Supplementary content

The economic feasibility of residential energy storage combined with PV panels: the role of subsidies in an European country

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Mathematical reference model used for the calculation of NPV [3]

$$NPV(PV) = DCI - DCO \quad (1)$$

$$DCI = \sum_{t=1}^{N} \frac{\omega_{self,c} \times E_{Out,t} \times p_t^c + \omega_{sold} \times E_{Out,t} \times p_t^s}{(1+r)^t} + \sum_{t=1}^{N_{TaxD}} ((C_{inv}/N_{TaxD}) \times TaxD_{u-sr})/(1+r)^t \quad (2)$$

$$p_{t+1}^c = p_t^c \times (1 + inf_{el});\ p_{t+1}^s = p_t^s \times (1 + inf_{el}) \quad (3)$$

$$DCO = \sum_{t=0}^{N_{debt}-1} (C_{inv}/N_{debt} + (C_{inv} - C_{lcs,t}) \times r_d)/(1+r)^t + \sum_{t=1}^{N} \frac{P_{Cm} \times C_{inv} \times (1 + inf) + P_{Cass} \times C_{inv} \times (1 + inf) + SP_{el,t} \times P_{Ctax}}{(1+r)^t} + \frac{P_{Ci} \times C_{inv}}{(1+r)^{10}} + C_{ae} \quad (4)$$

$$C_{inv} = C_{inv,unit} \times (1 + Vat) \times P_f \times \eta_f \quad (5)$$

$$E_{Out,t} = t_r \times K_f \times \eta_m \times \eta_{bos} \times A_{cell} \times P_f \times \eta_f \quad (6)$$

$$E_{Out,t+1} = E_{Out,t} \times (1 - dE_f) \quad (7)$$

$$E_{Out} = \sum_{t=1}^{N} E_{out,t} \quad (8)$$

where DCI = discounted cash inflows; DCO = discounted cash outflows; t = single period; CI = cash inflows; CO = cash outflows; E_{Out} = energy output of the system; C_{inv} = total investment cost; C_{lcs} = loan capital share cost; SP_{el} = sale of energy; η_f = number of PV modules to be installed and P_f = nominal power of a PV module. Other economic inputs, used in this analysis, are defined in Table S1.

Table S1. Economic inputs [3]

Acronym	Variable	Value
A_{cell}	Active surface	7 m^2/kWp
C_{ae}	Administrative and electrical connection cost	250 €
$C_{inv,unit}$	Specific investment cost	1850 €/kW
dE_f	Decreased efficiency of a system	0.7%
inf	Rate of inflation	2%
inf_{el}	Rate of energy inflation	1.5%
k_f	Optimum angle of tilt	1.13
N	Lifetime of a PV system	20 y
N_{debt}	Period of loan	15 y
N_{TaxD}	Period of tax deduction	10 y
η_{bos}	Balance of system efficiency	85%
η_f	number of PV modules to be installed	function of S
η_m	Module efficiency	16%
p^c	Electricity purchase price	19 cent €/kWh
p^s	Electricity sales price	9.8–10.9 cent €/kWh
P_{Cass}	Percentage of assurance cost	0.4%
P_{Ci}	Percentage of inverter cost	15%
P_{Cm}	Percentage of maintenance cost	1%
P_{Ctax}	Percentage of taxes cost	43.5%
P_f	nominal power of a PV module	function of S
r	Opportunity cost of capital	5%
r_d	Interest rate on a loan	3%
t_r	Average annual insolation	1350–1550 kWh/(m^2×y)
S	Size	1–6 kW
$TaxD_{u-br}$	Specific tax deduction (baseline rate)	36%
$TaxD_{u-sr}$	Specific tax deduction (subsidized rate)	50%
$\omega_{self,c}$	Percentage of energy self-consumption	30–50%
ω_{sold}	Percentage of the produced energy sold	50–70%
Vat	Value added tax	10%

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