The research project is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union –Next Generation EU (H.F.R.I. Project Number: 016638).

Cost-benefit analysis for Greek case studies

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Dr. Konstantinos Bithas, Panteion University & Michigan State University, USA

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Cost-benefit analysis

Energy Efficiency & Socioeconomic Considerations

Understanding Household Energy Consumption

- Socioeconomic, demographic, dwelling, and energy performance characteristics
- environmental, social, and economic costs of residential energy use

Case Studies: Real-World Energy Cost Analysis

- Selection of 6 households from different areas (in Greece)
- Energy cost analysis before and after PV installations/ or energy retrofit measures
- Incorporates the installation cost of PV systems/ energy retrofit measures

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Cost-benefit analysis

Cost-Benefit Analysis & Energy Poverty Reduction

- Assesses long-term cost savings and energy efficiency improvements
- Aims to reduce energy poverty vulnerability through sustainable solutions

Innovative Approach

- Analysis conducted under real-life conditions
- Data-driven insights to support policy recommendations and sustainable practices

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Collect information for 6 case studies:

- ❑ existing information
- ❑ surveys
- ❑ previous EU H2020 projects’ results

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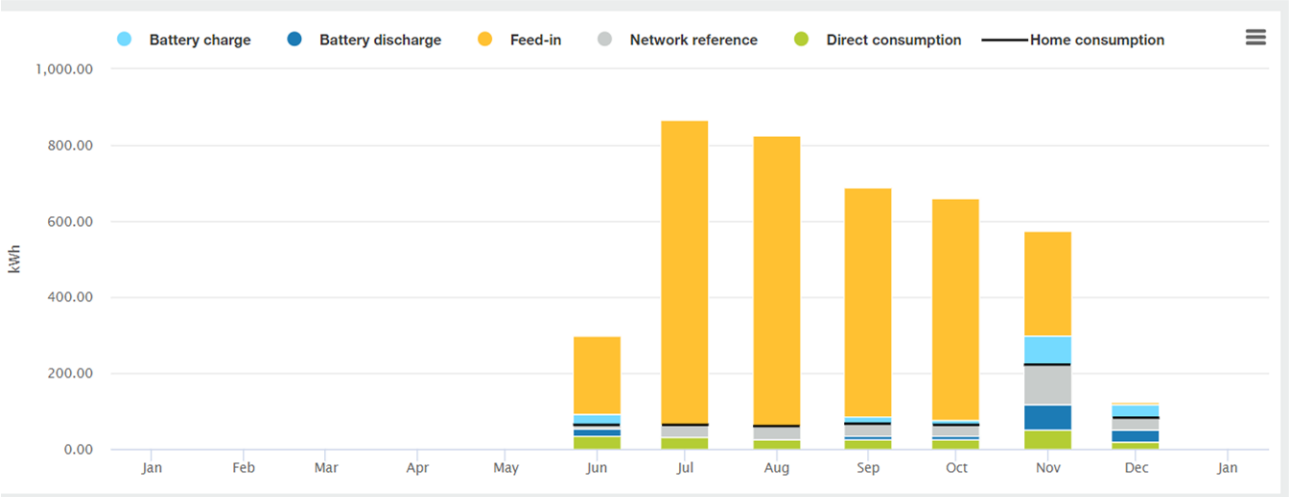
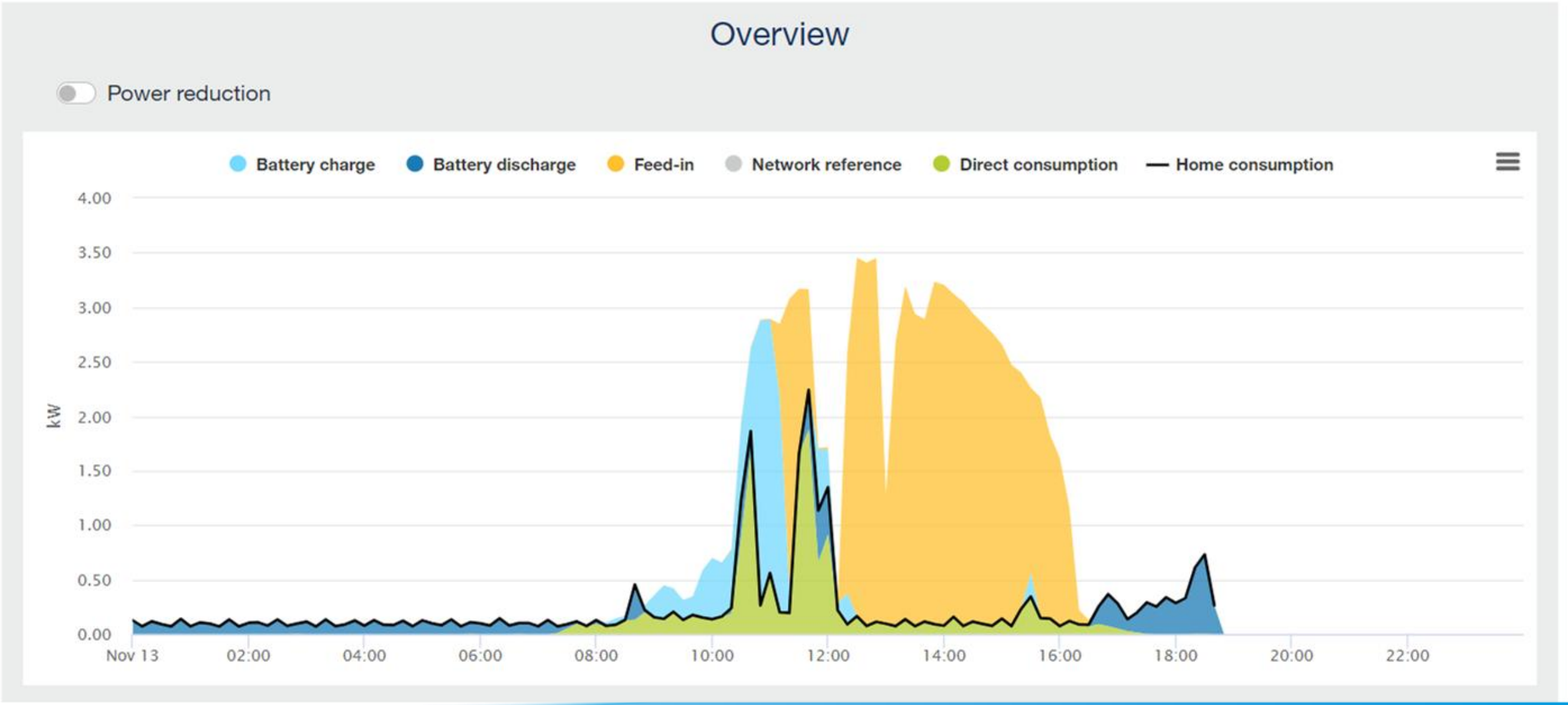


Figure 1. Energy production from PV panels after energy renovation

Category	Description
Investment	PV, heat pump, battery box, solar thermal, insulation
Energy Benefits	Reduction in energy demand, PV generation
Environmental Benefits	CO_2 reduction
Social Benefits	Improved comfort, reduced energy poverty
Economic Efficiency	NPV and payback period


Overview
Power reduction
Battery charge
Battery discharge
Feed-in
Network reference
Direct consumption
Home consumption
kW
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Nov 13
02:00
04:00
06:00
08:00
10:00
12:00
14:00
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22:00

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Socioeconomic Evaluation of Energy Saving Investments in Greece

ECONOMIC EVALUATION COST-BENEFIT ANALYSIS

ENVIRONMENTAL EVALUATION: FORGONE CO2 EMISSIONS

Energy/Fuel and human POverty: public policy and REcommendations in Southern Europe

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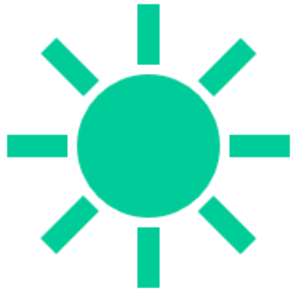
Socioeconomic Evaluation of Energy Saving Investments in Greece



6 Households investing in

- Solar Heating Systems and Insulation
- Replacement of conventional window frames with insulated ones
- Wall and Roof insulation
- Photovoltaic System (PV) for electricity generation- net metering

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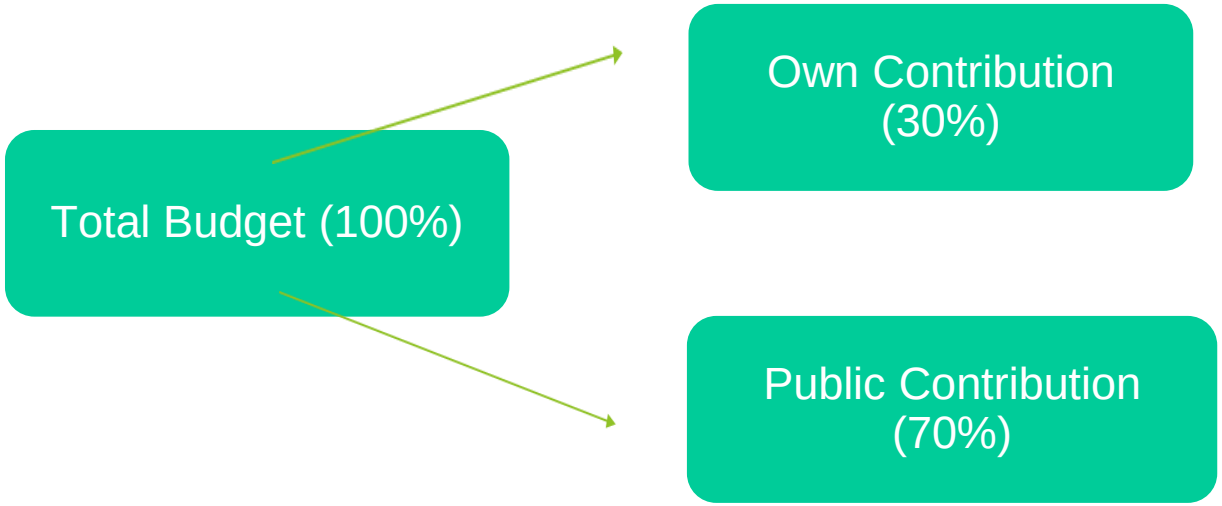

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Socioeconomic Evaluation of Energy Saving Investments in Greece

Net Present Value (NPV) of the Investment at 30 years

Payback period: the year when the costs equal with the Benefit and so the investment start to become “positive”-“beneficial”

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CASE 1

Household in very cold weather (Northern Greece)- 1 member

	Total	Public	Private
Investment (€)	6000	4000	2000
NPV (€)	-1834	165	2165
Payback (year)	-	27	10
Annual economic benefit (€/ year)	250		
Annual environmental benefit (€/ year)	32		
CO2 abatement (ton CO2/ year)	0,17		

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CASE 2

Household in very cold weather (Northern Greece)-4 members

	Total	Public	Private
Investment (€)	10000	6000	4000
NPV (€)	-1668	2331	4331
Payback (year)	-	17	10
Annual economic benefit (€/ year)	500		
Annual environmental benefit (€/ year)	95		
CO2 abatement (ton CO2/ year)	0,5		

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CASE 3

Household in warm weather (Southern Greece- only for summer holidays) -2 members

	Total	Public	Private
Investment (€)	20000	12000	8000
NPV (€)	-15834	-7834	-2834
Payback (year)	-	-	-
Annual economic benefit (€/ year)	250		
Annual environmental benefit (€/ year)	12		
CO2 abatement (ton CO2/ year)	0,1		

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CASE 4 PVs*

Household in moderate weather (Athens)-2 members

	Total	Public	Private
Investment (€)	50000	35000	15000
NPV (€)	-23336	-8005	1663
Payback (year)	-	-	24
Annual economic benefit (€/ year)	1620		
Annual environmental benefit (€/ year)	72		
CO2 abatement (ton CO2/ year)	0,6		

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CASE 5

Household in cold weather (mountainous area Southern Greece)-4 members

	Total	Public	Private
Investment (€)	30000	22500	7500
NPV (€)	19969	17000	42000
Payback (year)	14	27	3
Annual economic benefit (€/ year)	3000		
Annual environmental benefit (€/ year)	120		
CO2 abatement (ton CO2/ year)	1		

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CASE 6

Household in moderate weather (Southern Greece)- 2 members

	Total	Public	Private
Investment (€)	30000	22500	7500
NPV (€)	3326	10826	25826
Payback (year)	24	16	5
Annual economic benefit (€/ year)	2000		
Annual environmental benefit (€/ year)	114		
CO2 abatement (ton CO2/ year)	0,6		

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Conclusions

The economic valuation is case-specific, but some general trends can be identified

- Household size matters: the bigger the better.
- Time-span of household occupancy matters: the longer the better.
- Weather conditions matter: the colder the better.
- **Public funding is essential.**

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Resilience Plan “Greece 2.0” funded by the European Union –Next Generation EU (H.F.R.I. Project Number:

Policy Recommendations for Energy Retrofit

- Promote deep renovations combining insulation, RES
- Improve financial access through income-based subsidies, green loans
- Prioritize energy-poor households and integrate comfort and affordability goals.
- Encourage smart meters and monitoring tools to verify savings and guide energy use.
- Align national programs with EU initiatives
- Support circular renovation practices and sustainable materials.
- Recognize co-benefits such as comfort, health, and higher property value in evaluations.