

INTRODUCTION OF RENEWABLE ENERGY SOURCES: LESSONS TO BE LEARNED FROM THE BRAZILIAN CASE

¹ Delft University of Technology, The Netherlands, +31-15-2781588, C.M.ChiongMeza@TUDelft.NL

² Delft University of Technology, The Netherlands, +31-15-2784887, G.P.J.Dijkema@TUDelft.NL

OVERVIEW

European countries struggle to diversify their energy portfolio with other energy sources while producing less CO₂ emissions and they have started their transition process by searching for alternative energy sources to avoid a system collapse. This situation, however, is not new. Already thirty years ago, Brazil started its transition to a less oil-dependent economy, which was triggered by the 1970s oil crisis, a drop in sugar prices. Although the economic evolution has been variable, Brazil has reached a stable bio-ethanol economy today. However, this transition is difficult to reproduce elsewhere. In Europe, the need for security of energy supply in the new century has led to the production of several directives, which focus on the encouragement of alternative energy sources use while promoting sustainable development (European Commission & Directorate-General for Energy and Transport, 2001), but the achievement regarding this issue varies among countries (Ernst & Young Renewable Energy Group, 2007).

With the question “what are the main lessons of the introduction of bio-ethanol in Brazil that could be used in the European context?” in mind, this paper analyses the Brazilian transition towards bio-ethanol using an approach elaborated on the synergy of Institutional Economics (North, 1990), and Actor-Network Theory (de Bruijn & ten Heuvelhof, 2000). This approach portrays dynamics at individual, interaction and system levels and the relevance of information feedback structures (Forrester, 1992) for giving shape to the bio-ethanol economy in Brazil.

METHODS

Transition is a complex institutional change that spans and occurs at a range of time-scales, whilst it is essentially driven by the decision making at actors' level. We have combined two approaches (Institutional Economics (North, 1990) and Actor-Network theory (de Bruijn & ten Heuvelhof, 2000)) to unravel the phenomenon of transitions. Institutional economics provides an explanation of the current governance mechanism arising from the interplay between the environment and the actors involved, while Actor-Network theory adds the priorities of resources over other actors depending on actors' power. This combined approach pretends to explain the transition from an existing paradigm to a new one by a process of technological substitution, which is triggered by dynamics at three levels: system (representing the surroundings), interaction (representing the governance mechanisms) and individual (representing the actors in a transition process). In this view, a transition originates from a drastic event influencing the system level and as a reaction of actors to this drastic event at the agents level. Two main features of this approach allow the understanding of the dynamics at different aggregation levels:

- The first characteristic of our approach is the use of a multi-layer perception of transitions: one must acknowledge at least an Individual and a System level. A third-layer is needed to discern between the interactions between individuals and the institution that determine these interactions – the coordinating mechanisms.

- The second characteristic is the mutual feedback among different layers. This feedback must be considered if one is to explain about transitions. This means that each layer is affected, shaped and constraint by the others in a direct or an indirect way. The speed of the information feedback is higher at Individual level and slows down at System level.

RESULTS

In the Brazilian case, it is possible to speak of an information feedback that gave shape to the current dynamic equilibrium of this transition process, coming from the system level towards the agent level and back to the system level. The 1970s oil crisis and the drop in sugar prices worked as a drastic event for the government to start few programs to stimulate the production and use of alternative energy sources. The new interaction mechanisms (e.g. facilitation of loans for expanding production capacity, cross-subsidy between gasoline and bio-ethanol) introduced by governmental programs reduced the uncertainty of other actors involves, e.g. producers and consumers, who concentrated on their core business and worked on a local optimization of their functions. In this way, sugar producers expanded and improved their production capacity and consumers could benefit from the diversification of the energy portfolio for transportation purposes. After several years of being complementary goods, gasoline and bio-ethanol have become substitutes due to the technological innovation of cars' motors (Flex-fuel cars). The successful diversification of the energy portfolio for transportation purposes has encouraged the government to try again the introduction of bio-diesel in the energy market.

CONCLUSIONS

The role of a "drastic" event is essential to a transition process because a "drastic" event works as a catalyst of the transition towards a particular objective, changing the interaction mechanisms between actors in the energy system or accommodating new ones.

Despite the historical and geographical differences, European countries can benefit from the experience of the Brazilian transition when struggling for a low CO₂ emission energy portfolio, by taking into account the relevance of a transition with few clear objectives to achieve, focusing on few feasible alternatives, while being aware of the risks of a direct application of the economic instruments used in the introduction of bio-ethanol in the energy market for transportation purposes in Brazil in the European context.

REFERENCES

1. de Bruijn, H., & ten Heuvelhof, E. (2000). *Networks and Decision Making*. Utrecht: Lemma. 134 p.
2. Ernst & Young Renewable Energy Group. (2007). *Renewable Energy Country Attractiveness Indices: Financing a sustainable future*: Ernst & Young Global Ltd.
3. European Commission, & Directorate-General for Energy and Transport (2001). *Green Paper - Towards a European strategy for the security of energy supply*. Luxembourg: Office for Official Publications of the European Communities. 105 p.
4. Forrester, J. W. (1992). Policies, decisions and information sources for modeling. *European Journal of Operational Research*, 59, p. 42 - 63.
5. North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge, UK: University Press. 152 p.