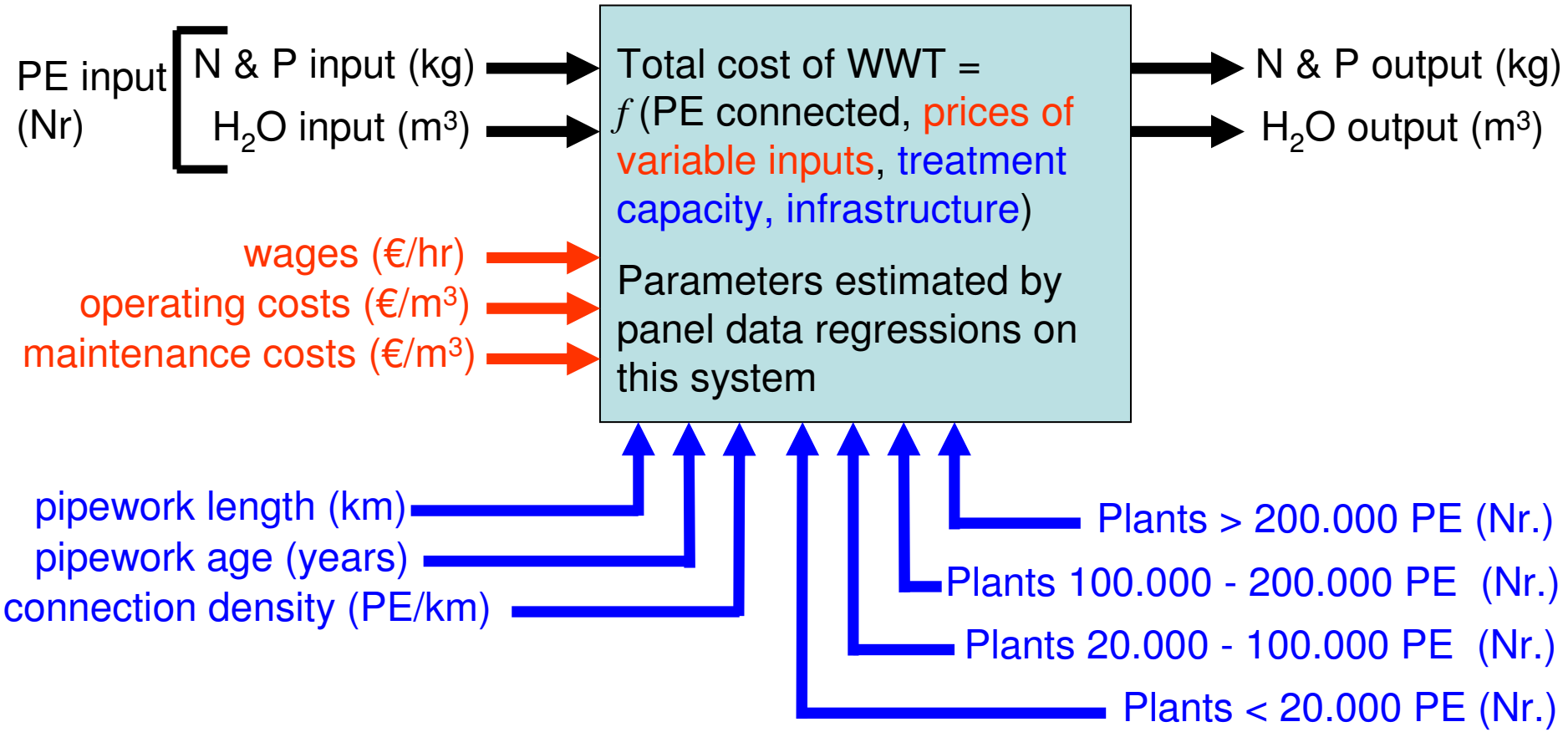
WWT Costs – translog cost model

- Investigates how WWT costs are influenced by relative and absolute prices of variable inputs and also examines cost impacts of installed infrastructure
- Should assist in extrapolating Mikolaj's WWT analysis around the Baltic
- Translog-form cost model estimated on DK data to establish functional form of links between total cost and marginal cost of WWT and:
  - number of person equivalents (PE) connected to treatment

  depending on:
  - local costs of variable inputs (wages, electricity, chemicals etc.)
  - installed capacity of treatment plants (in PE)
  - PE already connected relative to installed treatment capacity
  - installed infrastructure: e.g. age of system, infrastructure density (pipe km / PE)

WWT Costs from DK data



Data from 14 Danish WWT companies across 3 years each operating 1 – 15 WWT plants of between 330 x 10^3 m^3 and c. 40.000 x 10^3 m^3 annually.

WWT Costs – initial (simplified) run

$$\ln CV = \alpha_0 + \alpha_Y \ln Y + \sum_j \beta_j \ln P_j + \gamma_Z \ln Z$$

$$+\frac{1}{2}\delta_{YY}(\ln Y)^2 + \frac{1}{2}\sum_i\sum_j \delta_{ij} \ln P_i \ln P_j + \frac{1}{2}\delta_{ZZ}(\ln Z)^2$$

$$+\sum_j \eta_{Yj} \ln Y \ln P_j + \eta_{YZ} \ln Y \ln Z + \sum_j \eta_{jZ} \ln P_j \ln Z$$

Where:

CV = total variable cost, Y = H_2O throughput,

P_j = input prices in which : P_w=wage rate (€/person),

P_{om} = op. & maint. price (€/m^3 H_2O treated),

Z = installed treatment capacity (person equivalents)

$\alpha,\beta,\gamma,\delta,\eta$ terms are parameters estimated by regression

Translog cost model – cost share eqns

Economic theory also indicates that the shares of input costs attributable to each variable input are:

$$\frac{\partial \ln CV}{\partial \ln P_j} = \beta_j + \sum_i \delta_{ij} \ln P_i + \eta_{Yj} \ln Y + \eta_{jZ} \ln Z$$

$$= M_j = \text{share of total costs due to variable input } j$$

Cost eqn and cost share eqns estimated as a ***system*** with cross-equation parameter restrictions (Very helpful for small datasets).

Estimated parameters can be checked against economic theory

WWT Costs – model application

- Model predictions of the cost of connecting a further X PE to a particular level of WWT (primary, secondary or tertiary) within a 10 x 10km grid square passed on to the main cost effectiveness optimiser
- Number of PE currently un-connected to particular levels of treatment (X) within that grid square predicted by GIS modelling from Erik Smedberg
- May require a secondary optimiser to combine unconnected populations from adjacent grid squares in the same catchment into most cost effective size of WWT plant – discussion on-going
- Main RECOCA cost effectiveness optimiser compares the cost per unit N load reduction via WWT at a particular grid square location with the cost per unit N load reduction incurred by other N-reduction options to identify the most cost effective, location-specific option for N load reduction
- Main optimiser then identifies most cost-effective combination of N reduction options in Baltic sea regions allowing for retention between site of N-reduction and coast, plus transport between sea regions

END of slides