Society, Science, Sustainability. A reflexive S^3 challenge

Towards a science for sustainability.
A European perspective

Presentation at the CSIC workshop
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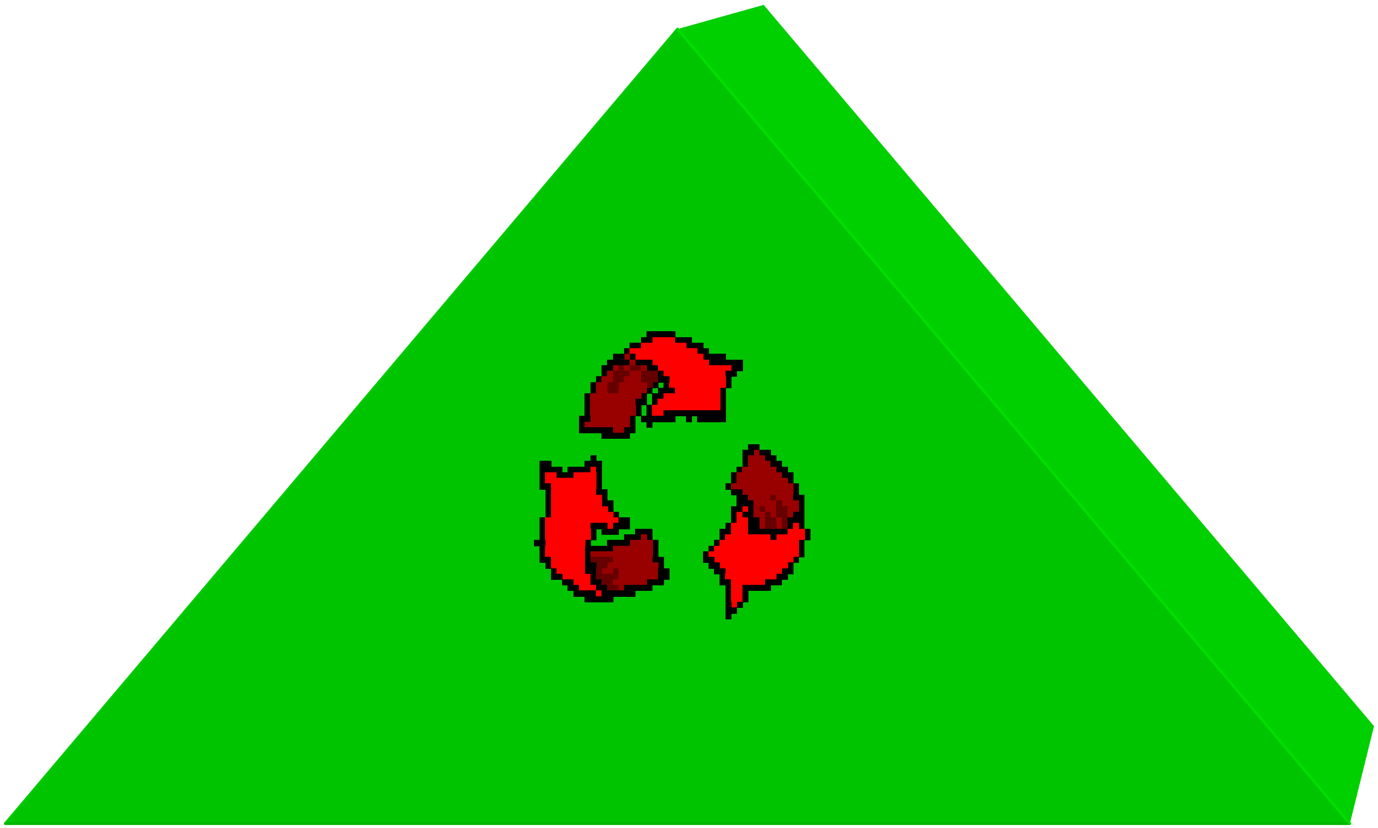
A permanent interaction…

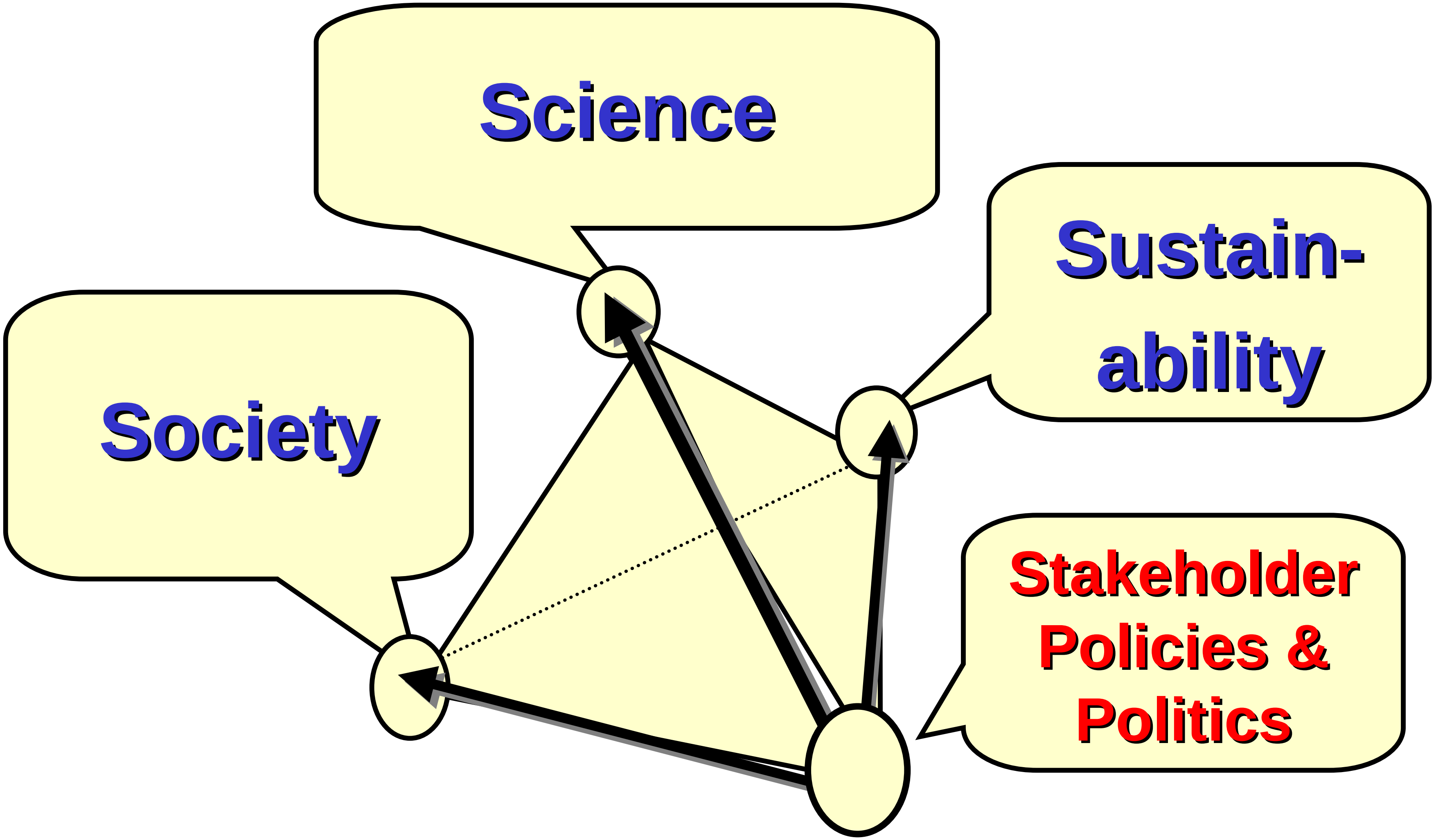
Science



Society

Sustainability

…influenced by stakeholders



I. Society - Sustainability

A policy challenge

The Origin

- **The origin of the concept is a economic crisis in 18th century Saxony.**
- **Earlier roots include a fiscal and institutional crisis in France, and a military security crisis in Britain.**
- **It is no „good weather concept“, rather a rescue force for failing economics.**
- **That’s why we need it today.**

Basic ideas

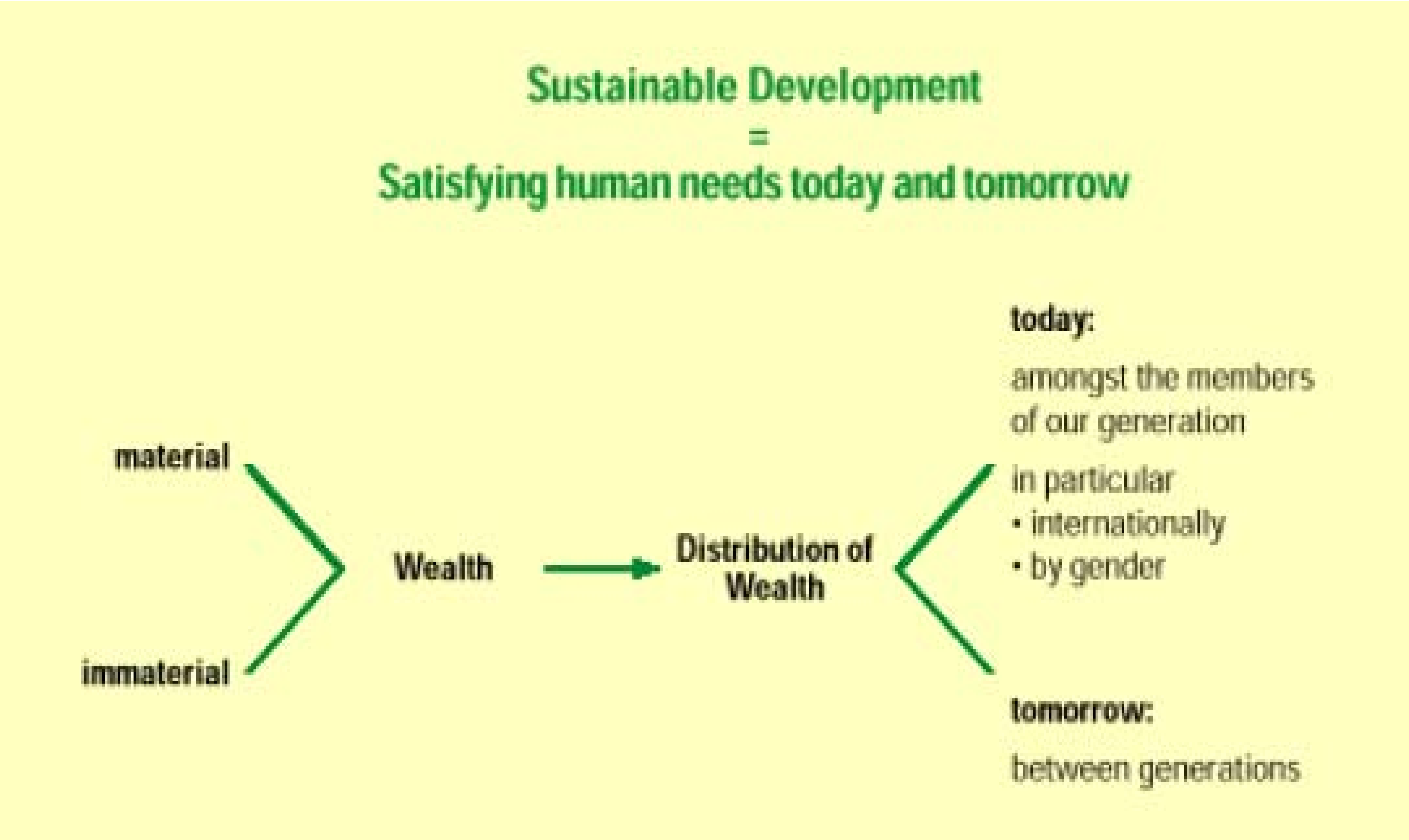
Since a quarter millennium, *Sustainability* offers an alternative to the one dimensional economic thinking (mercantilist, capitalist). These

- **Consider every good as scarce**
- **Value it due to its contributions to the market economy**
- **Claim that every scarcity is relative, i.e. substitutes exist.**

***Sustainability* was a multi-dimensional concept from the outset. It**

- considers most goods, in particular environmental and social ones, as plentiful.
- insits that many of them cannot be substi-tuted regarding any particular service, and none can be so for all possible uses.
- Assesses value based on the contribution to human well-being.

Where we start: The concept of “Sustainable Development”



Policy implications

Thus the economic strategy is

- *expansion* (imperial, colonial, economic) to secure access to new resources, plus
- *technology*, finding substitutes.

The sustainability strategy is

- Living within *limits*, including fair sharing and (undiscounted) responsibility, and
- *Knowledge* (scientific, social,…) to support problem solving decision making.

Sustainable development's constitutive elements are:

- ✓ the integration of economic, social, environmental and institutional issues into a coherent framework, safeguarding the essential interests of each dimension,
- ✓ the (re-)introduction of explicit normative targets into the discourse (justice, responsibility).
- ✓ the extension of the perspective to include local and distant regions, past and future generations, monitoring our impacts and accepting responsibility for them.

Policy choices

- ✓ Sustainability was developed as a concept to deal with absolute scarcities without expansion.
- ✓ Today, we are facing such scarcities again (water, peak oil,…).
- ✓ We try to solve them by expansion (globalisation of supply through free markets, military means and environmental neglect).
- ✓ We develop ways to live with what we have, and share it (inter-, intragenerational justice).

The challenge

Irreducible uncertainties (unpredictability of complex systems, real yet non quantifiable risks to health, environmental damage, loss of economic opportunity);

- A plurality of social values and hence divergent concerns and justification criteria; and
- High decision stakes (incl. commercial and military interests, risks of social disruption, severe irrever-sible impacts on health of populations and/or life support Systems) and long impact time-horizons.

II. Science - Society

Different society, different science

Neo-liberalism	Authoritianism	Sustainable Development
	Securing resource supply by	
Imperial expansion	intensification of exploitation	responsible management within limits
	This implies a different science, a different technology, also a different knowledge society, and differing policy orientations	
growth of value and profit	growth of output	cohesion
	This is to be archived through policies	
Favouring markets	ignoring markets	modifying markets
	Policy objectives are set	
By the market/business	by the state / party	by society
	Key instruments are / the preferred mode of regulation is	
Market deregulation	state planning	discourse and participation
	In such a system, science is	
Isolated or corrupt	emigrated or opportunistic	public or irrelevant
Technocratic, innovative	technocratic, conservative	discursive, innovative
Product and market oriented	reputation oriented	problem oriented
	Scientists are	
Useful dwarfs	technocratic elites	active citizens
	Values are	
Post modern (anything goes)	dogmatic	undogmatic, ethical, pluralistic

What we have...

...in science – society interaction:

- ✓Five models of relating science and decision making existing in parallel,
- ✓each developed for a specific kind of problems, and a specific per-ception what indeed are problems
- ✓with different assumptions, results, methods, qualifications, participants

Five Models: 1

The initial 'modern' model:

Scientific facts are unproblematic to define, reproducible and employed in rigorous demonstrations.

They are not context dependent and determine correct policy: Truth speaks to power.

Perfection/perfectibility of science in theory and also (progressively) in practice is given.

Five Models: 2

The Precautionary model

Once it is discovered that the scientific facts are neither fully certain in themselves, nor conclusive for policy, progress cannot be assumed to be automatic. Truth/validity of science in general is upheld, but because of ‘imperfection’ in the science, precaution is proposed to both protect and legitimise decisions.

Five models: 3

The Model of Framing

Scientific information is one among many inputs to a policy process. Each stakeholder has his/her own perspective, values and theoretical constructions of reality. There are no simple ‘facts’. An incorrect framing of problems is a misuse of the scientific investigation, although the choice is always arbitrary. This can lead towards ‘post-modern’ and ‘relativist’ positions.

Five models: 4

The Model of Science/Policy Demarcation

Science practitioners and research funders have specific, at least partly diverging interests and values.

Science will be abused in the policy process. A clear demarcation between those providing the science, and those using it, is advocated, although very difficult while still carrying out ‘policy relevant’ economic analysis.

Five models: 5

The Model of Extended Participation

'Science' (the activity of specialised 'technical experts') is only one part of the 'relevant knowledge' that is (or may be) brought in as evidence to a decision or policy process. Decisions are informed through knowledge producer-user networks, with shifting roles of participants. A plurality of co-ordinated legitimate perspectives (each with their own value-commitments, world views and framings) is accepted.

Choosing a model

The choice of models must not be a competition of scientific schools, but be based on identifying the most appropriate model for the problem under investigation. Taking the wrong choice is a scientific (category) error, as a complexity deficit can mask uncertainties and responsibilities. This is why the choice includes also a political conflict; furthermore, each model may serve specific partisan interests best.

III. Science - Sustainability

Sustainable Development

Sustainable development

- Is a phenomenon of synchronising complex systems
- Must focus on the interlinkages of dimensions
- Deals with non-linear effects, beyond cause-effect logic
- Regards long term and long distance problems
- Depends on non-scientific pre-analytical visions

Â is inherently dealing with uncertainty of data, analyses, and in particular projections and prognosis.

What we need

Sustainable Europe Research Institute

Sustainability policies are a means of a comprehensive **transition management**

- They need a solid **knowledge base** for success,
- with a sufficient level of **complexity** for the co-evolution problems dealt with.
- This requires a **paradigm shift** of stakeholders,
- and an adequate contribution of science and technology (RTD).

Choosing the right tools is not necessa-rily easy, but essential

Sustainability causes problems…

…for the current scientific patterns of:

- Specialisation and fragmentation of science,
- Reducing uncertainty by making valid statements only for narrowly defined slots in time and space,
- Claiming a value free stance as a precondition for a neutral position as the basis for the validity of scientific input and as justification of a superior quality of judgement.

This represents a challenge…

…for the everyday conduct of science, research and technology development. It challenges:

- the freedom of choosing fields of work in curiosity-driven science (although few, if any researchers these days are independent of donors' demands),
- the freedom to chose a style of communication only few can understand (which may be a positional good),
- the freedom to restrict the analysis to slots of specific interest, and to tools and models one prefers, and
- the privilege not to be assessed by anybody else than by members of the same community.

Science for Sustainability

Sustainability is a normative objective

Sustainability politics is a societal process

Science for sustainability is a contribution to this process, embodied in it. It answers questions of society, gives hints about the consequences of proposals under discussion, warns against ignored risks.

Science for sustainability takes no decisions, but urges for them and provides the information for better decisions.

To be effective,…

…research underpinning a transition towards sustainability has to emphasise

- Relevant problems, based on relevance criteria of stakeholder, decision makers and the society at large,
- Transparent procedures, as the basis of confidence building not only within the scientific communities, but with all stakeholder and interested citizens,
- Adequate results, applicable in social reality and acceptable, respecting the complexity of society, its mechanisms and diverse legitimate interests.

Integration

As sustainability emphasises integration, sustainability science must integrate

- Scales (local, regional, national, EU, global) but avoid not seeing the forest for the trees;
- Functions (research, recommendations, evaluation, monitoring,…)
- Disciplines (including natural, social and cultural sciences);
- Stakeholders / actors (administration, politics, business, unions, NGOs, consumer groups, citizens' associations,…)

Integrating scales

- Policies on different levels are not independent.
- Sustainability policy is a second order problem.
- (1st order is plan by competent actors → implementation → enforcement → control).
- 2nd order decision making necessitates phases of discursive opening-up and scientific closing-down.
- Discourses and narratives can bridge the mirco-macro gap, but need rigorous analysis.
- Discursive scenario development is one way to do so (see example below)

Spatial delimitation of perspectives

Delimitation requires a global view, but also the inclusion of local & regional processes, today and tomorrow (and with responsibility for yesterday)

Integrating functions

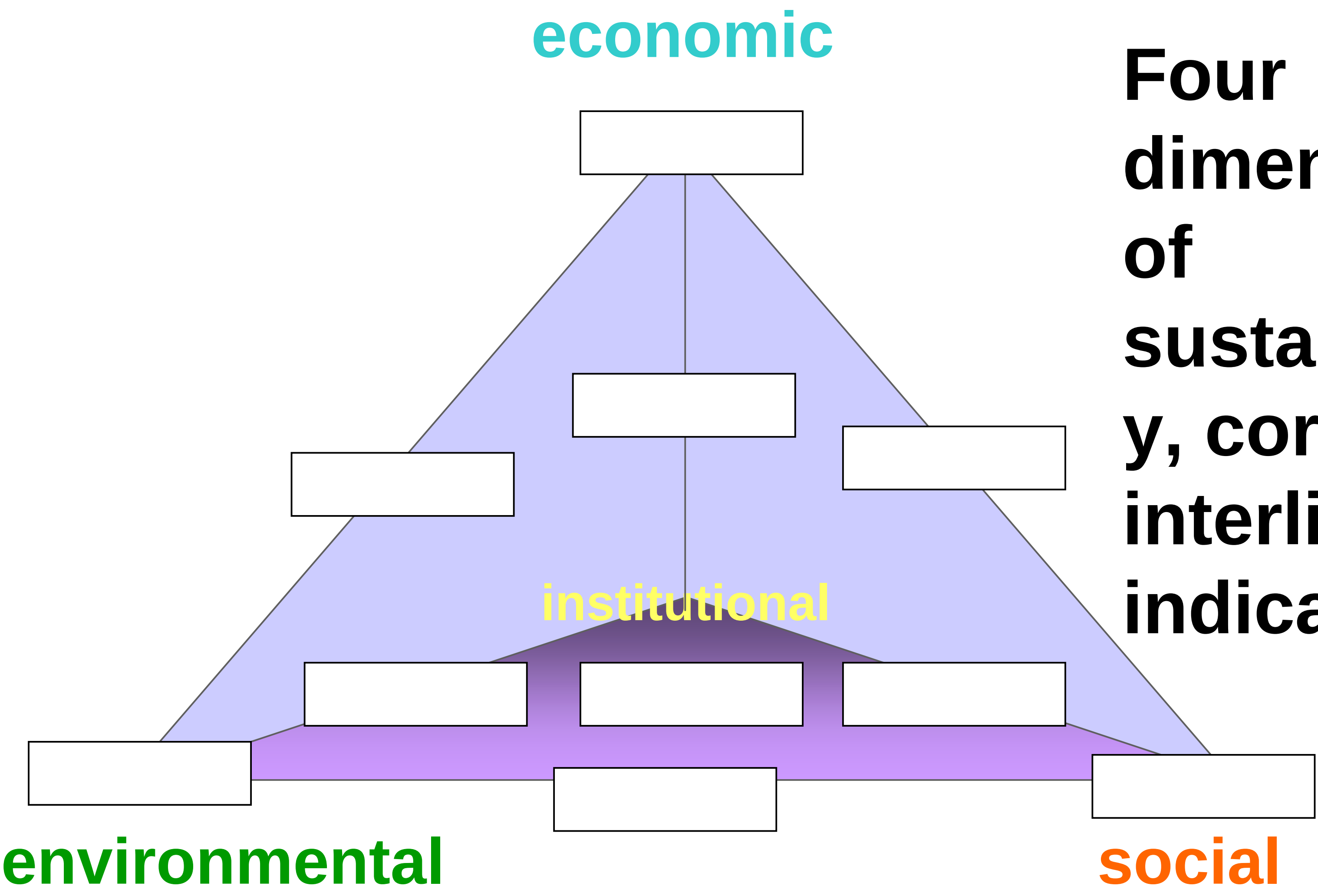
If science is not to be l'art pour l'art, it must be applicable.

Analysis, evaluation and monitoring should be coherent, based on common standards but specified according to needs.

Sustainability Indicator Systems are a frequently used means for this purpose.

Aggregate indices and monetisation do not do the job.

Integrating functions



Four dimensions of sustainability, core and interlinkage indicators

Integrating disciplines

Integrating disciplines is more than multi-disciplinarity with several disciplines working in parallel. It calls for **Interdisciplinarity**

- Multi-dimensional problems can neither be understood nor be solved by one discipline. Sustainability science is necessarily interdisciplinary.
- This requires the definition of joint research questions, collaboration in the process, modifications of methodologies and a shared interpretation of the results.

Interdisciplinarity

To make it work, we have suggested the

Basic Law of Interdisciplinarity

"No discipline must base its work on assumptions which are in contradiction to the established body of knowledge of another discipline competent for the issue concerned."

The broad knowledge base

Scientific knowledge

- Biology, biodiversity research, ecosystem analysis
- Chemistry, toxicity analysis, atmospbheric chemistry
- Ecological economics, economy-environment interaction
- Environmental sciences, cause-effect networks
- Evolutionary economics, sustainable economic structures
- Physics and meteorology
- Political sciences, institutional analysis, governance
- Psychology, individual preferences and behaviour change
- Socio-economics, driving forces and incentive structures
- Sociology, attitudes, behavioural patterns

Recognising emergent properties

– for our opinion, elephant is some abstraction
Realy are only four parts...

Transdisciplinarity: integrating actors

Interdisciplinary research provides insights. To become knowledge and understanding offering solutions, the context and the relevance of individual aspects must be evaluated.

This is not scientific decision, but a societal one.

Consequently, the scientific definition of peers must be extended (“Larger Peer Community”): the experts to be involved are from all stakeholder groups involved in the issue. Their knowledge is as relevant as the scientific, although different.

Non-scientific knowledge

- Trade unions, works councils, labour representatives
- Churches and religious groups, philosophers
- Environmental NGOs, nature & wildlife protection groups
- Development NGOs and institutions, solidarity movements
- Social organisations, health, homeless and poverty care
- Business representatives of different levels
- Media people, journalists, news makers
- Administrators, from local to EU level, all policy sectors
- Politicians of different parties, sustainability committed
- Women and feminist organisations

Science for Sustainability or Sustainability Science

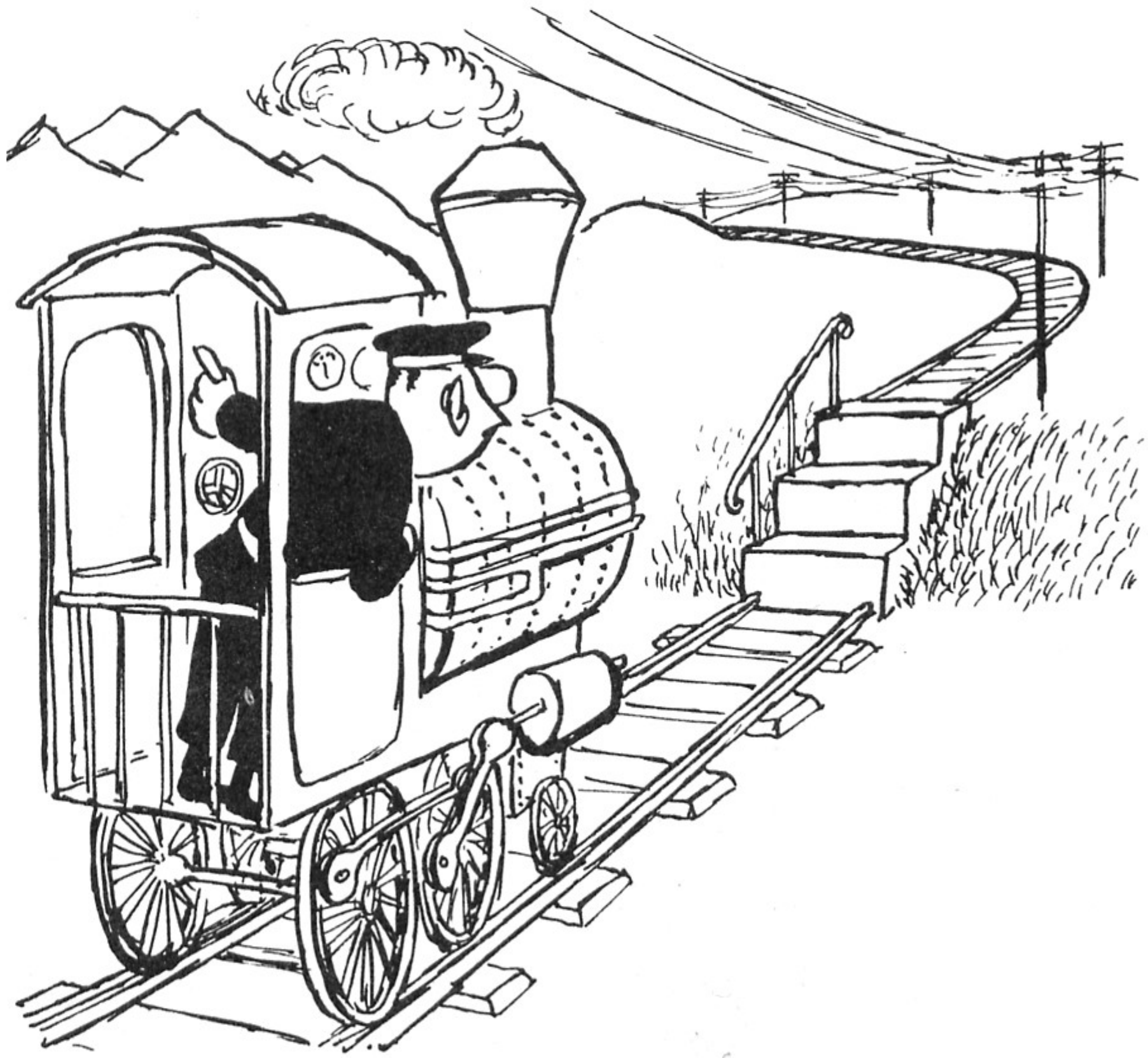
- analyses problems within their context, in complex evolving systems with non-linear behaviour, thus dealing with reflexivity, indeterminism and uncertainty, the impossibility to know.
- uses transdisciplinary joint problem definitions and produces complementary answers by involving non-scientific knowledge and broadening the peer community to involve all relevant stakeholders.

Sustainability Science (cont.)

Sustainability science is *post-normal science,*

- advocating system management through negative feedback loops and dynamic framework conditions, permanent adjustment and mutual learning.
- It cannot generate predictability and optimal solutions, how much ever decision makers may request them.
- In this sense, is better science since it carefully chooses the instruments to be suitable for the system being analysed.

Open questions remain



An illustration

Sustainable development scenarios

An exercise in applied sustainability science

What are Scenarios?

- Scenarios are comprehensive stories (narratives, storylines), describing possible/plausible future developments.
- They can be purely qualitative narratives, or some elements can be quantified.
- Computer modelling serves to illustrate a selected set of quantifiable parameters. Its results must be interpreted against the backdrop of the narratives, including the non-modelled elements.

When to Use Scenarios?

- In a static world, everything is fixed and thus reliably predictable. In cases of predictability, no scenarios are needed.
- In a dynamic world, the suitability of analytical tools depends on the kind of dynamics. In some cases, scenarios may be useful, in others they are either unnecessary or not appropriate.

Which Dynamics?

- In deterministic systems, no uncertainty exists, prediction and detailed impact assessment are possible.
- In stochastic/dynamic systems, there is not uncertainty but risk. The results are probabilistic, and thus probabilistic prediction and impact assessment are possible.
- In chaotic/unstructured systems, absolute uncertainty prevails. There is no predictability beyond the "rules of chaos", but also little scope for scenarios as plausible narratives.

In between...

… are evolving systems, characterised by the

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and the

- fgvgto kpkuvke"rtqeguu'qh'ugngevkqp.

The latter results in directed but non-teleological development, however with irreducible uncertainty caused by the former.

The result is a path dependent development with unpredictable results due to bifurcations.

Which Bifurcations?

Bifurcations will can and will be influenced by

- The interaction with other systems, changing the selection criteria and thus the direction of development (Co-evolution)
- Deliberate interventions by self-conscious and reflexive system elements, i.e. by stakeholders, individually or collectively.
- The system elements are influenced by the system, but in turn also influence the system functioning in (multi-level governance).

Dealing With Evolving Systems

- Their development is not predictable, even if system structures and starting conditions are known.
- The development trajectory can flip from one attractors basin to another, with varying probabilities.
- All developments are non-equilibrium processes, structures often dissipative patterns.
- They are not chaotic, but follow trends which are the more predictable the short run.

Influences

- These trends (and thus the probability of flips) can be changed by external influences (gradually, including non-linearities caused by thresholds and delays, or suddenly by shocks), and by internal structural change (gradually or suddenly), and by interventions resulting from reflections about the future internal development.
- **Nature, population, society and the economy are such co-evolving systems.**

Analysing Futures

- Evolving system have not one predetermined future, but a wealth of possible futures. Each of these futures is a comprehensive narrative; they can be sketched out by informed reasoning without being able to quantify their probability (for the case of gradual change).
- Negative outcomes give reasons for intervention altering the framework gradually.
- However, decision making and enforcement by one key actors following one well-specified rationality (1st order governance), fails due to the uncertainties incurred

- For shocks, unexpected mid-way changes of course must be foreseen. Although their probability cannot be quantified either, scenarios can help to derive interventions which reduce this unknown probability.
- In both cases, reflexive actors try to direct the system towards a more desired attractor basin.
- To be effective, such a process must take diverse rationalities into account (2nd order governance), basing interventions of discourses.

Scenarios Revisited

- Scenarios are tools to sketch out these possible futures, both by means of "linear scenarios" (incremental change including feedback loops), and shock scenarios, including the reaction to sudden changes of the selection criteria and process.
- They are no predictions, but improve the knowledge base for policy deliberations.
- 2nd order problems need 2nd order governance, i.e. participatory approaches in scenario development.b

The Process

Step 1: Opening Up

- Collect information by desktop research and discourses top identify the known sustainability problems (ALARM: pressures on biodiversity).
- By the same means, identify the pressure mechanisms leading to the problems, with special emphasis on their interaction.
- Identify the underlying orientations on which the policies are based (ideologies, habits, routines,…) by literature reviews and stakeholder dialogues.

Step 2: Closing Down

- Develop storylines characterising the relevant policy patterns (desktop research, scientific analysis).
- Integrate them into coherent narratives for possible futures, across a broad set of policies.
- Link them to existing (climate and land use) scenarios: which CAP, REACH, transport, trade, market, energy, etc. scenarios fit to each other?
- Add the relevant social and labour market policies, integrate them with a view on the feedback loops.
- Identify relevant institutions and the relevant processes of institutional change.

Step 3: Opening Up Again

- Having developed draft scenarios, cross-check them with experts from all relevant disciplines to make sure the factual information included is robust.
- Present the scenarios for assessment and modification to stakeholders (EU level: representatives) as experts for coherence and relevance.
- Discuss the refined scenarios with decision makers regarding their plausibility.

Good bye

Thank you for your attention.

- For further information and
- to download publications

you are invited to visit the
Sustainable Europe Research Institute at:

www.seri.de

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Annex: EU Research & Sustainability

What we get

European Research (6th and 7th FP) provides

- Increasing funding for research (RTD),
- More freedom in project management (change partners en passant),
- Extended perspectives (five years project duration),
- Large teams (>50) combining all available experience,
- Global partnerships with EU funds

It frustrates by a lack of integration within and between ERA member countries and with the EU, partly due to the purpose allocated to RTD, to enhance the competitiveness (against whom?)

It ain't easy…

Difficulties arise from

- disciplinary claims for primacy in defining sustainability research (specific framings) are reflected in calls to tender,
- a capability deficit in transdisciplinary research in most, if not all, scientific communities makes integrated research an ambitious task,
- bureaucratic burdens, a preference for large institutes, multi-million € projects and teams of hundreds of scientists,
- the focus on product development and the need to have participating SMEs.

The resulting EU-RTD deficits

- **Technology fix:** technological solutions for all problems,
- **Product fix:** product development without sustainability assessment of the results, if only marketable,
- **Deficits in strategy and concepts development:** calls for strategy development go from the assumption that the administration knows WHAT to do, whereas science could deliver the methodology HOW to do it, and a proper reasoning WHY it should be done (the useful dwarf's role):
- **Significant deficits in the impact of RTD:** it is best used if products are developed by producers, or concepts are confirming plans anyway pursued.

Effective impact needs

- ✓ **Confidence:** Mutual trust of the actors involved is built and strengthened by transparency, openness of motives and actions, accountability, inclusiveness, dialogue and communication.
- ✓ **Competence:** The perception of competence emerges from the experience of actual relevance, appropriateness and reliability of the information and knowledge provided. It requires recognition of the equal importance of different groups of knowledge providers.
- ✓ **Capability:** Knowledge delivered must be recognised as not only factually, but also politically relevant. This requires the capability to modify the information on offer according to the specific situations and target audiences.

10 steps EU-RTD projects usually include

8 steps in preparing and conducting research

1. Extended discourses, **searching** themes and funds, creating networks of competent partners
2. **Defining** desirable scientific innovation/activities /results
3. Reviewing information to build the **knowledge base**
4. Allocating **responsibilities** according to perceived competences
5. **Harmonisation** of the approach chosen,
6. **Planning** research activities and subsequent information dissemination, putting together a competent team,

The resulting EU-RTD deficits

7. **Research process**, producing information /data
8. Involving **peers, stakeholders** in advisory boards etc.

Ex post: step 9 and 10 in business as usual

9. Giving meaning to the data generated by **interpretation and contextualisation**
10. **Dissemination** of research

- regarding methodology: to the peers,
- regarding data: to the scientific community,
- regarding interpreted data: to stakeholders and public

This is not bad, but there is obvious room for improvement

Bridging the gap

- **Product fix:** Appropriate choice of models and methodologies in all disciplines, even if this questions earlier successes and the discipline's status,
- **By defining clear sustainability objectives and tasks:** a political initiative is necessary,
- **Developing learning research funding programs:** for instance, by formulating not impact-relevant efforts, but an impact hypothesis, making every project an experiment in impact potential analysis and helping to focus the research community on promising strategies.
- **Fortunately,** some steps have been taken, and more could be done in FP 7 if sustainability is taken seriously.