

# A COST – EFFECTIVENESS MODEL FOR OPTIMIZATION OF THE PROGRAMMES OF MEASURES

J. SMITZ, E.EVERBECQ, J.F. DELIEGE,  
M. BOUROUAG, A. GRARD, S. LANGE

*Environmental Modelling Centre,*  
Aquapole, University of Liège, Belgium

[j.smitz@ulg.ac.be](mailto:j.smitz@ulg.ac.be)

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# Implementation of the European Water Framework Directive

The programmes of measures (POM) must contain (Art. 11) :

- BASIC measures (minimum requirements to be complied with) e.g. existing legislations and controls
- SUPPLEMENTARY measures, in addition to the basic measures, where necessary in order to reach the Art. 4 environmental objectives

The economic analysis (Annex III) must contain enough detailed information to make judgment about the most **COST – EFFECTIVE COMBINATION (\*)** of measures in respect of water uses

(\*) based on estimates of the potential costs of these measures


# Implementation of the European Water Framework Directive

In order to meet these requirements of the WFD, each Water Agency must be able to assess :

- the costs
- the effectiveness of the measures and of the combination of measures

The use of a MODEL is a great help in this perspective

# The PEGASE model : utilisation in the scope of the European Water Framework Directive

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- 1) IMPLEMENTATION of the model in a river basin
  - 2) VALIDATION of the model : simulation of past/present situations
  - 3) PRESSURE / IMPACT ANALYSIS  
Assessment of the impacts of domestic, industrial, diffuse loads
  - 4) SIMULATION OF SCENARIO'S (2015 scenario's)  
Assessment of the RISK of failing to meet the GOOD STATUS
  - 5) SIMULATION OF BASIC / ADDITIONAL MEASURES  
+ COST – EFFECTIVENESS ANALYSIS
    - preparation of the River Basin Management Plans (2009)
    - support for the public consultation & participation
  - 6) SUPPORT for the DESIGN of the MONITORING NETWORKS

# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

## TERMS of REFERENCE :

- 1) The BASIC measures are COMPULSORY
  - are considered to be effective
  - are considered to be a pre-requisite to the cost – effectiveness analysis
  
- 2) Only SUPPLEMENTARY measures are subject to a cost – effectiveness analysis in order to find the most effective combination(s) at minimal cost

# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

A TEST of the method has been made for the SCHELDT and MEUSE basins in Wallonia

- 1) The “initial situation” is the reference year 2005
- 2) The BASIC measures considered are
  - . Urban Waste Water Treatment Directive
  - . Nitrate Directive
  - . IPPC Directive
- 3) The SUPPLEMENTARY measures considered are :  
*see list*

# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

- 3) The SUPPLEMENTARY measures considered are :
- A. Nutrients removal / existing WWTP's 2.000 – 10.000 EI
  - B. Nutrients removal / future WWTP's 2.000 – 10.000 EI
  - C. Nutrients removal / existing WWTP's 500 – 2.000 EI
  - D. Nutrients removal / future WWTP's 500 – 2.000 EI
  - E. Individual household waste water treatment (in 'rural' areas)
  - F. Additional reduction -20% IPPC industrial discharges
  - G. Additional reduction -20% non-IPPC industrial discharges
  - I. Additional reduction -40% IPPC industrial discharges
  - J. Additional reduction -40% non-IPPC industrial discharges
  - K. Additional reduction -20% diffuse loads from agricultural soils

Potential COST FUNCTIONS have been established for each of these supplementary measures (expert judgment)

# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

THE METHOD is a 3 steps method :

Step 1 :

Simulation of the water quality in the river network  
for the reference year (2005)

Step 2 :

Simulation of the water quality in the river network  
obtained by implementing the BASIC measures



# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

Step 3 :

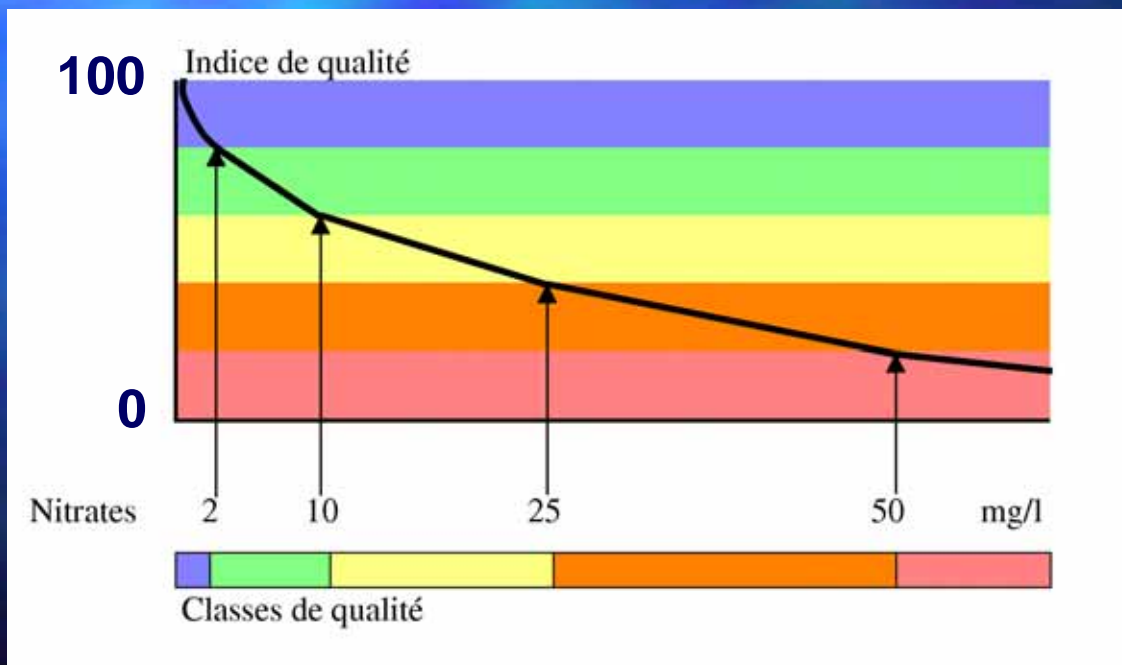
As regards SUPPLEMENTARY MEASURES :

- \* each supplementary measure is first considered ALONE  
(1 measure = 1 scenario)
  - . the model is used to assess the improvement of the w.qual. ( $\Delta$ )
  - . the cost functions are used to calculate the COSTS
    - 1st result : cost and effectiveness + marginal cost of each supplementary measure (Sub-basin / Water Body)
  
- \* then calculation of costs and effectiveness of any combination of supplementary measures is done : 2/2, 3/3, 4/4, ..... N/N
  - 2d result : cost and effectiveness of each combination of supplementary measures (Sub-basin / Water body)

# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

Key point of the method : the water quality levels

- 1) are computed as concentrations (daily non-stationary → P90)  
(BOD, COD, TOC, NH4, NO2, NO3, NKj, Ptot, PO4, DOxyg,...)
- 2) then are translated in QUALITY INDEX VALUES  
using the SEQ-Eau quality index (*non-linear transformation*)  
→ water quality levels are calculated on a scale [ 0 – 100 ]



# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :

## RESULTS :

For each SUPPLEMENTARY MEASURE and  
for all the COMBINATIONS of SUPPLEMENTARY MEASURES,  
the method provides for each Sub-basin / Water body :

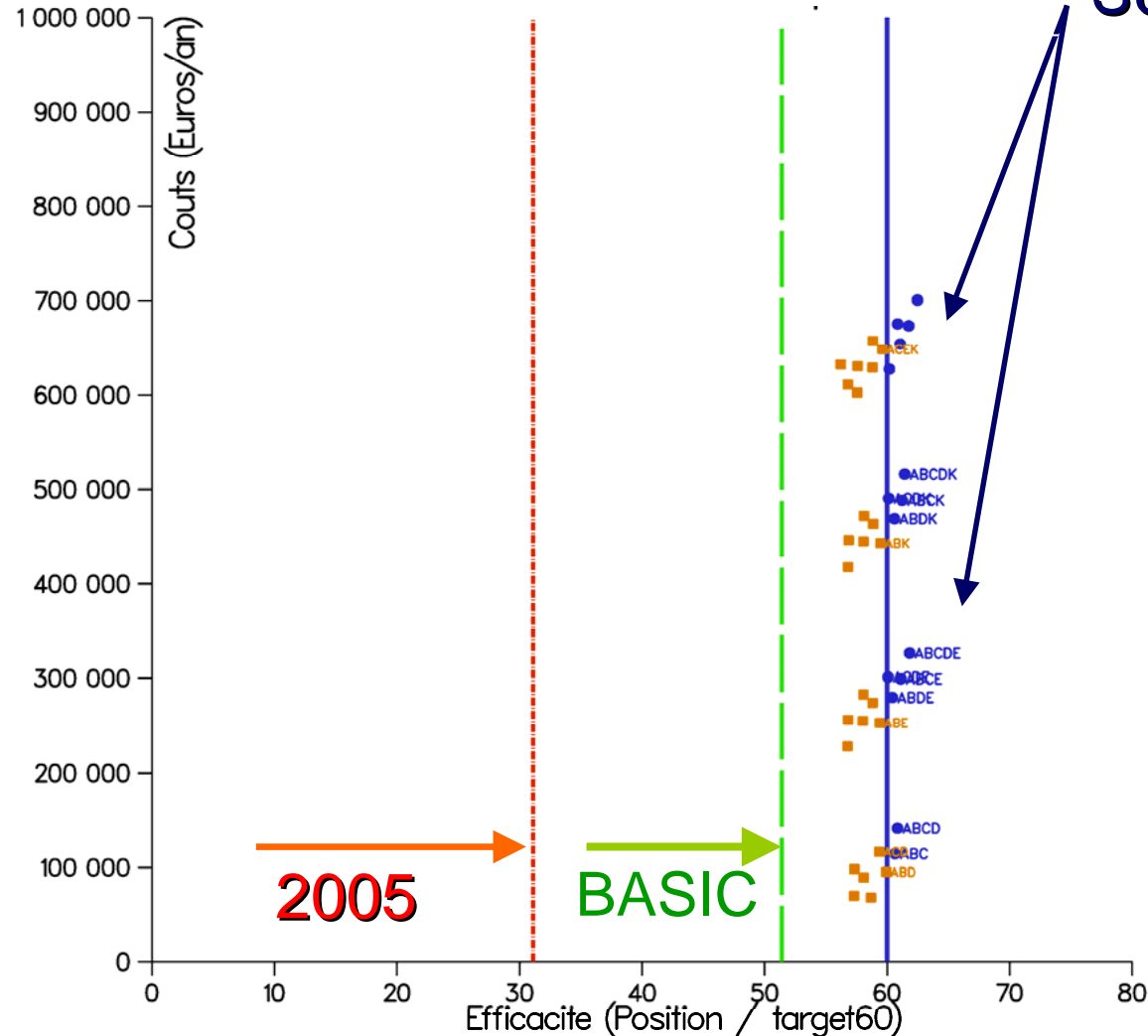
- the COST
- the water quality reached (quality indexes) = EFFECTIVENESS  
(the *WORST value* among the different quality indexes / variables  
is considered for each W.B.)

So that the results can be plotted on

COST – EFFECTIVENESS DIAGRAMS

# SAMBRE sub-basin - Water Body SA17R

## COST



## SUPPLEMENTARY

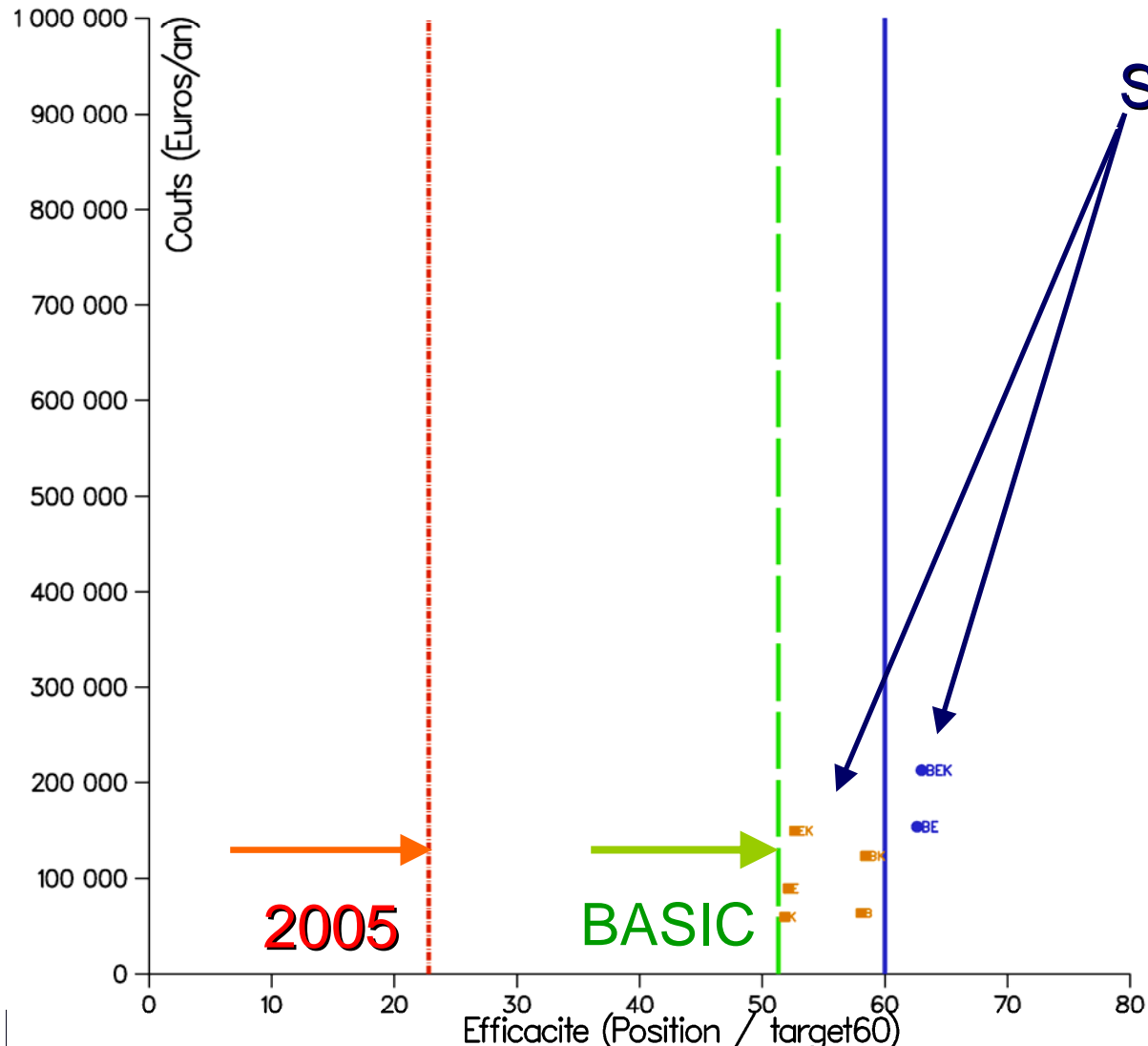
- IQ atteint avec situation de reference (IQ=31.1)
- IQ atteint avec mesures de base (IQ=51.4)
- Limite bonne qualite (IQ=60.0)

LISTE DES MESURES SIMULEES	COUTS EUROS/AN	IQmes Compl.	C marginal Keuros/pt
A : tert step exist 2000-10000	43 157	56.0	9.301
B : tert nouvel step 2000-10000	24 956	54.0	9.489
C : tert step exist 500-2000	46 275	53.5	22.573
D : tert nouvel step 500-2000	26 935	52.7	21.548
E : assainissement autonome	184 800	52.1	253.151
F : reduct 20% rejind IPPC non racc	0	51.4	-
G : reduct 20% suppl rejind IPPC non racc	0	51.4	-
H : reduct 20% rejind non IPPC non racc	0	51.4	-
I : reduct 20% suppl rejind non IPPC non racc	0	51.4	-
J : reduct 50% apports inconnus	0	51.4	-
K : reduct 20% apports diffus	374 400	52.2	480.001

## EFFECTIVENESS

# ESCAUT LYS sub-basin - Water Body EL04R

## COST



## SUPPLEMENTARY

- IQ atteint avec situation de reference (IQ=22.8)
- IQ atteint avec mesures de base (IQ=51.3)
- Limite bonne qualite (IQ=60.0)

LISTE DES MESURES SIMULEES	COUTS EUROS/AN	IQmes Compl.	C marginal Keuros/pt
A : tert step exist 2000-10000	0	51.3	-
B : tert nouvel step 2000-10000	63 664	58.0	9.460
C : tert step exist 500-2000	0	51.3	-
D : tert nouvel step 500-2000	0	51.3	-
E : assainissement autonome	89 600	52.1	112.000
F : reduct 20% rejind IPPC non racc	0	51.3	-
G : reduct 20% suppl rejind IPPC non racc	0	51.3	-
H : reduct 20% rejind non IPPC non racc	136	51.3	-
I : reduct 20% suppl rejind non IPPC non racc	131	51.3	-
J : reduct 50% apports inconnus	0	51.3	-
K : reduct 20% apports diffus	59 400	51.8	116.471

## EFFECTIVENESS



# The COST – EFFECTIVENESS MODEL (PEGASE – extended) :



## ANALYSIS of the RESULTS :

The results make appear :

- Supplementary measures alone :
  - some are strongly cost-effective (low marginal cost)
  - some are poorly effective (high marginal cost)
- Combinations of supplementary measures :  
existence of “clusters” of combinations,  
some are strongly - , some are poorly cost-effective

The same quality levels can sometimes be reached with different combinations of measures the costs are within a range of 1 to 4

# The COST – EFFECTIVENESS MODEL (PEGASE – extended)

## CONCLUSIONS

- 1) COST – EFFECTIVENESS ANALYSIS makes sense
- 2) A COST – EFFECTIVENESS MODEL (like the PEGASE – Extended) is very useful :
  - \* to help ELIMINATING the less cost-effective combinations of measures
  - \* to help DETERMINING the most cost-effective solutions
  - \* to allow some room for debate among actors and for 'political' decision (within sets of measures which have approximately the same total cost and the same effectiveness)
- 3) The development of the method has to be continued (e.g. to take into account hydromorphology, biological quality, ... )

THANK YOU



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