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# Abstract

# Introduction

\_" For whoever has will be given more, and they will have an abundance. Whoever does not have, even what they have will be taken from them."\_ Matthew 25:29. Although the words are primary about divine discipleship, it is also a principle in natural world: people that have the upper hand gain advantages to further increase their lead [@merton\_1968; @gladwell\_2013]. One of the places where this effect is visible, is in the adaptation of new technology’s. More educated people are the first to take advantage of new technological advances [@rogers\_1983], and thereby improve their position in relative comparison to the people that are unable to adopt. Evidently, this effect is happening in the transition to (more) sustainable sources of energy. The process of modernization, unsustainability is produced as a side-effect of economic and technological development. The unsuitability becomes visible in the over-consumption of natural resources, loss of biodiversity and climate change problems. To overcome these problems, climate change urge national and local governments to make policy’s to enable energy transition from fossil energy sources that are free from emitting carbon in the atmosphere. The aim of the Dutch government is to reduce the emission of carbon by 50% or more before 2030. One of the challenges in the vision for a carbon- neutral environment is the transformation of more than 7 million houses, mostly moderately insulated and almost all heated by natural gas, to well insulated houses which are headed with energy from a sustainable source and in which clean electricity is used [@klimaat\_2019, p. 21]. This means an extensive and expansive transformation of the Dutch society in there everyone has to participate. The technology used for achieving this goal are mainly decentralized power generation through photovoltaic solar panels (PV), wind mills and head pumps (HP). Fossil-based transport shall be replaced by electric vehicles (EV), either with batteries or hydrogen [@klimaat\_2019]. Technology’s like these, that enable a more sustainable way of living, will be called “ECO-innovations” [@James\_1997] in this article. This will be further described in the theoretical framework of this article.

The Matthew effect again becomes visible through the way the Dutch government uses a neoliberal marked principles to push energy transition: people that are able to adapt new technologies are able to sustain their lifestyle as consumers while lowering their environmental impact with benefits of subsidies, while people that are not adopting the new technology can only create a sustainable lifestyle by consuming less [@jhagroe\_2015]. Thereby Jhagroe argues that the transitions increases the already existing gap between rich and poor [-@jhagroe\_2015]. A large amount of research is devoted to identifying innovators in general [make a list] and innovators of sustainable technology such as PV [make a list]. However, there is not much theory (that we know of) about the people who are not transitioning themselves to sustainable forms of energy. Therefore academic research on this topic is needed. Late adopters of innovation are most likely to be individually blamed for not adopting an innovation or for being much later in adopting than the other members of their system, while careful analysis can show that an innovation maybe is not appropriate for this group [@rogers\_1983]. Therefore it is important to study the people that are not adopting sustainable innovations in the present-day energy transition. In investigating the stigma on the non-adopters this article gains social relevance. This study consists of two part to study the not-adopters of sustainable innovations: the first part is about identifying the publics that are not adopting via an analysis of the spatial distribution of PV. The second part of this article is about understanding why the people in the differed groups are not adopting sustainable innovations. This part of the research will be done by interviewing people from the identified groups.

#Problem statement

The (potential) disruptive effect that the energy transition has on the Dutch society creates a necessity to precisely identify and understand the precarious publics that are - by not adopting – targeted by the process of innovating to a carbon free society. According to Rogers late adopters are stereotypically perceived as traditional, uneducated, and/or resistant to change, and that may become a self-fulfilling prophecy [@rogers\_1983, p. 107]. However, the choice to adopt is also not only a matter of economic resources. A division of adopters vs. not adopters of new sustainable energy technology’s simply on a basis of their annual income, perceives the citizens as merely rational operating actors that act on economic benefits. Technological innovation are always an interplay between material and social landscapes [@jasanoff\_kim\_2015]. This process, that Jasanoff calls “co-production”, and is about the ways in which knowledge about the world is inseparable from the ways in which we choose to live in it [-@jasanoff\_2004]. The adoption of innovations is, in that manner, influenced by individual and public visions of the desirable future in terms of social practices, identities, norms and instruments. On the basis of co-production, both innovators and non-innovators can be divided into numerous publics for innovation discourse. Thereby the economic resources of adopters are maybe not an motivator for innovation, increasing the possibility of adoption on a continues scale as suggested by research [@Bernards\_2018], but more as an enabler with a threshold from where the investment becomes possible. Sociotechnical imaginaries shape the future of the transition to a sustainably future, understanding this imaginaries for the non-adopters is key in understanding why this group is not innovating. The real decision making is an interplay between the natural resources and the social world of the adopter. This interplay between the natural and social resources on the possibility of a household (not) to invest in sustainable innovations will be investigated in this article. Only the investigation of the interplay between these concepts will create an understanding of why household are not adopting new technology. This understanding makes possible public issues in the transition to sustainable energy visible and can thereby help in creating a more inclusive framework for transitions.

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Built from the findings from Rogers that laggards non-adopters are not just negative to change, but can experience real boundaries in adopting innovation [@rogers\_1983], the research question in this article is the following: \_what is the role of normative frameworks of social networks in adopting sustainable innovation in the Dutch society\_. This questing will be investigated in two parts. The first part of the research in this article is about identifying different social groups in the adoption of innovation based on natural resources, by an empirical study of the distribution of ECO-innovations in the Dutch landscape "[James\_1997]. By investigating the natural factors, such as annual income, house ownership and characteristic of the house itself. By investigating these factors we create more insight in the factors that enable an household to adopt new technology. The social systems that are identified as not adopting ECO-innovation is further investigated in the second part of the article. This second part is an exploration on the normative framework of the social network of an household. This part will be investigated by conducting extensive interviews amongst identified groups.

# Theoretical framework

To investigate the sociotechnical imaginaries of the people that are not adopting innovation, this article explores the normative framework of persons from this group concerning sustainability. This chapter explains what we mean when we talk about imaginaries and about the diffusion of ECO-innovation.

## Imagining climate change

Jasanoff argues that technological inventions often follows on the heel of science fiction, lagging the imagination of the public [-@jasanoff\_kim\_2015]. Fantasy produced the robots before scientist did. Following this logic, Jasanoff explains the CO-production as the way popular visions about the desired future and the technological possibility’s shape history. Adaptation of new technology is thereby not merely a matter of ability, but maybe even more a matter of vision. Both ability and vision needs to present to successful adopt innovations like solar energy. The interpretive framework of Co-production from Jasanoff argues that interpretation of knowledge depends on the interests of society. In this view, making of the natural and the social worlds develop simultaneous. co-production allows to consider how time and space are involved in the formation of the social world, and how different meanings can be ascribed to the same activity or technology. Thereby it helps in making make explicit the role of media and dominant imaginaries in things like the Reformation, the Enlightenment, decolonization (and the climate crisis) [@jasanoff\_2010]. Imaginaries describe the way people imagine their surroundings and are made visible in norms, values, institutions and symbols used within a social group. Imaginaries describe the way ordinary people \_imagine\_ their social surroundings and is made visible in images, stories, and legends, necessary for common understanding of practices and a widely shared sense of legitimacy of things like borders and nationalities [@taylor\_2004]. These imaginaries also play a role in the climate crisis. Levy and Spices [-@levy\_spicer\_2013] derive convincingly differed imaginaries from observation and analysis of the various framings and positions adopted by actors and the media on sustainability. These four core imaginaries they identify are the 1) 'fossil fuels forever': this (obsolete) popular imaginary viewed abundant cheap fossil fuel as the prime motor behind a competitive industrialization. 2) the 'climate apocalypse' imaginary paints an alarming picture of the coming decades, visible in movies like “day after tomorrow” [-@DAT]. Change is inevitable, attempts to avoid it is useless. 3) 'techno-market' is the combination of capitalism and sustainability. In this view, the marked provides new product that enable a life as consumers in sustainable way's. 4) 'Sustainable lifestyle': these movements are inspired by an simpler and less materialistic lifestyle. In this view, solar does not necessarily needs to be adopted to reduce the production of CO2. Thereby in this article we investigate in what way the imaginary that people have influences the adaptation of sustainable.

## Diffusion of ECO-innovation

In this article, the spread of a new technology in a society is conceptualized by the process of diffusion of innovation, " the process by which an innovation is communicated through certain channels over time among the members of a social system." [@rogers\_1983, p. 5]. Innovation is the new product or idea. In this study, the focus is on ECO-innovations. ECO-innovations are about new products and processes which provide customer and business value but significantly decrease environmental impacts [@James\_1997]. This combination of reducing carbon emission and provide economic opportunity’s, which is also the way the energy transition is described in the klimaatakkoord [@klimaat\_2019]. Communication is the process of sharing new information to people that have not adopted the innovation. A communication channel is the means by which messages get from one individual to another, that can be things like media or personal relations. The strength of the ties an individual maintains with a communicator of an innovation influence the change of a successful adoption. Time is involved in diffusion through the process which an individual passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to conﬁrmation of this decision. Thereby the time that it takes to spread an innovation in a social system is key in this research. The innovation is distributed in a social system. There are differed types of social networks, this article focused on residential spatial networks. Rogers [-@rogers\_1983] classiﬁed the categories of the adopters as innovators, early adopters, early majority, late majority and laggards, and an innovation is spread through a network in the respective order. This leads us to conclude that *the diffusion of ECO-innovation follows a visible spatial path from innovators to the majority in an local network trough, in which the strength of the relations influences the speed of adoption*.

This article holds an inductive approach. Grand theories are avoided as much as possible, instead the data from the first part of this article in analyzed to find patterns for generalizations of the diffusion of ECO-innovation. This will be done from an interpretive perspective

# ToDo

A difficult factor in this research, is the "Naive Psychology" in investigating the peer-effect of the spread of sustainable technology, since people seems unable to detect the effect of normative social influence. In many cases, people underestimate the effect that the norms of their peers.