

Implications of the solar rebound effect for the European energy transition

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APPENDIX H – NOMENCLATURE

Indices and Sets

r, r'	Regions
u	Generation units (vintage classes)
t	Time segment
n	Stochastic node
m	Month
U	Set of generation units
R^{cap}	Set of capacity regions

Parameters

ΔE_T	Change in total household electricity consumption
ΔE_{PV}	Change in solar electricity generation
$l_{r,t}$	Exogenous electricity demand in region
$c_{r,u}$	Installed capacity of generation (of previous year)
c_{var}	Variable generation costs
$\phi_{r,u,t,n}$	Capacity factor of generation
sre	Solar rebound intensity
sre_t^{disc}	Discrete SRE intensity
ω_r	Share of total electricity demand attributable to private households
γ_r	Share of households with PV systems
$\alpha_{r,t}$	Household share of PV generation
$C_f(r \rightarrow r')$	Maximum transmission capacity between two neighboring regions
$C_f(r' \rightarrow r)$	Maximum transmission capacity between two neighboring regions (reserve limit)
$avail_{t,u}$	Availability factor of technology
$w_{t,r,u}$	Minimum guaranteed hydro inflows
L_r^{max}	Maximum total electricity demand
f_t	Frequency of a time segment
h_t	Duration of a time segment
p_n	Probability of stochastic node
p_{CO_2}	CO ₂ price
p_u	Fuel price
β	Weighting factor for combining simultaneous and sweeping SRE (set in the dynamic profile)

Variables

$C_{r,u}^{inv}$	Newly installed capacity within the current simulation year
$P_{r,u,t,n}$	Power generation
$P_{r,u,t,n}^{cons}$	Electricity consumption of storage and electrolyzes
$E_{r \rightarrow r',t,n}$	Electricity transfer (representing the dispatched power in that region/direction)
$E_{r' \rightarrow r,t,n}$	Electricity transfer (capturing the reverse transmission)
$SRE_{r,t,n}$	Additional Demand resulting from the solar rebound effect
q_{elec}	Electricity production
$C_{r,t,n}^{curt}$	Curtailment of electricity generation if production and imports exceed demand
$\beta_{r,t}^{sim}$	Endogenous time-varying weight of the simultaneous (marginal) component in the dynamic profile
$\beta_{r,t}^{off}$	Endogenous time-varying weight of the offpeak (discrete) component in the dynamic profile (dimensionless)

Equations

- (1) Demand Balance Equation: Ensures that total generation, including rebound-driven demand, matches consumption and net exports
- (2.1) & (2.2) Transmission Capacity Constraint: Limits interregional power flows to exogenous capacity values
- (3) Simultaneous SRE: Defines the rebound proportionally to solar PV output
- (4) Sweeping SRE: Distributes the rebound effect evenly over all time segments
- (5) Dynamic SRE: Convex combination of simultaneous (marginal) and sweeping (discrete) components with time-varying weights
- (6) Capacity Constraint: Ensures sufficient generation resources to cover peak demand, considering availability factors
- (7) Peak Demand: Determines maximum electricity demand, incorporating exogenous demand, flexibility needs, and the additional demand from the SRE