

Technology Diffusion Model

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Agenda

- 1. Introduction
- 2. Overview of Agent-Based Modeling
- 3. Preliminary Results
- 4. Modifications in Progress





Introduction

 Forecasting the diffusion of residential Photovoltaic systems in Austria: An Agent-Based Modeling Approach



Yearly Installed PV Power in Austria Source: Biermayr (2023)





Introduction

Technological Diffusion and Agent-Based Modeling



Source: Own Illustration based on Rogers (1962)





Introduction

Year	Feed-in Tariff [€- Ct/kWh]	Average Wholesale Electricity Selling Price [€-Ct/kWh]	Capital Incentives [€/kWp]		Capital Incentives on Batteries [€/kW]
	5-10 kWp		< 5 kWp	5-10 kWp	
2008	39.99	7.28	2800	0	0
2009	39.98	4.72	2500	0	0
2010	38.00	4.66	1300	0	0
2011	38.00	5.66	1100	0	0
2012	27.60	4.87	800	0	0
2013	18.12	4.02	200	200	0
2014	12.50	3.53	200	200	0
2015	12.50	3.23	200	200	0
2016	8.24	2.70	275	375	0
2017	7.91	3.33	275	375	0
2018	7.91	4.45	250	250	500
2019	7.67	5.10	250	250	500
2020	7.67	3.99	250	250	200
2021	0.00	7.80	285	250	200
2022	0.00	33.43	285	285	200
2023	0.00	16.87	285	285	200







Adoption Decision is Influenced By Four Factors:









- Household Income: 31,000 €/a
- Electricity Consumption: 3500 kWh/a
- Electricity Production: 3000 kWh/a





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Dynamic and growing population (number of households)







Household Deputation per Vear

8

Economic Utility considers:

- Investment costs
- Capital incentives
- Feed-in tariffs
- Savings from self-generated electricity
- Administrative and Maintenance costs





Environmental Utility considers:

- Electricity consumption of household – assumed to be quite high
- Consumption covered by the renewable generation
- Household type
- Logarithmic probability distribution of household consumption

Number of inhabitants	Mean [kWh/a]	Median [kWh/a]	Standard Deviation
1	3,225	2,957	1,416
2	4,836	4,528	1,844
3	5,850	5,561	2,019
4+	6,113	5,568	2,197

Electricity Consumption by Household Size (Source: Odyssee-Mure, 2022)

State	Owned House	Owned Apartment	Rented House	Rented Apartment
Burgenland	66%	3%	9%	22%
Carinthia	47%	8%	12%	33%
Lower Austria	55%	8%	8%	29%
Upper Austria	44%	9%	18%	29%
Salzburg	34%	17%	27%	22%
Styria	44%	12%	16%	28%
Tyrol	36%	18%	25%	21%
Vorarlberg	39%	17%	24%	20%
Vienna	5%	15%	45%	35%

Home Type Distribution (Source: Statistics Austria, 2023)







Logarithmic Probability Distribution of Electricity consumption Data Source: EUROSTAT (2023)





10

- Communication Utility considers:
 - Interpersonal communication model
 - Higher communication utility – social circle containing more adopters



Communication Utility Source: Own illustration





- Three Scenarios (PV Prices):
 - Baseline
 - CAGR of PV prices (-6.8%)
 - Pessimistic
 - CAGR of PV prices (-3%)
 - Optimistic
 - CAGR of PV prices (-9%)

Three Scenarios (PV Regulations):

- Baseline
 - Expiration of Zero-Tax Policy at the end of 2025
 - Moderate decline of financial support
- Pessimistic
 - Complete cessation of incentives for PV systems from 2026
- Optimistic
 - Continued support of the Zero-Tax Policy





- Pessimistic:
 - Slower decline of prices
 - Adoption relatively low
 - Less favourable financial situation slow growth rate
- Optimistic:
 - Substantial increase in PV demand
 - Deceleration in 2040s market saturation & shrinking pool of potential adopters
 - Most early and mid-market segments already transitioned



Scenario Analysis of Adoption based on Future PV System Price





- Optimistic:
 - Highly correlated with Baseline
 - Dip in 2040s large group of potential adopters re-entering market
- Pessimistic:
 - Sudden short-term dip in adoption
 - Late convergence potential adopters delaying investment decisions
 - Impact of incentives diminishing over time as costs decline



Scenario Analysis of Adoption based on Future Incentives







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15

16







Year



Cumulative PV Adoption - Pessimisstic PV Price Scenario

Cumulative PV Adoption – Optimistic PV Price Scenario







Cumulative Adopters by State – Baseline Scenario





18



Adoption Per Home Type in Different States - Baseline Scenario





Modifications in Progress

- 20
- Sensitivity analysis for the PV price level (PV cost data from AIT)
- Further calibration using Survey Results
- Addition of an ML-Based Approach
- Potentially improving regional insights
 - Contingent upon the availability of more data from OeMAG







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