

# **DESPITE ALL STRATEGIES FOR ENHANCING RESOURCE EFFICIENCY, PER CAPITA MATERIAL STOCK IS INCREASING – HOUSING STOCK AND BUILDING MATERIAL FLOWS IN GERMANY 2050**

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## **Summary**

After the Second World War, housing construction in East and West Germany developed differently in volume and structure. Housing stock in the two parts of the country still differs in age and building structure and in occupied floor area. After 1990, population figures in East Germany fell while building activity thrived, leading to growing housing vacancies. In West Germany, by contrast, construction proceeded in step with the high increase in the population (Banse, Effenberger 2006). Up to 2050, according to the Federal Statistical Office, the population can be expected to develop very differently in East and West Germany. This will affect the housing stock and hence the resources and land utilization provoked by changes and adjustments (rehabilitation, demolition, development).

With the aid of the “material flow model” developed at the IOER, material flows and land consumption caused by demographic change are defined and shown in the form of scenarios. The studies discussed show the quantities of material incorporated into East and West German housing stock, the material flows needed to adapt housing stock to demographic developments, and whether these developments enhance the resource efficiency of housing material stock.

**Keywords:** Demographic change, housing stock, demolition and development, material stock and material flows, resource efficiency.

## **1 Methodology**

Studies on the effects of demographic change (Banse, Effenberger 2006) present assumptions about arrivals and departures, inventory and vacancies in the housing stock. To translate these assumptions into material flows and material stock, building types have to be defined in terms of age classes (1. figure 1).

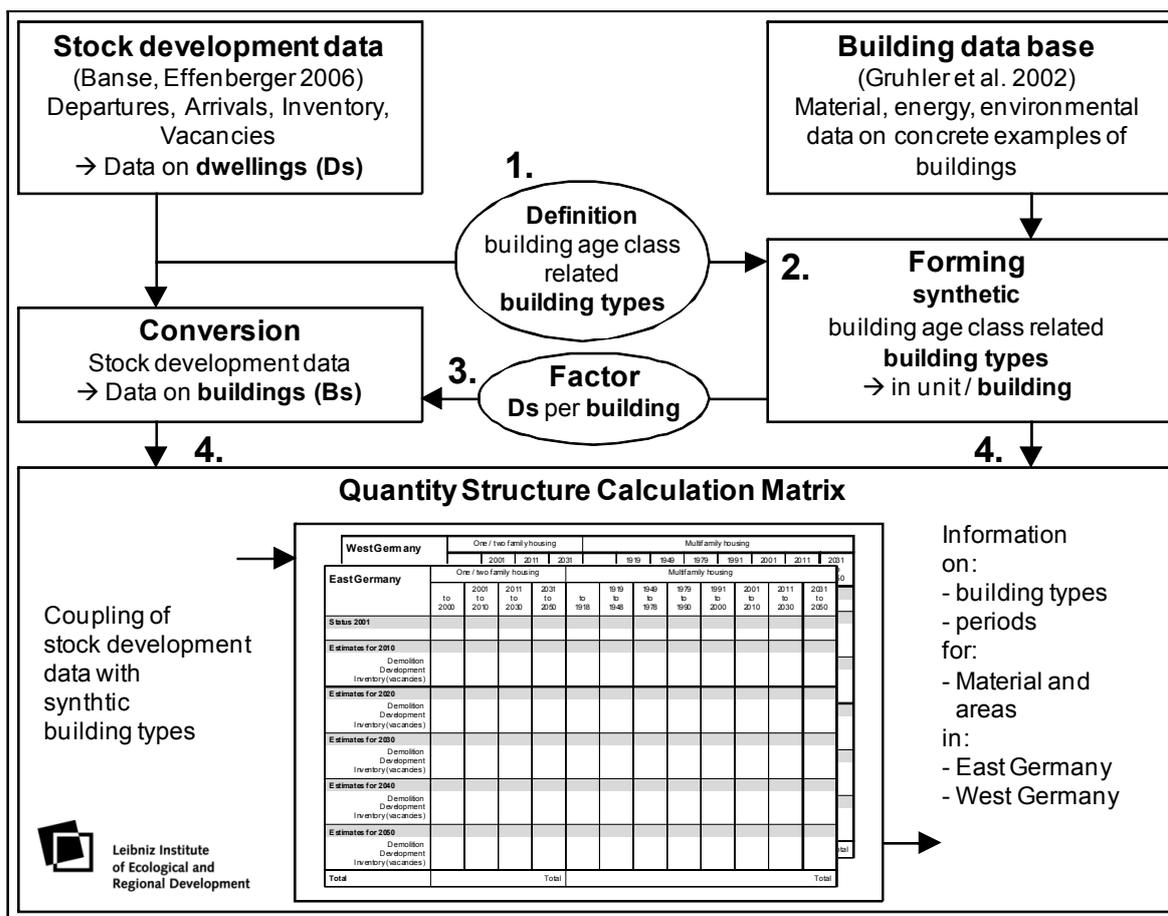


Fig. 1 Material Flow Modelling 2050 – Housing Sector

For the physical description of these building types (step 2), synthetic age-related class types are defined. They are generated from existing examples of buildings and reflect design, construction, and building materials. Dwelling-related data on the development of stock are then converted into building-related data. For this purpose a factor stating the number of dwellings per building type is used (3.). The fourth step is to couple housing stock development data with the physical data on the synthetic building types. The data on stock development are differentiated by building type and period and related in a calculation matrix to the material, energy, and environmental data on the synthetic building types to form a quantity structure.

## 2 Housing Material Stocks and Flows

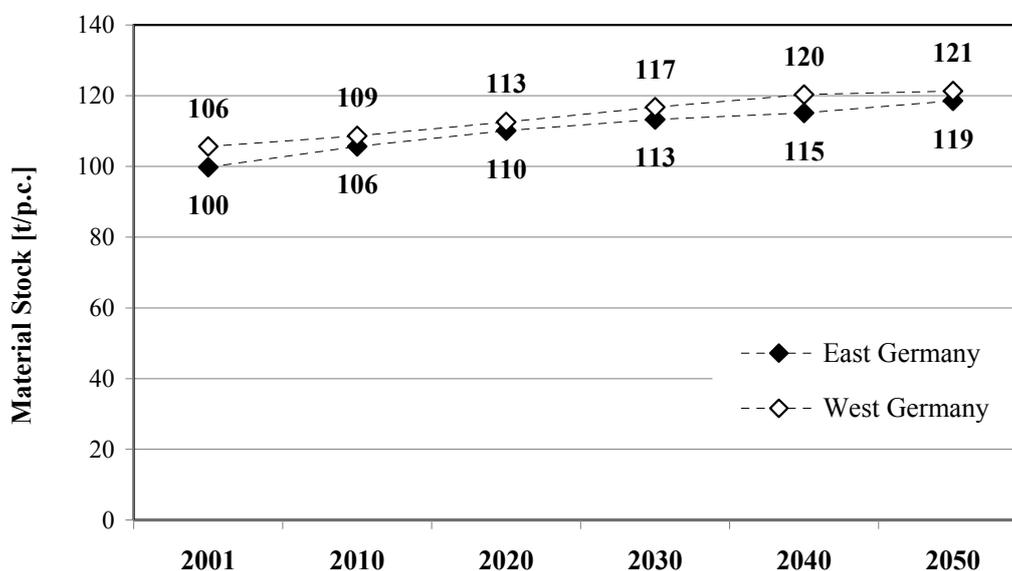
In 2001, about 1,400 million tons of building material had been incorporated into the East German housing stock.. Because there are many more dwellings and thus many more residential buildings in West Germany, no less that about 6,900 million tons of material went into housing in that part of the country. Vacant buildings are included in these figures. (Tab. 1).

**Tab. 1** Development of the Building Material Stock in Housing

		2001	2010	2020	2030	2040	2050
<b>East Germany</b>	Mio. t	1,370	1,359	1,328	1,280	1,217	1,165
	%	100	99	97	94	89	85
	Vacancies %	14.8	15.6	15.0	14.4	13.6	14.3
<b>West Germany</b>	Mio. t	6,903	7,244	7,560	7,743	7,753	7,507
	%	100	105	110	112	112	109
	Vacancies %	6.4	6.7	7.4	8.9	10.4	10.3

The development of the material stock incorporated in buildings differs in East Germany and West Germany. Owing to the declining population and consequent demolition, the material stock in East Germany fell by 15 % to some 1,200 million tons. Despite the fall in population in West Germany, by contrast, the figure will continue to grow until 2040 owing to a decline in the size of households. The material stock rose by 9 % to 7,500 million tons. The vacancy rate in East Germany ranges from 14 % to 15 %. The number of households in West Germany is expected to fall only from 2020 onwards. From then on, demolition will increase and development will slow, so that absolute material stock in millions of tons will rise until 2040 before declining with the rise in demolitions. Vacancies in West German housing will increase over the period under study from 6 % to 10 %.

Although the housing material stock can be adjusted to demographic developments by targeted demolition and construction, if it declines when the the population is shrinking, this is not generally a sign of resource-efficient development. This is clear where the development of the population is taken as yardstick in material calculations (Figure 2).



**Fig. 2** Housing Material Stock in Tons per capita.

In spite of falling absolute material stock figures, the volume in tons per capita is rising in East Germany. And – despite the expected decline after 2040 – per capita consumption is also expected to rise steadily in West Germany.

In East Germany, demolition (per decade > 5 t/p.c.) and development (per decade  $\approx$  3,5 t/p.c.) has adjusted to the decline in population. Vacancies remained constant at 15%, +/- 1%. Nevertheless, per capita material stock has risen. This has been because of changes in building structures. There has been greater demand for one and two-family houses, as well as blocks with fewer but larger flats. This increases building and construction volume and thus per capita material stock. In West Germany, demolition and construction have not yet adapted to population developments. Vacancies have risen from 6 % to 10 %. Only after 2040 will demolition reach volumes of over 5 tons per capita. As vacancies increase so does material stock in tons per capita, favoured by the trend towards residential blocks with fewer but larger flats.

Since buildings in the existing age groups in West Germany always contained fewer flats (especially in housing built between the end of the Second World War and 2000), per capita material stock is higher there than in East Germany, despite a vacancy rate lower by an average 6%. Leaving vacancies out of account, an East German requires an average 94 tons for housing, a West German 105 tons.

### **3 Conclusions**

The impacts of demographic change on the the housing material stock are complex, arising from the constant interplay between inventory, vacancies, demolition, and development. If the vacancy rate in housing stock is not to rise disproportionately (over 15%), more must be demolished than is built, especially in regions with a shrinking population. This is particularly true for East Germany.

The housing stock is not developing in the direction of resource efficiency. On the contrary, per capita material stock in East Germany is increasing owing to changes in building structures, i.e., the trend towards single-family housing and residential buildings with fewer but larger flats. In West Germany, not only this trend but also the rise in vacancies will lead to an increase in per capita material stock.

### **References**

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