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CROSS-SECTOR ANALYSIS OF THE HUNGARIAN SECTORS COVERED BY THE EFFORT SHARING DECISION – CLIMATE POLICY PERSPECTIVES FOR THE HUNGARIAN AGRICULTURE WITHIN THE 2021-2030 EU PROGRAMMING PERIOD

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Abstract: *Ever since 2012, the EU ETS (European Union's Emission Trading Scheme), which is the EU's climate policy was extended to include the ESD (Effort Sharing Decision) sectors' (agriculture, transport, building) regulations. As its name implies, this mechanism is based off of shared interests and efforts, all in order to reach the climate goals. Therefore, analysing the agriculture sector from an environmental viewpoint requires the analysis of related sectors as well, since their performances will have an impact on determining the requirements to be met by the agriculture. Seeing that those primarily present in said sectors are not various firms, but people and public utility management institutions instead, the level of regulations draws from the economic state of the various countries in question (GDP per capita). Therefore, member states like ours did not receive difficult goals until 2020, due to our performance being lower than the average of the EU. However, during the program phase between 2021 and 2030, all nations are to lower their GHG (greenhouse gases) emission, and have to make developments to restrict GHG emission level growth within the ESD, which means we already have to estimate our future possibilities. During the analyses, we will see that analysing agriculture from an environmental viewpoint, without doing the same to their related sectors and their various related influences is impossible. The GHG emission goals determined by the EU have to be cleared by the agriculture sector, but the inputs from transport, waste management and building are required nonetheless.*

Keywords: *effort sharing, emission trading scheme, agricultural emissions, green transport sector, building sector, climate policy* (JEL classification: Q58)

Introduction

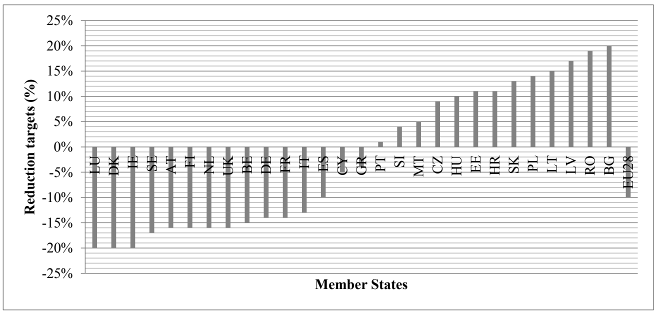
During the operation of the EU's quota-based trade system (EU ETS), one has to see that the sectors in question only hold the EU's greenhouse gas (GHG) emission rates' half, meaning the EU ETS regulations in and of themselves will not fulfil the requirement of reaching the set goals.

This is how the idea to segregate non-ETS sectors (transport, agriculture, building, waste management) and introduce an emission planning program related to them came up. This created the "Effort Sharing Decision" mechanism (ESD), as part of the EU 2009 Climate- and Energy Pack (406/2009/EB). It is in effect for each GHG, and the settling units are also in CO_2 values. However, one could say that other than this fact, it differs from its predecessor in just about everything. The main reason of this is that related sectors (transport, building, agriculture, waste management, etc.) are hard to identify, unlike the ETS, as well as the main actors are not various firms, but often private individuals, whose emission rates are much harder to measure and regulate. Therefore, externalities resulting from this are also harder to identify, which makes internalisation strategy planning complicated. However, it is important to ensure that decision-makers and professionals on the field devise a well-performing framework, since these sectors hold 58% of the entire EU's GHG emissions, or even more - in Hungary's case, this number is around 75% (Kollmuss, 2014a). In many cases, the various ESD sectors intertwine with each other, e.g. the relation between bio-fuels and transport is important during the cross-sector analysis from an agricultural viewpoint. Reason is: the GHG emission reduction goals are determined for the entire ESD mechanism universally, making the processes of sectors one would think are irrelevant to each other become an influencing factor on each other in the end. This is why they can fundamentally influence the cost-effectiveness of GHG emission reduction strategies.

The policies for lowering GHG emission rates inside the ESD are determined not on a level of emission units, but decide border values for each member states' emission reduction - or increase - on a national level, which they have to keep until 2020. In the case of Hungary, an effective +10% GHG emission border value was decided on.

It is important to take note that we are not specifically talking about *lowering* emission rates for some countries, since the limits determined not only advance the completion of the Kyoto goals, but also try to determine the ranking of various nations' economic state using the average EU GDP, and giving them proper goals to aim for, which reflect their estimated capacities. Therefore, countries which are above the average GDP had to make promises to realise a GHG emission reduction of 0-20%, while those who are below it had the option of increasing their emission by up to 20%, to help their economies keep up with that of other EU member states. Figure 1. shows the ranking, which also includes Croatia, who only joined on the 1st of July, 2013 (Forster et. al, 2012).

Figure 1. Goals accepted under the ESD's jurisdiction on EU member state level, compared to the 2005 level.



Source: Forster et. al, 2012

As we can see on Figure 1., the European Commission ordered a 10% emission reduction goal for the entirety of the ESD sector, so that it can reach a 20% reduction overall, compared to 1990 values. However, for this to happen, the three most wealthy member states (Luxembourg, Denmark and Ireland) based on 2005 data, had to maintain a 20% reduction to balance the poorest member state's (Bulgaria) up to 20% increase potential, and for the others to take place between the two ends. Among others, our country was also one of the member states which were allowed an increase until 2020, namely by 10%. Naturally, criticism arose regarding these initiatives ever since, seeing how they do not take the continuous shift in GDP into consideration, and how they require the goals until 2020 to be met based on the 2005 base data from each nation. One of the biggest losses was incurred by Ireland, who is only 5th in the nations' ranking, but had to maintain its 20% goal (Kollmuss, 2014b). Next, we will review how the ESD sectors can be defined both internationally and domestically, most importantly agriculture, which is the focus of our cross-sector analysis.

Connection between sectors of ESD

If we would like to produce a general evaluation of the ESD sectors and their connections, influences on each other inside the EU, we mainly have to discuss transport, building, and agriculture aspects. While waste management also relates here, it has such a low share from both non-ETS (5,4%) and the EU's overall GHG emission rate (3-4%), that not even most of the studies which analyse this factor mention it in detail, since it does not even offer any serious potential for increasing cost-effectiveness. Unlike this, transport with its 34% ESD share, and 20% overall EU GHG emission share (Borkent et. al, 2012) is one of the most influential sectors. Also, unlike the other sectors, its GHG emission decrease costs can be said to be quite expensive, and the volume of emission has been constantly on the rise since 1990. The building and agriculture sectors hold 19% and 18% respective shares of the overall non-ETS GHG emission (Forster et. al, 2012), which is also substantial, but these sectors have their development in a special energy-environment. When remodelling buildings, or making new residences, modern technologies are much more energy- and climate-effective compared to outdated systems, which means that the sector can get rid of a high volume of GHG emission even with non-"low-carbon" orientated programs. Based on this, we can state that the investments of the building sector generate automatic decrease in emission rates even without a regulation framework.

As for agriculture - as we have seen in many occasions regarding European decision-making - due to the priorities of foodstuff production, technological developments are quite contradictive. One of the reasons for this is that its products (foodstuffs, and fodder) always had a special place in the economic system. Therefore, the market protection, income support and rural development functions greatly deformed the optimal use of resources.

This is where we can think of e.g. the Common Agricultural Policy (CAP), which has foodstuff safety as a cornerstone, meaning giving food to as many people as possible, while keeping the quality as high as possible. This immediately offers a proper foundation for those who rationalise against the regulation of agriculture, since they always provide the argument that limiting GHG emission can only worsen the contestability of the sector, and would negatively impact the efficiency of production (Matthews, 2012). Also, the fact that we can view the EU's decisions up until now to be unfounded, since they want to regulate agricultural emission by ignoring the LULUCF (Land Use, Land Use Change and Forestry), which covers the CO_2 volume of land usage, management, and forestry processes. Selecting the optimal decrease strategies is further complicated by the differences in indicators in various countries (default values), and not with ones specifically made for their various attributes (Kovács et. al, 2014). And the biggest problem which stems from these arguments is that they were not concluded as of yet, meaning professionals have a harder job if they want to calculate with the measurements of future endeavours. In conclusion, we can say that the ESD sector which has the most potential to decrease GHG emission is obviously the building sector, where most of the cost-effectiveness optimisation potential lies. This means that most countries do not really dedicate many resources to e.g. transport in terms of climate impact decrease, and they do not really focus on its growth, rather balancing the path to reaching set goals via the investments into buildings. Agriculture remains a stagnant sector, to which no one tends to turn, as long as it is not absolutely necessary. Of course, differences in any country appear compared to this general outline, and we will see how agriculture performs, and aids in reaching the climate policy goals (Hermann et. al, 2014).

Research method

Due to the many perspectives a cross-sector analysis tends to have, we tried to match the indicators of the various sectors during the methodological selection. For this, we implemented the benchmarking method, which is basically a level-comparison method. Its focus is to compare differences in a given space- and timeframe based on a condition system (Bakosne, Fogarassy, 2010). Therefore, we can evaluate a future state of affairs using an attribute group which is at hand at present. Its main advantage is that it can be freely shaped to match the analysis, and highlights how various states differ from our designated state of equilibrium (Camp, 1992). Seeing how this research evaluates the environmental load different sectors have, and by this, also analyses their effect on climate policy, we designated the CO_2 decrease potentials as the main aspect. We also analysed the *technological, environmental and economic* dimensions which have an effect on the changes in CO_2 emission. The first of these factors means technological developments, which offer operation efficiency in the system, and result in lower contamination rates. The environmental side analyses applicability of possible regulations, while the economic dimension shows which areas are the best to invest in (Fogarassy, 2012). To keep the general outlook, each dimension was allotted 3-3 indicator. Next, Tables 1, 2, and 3 show the analysis systems for each sector.

Table 1. Indicator group of agricultural GHG emission's benchmarking analysis

Dimensions	**Code**	**State indicators**	**Code**	**Performance indicators (with design method)**
ASPECTS OF DECREASING CO_2 EMISSION				
Technological	CS1	GHG emission's intensity based on technology	CP1	GHG emission based on evaluating technology variants which can be implemented
	CS2	Opportunities to introduce Low-carbon technology in the sector	CP2	Share of bio-ethanol on the field of bio-fuels
	CS3	Composition and volume index of typical GHGs	CP3	Decrease potential of CO_2 share of overall GHG emission
Environmental	CS4	Environmental attributes of GHGs subject to emission	CP4	Detailed characterisation of GHGs' environmental attributes, and analysis related to expected directives
	CS5	Consistency of environmental regulations / norms, border values	CP5	Does the regulation aid or hinder the completion of environmental policy goals?
	CS6	Level of environmental risks for emission	CP6	Attributes and usefulness of adaptation policies
Economic	CS7	Attributes / Level of share in overall GHG emission	CP7	Total volume of CO_2 emission for all sectors under the jurisdiction of regulations
	CS8	General costs for GHG avoidance for each unit of ÜHG CO_{2e}	CP8	Cost index of CO_{2e} emission decrease in the sector
	CS9	Form of aiding the completion of GHG climate policy goals	CP9	Calculations regarding volume and efficiency

Abbreviations: "CS1...9" - state indicators of CO_2 reduction aspect by dimensions; "CP1...9" - performance indicators of CO_2 reduction aspect by dimensions

We can see the generic climate policy analysis' framework in Table 1. We defined two main aspects of the various indicators: *State and Performance indicator groups*. The first defines the analyses' point of view, a starting state, which has to be explored to get a clear view of the current state of the various sectors. This point of the analysis does not change for the sake of comparison, and can be considered constant. The other, performance indicator however is different, since e.g. we cannot evaluate the same technological system both for the transport and agriculture sectors. Therefore, this indicator group was made to measure the previous, in other words, state indicators' change in direction and level. Another important element of the analysis is that the EU wants to draw relevant conclusions for the next program period (2021-2030). However, for this to happen, we also have to know the previous timeframe's specifics. Therefore, the level of change in state between 2020 and 2030 can only mean one part of the analysis, the other one is evaluates processes in effect between 2010 and 2020. This is advantageous, due to a portion of the timeframe already passed, so analysing it can help us evaluate trends in the future.

The basis of scenarios until up to 2030 were built using models and databases like the IPCC Hungary database, the transport analysis mechanism accepted by the EU, the Tremove (Nemry, 2011), and the effect evaluation of our apartment block programme (Vorsatz et. al, 2010).

Table 2. Indicator group of transport GHG emission's benchmarking analysis

Dimensions	Code	State indicators	Code	Performance indicators (with design method)
		ASPECTS OF DECREASING CO$_2$ EMISSION		
Technological	CS1	GHG emission's intensity based on technology	CP1	GHG emission based on evaluating technology variants which can be implemented
	CS2	Opportunities to introduce Low-carbon technology in the sector	CP2	Changing the shares of public transport and traffic
	CS3	Composition and volume index of typical GHGs	CP3	Decrease potential of CO$_2$ share of overall GHG emission
Environmental	CS4	Environmental attributes of GHGs subject to emission	CP4	Detailed characterisation of GHGs' environmental attributes, and analysis related to expected directives
	CS5	Consistency of environmental regulations / norms, border values	CP5	Does the regulation aid or hinder the completion of environmental policy goals?
	CS6	Level of environmental risks for emission	CP6	Attributes and usefulness of adaptation policies
Economic	CS7	Attributes / Level of share in overall GHG emission	CP7	Total volume of GHG emission for all sectors under the jurisdiction of regulations
	CS8	General costs for GHG avoidance for each unit of ÜHG CO$_{2e}$	CP8	Cost index of CO$_{2e}$ emission decrease in the sector
	CS9	Form of aiding the completion of GHG climate policy goals	CP9	Calculations regarding volume and efficiency

Abbreviations: "CS1…9" - state indicators of CO$_2$ reduction aspect by dimensions; "CP1…9" - performance indicators of CO$_2$ reduction aspect by dimensions

Table 3. Indicator group of building GHG emission's benchmarking analysis

Dimensions	Code	State indicators	Code	Performance indicators (with design method)
		ASPECTS OF DECREASING CO$_2$ EMISSION		
Technological	CS1	GHG emission's intensity based on technology	CP1	GHG emission based on evaluating technology variants which can be implemented
	CS2	Opportunities to introduce Low-carbon technology in the sector	CP2	Level of applicability for known low-carbon technologies
	CS3	Composition and volume index of typical GHGs	CP3	Changes in CO$_2$ decrease rates
Environmental	CS4	Environmental attributes of GHGs subject to emission	CP4	Detailed characterisation of GHGs' environmental attributes, and analysis related to expected directives
	CS5	Consistency of environmental regulations / norms, border values	CP5	Does the regulation aid or hinder the completion of environmental policy goals?
	CS6	Level of environmental risks for emission	CP6	Attributes and usefulness of adaptation policies
Economic	CS7	Attributes / Level of share in overall GHG emission	CP7	Total volume of CO$_2$ emission for all sectors under the jurisdiction of regulations
	CS8	General costs for GHG avoidance for each unit of ÜHG CO$_{2e}$	CP8	Cost index of CO$_{2e}$ emission decrease in the sector
	CS9	Form of aiding the completion of GHG climate policy goals	CP9	Calculations regarding volume and efficiency

Abbreviations: "CS1…9" - state indicators of CO$_2$ reduction aspect by dimensions; "CP1…9" - performance indicators of CO$_2$ reduction aspect by dimensions

Interpreting the externalities

During our research, we did not interpret externalities in their usual, economy related meaning, but acted as a container for any positive or negative effect which can induce a change in the related sectors' CO$_2$ equations instead. The basic goal was to analyse if the indicator supports or hinders the sector in reaching the set GHG emission decrease goals. Since the direction of the indicator's change is not enough for us in and of itself, we also ranked the level of their change, giving each indicator a value between -2 and +2. When they were summarised, the value 0 meant the optimal level of the system (best practice), and any difference was a pointer which meant something was amiss. Where negative externalities are amassed, it means the system has faults in its basic structure, which is why allocating resources into its operation is a lost cause. In this case, we mostly have to remedy errors in structure, and development programs can only come after. If there are too many positive externalities, we can conclude that there are unused capacities. This means that we have to support the sector with funds, since it can produce even better than current results in the future (Fogarassy, 2012).

Research results

The results for the GHG emission reduction benchmarking analysis for each sector can be seen in Table 4. Summarising the externalities can be done from various perspectives, which all have different amounts of inherent information. During our evaluation of results, we used three different points of view, which were named "A", "B" and "C". "A" was the "net

Table 4. Evaluating the benchmarking analysis

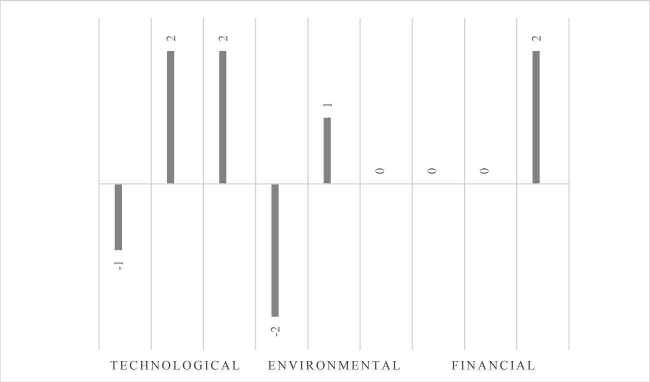
Number		Aspects of decreasing CO_2 emission of the agriculture sector		Aspects of decreasing CO_2 emission of the transport sector		Aspects of decreasing CO_2 emission of the building sector	
		2010/2020	**2020/2030**	**2010/2020**	**2020/2030**	**2010/2020**	**2020/2030**
Technological	1	-1	-1	0	-1	0	1
	2	1	2	0	0	0	1
	3	2	2	1	-2	1	2
Environmental	4	-2	-2	-2	1	-2	-1
	5	-1	1	-2	1	0	1
	6	-1	0	-2	-1	0	0
Economic	7	0	0	-1	-2	1	2
	8	0	0	-1	-1	2	2
	9	2	2	-2	-1	1	2
A: Net positive externality ∑ (1;9)		**0**	**4**	**-9**	**-6**	**3**	**10**
B: Total externality ABS (1;9)		**10**	**11**	**11**	**10**	**7**	**13**
C: Share of net positive externality effects in total externality effects		**0%**	**40%**	**0%**	**0%**	**43%**	**77%**

Explanation: *A - Net positive externality sum (1;9) means the amount of appearing positive externalities in the various aspects between 2020 and 2030, if there are not any direct climate policy developments apart from BAU; B - Total externality ABS (1;9) is the absolute value of all externalities present ; C - the share of net positive externality effects in the total externality effects, shown in percentages to describe the dimension of development ability on the examined area.*

positive externality” value, which means a simple summation. “B” became the “total externality ABS”, with which we wanted to know the total amount of externalities present in the sector, therefore, we summated the absolute values there. Finally, “C” shows how apparent the ratio of net positive externality (A) is in the total externality (B). We have to be careful here, because if the net positive externality amount is already negative, their ratio will also naturally become 0 (Fogarassy, Bakosne, 2014). However, this does not imply optimal operation, but shows structural faults instead.

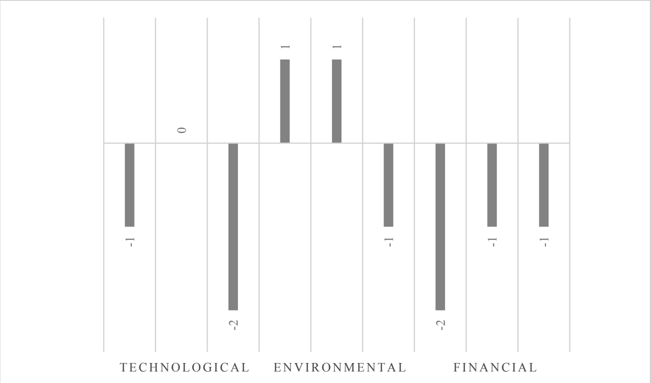
Evaluating the agriculture sector: in the case of the agriculture sector, we can see that there are no decisive differences in externality amassment between the two timeframes, but we can see differences in structure. Hungarian agriculture produces optimal results until 2020 from a climate policy perspective, however, unused potential in the system appears before 2030 (Figure 2). We can follow this best by analysing the indicators which have different externality domains for the two timeframes. We can see that three of the externalities with a +4 value appear for environmental indicators, meaning that is where changes should be made to optimise operations. This dimension means the intensity of environmental regulations, so it is no wonder that the sector’s analysis shows unused opportunities. We already mentioned that not only climate policy goals, but other economic interests are pushed back in favour of other priorities of agriculture, so some already say that the operation system is not as effective as it could be (Barry et. al, 2010). We can also see this in the process of amassing negative externalities in the environment dimension, which may be the result of possibly implemented wrong decisions. However, our benchmarking analysis still decided that the current state of affairs is optimal, but not issuing strict regulations may cause problems in the future. The other important aspect is the question of technological development, where we can again see the strong change in an indicator, which may keep this group on the side of positive externality content by 2030. This also means a problem which is already discussed by many: not using the energy production potential of agriculture (Magda, 2011). We have long understood that the sector holds energy production potential, which could support other sectors (e.g. bio-ethanol, biogas for transport), but could at the very least be self-sufficient regarding energy input (Fonseca et. al, 2010; Elbersen et. al, 2012). Therefore, for the next program timeframe, implementing these technological developments is advised.

Figure 2. Number of externalities within the agriculture sector in 2030



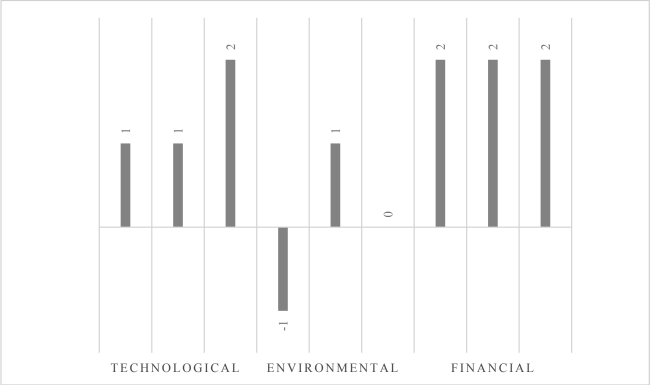
Evaluating the transport sector: the negative externality amassment of the transport sector is not surprising, since it is widely known that this is one of the worst performing sector of the EU's climate policy (Schade, Krail, 2012). The 0% in this instance does not mean optimal performance, but instead an over-abundance of negative externalities. This also highlights how the error should be in the structure of the current transport (both public and private). Out of the nine indicators, seven show a difference in the externality-domain, which means that major developments and changes have to be made. We can see that the current, more-or-less optimal operation in the technological dimension may result in strong negative consequences based on current trends. New, environmentally friendly transport technologies (CNG, electric cars) will become more easily acquired, and their spread - even via subsidies - may become a matter of life and death for the sector's future (Stanley et. al, 2011). For the environmental regulations, we can clearly see that the current structure is not good from a climate policy aspect, but the best positive feedback can be achieved here, compared to others (Figure 3). In the future, it might be advantageous to implement western-European solutions which can advance the dismissal of vehicles ran on fossilised energy resources (e.g. traffic jam fee) (Selih et. al, 2010), and the users of new technology can be aided (e.g. being excluded from said fee) (Strong, Chun, 2014). The subsidy system does not amass externalities by chance for the next timeframe, since it is obvious that resources should never be allocated to traffic systems which were designed with faults.

Figure 3. Number of externalities within the transport sector in 2030



Evaluating the building sector: we have known for a while that the building sector means a lifebelt in the ESD for most climate impact decrease goals to the EU member states (Korytarova, 2010). While the GHG emission of the transport sector is on the rise daily, and that of the agriculture sector is stagnant, the biggest and cheapest reduction volume can be achieved here (Rysanek, Choudhary, 2013). This is the reason that the analysis showed unused development opportunities in the system for the 2015-2020 timeframe already, and their numbers will rise until 2030 (Figure 4). While the technological side works more-or-less optimally until 2020, the next timeframe brings a rise in positive externality amount. This is the result of most - currently, only minor - modern systems will spread until then. The examples are passive houses, or "zero-energy" buildings, which are based on a minimal energy consumption already in concept, and the latter uses renewable energy resources even for these reduced requirements (Schimschar et. al, 2014). Opportunities which show themselves refer to the adaptation of such developments exactly, which have to be implemented to achieve efficiency. The optimal value of the currently slightly negative regulations may be achieved after 2020. This is a result of the EU's decision that new buildings can only be built using said zero-energy concepts after 2018 (Klinckenberg et. al, 2013). The source of non-utilised opportunities obviously result from the economic side, meaning the fact that monetary resources are not utilised to the best effect. In recent years, we saw how various "climate resources" were at hand, which we could not use as effectively as we intended to, since we could not place most of the resources at hand.

Figure 4. Number of externalities within the building sector in 2030



Conclusions

During the analyses, we saw how evaluating the agriculture sector from a climate policy aspect is impossible without doing the same to the effects on other sectors. The GHG emission rate decrease goals set by the European Union have to be achieved by including the inputs of the transport, waste management and building sectors as well. Our research shows that out of our three sectors, transport is the one which has negative development tendencies, that can be balanced out by the cheap development opportunities of old buildings on a national economy level. However, these trends are only good solutions at present, knowing how short the life cycle of apartment blocks became. We have to state that out of the three sectors, agriculture is the one that did not require any climate policy inputs as of now, and due to this, has a more-or-less stagnant emission value as well. The other important aspect of the question is that we never had the chance to maintain climate policy regulations for agriculture, since the ones subject to regulation usually resist through various lobby groups. This resistance relies upon stressing the safe foodstuff support function, which is handled as exceptionally important in the EU since WWII. The question is, how long the sector can escape strong regulations, and when we will need a higher contribution from the agriculture sector to reach the climate policy goals that were enforced upon us. Analysing the data in the evaluation matrix, we can say that the current workings from a GHG emission rate decrease aspect is more-or-less optimal, but various dimensions do not say the same on their own. Many believe that the lax environmental checks, and production discipline results in the energy production potential of the agriculture sector not performing as it should. E.g., an effect of this is that Austria's or Germany's biogas facilities, which can be said to be an important part of husbandry are not present in our own domestic husbandry. This contradictive situation is also supported by our benchmarking analysis, and we can also see how these anomalies may destroy the equilibrium of the entire sector by 2030. As a generic term of economy, the "lock-in effect" describes how currently dismissed developments may cause damages in the long-term, since they may cost a lot more in the future. This may be a fundamental point for agriculture. Therefore, strengthening the energy production scheme of the agriculture in the next program timeframe is highly advised, which may not only help the sector itself, but other sectors (e.g. transport) to realise climate friendly development.

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