Assessing the Effectiveness of Policy Measures with the help of Qualitative Modeling

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Abstract

The aim of a recent project of the UBA was to get a systemic and hence a better understanding of the effectiveness of measures that are meant to help achieve more sustainability in our country. Questions were raised as to why some measures had little effect and also why many measures known to be effective were not being implemented. It was also important to determine what additional measures could be taken. We began the cause and effect model by taking some predefined factors that described the overall goal of becoming a sustainable country. We then applied the KNOW WHY Method to systematically create a model that would include the crucial factors. We did this by repeatedly asking what would directly lead to more of a given factor, and what would directly hinder it, both today and in future. These are the so-called KNOW WHY questions, and we asked them for each and every factor in our model. This resulted in us being able to determine early cross connections, and through them feedback structures became apparent. The model included policy measures, social and psychological factors, as well as economical and environmental aspects.

Qualitative modeling makes visible the connections that exist between so-called factors, which carry information about the direction of impact (positive or negative), the strength (weak, middle or strong) and any possible delays in terms of time (short term, medium term or long term). Taken all together, these connections can then be analyzed in so-called Insight Matrices that make it possible to compare the short, middle and long term impact of factors, and hence to see what factors are involved in creating a greater or a lesser impact – in the case of this project, this meant determining what measures promised to be more or less effective and what might hinder the success of these measures to a greater and lesser degree, both now and in the future.

In our approach, the factors and connections are not mere visualizations of predefined knowledge gained by modeling experts, but the result of collaborative modeling done by experts from different fields with the aim of obtaining new insights and a deeper understanding of the complex challenge at hand. Therefore, the approach is comparable to that of grounded theory or qualitative social research where scenarios of possible developments cannot be based on empirical data from the past either.

Ultimately, the model consisted of over 100 factors and had more than 1 million feedback loops.

The results gained by taking this approach shed some light on why the process of change in our society on its way to becoming more sustainable is so slow. The results also explained how and why policymakers, consumers, companies and the media are dependent on each other, and made clear what obstacles the first movers among them face. The model offered an explanation for a widespread phenomenon: rationally knowing what should been done and yet

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being emotionally satisfied by engaging in non-sustainable behavior. And finally, the model offered a lever, an entry into the cycle of passive, interdependent players: we need to make sustainable consumption and hence non-consumption emotionally felt through a system that scores behavior.

In this short article we will provide one concrete example of how we reflected on the effectiveness of a common policy measure, i.e. the introduction of a resource tax, and how we then assessed it and determined possible impacts and constraints.

Introduction

One major challenge for any decision maker is to choose the most effective option available in reaching a set objective. A good and experienced decision maker has knowledge of best practices and therefore has both good intuition and good negotiating skills. In some cases, a consultant or adviser might be called in to help the decision maker think about the impact of the decision or measure to be taken in a more clear way. Quantitative models can in many instances help to better assess and evaluate the consequences that the measures implemented will have, but it is simply a reality that most decision makers lack the ability to model: not only is it difficult to find data that is exclusively related to the past, but it takes a great deal of effort to build a model with a validated formula and data.

It is also a common occurrence that during the process of negotiating, parties will very often either be for or against a measure in principle – their opinion is then not based on rational arguments. Also, it is important to note that the most widespread alternative is not always the most effective. Many times, different arguments are simply not brought to the table or presented in a balanced and transparent way, and in the end the decision makers have to make decisions based on uncertain information that is based on gut feelings (Hastie, Dawes 2010).

Every option available for a given measure comes with this kind of ambivalence, both in terms of the benefits as seen from the stakeholders' perspective and the effectiveness of the measure. Additionally, decisions based on intuition are normally influenced by emotions, and if decisions are made based on best practices, it is important to keep in mind that they cannot predict the future, as they are always based on past experiences that took place under different circumstances. There is also quantitative modeling, which provides a more rational way of thinking about things and makes it possible to play around with different options (scenarios). However, quantative models are usually quite sophisticated and since only experts can use them, actual decision makers seldom rely on them.

The standard definition of sustainability pinpoints three pillars: social, economic and environmental sustainability. However, these pillars of sustainable development are highly interconnected and interdependent, and therefore this definition entails much ambivalence: conflict of interests, contradictions and missing determinants, which simultaneously and sequentially encourage both sustainable and unsustainable lifestyle choices and alternative futures. It comes as no surprise then that despite many discussions and initiatives, real progress towards sustainability has not yet been made.

Current discussions about sustainability suggest a "great transition" towards more sustainability, e.g. WBGU (German Advisory Council on Climate Change) in their report from 2011. This idea implies that policy measures must accompany and shape such a transition. However, the complexity and ambivalence is extremely challenging for all stakeholders involved. Current research in the field of sustainability analyzes different kinds of visions regarding just how a sustainable future might look like and how such a future could be shaped and by whom. This implies that there are different players involved who all have different preferences when it comes to the concept of sustainability.

It was a central aim of the small study to identify what exactly the drivers for and against sustainability were. The possible views of different players were taken into account. This could be done by applying Qualitative Modeling using the CONSIDEO software tool[3]. Qualitative modeling, as applied in this study, can be used by everyone. It makes it possible to take a close look at possible future effects while incorporating best practices, true knowledge and gut feelings into the equation. In the following sections, we will briefly describe the methodology and the tool. We will then present some results that were achieved and then in closing reflect on the methodology and on the content of this study.

Tools & Methods

Basic Principle of Qualitative Modeling

Qualitative modeling is a form of structural modeling where gaining a rather rough understanding of the (causal) relations and interconnections of factors and concepts is the central aim. In quantitative modeling, the central aim is to get concrete figures for a certain point of time from a simulation (Lendaris 1980). In this study, we systematically asked a small group of experts for the qualitative causal relations between different factors and concepts; we had them graphically visualize them in a model and then evaluate and compute the effects within these networks using a computer-based tool.

A model can be a mental or graphical representation of the reality as we perceive and interpret it. Studies have shown that humans have the tendency to reach a mental barrier when trying to grasp the interconnections between more than four factors without the assistance of a computer or pen/pencil and paper. In such cases, there is a tendency to listen to gut feelings and assumed best practices (Halford 2005). Both, as already explained in the introduction, can significantly limit the analytical value and credibility of decisions and outcomes made under such conditions.

Qualitative modeling with the use of a software tool such as the CONSIDEO MODELER or the iMODELER is a further development bringing together elements of CLD (causal loop diagrams) as known from System Dynamics (e.g. Sterman 2000), and Fuzzy Cognitive Maps (Kosko 1986). Arguments formed by experts from any field in their field's or natural language can be directly visualized by means of so-called factors that are connected with arrows. When connecting two or more factors in a qualitative model, additional information is added in, e.g., direction of the effect, increasing or decreasing effect, its strength/weighting and a delay of the effect. The weighting is determined by the attribute "weak," "middle" and "strong," or accordingly chosen values between 0 and 100.

[3] http://www.consideo.de

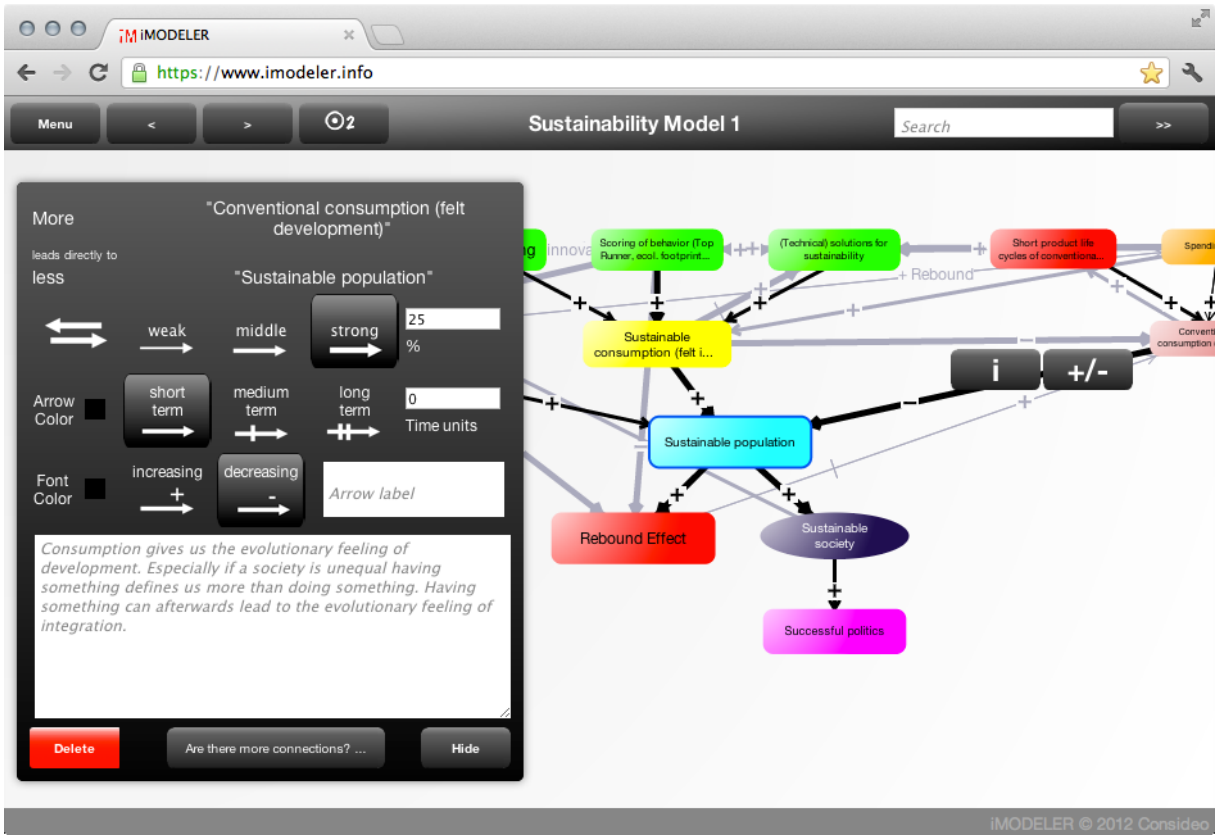

Figure 1: The qualitative weighting of connections within a cause and effect model. The properties of a connection between two factors shown in the iMODELER help to verify the connection through the sentence "More … directly leads to more/less of …" The weighting of weak, middle and strong impacts is predefined with the values 10, 17 and 25. Alternatively, a value between 1 and 100 can be chosen to weight the connection in comparison to the impact other factors have on the same factor. The delay of a medium or long impact is related to the time scale a model is focusing on. If 10 years are the time horizon then mid-term might mean within 3 to 5 years, while long-term could mean that an impact will develop within 5 to 10 years.

The consequences of all the connections, their strengths, possible delays and the effects of reinforcing or balancing feedback loops that are triggered are analyzed using the so-called Insight Matrix. For each factor in the model, the Insight Matrix will show how it is influenced by the other factors for the short, middle and the long term. The algorithms to calculate this kind of Insight Matrix through multiplication along the cause trees and the calculation of impulses from feedback loops were developed by the Consideo company.

To systematically build a model, all the experts have to do for each factor is to ask if there are factors hindering/decreasing or supporting/increasing the factor in question. Any additional information is added in as well. This is done row-wise for each factor. By doing so, interconnections are identified and feedback loop structures can be discovered and displayed with the software tool. The model is then valid if all of its connections are correct! This means that if we can form a correct sentence for each connection, e.g., more of one factor with a comparably weak, middle or strong impact for the short, middle or long term leads directly to more or less of another factor, then the model is correct.[4]

[4] Please note that there are other qualitative modeling approaches based on the cross impact analysis that analyze the connectivity, the activity of factors through matrix operations and calculation of active and passive sums. For those approaches the person who is modeling needs to reassure him or herself that only comparable factors are included and that a number of rules are followed. The approach of Consideo with its analysis via Insight Matrices from relative perspectives of selected factors, however, makes it possible to model any kind of argument without further rules.

The Insight Matrix illustrates the strengths and dynamics of the relationships between factors: the position of a factor on the horizontal (x) axis indicates its increasing or decreasing effect in comparison to the other factors. The position on the vertical (y) axis reflects the involvement of loops (either balancing or reinforcing) and delays.

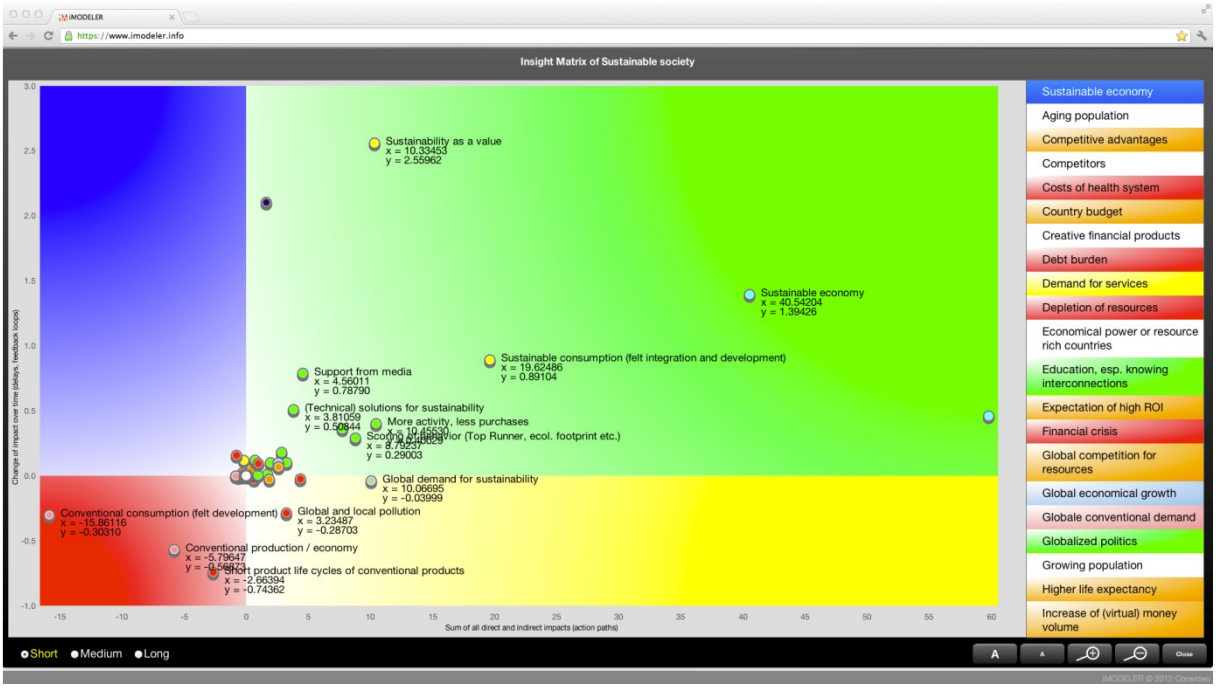

Figure 2: The Insight Matrix showing how other factors influence a chosen factor. The short, middle and long-term impact of factors can be compared by their positions on the horizontal axis. Thus, one factor can have more or less of a positive or negative impact on a chosen factor. The values are the result of the impacts along all of the cause trees that the factors are influencing of the target factor. The vertical axis indicates how this impact might change over time due to feedback loops and delays. For example "Global and local pollution" seems to have a positive impact on the sustainability of a country although this impact might develop into having an increasingly negative impact. A further analysis of the connections gives an explanation for this: "pollution" sensitizes media, politics and consumers to the problem and they take action.

Thus a factor can become more or less important over time. It might even switch from having a positive to a negative effect and vice versa. Interpreting the Insight Matrix can answer questions such as "What is the strongest driver for or against a certain goal?" Looking at the underlying cause chains, ambivalences can be explored and explained.

KNOW WHY Method and Thinking

The extent to which a model is useful depends on whether or not the crucial factors are included in it. While many modeling approaches try to limit the number of factors and are limited to the knowledge that the person modeling already has, applying the so-called "KNOW WHY Method" (Neumann, 2012) with the CONSIDEO tool, this limitation does not exist. The KNOW WHY Method helps to consider crucial factors by simply repeatedly asking the following questions for each factor in the model:

- What directly leads to more of it in the present?
- What directly leads to less of it in the present?
- What might directly lead to more of it in the future?
- What might directly lead to less of it in the future?

It is important that all four questions are answered. Not only do they encourage us to think of additional factors by affecting our creativity, the method of asking questions is also based on

a systemic thinking approach: so-called KNOW WHY Thinking (Neumann, 2012). According to this, everything in the world – following an evolutionary logic – needs to both integrate and to develop. Integration means adapting to the environment and the circumstances at hand. Development means adapting to changes in the environment and succeeding in competition with others. This applies to projects, people, societies, companies, families, cities, etc. If something does not develop for a longer period of time or if it develops too fast, it will be in jeopardy.

These four questions of the KNOW WHY Method explicitly ask for the development and the integration of a factor within a model, which means that the method takes both a systematic and a systemic approach. It is worth repeating that very often in other modeling approaches new causal relations (regardless of whether they are direct or indirect through feedback loops) are gained with the limited knowledge that the expert who is modeling already has, while qualitative modeling applying KNOW WHY is much more exploratory. A good and useful model often yields surprising and counterintuitive results (e.g., wrongly estimated, not seen ambivalences, etc.) and gives good indications as to what the real levers and crucial factors are.

To explore the effectiveness of measures for more sustainability, another aspect of KNOW WHY Thinking was important: human beings act either because they have to (based on discipline) or because they want to. Whatever we want, we want because we have an evolutionary need to integrate and to develop. So all of our feelings, our neurotransmitters and hormones give us the good feeling of integration or development, or the bad feeling of lacking them. If we now want to change people's behavior we can hope that their discipline will make them do that which is rationally right and good, but almost everything that is not sustainable gives us a good feeling of integration and even more often the feeling of development. So any measure for more sustainability can only successfully address the majority of people if it somehow leads to an alternative good feeling.

For our project, KNOW WHY Thinking and the KNOW WHY Method helped us to understand the mechanisms of stagnation, helped us to find and understand rebounding and balancing effects, and it explained why we need sustainability to be a value shared by the majority of people, why cheap products with a bad ecological footprint prevail, why conservative opinions prevent the much needed change in politics, why good examples of alternatives remain far and few between, and so on and so forth.

The Approach for this Project

We started by taking the main factor "Sustainable development in Germany" and connected it to the three main concepts: "resource efficiency," "emissions neutral" and "equitable." For each of these three objectives we asked KNOW WHY Questions: "What directly supports the objective today and in the future?" and "What directly hinders the factor?" These questions were asked for all newly identified factors until they were sufficiently answered. At a certain stage during the modeling process, factors that represented concrete measures were then connected. We included measures that had already been identified in published strategies and papers such as "World in Transition" (WBGU 2011), "Deutsches Ressourceneffizienz-programm" (Bundesregierung 2012)," and Adaptation Action Plan of the German Strategy for Adaptation to Climate Change (Bundesregierung 2011).

The qualitative model ultimately consisted of 143 factors, in addition to the main objectives and about 43 measures. These factors have 403 connections and form more than million feedback loops.

The participants of the modeling sessions came from different fields of expertise, ranging from economics to social sciences and natural sciences.

Results

Role of the Main Players

We discovered that successful action towards sustainability of one player depends on the action taken by other players: policy waits for demand in the population and is mainly influenced by industrial lobbies; players in industry and economy are currently mainly driven by short-term orientation and profit maximization, and, of course, by demand. As long as the public (or better put, the shareholder) makes no demands and policy does not "encourage" sustainability, why should industry be more sustainable? The majority of the people is also "waiting" to be ruled by a policy and for offers from industry. Additionally, very few people like to take the risk involved in being a "first mover." Hence, people wait for others to be more sustainable first. Even media takes a passive role.

All players wait for the other to act first, and the first movers are not rewarded anyway. On the contrary, for a politician, being too progressive means losing his or her mandate; for a business it means maybe losing a share of the market, and as a citizen it might mean becoming socially isolated in a way.

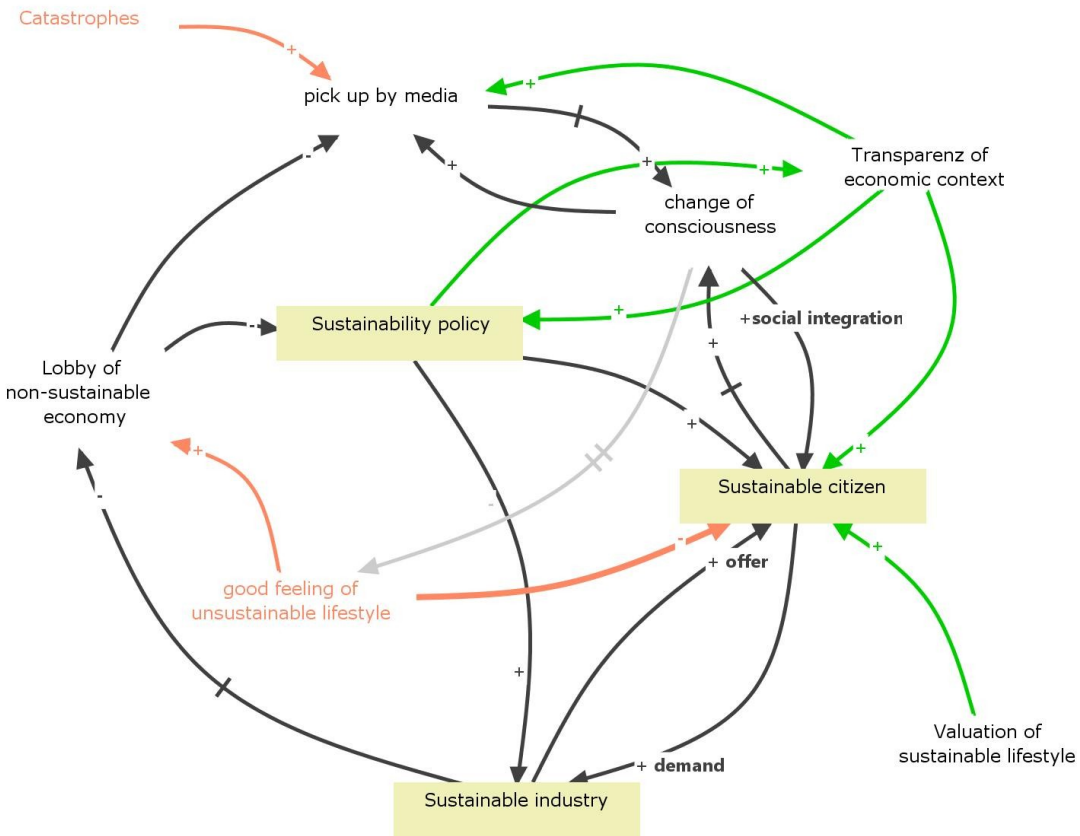

Figure 3: Small excerpt derived from the large model: causal connections of the main players: policy, citizens and industry. Sustainability policy has a positive influence on the citizens and industry, and can provide transparency of the economic context. Sustainable citizens and a sustainable industry are interdependent through supply and demand. In the mid-term, a sustainable industry will decrease the impact that the lobby for a non-sustainable economy has. "Pick up by media" means that the mass media is actively promoting sustainability values; this might be supported by "Catastrophes" through more transparency of economic context and when people changed their way of thinking (change of consciousness). The media will have a positive influence on this change of consciousness. This change will help the citizens to be more sustainable; the valuation of sustainable lifestyles will also help. However, the good feeling that unsustainable lifestyles provide supports the lobby for a non-sustainable economy and hinders citizens from being sustainable.

Interestingly enough, the model clearly indicated that catastrophes in the environment have the power to spur all players to action immediately.

Obviously, small steps towards more sustainability in our society are always being taken. Some examples are the increased usage of renewable energies, bio-products, putting environmental topics on the agenda in the media. But all of these developments seem to be happening too slowly to prevent environmental problems and catastrophes, such as an economic crash caused by resource scarcity, climate change or the high vulnerability of production systems due to the depletion of all buffer systems in the long run (WBGU 2011, Randers & Meadows 2007). We can see in the model that many gains in terms of more sustainability are offset by rebound effects.

The most promising lever for change is the public (the consumer). Due to the underlying modeling approach we got explanations as to why a consumer takes action or not and what is preventing him or her from being more sustainable. As mentioned earlier, the main motivation for all behavior is the basic need for (social) integration and development. Hence, it came as no surprise to us to discover that "social integration" and "material security" (consumption/lifestyle) were extremely important factors (in terms of being obstacles for more sustainability) in the model. Most people get a "bad feeling" when they lose or change their preferred material status and the social network around them does not follow suit. People only change if it feels good to do so; if not consuming is emotionally rewarding. Whatever measures are planned, in order to be successful, they have to be emotionally motivating and/or rewarding, and they also need to quickly reach a critical mass of people who all share the same values. However, in order for sustainability to become a value, it might require the populace to be able to see its benefits in a rational way as well.

In this context, media (TV, the Internet, etc.) play an important role: they have the power to cause change by reflecting on interconnections, but they also depend on consumer and economic demand. They are waiting for change in both, because as they are "first movers" the media would otherwise lose its customers.

Taking all of this into account it is no wonder why we are facing stagnation when it comes to more sustainability. Of course, we can find many examples of innovative people and good experiments, but sustainability has still not yet become a mainstream movement. Sadly, catastrophes and crises are what stimulate change. Pure knowledge and rational reflection do not induce a change in behavior unless we are rewarded with positive emotions. Fortunately, ever more companies try to sell sustainability, making it something that is emotionally rewarding. But concerted action is needed for sustainability to become mainstream; it needs transparency and rules, and consuming less needs to have value, especially because large parts of the population cannot afford pricey sustainable products.

Effectiveness of Measures

In the following section we will take a close look at how the effectiveness of a common policy measure might be assessed and offer descriptions of possible impacts and constraints.

A "common measure" by politics is to introduce a resource tax. We included this as a factor in our model. We can conclude that such a taxation would make products and the related services more expensive. The normal mechanism would be that due to higher prices, demand would decrease if the higher cost of production is passed on to the consumer, or else the production would not be profitable and sustainable for the company. However, the consumer would not be willing to pay higher prices as long as alternatives (from other countries) are available (unless they are also taxed, which would have implications for trade policies). The consumer might be willing to pay higher prices when society values and rewards this kind of behavior (this is also a question of social cohesion).

In the mid-term, the market would adapt to the expensive resources in an intelligent manner and would apply resource efficiency measures. This would trigger the desired effect: closed material cycles would be the result, and products might be more modular. A fruitful dynamic of a development of new intelligent products might start leading to competitive advantages on the world markets.

A resource tax would make consumption more expensive in the short term; in the mid-term, the price levels would remain the same due to the inevitable increase of resource prices. In the long term, the industry and/or company that did not adapt to scarce resources will lose its advantages on the market. Hence today, strong opposition will come from consumers and the economy and their associations, including retail, because there is no transparency when it comes to the mid and long term development of prices.

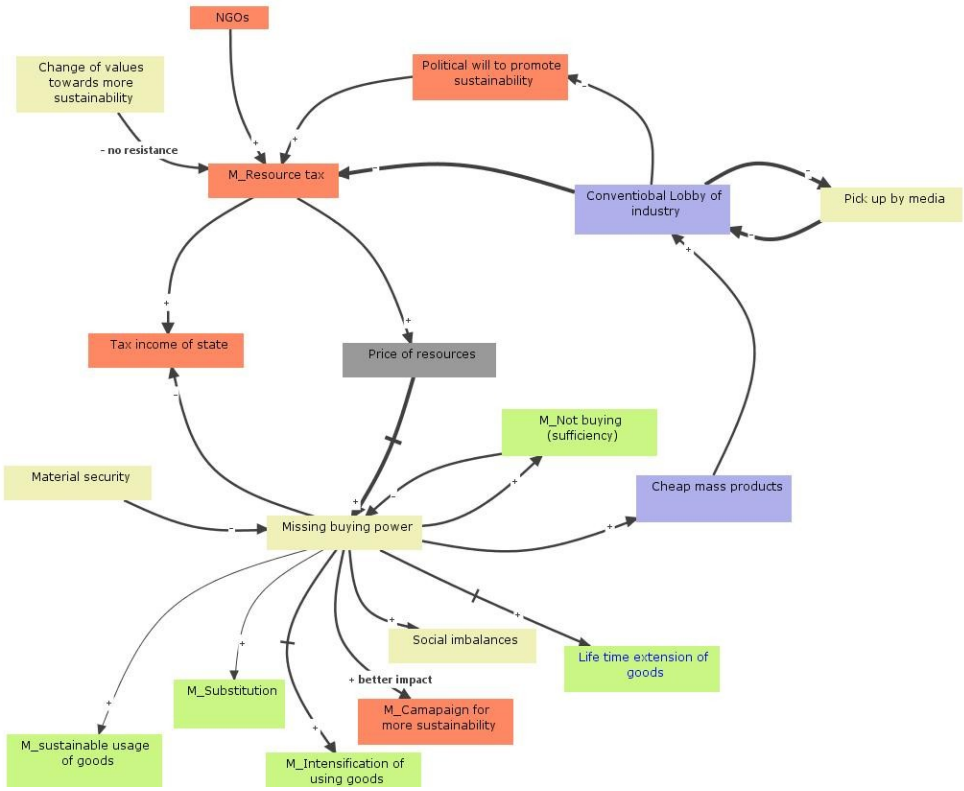

Figure 4: Small excerpt from the big model, showing the main feedback loops in relation to a resource tax. A resource tax would increase the price of resources and at the same time increase the tax income of the state. Increasing prices of resources means more expensive products and hence less buying power, which in turn means less consumption and hence less tax income for the state. A lack of buying power will also lead to more cheap mass-produced products (which are non-sustainable), and which will support the industrial lobby that is unsustainable. The industrial lobby would be (and is) in opposition to new tax proposals. The lack of buying power triggers a series of "secondary" sustainability effects, such as extending the life span of goods, intensifying usage of resources (e.g., sharing systems) or more reasonable usage (e.g., standby, energy saving tips, etc.).

The model also points to the fact that investing in change is not immediately rewarding unless it gives a competitive advantage. The contrary is true, because if just a few companies and countries start to change, others will end up with both the advantage of having resources last longer and the possibility to see the learning curve the first movers go through. "Thank you for driving a slow electric vehicle despite the fact that you could have loads of fun driving a

fast Porsche for the same price. Since you consume no fuel, driving a Porsche remains affordably to me. If everyone drove electric cars, they might become faster and more affordable, and I might also switch to one – later!"

What is not explicit in the model (but obvious and can be deduced) is the problem that once the resource prices begin to grow exponentially we will neither have the time nor the financial power to change to alternatives. The solar panels, the heat pumps, the power grids, etc. being built today depend heavily on the inexpensive supply of energy and materials. Once their prices go up it will be too late to change. Though this is a fairly simple idea and one that is logical, we don't see this being put into practice in countries other than China, which has a long term resource strategy. In other – unfortunately not our – words: "We should dig a well when we have the energy to do so and not when we are thirsty."

Another important aspect that needs to be taken into account regarding a resource tax is that if it is too low consumers might get used to it and they won't see the need to change their behavior. This will lead to negative impacts elsewhere. One good example of this is the fact that an increase in fuel prices seems to have had no impact on the behavior of consumers. On the macro level it seems more likely that they will put less into their pension funds and hence shift an even bigger burden into the future.

The model shows many more details, e.g., the dependencies of the real economy on the financial industry and the impact of education and the need for transparency when it comes to logical macroeconomic developments. The crucial insights, however, stem from the need individuals have to feel integration and development; this will also decide whether measures will succeed or fail.

In summary, a resource tax will only be successful if accompanied by measures that explain the macroeconomic need for it, and if there are more competitive alternatives available to the industries. Alternative products for consumers that offer the same potential for feeling integration and development must also be available. Before this is the case, any political action in this direction would be opposed by lobbyists and punished by voters. To be an effective and successful measure it also needs to be internationally harmonized and realized consistently. Another important aspect is the shift of purchasing power and the question of whether it leads to more jobs, more process intelligence or simply helps resource rich countries. Without change the latter is inevitable and the impact that it will have on our economy will be catastrophic.

Discussion

Methodology

Human beings tend to think linearly and mainly in terms of patterns and experiences from the past ("intuition"). If we don't want to rely on fixed assumptions from only a few people who are relying on their gut feelings, or depend on best practices from a past that may be quite different from our present situation, and if we want to overcome our mental limits and be able to grasp the interplay of more than four interdependent factors, we need to visualize and analyze the interconnections of the challenges that we face. Qualitative modeling allows us to do this with experts from different fields – and these experts do not need to be experts at modeling. In order to determine what the crucial factors are it is useful to apply the KNOW WHY Method: continuously asking why something might happen or what might hinder something from happening both now and in the future. It is an interesting experience to learn that "hard decisions" need to be based on hard facts, i.e. numbers. This might be one reason why today's decision makers unfortunately still don't ask for the WHY of something and use no tools to grasp the complexity of the challenges they are faced with. The effectiveness of

measures, as well as the measures that lead to these much needed measures for more sustainability can be contemplated and understood by applying this methodology. Linear thinking has led to the challenges we face today with their nonlinear implications. What we need now is nonlinear thinking – in order to deal with these challenges, and we need decision makers to use the tools themselves, not just modeling experts. In the context of policy consulting and policy making this methodology is easy to apply and gives more insights and robustness to any kind of decision compared to relying on intuition and gut feeling.

Content

Reflecting on the challenge to transform into a more sustainable society showed us that most known possible measures are quite unlikely to be realized, at least to the extent needed, e.g., policy measures that hold the economy back from its full competitiveness and deprive citizens and voters of feeling good. Other measures remain ineffective if rebound effects offset their positive effects. Most measures rely on the rational conviction and the discipline that is needed to change. But as our emotional motives are stronger than our rational knowledge, those measures are doomed to remain ineffective. An interesting measure that might be an entry into the cycle of passive, interdependent players could be establishing an intelligent system that can measure our ecological footprint – not just in terms of our consumption, but also in terms of our behavior and hence our non-consumption.

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