

Appendix: Model Pseudocode

Begin the code by setting up parameters that are the same for the whole model (as opposed to parameters that change depending on the agent)

Create for the whole model (the variables names in the model are in brackets):

Number of People [Numberagents]

Allowances per Person [allowance]

In the beginning, this equals the average demand plus a certain percentage of the average determined by the user

Allowances to be Sold [allowpool]

Arbitrarily set up in the beginning, will be overridden after the first few ticks

Allowances Sold Last Week [allowpool_new]

Total Amount of Carbon Dioxide demanded by Agents [demandpool]

Amount of Carbon Dioxide Demanded by Agents in the beginning [BeginDemand]

Price of Allowances [price]

Average Reduction in Demand Each Year [averageReduce]

Now, create parameters that vary by person

Create for each agent:

Number of People per household [number_persons]/*this is set to 1 for the model in general, but we keep this variable here in case we want to change it*

Demand per person in the beginning [originald]

Demand for Each Week [demand]

Actual Demand = $(1.1 - \text{Number of People per Household} * 0.05) * ((\log(\log(\text{Income}))) - 0.9) * 20278 * (0.8 + \text{random factor}) * 0.527$ [actuald]

Amount of Fossil Fuel Energy Saved [saving]

Weekly Income [income]

Weekly Income has:

3.5% chance of equalling 6000

3% chance of equalling 5000

5.4% " 4500

6.5% 4000

9.8% 3500

12.7% 3000

17.9% 2500

15% 2000

12.3% 1500

5.9% 1000

0.6% 500

Socio-Ecological Motivation [socio-ecological], which has

68.7% chance of being about 0.5

21.8% chance of being about 0.2

8.8% chance of being about 0

Economic Motivation [economic]

Equals probability of selling + (plus a random number between 0 and 0.6) - 0.2

Minimum value 0, maximum value 1

How Many Times People saved due to Socio-Ecological Motivation

[savingLsocio-ecological]

How likely the agent wants to sell Allowances: [selling]

51.5% chance of being about 0.2

29.3% chance of being about 0.4

18.9% chance of being about 0.7

(maximum value is 1)

Indicator for if the agent is actually selling allowances [actualSelling]
Indicator for if the agent will invest to save energy, even if they don't have to
[actualEconomic]
Only 15% of those earning more than 3000 weekly

For every 12 weeks:
Reduce allowances by amount specified by user

Give instructions for every actor in the model

For each individual:

If demand bigger than difference AND selling pool has enough allowances to buy AND
amount needed to spend on carbon is less than amount consumer willing to pay for
allowances:

Buy allowances
Decrease amount of allowances available
Increase amount of allowances demanded

If the demand is bigger than difference AND agent cannot buy, then
Make them have sad face in the model
Increase amount of allowances demanded

If demand > allowances,
Agent less predisposed to sell (decrease selling by maximum 0.3)
Will not sell in this round

If they're not already and sufficiently motivated to sell (selling > 0.8) and 8% chance
[random-float 1 < 0.08]
They actually sell [set actualSelling true]
Set selling to be weighted average of mean of selling of neighbors (10%) and of
previous selling score (90%), so that people learn from their neighbors.

If they're selling and demand less than their allowance
Increase the selling pool by the number of allowances the agent is selling

If the difference between savings and selling is less than twice the amount that
allowances will be reduced, and sufficiently socio-ecologically motivated:
increaseSavingLevel

Let amount of possible reductions= economic motivation * income * 0.6 / (1.001 ^
saving * CarbonVal) (this means that in the beginning carbon reduction costs are
almost linear, but increases quite fast)

If difference between allowances and demand less than 0.3% of allowances
Reduce amount of savings (*as it's not absolutely required*) [set saving saving +
savable * (0.8 - IncomePercentAvailable)]

Else:

If economically motivated:
Increase amount of savings [set saving saving + savable * (0.2 +
IncomePercentAvailable)]

These are methods called in other parts of the model that are written here:

To reduce allowance level
Calculate average emissions reductions in past 12 months

Reduce allowances by target percentage plus sensitivity * (target - average reduction) [set allowance allowance * target * sensitivity * (target - averageReduce)

to increaseSavingLevel

if amount of socio-economically motivated reductions < 10 * socio-ecological motivation and (actual demand > total allowances * 1.1 or savinamount of socio-economically motivated reductionsgLsocio-ecological < 5):

If reduced emissions three times or more than seven times due to

socioecological motivation: = 3 or savingLsocio-ecological >= 7

Reduce demand by 4%

When going down with mobility, (using the car less often, doing less trips by plane or trips in total, going by public transport) there are basically two levels each inducing a decrease of around 4 percent each time.

Else:

Reduce demand by 2%

according to Zannini et al. an agent can reduce it' (energy) usage due to in-house changes (switching devices really off if not required, using them less, ...) more or less in four stages, each resulting in a decrease in around 2 percent each time.

Increase number of socio-ecologically motivated reductions by 1

to update price:

Let price = old price + alpha(demand - supply)

[set price price + alpha * (demandpool / NumberPersons - allowpool_new / NumberPersons)]