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Actions to Mitigate Energy Poverty
in the Private Rented Sector

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# SPLIT INCENTIVES QUANTIFICATION TOOL- USER GUIDE

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# 1. THE MAIN IDEA BEHIND THE "SPLIT INCENTIVES QUANTIFICATION" TOOL

"Split incentives" refer to any situation where the benefits of a transaction do not accrue to the actor who pays for the transaction. In the context of energy efficiency in buildings, split incentives are linked with cost recovery issues related to energy efficiency upgrade investments due to the failure of distributing effectively financial obligations and rewards of these investments between concerned actors [1]. Especially, when it comes to the Private Rented Sector (PRS), existing literature identifies "split incentives" among landlords and tenants, as one of the main barriers when implementing energy efficiency policies to tackle energy poverty [2]. Moreover, according to the Energy Efficiency Directive, Member States shall evaluate and if necessary, take appropriate measures to remove regulatory and non-regulatory barriers to energy efficiency, such as split incentives, without prejudice to the basic principles of the property and tenancy law of the Member States.

More specifically, Member States should address: "*the split of incentives between the owner and the tenant of a building, with a view to ensuring that these parties are not deterred from making efficiency-improving investments that they would otherwise have made by the fact that they will not individually obtain the full benefits or by the absence of rules for dividing the costs and benefits between them, including national rules and measures regulating decision- making processes in multi-owner properties*" [3].

Moreover, in most European Union (EU) countries, there is significant lack of studies or estimations on the extent of the "split incentives" issue, which leads to the design of renovation policies with a subsidy rate that is not often adequate or optimised as it cannot capture the impact of "split incentives".

In this context, ENPOR project aims to contribute to addressing this gap with the development of a "split incentives quantification" tool. **The main objective of the tool is to identify the share of the triggered benefits from the implementation of energy efficiency interventions between landlords and tenants in order to quantify the appropriate allocation of costs or subsidy rates for both sides, towards specific renovation scenarios in the seven ENPOR countries (i.e., Austria, Croatia, Estonia, Germany, Greece, Italy, Netherlands)**.

By doing so, we seek to better understand the issue and enhance the uptake of energy efficiency investments in the PRS. More specifically, the "split incentives qualification" tool provides useful insights to all key actors involved in the PRS energy efficiency renovation value chain (e.g., energy agencies,

construction companies, landlords, vulnerable tenants, etc.), while it also assists policymakers in quantifying the financing requirements for promoting energy efficiency investments in the PRS, and, thus, in designing energy efficiency policies that target the PRS more efficiently.

## 2. METHODOLOGICAL BACKGROUND OF THE TOOL

For the quantification of the share of benefits for landlords and tenants towards the implementation of energy efficiency interventions, the tool's methodological background is based on the quantification of the energy savings, along with the positive externalities related to energy efficiency interventions in the PRS.

### 2.1 Quantification of the energy savings

For the quantification of the energy savings, the tool makes use of specific assumptions according to the case study. The assumptions are differentiated according to the chosen country. More specifically, these assumptions concern the average energy consumption of the building in kWh/$m^2$, the percentage of space heating and cooling energy consumption, and the energy prices. Therefore, based on the user inputs (i.e., country, construction year, building area in $m^2$, and heating source) and the abovementioned assumptions, the tool uses the respective energy saving rate for each energy efficiency scenario and calculates the heating and cooling energy saving in kWh and €.

### 2.2 Quantification of the positive externalities

Energy efficiency investments aim first at reducing energy consumption, but they have impact also to other challenges such as energy supply security, climate change, employment, etc. In addition, the implementation of energy efficiency interventions can have other "non-energy", socio-economic and environmental effects such as effects on social welfare or reduced pollution levels. These effects are defined as externalities.

In this context, **four different types of externalities** are assessed within the framework of the ENPOR "split incentives quantification" tool. As shown in **Fig. 1**, these are the environmental impacts, the macroeconomic impacts (e.g., Gross Domestic Product (GDP)), the increasing in building value, as well as other multiple benefits (e.g., improved comfort and health, etc.). To what concerns the first two, i.e., environmental, and macroeconomic impacts, we consider that they provide wider societal benefits and, therefore, they affect equivalently both landlords and tenants. On the other hand, the increasing in building value solely benefits the landlord, while the multiple benefits, such as the improved comfort and health, are benefiting tenants.

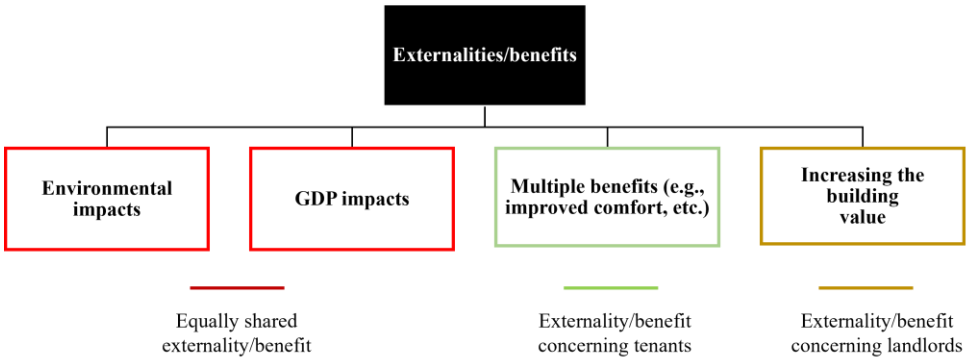


**Fig. 1.** The four types of externalities assessed within the framework of the "split incentives quantification" tool.

Therefore, the tool estimates the Net Present Value (NPV) of the landlords' benefit derived for the increasing building value, as the ratio of the **cost savings** due to the reduction of the energy expenses to the **capital rate** of the building.

Furthermore, the tool also calculates the NPV of the tenants' benefits, as derived from the energy costs savings, and the multiple benefits, such as improved comfort, caused by the energy efficiency interventions. More specifically, the tool calculates the NPV of the energy cost savings based on the following equation: $\sum_{n=1}^{N} \frac{C_n}{(1+i)^n}$ , where N= Total number of time periods, n= Time period, $C_n$= Net cash flow at time period, i= Internal rate of return.

Furthermore, for the calculation of the NPV of the multiple benefits, a percentage of the cost savings is considered as the most effective metric. The respective value for the current study is considered equal up to 10% of the achieved cost savings, while it can reach up to 25% of energy savings in the case that all multiple benefits will be quantified, indicating a rather conservative estimate.

Consequently, the quantification of the monthly impact in rental price is calculated based on the share of the participation of each side in the investment and the NPV of each side's total benefits.

# 3. HOW TO USE THE TOOL

## 3.1 Running the ENPOR "Split incentives quantification" tool

In order to run the ENPOR "split incentives quantification" tool the user should open the "ENPOR_Split-incentive tool.xlsx" file, which can be found in this link.

## 3.2 Filling in the "Assumptions" sheet of the tool

At first, the user should define some basic assumptions in the "Assumptions" sheet of the excel file. As shown in **Fig. 2**, these inputs concern some basic characteristics of the household, i.e., the country where the household is located, its construction year, its building area and heating source.

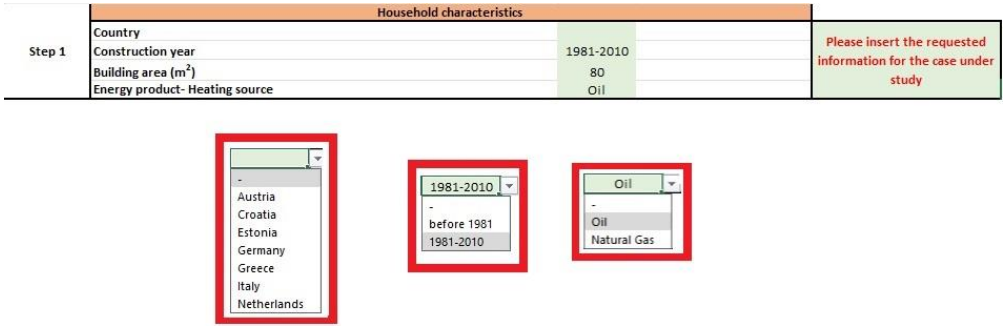


**Fig. 2.** Basic characteristics of the household under study that should be inserted by the user.

Moreover, the user must choose among specific energy efficiency intervention scenarios (i.e., windows upgrade, thermal insulation, windows upgrade & thermal insulation, heat pump, windows upgrade & thermal insulation & heat pump) for the household under study (**Fig. 3**).

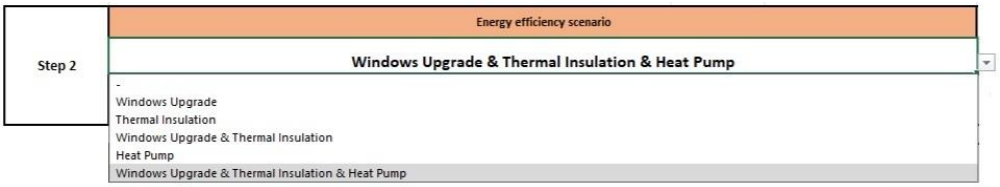


**Fig. 3.** Indicative energy efficiency intervention scenarios for the household under study.

In addition, the user must specify each side's contribution to the investment. The analysis does not consider the case where the landlord does not participate in the investment. As shown in **Fig. 4**, if the user, set the landlord participation as 0% a message will appear indicating that the value must change and the tool will not work.

| Step 2 | Energy efficiency scenario | | |
|---|---|---|---|
| | Windows Upgrade & Thermal Insulation & Heat Pump | | |
| | Landlord's participation in the investment | 50% | |
| | Tenant's participation in the investment | 50% | *(calculated automatically)* |
| | OK | | |

| Step 2 | Energy efficiency scenario | | |
|---|---|---|---|
| | Windows Upgrade & Thermal Insulation & Heat Pump | | |
| | Landlord's participation in the investment | 0% | |
| | Tenant's participation in the investment | 100% | *(calculated automatically)* |
| | Landlord participation in the investment cannot be zero | | |

**Fig. 4.** Indicative participation in the investment from landlord and tenant.

After filling in these inputs, several cells will automatically use them, based on specific assumptions connected to energy efficiency scenario chosen and the country, construction year, area, and heating source of the household. These assumptions are presented in **Fig. 5**.

| Step 3 | Proposed assumptions based on the dwelling's characteristics (i.e., country, construction year, etc.) and the chosen energy efficiency scenario | | |
|---|---|---|---|
| | Technical characteristics | | |
| | Heating system power (kW/m$^2$) | 0.08 | |
| | Cooling system power (kW/m$^2$) | 0.07 | |
| | Windows surface | 0.30 | |
| | Windows upgrade: Energy saving rate (%) heating | 3.4% | |
| | Windows upgrade: Energy saving rate (%) cooling | 3.4% | |
| | Thermal insulation: Energy saving rate (%) heating | 32% | |
| | Thermal Insulation: Energy saving rate (%) cooling | 32% | |
| | Windows upgrade & Thermal Insulation : Energy saving rate (%) heating | 35% | |
| | Windows upgrade & Thermal Insulation : Energy saving rate (%) cooling | 35% | |
| | Heat Pump: COP | 4.30 | |
| | Heat Pump: EER | 4.70 | |
| | | | |
| | Intervention costs | | |
| | Windows Upgrade: Unit implementation cost of interventions (€/m$^2$) | 434 | |
| | Thermal Insulation: Unit implementation cost of interventions (€/m$^2$): external walls | 42 | |
| | Thermal Insulation: Unit implementation cost of interventions (€/m$^2$): ceiling | 37 | |
| | Heat Pump: Unit implementation cost of interventions (€/kW) | 1,560 | |
| | | | |
| | Investment parameters | | |
| | Discount rate (%) (European average) | 3.98% | |
| | Investment's lifetime (years) | 30 | |

**Fig. 5.** The proposed assumptions based on the dwelling's characteristics (i.e., country, construction year, area, and heating source) and the chosen energy efficiency scenario.

**It is important to note that the user can proceed with these data, which are based on specific assumptions, or insert more detailed data for the specific case study- if available.**

If all previous steps are completed the user should click the "Benefits Calculation" button shown in **Fig. 6**.

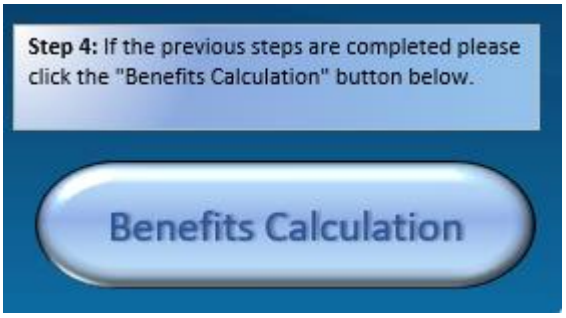


**Fig. 6.** The "Benefits Calculation" button.

## 3.3 The "Benefits_Calculation" sheet of the tool

By clicking the "Benefits Calculation" button, the tool moves on to the next sheet of the Excel file, the "Benefits_Calculation" sheet. In this sheet, the tool presents the annual energy cost savings (in €) due to the energy efficiency interventions (**Fig. 7**).

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump |
|---|---|
| Household category | Estonia |
| | before 1981 |
| 1,391.7 | |

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump |
|---|---|
| Household category | Estonia |
| | before 1981 |
| 1,391.7 | |

**Fig. 7.** The annual energy cost savings (in €) which are calculated in the "Benefits_Calculation" sheet of the tool.

Based on them, the tool calculates, by using appropriate formulas, the Net Present Value (NPV) of the landlords' and tenants' benefits and the NPV due to multiple benefits for the tenants (**Fig. 8**). Furthermore, the tool determines the two parties' participation in the investment based on the assumptions provided by the user (**Fig. 9**).

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump | | |
|---|---|---|---|
| Household category | Estonia<br>before 1981 | | |
| 1,391.7 | | NPV of the Landlord benefit-Property value increase | 34,967.4 |

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump | | |
|---|---|---|---|
| Household category | Estonia<br>before 1981 | | |
| 1,391.7 | | NPV of the Tenant Benefits - Energy Savings | 24,123.9 |

| NPV of Multiple Benefits (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump | | |
|---|---|---|---|
| Multiple benefits 10% | 139.2 | NPV of the Tenant Benefits - Multiple benefits | 139.2 |

**Fig. 8.** Calculation of the NPV of the total landlords' and tenants' benefits as calculated in the "Benefits_calculation" sheet of the tool.

| Costs calculation | Total intervention cost (€) | 30,342 |
|---|---|---|
| | Landlord's participation in the investment | 19,722 |
| | Tenant's participation in the investment | 10,620 |

**Fig. 9.** Calculation of the costs of landlord's and tenant's participation in the investment as calculated in the "Benefits_calculation" sheet of the tool.

Finally, as presented in **Fig. 10**, the tool calculates the monthly impact in rental price due to each side's participation in the investment, as well as the monthly impact in rental price due to each side's benefit (i.e., landlords' and tenants' benefits). Finally, the tool utilizing the previous calculations presents the overall monthly impact in rental price due to both the benefits and participation in the investment for both parties and sums the overall monthly impact in rental price.

| Monthly impact in rental price calculation | Monthly impact due to landlord participation in the investment (MIPI) | 95 |
|---|---|---|
| | Monthly impact due to tenant participation in the investment (MIPI) | 51 |
| | Monthly impact in rental price due to landlord's benefits (MIB) | 168 |
| | Monthly impact in rental price due to tenant's benefits (MIB) | 117 |
| | Monthly impact in rental price due to landlord's benefits and participation in the investment | 109 |
| | Monthly impact in rental price due to tenant's benefits and participation in the investment | 76 |
| | **Overall monthly impact in rental price** | **185** |

**Fig. 10.** Calculation of the monthly impact in rental price as calculated in the "Benefits_calculation" sheet of the tool.

# 4. EXAMPLE OF USING THE TOOL: A CASE STUDY IN GREECE

In this section the applicability of the "split incentives quantification" tool is demonstrated for the geographical and socio-economic context of Greece.

## 4.1 Running the ENPOR "Split incentives quantification" tool

As a first step we downloaded the tool from this link (**Fig. 11**).


**Fig. 11.** Download link for the "ENPOR_Split-incentive tool"

Then we ran the downloaded excel file "ENPOR_Split-incentive tool.xlsx" (**Fig. 12**).


**Fig. 12.** The Excel file of the ENPOR split-incentive tool.

## 4.2 Filling in the "Assumptions" sheet of the tool

For the needs of this case study a typical Greek residential building is assumed, which is built in the period 1981-2010 and uses **Oil** as the main heating source (**Fig. 13**).

| | Household characteristics | |
|---|---|---|
| Step 1 | Country | Greece |
| | Construction year | 1981-2010 |
| | Building area ($m^2$) | 80 |
| | Energy product- Heating source | Oil |

**Fig. 13.** The basic characteristics of the household under study.

Then, we chose "Windows Upgrade & Thermal Insulation & Heat Pump" as the energy efficiency intervention scenario of this case study and equal participation in the investment (**Fig. 14**), while the tool calculates the proposed assumptions for the case under study (**Fig. 15**).

| | Energy efficiency scenario | | |
|---|---|---|---|
| Step 2 | Windows Upgrade & Thermal Insulation & Heat Pump | | |
| | Landlord's participation in the investment | 50% | |
| | Tenant's participation in the investment | 50% | *(calculated automatically)* |
| | OK | | |

**Fig. 14.** The energy efficiency intervention scenario and participation in the investment for the household under study**.**

| | | | |
|---|---|---|---|
| Step 3 | Proposed assumptions based on the dwelling's characteristics (i.e., country, construction year, etc.) and the chosen energy efficiency scenario | | |
| | Technical characteristics | | |
| | Heating system power (kW/m$^2$) | 0.08 | |
| | Cooling system power (kW/m$^2$) | 0.07 | |
| | Windows surface | 0.30 | |
| | Windows upgrade: Energy saving rate (%) heating | 3.4% | |
| | Windows upgrade: Energy saving rate (%) cooling | 3.4% | |
| | Thermal insulation: Energy saving rate (%) heating | 32% | |
| | Thermal Insulation: Energy saving rate (%) cooling | 32% | |
| | Windows upgrade & Thermal Insulation : Energy saving rate (%) heating | 35% | |
| | Windows upgrade & Thermal Insulation : Energy saving rate (%) cooling | 35% | |
| | Heat Pump: COP | 4.30 | |
| | Heat Pump: EER | 4.70 | |
| | | | |
| | Intervention costs | | |
| | Windows Upgrade: Unit implementation cost of interventions (€/m$^2$) | 434 | |
| | Thermal Insulation: Unit implementation cost of interventions (€/m$^2$): external walls | 42 | |
| | Thermal Insulation: Unit implementation cost of interventions (€/m$^2$): ceiling | 37 | |
| | Heat Pump: Unit implementation cost of interventions (€/kW) | 1,560 | |
| | | | |
| | Investment parameters | | |
| | Discount rate (%) (European average) | 3.98% | |
| | Investment's lifetime (years) | 30 | |

**Fig. 15.** The proposed assumptions based on the dwelling's characteristics (i.e., country, construction year, area, and heating source) and the chosen energy efficiency scenario.

## 4.3 The "Benefits_Calculation" sheet of the tool

Considering the provided energy costs in the "Assumptions" sheet, the tool calculates the annual energy savings (€) due to the chosen energy efficiency intervention scenario (**Fig. 16**).

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump |
|---|---|
| Household category | Greece |
| | 1981-2010 |
| | 1,011.2 |

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump |
|---|---|
| Household category | Greece |
| | 1981-2010 |
| | 1,011.2 |

**Fig. 16.** The annual energy cost savings (in €) for the case under study.

Then, the tool calculates the NPVs of landlords' and tenants' benefits separately. As shown in **Fig. 17**, the NPV of the total landlords' benefits is equal to **25,408.1€**, while the NPV of the total tenants' benefits is equal to **17,630.1€**, which means that landlords gain the **59.0%** of the total benefit, while tenants receive the **41.0%.**

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump | | |
|---|---|---|---|
| Household category | Greece<br>1981-2010 | | |
| 1,011.2 | | NPV of the Landlord benefit-Property value increase | 25,408.1 |

| Annual Energy Savings (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump | | |
|---|---|---|---|
| Household category | Greece<br>1981-2010 | | |
| 1,011.2 | | NPV of the Tenant Benefits - Energy Savings | 17,529.0 |

| NPV of Multiple Benefits (€) due to | Windows Upgrade & Thermal Insulation & Heat Pump | | |
|---|---|---|---|
| Multiple benefits 10% | 101.1 | NPV of the Tenant Benefits - Multiple benefits | 101.1 |

| Benefits calculation | | |
|---|---|---|
| | NPV of the total Landlords' benefits (€) | 25,408.1 |
| | NPV of the total Tenants' benefits (€) | 17,630.1 |

**Fig. 17.** The NPVs of the total landlords' and tenants' benefits for the case under study.

Furthermore, based on the provided participation in the investment in the "Assumptions" sheet, the tool calculates the total intervention costs and landlord's and tenant's total costs which are **23,817 €**, **11,908 €** and **11,908 €** respectively (**Fig. 18)**.

| Costs calculation | | |
|---|---|---|
| | Total intervention cost (€) | 23,817 |
| | Landlord's participation in the investment | 11,908 |
| | Tenant's participation in the investment | 11,908 |

**Fig. 18.** The total landlords' and tenants' cost for the case under study.

Based on the latter, the tool calculates the monthly impact due to landlord's and tenant's participation in the investment, which is equal to **57€/month** and **57€/month,** respectively, and the monthly impact due to landlords' and tenants' benefits, which is equal to **122€/month** and **85€/month**, respectively (**Fig. 19**).

| | |
|---|---|
| Monthly impact due to landlord participation in the investment (MIPI) | 57 |
| Monthly impact due to tenant participation in the investment (MIPI) | 57 |

| | |
|---|---|
| Monthly impact in rental price due to landlord's benefits (MIB) | 122 |
| Monthly impact in rental price due to tenant's benefits (MIB) | 85 |

**Fig. 19.** The monthly impact in rental price due to each type of benefit and investment participation.

Subsequently, the tool calculates the monthly impact in rental price due to each party's benefits and participation in the investment, which is equal to **61€/month** and **42€/month**, for landlord and tenant respectively. Finally, the tool sums the above in order to present the overall monthly impact in rental price (**Fig. 20**).

| | |
|---|---|
| Monthly impact in rental price due to landlord's benefits and participation in the investment | 61 |
| Monthly impact in rental price due to tenant's benefits and participation in the investment | 42 |
| **Overall monthly impact in rental price** | **103** |

**Fig. 20.** The overall monthly impact in rental price due to each type of benefit and investment participation.

In addition, in **Fig. 21** and **Fig. 22**, we see the calculation of the monthly impact in rental price for two alternative percentages of participation in the investment, i.e., 75% landlord and 25% tenant, as well as the case in which the landlord fully funds the intervention (100% landlord – 0% tenant).

| | | |
|---|---|---|
| Monthly impact in rental price calculation | Monthly impact due to landlord participation in the investment (MIPI) | 86 |
| | Monthly impact due to tenant participation in the investment (MIPI) | 29 |
| | | |
| | Monthly impact in rental price due to landlord's benefits (MIB) | 122 |
| | Monthly impact in rental price due to tenant's benefits (MIB) | 85 |
| | | |
| | Monthly impact in rental price due to landlord's benefits and participation in the investment | 92 |
| | Monthly impact in rental price due to tenant's benefits and participation in the investment | 64 |
| | | |
| | **Overall monthly impact in rental price** | **155** |

**Fig. 21.** Monthly impact in rental price due to each type of benefit and investment participation (**75%-25%** landlord-tenant case).

| | | |
|---|---|---|
| Monthly impact in rental price calculation | Monthly impact due to landlord participation in the investment (MIPI) | 114 |
| | Monthly impact due to tenant participation in the investment (MIPI) | 0 |
| | | |
| | Monthly impact in rental price due to landlord's benefits (MIB) | 122 |
| | Monthly impact in rental price due to tenant's benefits (MIB) | 85 |
| | | |
| | Monthly impact in rental price due to landlord's benefits and participation in the investment | 122 |
| | Monthly impact in rental price due to tenant's benefits and participation in the investment | 85 |
| | | |
| | **Overall monthly impact in rental price** | **207** |

**Fig. 22.** Monthly impact in rental price due to each type of benefit and investment participation (**100%-0%** landlord-tenant case).

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