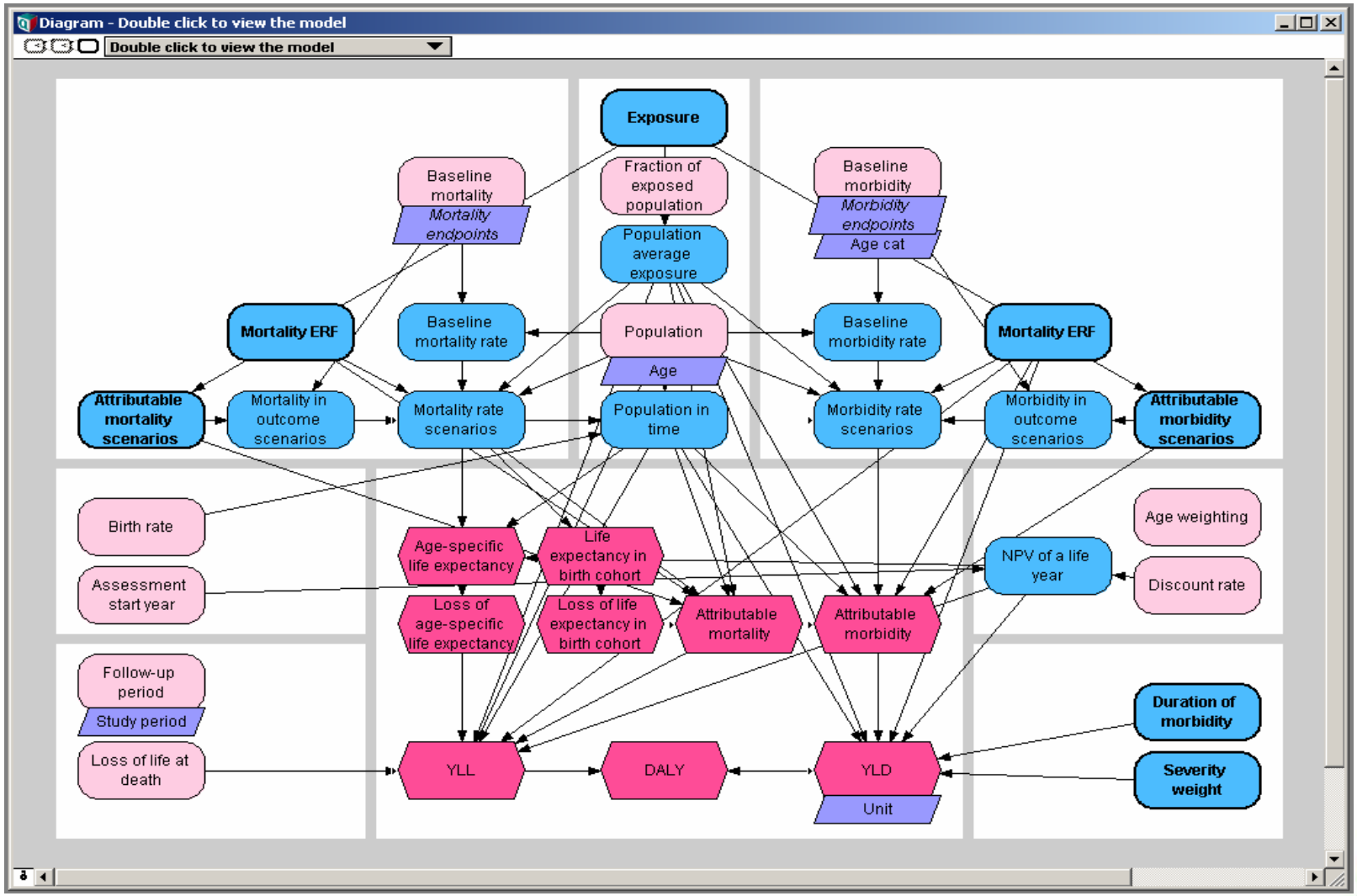
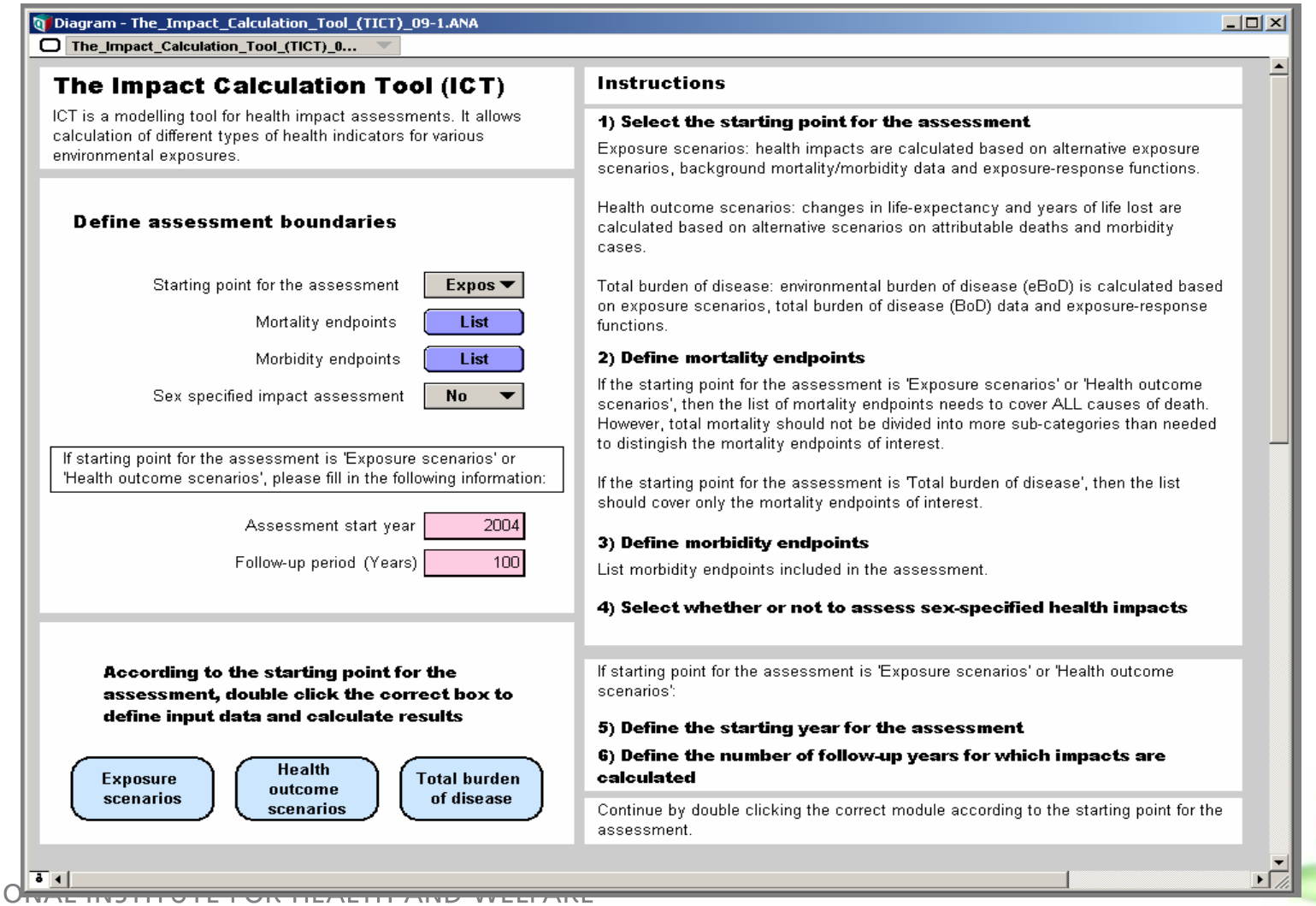
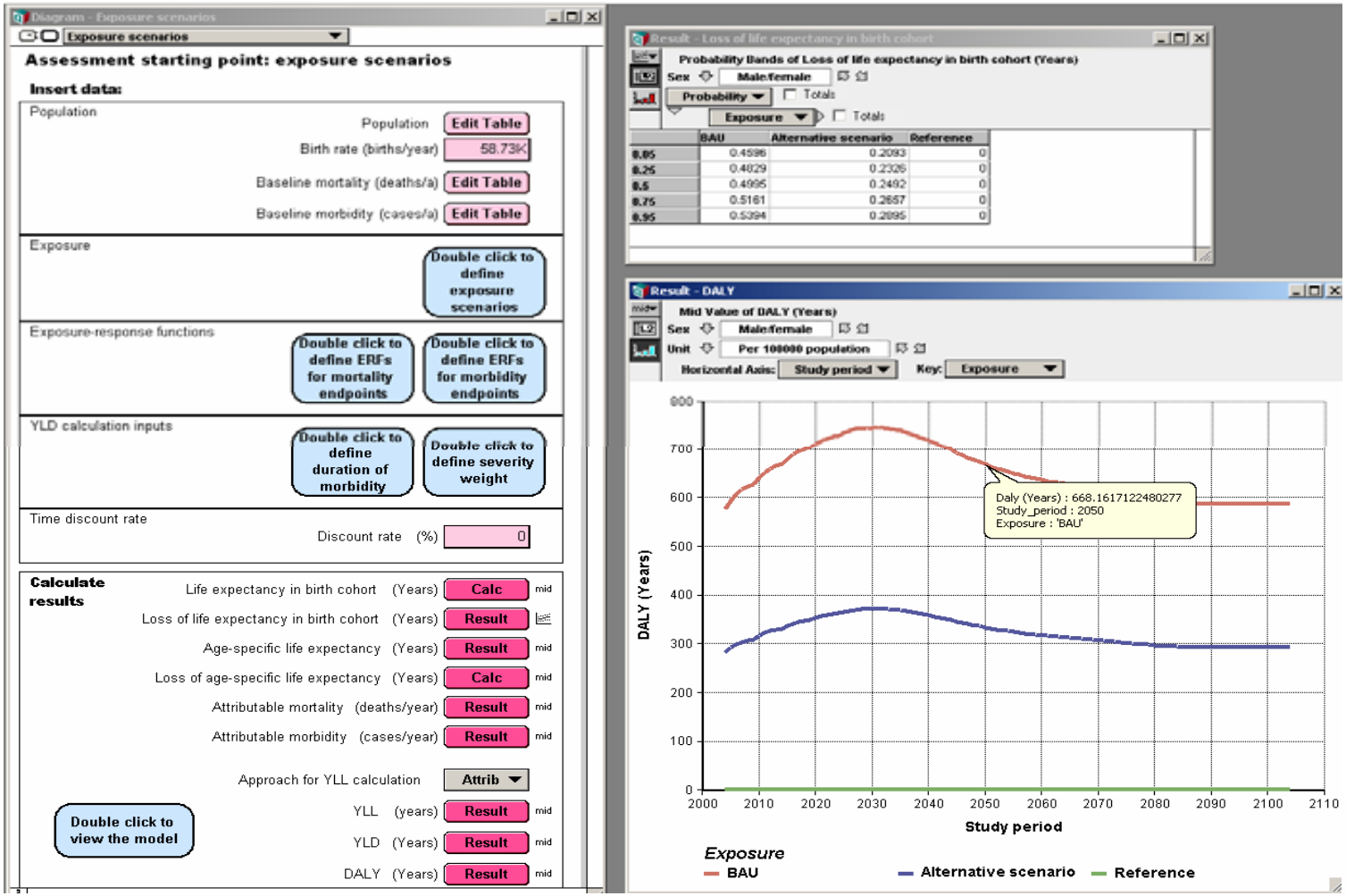


Diagram - Double click to view the model
Double click to view the model
Exposure
Baseline mortality
Mortality endpoints
Fraction of exposed population
Baseline morbidity
Morbidity endpoints
Age cat
Population average exposure
Mortality ERF
Baseline mortality rate
Population
Baseline morbidity rate
Mortality ERF
Age
Attributable mortality scenarios
Mortality in outcome scenarios
Mortality rate scenarios
Population in time
Morbidity rate scenarios
Morbidity in outcome scenarios
Attributable morbidity scenarios
Birth rate
Assessment start year
Age-specific life expectancy
Life expectancy in birth cohort
Loss of age-specific life expectancy
Loss of life expectancy in birth cohort
Attributable mortality
Attributable morbidity
NPV of a life year
Age weighting
Discount rate
Follow-up period
Study period
Loss of life at death
YLL
DALY
YLD
Unit
Duration of morbidity
Severity weight

User interface – first level



User interface – second level



Model boundaries

- One exposure / risk factor per assessment
- Time frame
  - 1…100 years
  - Exposure / risk level can be varied through follow-up
- Target population
  - Sex specified?
  - Current population or everyone alive during follow-up?
- Health endpoints of interest
  - Free selection of mortality and morbidity endpoints
- All input data provided by the end user

Model outputs

- Loss of disability-adjusted life years (DALY)
  - Years lost due to mortality
  - Years lost due to morbidity
  - → annually
- Loss of life-expectancy
  - Age-specific for target population
  - Birth cohort
- No. of attributable deaths and morbidity cases
  - → Age-specific
  - → Annually

Quantification of health impacts in ICT (1)

- Health impacts can be quantified using different approaches

  → Depending on the type of exposure and input data available

1) Exposure or health outcome scenarios
   → Change in mortality / morbidity risk
   → Population projections with dynamic lifetables
   → Years of life lost due to mortality / morbidity

2) Calculation of attributable BoD from total BoD
   → Fraction caused by the risk factor of interest

Input data:
Exposure / health outcome scenarios

- Exposure scenarios
  - Exposure level (reference, BAU, alternative)
  - Exposure-response functions for health endpoints of interest (RRs, ARs)
- Health outcome scenarios
  - Change in health outcome (% or no. of cases)

→ Exposure / risk can vary through time

- Population data (age-specific)
- Birth rate
- Baseline mortality / morbidity (age-specific)
- Severity weight and duration for morbidity endpoints
- Optional: time discount factor

Input data: Attributable BoD from total BoD

- Exposure level (BAU, reference)
- Exposure-response functions for health endponts of interest
- Burden of disease data for health endpoints of interest

→ Calculated for the time period represented by the total BoD data

Model validation /evaluation

- Comparison to other models, e.g. IOMLIFET

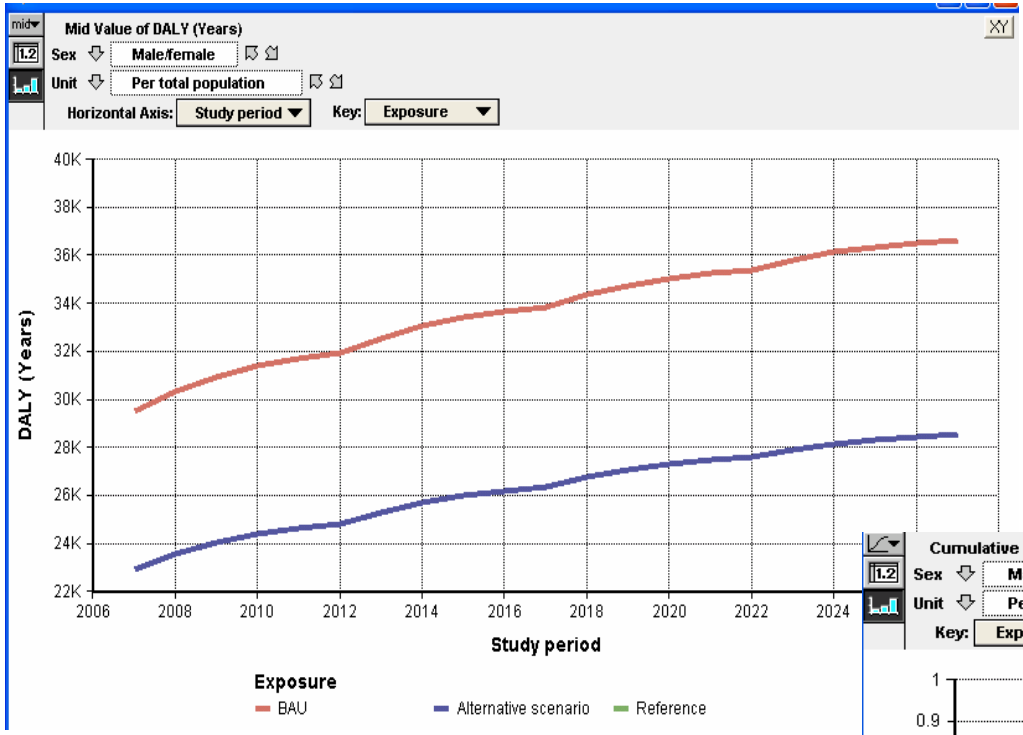
Uncertainty and sensitivity

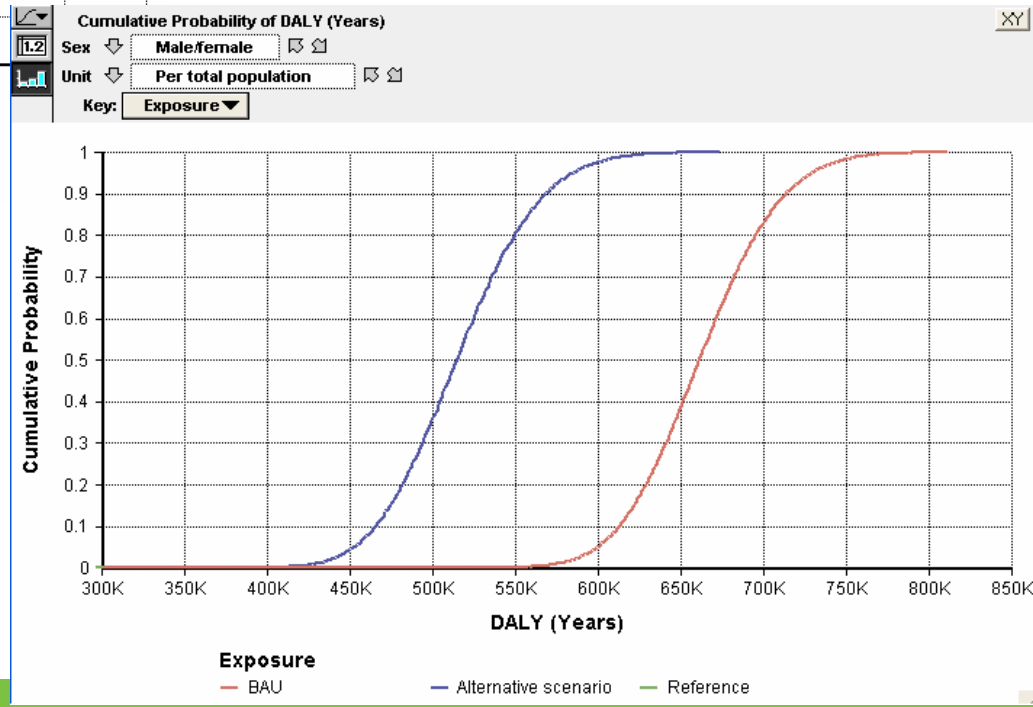
- ICT enables probabilistic assessment with Monte Carlo simulation
  - Probability distributions defined for key inputs
- Provides uncertainty views for outputs
  - Basic statistics
  - Probability bands
  - Probability density function
  - Cumulative probability density function
- Analytica has several built-in functions for sensitivity analyses
  - For both deterministic and probabilistic analyses
  - Not yet incorporated into the user interface

Demonstration: Health impacts of PM2.5 exposure in Finland

- Exposure level
  - BAU: 9 µg/m3
  - Alternative: 7 µg/m3
  - Reference: 0 µg/m3
- Time frame:
  - Start year 2007
  - Follow-up 20 years
- Target population
  - Everyone alive during follow-up
- Mortality endpoint
  - Total mortality (non-accidental)
- Morbidity endpoints
  - New cases of chronic bronchitis
  - Restricted activity days (RAD)

DALY due to PM2.5 exposure





Predefined HIA case study

- Prevention of domestic falls in older people by increasing the proportion of barrier free residences
  → Assessment can be conducted with ICT
- Simplest way is to use health outcome scenarios – approach
- Define model boundaries
  - Health endpoints of interest, e.g.
    - Femoral fractures
    - Accidental deaths
  - Follow-up time
  - Target population

Predefined HIA case study: input data

- Health outcome scenarios
  - BAU: fraction of outcomes caused by housing with barriers currently
  - Alternative: change in the risk due to increase in barrier free residences
- Population data (Age classification: 1 year intervals)
- (birth rate)
- Baseline data mortality (Age classification: 5 year intervals)
  - Total mortality
  - Accidental deaths
- Baseline morbidity data (Age classification: 5 year intervals)
  - Femoral fractures
- Severity weight and duration for a femoral fracture

Predefined HIA case study: outputs

- Femoral fractures attributable to residences with barriers
- Accidental deaths attributable to residences with barriers
  → Annually, total per follow-up period
  → Age-specific
- Change in life-expectancy due to prevented deaths
- Loss of disability adjusted life years (DALY)
  → Fractures, deaths, total
  → Annually, total for follow-up period