

# Current solutions for the energy transition

A feasibility study for homeowners.

Tim Luijt | P5 presentation | April 12, 2019

'... the great reconstruction ...'

# 2050

Energy neutral built environment

78%



Utility  
9%



Social  
12%



Private  
19%



# Annual transition rate

Current

2.000

By 2021

50.000

By 2030 until 2050

200.000



## Main barriers

Expensive

39%

No benefit

24%

No knowledge

24%

# Servitization

Going from products  
to services



# Problem Statement

Mismatch between national ambition and capacity of homeowners to become gas-free.

Homeowners miss information

Effect of servitization is unknown

“What does the energy transition mean  
for the private housing stock  
to become gas-free? ”

# Methodology

# Transition tool

1. Transition packages
2. Quantify effect of servitization

Building Performance  
Simulation (BPS) model

Feasibility analyses (both  
economic and financial)

# Input



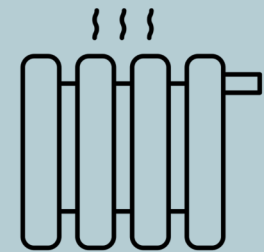
19 target groups

3.7 million houses  
16% of NL energy



4 user groups

Average, working couple,  
family, elderly



Current: gas-boiler

Future: air-source heat pump  
(45°C, 55°C, 65°C)

## Economic feasibility

'Traditional model'

$$F_{eco} = \frac{\text{initial cost} - \text{price premium}}{\Delta \text{operational costs}} < \left( \begin{array}{c} \text{moving cycle} \\ -1 \text{ year} \end{array} \right)$$

## Financial feasibility

'Servitization model'

$$F_{fin} = \frac{\text{Leasing costs}}{\Delta \text{operational costs}} < 100\%$$

		Depreciation period			
		10 years	15 years	20 years	25 years
Interest rate	3%	11,6%	8,3%	6,7%	5,7%
	4%	12,2%	8,9%	7,3%	6,3%
	5%	12,7%	9,5%	7,9%	7,0%
	6%	13,3%	10,1%	8,6%	7,7%
	7%	13,9%	10,8%	9,3%	8,4%



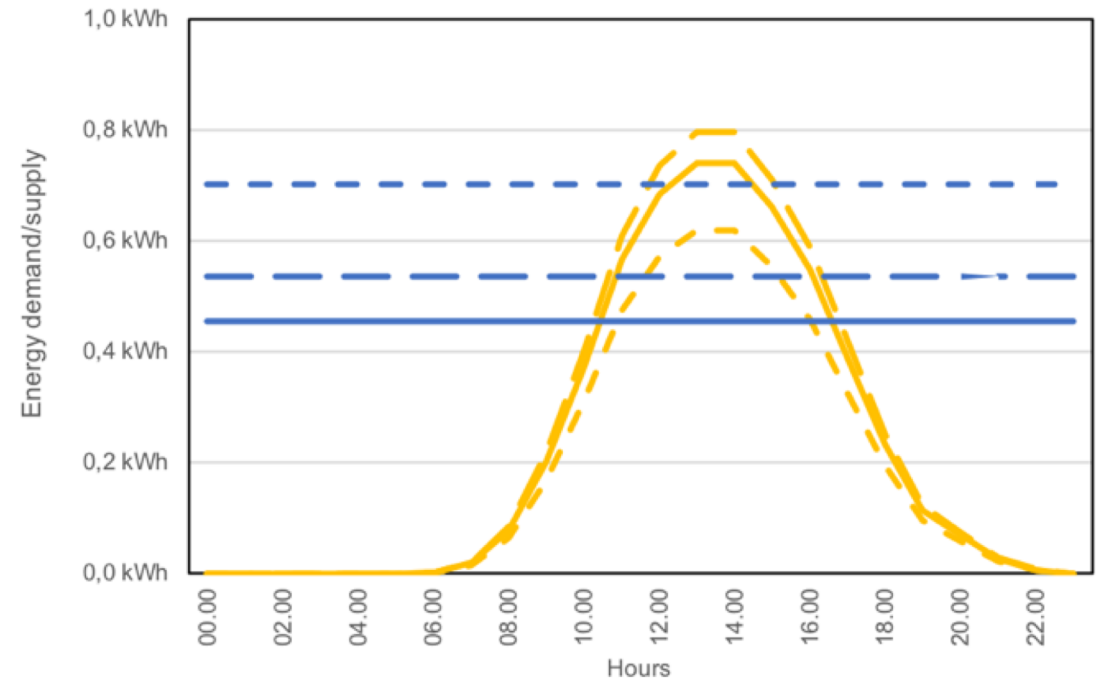
INPUT

SERVICE

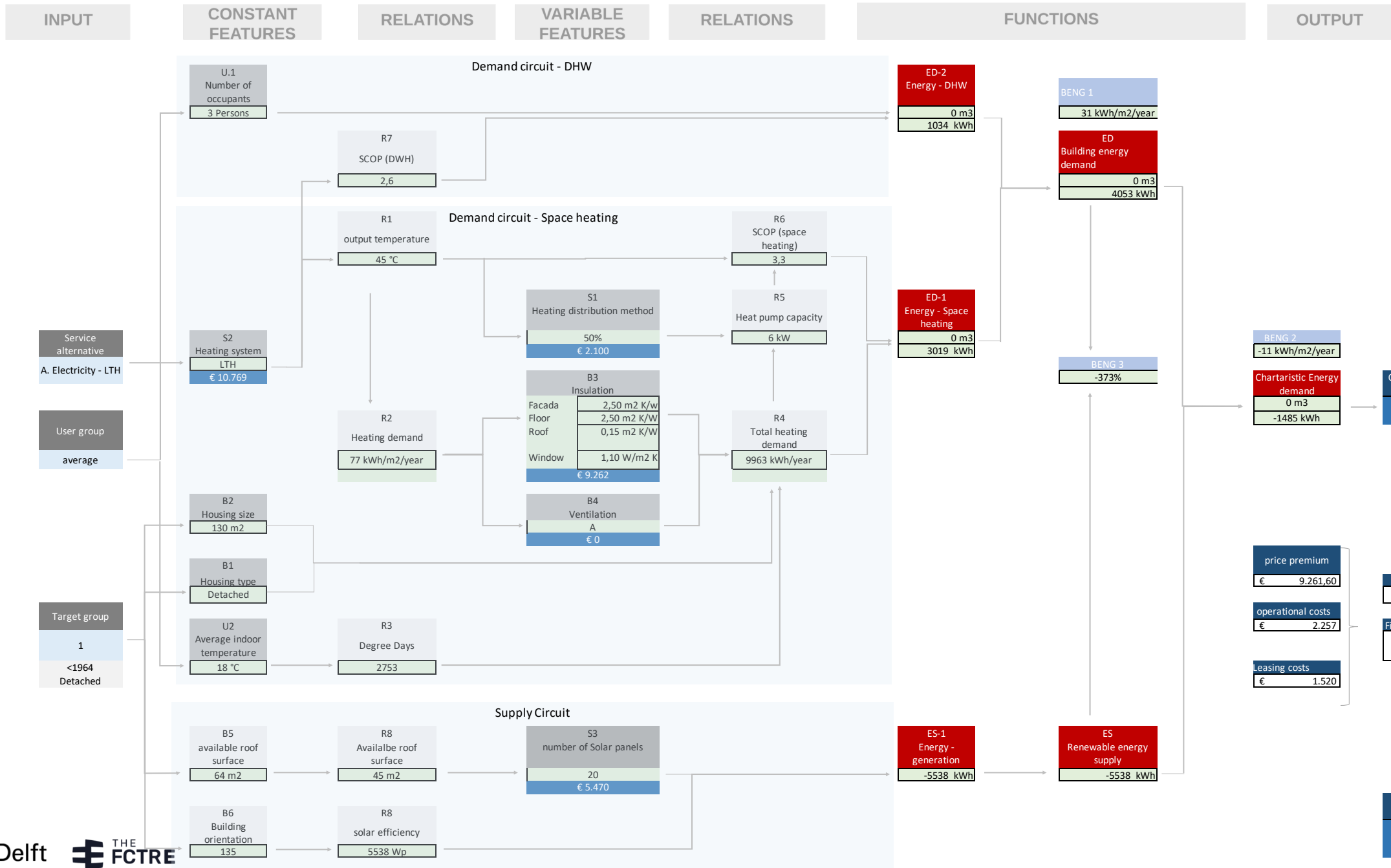
USER

BUILDING

## SSR (Self Sufficiency Ratio)



- Energy supply (8 panels 180 degrees)
- Energy supply (8 panels 135 degrees)
- - Energy supply (8 panels 90 degrees)
- Energy demand (heat pump Alternative A)
- Energy demand (heat pump Alternative B)
- - Energy demand (heat pump Alternative C)



# Output

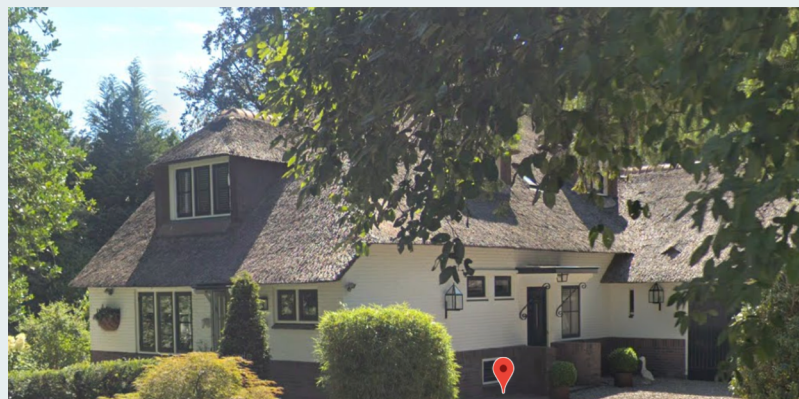
Scenariosamenvatting								
	1 current	1A	1B	1C	2 current	2A	2B	2C
Veranderende cellen:								
target_group	1	1	1	1	2	2	2	2
service alternative	0 A	B	C		0 A	B	C	
Resultaatcellen:								
target_group	1	1	1	1	2	2	2	2
construction_period	<1964	<1964	<1964	<1964	1965-1974	1965-1974	1965-1974	1965-1974
B1 Housing_type	Detached	Detached	Detached	Detached	Detached	Detached	Detached	Detached
B2 Surface	130 m2	130 m2	130 m2	130 m2	144 m2	144 m2	144 m2	144 m2
B5 floors	2 layers	2 layers	2 layers	2 layers	2 layers	2 layers	2 layers	2 layers
B6 building_orientation	135,0°	135,0°	135,0°	135,0°	135,0°	135,0°	135,0°	135,0°
user_group	average	average	average	average	average	average	average	average
U1 Number_of_occupants	3 persons	3 persons	3 persons	3 persons	3 persons	3 persons	3 persons	3 persons
U2 average_indoor_temperature	18 °C	18 °C	18 °C	18 °C	18 °C	18 °C	18 °C	18 °C
B3 facade	0,36	2,5	0,36	0,36	0,43	2,5	0,43	0,43
B3 insulation_roof	0,15	0,15	0,15	0,15	0,17	0,17	0,17	0,17
B3 Ground_Floor	0,39	2,5	2,5	0,39	0,86	2,5	2,5	0,86
B3 Glazing_insulation	5,2	1,1	5,2	5,2	5,2	5,2	5,2	5,2
B4 Ventilation_metod	A	A	A	A	A	A	A	A
S1 radiant_heating_method	100%	50%	80%	100%	100%	50%	80%	100%
S1 Convective_heating_method	0%	50%	20%	0%	0%	50%	20%	0%
S2 Heat_pumP_TYPee	-	LTH	LTH	HTH	-	LTH	LTH	HTH
S3 Number_of_solar_panels	0 panels	20 panels	20 panels	20 panels	0 panels	20 panels	20 panels	20 panels
R1 minimal_heating_demand	166	61	106	166	169	69	106	169
R2 total_heating_demand	21546	7987	13828	21546	24353	9967	15206	24353
R3 available_roof_surface	64 m2	64 m2	64 m2	64 m2	60 m2	60 m2	60 m2	60 m2
R4 output_temperature	65 °C	45 °C	55 °C	65 °C	65 °C	45 °C	55 °C	65 °C
R5 Efficiency_space_heating	0,9	3,3	2,8	2,6	0,9	3,3	2,8	2,6
R6 Efficiency_DHW	0,9	2,6	2,6	2,9	0,9	2,6	2,6	2,9
R7 heat_pumps_capacity	0	6	8	20	0	6	8	20
R8 solar_efficiency	277 kWh	277 kWh	277 kWh	277 kWh	277 kWh	277 kWh	277 kWh	277 kWh
R9 Degree_days	2753	2753	2753	2753	2753	2753	2753	2753
ED1-G Gas_space_heating	2449 m³	0 m³	0 m³	0 m³	2768 m³	0 m³	0 m³	0 m³
ED2-G Gas_Domestic_hot_water	300 m³	0 m³	0 m³	0 m³	300 m³	0 m³	0 m³	0 m³
ED1-E Elec_space_heating	-	2.420	4.939	8.450	-	3.020	5.431	9.550
ED2-E Elec_Domestic_hot_water	0 kWh	1034 kWh	1034 kWh	900 kWh	0 kWh	1034 kWh	1034 kWh	900 kWh
ES1 Elec_solar_panels	0 kWh	-5538 kWh	-5538 kWh	-5538 kWh	0 kWh	-5538 kWh	-5538 kWh	-5538 kWh
ES2 Elec_BESS								
Etot-G Tot_gas_consumption	2749 m³	0 m³	0 m³	0 m³	3068 m³	0 m³	0 m³	0 m³
Etot-E Tot_electricity_consumption	0 kWh	-2084 kWh	434 kWh	3811 kWh	0 kWh	-1484 kWh	926 kWh	4912 kWh
BENG_1	186	27	46	72	187	28	45	73
BENG_2	186	-16	3	29	187	-10	6	34
BENG_3	0%	-266%	1275%	145%	0%	-373%	598%	113%
oper Costs gas space heating	€ 2.073	€ -	€ -	€ -	€ 2.313	€ -	€ -	€ -

Detached house, build between 1946 and 1964, average user group:

Service	Heat pump type A	Heat pump type B	Heat pump type C
Economic feasibility	9 years	15 years	37 years
Financial feasibility	-18%	6%	55%

# Case study

## Transition tool validation




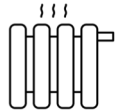
# Results

# Transition packages

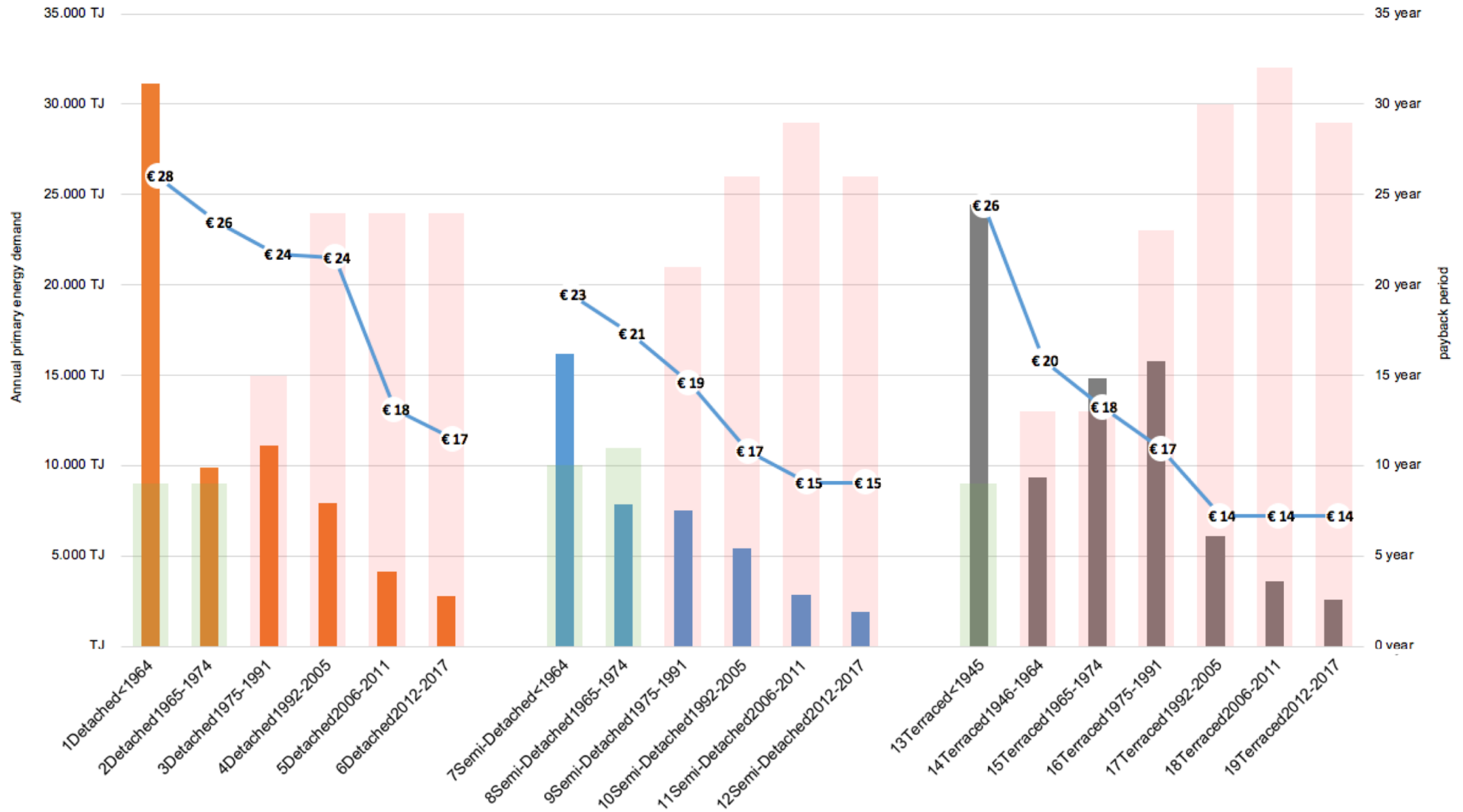
Detached

target group	<1945	<1965 / 1946-1964	1965-1974
Optimal service alternative		A	A
Average		9 year -18%	9 year -21%
Optimal service alternative		A	A
Working couple		12 year -3%	11 year -11%
Optimal service alternative		A	A
Familiy		9 year -17%	9 year -20%
Optimal service alternative		A	A
Elderly		8 year -38%	7 year -35%

<1945	<1965 / 1946-1964	1965-1974
	1	2
	A	A
	9 year -18%	9 year -21%
	A	A
	12 year -3%	11 year -11%
	A	A
	9 year -17%	9 year -20%
	A	A
	8 year -38%	7 year -35%

	Insulation measures	€9.261
	<ul style="list-style-type: none"> <li>- Façade: FA-1 (cavity wall)</li> <li>- Floor: FL-1 (bottom insulation)</li> <li>- Roof: no measures</li> <li>- Window: WI-1 (HR++)</li> </ul>	
	Heating distribution system	€2.100
	Heat pump	€10.768
	- LTH air source 8kW	
	Solar panels	€5.469
	- 20x 300Wp solar panels	
Costs	Total initial costs	€27.599
Benefits	Yearly operational costs savings	€1.936
	Housing value increase	€9.261
Feasibility: Economic Financial	Payback period	9 years
	Annual operational costs	- 17 %

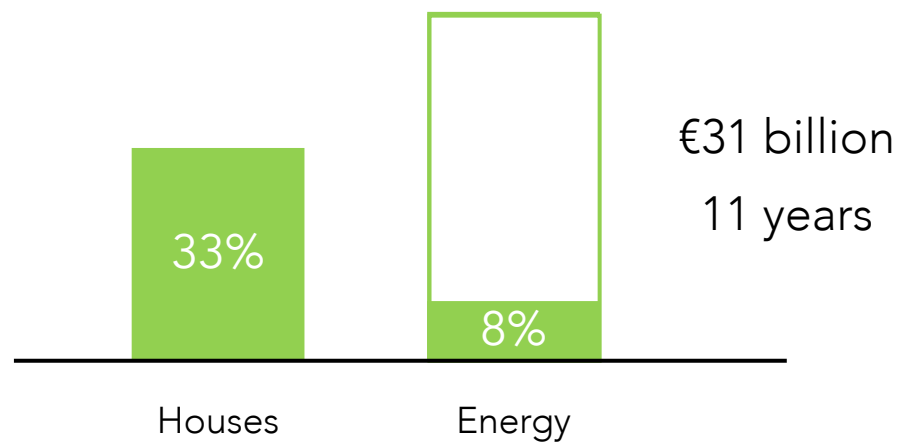
A	A	B	A
13 year	25 year	24 year	21 year
6%	36%	47%	44%



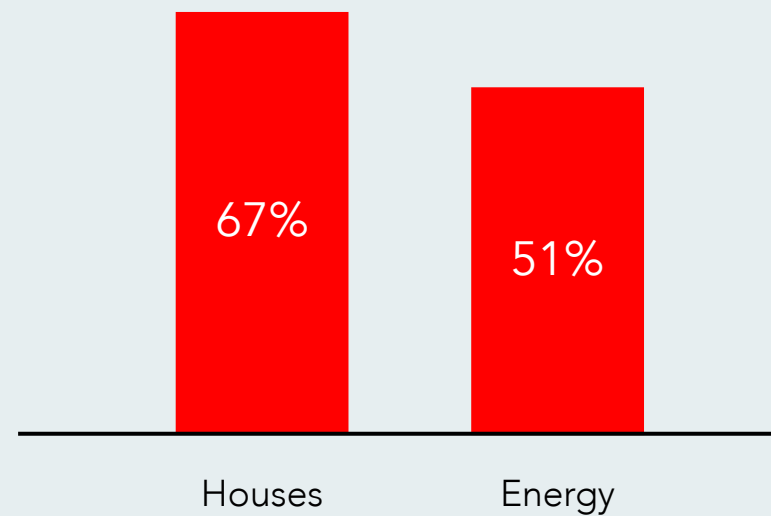
# Conclusions



## Feasible



## Not feasible



# Servitization

	Traditional model	Servitization model
Feasibility rate	33%	33%
Investment	€24.800	X
Moving cycle	Dependent	Flexible
Total Cost of Ownership	>11.3 years	<11.3 years

# Servitization

Feasibility rate

Investment

Traditional model

33%

€31 billion



Servitization model

33%

€46 billion

		15 years
Interest rate	2%	51%
	3%	46%
	4%	38%
	5%	33%
	6%	33%
	7%	30%
	8%	23%

# Wrap up

- Empowerment of 1.2 million homeowners
- Additional perspective through servitization

'Guts & Courage'

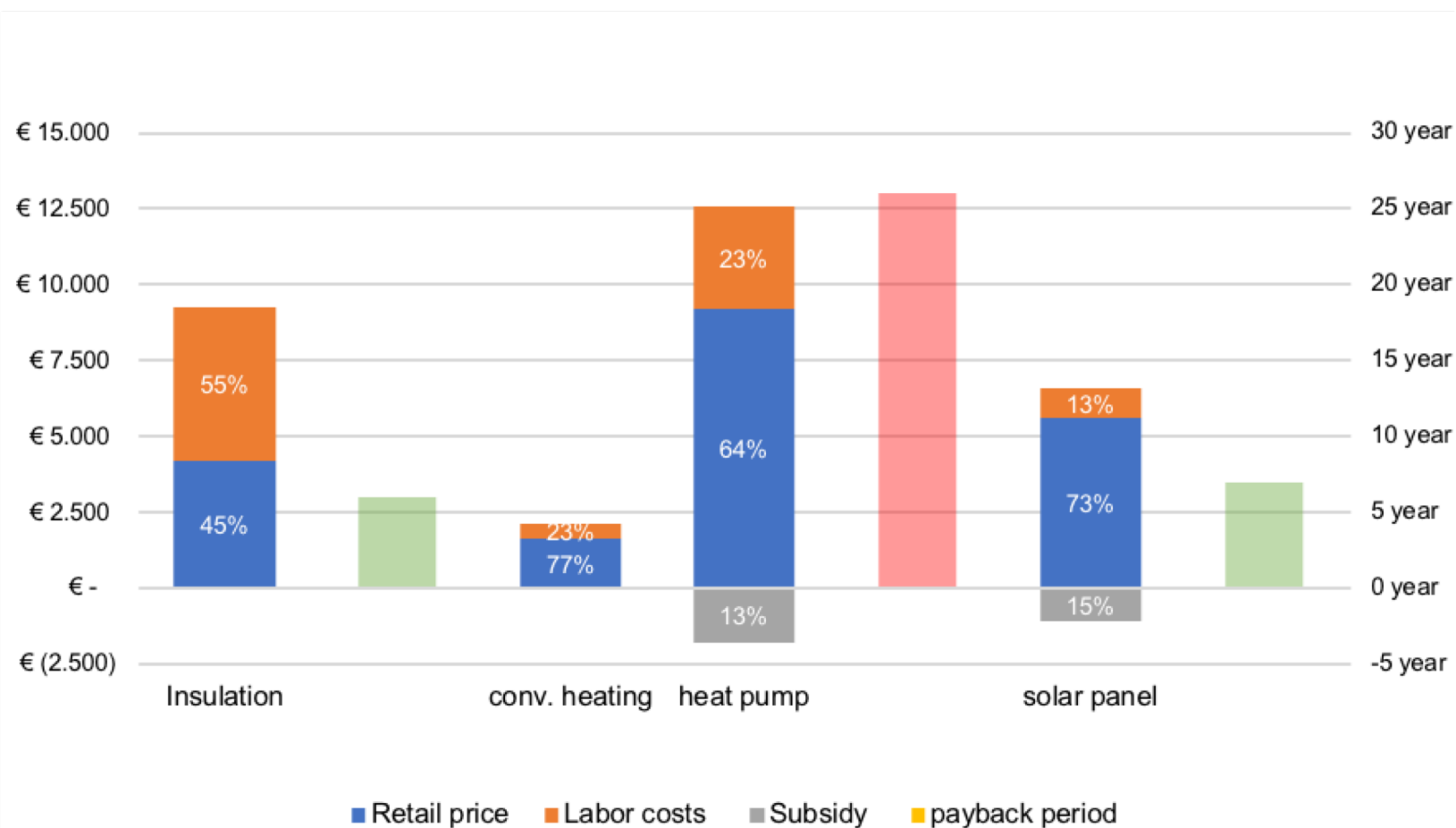
# THANK YOU

Any questions?

# References

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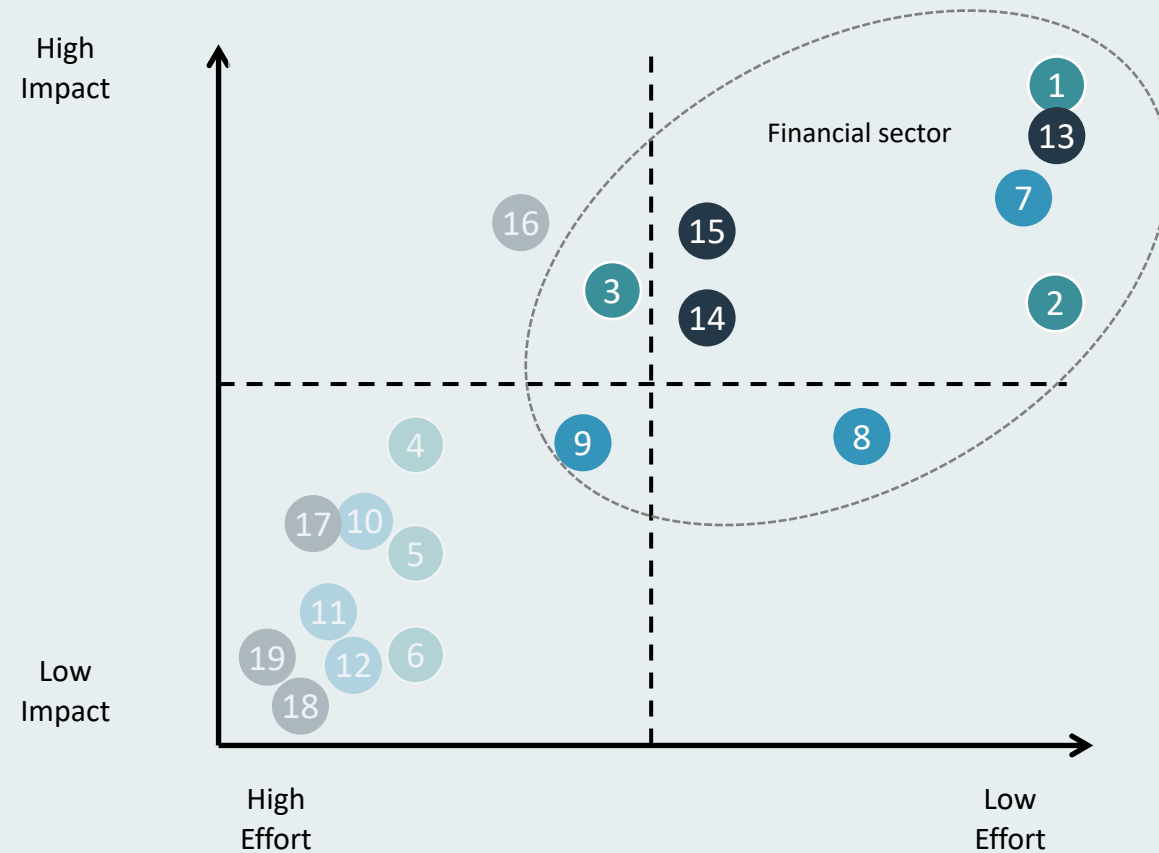
# Cost breakdown



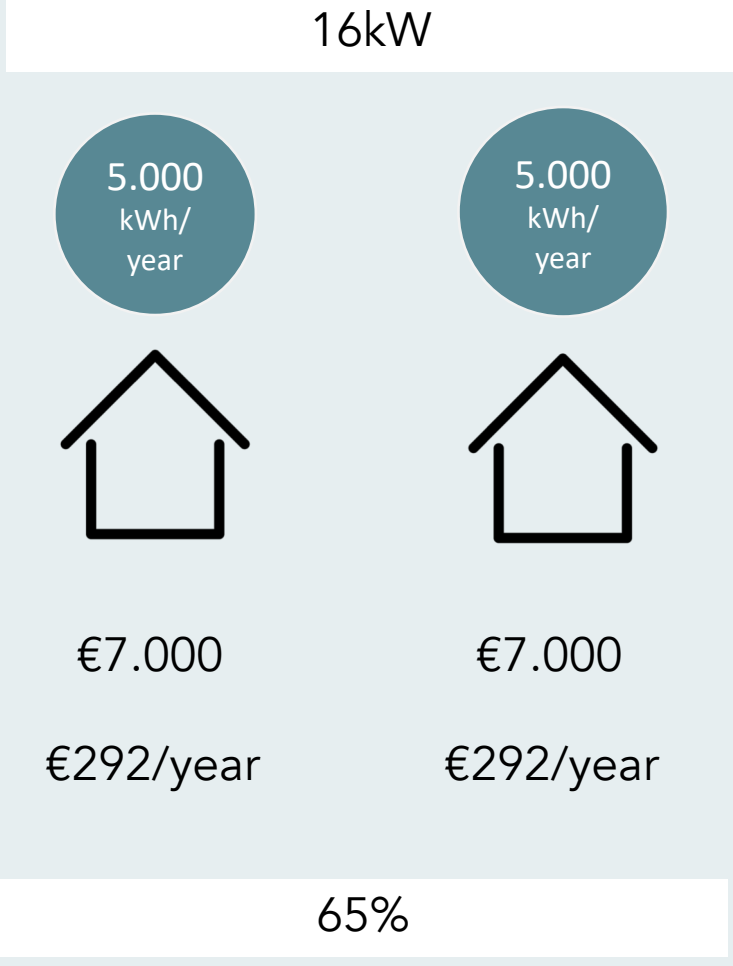
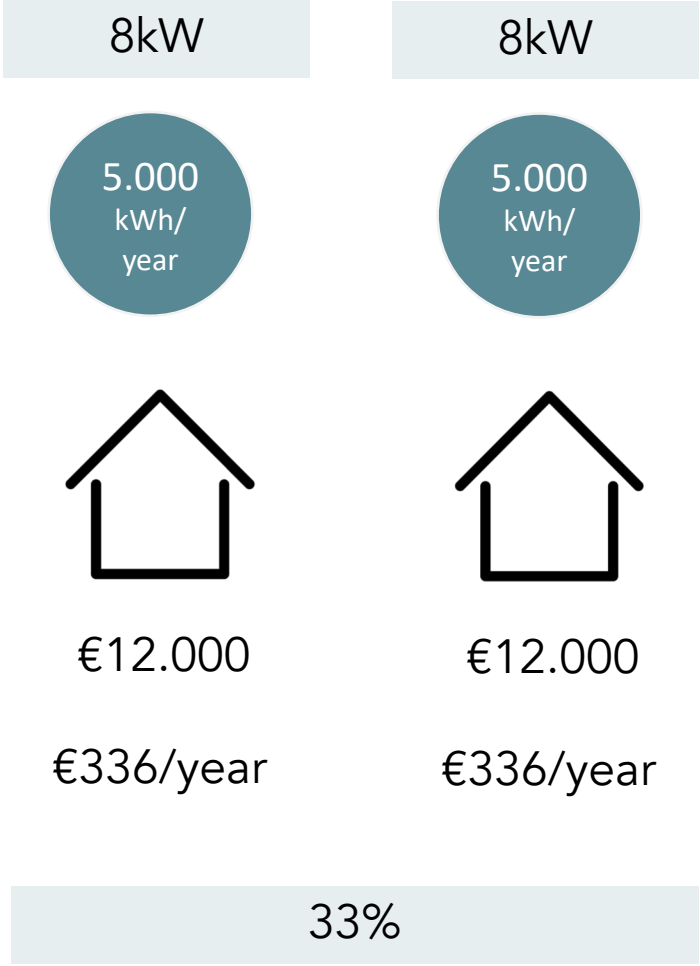


# Implications

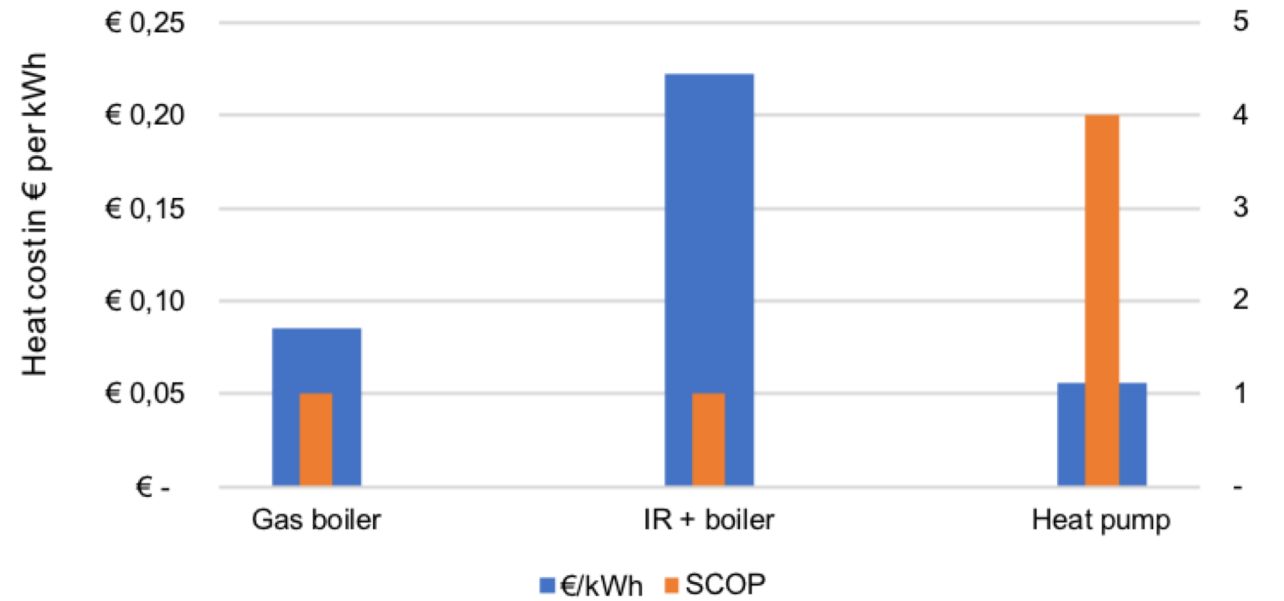
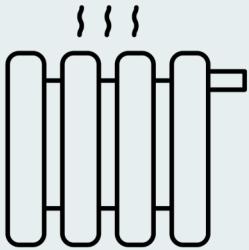
		15 years
Interest rate	2%	51%
	3%	46%
	4%	38%
	5%	33%
	6%	33%
	7%	30%
	8%	23%



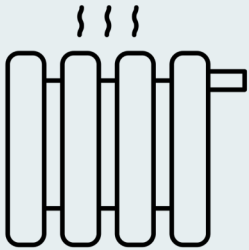
- Detached dwellings
- Semi-detached dwelling
- Terraced dwellings



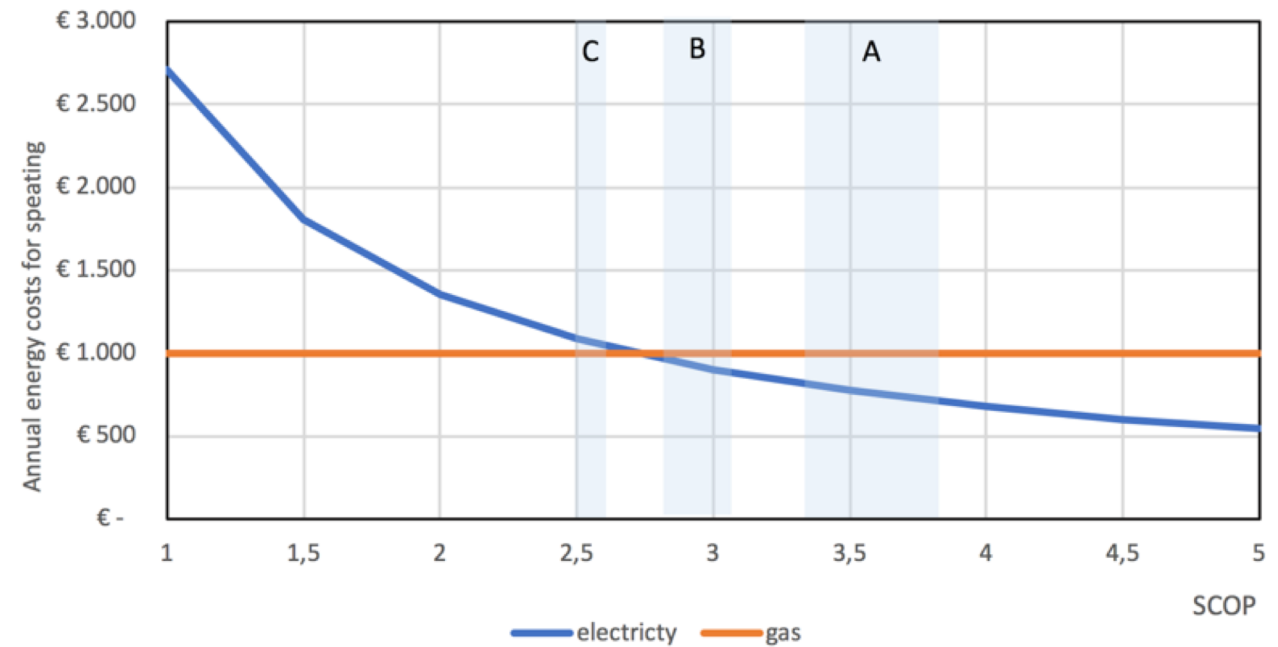
# Input

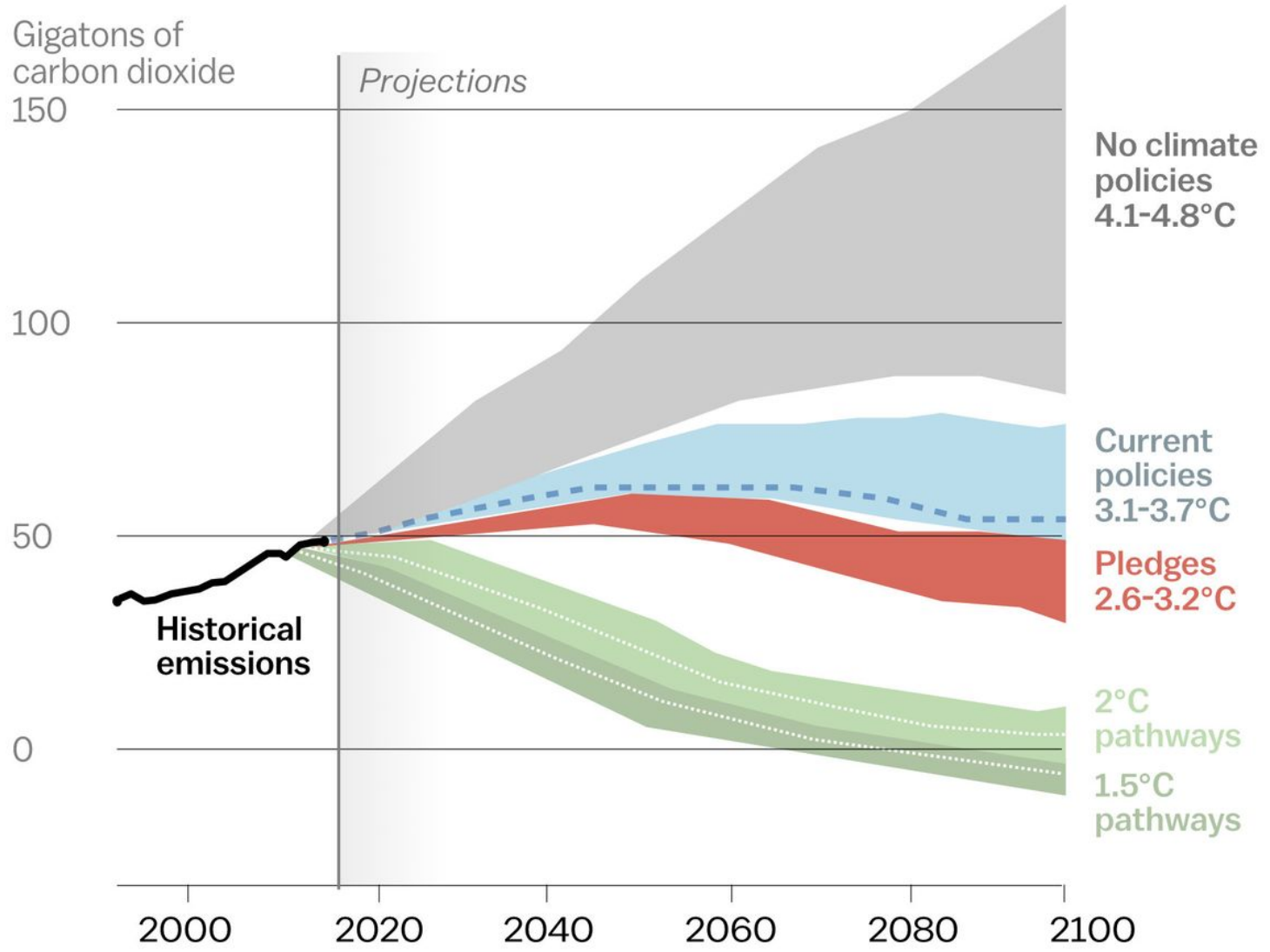


# Input



## Air-source heat pump





By 2030 until 2050

200.000