



# Extra energy savings with solar shading

*17 April 2015*

*Martin Straver - Romazo*

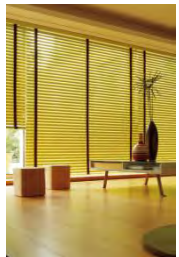
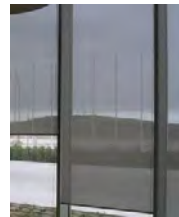
*( based on TNO presentation Leo Bakker )*



# Energy savings with solar shading

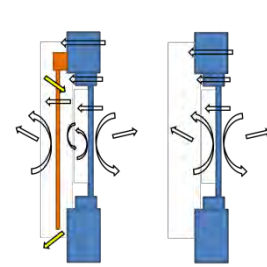


1. Savings on the **“cooling energy”**
2. Savings on the **“heating energy”** by extra heat resistance



# Calculation heat resistance solar shading

- Window Information System (**WIS**)
- European program TNO projectleader



**Transparent system configuration window:**

name: Romazo binnenzonwering id: 71

Width (w) [m]: 1.2  
Height (h) [m]: 1.4

**Forced Ventilation Input**

Gap id	From		To		Flux [dm <sup>3</sup> /s.m]
	Gap	outd	ind	ind	
2		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	0
4		<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0

**Free Ventilation Input**

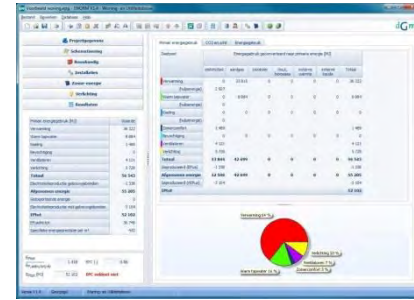
Gap id	From		To		Air openings [mm]		
	Gap	outd	ind	ind	d1	d2	d3
2		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	5	5	5
4		<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0	0	0

**Material Properties (Notepad):**

```

Units: Nanometers}
Manufacturer: Verosol}
Product name: Silverscreen}
Reference: www.verosol.com}
Product type: 1}
Position: 1}
Material: Cloth }
Appearance: 2% 202 ED01}
Thickness: 0.4}
conductivity: 0.2}
Emissivity front: 0.07 }
Emissivity back: 0.89 }
IR transmittance: 0.02}
Permeability: 0}
Info: openness Factor 2 %}
280 0.020 0.004 0.020 0.004 0.000 0.700 0.000 0.053
285 0.020 0.004 0.020 0.004 0.000 0.707 0.000 0.054
290 0.020 0.004 0.020 0.004 0.000 0.717 0.000 0.056
295 0.020 0.004 0.020 0.004 0.000 0.723 0.000 0.058
300 0.020 0.004 0.020 0.004 0.000 0.726 0.000 0.059
305 0.020 0.004 0.020 0.004 0.000 0.726 0.000 0.058
310 0.020 0.004 0.020 0.004 0.000 0.726 0.000 0.057
315 0.020 0.004 0.020 0.004 0.000 0.728 0.000 0.056
320 0.020 0.004 0.020 0.004 0.000 0.726 0.000 0.055
325 0.020 0.005 0.020 0.005 0.000 0.726 0.000 0.055
330 0.020 0.005 0.020 0.005 0.000 0.727 0.000 0.058
335 0.020 0.005 0.020 0.005 0.000 0.728 0.000 0.072
340 0.020 0.005 0.020 0.005 0.000 0.730 0.000 0.104
345 0.020 0.005 0.020 0.005 0.000 0.732 0.000 0.148
350 0.020 0.005 0.020 0.005 0.000 0.734 0.000 0.187
355 0.020 0.005 0.020 0.005 0.000 0.736 0.000 0.212
360 0.020 0.005 0.020 0.005 0.000 0.737 0.000 0.231
365 0.020 0.005 0.020 0.005 0.000 0.739 0.000 0.249
370 0.020 0.005 0.020 0.005 0.000 0.741 0.000 0.269
375 0.020 0.005 0.020 0.005 0.000 0.742 0.000 0.298
380 0.020 0.005 0.020 0.005 0.000 0.743 0.000 0.348
385 0.020 0.005 0.020 0.005 0.000 0.744 0.000 0.413
390 0.020 0.006 0.020 0.006 0.000 0.746 0.000 0.489
    
```

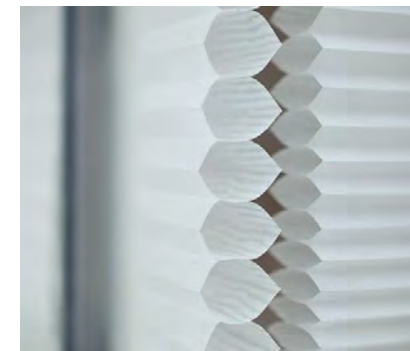
# EPG calculations



Energy savings heating + EPC- gain

by additional heat resistance from solar shading

- All windows have solar shading
- Heat resistance solar shading systems variety
- Calculations afterwards adjustments ( effect summer)



# EPG software

**Projectgegevens**

**Schematisering**

**Bouwkundig**

**Installaties**

**Zonne-energie**

**Verlichting**

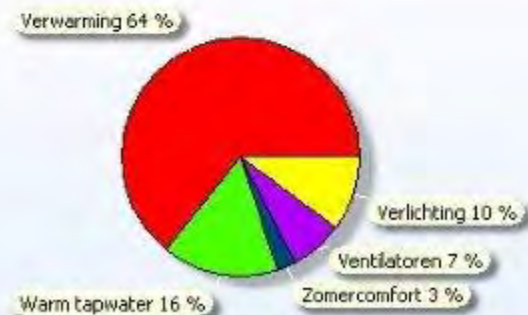
**Resultaten**

Primair energiegebruik [MJ]	Waarde
Verwarming	36 322
Warm tapwater	8 884
Koeling	1 489
Bevochtiging	0
Ventilatoren	4 121
Verlichting	5 728
<b>Totaal</b>	<b>56 543</b>
Electriciteitsproductie gebouwgebonden	-1 338
<b>Afgenomen energie</b>	<b>55 205</b>
Geëxporteerde energie	0
Electriciteitsproductie niet gebouwgebonden	-3 104
<b>EPTot</b>	<b>52 102</b>
EP;adm;tot	36 748
Specifieke energieprestatie per m <sup>2</sup>	420

EPTot	1,418	EPC [-]	0,86
EP;adm;tot;nb			
EPtot [MJ]	52 102	<b>EPC voldoet niet</b>	

Primair energiegebruik    CO2 en schil    Energiegebruik

Deelpost	Energiegebruik geconverteerd naar primaire energie [MJ]						
	elektriciteit	aardgas	stookolie	hout, biomassa	externe warmte	externe koude	Totaal
Verwarming	0	33 815	0	0	0	0	36 322
(hulpenergie)	2 507						
Warm tapwater	0	8 884	0	0	0	0	8 884
(hulpenergie)	0						
Koeling	0	0	0	0	0	0	0
(hulpenergie)	0						
Zomercomfort	1 489						1 489
Bevochtiging	0	0	0	0	0	0	0
Ventilatoren	4 121						4 121
Verlichting	5 728						5 728
<b>Totaal</b>	<b>13 844</b>	<b>42 699</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>56 543</b>
Geproduceerd (EPus)	-1 338						-1 338
<b>Afgenomen energie</b>	<b>12 506</b>	<b>42 699</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>55 205</b>
Geproduceerd (nEPus)	-3 104						-3 104
<b>EPTot</b>							<b>52 102</b>



1 Inleiding

2 Doel en gebruik referentiewoningen

> 3 Zes referentiewoningen uitgewerkt

> 3.1 Tussenwoning

3.2 Hoekwoning

3.3 Twee-onder-een-kapwoning

3.4 Vrijstaande woning

3.5 Galerijcomplex

3.6 Appartementencomplex

4 Verantwoording van keuzes

5 Een goede woning vergt aandacht

6 Literatuurverwijzing

Colofon

### 3.1 Tussenwoning



#### Algemene beschrijving

De oppervlakte van een tussenwoning is gemiddeld 125 m<sup>2</sup> (bron: MNW). In een tussenwoning zijn doorgaans drie slaapkamers aanwezig. Een tussenwoning komt in verschillende uitvoeringen voor, zowel met een zadel- of een lessenaarsdak als met een plat dak. Een zaddeldak komt relatief vaak voor.



## 1 Inleiding

## 2 Doel en gebruik referentiewoningen

### > 3 Zes referentiewoningen uitgewerkt

#### > 3.1 Tussenwoning

#### 3.2 Hoekwoning

#### 3.3 Twee-onder-een-kapwoning

#### 3.4 Vrijstaande woning

#### 3.5 Galerijcomplex

#### 3.6 Appartementencomplex

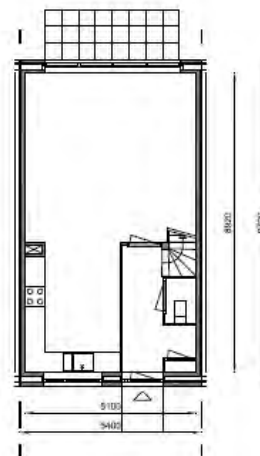
## 4 Verantwoording van keuzes

## 5 Een goede woning vergt aandacht

## 6 Literatuurverwijzing

## Colofon

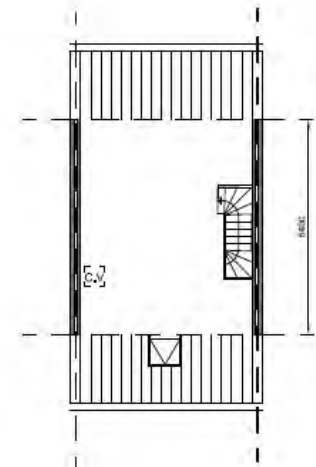
## Tekeningen



beganegrand



1e verdieping



2e verdieping

## 1 Inleiding

## 2 Doel en gebruik referentiewoningen

### > 3 Zes referentiewoningen uitgewerkt

#### 3.1 Tussenwoning

#### 3.2 Hoekwoning

#### 3.3 Twee-onder-een-kapwoning

#### 3.4 Vrijstaande woning

#### 3.5 Galerijcomplex

### > 3.6 Appartementencomplex

## 4 Verantwoording van keuzes

## 5 Een goede woning vergt aandacht

## 6 Literatuurverwijzing

### Colofon

## 3.6 Appartementencomplex



### Algemene beschrijving

De oppervlakte van een meer-gezinswoning in de koopsector is gemiddeld 105 m<sup>2</sup> (bron: MNW). In dit gemiddelde zijn zowel luxe penthouses als eenvoudige galerijwoningen opgenomen. Een meer-gezinswoning heeft meestal twee slaapkamers.





## 1 Inleiding

## 2 Doel en gebruik referentiewoningen

## > 3 Zes referentiewoningen uitgewerkt

### 3.1 Tussenwoning

### 3.2 Hoekwoning

### 3.3 Twee-onder-een-kapwoning

### 3.4 Vrijstaande woning

### 3.5 Galerijcomplex

## > 3.6 Appartementencomplex

## 4 Verantwoording van keuzes

## 5 Een goede woning vergt aandacht

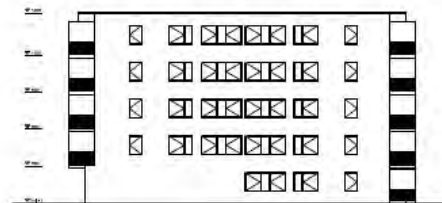
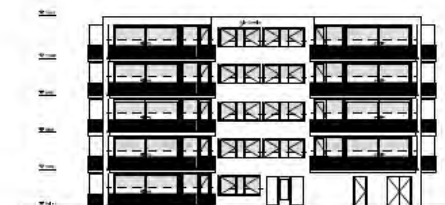
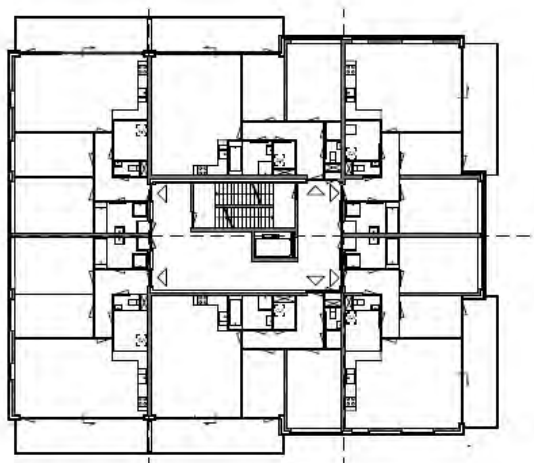
## 6 Literatuurverwijzing

## Colofon

### Gebiedsgebonden maatregelen en bijna energieneutrale woningen

	EMG variant 1	EMG variant 2	BENG
<b>EPC volgens NEN 7120</b>	<b>0,54</b>	<b>0,40</b>	<b>0,16</b>
Jaarlijks energieverbruik per m <sup>2</sup> volgens NEN 7120	256 MJ/m <sup>2</sup>	191 MJ/m <sup>2</sup>	74 MJ/m <sup>2</sup>
Jaarlijkse CO <sub>2</sub> -emissie	51.394 kg	35.596 kg	10.275 kg

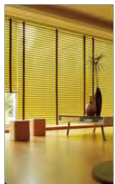
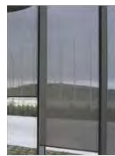
### Tekeningen





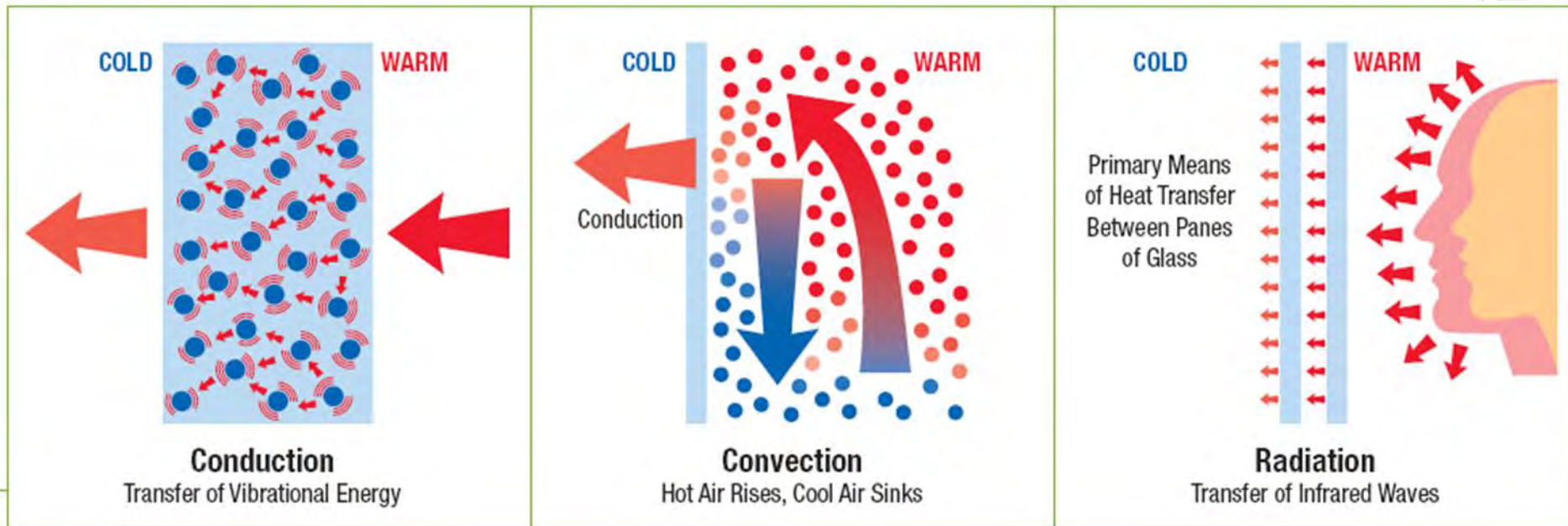
## Starting point

- Standard reference townhouse and apartment with EPC of 0,6
- Window size 140 cm X 120 cm
- U value 1,65 W/m<sup>2</sup>K = HR++ glazing in a wooden window frame
- The solar shading covers the entire window
- WIS program used for calculations



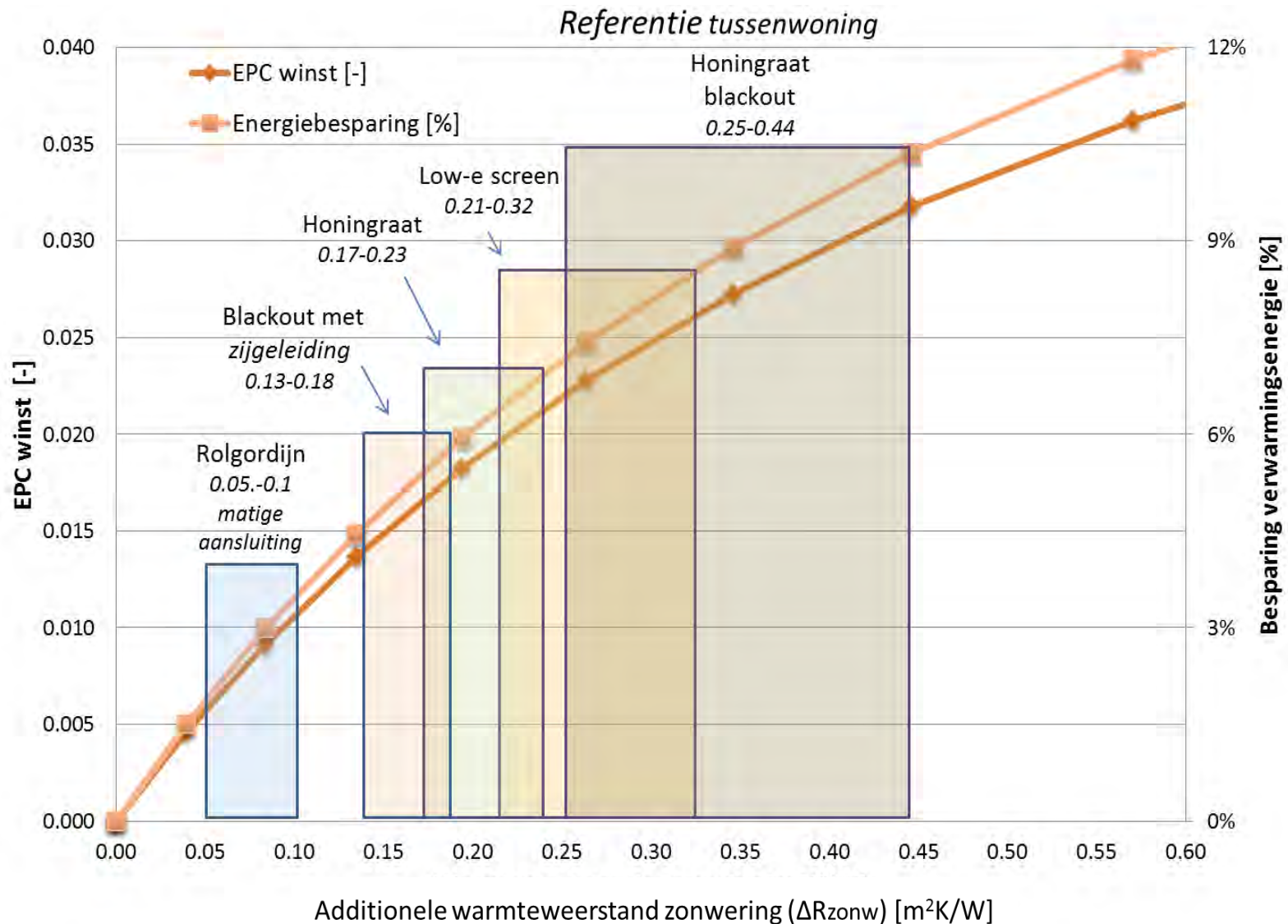


# Heat transfer

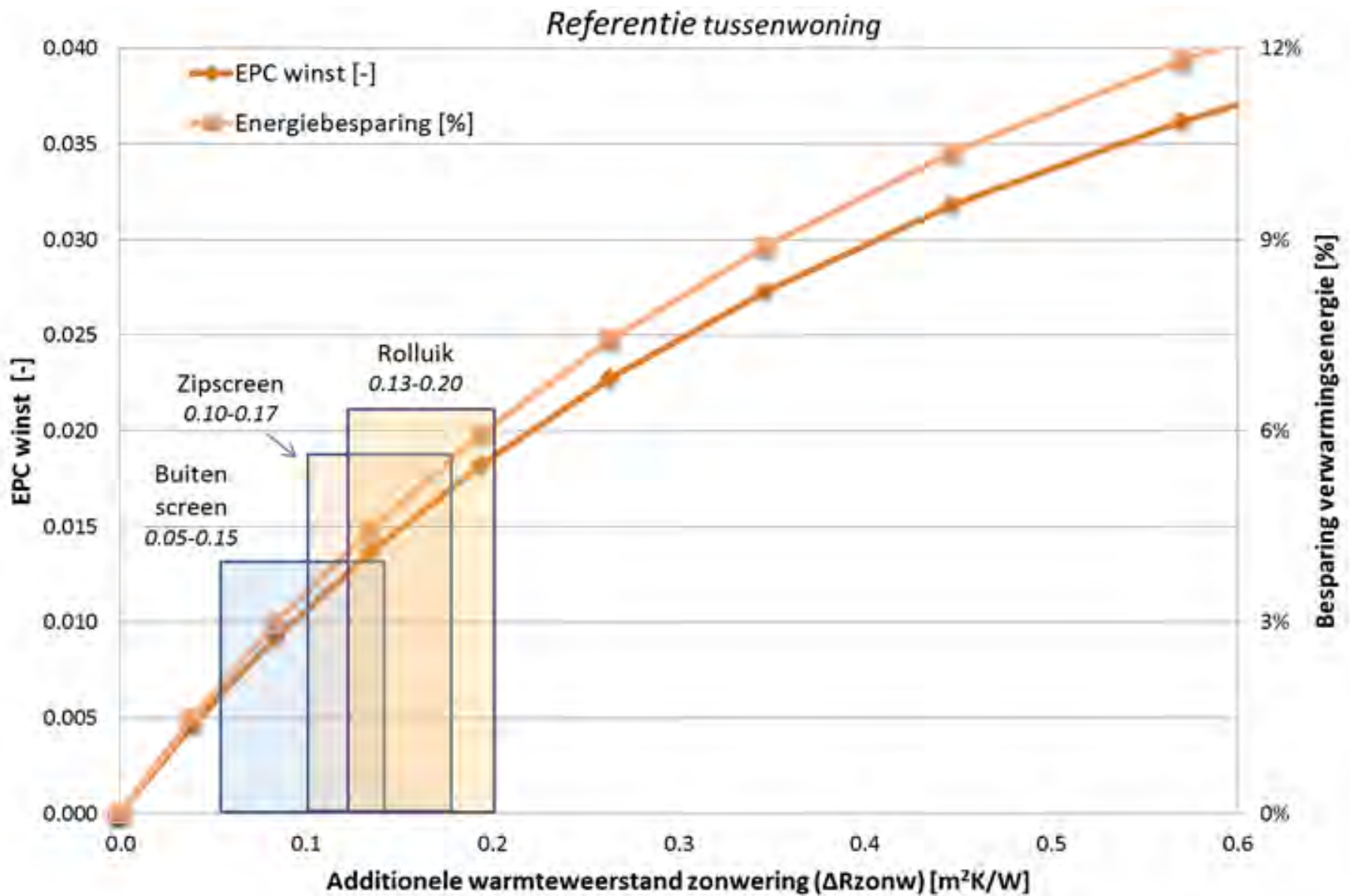


# Compare mounting methods



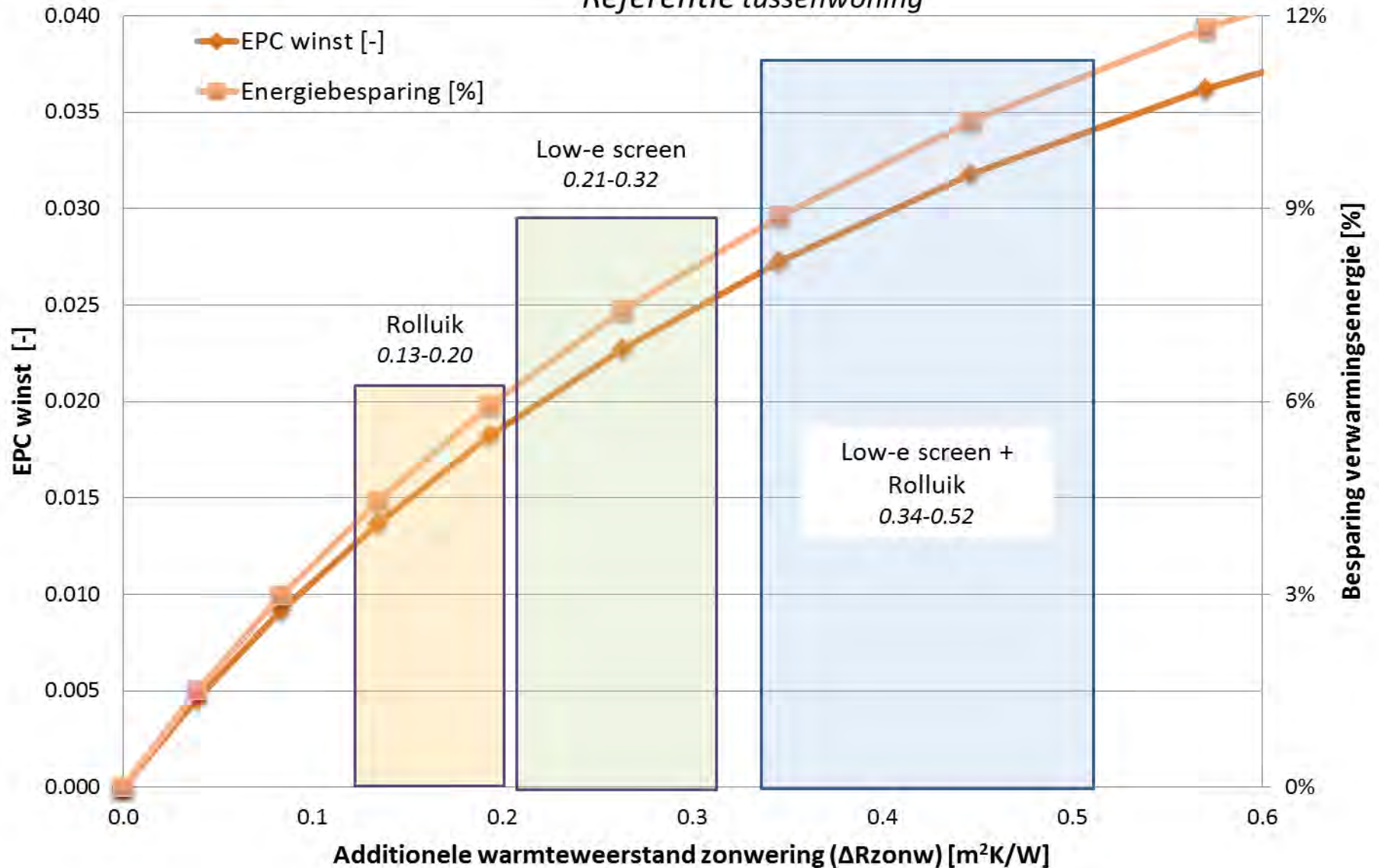


**Diagram 10: Energy savings on heating and potential EPC-gain by different types of interior shading for reference dwelling (tussenwoning).**  
**NB - reference is to apply on all façade orientations shading without adapting U-value (variant 1, table 1).**



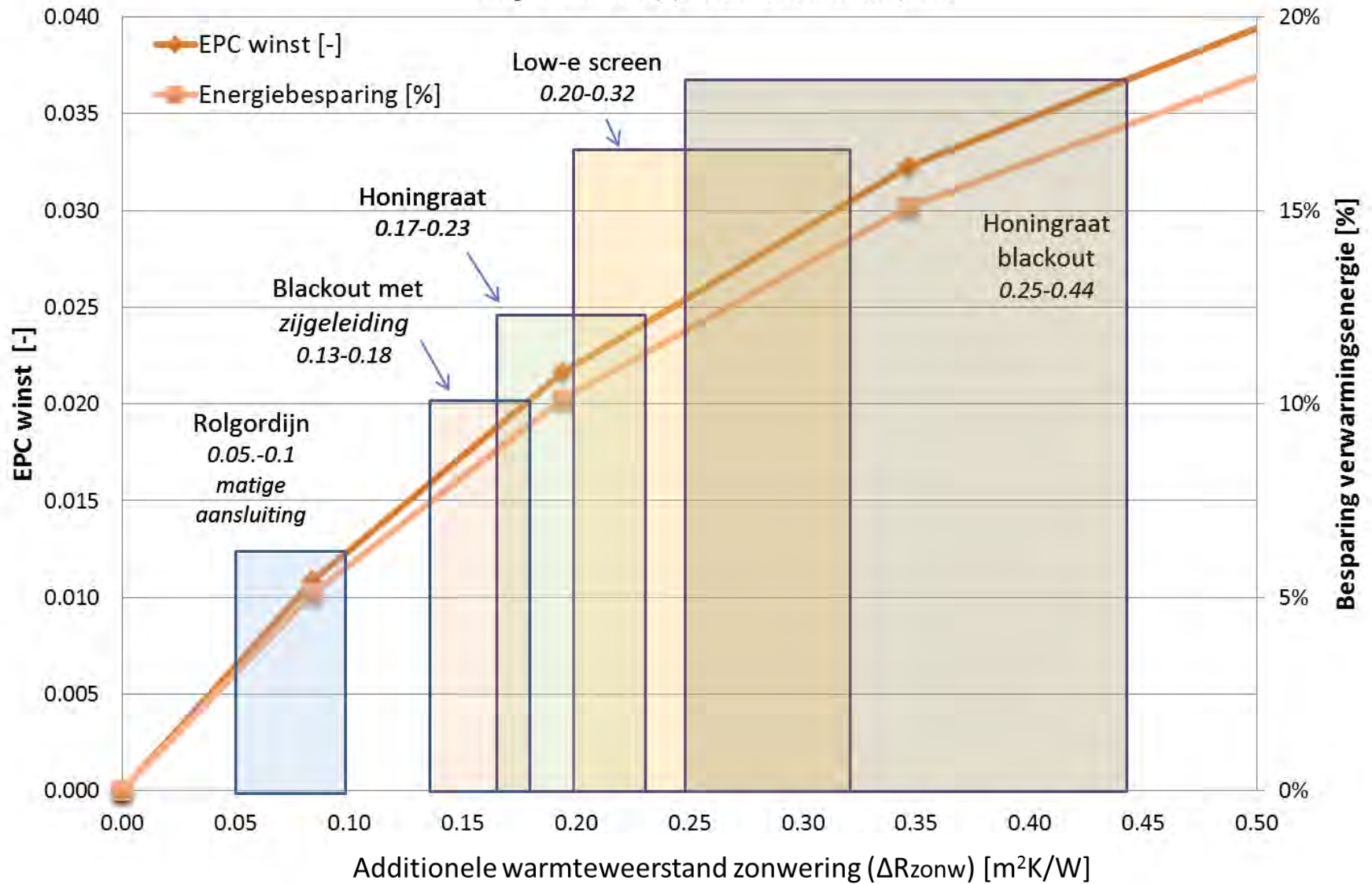
**Diagram 11: Energy savings on heating and potential EPC-gain by different types of exterior shading for reference dwelling (tussenwoning).**  
**NB - reference is to apply on all façade orientations shading without adapting U-value (variant 1, table 1).**

## Referentie tussenwoning



**Diagram 12: Energy savings on heating and potential EPC-gain by roller shutter (exterior), a low interior e-screen and a combination of both for the reference dwelling (tussenwoning).**

# Referentie appartementencomplex

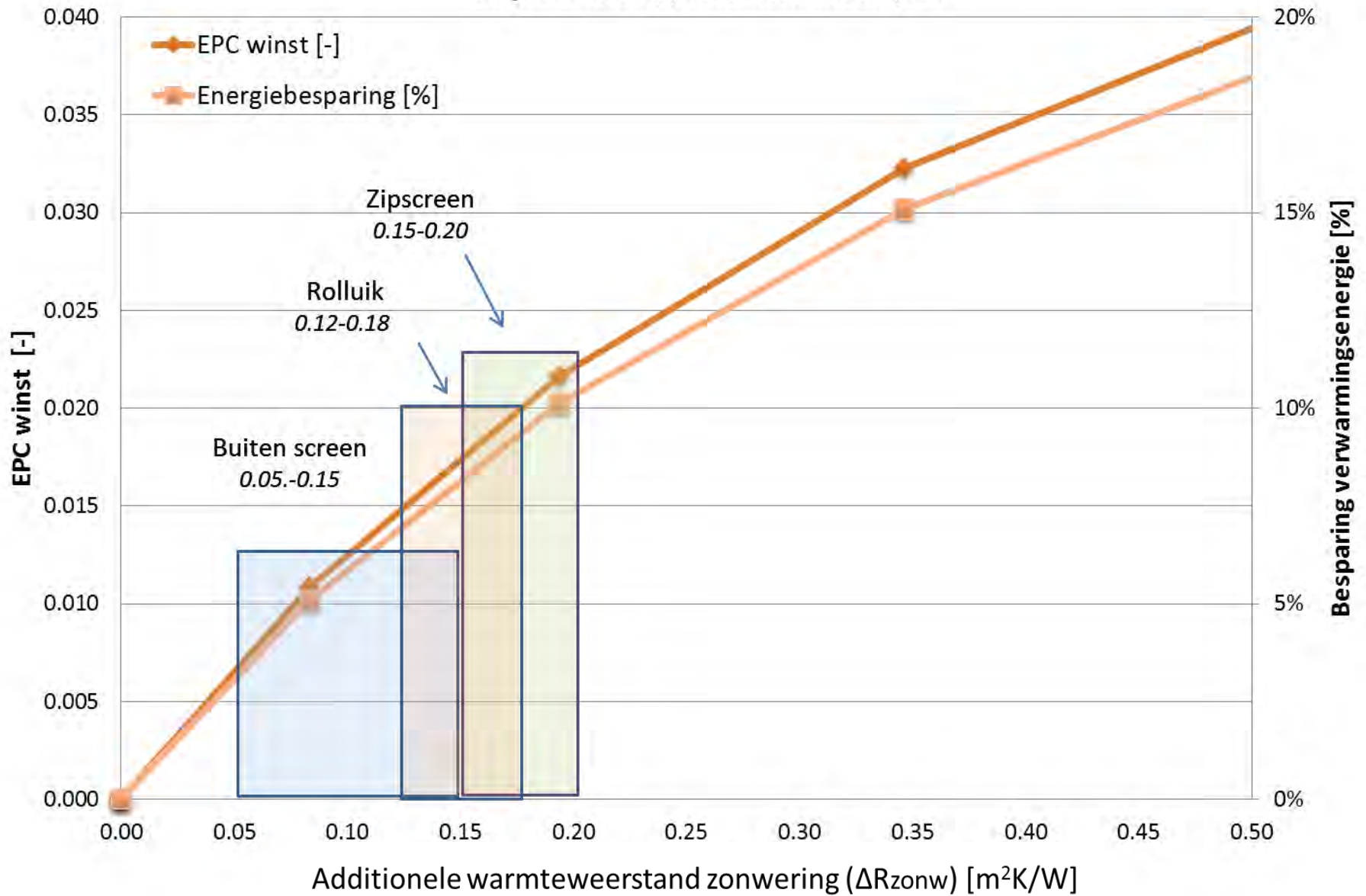


**Diagram 13: Energy savings on heating and potential EPC-gain by different types of interior shading for reference dwelling (apartment).**

**NB - reference is to apply on all façade orientations shading without adapting U-value (variant 1, table 2).**



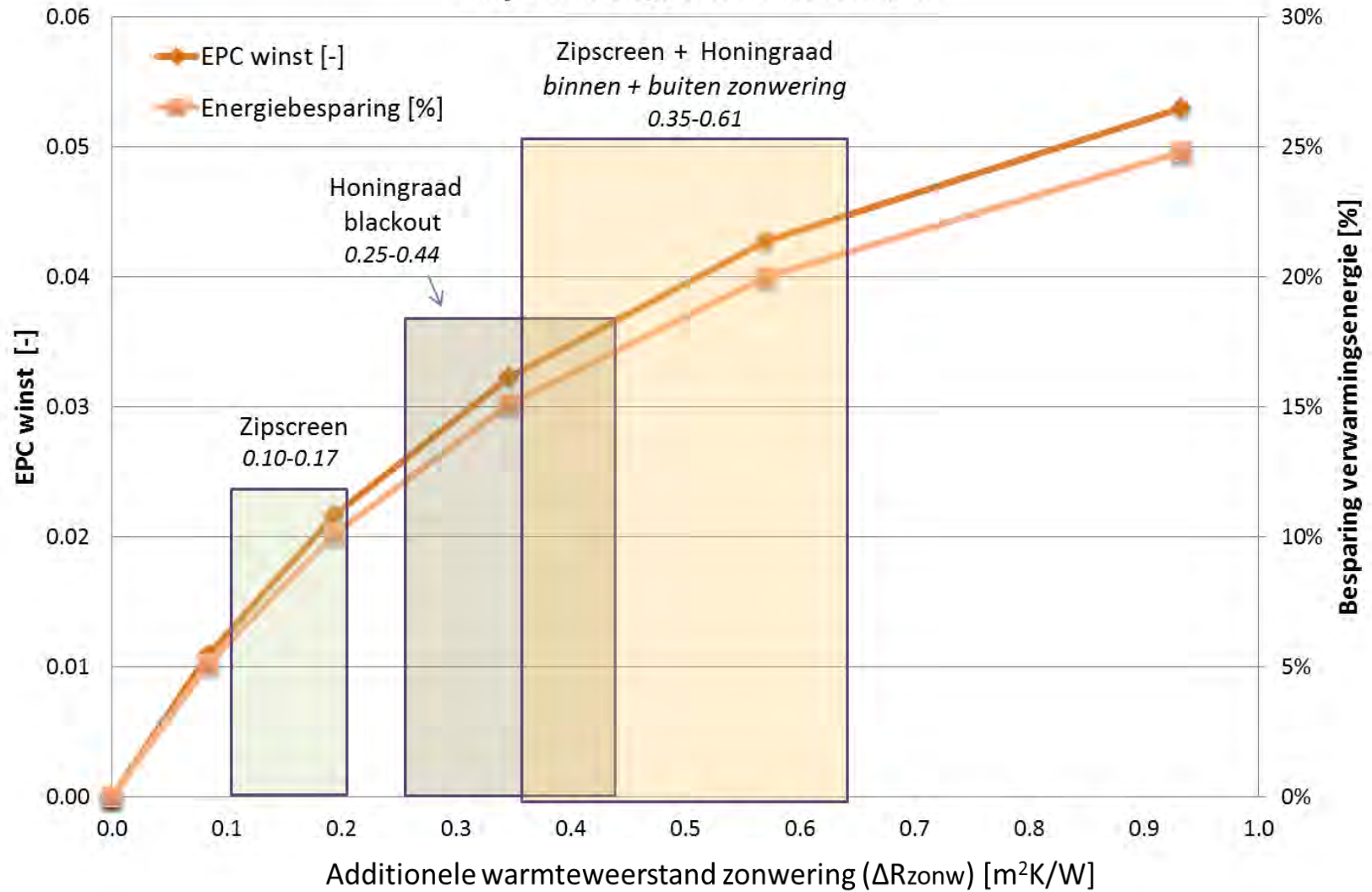
# Referentie appartementencomplex



**Diagram 14: Energy savings on heating and potential EPC-gain by different types of exterior shading for reference dwelling (apartment).**

**NB-reference is to apply on all façade orientations shading without adapting U-value (variant 1, table 2).**

# Referentie appartementencomplex



**Diagram 15: Energy savings on heating and potential EPC-gain by an exterior zip screen, an interior honeycomb black-out and a combination of both for the reference apartment.**

# Conclusions

- 1. Heat resistance of solar shading** is achieved by:
  1. The mounted position of the solar shading
  2. The airtightness of the material or system
  3. The airtightness of the connection of the junction to the cavity
  4. Coatings (for example Low-e coating)
  5. Captured air in the solar shading itself (for example honeycomb)
- 2. The calculated savings on the energy consumption** for heating by solar shading can achieve up to 17% for townhouses and 29% for apartments.
- 3. The EPC improvement is comparable for both townhouses and apartments**
4. The method makes **determining and comparing** the energy demand for heating and EPC for (combinations) of solar shading products **easier**

# Recommendations

- 1. Make sure that the cavity between the window and solar shading is as airtight as possible**
- 2. If the solar shading system also covers the whole window frame the heat resistance of the whole window will be significantly higher.**
- 3. Avoid thermal bridges for ex. by leaving space between the solar shading and the windowframe in case the solar shading also covers the window**
- 4. The combination of interior and exterior solar shading improve the thermal insulation significantly**
- 5. Automated systems can ensure solar shading is closed during the night in the heating season**