

FutuRES-PV

Stakeholder Workshop

20.04.2026, 09:00, WIFO

Projektüberblick



Projektüberblick

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A Comprehensive Analysis of Future Residential PV Development in Austria

- ACRP – 15. Call
- Projektlaufzeit: November 2023 – Dezember 2026
- Projektteam
 - WIFO
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Projektziele (I)

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- Hauptziel:

Integrierte Analyse von Diffusionsszenarien für Haushalts-PV-Systeme in Österreich

- Simulation von unterschiedlichen Diffusionsszenarien für Haushalts-PV-Systeme ("Prosumer Scenarios") mit einem neuartigen Technologiediffusionsmodell
- Evaluierung der makroökonomischen Effekte sowie der Verteilungswirkungen dieser Szenarien auf verschiedene Haushaltsgruppen (differenziert nach Einkommensquintilen und Gebäudetyp)
- Entwicklung von Politikempfehlungen, die die Beteiligung vulnerabler Gruppen an der Energiewende sicherstellen

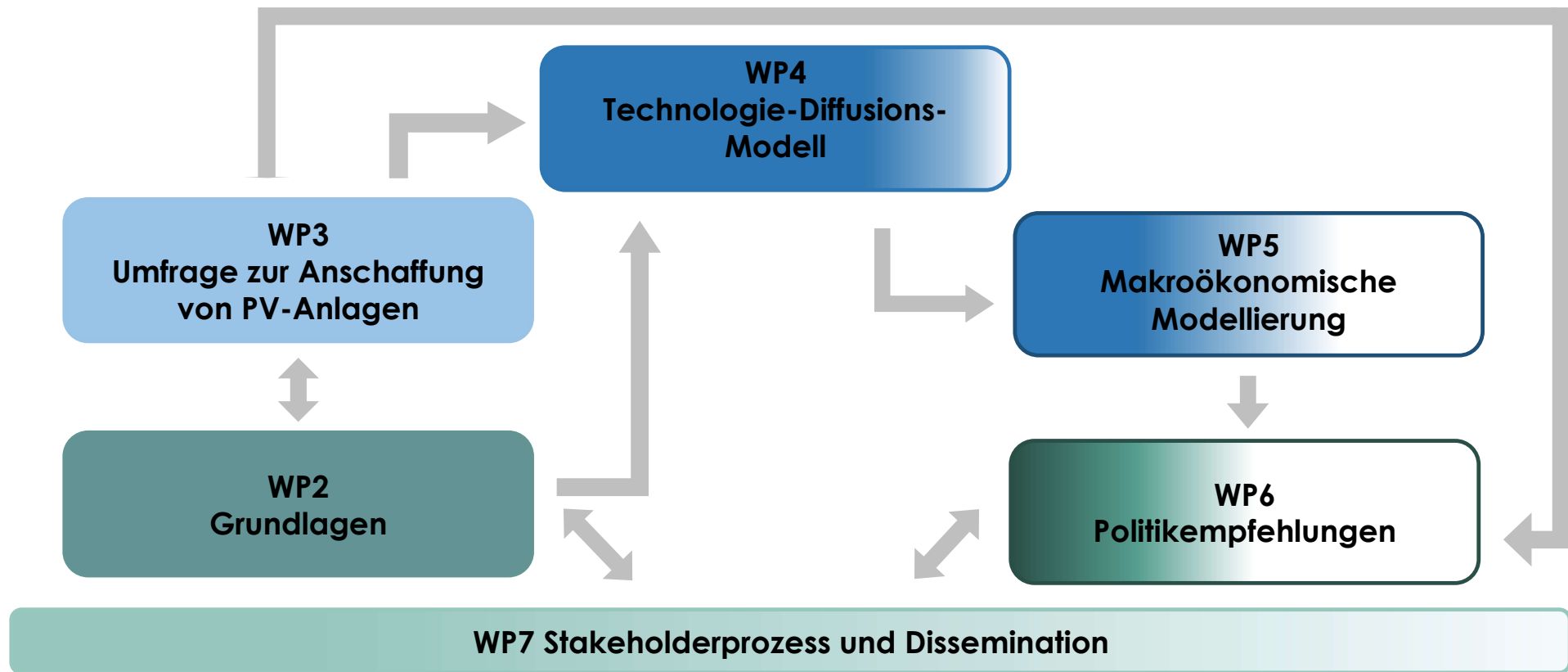
Projektziele (II)

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- Nebenziele:
 - Ermittlung von Faktoren, die die Investitionen österreichischer Haushalte in PV-Systeme mit und ohne Batteriespeicher bestimmen
(z.B. Haushaltsmerkmale, rechtliche Rahmenbedingungen und Förderprogramme)
 - Bestimmung der Motive für die Anschaffung von PV-Systemen
 - Identifikation nicht-finanzieller Barrieren für die Einführung von Haushalts-PV-Systemen
 - Entwicklung eines Technologiediffusionsmodells für Haushalts-PV-Systeme und Integration in das makroökonomische Modell DYNK

Projektstruktur

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WP3: Structural and Financial Constraints Driving Residential PV Adoption in Austria

20.04.2026, Stakeholder Workshop

Background and Motivation

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- Residential PV is central to Austria's energy transition
- Despite **declining technology costs**, adoption **remains** uneven and **below technical potential**.
- Do households mainly fail to adopt because of insufficient motivation, or because they face structural and financial constraints?
- This distinction matters for policy design:
 - If motivation is the issue → information/awareness tailored policies
 - If constraints dominate → access/feasibility policies

What Drives PV Adoption? Insights from the Literature

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Behavioral Drivers

- Environmental motives/concerns (Palm, 2020)
- Social influence / peer-effects (Gillingham & Bollinger, 2021)

Financial Feasibility

- Upfront investment costs
- Access to loan & concerns related to investment payback (Karakaya & Sriwannawit, 2015)

Structural Constraints

- Roof suitability
- Ownership structure
- Housing type (multi-family vs. detached or semi-detached) (Sovacool et al., 2022)
- Administrative procedures (Kyerere et al., 2024)

Insights from the Literature (II)

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Household Investment Strategy (co-adoption of technologies)

- Households often evaluate multiple technologies jointly rather than separately (Cohen et al., 2019, Hajhashemi et al., 2024)
- E-vehicles and heat pumps both increase household electricity demand
 - Strengthen PV investment case
- But such strategies remain uneven
 - Depends on housing conditions
 - Income/access to capital

Research Gap & Contribution

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Existing studies identify many drivers, but their relative importance remains unclear.

- Analyze isolated mechanisms
- Provide limited evidence for Austria
- Limited adopter/non-adopter comparisons

Our contribution:

- Integrated framework
 - Jointly measure housing conditions, complementary technologies, and indicators on finances as well as environmental preferences
- Survey questionnaire among households in Austria
 - Quota-based sample broadly representative in age, gender, region

Survey Design

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- Web-based survey conducted in **December 2024** (N=1,001)
- Quota targets were used for age, gender, and region
- **Screening questions** ensured respondents were household heads responsible for energy-related decisions
- **Split sample:**
 - PV adopters (n=358, ~ 36%)
 - Non-adopters (n=643, ~ 64%)
- Collected **socio-demographic and other data:** Income, housing, technology adoption, education, preferences

Model Specification

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- We estimate the probability that a household owns PV as a function of key characteristics we observe:

$$P(PV_i = 1) = f(\text{Housing}_i, \text{Income}_i, \text{Technology}_i, \text{Preferences}_i, \text{Region}_i)$$

- Estimate propensity to adopt using logit model and report average marginal effects

Baseline Results: Structural Feasibility Dominates

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Average Marginal Effects on PV Adoption

Variable	AME	Std. Err.	
Heat pump (=1)	0.348***	(0.035)	▪ Heat pump strongest correlate
E-Vehicle (=1)	0.154***	(0.050)	▪ EV and homeownership positive
Multi-family house (=1)	-0.158***	(0.033)	▪ Multi-family house negative
Homeowner (=1)	0.117***	(0.032)	
No. of Obs.	981		

Notes: Average marginal effects from logit model. Robust standard errors in parentheses. Reported effects represent the discrete change in the probability of PV adoption.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Extended Model: Constraints Matter More Than Preferences

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Variable	w/o Region Dummies	w Region Dummies
Heat pump	0.339*** (0.039)	0.337*** (0.039)
E-Vehicle	0.139*** (0.054)	0.159*** (0.055)
Multi-Family House (MFH = 1)	-0.163*** (0.037)	-0.140*** (0.039)
Occupant Status (Homeowner = 1)	0.056 (0.037)	0.048 (0.036)
Lower Middle Income	0.046 (0.051)	0.045 (0.049)
Upper Middle Income	0.095** (0.044)	0.099** (0.042)
High Income	0.136** (0.054)	0.146*** (0.052)
Age (>50 = 1)	-0.034 (0.030)	-0.033 (0.029)
Environmental Awareness	0.002 (0.003)	0.002 (0.003)
No. of Obs.	840	840

- High income **significant**
- Homeownership **loses significance**
- Environmental awareness **insignificant**

Conclusions

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Structural Feasibility Matters

- Multi-family housing significantly lowers adoption likelihood
- Detached / owner-occupied households remain advantaged
- Housing conditions shape practical feasibility of installation

Financial Capacity Matters

- Higher-income households significantly more likely to adopt
- Homeownership partly reflects underlying economic resources

Technology Context Matters

- Heat pumps and EVs strongly associated with PV adoption
- PV often part of broader household electrification strategy

Preference Variables Less Decisive

- Environmental awareness not significant

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Work Package 4

Stakeholders Workshop, 20.04.2026

Outline

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- Austria's PV Expansion Challenge
- Agent-Based Model
 - Agent Segmentation
 - Utility Framework
 - Untapped Potential
- National Simulation
 - Design
 - MFH Restriction - The Binding Constraint
 - MFH Unlock Effect
 - Robustness and Policy Instrument Comparison
- Policy Recommendations

Austria's PV Expansion Challenge

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11 TWh

PV target by 2030
(EAG, BGBl. I Nr. 150/2021)

9.4 GW

Installed by the end of 2024
(7.7 TWh produced)

45%

Households in MFH
— effectively excluded

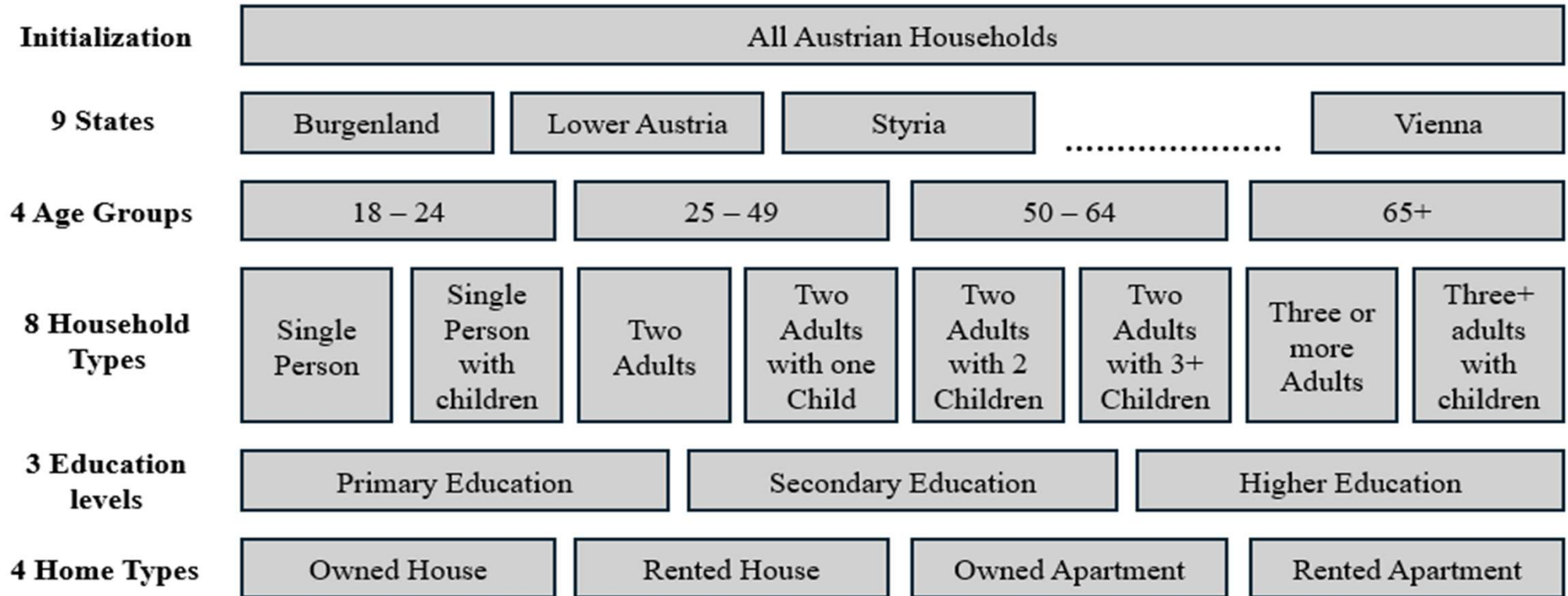
- WEG 2002 & MRG impose procedural barriers on MFH rooftop PV.
- The 2024 balcony micro-PV amendment (< 0.8 kW) addresses only a marginal fraction of available capacity.

Critical Question: Can subsidies or technology cost reductions compensate for this structural exclusion — or is tenure reform a necessary precondition?

Agent-Based Model



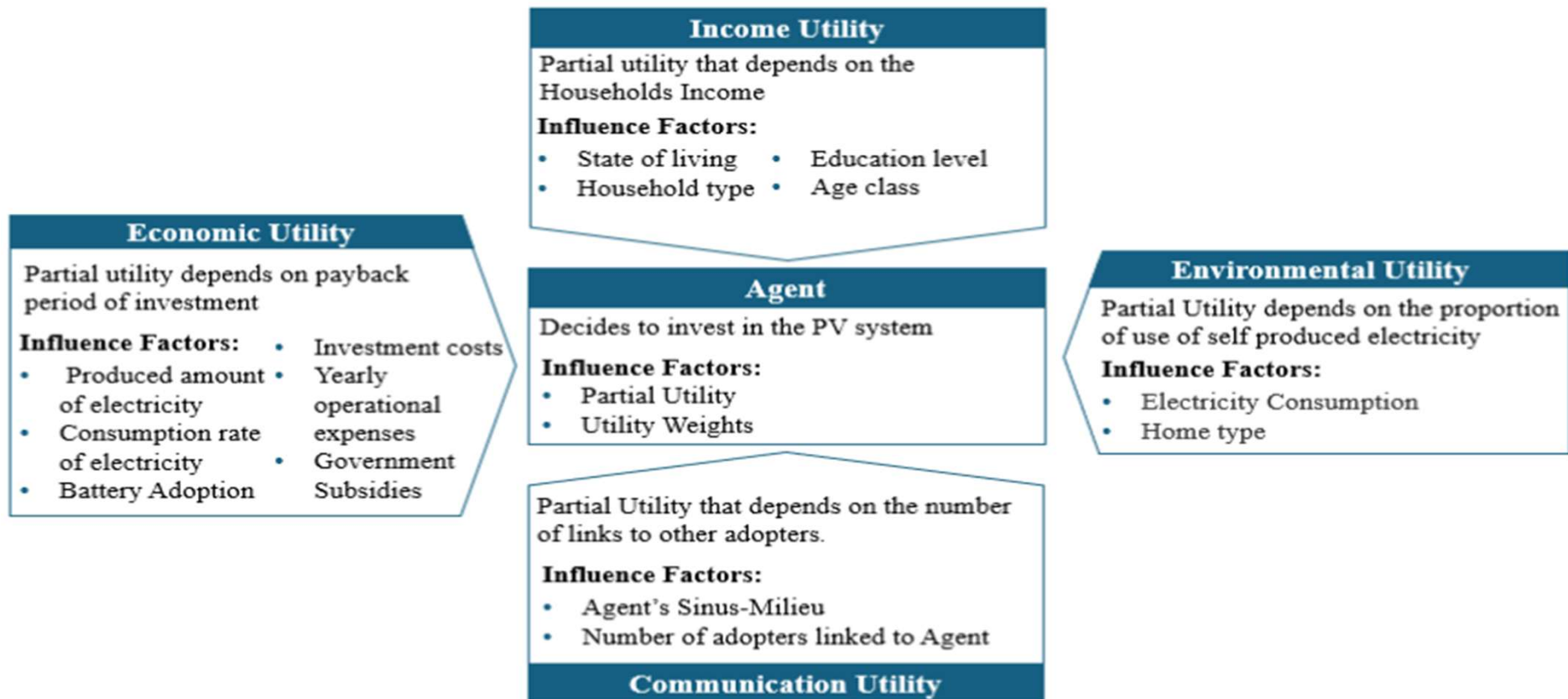
Agent-Based Model: Segmentation



- 3,456 distinct agent combinations across Austria's nine federal states
- Each household is an autonomous decision-making agent with individually sampled attributes.

Agent-Based Model: Utility Framework

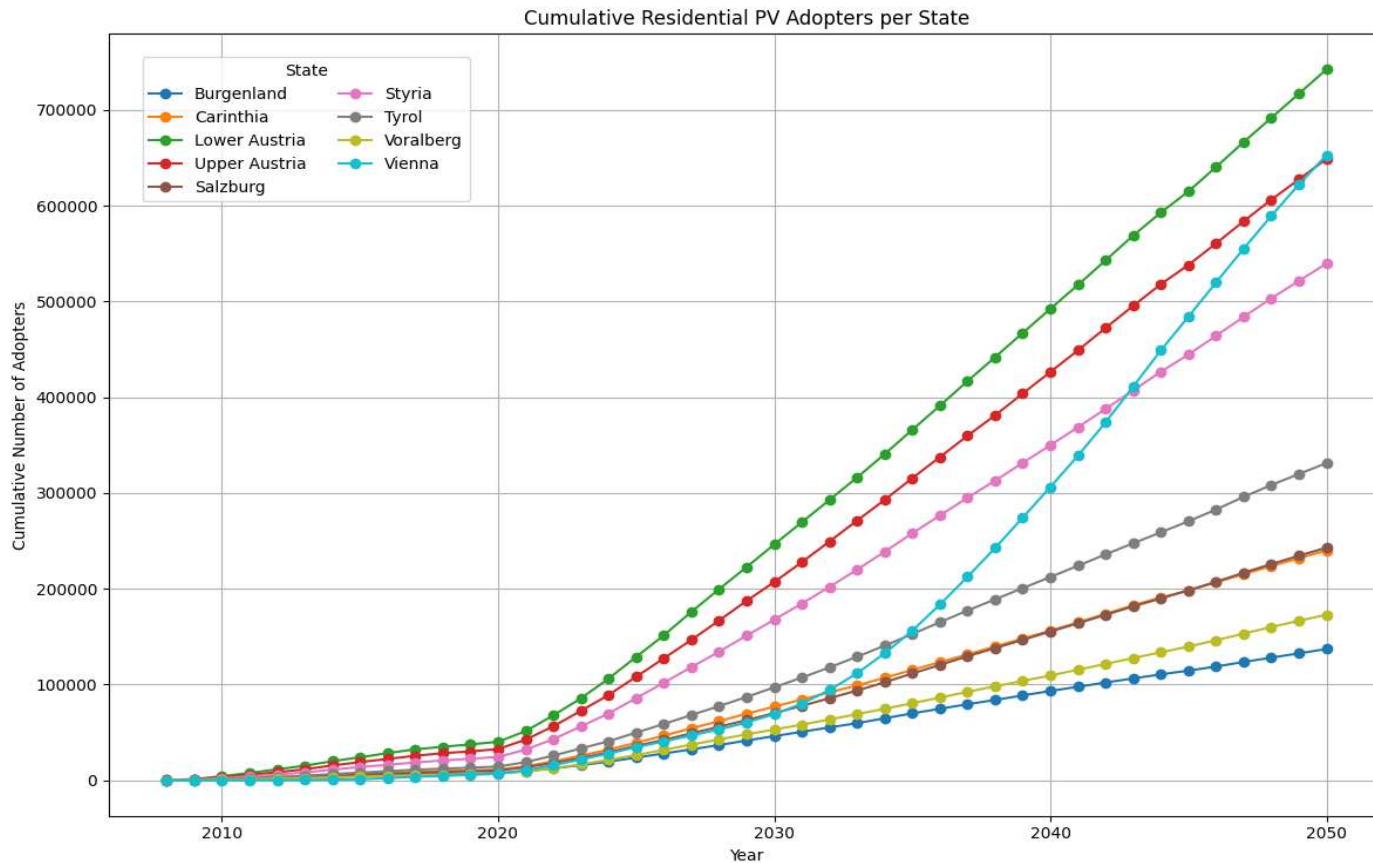
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- Adoption occurs when composite utility exceeds a calibrated threshold

Agent-Based Model: Untapped Potential

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Key Finding

Vienna — highest population density and MFH share — exhibits the greatest untapped adoption potential.

No combination of subsidies or cost reductions in the ABM matches the impact of enabling MFH participation.

→ MFH reform becomes the focal point for the national simulation

National Simulation



National Simulation: Design

Agent-Based Model

- State-Level Segmentation
- 9 Federal States
- 6 Age Groups
- 8 Household Types
- 3 Education Levels
- 4 Home Types

Consolidation for DYNK →

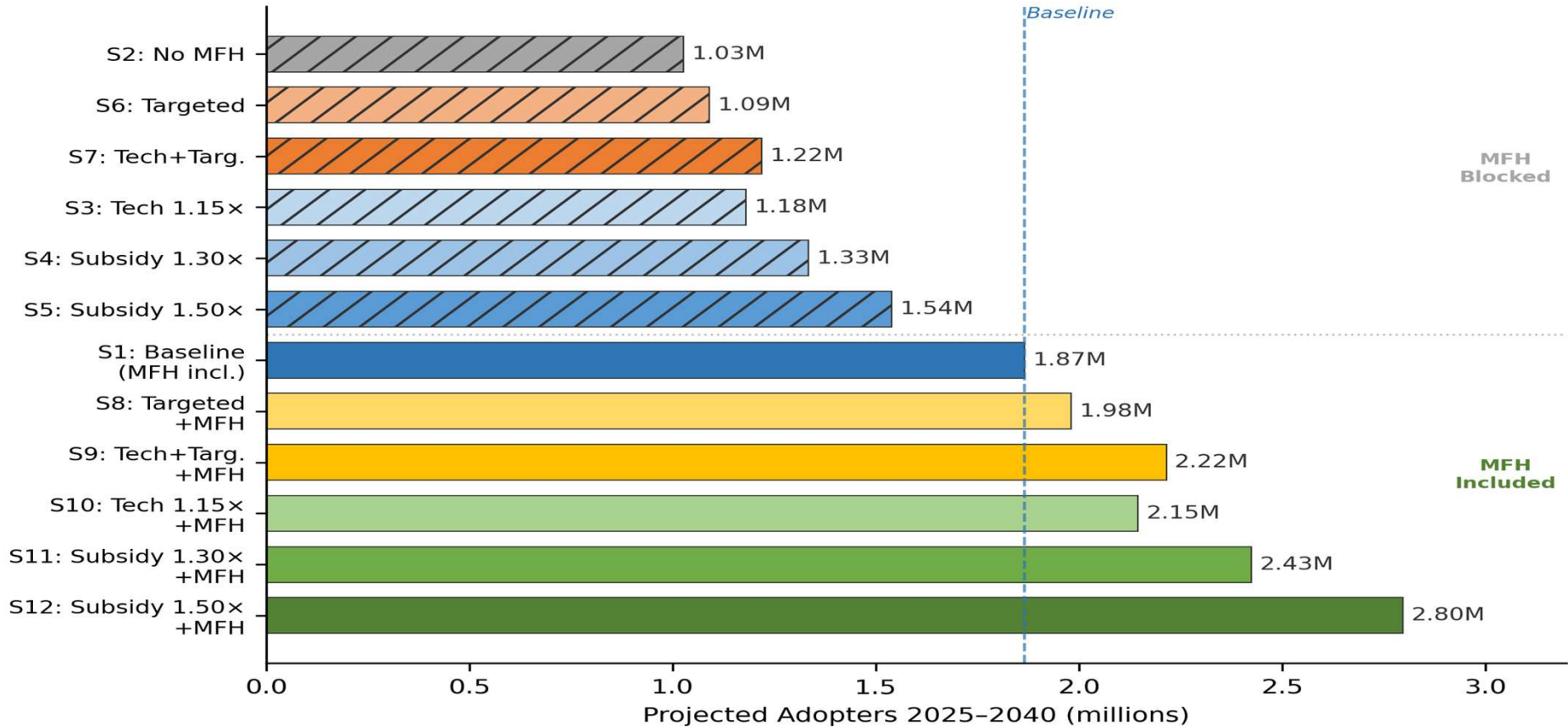
National Simulation

- DYNK-Compatible Segmentation
- 2 Age Groups
- 4 Housing Tenure Types
- 5 Income Quintiles
- Only Economic Utility

#	Scenario	MFH	Boost	Description
S1	Baseline	Incl.	1.00×	Reference — MFH included
S2	No MFH	Blk.	1.00×	Current MFH restriction
S3–S5	Uniform boost	Blk.	1.15–1.50×	Tech cost / subsidy (MFH blocked)
S6–S7	Targeted	Blk.	Dual	Q1–Q2 at 1.50×; upper Qs at 1.00/1.15×
S8–S9	Targeted + MFH	Incl.	Dual	S6–S7 with MFH unlocked
S10–12	Uniform + MFH	Incl.	1.15–1.50×	S3–S5 with MFH unlocked

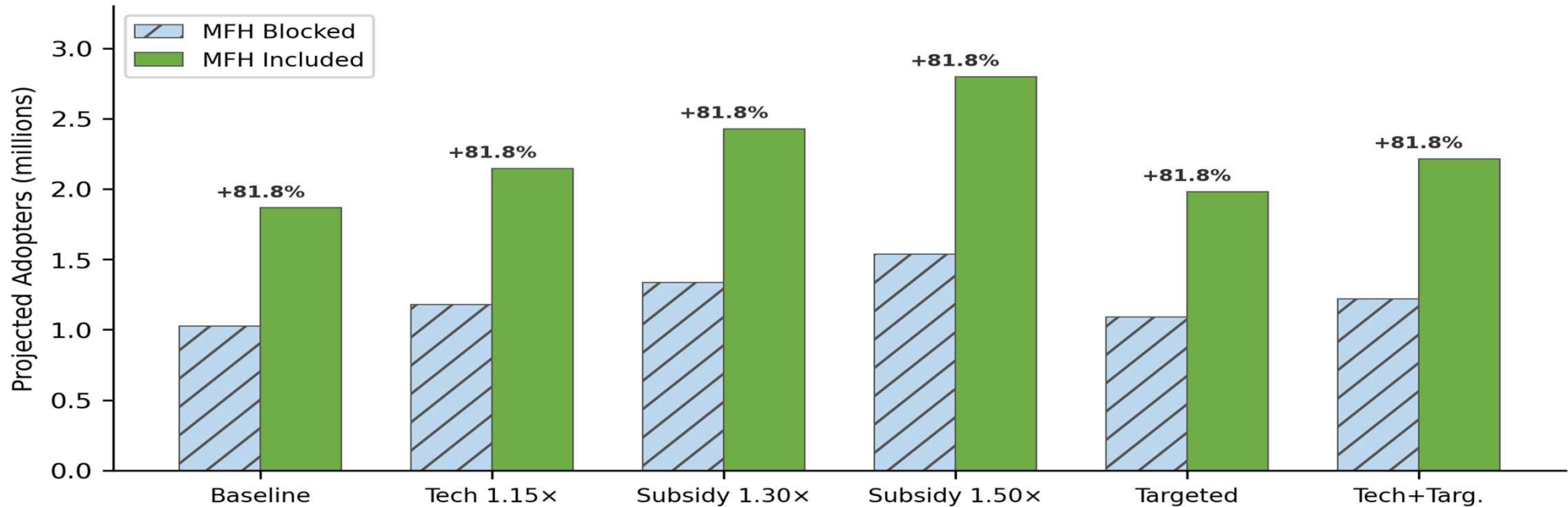
Three orthogonal policy levers: boost multiplier × activation schedule × MFH eligibility

National Simulation: MFH Restriction – The Binding Constraint



National Simulation: MFH Unlock Effect

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SFH adoption is identical between paired scenarios

MFH reform does not cannibalise existing SFH programmes.

+81.8% uplift comes entirely from newly accessible MFH

The entire increase is genuinely incremental demand.

National Simulation: Robustness and Policy Instrument Comparison

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Proportional Scaling

Boost multipliers produce exact year-by-year proportional adoption:

S3 / S2	= 1.150	Tech 1.15x
S4 / S2	= 1.300	Subsidy 1.30x
S5 / S2	= 1.500	Subsidy 1.50x

Same ratios hold for MFH-included family (S10–S12 vs S1).

→ **Linear, predictable, no emergent instabilities**

Targeted vs. Broad Subsidies

Concentrating 1.50x on Q1–Q2 only:

S6 (targeted)	1.09M	–6% vs S2
S7 (tech+targ.)	1.22M	+19% vs S2
S5 (broad 1.50x)	1.54M	+50% vs S2

Why? Q1+Q2 share ≈ 11.4% of total adoption propensity weight.

But: S8/S9 (targeted + MFH) exceed baseline — equity AND volume require combined levers.

Policy Recommendations

Policy Recommendations

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1

MFH reform is the necessary precondition

No policy combination achieves baseline adoption without enabling MFH participation. Legislative reform of WEG & MRG — beyond the 2024 balcony provision — is required.

2

MFH reform is additive, not redistributive

SFH adoption is entirely unaffected. The +81.8% aggregate uplift is composed exclusively of incremental MFH demand. No cannibalisation of existing SFH programmes.

3

Equity and volume require complementary instruments

Targeted low-income subsidies advance distributional goals; broad subsidies drive volume. Combining tenure reform with income-targeted support (S8, S9) delivers both.

Thank you for your attention!
Any questions?

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Makroökonomische Analyse

Die Rolle des makroökonomischen Modells

Mark Sommer

Stakeholder Workshop

Wien, 20.4.2026

Übersicht

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- Rolle im Projekt
- Modell
- Schnittstellen
- Erste Ergebnisse

Übersicht

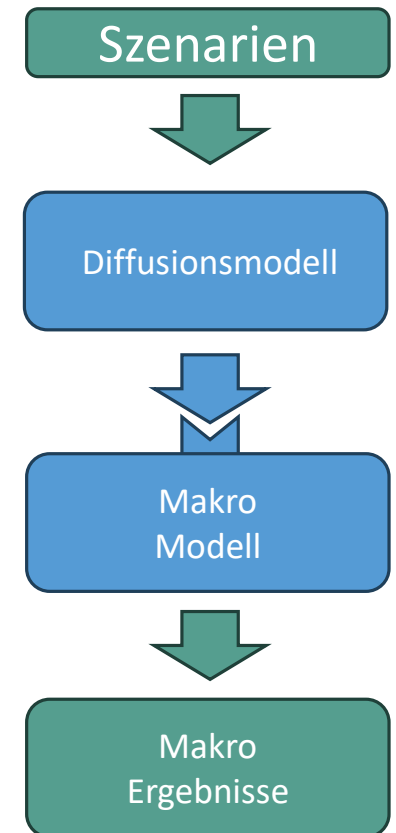
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- **Rolle im Projekt**
- Modell
- Schnittstellen
- Erste Ergebnisse

Rolle im Projekt

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- **Projektziel:**
 - Integrierte Analyse von Diffusionsszenarien für Haushalts-PV-Systeme in Österreich
- **Methode:** Modellbasierte Szenarien-Analyse
 - Szenarien Definition
 - Simulationen Technologiediffusionsmodell (TDM)
 - Datentransfer in Haushalts-Modul von DYNK (Schnittstelle)
 - Simulation makroökonomisches Modell (DYNK)
 - Bewertung der nachgelagerten volkswirtschaftlichen Effekte
- **Ergebniskategorien (DYNK)**
 - Einkommen und Konsum je Haushaltsgruppe
 - Makroökonomische Indikatoren



Übersicht

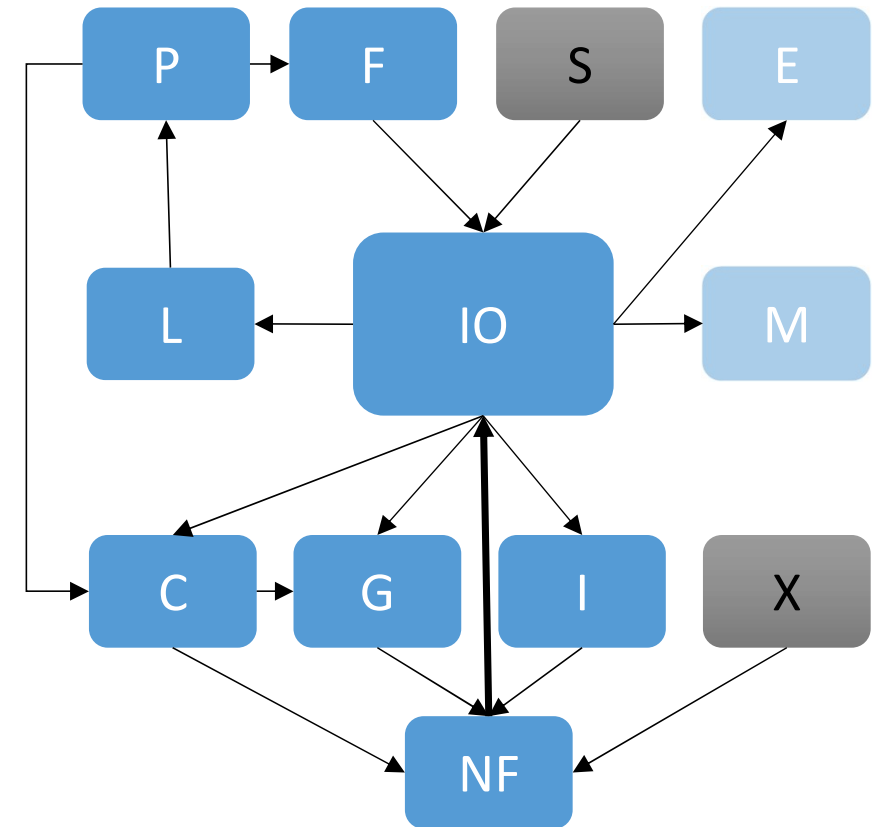
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- Rolle im Projekt
- **Modell**
- Schnittstellen
- Erste Ergebnisse

Modell

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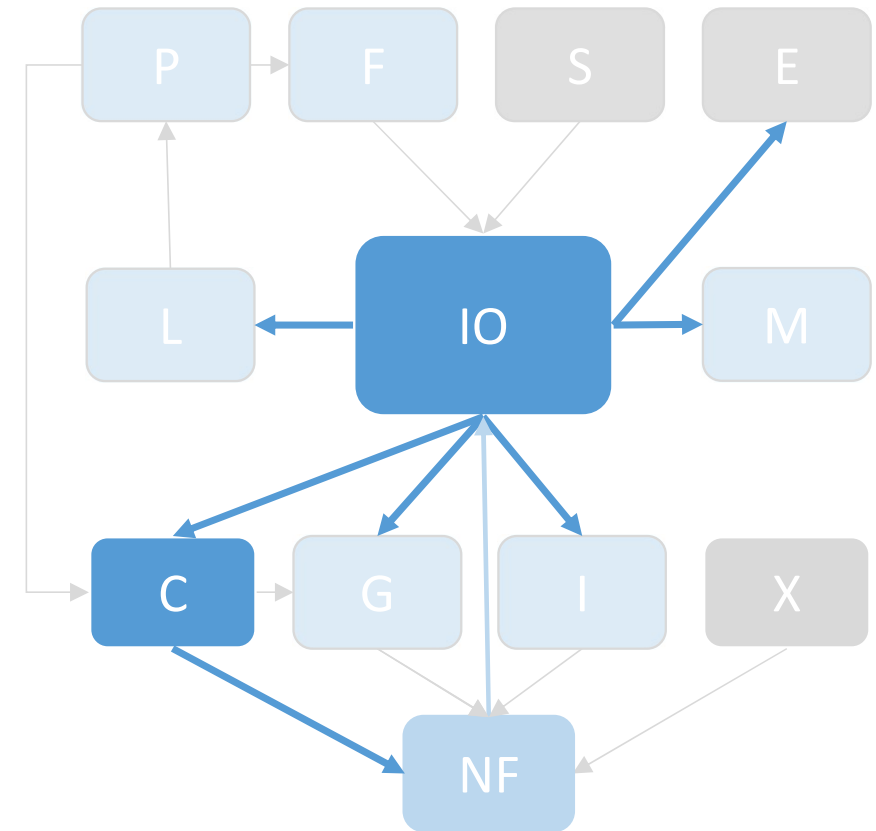
- **Dynamic New Keynesian Model (DYNK)**
- **Abdeckung: 1 Land & jährliche Zeitschritte**
 - 90 Sektoren & Gütergruppen
 - 60 Konsumgüter & 40 Haushaltsgruppen
- **Typ: Erweitertes Input-Output Modell**
 - Input-Output-Modell (**IO**)
 - mit fixen Exporten (**X**) & Endogene Importe (**M**)
 - Privater Konsum & Einkommen (**C**)
 - Öffentlicher Konsum & Steuern (**G**)
 - Investitionen (**I**)
 - Preissystem (**P**) & Produktionsfunktion (**F**)
 - Arbeitsmarkt (**L**)
 - Strom- & Fernwärmeerzeugung (**S**)
 - Energienachfrage & Emissionen (**E**)



Modell

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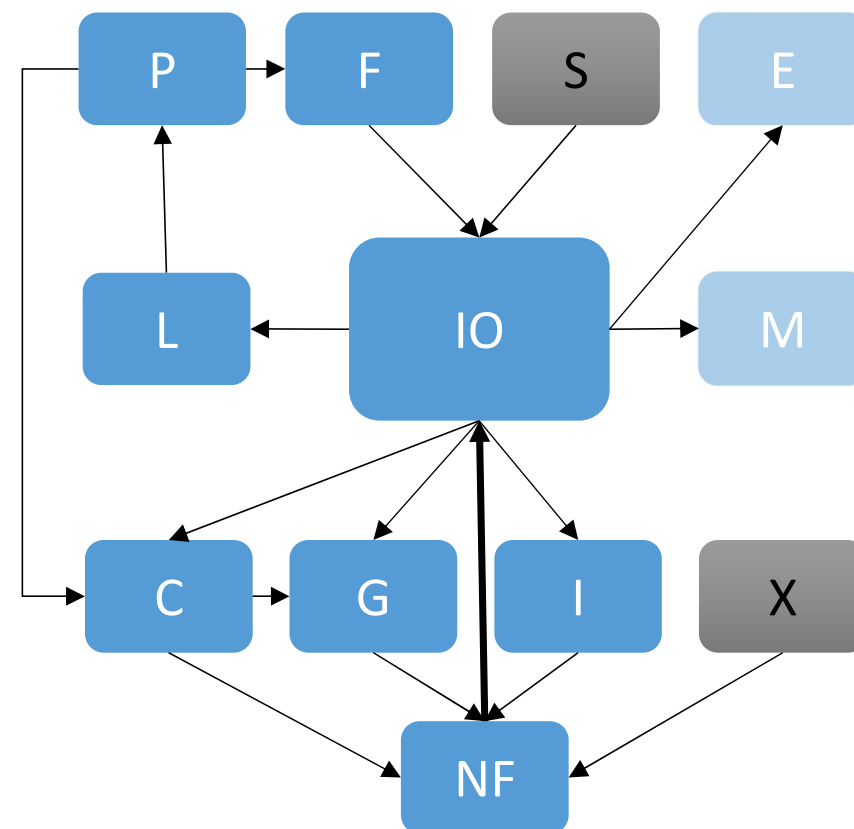
- **Konsum-Mix Änderung**
 - Produktions-Mix
- **Produktion-Mix verlagert**
 - Löhne, Steuern, Gewinne,
 - Arbeitskräfte, Importe, Energie
- **Arbeitskraft-Nachfrage**
 - Lohnverhandlungen
- **Produktionspreis**
 - Konsum & Produktion reagieren
- **Vorleistungs-Mix Änderung**
 - Feedback setzt sich fort...



Modell - Zusammengefasst

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- **DYNK bewertet Änderungen von**
 - Preisen / Steuern
 - Nachfragestrukturen
- **im makroökonomischen Kontext entlang der Wertschöpfungskette**
- **zu laufenden und konstanten Preise**
- **über Jahresschritte z.B. 10 Jahre**



Übersicht

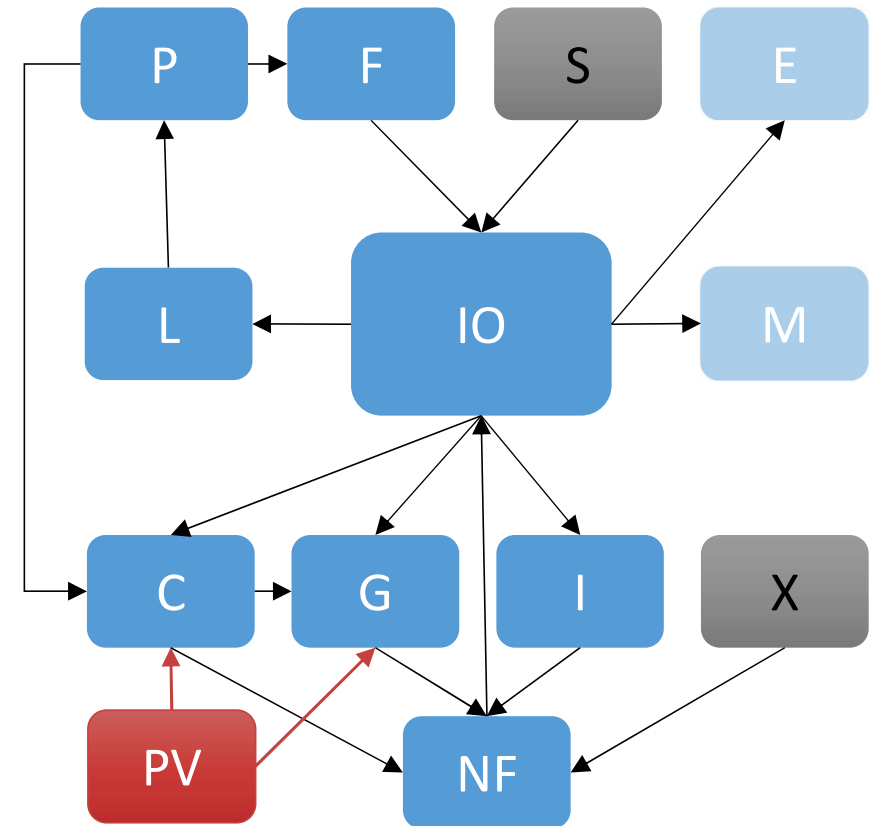
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- Rolle im Projekt
- Modell
- **Schnittstellen**
- Vorläufige Ergebnisse

Schnittstellen: Übersicht

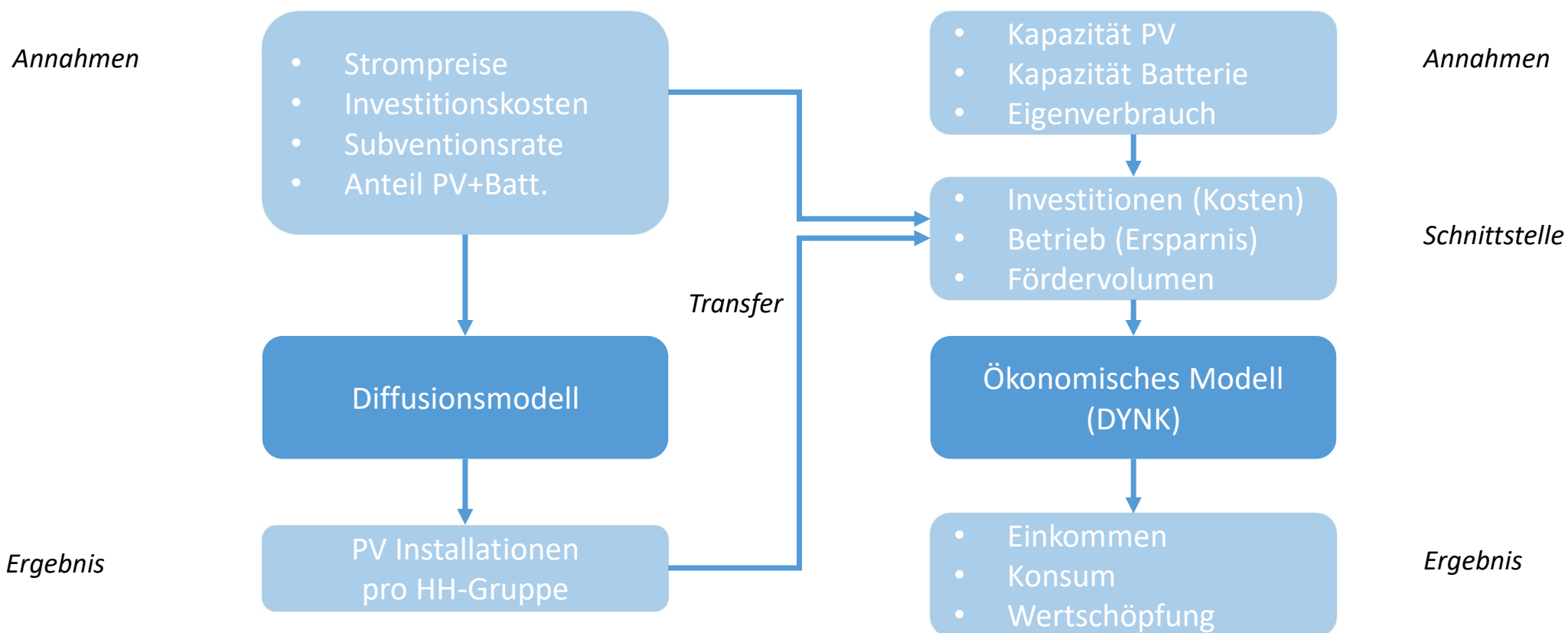
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- **Energiemarktmodelle**
 - Strom- bzw. Fernwärmeerzeugungsmix
- **Mobilitätsmodelle**
 - Investitionen und & Nutzung PKW bzw. ÖV
- **Gebäudemodelle**
 - Sanierung und Investitionen bzgl. Raumwärme und - kälte
- **NEU: Diffusionsmodell**
 - Investition & Betrieb von PV-Anlagen
 - Förderungen



Schnittstelle: FutuRES

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Übersicht

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- Rolle im Projekt
- Modell
- Schnittstellen
- **Erste Ergebnisse**

Erste Ergebnisse: Szenarien

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- **Simulation:** Fortsetzung bestehende Rahmenbedingungen 2025 bis 2040
 - **Referenz (S2):** Nur Mehrfamilienhäuser (MFH) investieren
 - **Szenario (S1):** Begrenzung aufgehoben

- **Implementierung in DYNK „Budgetneutral“ aus Haushaltssicht**
 - Investitionen in PV und Batterien
 - **Reduzieren** Konsum Nicht-Dauerhaften Güter
 - Stromkosten-Ersparnis & Erlöse durch Einspeisung
 - **Erhöht** Konsum Nicht-Dauerhafter Güter
 - Subventionen
 - Nicht simuliert

Erste Ergebnisse: Effekte

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- **Verlagerung im Konsum bewirken**
 - → Reduktion Importe (Gas und Strom)
 - → Anstieg Importe (PV-Module)
 - → erhöhte Nachfrage nach Arbeitskraft → Löhne steigen → Preise steigen
- **Fazit: Effekte heben sich auf**
 - Keine realen Lohnsteigerungen wegen höheren Preisen
 - Positiver BIP-Effekt wird durch Importe neutralisiert
- **Plausibilitäts-Checks folgen**
 - Z.B. Verwendung des PV-Stroms & Auswirkung auf Außenhandel
 - Import-Effekte von PV-Modulen

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Thank you!

Mark Sommer

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