

# The Role of Firm Level Motivations, Barriers and Managerial Capabilities for Diversification in Energy System Transitions

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## Overview

This article seeks to contribute to the growing literature of sustainability transitions by incorporating managerial science and strategy literature streams that allow us to provide deeper analyses into the micro level processes at the firm level that drive and/or hinder change in the energy sector. To answer the following questions we operationalize a regression analysis of responses from top managers of energy firms, namely upstream energy producers and their suppliers.

- RQ1: What is the role of motivation on technological diversification?
- RQ2: What role do barriers play in technological diversification?
- RQ3: What role do managerial capabilities play on technological diversification?

We contribute to the literature on sustainability transitions through a first-of-its-kind quantitative study design of a heterogeneous set of firms and the determinants of their technological diversification (TD) activities within and across several energy sectors. Theoretically we contribute to the sustainability transitions literature with enhanced understanding of agency in understanding micro level processes of firms, also formerly referred to as opening the black box of regime dynamics. Empirically speaking, sustainability transitions theories may benefit from our quantitative research design, which have been severely lacking in transition studies. By taking a micro level approach at the firm level underpinning determinants of change for firms within the energy system we move much further beyond single case studies of firms of technologies to provide more comprehensive understanding. Our focus is upon determinants of TD into other energy sectors, namely forces in the endogenous and exogenous environments that shape strategic behavior and firm tendency to pursue TD.

## Methods

Our research design uses a binary logistic regression based on a survey of 213 active energy firms in Norway to test if endogenous/exogenous motivations and barriers or managerial capabilities have an effect on TD within the energy sector. Figure 1 displays our research model which shows that firms in their core sectors may diversify into other (clean) energy technology sectors. The model reflects the aforementioned endogenous and exogenous factors that constitute the complex business environment managers face. Managers must therefore use their adaptive capacity to make sense of the opportunities and risks associated with pursuing TD.

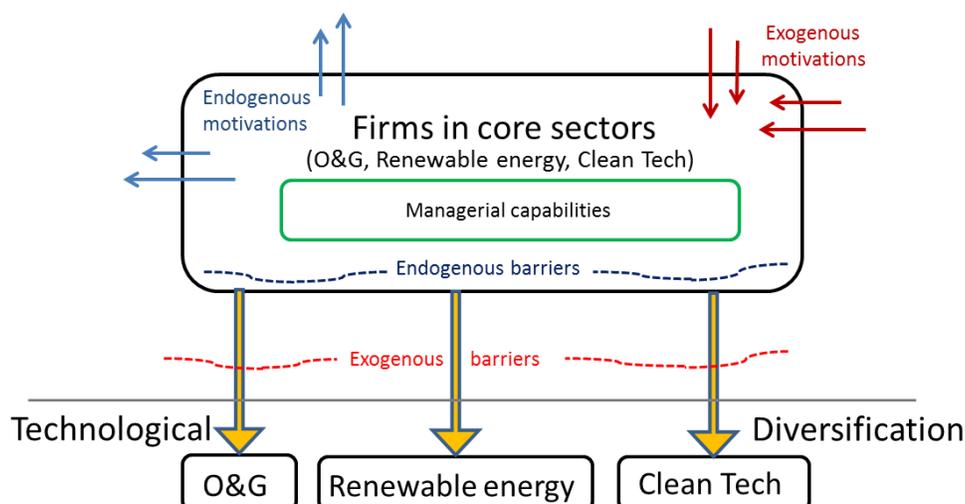


Figure 1: Model of determinants for technological diversification in energy systems

Our empirical design sought to test the following hypotheses. Our dependent variable is TD, which is whether a firm is active or currently establishing activities in one or more other energy sectors outside of their core operational sector.

*H01: There is a positive relationship between motivations and TD*

*H01-1: There is a positive relationship between endogenous motivations and TD*

*H01-2: There is a positive relationship between exogenous motivations and TD*

*H02: There is a positive relationship between barriers and TD*

*H02-1: There is a positive relationship between endogenous barriers and TD*

*H02-2: There is a positive relationship between exogenous barriers and TD*

*H03: There is a positive relationship between managerial capabilities and TD*

## Results

The table below shows the results of our study.

	Model 1	Model 2	Model 3	Model 4
Constant	1,734	,953	1,426	1,104
Firm Age	,291	,108	,092	,056
Ownership	20,382	20,470	20,594	20,594
Firm Size	1,734	-,383	-,398	-,410
Innovative		-,829*	-,882**	-,924
Adaptive		,414	,409	,461
Explorative		,839	,829	,804*
Motivation (endogenous)			-,215	-,253
Motivation (exogenous)			-,200	,193
Barrier (endogenous)				,058
Barrier (exogenous)				,152
Model Fit	77,454	65,976	65,433	65,037

## Conclusions

The results indicate that firm size (negatively) influence the tendency of energy companies to diversify into new sectors, a result in line with the Schumpeterian argument that larger firms have more capital, R&D, knowledge and network resource bases to leverage for TD. There is a strong relation towards the firms' managerial capabilities. In the regression analysis both a positive (*Explorative*) and a negative relationship (*Innovative*) is implied, but the signs are most certainly related to multicollinearity as both factors are positively related to TD in the correlation matrix. Surprisingly both endogenous and exogenous motivations and barriers do not significantly influence the tendency of energy firms to diversify into other energy sectors. This conclusion is based on both the finding that the independent variables themselves are not significant, but the inclusion of these variables in the model does not contribute with increased model fit. Akin to the findings of Darmani et. al (2016), even in capitally intensive energy based industries growth and profit may not form companies' main priorities for pursuing TD.

These findings lead us to conclude that managerial capabilities are far more important for TD than the drivers and impediments for change. These results echo those of Näyhä and Pesonen (2014) which found that even though managers in forestry industry firms recognized the need for strategic renewal towards biorefineries as both internal and external drivers for change mounted, the lack of managerial capabilities for implementing changes in business models towards developing new products and services resulted in continued stagnation of this similarly mature capital intensive industry. Thus path dependence of energy firms and other traditional heavy industries often constrains strategic renewal, despite managerial adaptive capacity.

Several implications can be derived from these results. For sustainability transitions theories, these findings underscore that through providing agency to these firms that are commonly discussed and theorized upon from the outside, we uncover that exogenous pressures do not play as large of a role as is portrayed in the literature stream. Conversely, our findings resonate well with theories on firm level capabilities. Larger, more established firms possess significant stocks of accumulated resources. However the choice to embark upon and pursue multiple paths comes with opportunity costs, as such resources are not limitless and must be allocated to focus areas appropriately. This juggling of exploration (into new areas) and exploitation (of existing product and market mixes) requires superior managerial capabilities within firms.