Holistic evaluation of different insulation alternatives

Ganzheitliche Bewertung von verschiedenen Dämmstoffalternativen

Endbericht

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Joachim Reinhardt, Corvin Veith, Julia Lempik, Florian Knappe, Peter Mellwig, Jürgen Giegrich, Nadine Muchow (ifeu)
Thomas Schmitz, Ilka Voß (natureplus)

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Pages 106 – 110 Translated

5.1.1. Disposal options for EPS boards

Table 5-11: Overview of the disposal options investigated for EPS insulation board (EPS).

Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Disposal in waste incineration plant	Energy in cement plant	Material Recycling CreaSolv® Process	EPS beads	Regranulation	Return to production up to 30%, rest Opt. 4
EPS MVA	***EPS Zement***	***EPS CreaSolv***	***EPS Sekundär***	***EPS Regran***	***EPS Rück***

The disposal of EPS boards in a waste incineration plant or cement plant produces emissions that have a relatively large greenhouse effect, because the fossil carbon contained in the raw material petroleum is emitted as fossil carbon dioxide. Since the EPS boards have a high calorific value, a relatively large amount of energy is recovered in the process. However, the savings achieved in this way are not sufficient to offset the loads, so that a net burden remains. In the other environmental impact categories, however, net reductions are also achieved with the waste incineration plant. In the case of the cement plant, this is achieved due to the assumed saving of coal firing through the heat gained from the energy recovery of the insulation material, this is also achieved in the greenhouse effect. In the other indicators, with the cement plant the loads are higher due to the poorer flue gas cleaning compared to the waste incineration plant. However, this is somewhat more than compensated for by the higher savings.

Savings are achieved via material recycling that are somewhat lower in the greenhouse effect and terrestrial eutrophication potential and higher in the other environmental impact categories than the values achieved with the cement plant in the case of substituted hard coal firing ("GS material allocation" sector). At the same time, however, the burdens associated with material recovery (sector "Material recovery") are significantly lower, with the exception of the cumulative fossil energy input, so that the material recovery paths perform better overall than the energy recovery paths. The CreaSolv® Process and the re-granulation process have a negative impact on the material recovery, whereas the impact for the shredding of the EPS insulation board for use as secondary raw material or return to production is very low. For the CreaSolv® Process and regranulation, the high electricity demand is visible here.

CreaSolv® extracts the raw material polystyrene from the EPS, which is then available for other products and can be saved there. Via re-granulation, PS recyclate is produced mechanically by shredding and melting, which can then likewise be used for the production of other products. Since the loads for PS production account for a large share of the total production loads of the EPS insulation board, the substitution successes shown for it are high in all indicators. In the fossil cumulative energy input, not only the energy raw materials burned for energy production, but also the energy contained in the materials used (feedstock) is subsumed according to its calorific value, so that the PS saved makes a corresponding contribution.

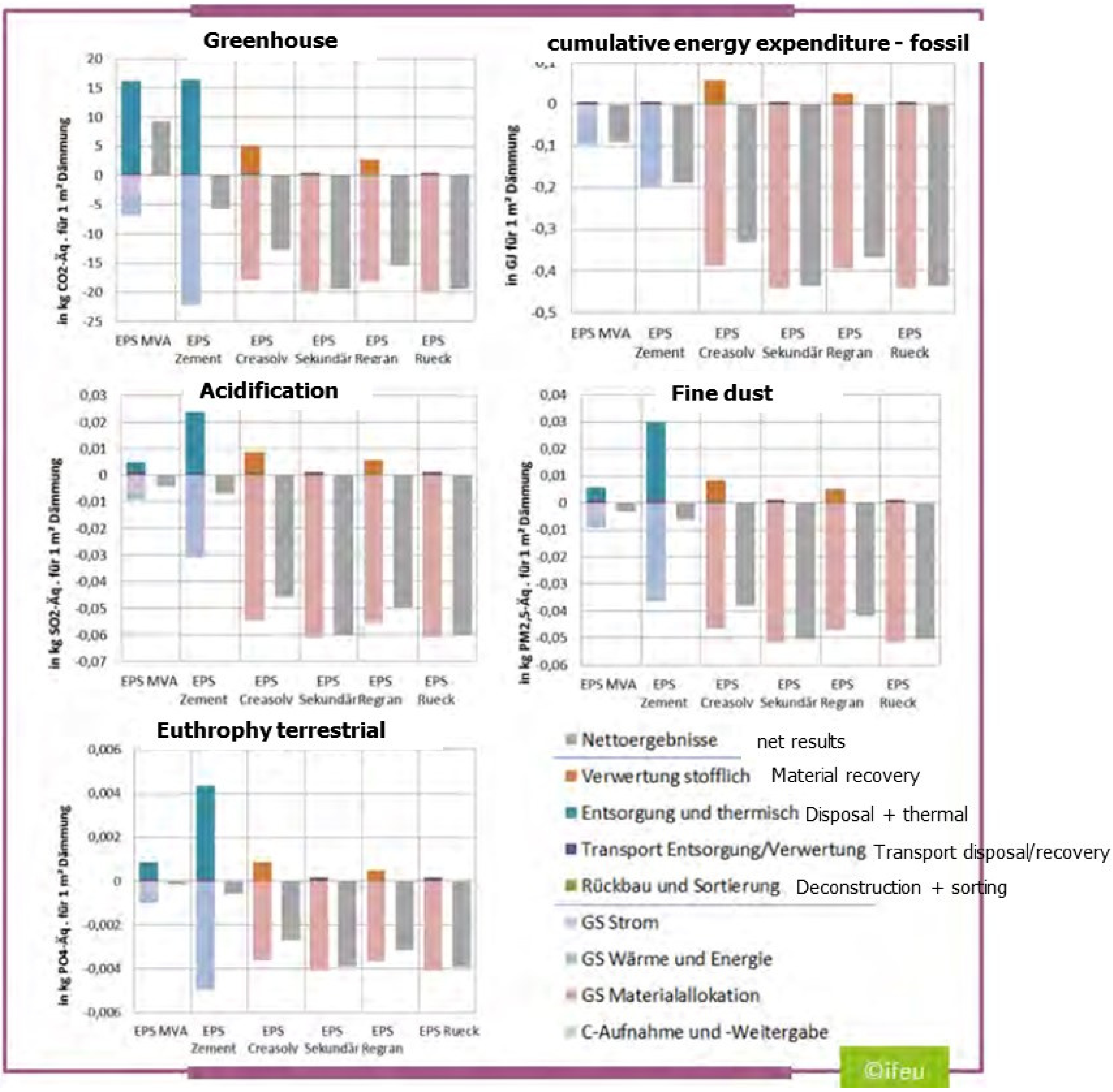

Figure 5-23: Results of the waste life cycle assessment for the different disposal routes of the EPS boards; reference: insulation flat roof, light

With the material recycling as secondary raw material, for example in thermal insulation plasters, and through the return to production, EPS beads are saved there and thus, in addition to the PS, also the energy for pre-foaming. For these, 35% of the heat and electricity requirements of the entire EPS board production are estimated in each case, so that the savings are even somewhat greater than for CreaSolv® and regranulation. Here, too, only part of the insulating materials can be recycled into production, an estimated 30 %. The remainder, however, is represented by material recycling as a secondary raw material, which is of almost equal importance from an environmental point of view.

Material recycling has clear advantages over thermal treatment (Figure 5-24). In the future, efforts should be made both to return as much as possible to production and to use it as a secondary raw material, thus saving the production of EPS pellets, and to use the remainder as completely as possible via re-granulation. Raw material recycling via the CreaSolv® process also performs favorably.

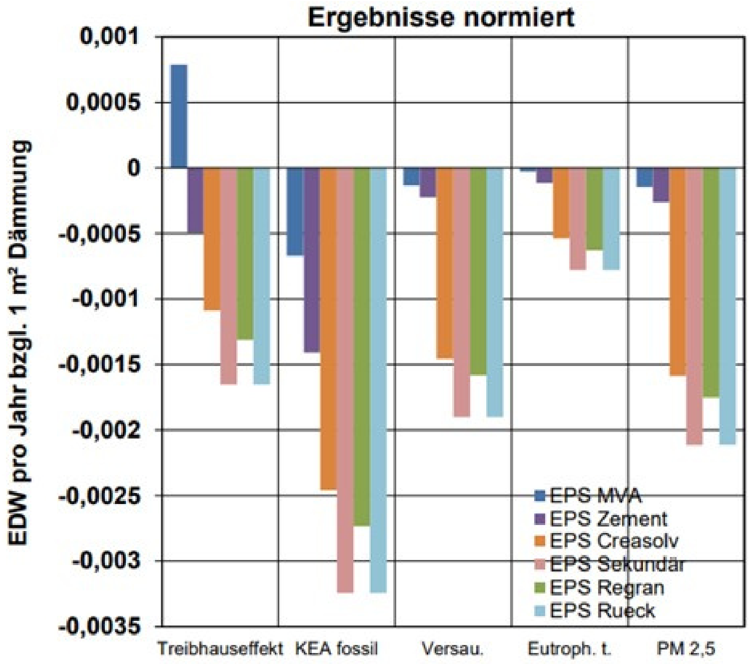

Figure 5-24: Results normalized to inhabitant average values (Einwohnerdurchschnittswert - EDW) for the waste eco-balance of EPS boards; reference: Insulation flat roof light

5.1.1. Disposal options for XPS boards

Table 5-12: Overview of the disposal options investigated for XPS insulation board (XPS).

Option 1	Option 2	Option 3	Option 4
Disposal in waste incineration plant	Energy in cement plant	Material Recycling CreaSolv® Process	Regranulation
XPS MVA	***XPS Zement***	***XPS CreaSolv***	***XPS Regran***

The results for the XPS boards are mostly the same as for the EPS boards (Figure 5-25). The absolute values are higher according to the larger mass needed to achieve the same insulating properties. The energetic disposal is associated with relatively high loads in the greenhouse effect due to the combustion of a fossil raw material, which cannot be compensated in the greenhouse effect via the benefits from the energy produced in the process in the form of electricity and heat; the energy efficiency is relatively low. The benefits are quantified by the savings in loads for current German grid electricity mix or Heat from gas heating systems. Due to the credited saving of hard coal firing in the cement plant, the benefit achieved there is also greater than the loads in the greenhouse effect.

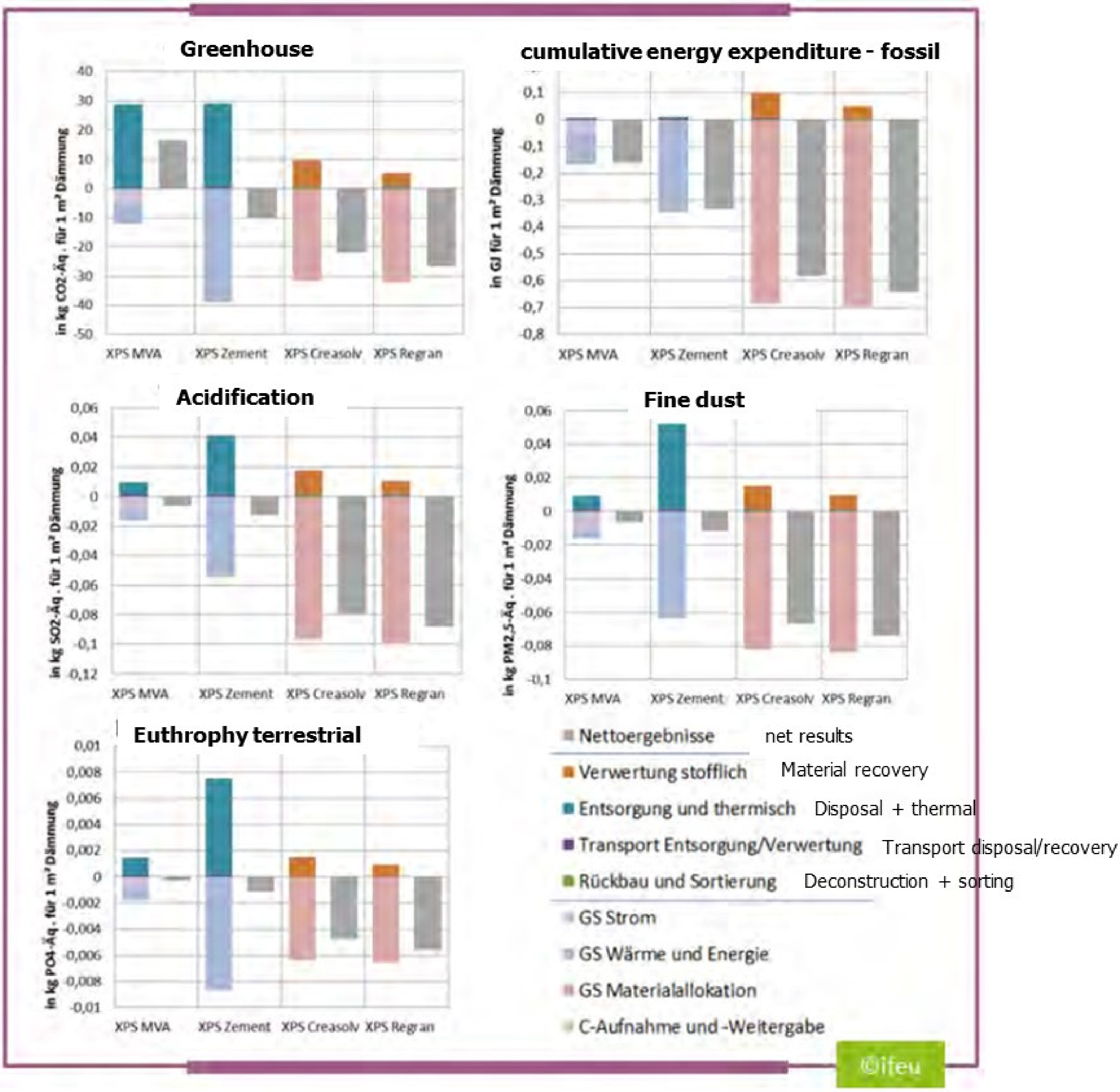

Figure 5-25: Results of the waste life cycle assessment for the different disposal routes of the XPS boards; reference: insulation flat roof, light

It is not possible here to recycle the material as a secondary raw material and return it to production, because XPS forms a homogeneous mass that has to be re-foamed after shredding. Here, too, it can be seen that recycling via re-granulation or CreaSolv® performs significantly better than thermal treatment. The loads thus saved for the provision of PS (sector "GS material allocation") account for a large part of the XPS insulation board production and turn out to be correspondingly large. At the same time, the loads representing the electricity demand for the CreaSolv® process or re-granulation (sector "recycling material") are not as large as the loads due to emissions, which result from energy recovery in the cement plant and are greater than those of the waste incineration plant due to poorer waste gas purification.

Material recycling has clear advantages over thermal treatment (Figure 5-26).
In the future, attempts should be made to make PS available again via regranulation.
Feedstock recycling via the CreaSolv® process also performs favorably.

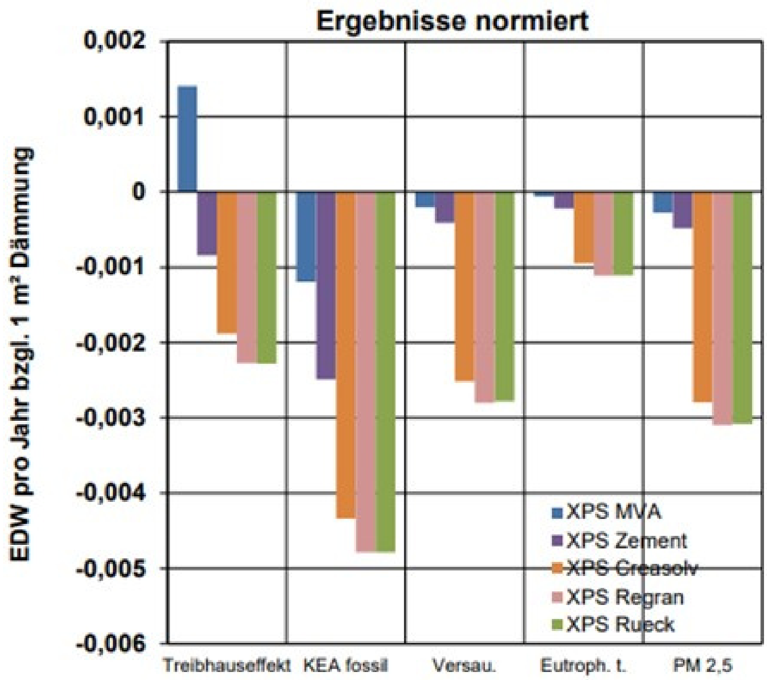

Figure 5-26: Results normalized to inhabitant average values (Einwohnerdurchschnittswert - EDW) for the waste eco-balance of XPS boards; reference: Insulation flat roof light

Link to ifeu study: https://www.ifeu.de/fileadmin/uploads/Bericht-D%C3%A4mmstoffe_23032020.pdf