

## Supplementary Materials

ANEX 1. |

medium cost of of natural quarried aggregates=

"cost ratio quarried aggregates/aggregate demand"(output of natural quarried aggregates previous year\

)

~ €

~ |

"cost ratio quarried aggregates/aggregate demand"(  
[(0,0)-(7.05033e+008,10)],(0,1),(1,6),(3e+008,6),(4e+008,7),(8e+008,7.5),(1.6e+009,8\

),(2.5e+009,8.5),(5e+009,9))

~ Dmnl

~ |

vi rcds tratados=

4.6e+008\*10

~

~ |

output of natural quarried aggregates previous year=

DELAY FIXED(output of natural quarried aggregates, 1, 0 )

~ t/year

~ |

SWcrec=

0

~ [0,1]

~ |

"medium cost of C&D waste"=

$7*(1+SWcrec*growth\ scenario+SWdec*ungrowth\ scenario)$

~ €

~ Coste de áridos reciclados de zavorra 0-60 mm publicado por el ministerio \  
en 2005

|

growth scenario=

RAMP( 0.05, 0, 10)

~ €

~ |

ungrowth scenario=

-RAMP( 0.05, 0, 10)

~

~ |

SWdec=

0

~ [0,1]

~ |

"Storage of treated C&D waste"= INTEG (

"recycled C&D waste"- "output of treated C&D waste",

vi rcds tratados)

~ t/year

~ |

"output of treated C&D waste"=

IF THEN ELSE("Storage of treated C&D waste">0, IF THEN ELSE(("difference in cost between C&D waste and quarried aggregates"\

<1 :OR: "external incentives offered for using treated C&D waste">0

), "% of mix"\*

consumption of aggregates, 0), 0)

~ t/year

~ |

"DIFFERENCE BETWEEN THE RECYCLING GOAL/ACTUAL RECYCLING"=

recycling goal-("recycled C&D waste"/("recycled C&D waste"+shipments to disposal sites\

))

~ Dmnl [0,1]

~ |

"treated C&D waste used previous year"= DELAY FIXED (

("output of treated C&D waste"/consumption of aggregates), 1, 0.3)

~ t/year

|

"% of mix"=

0.3

~ Dmnl [0,1]

|

"recycled C&D waste"=

"% of recycled material"\*"Disposal of untreated C&D waste"

~ t/year

~ |

"DIFFERENCE BETWEEN THE GOAL OF UTILISATION/REUSE OF TREATED C&D WASTE"=

goal of utilisation-"treated C&D waste used previous year"

~ Dmnl

~ |

"generation of untreated C&D waste used in building"=

0.08\*(0.7297\*demand of aggregates)

~ t/year

|

"external incentives offered for using treated C&D waste"=

IF THEN ELSE(("DIFFERENCE BETWEEN THE GOAL OF UTILISATION/REUSE OF TREATED C&D WASTE"\

>0 :AND: "difference in cost between C&D waste and quarried aggregates"  
 >1),( "difference in cost between C&D waste and quarried aggregates"  
 -1), 0)  
 ~ Dmnl  
 ~ |

output of natural quarried aggregates=

consumption of aggregates-"output of treated C&D waste"  
 ~ t/year  
 ~ |

goal of utilisation=

0.35  
 ~ Dmnl [0,1]  
 ~ |

Storage of natural quarried aggregates= INTEG (

generation of natural quarried aggregates-output of natural quarried aggregates,  
 4.6e+008)  
 ~ t/year  
 |

generation of natural quarried aggregates=

output of natural quarried aggregates

~ t/year

~ |

ungrowth=

-RAMP( 0.05, 0, 20)

~ t/year

~ |

growth=

RAMP( 0.05, 0, 20)

~ t/year

~ |

demand of aggregates=

$4.6e+008 * (1 + SWC * growth + SWD * ungrowth)$

~ t/year

|

SWC=

1

~ [0,1]

~ |

SWD=

0

~ [0,1]

~ |

consumption of aggregates=

IF THEN ELSE(demand of aggregates>0, demand of aggregates, 0)

~ t/year

~ |

Storage of aggregates= INTEG (

output of natural quarried aggregates+"output of treated C&D waste"-consumption of aggregates\

,

4.6e+008)

~ t/year

recycling goal=

0.25

~ Dmnl [0,1]

~ % de reciclaje y valorización para 2010

|

"difference in cost between C&D waste and quarried aggregates"=

"medium cost of C&D waste"/medium cost of of natural quarried aggregates

~ Dmnl

~ |

shipments to disposal sites=

(1-"% of recycled material")\*"Disposal of untreated C&D waste"

~ t/year

~ |

"generationof untreated C&D waste from civil engineering"=

0.08\*(1-0.7297)\*demand of aggregates

~ t/year

"Disposal of untreated C&D waste"= INTEG (

"generation of untreated C&D waste used in building"+"generationof untreated C&D waste from civil engineering"

-shipments to disposal sites-"recycled C&D waste",

3.15934e+007)

~ t/year

|

"% of recycled material"=

0.17

~ Dmnl [0,1]

|

\*\*\*\*\*

.Control

\*\*\*\*\*~

Simulation Control Parameters

|

FINAL TIME = 20

~ year

~ The final time for the simulation.

|

INITIAL TIME = 0

~ year

~ The initial time for the simulation.

|

SAVEPER =

TIME STEP

~ year [0,?]

~ The frequency with which output is stored.

|

TIME STEP = 1

~ year [0,?]

~ The time step for the simulation.

|

\\---// Sketch information - do not modify anything except names

V300 Do not put anything below this section - it will be ignored

\*View 1

\$192-192-192,0,Times New Roman|12||0-0-0|0-0-0|0-0-0|-1--1--1|-1--1--1|96,96,5,0

10,1,"Disposal of untreated C&D waste",578,520,49,32,3,131,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

12,2,48,351,520,10,8,0,3,0,0,-1,0,0,0

1,3,5,1,4,0,0,22,0,0,0,-1--1--1,,1|(488,520)|

1,4,5,2,100,0,0,22,0,0,0,-1--1--1,,1|(398,520)|

11,5,48,442,520,6,8,34,3,0,0,1,0,0,0

10,6,"generation of untreated C&D waste used in building",442,559,86,31,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

12,7,48,578,353,10,8,0,3,0,0,-1,0,0,0

1,8,10,1,4,0,0,22,0,0,0,-1--1--1,,1|(575,465)|

1,9,10,7,100,0,0,22,0,0,0,-1--1--1,,1|(575,396)|

11,10,48,575,437,8,6,33,3,0,0,4,0,0,0

10,11,"generationof untreated C&D waste from civil engineering",667,437,84,31,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

12,12,48,578,700,10,8,0,3,0,0,-1,0,0,0

1,13,15,12,4,0,0,22,0,0,0,-1--1--1,,1|(580,651)|

1,14,15,1,100,0,0,22,0,0,0,-1--1--1,,1|(580,575)|

11,15,48,580,604,8,6,33,3,0,0,4,0,0,0

10,16,shipments to disposal sites,638,604,50,21,40,131,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,17,"Storage of treated C&D waste",1031,520,52,32,3,131,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,18,20,17,4,0,0,22,0,0,0,-1--1--1,,1|(864,509)|

1,19,20,1,100,0,0,22,0,0,0,-1--1--1,,1|(682,509)|

11,20,412,743,509,6,8,34,3,0,0,1,0,0,0

10,21,"recycled C&D waste",743,538,52,21,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,22,"% of recycled material",862,624,50,21,8,131,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,23,22,16,0,0,0,0,64,0,-1--1--1,,1|(756,614)|

1,24,22,21,0,0,0,0,64,0,-1--1--1,,1|(808,585)|

10,25,Storage of aggregates,1500,522,55,32,3,131,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,26,28,25,4,0,0,22,0,0,0,-1--1--1,,1|(1357,521)|

1,27,28,17,100,0,0,22,0,0,0,-1--1--1,,1|(1170,521)|

11,28,796,1264,521,6,8,34,3,0,0,1,0,0,0

10,29,"output of treated C&D waste",1264,550,60,21,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,30,31,25,4,0,0,22,0,0,0,-1--1--1,,1|(1510,617)|

11,31,444,1510,686,8,6,33,3,0,0,4,0,0,0

10,32,output of natural quarried aggregates,1593,686,75,21,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

12,33,48,1771,522,10,8,0,3,0,0,-1,0,0,0

1,34,36,33,4,0,0,22,0,0,0,-1--1--1,,1|(1712,522)|

1,35,36,25,100,0,0,22,0,0,0,-1--1--1,,1|(1603,522)|

11,36,48,1658,522,6,8,34,3,0,0,1,0,0,0

10,37,consumption of aggregates,1658,551,57,21,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,38,"external incentives offered for using treated C&D waste",958,793,96,31,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,39,"difference in cost between C&D waste and quarried aggregates",1264,685,96,31,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,40,medium cost of of natural quarried aggregates,1262,838,65,31,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,41,40,39,0,0,0,0,64,0,-1--1--1,,1|(1262,768)|

10,42,"DIFFERENCE BETWEEN THE RECYCLING GOAL/ACTUAL RECYCLING",908,433,112,31,8,131,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,43,demand of aggregates,1658,306,43,21,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,44,43,37,0,0,0,0,0,64,0,-1--1--1,,1|(1658,421)|

1,45,1,16,0,0,0,0,0,64,0,-1--1--1,,1|(607,561)|

1,46,1,21,0,0,0,0,0,64,0,-1--1--1,,1|(652,527)|

10,47,recycling goal,1120,431,50,12,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,48,47,42,0,0,0,0,0,64,0,-1--1--1,,1|(1052,431)|

10,49,"medium cost of C&D waste",1086,840,56,21,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,50,49,39,0,0,0,0,0,64,0,-1--1--1,,1|(1163,772)|

1,51,39,29,0,0,0,0,0,64,0,-1--1--1,,1|(1264,619)|

1,52,39,38,0,0,0,0,0,64,0,-1--1--1,,1|(1117,736)|

10,53,growth,1544,161,26,12,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,54,ungrowth,1794,164,35,12,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,55,SWC,1616,116,20,11,8,3,1,0,0,0,0,0

10,56,SWD,1725,117,20,11,8,3,1,0,0,0,0,0

1,57,53,43,0,0,0,0,0,64,0,-1--1--1,,1|(1592,223)|

1,58,54,43,0,0,0,0,0,64,0,-1--1--1,,1|(1735,225)|

1,59,55,43,0,1,0,0,0,64,0,-1--1--1,,1|(1633,199)|

1,60,56,43,0,1,0,0,0,64,0,-1--1--1,,1|(1695,199)|

10,61,goal of utilisation,657,699,60,12,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,62,Storage of natural quarried aggregates,1520,801,56,34,3,131,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

12,63,48,1512,967,10,8,0,3,0,0,-1,0,0,0

1,64,66,62,4,0,0,22,0,0,0,-1--1--1,,1|(1512,863)|

1,65,66,63,100,0,0,22,0,0,0,-1--1--1,,1|(1512,931)|

11,66,48,1512,897,8,6,33,3,0,0,4,0,0,0

10,67,generation of natural quarried aggregates,1596,897,76,21,40,3,0,32,-1,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,68,31,62,100,0,0,22,0,0,0,-1--1--1,,1|(1510,729)|

10,69,"DIFFERENCE BETWEEN THE GOAL OF UTILISATION/REUSE OF TREATED C&D WASTE",881,699,122,31,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,70,61,69,0,0,0,0,0,64,0,-1--1--1,,1|(731,699)|

1,71,38,29,0,0,0,0,0,64,0,-1--1--1,,1|(1111,670)|

1,72,29,31,0,0,0,0,0,64,0,-1--1--1,,1|(1395,622)|

1,73,69,38,0,0,0,0,0,64,0,-1--1--1,,1|(914,740)|

1,74,43,6,3,0,0,0,0,64,0,-1--1--1,,1|(441,306)|

1,75,43,11,3,0,0,0,0,64,0,-1--1--1,,1|(978,353)|

1,76,20,42,3,0,0,0,0,64,0,-1--1--1,,1|(791,486)|

10,77,"% of mix",1261,421,32,12,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,78,77,28,3,0,0,0,0,64,0,-1--1--1,,1|(1261,463)|

1,79,37,32,3,0,0,0,0,64,0,-1--1--1,,1|(1657,674)|

1,80,32,67,3,0,0,0,0,64,0,-1--1--1,,1|(1609,808)|

10,81,"treated C&D waste used previous year",1050,603,71,21,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

1,82,81,69,3,0,0,0,0,64,0,-1--1--1,,1|(951,617)|

1,83,29,81,3,0,0,0,0,64,0,-1--1--1,,1|(1145,552)|

1,84,37,81,3,0,0,0,0,64,0,-1--1--1,,2|(1602,417)|(1199,378)|

1,85,16,42,3,0,0,0,0,64,0,-1--1--1,,1|(655,475)|

1,86,17,28,3,0,0,0,0,64,0,-1--1--1,,1|(1220,481)|

1,87,37,28,3,0,0,0,0,64,0,-1--1--1,,1|(1464,429)|

10,88,vi rcads tratados,902,566,49,11,8,3,1,0,0,0,0,0

1,89,88,17,3,1,0,0,0,64,1,-1--1--1,,1|(945,549)|

10,90,growth scenario,1021,917,58,12,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,91,ungrowth scenario,1140,925,35,21,8,3,0,32,0,0,0,0,0-0-0,0-0-0,@Arial Unicode MS|12||0-0-0

10,92,SWcrec,955,894,27,11,8,3,1,0,0,0,0,0

10,93,SWdec,1207,901,25,11,8,3,1,0,0,0,0,0

1,94,92,49,3,1,0,0,0,64,0,-1--1--1,,1|(1013,869)|

1,95,90,49,3,0,0,0,0,64,0,-1--1--1,,1|(1048,883)|

1,96,91,49,3,0,0,0,0,64,0,-1--1--1,,1|(1116,888)|

1,97,93,49,3,1,0,0,0,64,0,-1--1--1,,1|(1152,873)|

10,98,output of natural quarried aggregates previous year,1412,943,80,19,8,3,1,0,0,0,0,0

1,99,31,98,3,1,0,0,0,64,0,-1--1--1,,1|(1453,772)|

1,100,98,40,3,1,0,0,0,64,0,-1--1--1,,1|(1328,862)|

10,101,coste de áridos inicial,1218,1003,49,19,8,3,1,0,0,0,0,0

10,102,"cost ratio quarried aggregates/aggregate demand",1359,1006,82,31,8,3,0,32,0,0,0,0,0-0-0,0-0-0-0,@Arial Unicode MS|12||0-0-0

1,103,102,40,3,0,0,0,0,64,0,-1--1--1,,1|(1314,928)|