



## The federal and cantonal building programme

### Evaluation of the estimation model for calculating CO<sub>2</sub> and energy impacts

#### Key facts

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The federal and cantonal building programme, financed through a partial earmarking of the CO<sub>2</sub> tax, is divided into two parts. Part A encourages renovation of the building envelope and is fully financed by the CO<sub>2</sub> tax. Part B supports cantonal programmes promoting renewable energy, waste heat utilisation and building technology in renovations and new buildings, with global contributions from the Confederation. The extent of such global contributions is determined by the individual canton's promotional efficiency; this is calculated using an estimation model in the cantons' harmonised model of financial assistance, which compares the energy and CO<sub>2</sub> savings made with the incentive costs. The estimation model was devised in 2003 and has been adapted twice since together with the harmonised model.

The Swiss Federal Audit Office (SFAO) examined the assumptions taken and methods used to estimate these savings. In a full-day workshop with seven experts representing both industry and research, the estimation model was analysed in detail with respect to three groups of incentive measures and three cross-cutting themes. The main focus with regard to the incentive measures was on estimating energy savings. The cross-cutting themes concerned aspects of the estimation model applicable to all measures: the model building, the conversion of energy into CO<sub>2</sub>, and grey energy.

#### **Not a general appraisal of the building programme by the SFAO**

This report is not a general appraisal of the efficiency of the building programme. According to the CO<sub>2</sub> Act, such an accountability report should be drawn up for parliament by the Federal Council. This report examines the methodology and assumptions of the estimation model, focusing only on those influencing factors actually included in the model. There is no reference to the more general impacts such as the overall economic effects of the building programme. Furthermore, the model was evaluated on the basis of current framework conditions with state-of-the-art knowledge and instruments, with a view to identifying the potential for future improvement. As such, this report cannot be used to automatically derive an appraisal of the quality of decisions for or against certain assumptions or methods when the model was revised in the past, as the historical context and state of knowledge have not been addressed.

This is the SFAO's second evaluation report on the building programme. The first one, on the programme organisation, was published in June 2013.

#### **Favourable view of the efficiency-driven distribution of global contributions**

In 2010, the partial earmarking of the CO<sub>2</sub> tax as a new source of funding modified the basis used for calculating global contributions. The estimation model was developed accordingly, by converting the energy-related key figures into the corresponding volume of CO<sub>2</sub>, and this model can now be used to calculate both energy as well as CO<sub>2</sub> savings.

The design and further development of the estimation model were based on pragmatic considerations. Still, after close examination of the estimation model, the SFAO looks upon of the efficiency-driven mechanism for distributing the global contributions favourably.

### **Estimation model at times opaque and difficult to understand**

The downside of taking such a pragmatic, step-by-step approach to developing the estimation model is the fact that it has grown organically. As a result, certain aspects of the model lack in transparency and traceability, exacerbated by the absence of documentation for many assumptions, the use of terms inconsistent with standard terminology, the not very explicit naming of energy levels and the many cross-references scattered throughout the documentation of the measures.

### **Energy savings overestimated in the model for the measures observed**

The following incentive measures were examined in the workshop: the promotion of individual components from part A and, in part B, promotion of the MINERGIE-(P) system and technical building measures for the use of solar energy and wood fuel. The promotion of individual components covers window replacement and renovation of the wall, ceiling or floor, while the conditions for receiving assistance formulate the quality criteria for such components. Regarding system promotion, however, the building is regarded as a complete system, and the criteria for financial assistance formulate threshold values for energy requirements per m<sup>2</sup> of the total floor area subject to heating or air conditioning. For the promotion of solar thermal energy (not photovoltaic) and energy from wood fuel, subsidies are available for the corresponding technical installations.

Regarding both individual component promotion and system promotion, the experts concluded that the energy savings were basically overestimated. This result is consistent with existing studies. Some of the experts attributed the overestimated energy savings to the assumptions taken, while others pointed to key factors outside of the model itself that prevent the calculated savings potential from being realised. One such factor, for example, is the possible increase in comfort brought about by renovations, assuming that a thicker building envelope enables rooms to be heated to 22°C instead of 20°C with the same heating level. Concerning the MINERGIE system paths, the assumptions used for unrenovated buildings or conventional new buildings not receiving subsidies are too high. In the case of measures for solar thermal energy and wood fuel, the methods and assumptions were found to be pragmatic and plausible as a whole.

### **Under and overestimation of CO<sub>2</sub> savings: no definitive judgment possible**

In converting energy into the volume of CO<sub>2</sub> emissions saved, certain areas revealed an overestimation or underestimation. For example, some figures are underestimated as a result of the different procedures adopted in parts A and B. While part A records the energy source prior to renovation, part B makes assumptions in this respect. This inconsistency results in CO<sub>2</sub> savings not being taken into account. On the other hand, for example, the assumption regarding the use of heating oil as an energy source in new buildings was too high, resulting in the energy savings being overestimated. Given such difficulties, it is not possible to determine whether the CO<sub>2</sub> savings are over or underestimated on the whole in the building programme.

### **Adjustments needed in the model buildings; inclusion of grey energy advisable**

Two model buildings – a single-family house and an apartment block – are used in the impact estimates. For example, these serve to differentiate between the impact of building envelope renovations and that of the building technology in the renovation system paths. This distinction became necessary after the building programme was organised into parts A and B in 2010. However, the two model buildings do not adequately reflect the non-residential buildings receiving financial incentives. A third model building should be introduced for this purpose. Furthermore, a distinction should be made in the future between incentive measures for single-family houses and apartment blocks.

Grey energy is an increasingly important topic with regard to energy consumption in Switzerland as a whole. Grey energy places the focus on energy consumption in the manufacture and transportation of construction materials and in the construction and dismantling of a building, for example. It would be advisable at this stage to arrange for preliminary work on including grey energy in a manner that could be enforced in the future and to clarify outstanding issues on how the savings are to be appropriately recorded in the greenhouse gas inventory and the CO<sub>2</sub> statistics.

### **Critical evaluation of consistency and of the attributed effects in the model**

At the end of the workshop, the consistency of the estimation model was critically evaluated by the experts. The object of this exercise was to verify whether the overall energy savings attained were correctly estimated with the individual impact calculations for each incentive measure, i.e. to validate the model. The experts agreed on giving priority to a model that estimates the impact of the incentive measures and the interplay in a system analysis of the building.

Sceptical about consistency, the SFAO assessed the different effects of the measures defined in the estimation model. The key question here was to what extent the building programme influences the developers' renovation pattern and where deadweight effects occur. Specifically, the SFAO welcomes the reasoning applied in part A, where deadweight effects lead to impact adjustments. However, existing surveys suggest that the extent of such deadweight is underestimated. Part B does not systematically reflect deadweight effects, as, by definition, only uneconomical subsidies with additional costs that cannot be amortised are included in the harmonised financial assistance model. This approach places high requirements on the accuracy of estimated energy savings and investment costs so that uneconomical measures can be identified and deadweight effects ignored. There is invariably a trade-off, however, between precision and ease of enforceability, which is why costs and benefits must be compared against each other.

### **New framework conditions and critical evaluation call for a fundamental debate**

The SFAO's first evaluation report, which analysed the programme organisation, already recommended merging parts A and B of the programme. In terms of estimating efficiency, it would appear that the division of the building programme into two parts also raises a number of difficulties and that a merger would be favourable. The programme's future organisation is currently the subject of parliamentary debate. Increasing the financial volume available to the building programme is also under discussion. From the original CHF 14 million envisaged in 2003, CHF 350 million is now planned for the 2050 energy strategy. Given this increase in funding, more stringent

requirements should also be placed on the precision and consistency of the estimation model. Moreover, since then, much preliminary work has been undertaken and interesting instruments and data sources created, which could be integrated into the impact calculations.

The changed framework conditions call for many adjustments to the model. Consequently, together with a critical assessment of the model's consistency, its fundamentals are now in question. It is an opportune moment to revise the model and, if necessary, redesign it.

### **Two development scenarios: revision or redesign of the estimation model**

For this reason, three recommendations (nos. 1 to 3) have been formulated for two development scenarios: either continue working with the existing model, or redesign it taking a system approach. The building energy certificate could be an interesting instrument in this respect. This certificate not only reflects the many individual effects in one system variable, but also takes account of individual parameters of building geometry and users' behaviour.

Due to some outstanding issues on compatibility with the existing incentive approach per measure, a thorough analysis of a new design with a consistent and validated system approach is recommended. If a new design is not envisaged, the SFAO recommends making numerous changes to the existing model. In addition, the quality of the existing estimation model should be validated using measurements and the impact claims corroborated across the entire building stock.

Irrespective of the scenario chosen for further development, recommendations 4 and 5 concern a series of adaptations that the SFAO regards as appropriate in any case.

Due to the pending parliamentary discussions of the Energy Strategy 2050, which might lead to a reorganization of the federal and cantonal building programme, the Federal Department of the Environment, Transport, Energy and Communications has agreed to consider above recommendations in the further development and to implement them as far as possible in the years after 2016. On the contrary, the conference of the cantonal energy councilors responded in their statement that modifications to the existing estimation model should be kept at a minimum level. Both written statements can be found in the annex.

### **Original text in German**