



The past, present and uncertain future of community energy in Denmark: Critically reviewing and conceptualising citizen ownership

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Introduction & Problem formulation

- Citizens' empowerment and participation are seen as strategic to meeting the EU's energy targets [2].
- Citizen ownership is the highest level of citizen participation. It confers control over the process and the outcome.
- Yet, there are important **confusion** and **knowledge gaps**.
 - Diversity in models & terminology
- As a consequence, adequate **policy design** is hindered

Research focus

The ownership of wind turbines and district heating systems in Denmark in the period of 1975-2016.

Research Questions:

- 1) what kinds of citizen ownership models have been implemented in Denmark?
- 2) what share of the wind capacity and DH demand has been citizen-owned?
- 3) what are the main characteristics of the implemented citizen ownership models?
- 4) which categories could help better understand the heterogeneity of citizen ownership in Denmark?

Theoretical approach

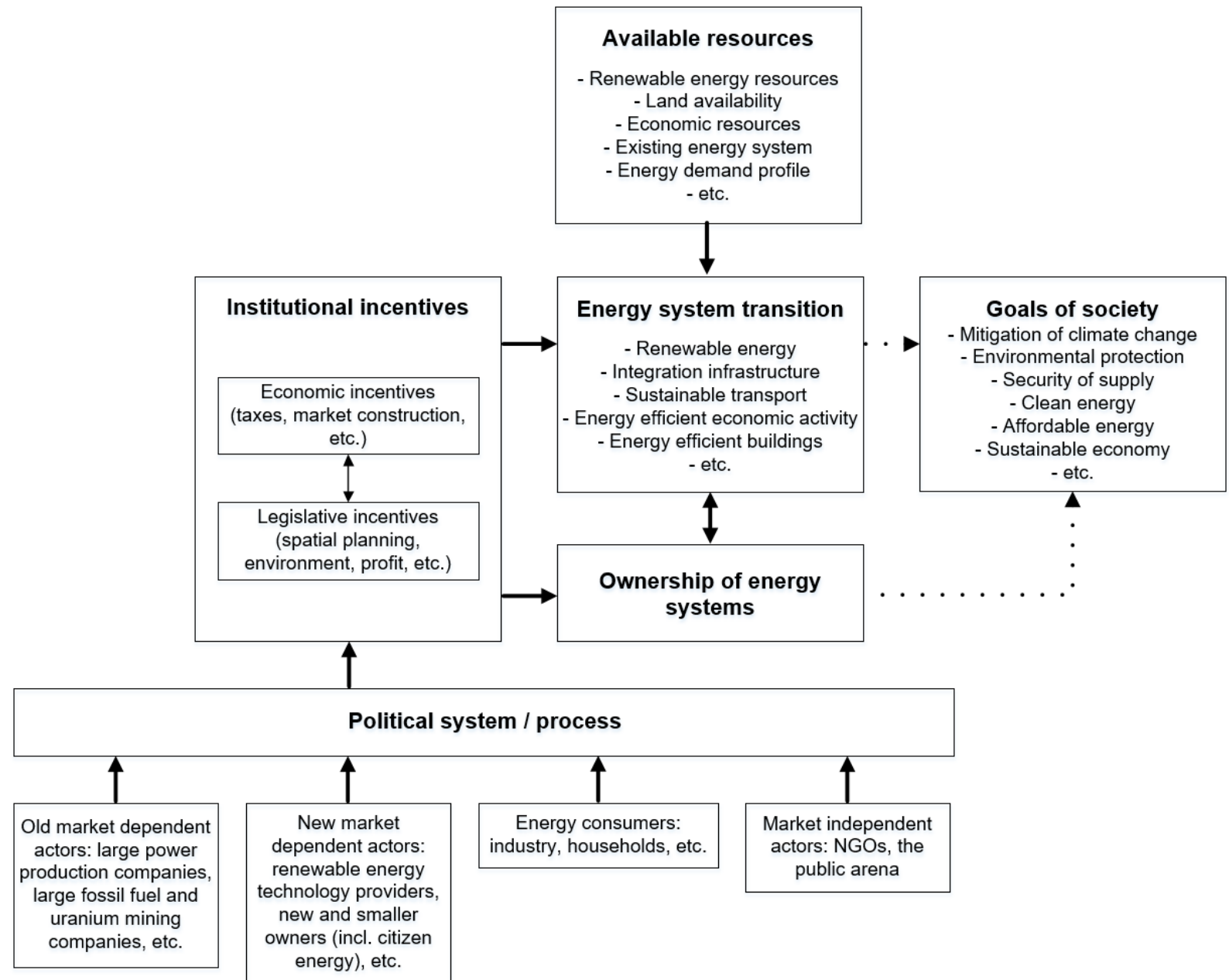



Fig. 1: Understanding of ownership of energy systems and energy transitions in Denmark and the EU. Inspired by Hvelplund [6] and Kooij *et al.* [24]

Theoretical approach

Community energy and citizen ownership

- 
- ***Citizen ownership*** has commonly been studied in relation to RE and as an alternative to the traditional energy companies, whether private or state-owned [5,25].
 - ***Community energy*** is a long disputed concept, which has been used to refer to several types of citizen ownership [5,10–12,23].
 - Other terminology: in Denmark, it is common to refer to ***community ownership, local ownership*** and ***consumer ownership*** [8,17,28,29], whereas the boundaries between them are blurry.

Methodology

- Actions: (1) **scoping** of implemented citizen ownership models, (2) **quantification** of citizen ownership, (3) **description** of ownership models and presentation of illustrative examples and (4) **development** of citizen ownership categories
- Methods: **statistical analysis** of secondary data (for wind turbines), **literature review** and **contact to experts**
- Delimitations:
 - **Wind turbines**: only the company registered in DEA's database
 - **DH systems**: only the company responsible for the entire system operation and supply to end users

RQ1:
what kinds of
citizen ownership
models have been
implemented in
Denmark?

Table 1: Identified citizen ownership models for wind turbines and DH systems in Denmark. In the case of wind turbines, the ownership may be a combination of several ownership models except for wind turbines owned by prosumers. Ownership combinations may comprise citizen ownership models and large investor ownership models. [7,8,17,34,38]

Citizen ownership models	
Wind turbines	DH systems
Prosumer	Municipal company (local)
Individual ownership (local and distant)	Consumer cooperative (local)
Cooperative (local and national)	
Guild (local and distant)	
Municipal company (local and distant)	
Consumer cooperative (local and national)	
Foundation (local and national)	

Methodology: Statistical analysis of wind turbine ownership

1. INPUTS

Doc_DEA

for all wind turbines 1977-Jan
2017:

- Identification number
- Capacity
- Year of connection to the grid
- Year of decommission
- Name of owner

Doc_EMD

for some wind turbines 1977-
2003:

- Identification number
- Recorded ownership category:
individual ownership; collective
ownership; electricity company;
industry; other, e.g. schools,
municipality owned; industry;
unknown

Danish Wind Turbine Owners' Association

In Denmark, small shareholders
tend to own 10 wind turbines or
less.

2. SIMPLIFICATION OF OWNERSHIP ANALYSIS

Ownership categories for analysis of databases	
Citizen ownership (own 10 or less wind turbines in Denmark)	Individual ownership
	Collective ownership
	Unidentified citizen ownership
Large investor ownership (own more than 10 wind turbines in Denmark)	
Unknown	

RQ2:
what share of the
wind capacity and
DH demand has
been citizen-
owned?

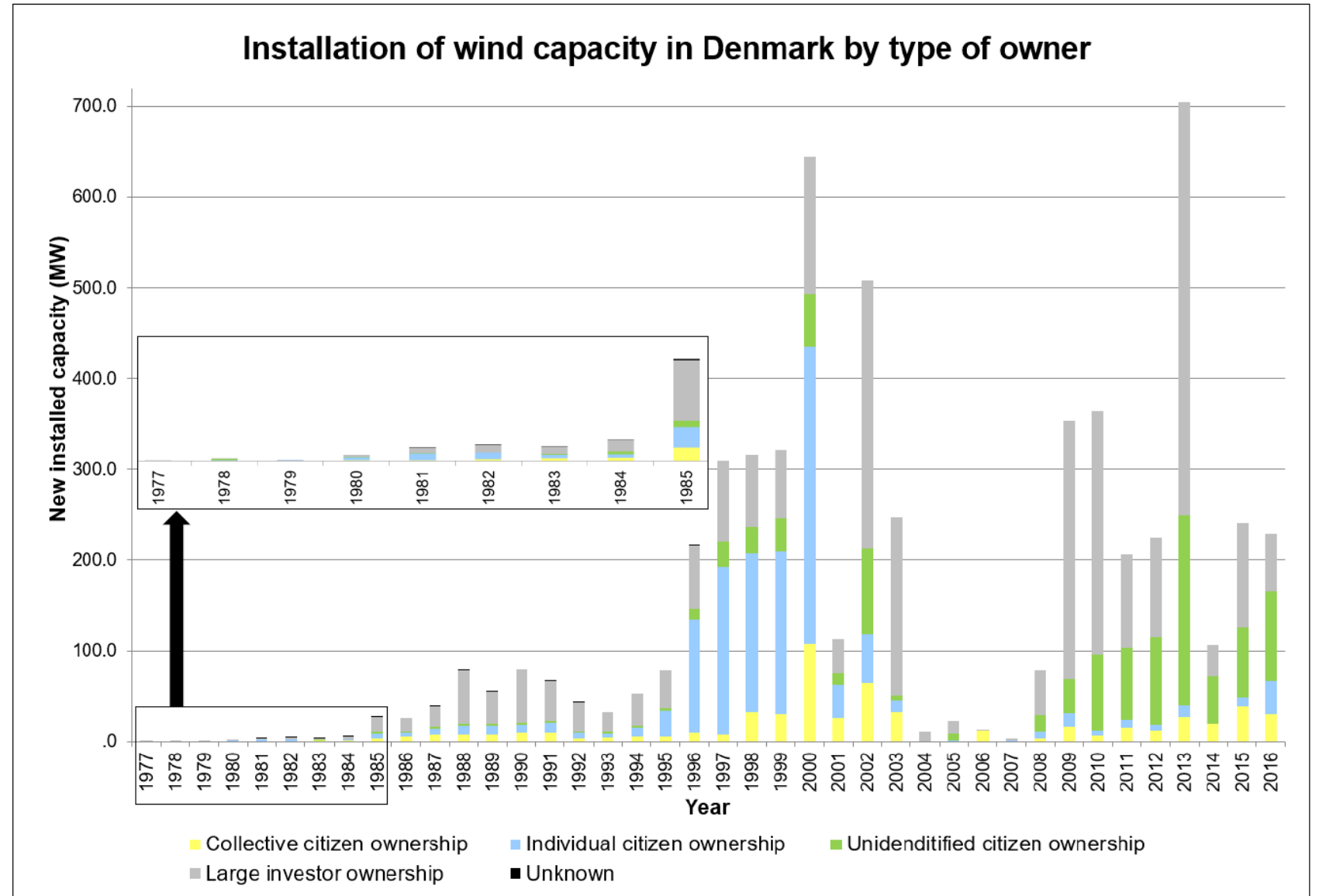
Table 2: Summary of ownership of wind turbines in Denmark in December 2016.

General data	Quantified ownership categories	Ownership of installed capacity (MW)	Ownership of installed capacity (%)
Existing wind turbines: 6,099 Decommissioned wind turbines: 3,051 Existing companies: 2,942 Closed companies: 607 Wind energy produced 37% of the final electricity demand in 2016 and 43% in 2017 [40]	Citizen ownership	2,747	52
	Individual ownership	1,212	23
	Collective ownership	507	11
	Unidentified citizen ownership	1,028	19
	Large investor ownership	2,499	48
	Unknown	0	0
	TOTAL	5,246	100

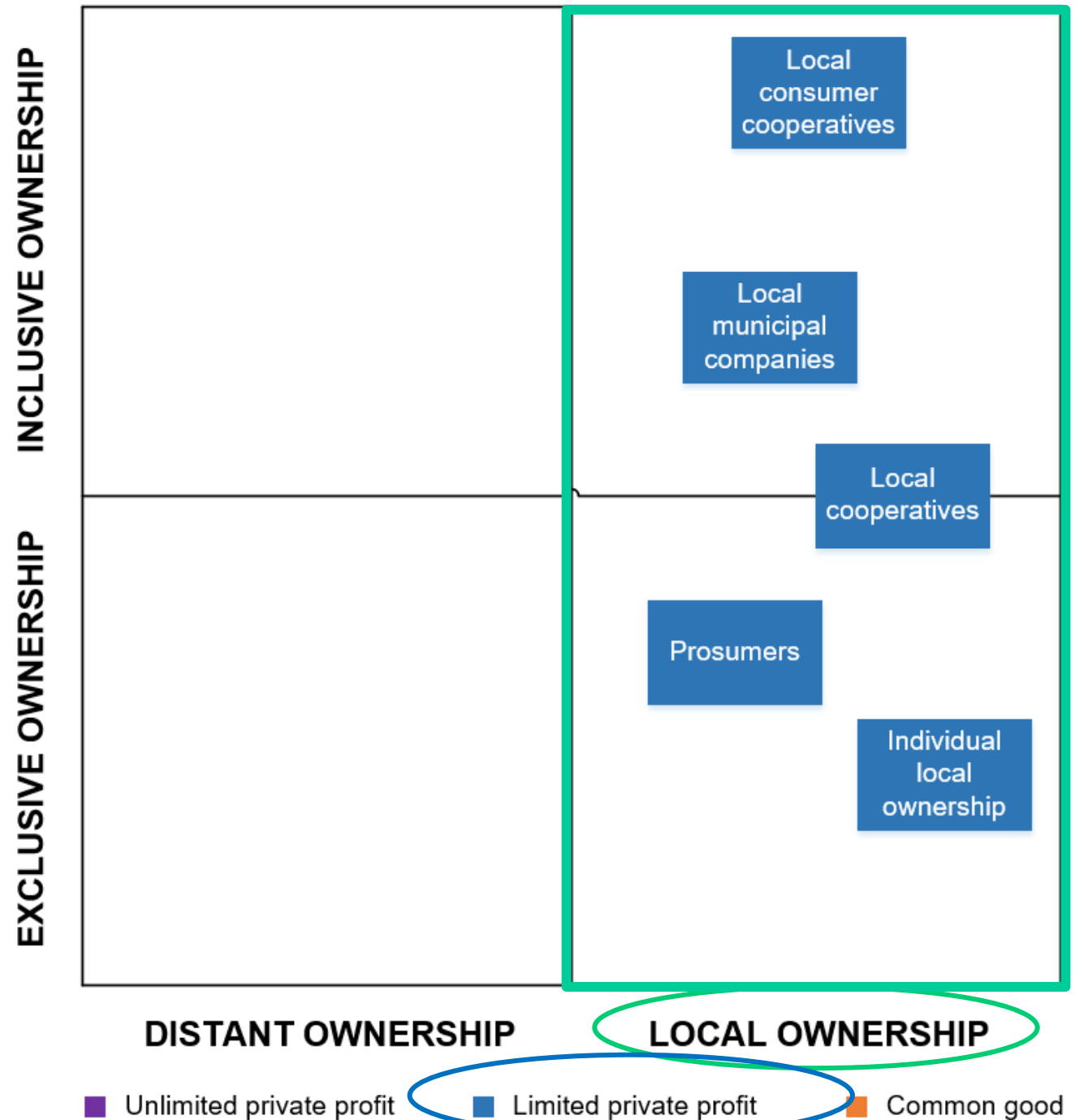
Table 3: Summary of ownership of DH systems in Denmark in December 2016. [20,31]

General data	Quantified ownership categories	Number of DH systems	DH demand supply (%)
DH systems supplied heat and hot water to approx. 64% of all households in Denmark in 2016 Approx. 52% of the DH demand was met with RE in 2016	Citizen ownership	388	96
	Municipal company	47	60
	Consumer cooperative	341	36
	Commercial company	13	4
	Others	6	0
	TOTAL	407	100

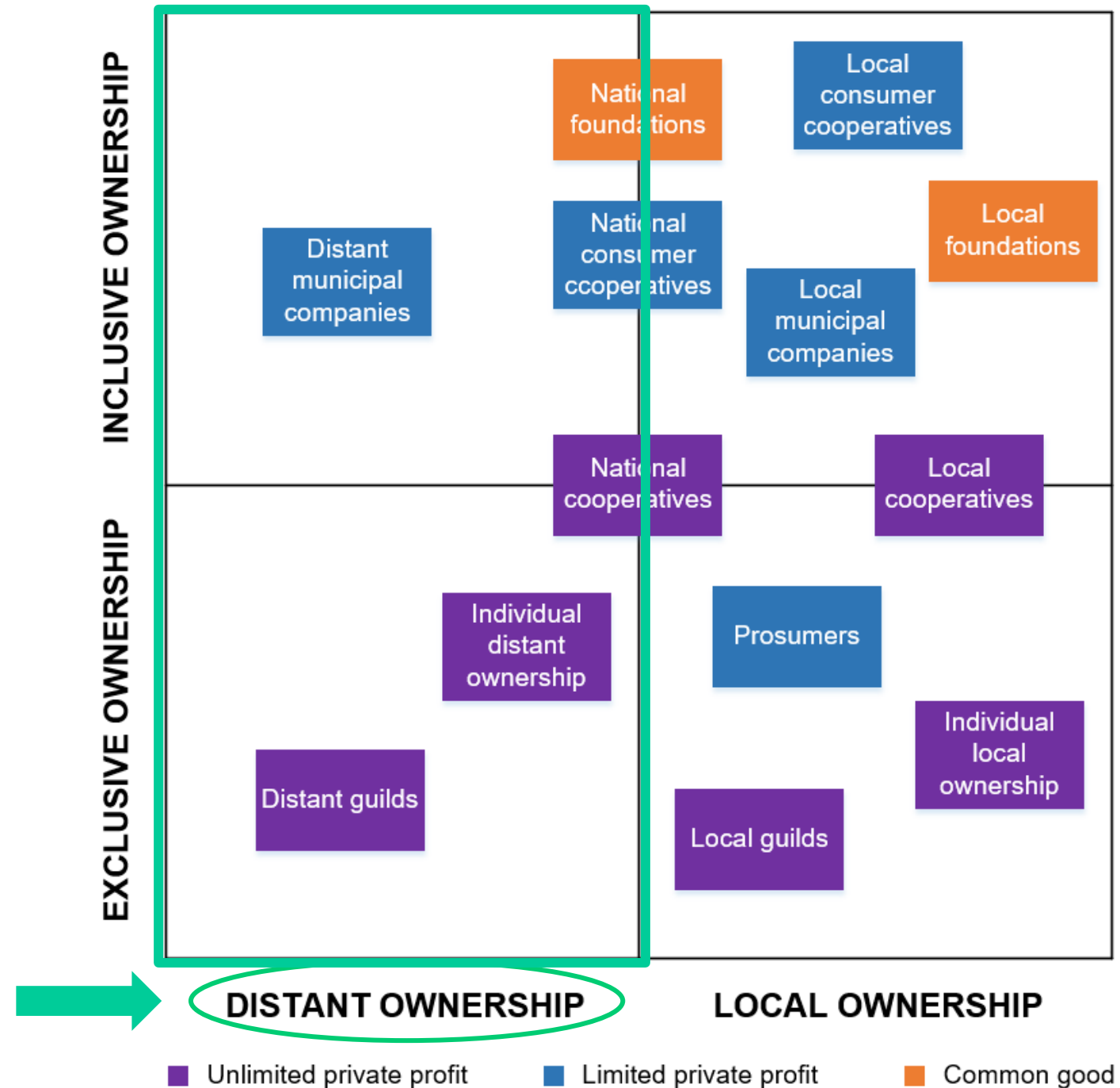
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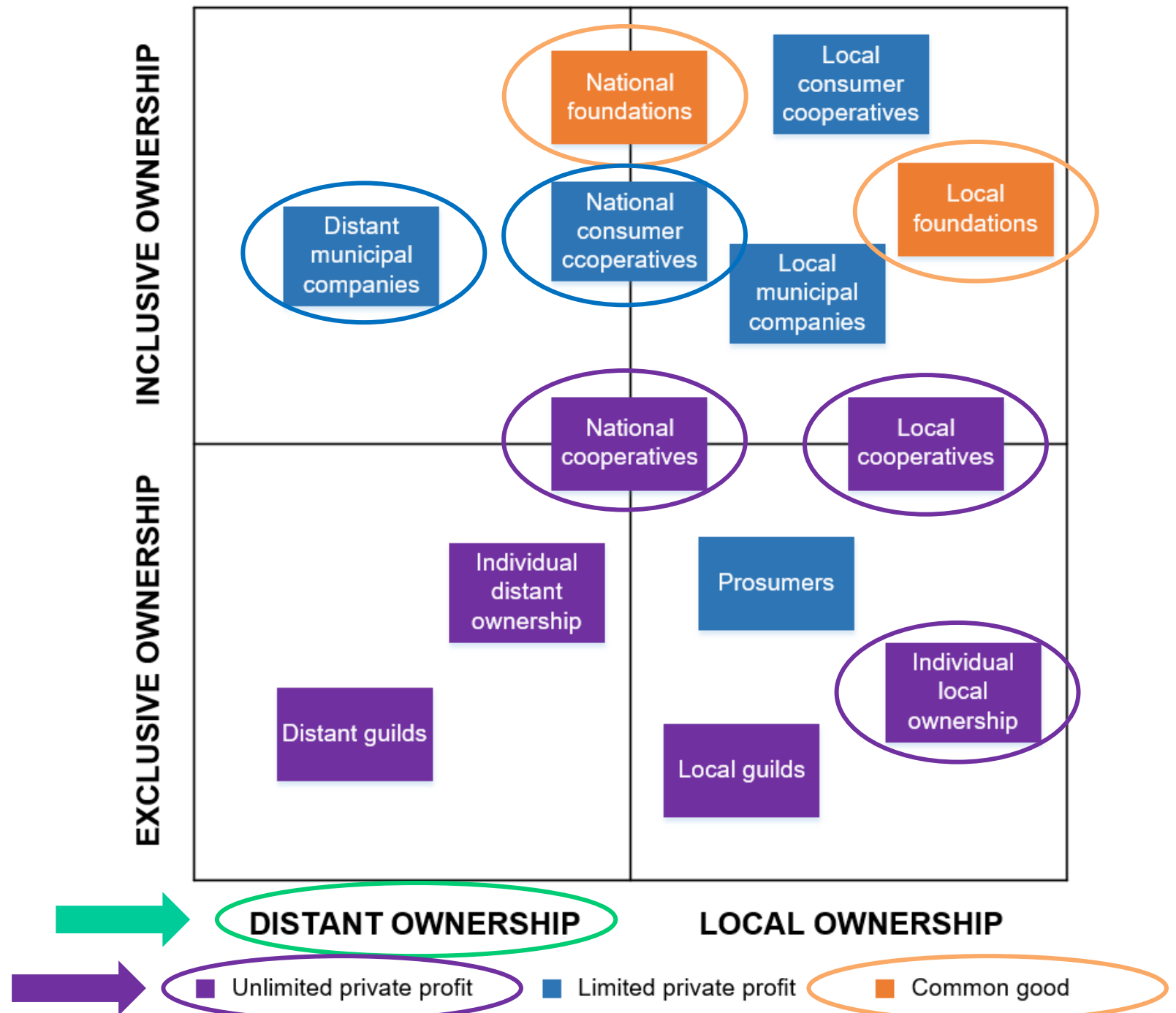
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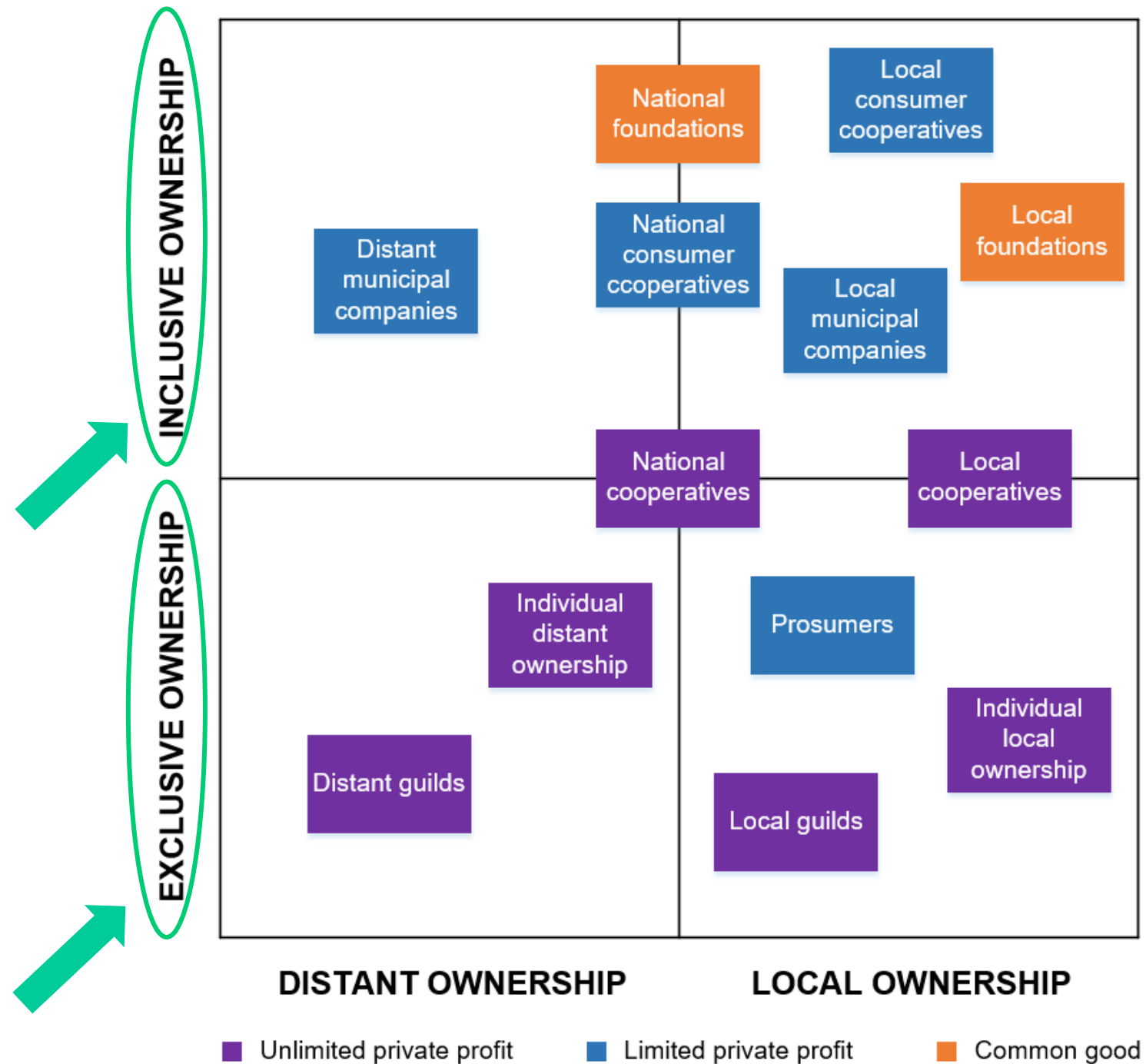
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Main conclusions

- Great variety of citizen ownership models (explains confusion)
- Important contribution of citizen ownership
 - individual ownership and exclusive collective ownership
 - background for expanding the research of ownership beyond the normative understanding of community energy.
- The citizen ownership categories presented in this article reduce confusion and, therefore, facilitate research and policymaking.

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ABSTRACT

Important progress has been made in the understanding of citizen ownership. However, confusion persists about distinct characteristics of different models and particularly about the concept of community energy. Moreover, quantitative understanding of the contribution of citizen ownership to energy transitions is limited. This study advances the knowledge of citizen ownership by describing the empirical characteristics of citizen ownership of wind turbines and district heating systems in Denmark in the period of 1975-2016. The methods comprise statistical analysis, literature review and contact to experts in order to identify, quantify, describe and categorise Danish citizen ownership models. The results show the significant importance of citizen ownership to investment in and implementation of decentralised sustainable energy technologies. Modifications of institutional incentives have led to multiple and diverse citizen ownership models, whose main distinctive characteristics are related to geographical scope, type of profits and distribution of benefits. This observation is valid also for other countries, which makes the citizen ownership categories developed in this study relevant for international research on the topic.

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