IVL Swedish Environmental Research Institute
Speaker: Diego Peñaloza

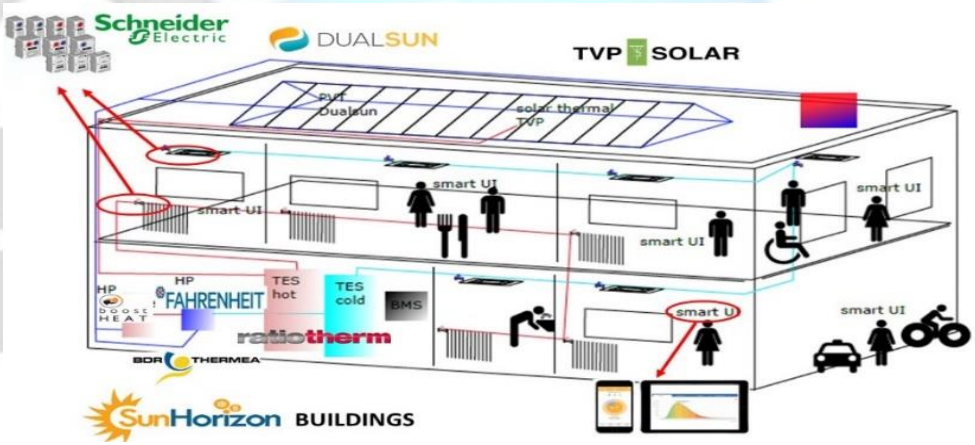
21/04/2021 – Presentation at BEHAVE 2020

Social and market acceptance of photovoltaic panels and heat pumps in Europe: A literature review and a survey

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

About SunHorizon

- Demonstrate up to TRL 7 Heat Pump solutions that acting properly coupled and managed with advanced solar panels can provide heating and cooling to residential and tertiary buildings with lower emissions, energy bills and fossil fuel dependency.
- Includes a cloud-based functional monitoring platform for the development of Data Driven/KPI oriented optimized algorithms and tools to predict maintenance, optimize management and give to the manufacturer inputs for new installation design.
- 5 low-emission technology packages (TPs)
- 21 partners and 8 demo sites



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Goal

- To conceptualize and assess the social and market acceptance of the innovative SunHorizon technologies (PVs and HPs) in Europe, in order to identify which aspects need more focus for the replicability of these key solutions for a low carbon building sector to a wider audience.
    - For social acceptance, to understand how to make stakeholders more positive towards the technology and thus less likely to oppose it
    - For market acceptance, to identify the barriers and motivators for different stakeholders to adopt the technology

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Methodology

- Systematically reviewing the existing scientific literature on social and market acceptance of similar technologies to contextualize acceptance and frame the survey questions
- Reviewing EU projects to obtain guidelines for the development of the survey.
- Collecting of data about the social and market acceptance amongst different stakeholder groups at the demo sites and beyond, through an online survey (EU survey service)
    - Identification and contact of local stakeholders
    - Collected responses between 2020-02-17 and 2020-03-03
    - 153 respondents completed the survey (Germany, Spain, Belgium and Latvia)
    - Stakeholders outside the project were also contacted via social media
    - Business representatives (31,4%), private building owners (20,9%), public building owners (9,8%), general public, residents and end-users (37,9%)
- Analysed the data obtained using multiple approaches
    - Multivariate data analysis with Principal Component Analysis (PCA)
    - MANOVA (Multivariate ANOVA)
    - COST (consider one separate variable at a time) analysis, using an ANOVA test.

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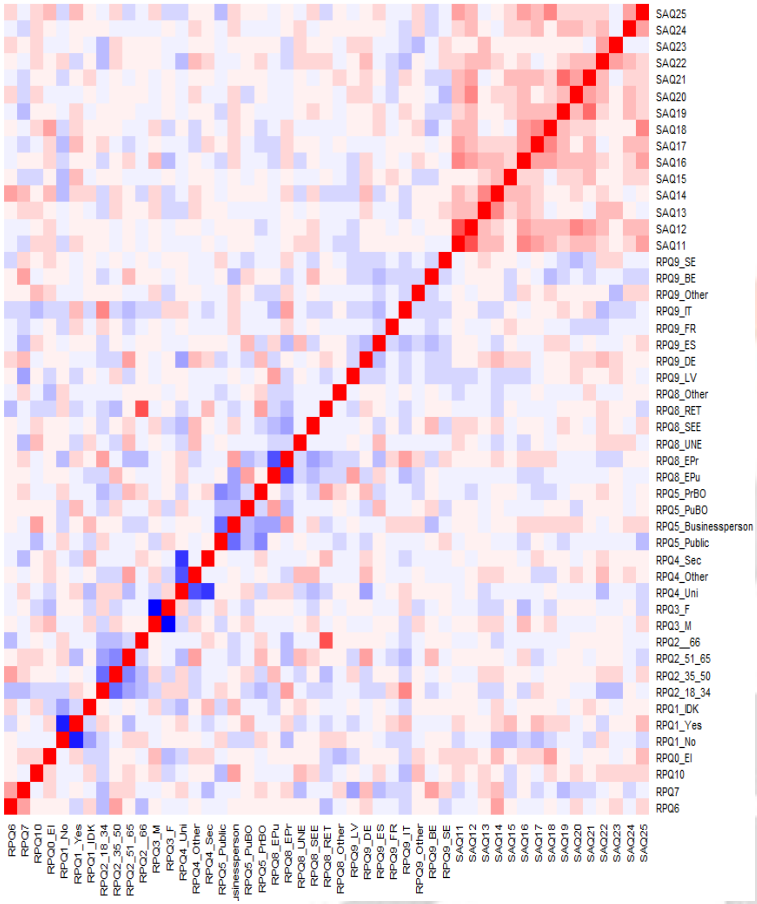
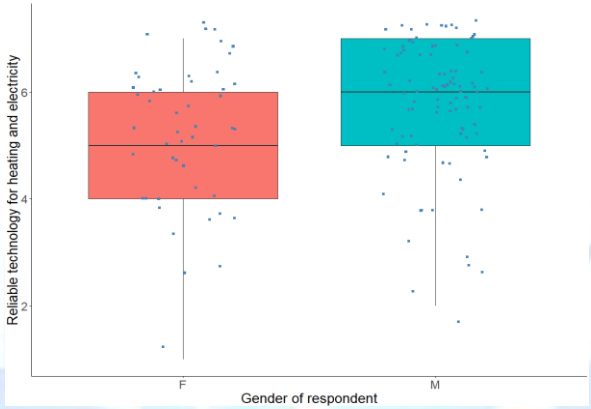
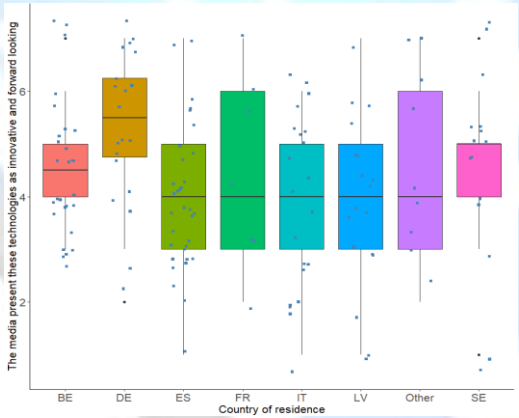
Results – Social acceptance



Correlation matrix





Anova

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Results – Social acceptance and country of residence

Negative statement	Positive statement	Latvia	Germany	Spain	Belgium
Does not generate economic savings	Generates economic savings			+	+
Waste of money	Good value for money			+	+
I do not see these technologies around the city/ region/ neighbourhood	I see the technologies frequently installed around the city region/ neighbourhood	-			-
No one I know has solar systems or heat pumps installed	Many people I know have solar systems or heat pumps installed	-		-	-
The media (newspapers, tv, websites) does not present these technologies as innovative and forward looking	The media (newspapers, tv, websites) present these technologies as innovative and forward looking	-			-
Unreliable technology for heating and electricity	Reliable technology for heating and electricity		+	+	+
Decreases social status	Increases social status by displaying environmental commitment to others	+	+		+
I am not interested in the technology	I am interested in the technology	+	+	+	+
Does not improve quality of my everyday life	Improves quality of my everyday life	+			
Noisy	Silent	+	+		
Decreases thermal comfort	Increases thermal comfort	+	+		
The design and size of my home are appropriate for this technology	The design and size of my home is not sufficient for this technology		+		
Comfort is not good in my home now and some technologies need to be replaced	I am very happy with my home as it is now				
The technology will look bad in my roof and effect negatively the visual landscape	Positive effect on the visual landscape				-
It is a dirty technology that increases pollution	It is a clean technology that reduces pollution	+	+	+	+

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Results – Social acceptance and stakeholder category

Negative statement	Positive statement	Business-persons	Public building owner	Private building owner	Public
Does not generate economic savings	Generates economic savings		+		
Waste of money	Good value for money		+		
I do not see these technologies around the city/ region/ neighbourhood	I see the technologies frequently installed around the city region/ neighbourhood	-		-	
No one I know has solar systems or heat pumps installed	Many people I know have solar systems or heat pumps installed	-			-
The media (newspapers, tv, websites) does not present these technologies as innovative and forward looking	The media (newspapers, tv, websites) present these technologies as innovative and forward looking		-		
Unreliable technology for heating and electricity	Reliable technology for heating and electricity	+	+	+	+
Decreases social status	Increases social status by displaying environmental commitment to others	+			+
I am not interested in the technology	I am interested in the technology	+	+	+	+
Does not improve quality of my everyday life	Improves quality of my everyday life		+		
Noisy	Silent				
Decreases thermal comfort	Increases thermal comfort		+	+	
The design and size of my home are appropriate for this technology	The design and size of my home is not sufficient for this technology				
Comfort is not good in my home now and some technologies need to be replaced	I am very happy with my home as it is now				-
The technology will look bad in my roof and effect negatively the visual landscape	Positive effect on the visual landscape		-	-	-
It is a dirty technology that increases pollution	It is a clean technology that reduces pollution	+	+	+	+

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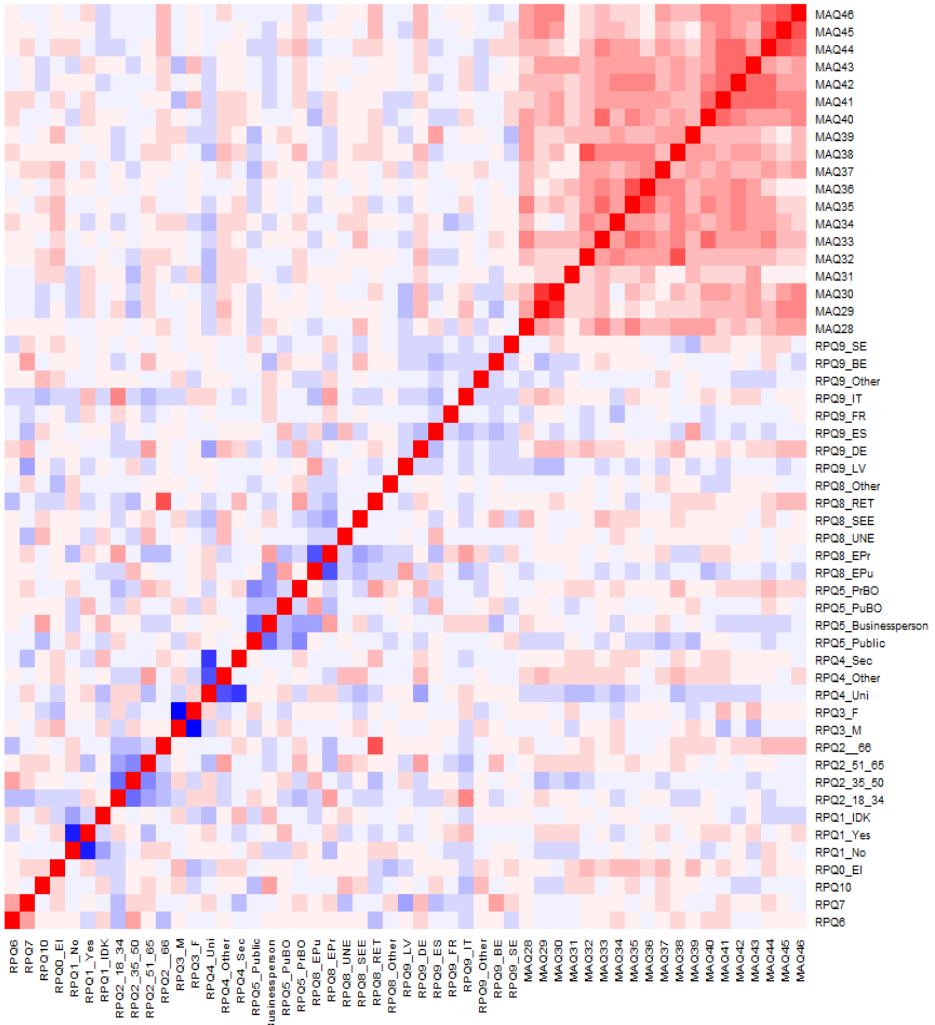
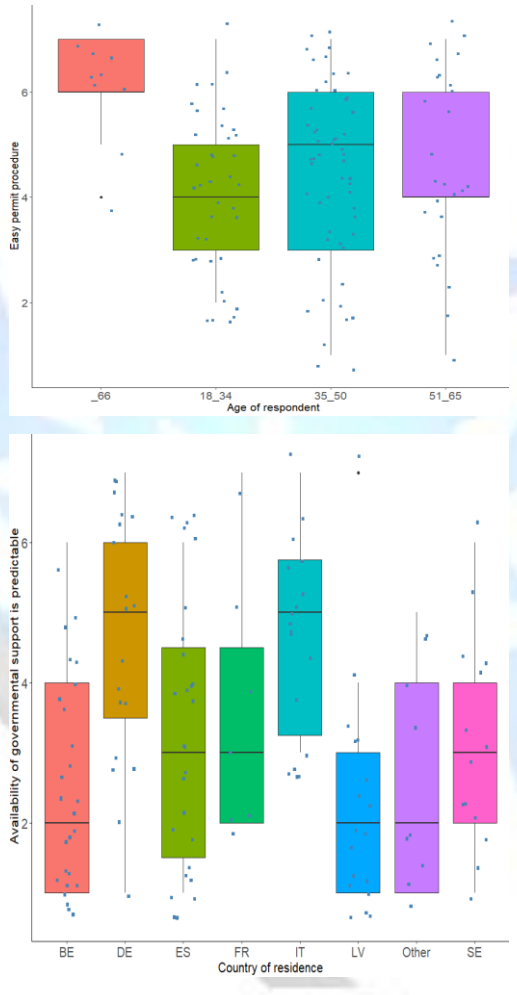
Results – Market acceptance



Correlation matrix



Anova

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Results – Market acceptance and country of residence

Barrier	Motivator	Latvia	Germany	Spain	Belgium
High investment cost	Low investment cost	-	-	-	-
Availability of governmental support is unpredictable	Availability of governmental support is predictable	-		-	-
Not enough subsidies available	Subsidies available	-		-	-
Decreases value of a property	Increases the value of a property	+	+	+	+
High maintenance costs	Low maintenance cost			-	
There is a lot of uncertainty with regards to recouping the investment costs	Investment is recoupable	-		-	-
Too complex technology	Easily understood technology				
Uncertain cost savings potential	Certain cost savings potential				
Uncertain performance of technology	Certain performance of technology	+			+
New and innovative technology is risky	New and innovative technology is an opportunity				
Requires more maintenance than existing heating system	Easy maintenance		+	-	
Not enough solar irradiation	Good solar irradiation			+	
Lack of suitable business models	Suitable business models are available			-	-
Not enough professional competence available	Enough professional competence available			-	
Not enough information is available about the technology	Sufficient information is available about the system			-	
Untrustworthy actors on the market	Trustworthy actors on the market				-
Difficult permit procedure	Easy permit procedure	-		-	
Unsupportive legal framework	Supportive legal framework	-		-	-
Unpredictable legal framework	Predictable legal framework	-		-	-

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Results – Market acceptance and stakeholder category

Barrier	Motivator	Business-persons	Public building owner	Private building owner	Public
High investment cost	Low investment cost	-	-	-	-
Availability of governmental support is unpredictable	Availability of governmental support is predictable	-	-	-	-
Not enough subsidies available	Subsidies available	-	-		-
Decreases value of a property	Increases the value of a property	+	+	+	+
High maintenance costs	Low maintenance cost		-		-
There is a lot of uncertainty with regards to recouping the investment costs	Investment is recoupable		-	-	-
Too complex technology	Easily understood technology				
Uncertain cost savings potential	Certain cost savings potential				
Uncertain performance of technology	Certain performance of technology			+	
New and innovative technology is risky	New and innovative technology is an opportunity	+		+	
Requires more maintenance than existing heating system	Easy maintenance				-
Not enough solar irradiation	Good solar irradiation		+		
Lack of suitable business models	Suitable business models are available	-	-		-
Not enough professional competence available	Enough professional competence available	-			
Not enough information is available about the technology	Sufficient information is available about the system	-	-		
Untrustworthy actors on the market	Trustworthy actors on the market	-	-		
Difficult permit procedure	Easy permit procedure	-			-
Unsupportive legal framework	Supportive legal framework	-			-

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Conclusions

- Market acceptance shows significant variations among stakeholders and countries
- Country of residence
    - In all countries, investment cost of the technologies is perceived as a barrier
    - In Spain, legal and organizational issues are also perceived as barriers, while Latvian and Belgian respondents identified economic and legal barriers
    - The respondents from Germany only perceived the investment cost as a barrier
- Stakeholder groups
    - Economic aspects are perceived as the main barriers among public building owners and the general public.
    - Businesspersons perceive the largest number of barriers including economic aspects, lack of information, trust, business models and legal issues
    - Private building owners perceive the least barriers, only related to economic aspects.
- The results of this work can be used as input for policy makers, as they formulate strategies to foster adoption in Europe

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THANK YOU!

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Apendix – Demographic profile of respondents

Part of SunHorizon project	
Yes	25,5% [39]
No	68,6% [105]
I don't know	5,9% [9]
Age	
18-34	30,7% [47]
35-50	39,2% [60]
51-65	21,6% [33]
>65	8,5% [13]
Gender	
Female	33,3% [51]
Male	66% [101]
Prefer not to say	0,7% [1]
Highest education level	
University degree	87,6% [134]
Secondary school	7,2% [11]
Primary school	0,7% [1]
Other	4,6% [7]

Respondent category	
Businessperson	31,4% [48]
1. Equipment manufacturer	29,2% of businesspersons [14]
2. Energy utility	0% of businesspersons [0]
3. ESCO	0% of businesspersons [0]
4. Energy consultant	35,4% of businesspersons [17]
5. Installer	16,7% of businesspersons [8]
6. Service/Maintenance	4,2% of businesspersons [2]
7. Real estate developer	0% of businesspersons [0]
8. Other	14,6% of businesspersons [7]
Private building owner	20,9% [32]
Public building owner	9,8% [15]
The public/residents/end-users	37,9% [58]

Country of residence	
Germany	13,1% [20]
Spain	21,6% [33]
Belgium	18,3% [28]
Latvia	12,4% [19]
Canada	0,7% [1]
France	4,6% [7]
Greece	0,7% [1]
India	0,7% [1]
Ireland	2% [3]
Italy	13,7% [21]
Sweden	9,8% [15]
UK	2% [3]

Occupants in household	
1	12,4% [19]
2	35,3% [54]
3	7,8% [12]
4	25,5% [39]
>4	19% [29]

Employment status	
Employed in private sector	47,7% [73]
Employed in public sector	29,4% [45]
Self-employed	9,1% [14]
Unemployed	3,3% [5]
Student	0,7% [1]
Retired	7,8% [12]
Other	2% [3]

Household annual income	
<20 000	5,9% [9]
20 000 – 40 000	19,6% [30]
40 000 – 70 000	24,8% [38]
70 000 – 90 000	15,7% [24]
>90 000	8,5% [13]
Prefer not to say	25,5% [39]

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