

Article

Behind the Scenarios: World View, Ideologies, Philosophies. An Analysis of Hidden Determinants and Acceptance Obstacles Illustrated by the ALARM Scenarios

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Abstract: In situations of uncertainty, scenarios serve as input for scientifically informed decision making. However, past experience shows that not all scenarios are treated equally and we hypothesise that only those based on a world view shared by scientists and decision makers are perceived as credible and receive full attention of the respective group of decision makers. While intuitively plausible, this hypothesis has not been analysed by quantitative correlation analyses, so instead of drawing on quantitative data the paper analyses the archetypical scenarios developed in the ALARM project to substantiate the plausibility by a comparative analysis of world views, value systems and policy orientations. Shock scenarios are identified as a means to explore the possibility space of future developments beyond the linear developments models and most scenario storylines suggest. The analysis shows that the typical scenarios are based on mutually exclusive assumptions. In conclusion, a comparison of storylines and empirical data can reveal misperceptions and the need to rethink world views as a necessary step to open up to new challenges. Deeply held beliefs will make this transition unlikely to happen without severe crises, if not dedicated efforts to explicate the role of world views for scenarios and policies are undertaken.

Keywords: scenarios; world views; values; policies; models and modes of science

1. Introduction

Recent forecasts predict that the world economy is set to grow by 238% by the year 2060 and the rich OECD countries by 146%, as compared to 2014 [1]. Air transport will nearly double by 2036 [2]. By 2030, biotechnology could contribute to 50% of primary production, 80% of pharmaceutical production and 35% of industrial production in sectors where biotechnology has potential applications [3]. Peter Johnson, SAP Marketing Strategy and Thought Leadership predicts that in the future digital economy by 2020, the average person will have more conversations with bots than with their spouse, by 2030 organs will be biologically 3D-printed on demand and the ‘Internet of Everything’ could be worth \$19 trillion over the next decade thanks to cost savings and profits for businesses and increased revenues for the public sector. 5G data speeds will be 1000-times faster than today, offering ubiquitous connections across the ‘Internet of Things,’ engagement across virtual environments with only millisecond latency and whole new Big Data applications and services [3].

At the same time, we know that if the Earth warms by three degrees Celsius (which is the trajectory under the current climate pledges), extreme events could become the normal state in the future, with the drought regions in Europe doubling from 13% to 26% of the total area and the most severe droughts in Europe lasting three to four times longer than in the past, affecting up to 400 million

people. In the Mediterranean, with droughts lasting almost half of the year (in Spain up to 7 months), water availability will be reduced by 35,000 m³ H₂O/km² of land [4], making large areas virtually uninhabitable. Most European cities will see increases not only in heat and drought but also in river flood risks. Over 100 cities are particularly vulnerable to two or more climate impacts while the predicted magnitude of impacts exceeds earlier expectations [5]. In the last two decades, one-tenth of the earth's total wilderness areas have been lost, an estimated 3.3 million km² [6] and today, 28.5% of the species analysed by IUCN have been classified as in risk of extinction.

In the social domain, in the affluent countries GDP per capita has increased roughly 1000% since the 1970s but average worker pay has increased just 11%, essentially stagnating while CEO pay has risen 1000%. Little wonder then that only 13% of employees worldwide are engaged, meaning that the other 87% are not involved in, enthusiastic about and committed to their work and company. This is set to intensify: 75% of Millennials would take a pay cut to work for a socially and environmentally responsible company while in a study of 100 variables, seeing purpose and value in work was the single most important factor that motivated employees, more than compensation. It even makes business sense: organizations in which employees perceive meaning at work are 21% more profitable [3].

All these prognoses are based on scenarios and they are virtually irreconcilable: rather obviously, the rosy economic prognoses, the environmental catastrophe emerging and the social challenges cannot occur simultaneously when taking the economic impacts of the social and environmental developments into account. Deserted countries do not grow economically, starving populations do not consume (and least so consumer electronics) and a bioeconomy without biodiversity is unthinkable. Nonetheless all these scenarios are the basis for decisions being currently taken, spending scarce human, material and financial resources on mutually exclusive visions of the future.

However, there is one big difference between these forecasts: those promising an extended and up-graded status quo where products and consumption patterns change but limits do not exist, receive billions of dollars, euros, yen and yuan in investments, while those calling for damage limitation receive miniscule funding even by governments not known for their problem denial and scientific illiteracy. Most firms fail to take the negative trends into account (except they spot a market niche there). For instance, Renault invests billions of euro to employ virtual reality and immersive simulation technologies to allow its design team, partners and suppliers to experience, interact with and test-drive new car designs without any physical prototypes, while car sharing could reduce the number of cars needed by 90% already in 2035, resulting in only 17% as many cars as there are today (Millennials are keen to share) [3].

Given that global change scenarios represent the best available knowledge of the best informed and educated generation in the history of humankind, how can these discrepancies be explained? Why is the world closely following the most pessimistic of the scenarios presented by the "Limits to Growth" report almost 50 years ago [7,8]? Why always "Late Lessons From Early Warnings" [9,10]? Environmental ignorance of economics, sociology and development theory has been accused but reality is more complex: if a scenario exercise offers a doomsday variant based on incremental change and a transformation based rescue variant, both based on the same disciplines, why is the rescue scenario lauded while the dominating practice of decision making resembles the doomsday scenario? Why is progress measured in metrics which tell us nothing about the emerging catastrophes [11,12]? Why do "modificationists" in science, politics and business not learn from or at least listen to "transformationists" and take the environmental and social facts on board? Economic interests and short-term thinking may explain part of the phenomenon, human inertia and loss aversion another bit (the preference for the "known evil" when facing transaction cost, that is, change is long known, see [13]). The European Environment Agency found that even well-crafted scenarios can fail to have their intended policy impact if they present information considered irrelevant by the recipients, lack support from relevant actors, are poorly embedded into relevant organisations or ignore key institutional context conditions [14]. So, the core question is not what kind of scenarios are needed to underpin a high-quality discourse between scientists and policy makers, considering the different

nature of science and politics but how to avoid that some policy explorative (but not prescriptive) gain superiority while others of the same quality are neglected. Our hypothesis is that the joint world views held by groups of scholars and decision makers are key variable explaining which scenarios are considered relevant. As in the political sphere gradual change is the norm, they are the context conditions which—often unconsciously—make scenarios of deep transformations appear strange, unreal and utopic. While scientifically sound, such scenarios would appear in the political sphere as expressions of illusions or idealism (as was Thomas Morus' "Utopia" in 1517 [15]—but it influenced policies) and not as realistic policy demands. This in turn would deprive them of support from relevant actors however good their scientific backing, the factual relevance of information and the embedment into relevant organisations may be.

In Section 2 we briefly describe the concepts we use in this paper (scenarios, world views, welfare regimes) and introduce the ALARM scenarios we will use to illustrate the link between scenarios and world views in Section 3. Section 4 discusses the results and draws some conclusions.

2. Method and Building Blocks

As so far analyses regarding the impact of underlying world views on the perception and appeal of scenarios are missing, we focus on making the world views underlying scenarios, as well as their social and economic implications explicit, using three archetypical scenarios from the ALARM project [16,17]. As adopting a world view is driven by deeply held beliefs and convictions, for scholars as well as for decision makers, it appears plausible that the implicit basis of scenarios influences their perception, with a similarity of world views enhancing the level of resonance. We will illustrate the plausibility of this hypothesis by explicating the world views and their implications for different scenarios in Section 3 to underpin our hypothesis. As there are no quantitative data regarding the correlation of world views and the acceptance of scenarios, our approach is limited to scenario analysis and common sense based reasoning, illustrating the plausibility of the hypothesis. First, however, we try to clarify what "world views" are in the context of our paper, drawing on philosophical discussions, before turning to scenarios in general and to the ALARM scenarios in particular.

2.1. World Views

World views are comprehensive systems of perceiving reality; which challenges are recognised, issues are emphasised, policies suggested and changes endorsed in order to approach sustainable development depends on the world views held by the respective agents in all walks of life. They have also been described as 'pre-analytic visions,' for example, by Herman Daly et al. [18] and are similar to metaphysics. A worldview can be expressed as the fundamental cognitive, affective and evaluative presuppositions a group of people make about the nature of things and which they use to order their lives. According to Michael Lind, a worldview is a more or less coherent understanding of the nature of reality, which permits its holders to interpret new information in light of their preconceptions [19].

The elements constituting a world view are its ontology including an anthropology, its epistemology and its axiology including a societal vision [20,21]. Ontology is a section of philosophy dealing with questions concerning what entities exist or may be said to exist and how such entities may be grouped, related within a hierarchy and subdivided according to similarities and differences. Epistemology is the branch of philosophy dealing with the theory of knowledge; it studies the nature of knowledge, justification and the rationality of belief. Axiology is another branch of philosophy, encompassing a range of approaches to understanding how, why and to what degree humans should or do value objects, whether the objects are physical (a person, a thing) or abstract (an idea, an action), or anything else. The Dutch World Views Research Group [22] gives a slightly different definition, including as here an ontology (and an explanation of where the world is heading), an epistemology and values (the axiology) but adding a praxeology or theory of action and an aetiology, reflecting on the origins and construction of the respective world view. We leave out the latter (although there are good arguments for including it) as despite the emergence of a 'reflexive modernity' [23] reflecting

on world views is a rare case in both scenario development and decision making—the modernity is reflexive but not reflective [24].

Clashes among worldviews cannot be ended by a simple appeal to facts as they permit their holders to interpret new information in light of their preconceptions: even if rival sides agree on the facts, they may disagree on conclusions because of their different premises [19]. For instance, different value systems shape the perception of what is important in reality: from an objective value perspective, there are no instrumental values, only means to things which may be valuable; the means may be valuable in themselves but not by their mean function. From an instrumental perspective, all values can be described in instrumental terms, bequest and existence value included (instrumental for enhancing one's own life satisfaction—a 'feel good' or 'warm glow' effect). According to utilitarian anthropologies, humans try to maximise their well-being in a 'pursuit of happiness' by accumulating as many things as possible. A stoic anthropology holds that a fulfilled and thus good life is not necessarily easy or pleasant but based on virtues and thus material goods can (but need not be) distractions from what makes a life worth living. Utilitarians strive for the greatest good for the greatest number [25], hedonists like the *homo economicus* for a maximum of individual satisfaction [26]. For both, satisfaction can be reached by egoistic or altruistic actions, a distinction which makes no sense for stoics applying deontological criteria to 'do the right thing' [27]. Different world views are associated with different value systems and different political philosophies which are appealing to one audience but can be appalling to another [28]. Accordingly, not only different decision makers but also different scholars (and the scenarios they develop) hold and express different world views, consciously or unconsciously which preform their perception, stance and recommendations.

However, although world views cannot be proven right or wrong, they can be assessed and compared regarding their plausibility, based on their 'fit' with observations. For instance, while a world view denying anthropogenic climate change is immune against the consensus of the scientific community, it may lose supporters due to the contradiction between their own experience, scientific findings and the explanations offered. Similarly, an explicit praxeology as part of a world view, offering a theory of effective action, can be compared with past experience. For example, claims that central planning economies are effective, or that a free market guarantees a just income distribution may be upheld by core believers of the respective world view but will limit their appeal to others as the explanations given for the known facts are of limited persuasive force. Such world views do not simply collapse or disappear (as would be the case if falsification was possible, like in the case of the pre-Copernican ontology) but tend to be gradually replaced by others which offer more convincing explanations for undisputed facts.

2.2. What Are "Scenarios"?

First of all, it appears useful to clarify what are scenarios and how they are distinct from predictions. The latter deal with certainty, requiring at least probabilistic knowledge about all possible outcomes of an event. Prognoses can be exact (A determines B with no ambiguity), or fuzzy (A determining a distribution of B) but are deterministic predictions in both cases. Scenarios are needed when certainty is missing, which is the case for most of the phenomena relevant to economic, social and environmental development. All scenarios are based on (necessarily subjective) assumptions: we assume that an accident may end our ability to work and buy an insurance against the ensuing economic impacts; that is the case of risks. Or we know the impacts of an event (nuclear war causing global winter, greenhouse gas emissions causing climate change) but we cannot say now if the event will be happening (the nuclear war) or if an ongoing process will continue or be terminated (the case of climate change). This is the situation of uncertainty, requiring not insurance but prevention. Then there is ignorance, a situation where we neither know the probability of the event, nor its potential impacts. For instance, we do not know yet if nano-particles from plastic waste will enter the human food chain and accumulate in our bodies and if so, which would be the resulting health impacts—this is the

case for precaution. Under both uncertainty and ignorance probabilities of final impacts cannot be quantified, by definition.

Forecasting scenarios are used to both better understand the probability of an event happening, under certain assumptions and to explore the potential impacts, under even more assumptions; backcasting scenarios start from normatively setting a desired or feared result and analyse how it could be achieved or avoided. Thus, scenarios do not predict events and thus cannot be policy prescriptive, they do not claim to outline the future that will be but describe different futures which might become reality. As such they are heuristic explorative tools giving indications how, again under certain assumptions for example, regarding the policies adopted, a system may develop. They can be used to explore what can be done and what should be avoided to redirect the development trajectory, always based on the assumptions made (which is why they should be explicit). Decision makers then have the opportunity to compare different plausible development trajectories, asking “what would happen if A or B was happening and if we did C or D?”

Building a scenario requires simplification to characterise the processes under analysis and support understanding them. Borrowing a phrase from Albert Einstein, scenarios should be as simple as possible but not simpler. This poses the challenge to find a level of complexity simple enough to be comprehensible but complex enough to adequately accommodate the different options to be compared and generate answers which are relevant in a real-world context. For this behalf, a scenario is based on a narrative, a storyline which can accommodate values, subjective motivations and other qualitative elements, which is often supported by computer models to illustrate certain aspects of the scenario quantitatively. However, models are constrained to dealing with the quantifiable parameters and the mostly linear developments their equations can handle. Thus, the quantitative results always have to be interpreted—and sometimes corrected—by embedding them into the narrative context [29–31].

Unfortunately, both academic literature and press releases and media coverage often lack a clear distinction between predictions, projections, probabilistic forecasts and scenarios. Predictions are often referred to as scenarios, while certain scenarios, such as economic growth forecasts, are habitually presented as (probabilistic) predictions. For instance, misinterpreting its scenarios as predictions was one of the main reasons for the economists’ profession rejection of the “Limits to Growth” report almost half a century ago. Ironically, some of its worst-case scenarios have turned out to be rather accurate predictions, against the best hopes of their authors [7,8] and in 2014, *The Guardian* published an article showing that data collected since the report’s publication supports the accuracy of the 1972 projections [32]. In the end, of course, as the world consists of different systems with different degrees of predictability, predictions and scenarios will ultimately need to come together to guide decisions.

2.3. The ALARM Scenarios

Developing effective strategies for biodiversity preservation requires analysing all major pressures affecting biodiversity and their interaction. Scenarios developed for this behalf must be broadly based, addressing production, consumption and administration patterns and attitudes alike. This requires scenarios which deal with the effects of quantitative and qualitative physical and social factors in an integrative way. In the ALARM project [16], a number of explorative scenarios was developed; all were based on storylines and included model simulations with a range of different models to assess the impacts of multiple pressures on biodiversity.

The ALARM storylines represent a set of possible development directions, all starting from the status quo but representing different policy orientations based on different world views, leading to diverging policies and results. In doing so, they illustrate that human societies have options to minimise biodiversity loss but that this requires political decisions now and in the future. They also show that the recommendations derived from different scenarios grounded in different world views can be mutually exclusive and thus choices should include opting for a world view—which will probably not be a consensus decision. The three ALARM storylines cover social, economic, environmental, agricultural, foreign and other policies (see Table 1 and the Supplementary Materials):

- “Business As Might Be Usual” (BAMBU) is a policy-driven scenario, that is, a scenario extrapolating the expected trends in EU decision making and assessing their intended sustainability and biodiversity impacts materialise. Policy decisions already made in the EU are implemented and enforced. However, BAMBU is no business as usual scenario, based on trend extrapolation, since recent or upcoming changes in EU policies would have been ignored that way. At the national level as well as in the EU, deregulation and privatisation continue except in “strategic areas.” Internationally, there is free trade. Environmental policy is mainly perceived as another technological challenge.
- “GRowth Applied Strategy” (GRAS) is a coherent liberal, growth-focussed policy scenario. It includes deregulation, free trade, growth and globalisation as policy objectives actively pursued by governments. Environmental policies will focus on damage repair and limited prevention based on cost-benefit calculations, with no emphasis on biodiversity beyond the preservation of ecosystem services ESS.
- “Sustainable European Development Goal” (SEDG) is a backcasting (inverse projection) scenario and as such it is necessarily normative, designed to meet specific goals and deriving the necessary policy measures to achieve them, for example, a stabilisation of GHG emissions. It aims at enhancing the sustainability of societal development by integrated social, environmental and economic policy. Policy priorities under SEDG are a competitive economy and a healthy environment, gender equity and international co-operation. SEDG represents a precautionary approach, taking measures under uncertainty to avoid not yet fully known future damages.

Table 1. Selected policies in the ALARM core scenarios. Starting from the same status quo conditions, the diverging policy assumptions drive the results into diverging directions. Source: [16].

Scenario	GRAS	BAMBU	SEDG
Climate envelope	fits to the IPCC SRES-A1FI storyline and its assumptions	SRES A2 (the best fitting available SRES scenario at the time of calculation)	SRES-B1 scenario (lowest SRES scenario available, 450 ppm not in SRES, B1 and SEDG story lines differ significantly)
CAP	Dismantling payments for production and for 2nd pillar (rural development & environment)	Shift 1st to 2nd pillar results in polarisation: intensification of high yielding locations, neglect of low yielding ones	Spatially explicit support structure to maintain (organic) agriculture throughout the landscape (only 2nd pillar transfers)
EU Funds	Phasing out, considered as subsidies	Focussed on infrastructure development and growth in poor regions	Focussed on local green development and opportunities, education and employment
Energy Policy	Efficiency, some renewables based on cost calculations	Efficiency, aiming at 20% reduction of GHG emissions by 2020 and 80% by 2080. Increase nuclear and renewables	Aiming at ¼ reduction of CO ₂ -emissions by 2050 through savings, changing consumption patterns and renewables
Transport Policy	Increased efficiency due to market pressure, no policy to shift the mode of transport or reduce transport volumes	Technological improvements and changing the share of different modes of mobility (walking, biking, trains, cars, boats, planes: modal split)	Transport reduction priority, plus modal split change (through pricing and infrastructure supply), technical improvements
Chemicals Policy	Focus on innovation and competitiveness. REACH not consequently implemented	REACH implemented	REACH plus; filling gaps for example, for metals, nanomaterials, endocrine disruptors
Trade Policy	Strong support for WTO and free trade	Promoting free trade except in “strategic areas”	Global sourcing reduced due to cost reasons; phytosanitarian controls

Although all ALARM core scenarios represent attempts to reach sustainable development, they diverge regarding how sustainability is operationalised (see Table 2). Whereas GRAS seeks to realise what is known as weak sustainability based on substitutability between capital stocks, BAMBU considers a minimum critical natural capital indispensable and SEDG foregoes the

notion of capital stocks altogether. This has immediate implications for the understanding of sustainable development.

Table 2. Diverging concepts of sustainability in the three ALARM scenarios (own compilation). All scenarios are dedicated to reaching sustainability but with divergent definitions and tools, based on different world views, they follow significantly different, partly mutually exclusive trajectories.

GRAS	Three to four capital stocks, non-declining sum, mutually substitutable (weak sustainability), the economy considered as having primacy. Processes including overshoot are reversible. Assumption that once the economy works properly, all other parts of the puzzle will fall in place, that is, social and environmental problems will be solved automatically (the Kuznets- and Environmental Kuznets Curve hypotheses). Focus on adaptation (managing impact), optimal solutions by <i>maximisation</i> .
BAMBU	Three to four capital stocks, non-declining sum plus conservation of critical natural capital, mostly comparable and commensurable, attempts to go “beyond GDP,” weak to reasonable protection standards. Precautionary principle, safe minimum standards, some ambitious protection standards set but not vigorously enforced, focus on innovation for the market to deliver the desired goods or fully equivalent substitutes. Focus on mitigation (reducing pressures) and restoration (stabilizing the state), optimal solutions by <i>optimisation</i> .
SEDG	Co-evolution of four sub-systems, with each having its own reproduction criteria and mechanisms, plus demands to the impacts of each other. Earth is a closed system with limited resources, permanent growth is not possible. Precautionary principle, addressing drivers of environmental and social crises, focus on prevention (redirecting drivers) and mitigation (overcoming pressures) limiting human impact, long term resilient/healthy ecosystems providing ecosystem services. Assessment is only possible by MCA/MCDS, (socially) optimal solutions by <i>legitimation</i> .

Developing these three options can be considered archetypical for sustainability-related scenario exercises: comparing a “muddling through” or business as usual scenario and one each representing a primacy of economic or environmental—and sometimes social—criteria, is a frequently used approach. It results in relatively similar, at least comparable scenario sets based on interpretations of two or three ‘standard’ world views, as Table 3 illustrates. “Tools such as scenario archetypes, that is, grouping scenarios together as classes based on similarities in underlying assumptions, storylines and characteristics, can then be used to integrate visions, thus highlighting conflicts and convergences across scales [33].” Thus, we consider the conclusions we will draw from analysing the ALARM scenarios as not case specific but most probably more generally applicable.

Table 3. Comparison of ALARM scenarios with other structurally similar global scenarios (adapted from an unpublished report for the Millennium Ecosystem Assessment). It illustrates that the typology chosen in ALARM (status quo policies, ambitious sustainability, radicalised neoliberal policies) is indeed archetypical for a wide range of scenario exercises.

ALARM	SRES	GEO-3	Millennium Ecosystem Assessment	Roads from Rio+20
2100	2100	2032	2100	2050
GRAS	A1FI	Markets First	Global Orchestration	Global Technology
BAMBU	A2	Security First	Order from Strength	
	B1	Policy First	TechnoGarden	Decentralized Solutions
SEDG	B2	Sustainability First	Adapting Mosaic	Consumption Change
Settele et al., 2005	IPCC et al., 2000	UNEP 2002	Millennium Ecosystem Assessment 2003	Kok et al., 2018

2.4. The Shocks

In illustrating the ALARM storylines, we combined, for each of them, climate scenarios from the set used by the IPCC, selected to offer the best fit with the expected climate development under the respective scenario [34]; a narrative-specific run of MOLLUSC [35], a spatially explicit land use scenario

generator; and a specific set of parameters for runs of GINFORS, a highly endogenised econometric input-output model [36]. In an iterative process, the outputs and inputs to and between the models were harmonised, based on the narratives.

However, assuming a gradual development, that is, no surprises, is probably the most implausible vision of the future. Thus, in ALARM a methodological innovation was introduced by developing scenarios reflecting potential shocks, assuming disturbances with widespread consequences considered extreme at the time of writing. A shock is any event that comes unexpectedly and has the capability to change the development trajectory of a system. In each of the three dimensions used for sustainability concepts, the environmental, the economic and the social one, one shock was defined. The shock scenarios serve to illustrate that there can be a significant divergence of real-world developments from what linear modelling suggests; consequently, the shock scenarios could only partially be simulated in computer model runs.

The three shocks are indicated in Figure 1 together with the core scenarios from which they diverge:

- Cooling Under Thermohaline collapse (GRAS-CUT) is the environmental shock. It describes a collapse of the Atlantic Ocean water circulation (the most familiar part of it being the Gulf Stream) and the resulting relative cooling of Europe; indications observed by now.
- Shock in Energy price Level (BAMBU-SEL) describes the economic shock of a permanent quadrupling of the energy price, as expected when Peak Oil, the global maximum of oil production, occurs or political or other influences limit the supply significantly and permanently. We had a flavour of that in 1972, 1978 and 2008.
- ContAgious Natural Epidemic (BAMBU-CANE) is the social shock, a pandemic out of control. Again, we had a flavour of that, with the Chinese bird flu in 2006 and the Mexican swine flu in 2009 which permitted to observe the political and psychological mechanisms at work, regardless of their relatively limited global health impacts. In 2018, the WHO and Bill Gates, as chairman of the Bill and Melinda Gates Foundation, warn of such a pandemic being unavoidable if not imminent [37].

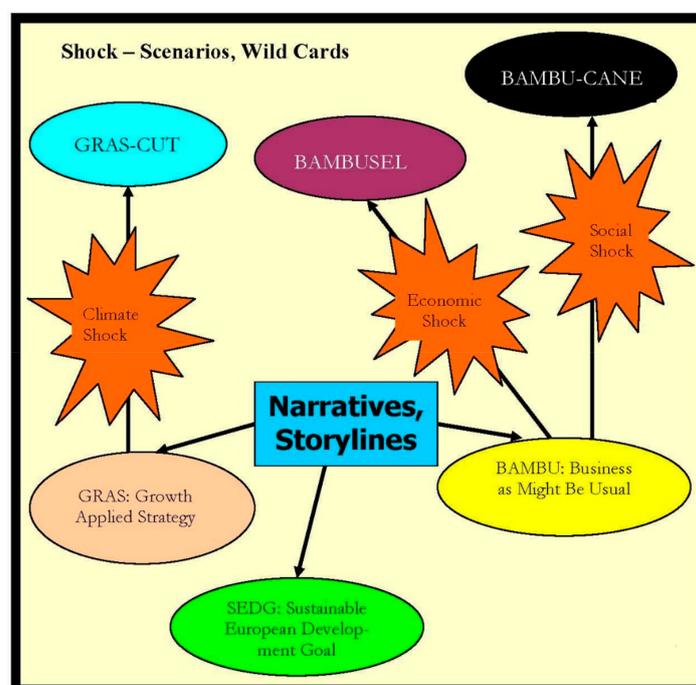


Figure 1. The ALARM core and shock scenarios. As SEDG is designed to avoid shocks, the analysis focusses on shocks under GRAS (as this is the high greenhouse gas emission scenario) and under BAMBU (shocks which are independent of scenario parameters).

As a climate shock is most probable under the scenario generating the highest greenhouse gas emissions, it is assumed to happen under GRAS. The economic shock is attributed to BAMBU as SEDG is assuming a reduction of resource consumption which would make such a shock less plausible. The social shock of a pandemic is essentially possible under all scenarios but probably less so under SEDG which assumes a reduction of global exchange for cost reasons (see Figure 1).

3. Results—Comparing the Scenarios and Their Background Assumptions

The model runs, complemented by biodiversity model analyses [38] and the results from a questionnaire survey addressing ALARM biodiversity experts showed that:

- GRAS consistently provides the least desirable outcome for biodiversity in Europe—across different biomes and for most ecosystems and species.
- “Muddling through” along the BAMBU path, although probably slowing down biodiversity losses, will systematically fail to meet the EU target to end the loss of biodiversity, by 2020 and beyond.
- From a biodiversity point of view, SEDG represents a significant step in the right direction, although not sufficient in every respect (in some biomes some species and ecosystems would still be lost).
- GRAS-CUT would reduce the average European temperatures to the level of the early 20th century. Minor declines in harvest could be compensated by imports or incremental diet changes.
- BAMBU-SEL represents an immediate burden on the economy which however recovers after shrinking significantly. More permanent damage is caused for the environment (by maximising biofuels at the expense of biodiversity) and the levels of disposable income (due to money transfers to oil exporting countries).
- BAMBU-CANE would lead to a collapse of the economy if more than 20% of the population left their occupations to seek shelter in their countryside houses; it does not kick-start again when they return.

3.1. The World Views in the Scenarios: Ontologies, Anthropologies, Axiologies

The reason for the divergences between the three core scenarios can be found in their different ideological orientations (see Table 4). Ideology is here understood in the sense of Söderbaum as praxeology [39], an understanding how means cause results and thus a core element of the respective world views. These orientations are rarely made explicit, in ALARM as in other scenario exercises but they are the result of and representative for the more or less conscious world views held by their authors. The less conscious scholars are regarding their world views and the influences these might have on their work, the more influences will affect the outcomes. This is true for the scenarios presented here and their analysis in this paper as well—although we tried to design all scenarios as we expected representatives of the respective world view would have done, we cannot rule out that the scenario authors’ inclination to an ecological or ecological economics world view such as the one underlying SEDG has influenced both.

According to the GRAS *ontology*, nature and society are part of an extended definition of the economy, being described as social and environmental capital and valued as production factors. Those parts of both domains that do not contribute to production are left aside, while those that do deserve protection by policy measures, in particular the ecosystem services ESS. In the SEDG ontology, the environment is not part of the economy but vice versa, the economy is a subsystem of society which itself is embedded in the environment metasystem. One of the direct implications of the differing ontologies is that in the first case, corresponding to the neoliberal approach, the laws of economics apply to society and the environment, while the laws of nature do not necessarily apply to the economy. This assumption allows ignoring the entropy law, the second law of thermodynamics, in neoclassical schools of economics such as those utilised for GRAS.

Table 4. Ideological orientation and institutional arrangements in the scenarios [40–42], modified.

Content	GRAS	BAMBU	SEDG
Ideological orientation	business as usual, sustained growth (macro) and profits (micro), quantitative, monetary criteria (no qualities)	ecological modernisation, qualitative growth, changes of aspects but not system basics, flexible adaptations	precaution, multi-dimensional objectives, limited win-win options, priority for justice, health and environment over net growth
Economic paradigm	Neoclassical	incoherent, neoclassical plus etatism, welfare state, technology, green growth	sustainability economics: ecological, evolutionary, institutional and political economics
Institutional arrangements	Institutions facilitating 'corporate globalisation' like IMF, World Bank, WTO	Focus on regional integration. EU a strong player in international institutions, modifying but not altering rules	Subsidiarity principle. For example, strengthening the UN, evaluating where the EU needs more and where it could have less competences and similarly so on the members state level

On the other hand, if the economy is a subsystem of society which itself is a subsystem of the environment, not only the laws of thermodynamics apply to the economy just like the laws of gravity but this is also true for the laws—or rather the rules—identified by sociology and psychology. Then enterprises can be understood as social constructs, with a lot of processes, far beyond management, shaping their functioning and outcomes, while functions and performance are constrained by the laws of nature [21].

Regarding the *anthropology*, GRAS follows the neoclassical approach of assuming rational decisions of the homo economicus (a necessary assumption in equilibrium models), complemented by a belief in the problem-solving capabilities of technology: the market and human ingenuity, will bring about the right solutions at the right time to permit frictionless development and growth. The humans populating SEDG are different, with reflection, doubt, some selfishness but also concern for others and keen to maintain the public goods and capable of sharing instead of owning.

In terms of values (*axiology*), in SEDG the contributions to citizens' quality of life an enterprise provides is an essential criterion for the 'social license to operate' any business requires [43,44]. However, SEDG inhabitants are open to diverse definitions of what people may consider to be contributing to their respective quality of life. Value pluralism in implementation also characterises the ideas of justice in SEDG, understood as enabling all inhabitants to lead a dignified life, including fair participation in the respective society. This presupposes a needs-based distribution to achieve more social equity (*iustitia universalis* and *iustitia distributiva* in the Aristotelian Nicomachean Ethics). Amongst GRAS inhabitants, instrumental values dominate; they identify the value of an object according to its contributions to one's own wealth and well-being. Equity of outcomes is no moral objective—justice is done when people are rewarded based upon what they contribute (meritocratic concept, *iustitia communitativa*). The three shock scenarios, when motivating demands for more ambitious precaution, philosophically draw on the 'imperative of responsibility' suggested by Hans Jonas: "Never must the existence or essence of man as a whole be made a stake in the hazards of action" [45] (p. 12). He argued: "In order to ascertain the indubitable truth, we should, according to Descartes, equate everything doubtful with the demonstrably wrong. Here on the contrary we are told to treat, for the purposes of decision, the doubtful but possible as if it were certain, when it is of a certain kind," that is, when violating the 'imperative of responsibility' [45] (p. 37), [46].

3.2. The World Views in the Scenarios: Economic Orientations

As a result of the different value orientations, the *economic orientations* listed in Table 5 also differ. GRAS is a market and competition society imaginary representing a typical liberal capitalism approach while SEDG—including markets and competition but embedding them into a social frame—pictures a postmodern, sustainability oriented society. Nonetheless it incorporates many elements of the more traditional model of "Rhenish Capitalism," which is in line with the welfare state to etatistic

socio-economic type underlying the scenario. BAMBU is not discussed here as it follows no coherent orientation but, representing EU policies, is a compromise between different approaches (with the balance changing from time to time).

Table 5. The economic orientations result from the values pursued and the ontologies (including praxeologies) prevailing in the respective world views as described in Section 3.1.

Orientation	GRAS	SEDG
Source of profit	Share value, speculation	Dividend, payment to owners
Ownership	Temporary, share-based	Permanent, individual
Level of profit	Fixed management objective, predetermined	Residual, after material, labour and finance costs
Perception of corporate success	Achievement of management and providers of finance (shareholders), at the expense of jobs and salaries	Achievement of partners, sharing of results
Salaries	Residual after material and finance costs, plus profit	Negotiated costs, based on productivity increase plus inflation compensation
Relation management/staff' salaries	Management increasing with profit or more, salaries stagnate or decline to generate profit	Increasing in line
Industrial relation	Exploitation	Partnership
Sustainability ethics	Utilitarianism	Fairness, procedural justice

Stakeholders in GRAS rely on the market to deliver environmentally optimal solutions once externalities have been internalised. They trust in solutions to environmental problems and scarcity through better and more efficient technologies necessarily emerging in a competitive and growing market economy. Opposed to that, SEDG citizens call for sufficiency to complement efficiency (and make it effective by skimming off rebound gains), for respecting nature's limits and for fair distribution of access to societal participation including to nature's contributions to people. In SEDG the assumption prevails that economic instruments can offer incentives complementing and dynamising regulations but that the market as such is not a reliable means to achieve environmental sustainability.

Consequently, substituting regulation for green taxation (the Pigouvian approach) and privatisation, definition of unambiguous property rights and deregulation (the Coasean approach) are both part of GRAS. Such instruments play a secondary role in SEDG and are only used on a case by case basis—here no silver bullet exists and each 'bullet' is considered as potentially causing damages to vulnerable groups, target or not [47]. Mobilising private capital is important in both scenarios but the means of doing so differ: while in GRAS public seed money and Public—Private—Partnerships PPP dominate, in SEDG private investment is mobilised by the necessity to comply with legal standards, for example, regarding emissions, waste treatment and product recyclability. As a result, investment in GRAS follows profit maximising criteria, while the obligation driven investment in SEDG can be oriented towards investment into public goods.

3.3. The World Views in the Scenarios: Social Models and Welfare Regimes

As social policies are part of the narratives and where appropriate the modelling, the attitudes towards social justice used in the scenarios have been based on those present in the EU. According to Opielka at the time of developing the scenarios three attitudes were dominant [41]:

- *The liberal model:* if interview partners supported state responsibility for securing individual income levels in at least two of the three cases "illness," "old age" and "unemployment" but not beyond. These preferences were implemented in GRAS.
- *The welfare state model:* if in addition interviewees saw state responsibility for "reduction of income disparities," or "provision of jobs," or both. This corresponds to the BAMBU scenario assumptions.

- *The etatistic model*: if in addition they supported the control of salaries by law (implying a redistributive tax system), or a legally guaranteed general, tax financed basic income. Not all but some elements were included in SEDG.

Table 6 illustrates that the three models indeed represent the attitudes of the vast majority of the European population (which are significantly different from the USA, calling for caution before applying conclusions drawn from US empirical data to Europe).

Table 6. Attitudes towards social justice in Europe. Data source: [41].

	No. State Responsibility	Liberal	Welfare State	Etatistic	Unclassified
<i>Average EU 15 member states</i>	0.5	8.9	29.8	56.5	4.4
Sweden	0.7	20.2	40.9	34.5	3.7
UK	0.2	15.1	32.5	46.7	5.6
France	1.9	8.5	23.9	56.0	9.7
W.-Germany	0.8	13.7	46.8	34.0	4.7
<i>Average CEE EU member states</i>	0.5	4.7	21.8	69.1	3.9
E.-Germany	0.0	2.8	13.9	80.7	2.6
Czech Republic	2.2	12.1	24.2	54.8	6.8
Poland	0.4	3.1	17.2	76.7	2.6
Hungary	0.1	5.1	30.8	61.0	2.9
Bulgaria	0.0	6.7	12.1	76.7	4.6

Despite significant differences between old and new EU member states and within each group, there is still a broad consensus that either the welfare state or the etatistic approach are what citizens want, across the political spectrum. The differences between West and East Germany were rather pronounced in the polls but there were also important commonalities. For instance, the statement “The state must take care that everybody has a good livelihood/a decent life (“ein gutes Auskommen”) in cases of illness, need, unemployment and old age” was supported by more than 77 resp. 86% of citizens in West resp. East Germany, across all party preferences, with the liberal party FDP scoring lowest [41]. Today, with more than decade of economic development, neoliberal policy and migration, the data might be different, although the basic patterns probably still prevail. Gerhards and Hölischer, in their analysis of the ISSP (International Social Survey Programme) results identified the same pattern, calling the three models European Commission, social-democratic and socialist [48].

The world views and their values shape the ways societies self-organise themselves, in particular their societal and political institutions, understood in the political sciences sense of being the rules by which political decision-making and implementation is structured (Table 7). Systems of rules shaping behaviour include formal and informal value-based orientations, mechanisms to realise them and including the mechanisms for rule enforcement [49,50]. Political organisations encompass both: they are social entities, appearing as actors in political processes, as well as systems of rules, structuring political behaviour and facilitating societal orientations.

While GRAS and SEDG are characterised by specific institutional settings shaped by the respective world views, BAMBU again exhibits a mix of views due to its character as reflecting the real-world political compromises. When the at least partially mutually exclusive suggestions derived from different world views have to be reconciled in international governance processes, this inevitably leads to either incoherent or vague policy formulations. This was already the case for the Brundtland Report and the Agenda 21 adopted in Rio 1992 and is still true for the 2030 Agenda adopted 2016 [51,52].

Table 7. ALARM Concepts of social justice and its institutional implementation [41], modified.

ALARM Scenario	Concept of Justice (in Aristotelian Nicomachean Ethics)	Institutional Level Involved			Famous Representatives
		Organisations	Mechanisms	Orientations	
		Steering System (Institutional Mechanism)	Social Relation, Typology of Reciprocity	Principle of Justice (Political)	
GRAS	Equity based upon what people contribute (Iustitia Communitativa)	Market	Instrumental association, exchange	Performance	Robert Nozick
BAMBU	Equity of opportunity (no clear relation)	State (often serving business)	Citizenship	Equity	John Rawls
SEDG	Equity based on distribution, needs based (Iustitia Distributiva)	Community	Community Solidarity, Communicative action	Need satisfaction, equality	Amitai Etzioni
	Equity based on enabling participation (Iustitia Universalis)	Legitimation	Political culture, human rights, communication of values	Participation, access, inclusion (N. Luhmann), global justice	Amartya Sen

The attitudes to social justice have also shaped the welfare regimes which emerged in different parts of Europe. Esping-Andersen identified three different political economies of the welfare state (liberal, social-democratic and conservative), with complex patterns of social policy including labour market, community system, family policy and the mode of state regulation itself [53]. We used his systematique to specify the social dimension in the scenario narratives (see Table 8). GRAS was designed to correlate to the liberal regime and SEDG with some—mainly environmental—modifications to the (traditional) social-democratic (the naming chosen by Esping-Andersen pre-dates the New Labour version of social democracy). No scenario is directly related to the conservative regime as traditional conservatism has largely given way to liberal policies. BAMBU as a political compromise is again characterised by a mix of elements from different regimes.

Table 8. Welfare regimes and social justice in Europe and their representation in the ALARM scenarios [41] (p. 330), based on [53], modified. As BAMBU is a mix of several components, the conservative welfare regime is added to make the comparison of sources easier.

Variable	Indicators	Liberal = GRAS	Social = SEDG	BAMBU	Conservative
Decommodification: protection against market forces and income loss	Level of income substitution, % of previous income.	Weak	Strong	Medium	Medium
	Share of individual financing	High	Low	Medium	Medium
Residualism	Share of basic support in total social expenditure	Strong	Limited	Medium to strong	Strong
Privatisation	Share of private expenditure for health and old age as share of total	High	Low to medium	Medium	Low to medium
Corporatism/Etatism	Number of social security systems for specific professions	Weak	Medium	Medium	Strong
	Share of expenditures for life-long employed government staff	Minimised	Increasing	Medium	Medium
Redistribution	Progression in (income) tax structure	Weak	Strong	Medium	Weak
	Equality of transfers received	Weak	Strong	Medium	Weak to medium
Full employment guaranty	Expenditures for active labour market policy	Low	Strong	Medium	Medium
	Unemployment quota, weighted by labour force participation	Medium	Low	Medium	Medium
Role of market in social security provision	Shares of transfers and recipients	Central	Marginal	Medium	Strong

Table 8. Cont.

Variable	Indicators	Liberal = GRAS	Social = SEDG	BAMBU	Conservative
Role of state in social security provision	Shares of transfers and recipients	Minimised	Central	Subsidiary to medium	Subsidiary
Role of family /community in social security provision	Shares of transfers and recipients	Subsidiary	Subsidiary	Marginal to subsidiary	Central
Role of human rights	Beyond legal status, respect in social life and employment	Medium	High	Medium to high	Medium
Dominant form of welfare state solidarity	Entitlement basis	Individual	Work focussed (in SEDG incl. unpaid work)	Labour focusses, tax support	Communitarian, etatistic
Dominant means of steering social policy	Agency and organising principle	Market, economic optimisation	State, equity principles for citizens/inhabitants	Mixed market and state, mixed ideas	Moral and economic
Underlying concept of social justice	As realised by institutional mechanisms	Equality of opportunity	Distributional justice	Opportunity & distribution	Fair participation, basic need satisfaction
Archetypical countries	Switzerland	USA	Sweden	EU	Italy, Germany

As one result of all these divergences, some of the most politically relevant factors also diverge, such as the target groups of policy recommendations and the justifications of the recommendations themselves, in particular the assumed resilience resp. vulnerability of the system and the calculation of future costs and benefits (Table 9). The difference in economic valuation mechanisms can be expected to contribute to and legitimate diverging policy priorities. The different ideas about dynamics, that is, whether or not social and environmental developments are reversible, lead to different levels of precaution and thus different policy recommendations. These are expected to appeal to different stakeholder groups—agents with a neoclassical economic background are expected to be more open for recommendations based on a similar world view and the same applies for proponents of other world views which are—other than the GRAS world view—today not hegemonic.

Table 9. Additional policy shaping implications of the world views in GRAS and SEDG, compiled from [54–58].

	GRAS	SEDG
Future value	Exponential discounting, positive discount rates	Object dependent: no, hyperbolic, linear or exponential discounting
Dynamics	Equilibrium with reversible deviations, series of equilibria, largely predictable, high inherent resilience	Nature and society are processes of continuous irreversible change, path dependent but unpredictable, with medium to high vulnerability
Resonance group of policy recommendations	Economic and fiscal policy makers, business	Policy makers, civil society

3.4. The World Views in the Scenarios: Epistemologies and Science Implications

Just like ontologies and axiologies, the epistemologies are different between the archetypical scenarios, with BAMBU an uneasy mixture of elements. Both SEDG and GRAS come with a specific philosophy of science related to the overall philosophical basis of the respective world view and this defines their epistemologies.

While critical realism based assessments searching for answers are dominant in SEDG, in GRAS positivism prevails, allowing scientists to claim knowing a superior truth and communicate that to decision makers ('truth speaks to power'). In SEDG, uncertainty and ignorance are acknowledged, as well as the plurality of legitimate knowledge sources including their potential contradictions, legitimacy plays an important role. Hence the focus on participatory processes, discourses and knowledge co-production (see Table 10).

Table 10. Science and science-society relationships in the scenarios. Mode 1 and mode 2 are terms from the sociology of science, coined by Gibbons et al., referring to the way (scientific) knowledge is produced [59]. Mode 1 is characterised by a co-operation between science and society without any change in working methods of either while mode 2 is defined as a partly descriptive and partly normative way to operationalise sustainability science. Funtowicz and Strand suggested a systematique of science-society relationship distinguishing five models [40]: 1. The initial ‘modern’ model (perfection/perfectibility), 2. The precautionary model (uncertain and inconclusive information), 3. The model of framing (arbitrariness of choice and possible misuse), 4. The model of science/policy demarcation (possibility of abuse of science), 5. The model of extended participation (working deliberately within imperfections). Post-normal science is a discursive model developed by Funtowicz and Ravetz [60].

	GRAS	BAMBU	SEDG
Theory of science, mode	Positivism Mode 1	Eclectic mix, positivism dominates, Mode 1 dominates	Social constructivism, subjectivism, hermeneutics, contextualism, Mode 2 dominates
Models of science-society relationship	The initial ‘modern’ model: perfection/perfectibility	The precautionary model, the model of framing & the model of science/policy demarcation	The model of extended participation: working deliberately within imperfections
Role of scientists	Outside, truth speaks to power	different attitudes, scepticism about truth and power	Citizen scientist, post-normal science, sustainability science, discourse based. Participatory, multi-criteria and multi-perspective assessments

In science the mode of working, the choice of methods, the composition of teams and the selection of research questions is not an individual free choice of each scholar based on her world views (determining which questions are regarded interesting and relevant), the theories and models of science held by her (of course not independent from the world views but not fully determined by them) and her education, skills and experience (determining the methods and concepts available to each scholar) as the claim of ‘independent science’ would like to have it. Value free science is even less on the books as already the world views held by each scholar infuse values into the decision making. Instead choices are co-determined by external factors such as the calls and funding conditions, the preferences of journal editors and the reviewers they choose and other institutional settings determining careers in science. Thus, the world views of decision makers in different functions and on different levels—and not only those of the scholars themselves—are crucial for the course the scientific endeavour takes, the information it generates and the advice it offers to inform and support decision making processes.

Besides the implications for our research hypothesis formulated in Section 1, in Section 4 we will point to some additional policy relevant conclusions that can be drawn from the conceptual analysis and its comparison to the empirical data upon which the scenario designs have been based.

4. Discussion and Conclusions

Scenarios are scientific tools to inform political and economic decision making. Consequently, having undertaken a deeper look into their fundamentals than usual, we can draw some conclusions regarding both, the role of science and decision making.

4.1. The Role of Science

That the world views of decision makers in different functions influences the course the scientific endeavour takes has positive and negative effects: on the positive side, according to our hypothesis, an alignment of world views (and thus of relevance criteria) will make it easier for scientific information and advice to be recognised, acknowledged and actively used in decision making. The potentially negative effects result from the character of the political process as interest-driven, which could make it difficult if not impossible for researchers to produce knowledge which may be used in policy processes by opposition parties and counter-hegemonial forces in civil society. The founding of autonomous

universities in Spain and other countries in the 1960s and the establishment of ecological research institutes in Germany in the 1970s and the Science Shops ('Wetenschapswinkel') in The Netherlands and elsewhere in the 1980s have been the result of such situations in earlier phases.

Currently however, while civil society complains about the lack of research on sustainability transition processes and other politically relevant issues while criticising the dominant influence of business interests on research spending, it appears to be the outside world, pressure groups and donors beyond the ivory tower, which pressurises the scientific establishment to open up to new thinking and methods developed by heterodox scientists over the last decades [61,62].

4.2. World View Based Science—Policy Resonance: Support for the Research Hypothesis

The GRAS scenario and those similar to it in other scenario exercises is based on a world view related to neoclassical economics, a view shared by many decision makers. While its perception of sustainability as a constant sum of capital stocks ('weak sustainability') has provoked criticism from environmental scientists for the insufficient reflection of complexity and path dependency and the assumption of reversibility of changes, it is considered as a suitable basis for sustainability policies by many decision makers holding a related world view. The result is the wide-spread endorsement of "green growth policies" and their implementation in national policies and international agreements. Not only that, it is also changing environmental science as its terminology (and thus its epistemology) are taken up by scholars seeking political attention and scientific bodies in charge of providing information for policy preparation processes such as the European Environment Agency, the IPCC or IPBES which phrase their advice using terms like natural capital and the internalisation of external cost. While the results offered by SEDG-like scenarios are consistently more promising regarding their sustainability effects and endorsed by governance agreements such as the 2030 Agenda, the means to achieve such effects are rejected as unrealistic, resulting in a cognitive dissonance: what is considered realistic is known to be of limited effectiveness (like the EU Biodiversity Strategy assessed by the European Commission itself to be on the brink of failing again) and what is effective is considered to be unrealistic. This is like being between a rock and a hard place—at least one of the two has to give in. In the case assessed here, either the imagination of "realistic instruments" has to be broadened to accommodate more radical measures, or the ambitious targets have to be given up in EU sustainability and climate policy (as it is the trend of the last decade in Germany). Thus, our hypothesis seems to be supported by the findings and offers policy relevant insights.

What is evidence in 'evidence based decision making'? The mechanistic thinking in equilibria inherent in GRAS has been criticised for its low level of complexity which allows for making predictions. This makes it virtually impossible to generate recommendations suitable as the basis for decisions in managing such complex systems as the economy, society or the environment [30]. However, the GRAS world view and the neoclassical economic thinking it supports are widely spread amongst decision makers and the resonance scientific policy proposals based on it find amongst them supports our hypothesis. Such proposals are effective despite the qualified scientific criticism regarding the proposals made, for instance in the cases of geo-engineering or GMO food. World views can be a kind of dangerous Procrustean bed; as Julie "Nelson said "Economists seeking to disguise their value judgements under a veneer of Cartesian objectivism [. . .] are dangerous" [63]. The reason is not least that deriving policy advice from linear extrapolation of past events in mechanistic systems can be described metaphorically as being like driving a car not looking for the road ahead but trying to determine the course to set by extrapolating from what can be seen in the rear mirror. Unfortunately (for this approach), in evolving systems past evidence is no reliable guide to conclusions regarding future events. Instead of promising evidence, the best available scientific information should be the basis of decision making and as uncertainty and ignorance necessarily remain, science has no "truth" to tell to "power." So, what scholars and decision makers alike can realistically strive for is scientifically informed decision making, not evidence.

Explaining communication failures: While in the ALARM scenarios, every inhabitant in one of them shares her scenario's world view and interacts with other agents on this basis, in the real world of course different groups endorse different world views, or, more precisely, different individuals do, strongly influenced in their decision process by their social environment (family, household, peers, colleagues, friends, role models, . . .). Reading the scenarios against this background also illustrates why real-world agents, despite articulating similar goals, cannot agree and sometimes even enter fierce conflicts about the definition of the shared goals (rarely discussed openly) and the way and means to get there—the latter dominating the public debate. The scenarios, read as mental maps of different agents, illustrate that what one agent may consider essential, another may perceive as effective betrayal of the common goal and as utterly obstructive. The UK discussion about the meaning of Brexit provides ample examples of such controversies.

4.3. Policies and World Views—The Probably Most Prominent Example

Limits to growth, the 1972 report of the Club of Rome [7], was perceived differently in the USA, where politicians and the economics profession immediately and fiercely rejected it, while in much of Western Europe it struck a chord with the public opinion and a part of the decision makers. The most prominent endorsement of a new world view, stimulated by the report, was probably the one of the then President of the Commission of the European Communities, Sicco Mansholt, who said in a round table statement on 14 October 1973 [64]:

“To me, the most important question seems to be: how can we achieve zero growth in this society? It is beyond doubt for me, that this zero growth must be achieved in our industrial societies, in America, Western Europe and Japan. ... Should we not succeed in doing so, then the distance, the tensions between arm and rich nations will become bigger and bigger. ... It would be an illusion and even a lie to pretend there could be no growth for the Third World economies unless we were performing growth as well. I am worried however whether we will manage to get those powers under control, which strive for a permanent growth. Our whole societal system insists on growth—not only single companies, big business, multinational giants.” (own translation)

However, in the meantime decision makers holding the SEDG-like world view of Mansholt have become a rare exemption, while the GRAS world view has become hegemonic. To Mansholt, a GRAS scenario, its objectives and policies would have been anathema due to its focus on GDP growth, with a secondary role for environmental concerns and even less dedication to overcome the tensions between the rich and the poor nationally and internationally. Opposed to that, all presidents of the European Commission after Jaques Delors held a GRAS world view, unshakable by environmental failures (biodiversity, climate) and social hardships (Greece, Portugal, . . .). To all of them, an etatistic development trajectory, let alone economic degrowth, were a priori unacceptable, even unthinkable. Instead “We need growth” describes the prevailing policy orientation [65], in line with a GRAS world view which expects the solution of social and environmental problems from sufficient economic growth. However, policies based on this world view are confronted with a number of policy failures and public scepticism which are increasingly hard to ignore. For instance:

Social aspiration discrepancy: As far as BAMBU is a realistic reflection of the current EU policies, this comparison demonstrates the divergence of EU policies and EU citizen preferences as they are obvious from table A1. Already this is an important result for European policy making and it underscores the preference of European citizens for a rather BAMBU-to-SEDG kind of policy priorities—which of course has impacts beyond the social domain, for both economic and environmental policies. Current policies tend to follow populist impulses towards a BAMBU-to-GRAS policy with some additional elements like migration controls, an issue dominating political discourses and media but not public concerns. The world views of decision makers and lay people appear to diverge, making communicative processes in decision preparation and mobilising public support

for policies based on the GRAS world view ever more challenging; the conflicts around free trade agreements and the unwillingness of the Commission to make substantive concessions are just one point in case.

Biodiversity conservation failure: For EU policies, the ALARM scenario results imply that although certain species and eco-systems may be stabilised under the EU policies as modelled in the BAMBU scenario, current policies will not be able to deliver on the 2020 target, not even with delay. The shock scenarios indicate both the resilience of the socio-environmental system and its vulnerability beyond certain tipping points; currently the EU institutions are not well prepared for such shocks.

Cognitive dissonance: While a reconceptualization of progress is already under way as “targets for human development are increasingly connected with targets for nature, such as in the United Nations’ Sustainable Development Goals” [33] (p. 1416), many decision makers suffer from the cognitive dissonance mentioned, an unpleasant and unstable state of mind caused by the political dilemma that while time-tested instruments fail (again), few alternatives exist in the world view held so dear for so long. Bill Rees describes the situation saying that “the ecologically necessary is politically infeasible but what is politically feasible is ecologically irrelevant” (pers. comm). Thus, as mentioned, the current pursuit of Green Growth by the EU but also by the OECD and UNEP can be understood as an attempt to reconcile the incommensurable [66–68]—a political approach which can succeed in conference resolutions and conventions but is bound to fail already in the medium term when the real-world implementation does not allow for the vagueness of paper work anymore [69]. Some of the erratic and inconsistent policy making can be plausibly explained by this constellation.

In a similar fashion, when the Great Recession hit the world’s economies in 2008, neoclassical economists—after an initial shock period as the crisis hit them unprepared—modified their stance, endorsing selected elements of the long-condemned Keynesianism but embedding it into their own world view. While reactivating the policy instrument of deficit spending, countercyclical policies were not on the table, let alone the improvement of purchasing power by increasing salaries, both core elements of Keynesian policies. Instead the Keynesian theory was declared to be a valid receipt in times of crisis, justifying the use of heterodox instruments while declaring the own, just failed approach as being the right one for ‘normal times.’ That following their prescriptions in such normal times had led to the disaster was fiercely denied, saving the world view from critical reflection.

4.4. Conclusions

World views do not manifest themselves as sets of axioms or deep analyses but as the stories which are the means by which we navigate the world. They allow us to interpret its complex and contradictory signals. We all hold a world view and we all possess a narrative instinct: an innate disposition to listen for an account of who we are and where we stand. When we encounter a complex issue and try to understand it, what we look for instantaneously is not consistent and reliable facts but a consistent and comprehensible story. When we ask ourselves whether something “makes sense,” the “sense” we seek is not primarily rationality, as scientists and philosophers perceive it but narrative fidelity. Does what we are hearing reflect the way we expect humans and the world to behave? Does it fit together? Does it progress as stories should progress? A string of facts, however well attested, will not correct or dislodge a powerful story and the world view it represents. The response it is likely to provoke is indignation: people often angrily deny facts that clash with the narrative “truth” established in their minds (they reject the epistemology to protect their ontology). The only thing that can displace a story is a story—a world view which is not able to present a comprehensive story is on the losing side of societal battles for influence.

Thus, as their core worldview shapes how they frame their arguments, people chose one scenario not for its outcomes but for the world view it represents and the story told about it. While not being a proof, we have presented a number of analyses of the archetypical scenarios which make it more than plausible that switching the decision basis from one to another world view requires a change against deeply held beliefs and established and time-tested routines, habits and practices—an almost

impossible step as long as the world view held does not clash with reality (as is the situation today) and a difficult one even then. This is probably a suitable explanation for the failure of so many sustainability scenarios ever since the “Limits to Growth” to motivate the policy changes the recommended. If even the Great Recession was not a shock significant enough to enforce rethinking (austerity policies were reactivated soon after the first symptoms of crisis began to recede), it is hard to imagine what could cause the shift to a different world view, except a change of leadership to people holding different world views from the outset. Populists have proven that this is possible but so far ‘sustainability’ have not achieved similar results—not least as they fail telling a story which has the flavour of being both desirable and realistic (i.e., not ignoring the downsides of a sustainability transition). Scenarios as a combination of narratives and modelling can be a means of developing such stories but have not been exploited to that end sufficiently to make a difference so far. However, while scenarios will most probably not have the power to initiate a real change of course by the incumbents (as they will interpret any new facts in the context of the world views they hold) they may stimulate reflections by the agnostic and empower those critical of the state of policies and searching for better solutions.

As far as a GREEN GRAS scenario is a contradiction in terms (as it is according to the author’s world view), unearthing the hidden world views behind different policies and exposing them to the scrutiny of public discourses in the glare facts and figures may be the only chance to enable the public at large to rethink its acceptance of policies not in line with their own world view and support alternative positions differing from the GRAS thinking in more than individual strategies and policy instruments. However, this requires that scientists as well make their world views and the assumptions derived from them explicit, to permit the public to identify those sources of information they consider trustworthy. Telling good stories about scientific findings, beyond the scientific publications, is an art most scientists do not command but which should be part of the curriculum in all disciplines, as step to truly public science for the common good.

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