This document attempts to explain a model to project the evolution of household composition starting in 2015, taking the available historical data as a source of information.

The stock variable will be the number of household of each type per 100 inhabitants of a country. This variable is called: *EU households per 100 people*

Its units are homes per 100 persons. And the subindexes are REGIONS EU27 I and HOUSEHOLDS DEMOGRAPHY I

Based on historical data, it is calculated what trend this stock has followed historically. That is, what has been the annual variation of this stock(*EU households per 100 people*). For these annual variations, the average, maximum and minimum values are obtained for each country.

These values are called:

MEAN\_SLOPE\_RATIO\_HOUSEHOLDS

MAX\_SLOPE\_RATIO\_HOUSEHOLDS

MIN\_SLOPE\_RATIO\_HOUSEHOLDS

Its units are homes per 100 inhabitants/year.

If we assume that in a scenario of maximum urbanization urban households evolve with MAX\_SLOPE\_RATIO\_HOUSEHOLDS and rural households with MIN\_SLOPE\_RATIO\_HOUSEHOLDS, this will give rise to URBAN\_SLOPE\_RATIO\_HOUSEHOLDS.

On the contrary, if we assume that in a maximum ruralization scenario urban households evolve with MIN\_SLOPE\_RATIO\_HOUSEHOLDS and rural households with MAX\_SLOPE\_RATIO\_HOUSEHOLDS, this will give rise to RURAL\_SLOPE\_RATIO\_HOUSEHOLDS.

a) If we choose MEAN\_SLOPE\_RATIO\_HOUSEHOLDS, the variation trend of households per 100 persons would always remain constant, and could give rise to very high values if it continues to grow or even negative values, if it continues to decrease. For this reason, it is necessary to regulate that the growth or decrease slows down over time. In order for this growth or decrease to slow down over time, different methods can be applied to regulate this growth. It is proposed as a regulatory function:

This regulating function will always be a positive number, less than 1 and greater than zero. It will be close to 1 when the stock value si(t) (*EU households per 100 people*) is close to its average value and it will be close to zero if the stock value is close to the maximum or minimum values.

The BUFFER parameter modulates the function, in such a way that a value of 2 makes the evolution of household composition similar to the historical one, while a value of 1 makes it slower and a value of 3 faster than the historical one.

In this way you will have to:

If we assume that a maximum urbanization scenario develops when the following occurs simultaneously: MAX\_SLOPE\_RATIO\_HOUSEHOLDS for urban homes and MIN\_SLOPE\_RATIO\_HOUSEHOLDS for rural homes, a scenario is proposed in which it progressively advances (with a ramp function) from the average trend (MEAN\_SLOPE\_RATIO\_HOUSEHOLDS) to URBAN\_SLOPE\_RATIO\_HOUSEHOLDS . In the case of a maximum ruralization scenario, the average trend will be advanced from the MEAN\_SLOPE\_RATIO\_HOUSEHOLDS to the URBAN\_SLOPE\_RATIO\_HOUSEHOLDS, also progressively following ramp functions.

The new approach is modelled as a stock and a flow.

Where:

**si(t)** is the stock (ST) that represents the number of households (by type, i) per 100 inhabitants. (*EU households per 100 people*)

is the flow that represents the variation of the stock over time.

**slopei** = annual variation of the number of households of type i per 100 inhabitants. This value is introduced via scenario. May be: MEAN\_SLOPE\_RATIO\_HOUSEHOLDS, URBAN\_SLOPE\_RATIO\_HOUSEHOLDS or RURAL\_SLOPE\_RATIO\_HOUSEHOLDS.

**MAXSTi** = maximum value of the stock, calculated from historical data.

**MINSTi** = minimum value of the stock, calculated from historical data.

**MEANSTi**= mean value of the stock, calculated from historical data.

**BUFFER** = constant parameter that is introduced to smooth the evolution of future trends. May be 1 (slow trend), 2 (historical trend) or 3 (fast trend)

The user can select among four different scenarios (scenario\_parameters.xlsx). The scenario determines the constants of **slopei**:

0: constant values of 2015.

1: mean values for future trend.

2: ruralization 🡪 minimum values for urban households and maximum values for rural households

3: urbanization 🡪 maximum values for urban households and minimum values for rural households