

# Energy Efficiency in Berlin's Housing Stock



...and cooperation  
projects with  
Central/East- European  
countries  
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Senatsverwaltung für  
Stadtentwicklung Berlin  
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# Berlin: Dwelling Data

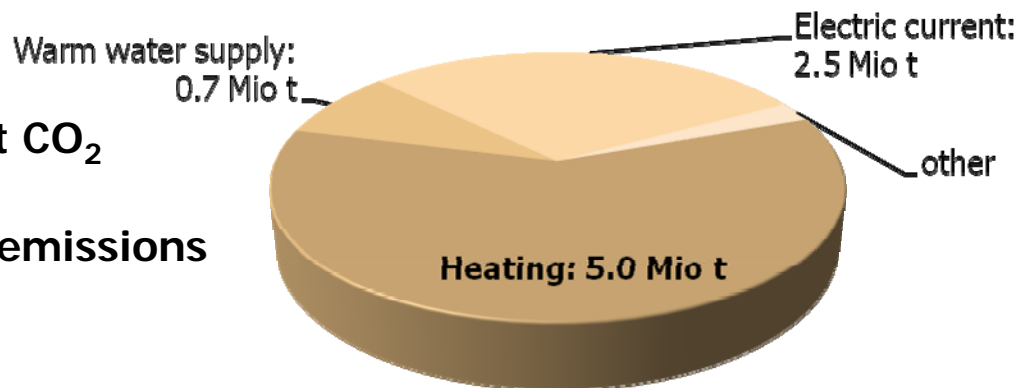
Urban population of 3.5 residents

- A total of 1.87 million dwellings,
- 1.9 residents per flat.
- Cost burden of rent below 25 % of a household's income
- Half of Berlin's housing stock was built before 1950
- 87 % of dwellings are rented flats,
- 90 % of them are flats in multi-storey buildings

# Berlin's Climate Objectives up to 2020

- **Target: CO<sub>2</sub>- Reduction (compared with 1990) 40 %**
  - 25% reduction achieved (2005) (1990: 29 Mio t; 2005: 22 Mio t)
  - To do: Further reduction of 4,3 Mio t CO<sub>2</sub> (15%) is needed (aim 2020: 17,6 Mio t = 5,2 t per inhabitant)
- **The residential housing stock can and must deliver an above average contribution**
- **CO<sub>2</sub>-Emissions of the housing stock 2005:**

- **Sum dwelling: 8,2 Mio t CO<sub>2</sub>**  
**= 37 % of Berlin's CO<sub>2</sub> emissions**



# CO<sub>2</sub>-Emissions of Different Energy Supply

<b>Specific values of energy supply and CO<sub>2</sub>-emissions</b>		
<b>Energy supply</b>	<b>Specific CO<sub>2</sub>-emissions (kg CO<sub>2</sub> per kWh final energy)</b>	<b>Primary energy coefficient</b>
Electric current	<b>0,58 bis 0,70</b>	<b>2,70</b>
Lignite	0,410	1,20
Hart coal	0,350	1,20
Oil	0,266	1,10
Natural gas	0,211	1,10
Timber (peletts)	-	0,20
Solar (thermal panels))	-	-
<b>District heating</b>		
Vattenfall	<b>0,149</b>	<b>0,567</b>
FHW MV	0,217	1,300
District heating Neukölln	0,220	0,940
BTB	0,046	0,387

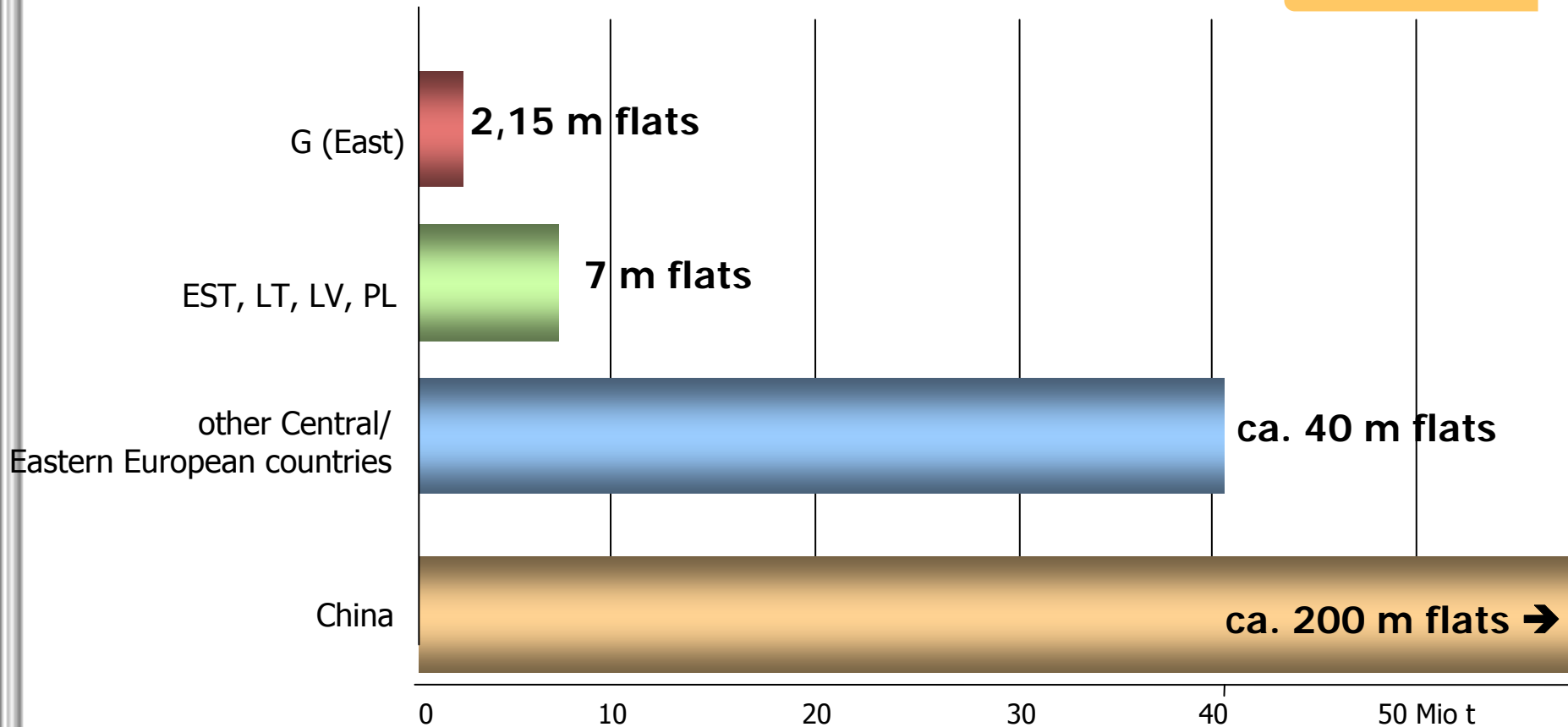
# Berlin's Own Housing Stock sets a Good Example

Heat energy consumption of Berlin's communal flats			Berlin's Average
	Sum	thereof HOWOGE	
number of flats	<b>267.824</b>	<b>48.433</b>	<b>1.840.000</b>
living space	16.746.648	2.970.212	128.248.000
m <sup>2</sup> per flat	<b>62,53</b>	<b>61,33</b>	<b>69,70</b>
<b>Final energy consumption</b>			
in MWh	1.912.809	229.732	20.519.680
kWh per flat	7.142	4.743	11.152
kWh/m <sup>2</sup> a	<b>114,22</b>	<b>77,35</b>	<b>160,00</b>
	<b>100 %</b>	<b>68 %</b>	<b>140 %</b>
<b>Primary energy consumption</b>			
in MWh	1.715.185	160.518	
kWh per flat	6.404	3.314	
kWh/m <sup>2</sup> a	102,42	<b>54,04</b>	135,00
	<b>100 %</b>	<b>53 %</b>	
<b>CO2-emissions</b>			
in t/a	377.896	37.750	4.924.723
tons per flat annually	1.411	0,78	2,68
kg/m <sup>2</sup> a	22,57	<b>12,71</b>	38,40
kg CO2 per kWh final energy consumption	<b>0,198</b>	<b>0,164</b>	<b>0,240</b>
	<b>100 %</b>	<b>56 %</b>	

# Renovation in Berlin



# Prefabricated Housing



# Achieved State of Renovation in Berlin

Total renovation investments (for the 273.000 precast flats): **5,5 Mrd. €**

- 65 % total renovated
- 35 % prevailing partly renovated
- Average renovation investments: 20.000 € per flat
- Included: 1.000 € per flat for surroundings

# The „Berlin“ Pilot Project in Riga



# Focus of Urb.Energy

## Focus of BEEN:

- What is the optimal package of energy-saving measures for prefabricated housing?
- How can be achieved, that the condominium ownerships (installed after privatisation) become able to implement these measures?

## Focus of Urb.Energy:

- Upgrading of the residential environment and infrastructure
- Integrated concepts for holistic rehabilitation of residential areas

# Subject of BEEN: The Traditional Package of Energy-Saving Measures

Measures		Function and purpose of measures
<b>Insulation</b>	gable	Reduction of heat loss
	longitudinal walls	
	top floor ceiling	
	cellar ceiling	
	heating pipes	Avoidance of unnecessary heat loss
<b>New windows</b>		Reduction of heat loss via window panes and frames
		Avoidance of unnecessary heat loss (due to unwanted draughts of rickety windows)
<b>Heating system</b>		To enable the realisation of energy savings



# Bleak Concrete Slabs Facades



# BEEN Best-Practice Projekt Paldiski Road 171, Tallinn (Estland)



# Learnt from Pilot-Projects?

What have we learnt from

- pilot projects and
- pilot programmes

with the aim

- to activate self-running large-scale refurbishment measures?

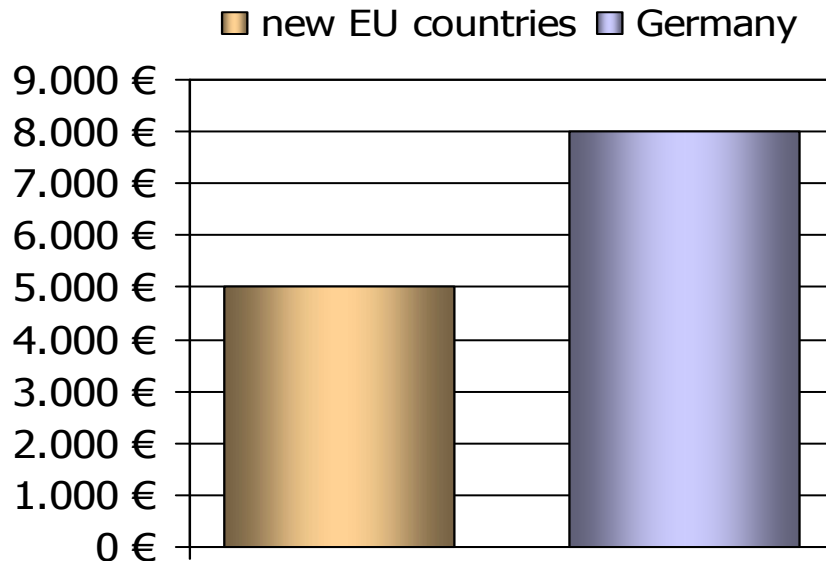


# Pilot Project in Beijing (GTZ China)



# Savings Potential in terms of the Final Energy Need of Dwelling

## Costs of energy-saving measures per flat



## Achievable Energy Savings: 50 %

i.e. per flat (54 m<sup>2</sup>) annually:

- reduction of heating need: **4.200 kWh**
- saving primary energy: **500 to 700 litres oil** (or equivalent gas, coal)
- reduction CO<sub>2</sub>: **1 to 1,4 t**

# Potential of Heating Cost Savings

per average flat building type 2		EST, LT, LV, PL (54 m <sup>2</sup> )	D (East) (56 m <sup>2</sup> )
Energy prices (per kWh)		0,03 €	0,06 €
Annual heating consumption	PRIOR renovation	8.370 kWh	8.990 kWh
Annual heating costs		251,10 €	539,40 €
Monthly heating costs		20,93 €	44,95 €
<b>Potential of saving</b>		<b>50%</b>	
Monthly heating costs savings		<b>10,46 €</b>	<b>22,48 €</b>

# Scope for Renovation Apportionments

Monthly per average flat	EST	LT	LV	PL	D (East)
Disposable household incomes	450,00 €	366,00 €	350,00 €	530,00 €	1.700,00 €
Typical housing costs	87,50 €	66,50 €	62,50 €	107,50 €	300,00 €
	19,4 %	18,2 %	17,9 %	20,3 %	17,6 %
Reasonable burden of housing costs in % of income	25,0 %				
Scope for renovation apportionments	25,00 €				125,00 €

# Scope for Financing in Total

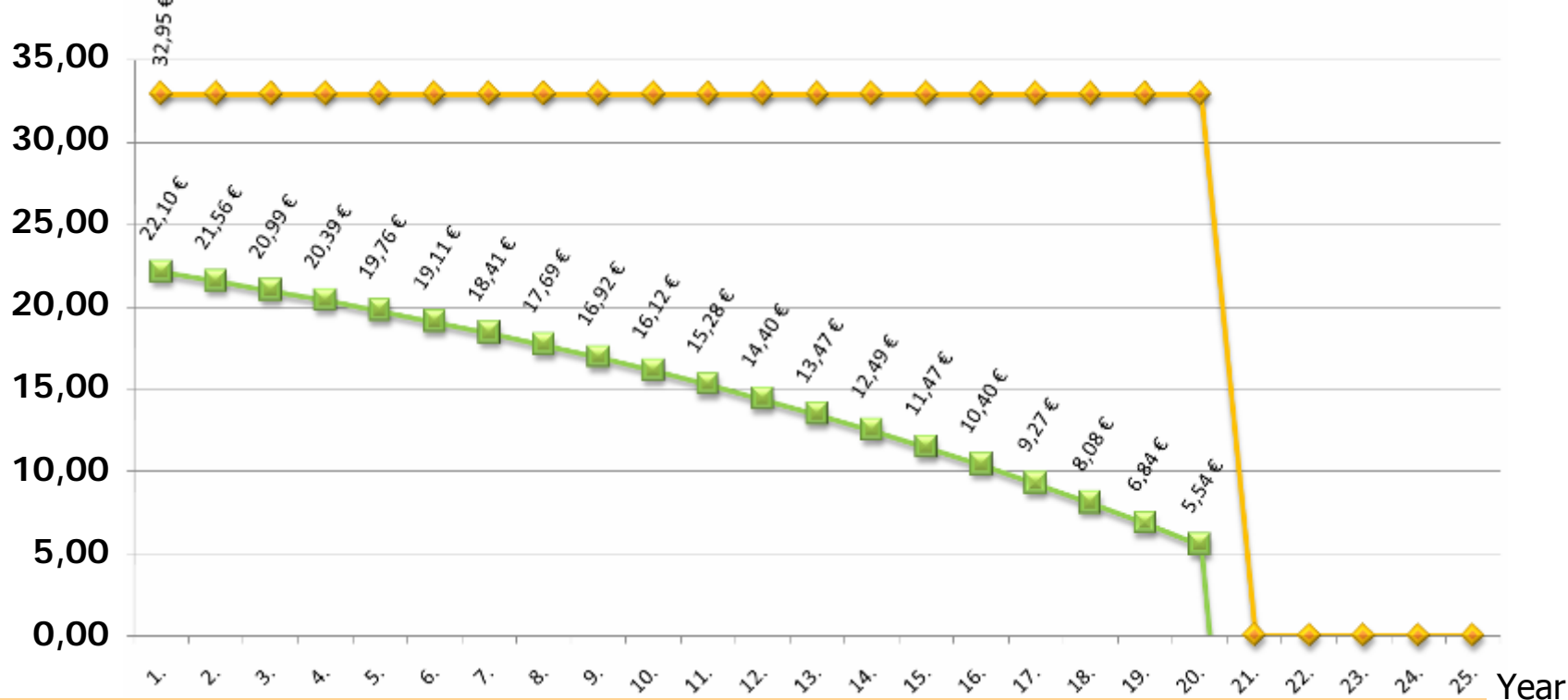
	EST LT LV PL	D (East)
Renovation apportionments	25,00 €	125,00 €
Scope of monthly heating cost savings	10,00 €	20,00 €
Sum of financing scope	35,00 €	145,00 €

# What Renovation Investments can be financed?

		EST LT LV PL	D (East) in the 1990th
Loan conditions	Term in years	8 to 12 years	20 to 25 years
	Interest	4,5 to 7 %	6 to 8 %
	Annuity ( $\Sigma$ redemption and interest )	15 %	8,5 %
Financing scope		35,00 €	145,00 €
Achievable loan		2.625,00 €	20.470,59 €
By comparison: costs of energy-saving measures		ca. 5.000 €	ca. 8.000 €

# Monthly Loan Apportionments per Flat with a BEEN recommended Support Loan

Apportionment in €  
per month and flat



◆ Loan burden (sum interest and redemption)  
for a loan amount of 5.000 € per flat,  
5 % interest; annuity 7,91 %

■ Burden after heating cost savings  
(for increasing energy prices  
by annually 5%)

# Advantages of Wall Insulation beyond Energy-saving Effects



Saves maintenance costs

Eliminates mould and mildew

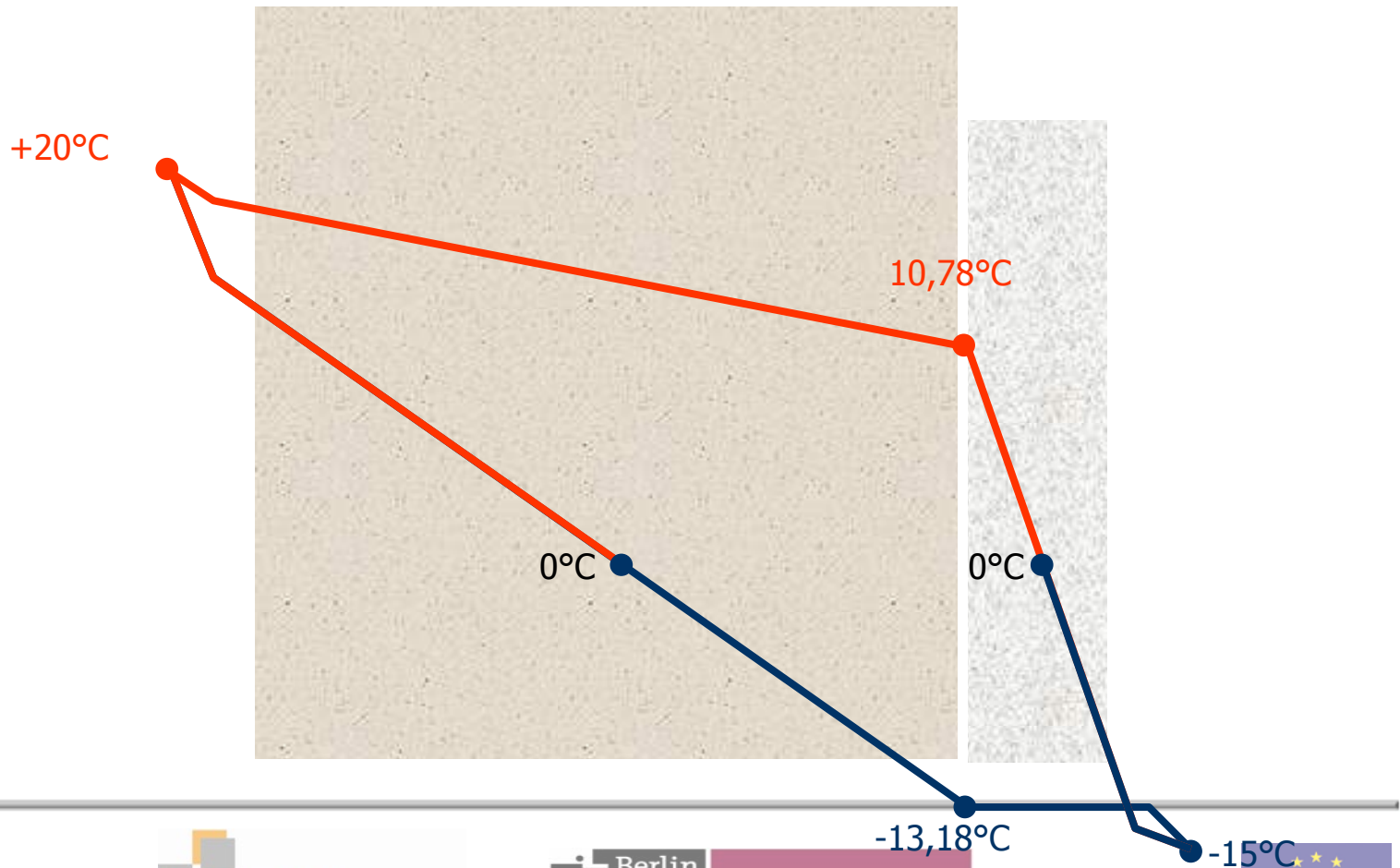
Eliminates “cold radiation”

Keeps temperatures balanced

New exterior appearance



# Wandering of the Dew Point due to Thermal Insulation



# Insulation Layer Thickness

**Influence of the insulation thickness in respect of the heat energy losses of prefabricated housing (Type 2)**

Thickness of insulation layer	U-value in W/m <sup>2</sup> K	Heat energy loss in kWh/m <sup>2</sup> per annum	Savings	Increase
Uninsulated exterior wall	1,30	82,00	–	–
1 cm	0,98	61,88	24,50%	24,50%
2 cm	0,79	49,70	39,40%	14,80%
4 cm	0,57	35,64	56,50%	17,20%
<b>8 cm</b>	<b>0,35</b>	22,77	72,20%	15,70%
<b>12 cm</b>	<b>0,27</b>	16,72	79,60%	7,40%
16 cm	0,21	13,25	83,80%	4,20%
20 cm	0,17	10,91	86,70%	2,80%

