EXPLORING THE ROLE OF STAKEHOLDER DYNAMICS IN RESIDENTIAL PHOTOVOLTAIC ADOPTION DECISIONS: A QUANTITATIVE SURVEY IN GERMANY

Remote from Leipzig to Copenhagen, 21.04.2021
Sören Graupner
Fabian Scheller, James Rhys Edwards, Russell McKenna and Thomas Bruckner
INTRODUCTION & MOTIVATION

- Residential rooftop photovoltaics is a mean to abate anthropogenic climate change.
- Though general public acceptance and high potential, adoption rates remain low.
- Residential decision-making with respect to low-carbon technologies has been studied intensively.
- Yet, in behavioral studies to date, individuals are typically assessed in isolation from their social environments.
- Relevant stakeholder interactions and their effects are barely accounted for in existing energy transition modelling approaches.

❖ This research gap is addressed by investigating stakeholder dynamics in residential PV decision-making from a procedural perspective.
EXPLORING THE ROLE OF STAKEHOLDER DYNAMICS IN RESIDENTIAL PHOTOVOLTAIC ADOPTION DECISIONS | A quantitative survey in Germany

RESEARCH OBJECTIVE

- What are drivers and barriers for residential PV adoption?
- Which stakeholders influence the adoption decision and how can the influence be explained by psychographic attributes?
- What can be learned from the decision process of house owners who already adopted PV to enhance adoption rates?
- Which policy measures can be derived?
METHODOLOGY

- Investigation of the perceived influence of various stakeholders on the residential PV adoption decision based on a quantitative survey on house owners that are potential or current adopters in Germany (n=1165).
- Relative importance of different stakeholders in different stages receive special attention.
- Decision process is divided into three stages: Awareness stage, Interest stage and Planning stage.
- In each stage the perceived influence of stakeholders is recorded.
- Psychographic attributes of stakeholders are recorded.
- Furthermore, socio-economic characteristics and drivers/barriers for adoption intention of participants are recorded.
- Statistical methods: regression models for marginal effects, tests for sub-sample comparisons etc.
SURVEY STRUCTURE

1) Decision status

- Technology knowledge
- Acquisition status
- System ownership

a) Adoption decision process

I) Awareness phase: "I am aware of the existence of residential PV systems"
II) Interest phase: "I find PV systems interesting and want to know more"
III) Planning phase: "I plan to install a residential PV system at my home."
IV) Utilization phase: "I have bought a residential PV system."

2) Attribute perceptions

- Personal characterization

b) Attribute list

- Trustworthiness
- Competence
- Power
- Reliability
- ... (other attributes)

3) Dynamics assessment

- Influence strength
- Contact making
- Pos. +/- Neg. influence

C) Stakeholder map

- Direct neighbours
- Municipal administrations
- Photovoltaic providers
- Energy consultants
- ... (other stakeholders)

d) Decision-maker

- Potential adopter / current adopter

4) Individual classification

- Technology benefits
- Socio-demographics
- Lifestyle milieus

Figure 1: Composition and structure of the computer-aided survey (1-4 set out the general structure, I-IV represent the different stages of the decision process, a-d are answer possibilities of the participants).
METHODOLOGY

- Stakeholders comprise
  - Family & Relatives, Friends, Acquaintances & Colleagues, Neighbours, Other private persons, Local Utilities, National Utilities, Local governments, Private organizations & societies, Financial institutions, Contractors & Architects, Energy consultants, PV manufacturers & providers, Reporters & media corporations

- Respondents were asked to evaluate stakeholders’ personal attributes on a 1 to 10 scale:
  - Trustworthiness, Competence, Power, Independence, Availability, Closeness, Likeability, Integrity, Reliability
EXPLORING THE ROLE OF STAKEHOLDER DYNAMICS IN RESIDENTIAL PHOTOVOLTAIC ADOPTION DECISIONS | A quantitative survey in Germany

METHODOLOGY

- Distribution of participants (n=1165) in subgroups:
  - Potential Adopters with low intention (n=486)
  - Potential Adopters with high intention (n=285)
  - Current Adopters (n=394)

- Low/high intention to adopt is determined by the question:
  - Will you adopt residential PV within the next three years? (5 Point-Lickert)
    - High intention: agree and strongly agree
    - Low intention: strongly disagree, disagree, neither agree nor disagree
Results and findings

DRIVERS & BARRIERS
RESULTS AND FINDINGS

- **Intention as dependent variable** in ordered probit regression on benefits/barriers exhibits
  - Positive marginal effects
    - investing time ($\beta=0.32$, $p<0.01$) and money ($\beta=0.26$, $p<0.01$) to get information on PV systems
    - having enough money to install a PV system ($\beta=0.11$, $p<0.05$)
    - believing to save money on the long run with a PV system ($\beta=0.25$, $p<0.01$)
    - knowing persons owning a PV system ($\beta=0.07$, $p<0.1$)
    - raising social status ($\beta=0.17$, $p<0.01$)
    - gaining independence from energy utilities ($\beta=0.15$, $p<0.01$)
  - Negative marginal effects
    - perceiving risk and cost ($\beta=-0.15, p<0.01$).
  - Environmental concerns and technological leadership were not significant in the regression and are only weakly to moderately correlated to the intention ($\rho=0.25$ and $\rho=0.35$, $p<0.01$).
EXPLORING THE ROLE OF STAKEHOLDER DYNAMICS IN RESIDENTIAL PHOTOVOLTAIC ADOPTION DECISIONS | A quantitative survey in Germany

RESULTS AND FINDINGS

- average income of participants higher than national average (house owners)
- Current adopters and high intention potential adopters have equal income, but low intention adopters lie significantly below (-247€/month, p<0.001)
- analogous results for a risk index constructed from milieu indicator questionnaire (SINUS-Questions)
- analogous results for sub-sample comparisons:
  - Gender
  - Eastern vs. Western German Federal States

❖ Monetary and risk-related considerations are eminent for adoption intention.
Results and findings

INFLUENCE STRENGTH EXPLAINED BY ATTRIBUTES
EXPLORING THE ROLE OF STAKEHOLDER DYNAMICS IN RESIDENTIAL PHOTOVOLTAIC ADOPTION DECISIONS | A quantitative survey in Germany

RESULTS AND FINDINGS

- Participants were asked about the influence of stakeholders on their decision (1 to 10 scale)
  - Influence regressed step-wise (p<0.1) on stakeholders’ attributes reveals that influence can be largely (R² between 0.4 and 0.7) explained by stakeholders’ attributes.
RESULTS AND FINDINGS

- Depending on stakeholder and stage, different stakeholder attributes contribute (marginal effects) to perceived influence (examples):
  - For family members and relatives the highest m.e. is found for likeability for all stages I-III ($I = .298$, $II = .258$, $III = .311$) followed by competence ($I = .213$, $II = .241$, $III = .221$).
  - For local utilities, the highest m.e. are found for trustworthiness ($I = .234$) in the first stage (awareness), independence ($II = .211$) and reliability ($II = .310$) in the second stage (interest) and availability ($III = .211$) and reliability ($III = .203$) in the third stage (planning).
  - PV manufacturers have the highest m.e. for availability ($I = .187$) and competence ($I = .183$) in the first stage, competence ($II = .201$) and reliability ($II = .195$) in the second stage and reliability ($III = .302$) in the third stage.
  - Building professionals demonstrate the highest m.e. for competence ($I = .252$) and reliability ($I = .230$) in the first stage, reliability ($II = .172$) and independence ($II = .169$) in the second stage and availability ($III = .143$) and reliability ($III = .138$) in the third stage.
Results and findings

INFLUENCE STRENGTH OF STAKEHOLDERS
RESULTS AND FINDINGS

- Box plots of influence strength by stage and stakeholder
- Actual adopters report highest influence strengths, followed by high intention potential adopters
- Low intention potential adopters report lowest influence strength
- Similar for contact rates (numbers below box plots)
- Two-sided t-tests were performed to prove differences in perceived influence strength

Figure 2: Influence strength of stakeholders through the stages by intention and adoption status. For various stakeholders the perceived influence (Q1, median, Q3) is shown for low intenders, high intenders and actual adopters.
CONCLUSIONS AND POLICY IMPLICATIONS
CONCLUSIONS AND POLICY IMPLICATIONS

- Monetary and risk-related considerations are eminent for adoption intention
  → Policy measures to reduce risk and monetary insecurities
    ❖ Income dependent tax benefits
    ❖ Location dependent feed-in tariffs
- Stakeholders’ attributes can explain perceived influence on adoption decision: for institutional and commercial stakeholders competence, reliability, trustworthiness and likability have highest influence
  → Investments in the enhancement of these attributes
    ❖ certification and training
THANK YOU FOR YOUR ATTENTION!

Sören Graupner
Institute for Infrastructure and Resources Management
Chair for Energy Management and Sustainability

graupner@wifa.uni-leipzig.de