

# Paths to Sustainable Energy Systems

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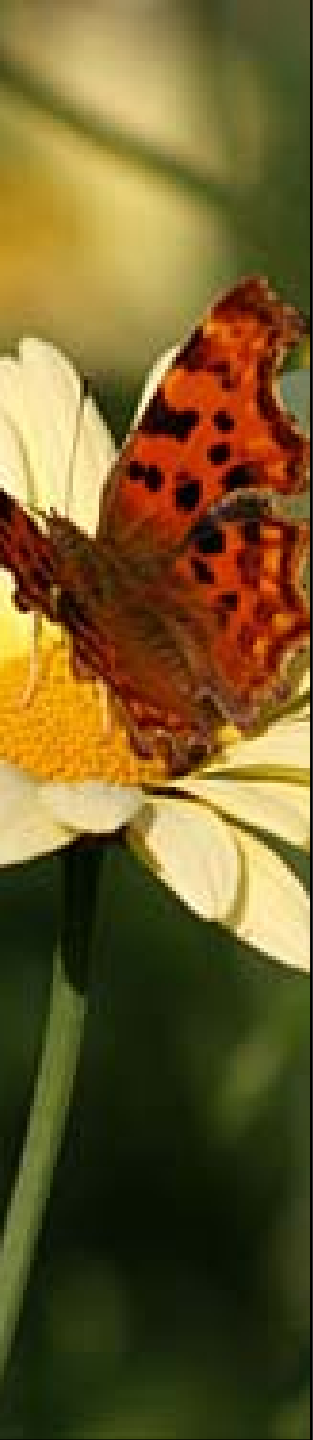
*Innovation Systems,*

*Complex Systems and Sustainable Development*

30-31 March 2009, Bolzano-Bozen

# Overview


- Challenges of governing complex adaptive systems
- Appraising the sustainability of futures
- 6 hybrid methods
- 3 energy case studies





# 'Non-equilibrium', 'complex systems' approaches

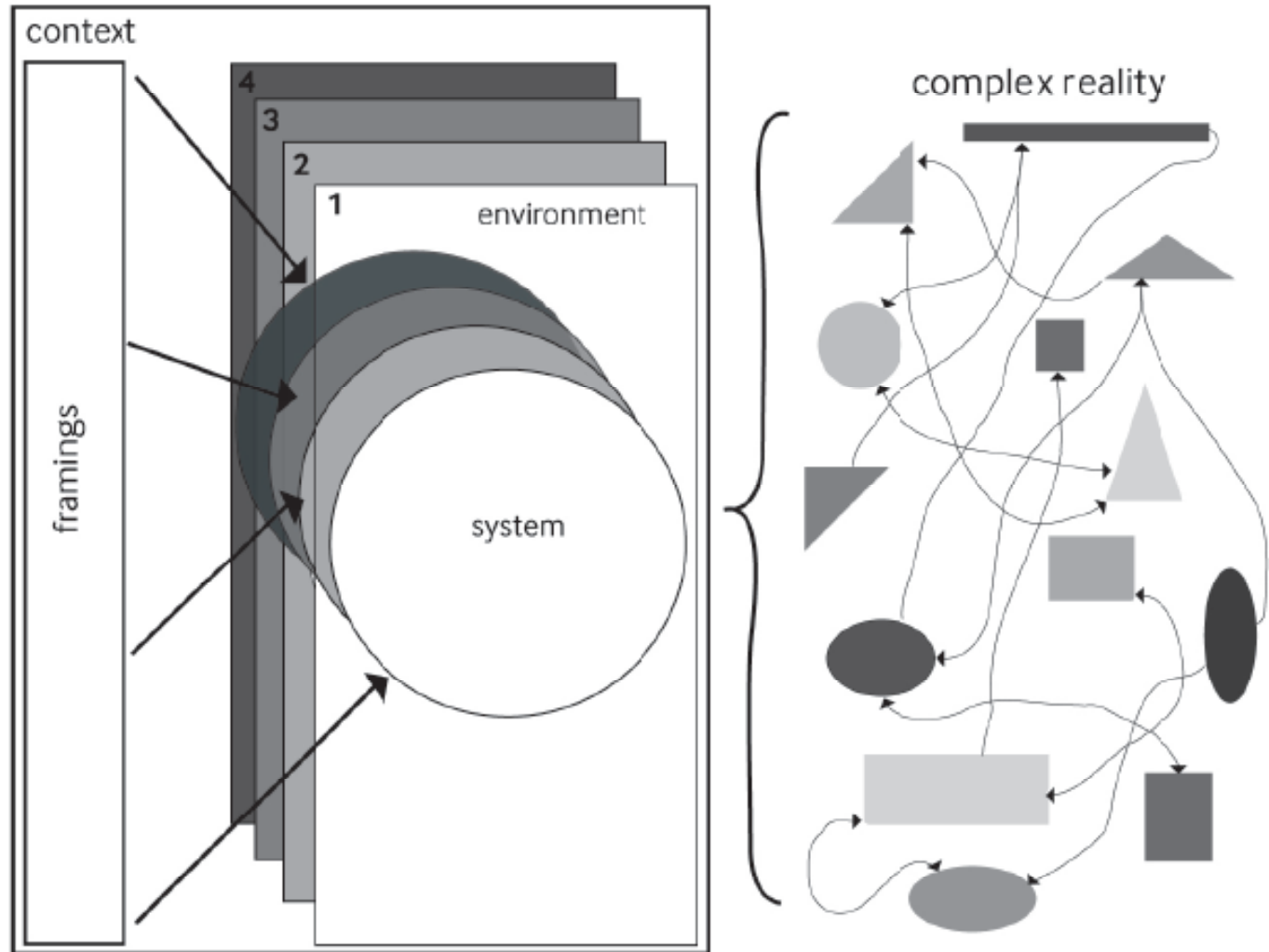
- **Key features:** Non-linearity, complexity, heterogeneity, uncertainty, ambiguity, ignorance, surprise
- **System organisation:** Multiple scales, interaction, integration
- **Models and methods:** Open experimentation, interactive modelling, trial and error, non-standard distributions and statistics, open-ended appraisal
- **Management implications:** Adaptive, responsive, context- and scale-dependent
- **Intervention principles:** Adaptive management and learning



“Complexity theory has shifted the perspective of many economists toward thinking that what was viewed as anomalous and unusual may actually be the usual and expected ...”

*(Rosser, JB 1999 ‘On the Complexities of Complex Economic Dynamics’, JEP)*

# An analytical heuristic of a complex system



# The neoclassical perspective

- Individualist: Decisions based on individual preferences → instrumental / strategic action
- The basic assumptions:
  - Rationality: Maximizing individual utility → one-dimensionality
  - Stable preferences
  - Unlimited calculative capacity

# The institutional economics perspective

- Both individual and social rationality – 'I' and 'We'
- Basic assumptions:
  - Which rationality pertains depends on institutional context
  - Uses also the concept of social rationality; reciprocity and norms; communication and cooperation (→ both self- and other-regarding logics).
  - Preferences are socially influenced – culture
  - Understanding is largely social – language and 'models'
  - People are boundedly rational – capacity constraints

# Challenges for environmental valuation

- **Social incommensurability** - derived from the concepts of reflexive complexity and post-normal science; refers to the existence of a multiplicity of legitimate perspectives in society.
- **Technical incommensurability** - evolving complex systems, multidimensional nature of complexity; uncertainty, ambiguity and ignorance; refers to the issue of representation of multiple identities in descriptive models.

*Munda, G. (2004) "Social multi-criteria evaluation: Methodological foundations & operational consequences." EJOR 158(3):662-77.*

# Weak comparability of values as foundation for ecol econ

- **Strong comparability** - single comparative term by which all actions can be ranked; implying strong or weak commensurability.
  - Strong commensurability – a common measure of consequence exists; cardinal comparison.
  - Weak commensurability – a common measure of consequence exists; ordinal comparison.
- **Weak comparability** – values irreducibly plural and cannot be uniquely ordered along a single scale; implying incommensurability.

Martinez-Alier J, Munda G, O'Neill J. (1998) Weak comparability of values as a foundation for ecological economics. Ecological Economics, 26(3):277-86



# From environmental valuation to sustainability appraisal

CBA has been criticised for ...

... **using (high) discount rates:**

- if environmental problems cause future consumption to decline then low or even negative discount rates might well be justified (*Dasgupta, Hoel & Sterner 2006*)
- appropriately accounting for uncertainty can radically increase the perceived present value of greenhouse gas emissions control.

*Weitzman, Martin L. 2007. "A Review of the Stern Review on the Economics of Climate Change", Journal of Economic Literature 45(3), pp. 703-724.*



# From environmental valuation to sustainability appraisal

CBA has been criticised for ...

... **lack of robustness**: “both altering the appearance of an interviewer and changing the degree of information provided can have significant impacts upon stated WTP.”

	Casual	Formal
Low	£13.66	£24.47
High	£19.36	£32.29

*Bateman, I. J. and Mawby, J. 2004 'First impressions count: interviewer appearance and information effects in stated preference studies', Ecological Economics 49(1): 47-55.*



# From environmental valuation to sustainability appraisal

CBA has been criticised for ...

... **misplaced concreteness**: "Climate change and biodiversity losses are two phenomena that are probably not amenable to formal, quantitative economics analysis. We economists should not have pressed for what I believe is misplaced concreteness. Certainly we should not do so now."

*Dasgupta, P. forthcoming. Discounting Climate Change, in Review of Environmental Economics and Policy*

# Sustainability appraisal

Multicriteria appraisal allows taking into account -

- a large number of data, relations and objectives; facts and values,
  - multiple criteria, measured on different scales (€, MT, ha, etc.) (requires only weak comparability between actions),
  - data from various scientific disciplines and different value judgements and interests.
- MCA enables us to rank a finite number of alternatives, while considering several, in part conflicting criteria.
- No solution optimising all criteria; compromise solution has to be found.
- Often combined with deliberative processes.





# Institutions and sustainability appraisal

- The valuation and appraisal methods determine -
  - who participates in the decision process;
  - how they participate and in what capacity (consumer, stakeholder, citizen);
  - what counts as data;
  - which data processing and aggregation procedures are used.
- Valuation methods can be seen as ‘value-articulating institutions’ (Jacobs 1997; Vatn 2004).
- The type of valuation and the institutional structures in which the appraisal is embedded influence the outcome.

# Emerging methods of SA

- Deliberative monetary valuation
- Social multicriteria evaluation
- Three-stage multicriteria analysis
- Multicriteria mapping
- Deliberative mapping
- Stakeholder decision / dialogue analysis


# Review Template

- Description
- Framing
- Nature of participation
- Decision context
- Treatment of criteria and values
- Applicability to different types of evidence bases
- Treatment of equity and distributional issues
- Results
- Human and financial resources
- Key studies



# Summary of Review

Name	Criteria come from	Transparency	Public and stakeholder engagement	Focus on opening up	Focus on closing down	Robustness	Uncertainty	Types of outcomes that the approach is good at producing	Indicative costs (in thousands £)	Indicative time (in months)
Deliberative monetary valuation	citizens panel/s and researchers	••	•	•	••••	••	Sensitivity or scenario analysis	Monetary value	40-50	4 – 6
Social multicriteria evaluation	stakeholders and / or research team	•••	••	••	•••	•••	Fuzzy numbers; sensitivity or scenario analysis	Complete or partial ranking	30-50	4 – 8
Three-stage multicriteria analysis	stakeholders	•••	••	••	•••	•••	Sensitivity or scenario analysis	Complete ranking	30-40	4 – 12
Multicriteria mapping	stakeholders and research team	••••	••	•••	••	•••	Optimistic and pessimistic scores; sensitivity or scenario analysis	Map of perspectives and ranking, plus qualitative discourse analysis	20-30	2 – 6
Deliberative mapping	stakeholders and research team	•••	•••	•••	••	•••	Optimistic and pessimistic scores; Sensitivity or scenario analysis	Map of perspectives and ranking, plus qualitative discourse analysis	30-40	4 – 12
Stakeholder decision analysis	stakeholders	••••	•••	•••	••	•••	Qualitative analysis	Complete or partial ranking	20-30	4 – 12



# Methodology of energy case studies

- Scenario development
- Life-cycle analysis
- Multi-criteria appraisal
- Expert interviews
- Stakeholder interviews
- Deliberative processes (citizen or stakeholder workshops)

A vertical photograph of a waterfall with white water cascading over dark rocks, positioned on the left side of the slide.

# Appraising energy futures / 1

- Public Participation on UK National Energy Policy
- Preparation for UK Energy White Paper (2003)
- Deliberative Workshops with citizens from three regions
- August 2002
- Funded by DTI



# Appraising energy futures / 1

Three options for 2020 were explored in groups:

- A – a continuation of current trends
- B – a focus on renewables development and reducing energy use
- C – a focus on UK based sources of energy with a focus on reducing energy use

# Appraising energy futures / 2

- Assessment of Renewable Energy Technologies on Multiple Scales (ARTEMIS) - A Participatory Multi-Criteria Approach
- Multi-level environmental governance
- Partners: SERI Vienna; CEPE, ETH Zürich and SPRU, University of Sussex, UK
- June 03 – May 06
- Funded by the Austrian Science Council



# Appraising energy futures / 2

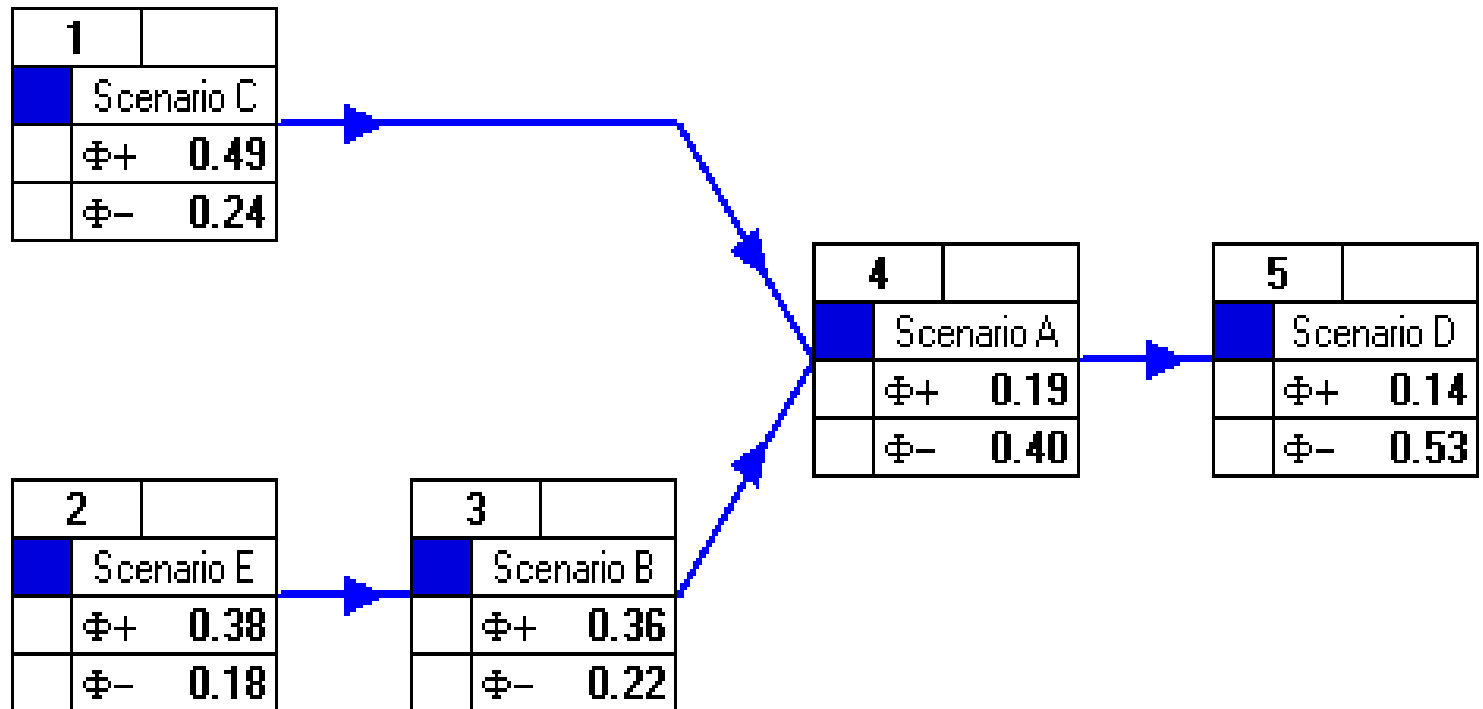
Scenario A: Rapid and familiar

B: Extending competitive advantage

Scenario C: Investing in the future

D: Biomass en gros

Scenario E: Big on small units



# Appraising energy futures / 3

- Appraising regional sustainable energy strategies for South-East England
- Sussex Energy Group
- April 05 – March 07
- Funded by ESRC

Scenario 1: Neotraditional

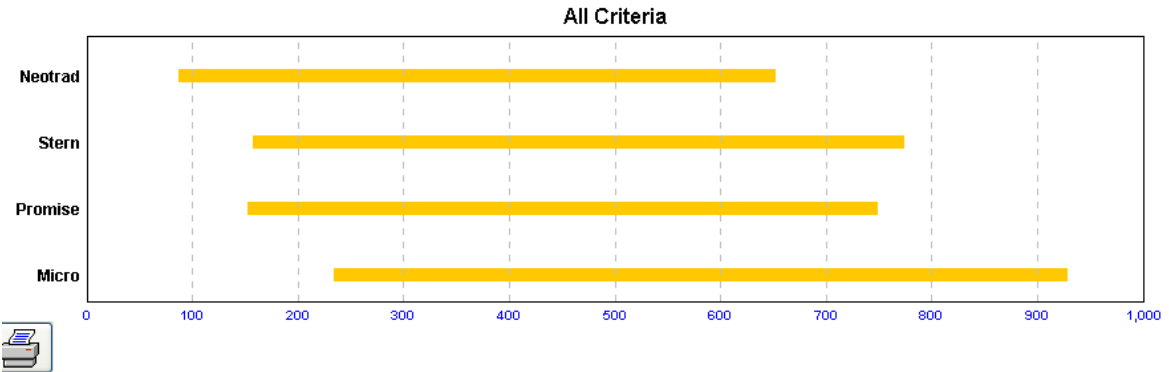
2: Stern Path to Sustainability

Scenario 3: Security of Supply Promise

4: Microtopia

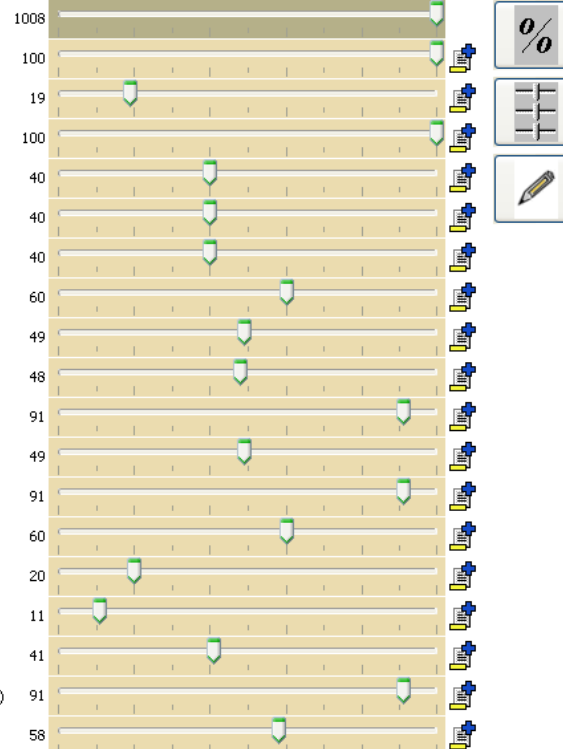
<http://www.sussex.ac.uk/sussexenergygroup/>

# Appraising energy futures / 3

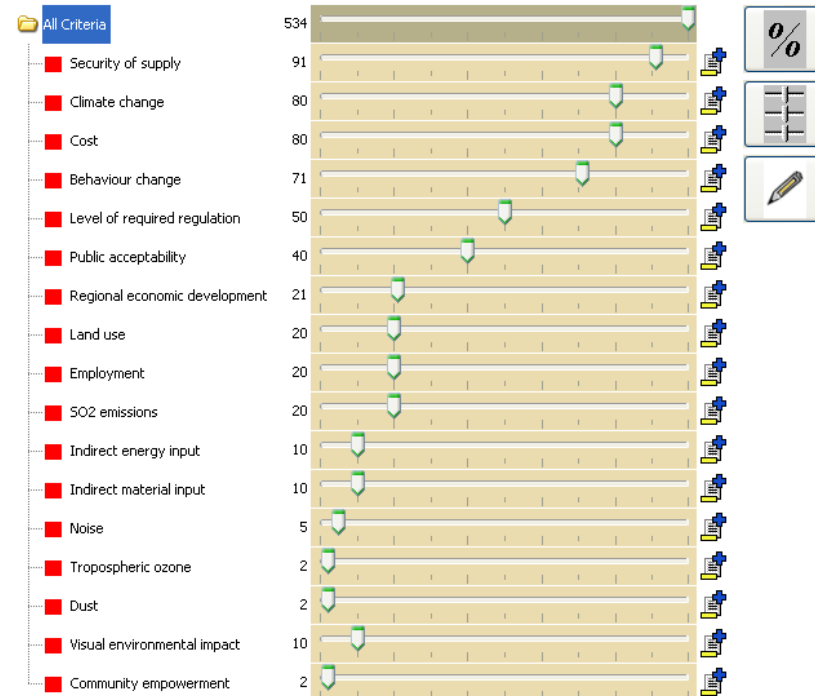
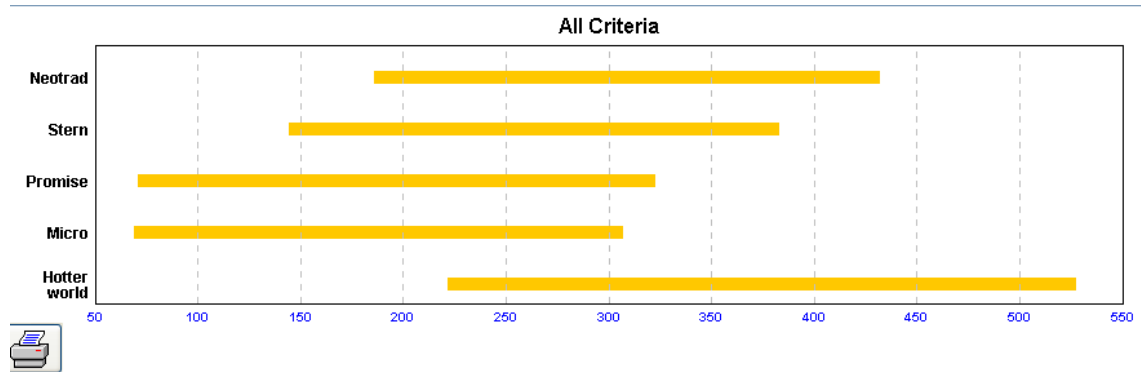


All Criteria

- Climate change
- Financial Cost
- Quality of Life
- Tropospheric ozone
- SO2 emissions
- Noise
- Land use
- Direct & Indirect material input
- Direct & Indirect energy input
- transport impacts
- Dust
- Landscape impact
- Public acceptability
- Regional economic development
- Employment
- Community empowerment
- Directly impacts on behaviour (reduced energy use)
- Material outputs



# Appraising energy futures / 3



# Some thoughts to finish ...

- The new methods will benefit from further testing and development, but they have already been shown to be effective tools of sustainability appraisal and valuation under a range of circumstances.
- No one method is best suited for appraising all types of policies, programmes and projects → a more differentiated approach produces better outcomes.

