Financial & Market analysis of TESSe2b solution

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Aim of social survey

Analysis and understanding of consumers' behavior and perspectives in different EU countries concerning:

1. **Perceived benefits** of the TESSe2b technology;
2. **Perceived adoption intention** of the TESSe2b technology;
3. **Willingness To Pay** (WTP) for the TESSe2b technology;
4. **Acceptable payback period** for the investment in TESSe2b technology.

Survey

A. Online survey: June 2016 – February 2017

B. 600 responses →
- Greece: 159
- Portugal: 109
- Spain: 132
- Germany: 166 (mainly students)
- Austria: 17

C. Analysis using SPSS 24.

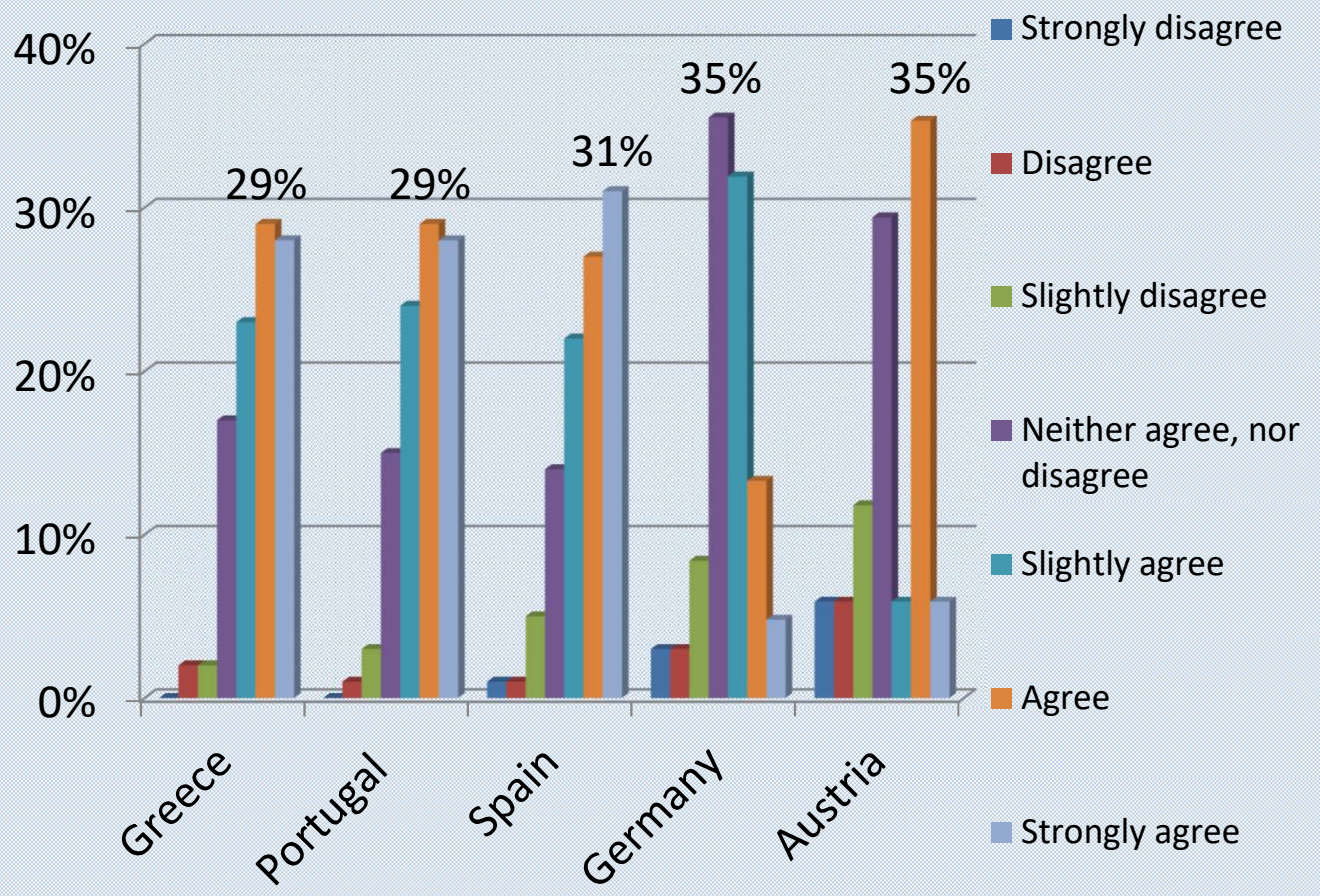
Descriptive statistics

	Greece	Portugal	Spain	Germany	Austria
Area of residence	> 40% Big city				40% Town or small city
Type of residence	>44% Apartment building				41% Detached single unit house
House ownership	>70% Living in own house			55% Living in rent	>70% Living in own house
House size	100-150 m^2	50-100 m^2		50-100 m^2 & >150 m^2	>150 m^2
Year of construction (or large renovation)	~25% Between 1970-1989			20% Don't know	35% 1990-1999
Household income used for energy costs	Between 5-10%			Don't know	Between 5-10%
Energy sources for heating	Heating oil	Electrical energy	Natural gas		
Energy sources for cooling	Electric energy	> 50% Don't use			
Energy sources for DHW	Solar thermal panels	Other*	> 50% Same as heating**		Electrical energy
Use of solar thermal collectors	40%	27%	24%	9%	29%
Use of geothermal energy	2%	1%	No	1%	6%

* other than electric energy, solar thermal panels and district heating; ** mainly natural gas, electric energy and heating oil

	Greece	Portugal	Spain	Germany	Austria
Gender	65% Male		75% Male	82% Male	76% Male
Age (Median)	42 years old			24 years old	48 years old
Education	Second stage of tertiary				
Professional/Employment status	Self-employed	Public sector	Private sector	Students	Private sector
I measure and record my thermal energy usage	39%	18%	38%	18%	41%
I have invested in thermal energy systems in the past 5 years	48%	39%	49%	15%	18%
I have invested in thermal energy systems using renewable energy in the past 5 years	33%	23%	25%	6%	
Involved in energy and/or environmental fields	60%			31%	60%
Monthly income	1000-1500€	500-1500€	1000-1500€	<500€	2000-2500€

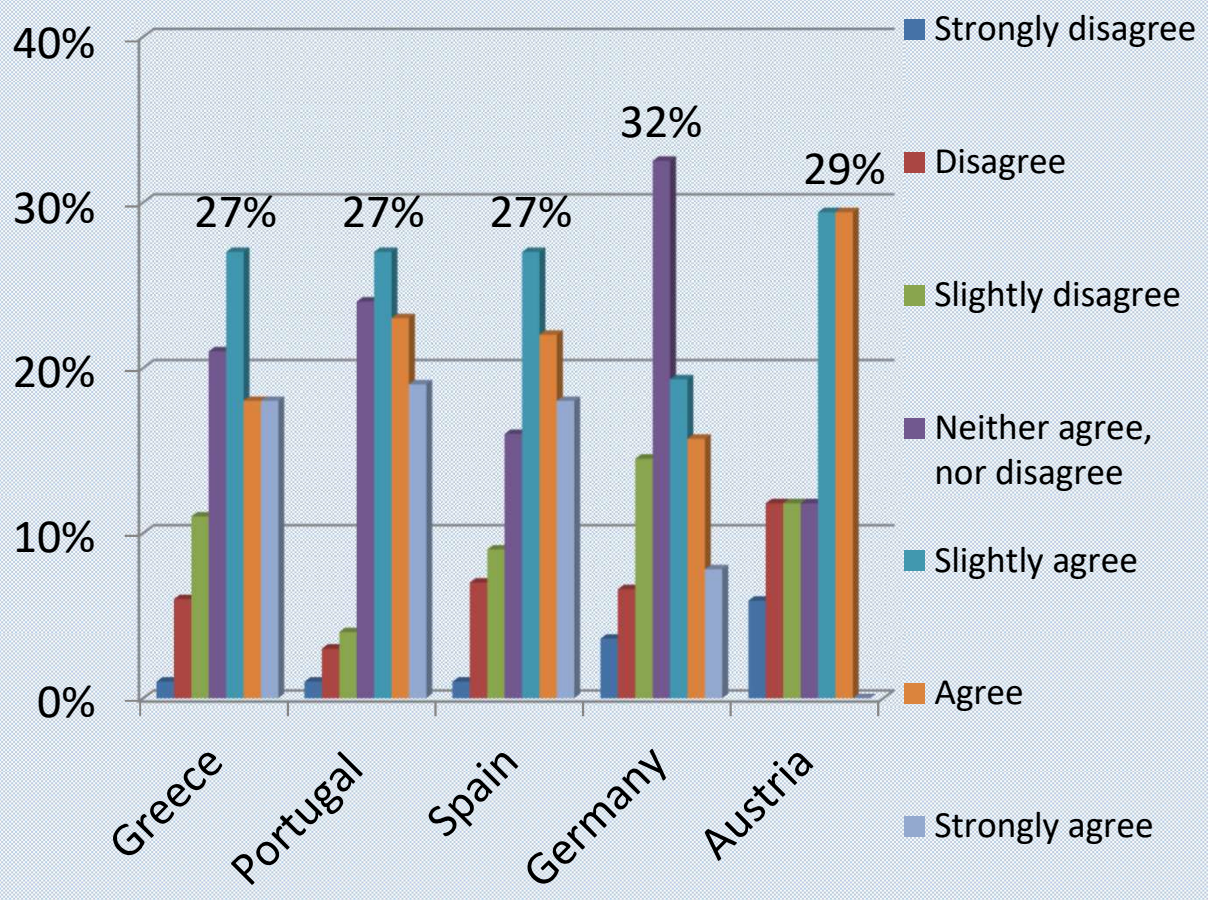
Perceived benefits of the TESSe2b system



Likert items included

- Life quality improvement
- Energy expenditure reduction
- Disposable income increase
- Energy security empowerment
- Self-sustainability of the building

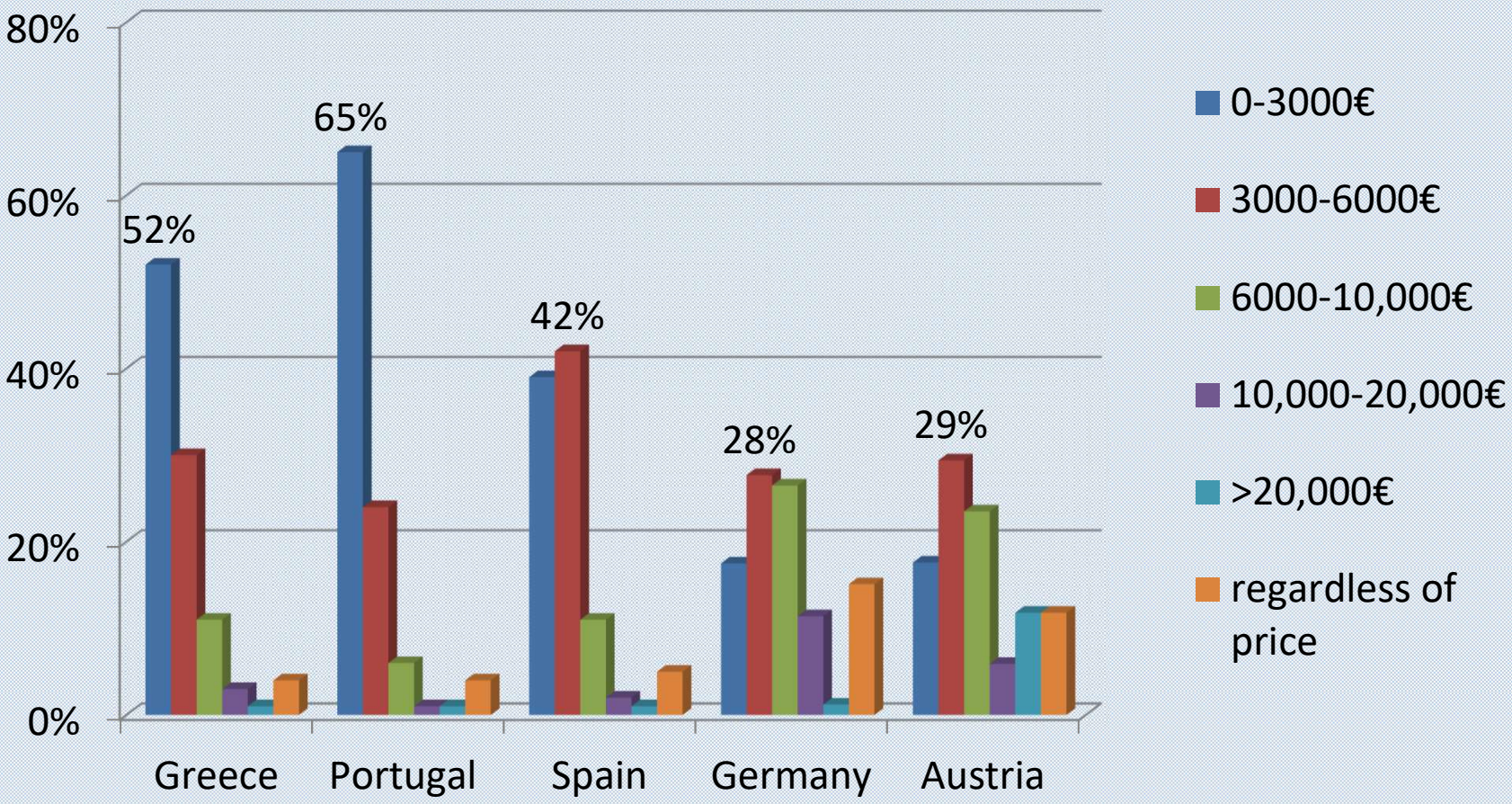
Adoption intention of the TESSe2b system



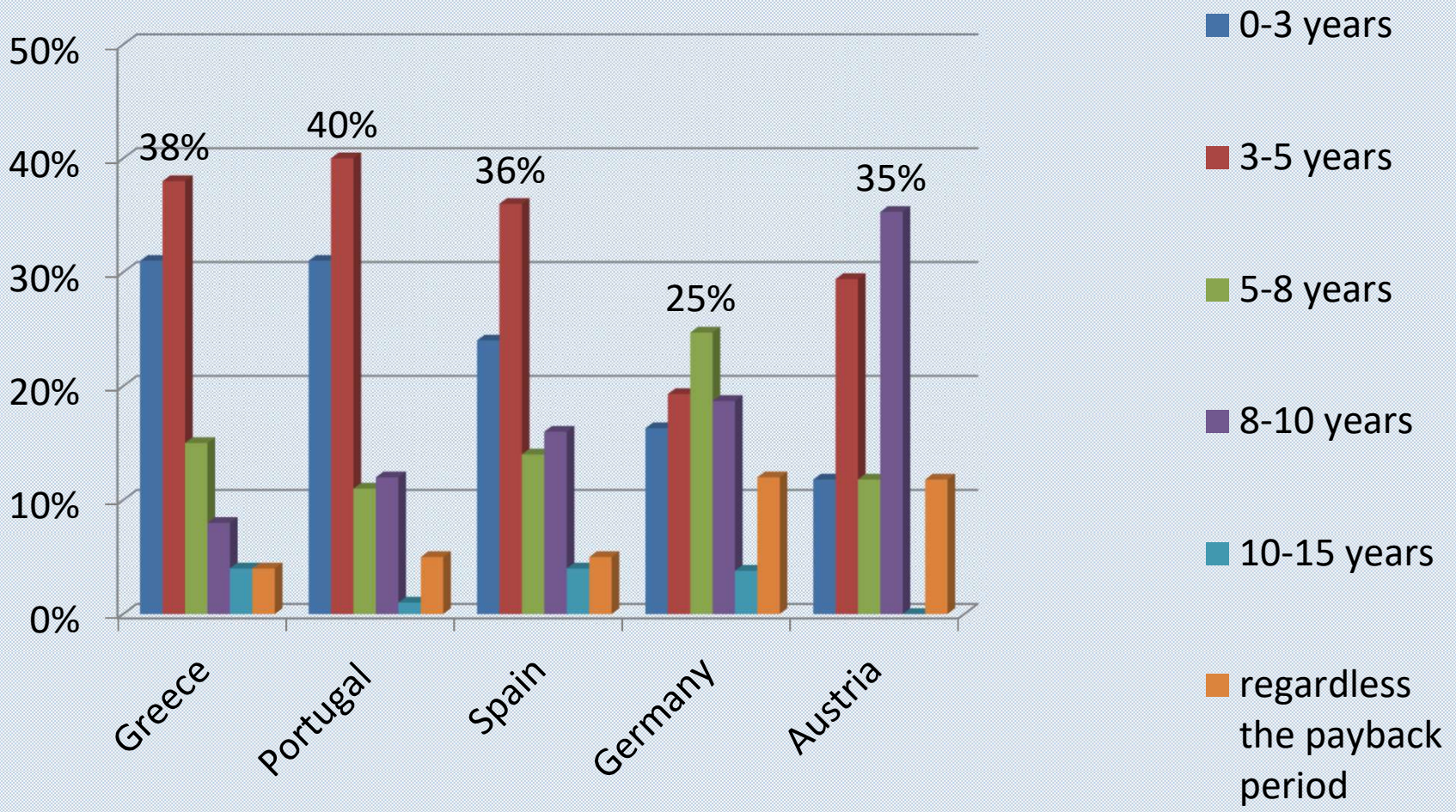
Likert items included

- Confident with the idea of adopting
- Comfortable with the idea of adopting
- Ease to adopt
- Intend to use
- Predict to use

Willingness to pay for the TESSe2b system (in €)



Acceptable payback period for the consumer to be willing to invest in the TESSe2b system



Factors affecting themes under investigation

Based on ordinal logistic regressions

Socioeconomic and residence characteristics affecting the issues of **benefit perception, adoption intention, WTP and acceptable payback period** for the TESSe2b system:

(+) higher than average **income**
(+) high level of **education**
(+) **occupation** relevant to energy and/or environment
(+) **self-owned** residence
(-) residence within **urban areas**
(-) residence in **apartment building**
(+) residence with an higher than average **size**
(+) **older** residence
(+) using **conventional sources** for heating and DHW (heating oil, natural gas, electricity)
(+) spending a higher than average percentage of their **income for household energy needs**

Financial and environmental comparison

- **Financial and environmental comparison** between the TESSe2b solution and conventional heating/cooling residential systems;
- Two different sets of comparisons made for each participating country;
- **Comparisons** made between **current fuels** (heating oil, natural gas, ASHP) and **TESSe2b solution**;
- All **scenarios** include heating mode and domestic hot water, and cooling mode only where necessary;
- **Financial indicators** calculated (NPV, IRR, SPBP, DPBP, PI);
- **CO_2 saving**;
- **Sensitivity analysis**.

Austria

1st case: TESSe2b (cooling) vs. HEAT OIL (no cooling)
Total annual operation cost savings: 83%
CO_2 savings: 90%
SPBP: 7.5 years
DPBP: 8.5 years

2nd case: TESSe2b vs. ASHP
Total annual operation cost savings: 68%
CO_2 savings: 66%
SPBP: 15 years
DPBP: 19 years

Cyprus

1st case: TESSe2b vs. HEAT OIL+ASHP
Total annual operation cost savings: 67%
CO_2 savings: 53%
SPBP: 5.8 years
DPBP: 6 years

2nd case: TESSe2b vs. ASHP
Total annual operation cost savings: 56%
CO_2 savings: 56%
SPBP: 10.5 years
DPBP: 12 years

Germany

1st case (no cooling): TESSe2b vs. HEAT OIL
Total annual operation cost savings: 61%
CO_2 savings: 74%
SPBP: 18 years
DPBP: 23.5 years

2nd case (no cooling): TESSe2b vs. NAT GAS
Total annual operation cost savings: 63%
CO_2 savings: 64%
SPBP: 17 years
DPBP: 22 years

Greece

1st case: TESSe2b vs. HEAT OIL+ASHP
Total annual operation cost savings: 69%
CO_2 savings: 49%
SPBP: 5.6 years
DPBP: 6 years

2nd case: TESSe2b vs. NAT GAS+ASHP
Total annual operation cost savings: 59%
CO_2 savings: 43%
SPBP: 8.5 years
DPBP: 10 years

Poland

1st case: TESSe2b vs. HEAT OIL+ASHP
Total annual operation cost savings: 83%
CO_2 savings: 51%
SPBP: 9.26 years
DPBP: 10.5 years

2nd case: TESSe2b vs. NAT GAS+ASHP
Total annual operation cost savings: 55%
CO_2 savings: 34.8%
SPBP: >25 years
DPBP: >25 years

Portugal

1st case: TESSe2b vs. HEAT OIL+ASHP
Total annual operation cost savings: 79%
CO_2 savings: 79%
SPBP: 4.5 years
DPBP: 5 years

2nd case: TESSe2b vs. NAT GAS+ASHP
Total annual operation cost savings: 78%
CO_2 savings: 72%
SPBP: 5 years
DPBP: 5.38 years

Spain

1st case: TESSe2b vs. HEAT OIL+ASHP
Total annual operation cost savings: 79%
CO_2 savings: 75%
SPBP: 5.8 years
DPBP: 6.34 years

2nd case: TESSe2b vs. NAT GAS+ASHP
Total annual operation cost savings: 70%
CO_2 savings: 68%
SPBP: 9 years
DPBP: 10.5 years

UK

1st case (no cooling): TESSe2b vs. HEAT OIL
Total annual operation cost savings: 71%
CO_2 savings: 76%
SPBP: 19 years
DPBP: >25 years

2nd case (no cooling): TESSe2b vs. NAT GAS
Total annual operation cost savings: 71%
CO_2 savings: 67%
SPBP: 18.5 years
DPBP: 25 years

Comparison's main findings

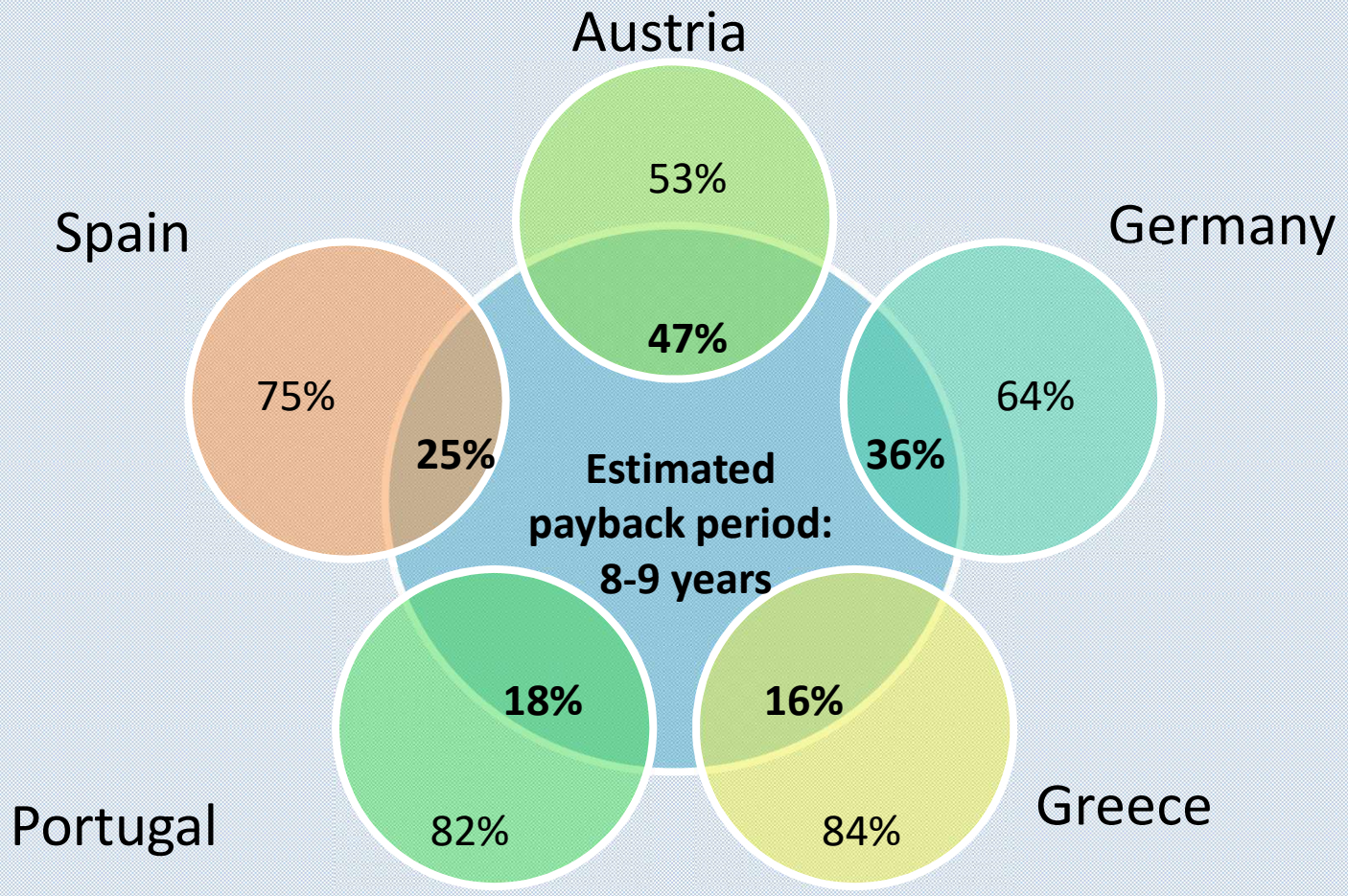
- **Operation cost savings** range from 55% to 83%;
- **CO_2 savings** range from 35% to 91%; they depend on CO_2 conversion factors for electricity, natural gas and heating oil in each country;
- **SPBP of TESSe2b system** is between 5 and 10 years when **compared to heating oil/ASHP & natural gas/ASHP systems**; PBP can be rather high when:
  - price of the conventional energy is very low
  - the system is not used for cooling
  - the installation cost of TESSe2b is high (e.g. solar thermal collectors delivering relatively low useful energy)
- **Compared to ASHPs**, PBP is higher compared to heating oil or natural gas, due to:
  - the common pricing of the energy used by the two systems
  - the higher efficiency of ASHPs compared to systems using fossil fuels

Sensitivity analyses main findings

- The **increase of the annual rate of electricity price** will decrease the payback period of TESSe2b system when there are **high cooling needs**.
- The **increase of the annual rate of heating oil/natural gas price** will generally decrease the payback period of TESSe2b system.
- The **increase of the building heating/cooling load** will lead to economies of scale, thus reducing the payback period of larger installations. This means that largest installations (office buildings, hotels, etc.) are of **high interest**.
- The decrease of the **installation cost** of TESSe2b will decrease the payback period of TESSe2b system; it can be reduced through the larger penetration of TESSe2b system. The factor that can really reduce the installation cost of TESS2b is the **further development of PCM market**, leading to the decrease of its price.

- Results should be treated and interpreted with caution; analysis has been based on various **assumptions** and **estimations** regarding system design, efficiencies, costs and economic indicators (inflation rate, discount rate).

Comparison of *estimated* payback period with *acceptable* payback period for the TESSe2b system



Conclusions

- **Behavioural survey:**
  - **Positive** attitude towards TESSe2b **adoption;**
  - **Willingness to pay** (WTP): GR, PT, ES: up to 6000€ / DE, AT: up to 10000€;
  - **Acceptable payback period**: GR, PT, ES: up to 5 years / DE, AT: up to 10 years;
  - **Socioeconomic & residence characteristics** affecting the issues under investigation.

- **Financial & environmental comparison:**
  - **Operation cost** and **CO_2** savings;
  - **SPBP** of TESSe2b system of **5 - 10 years** when compared to heating oil/ASHP & natural gas/ASHP systems;
  - The system installation is favorable in **large scale buildings**;
  - Further development of **PCM market** can lead to lower installation cost of the system.

Thank you for your attention!