Futures Studies Aspects on Sustainability before the Year 2100

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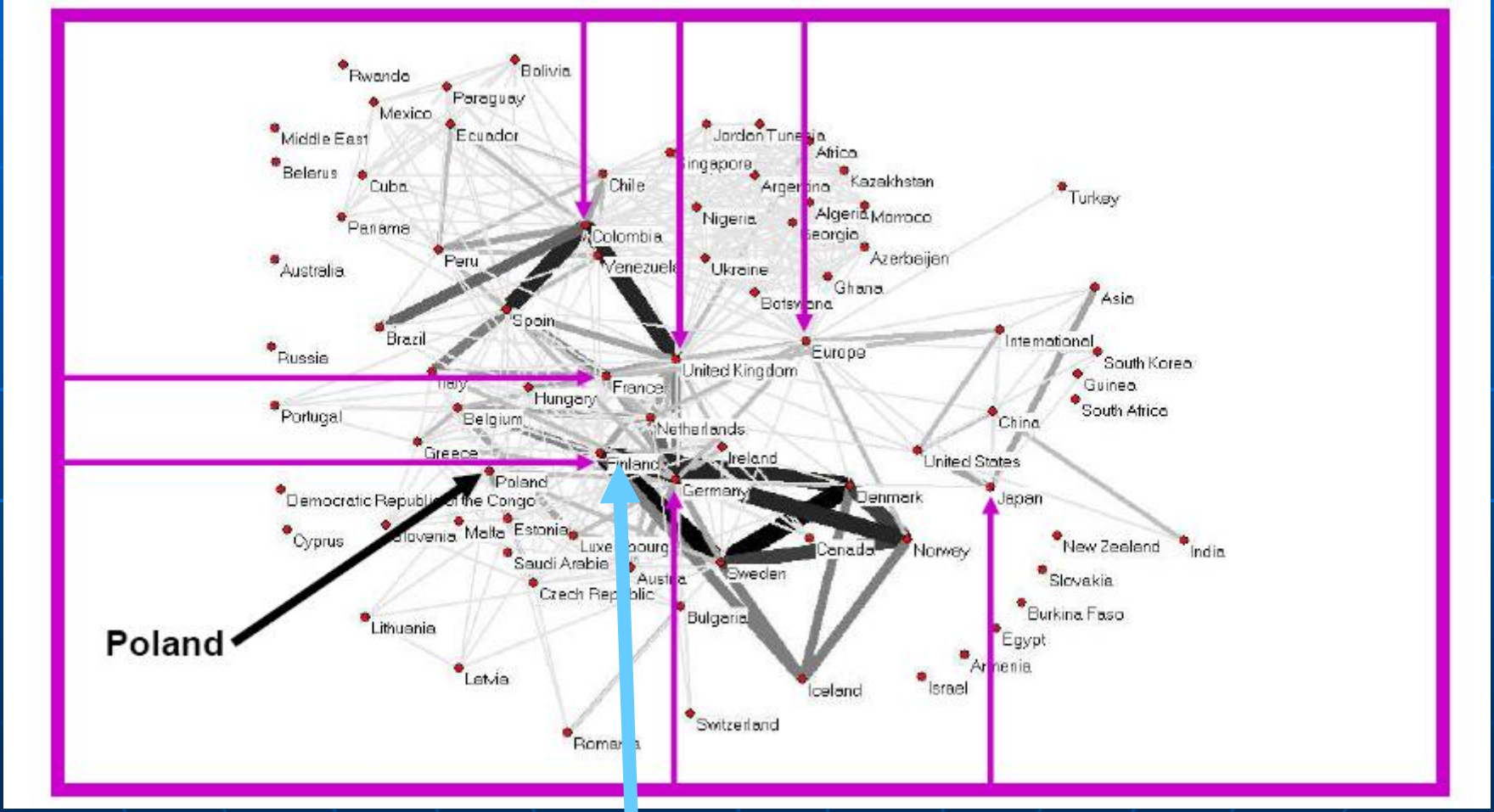
Short Background: Discussion about Sustainability Policy

- From sustainability to survivable development analysis
- The strategic role of eco-innovation policy and STI policy is increasing
- Risk and scenario analyses should be integrated in industial ecology projects/programs
- Weak signals and Wild Cards of sustainability trends require more critical attention
- Emerging professional challenge: Co-operation with the expert communities and the communities of practice in futures making processes
- Network economy and sustainability
- Foresight, change management and action research triangle needs more research activity in the field of IE

Finland in foresight world (Popper 2009)



Sustainability research tradition in the FFRC, TSE, some examples

-Global trend analyses (decomposition methodology) related to global climate change/energy policy (example projects SMILE, DECOIN etc. for the EU)

-Advanced Sustainability Analysis (ASA) Framework

-European Sustainability Strategy Network (http://www.sustainability-strategy.net/)

-Sustainability Scenario Frameworks

-Sustainability Indicator Studies

-Information Age Sustainability Analyses (TERRA 2000, http://www.terra-2000.org/)

-Responsible Business and Business Ethics (Centre for Responsible Business, CEREBIN Web: http://www.tse.fi/FI/yksikot/erillislaitokset/tutu/tutkimus/tutkimusryhmat/cereb/Pages/default.aspx

-Mekong River RG Sustainable Energy in the Mekong River: http://www.mekong.fi/

-Sustainable Development Wild Cards and Science, Technology and Innovation Policy of the European Union (iKnow project), years 2009-2011

-Eco-Innovation Observatory (EIO) project starting in 2010

-IFs/ASA scenario model analyses with Prof. Barry Hughes/University of Denver

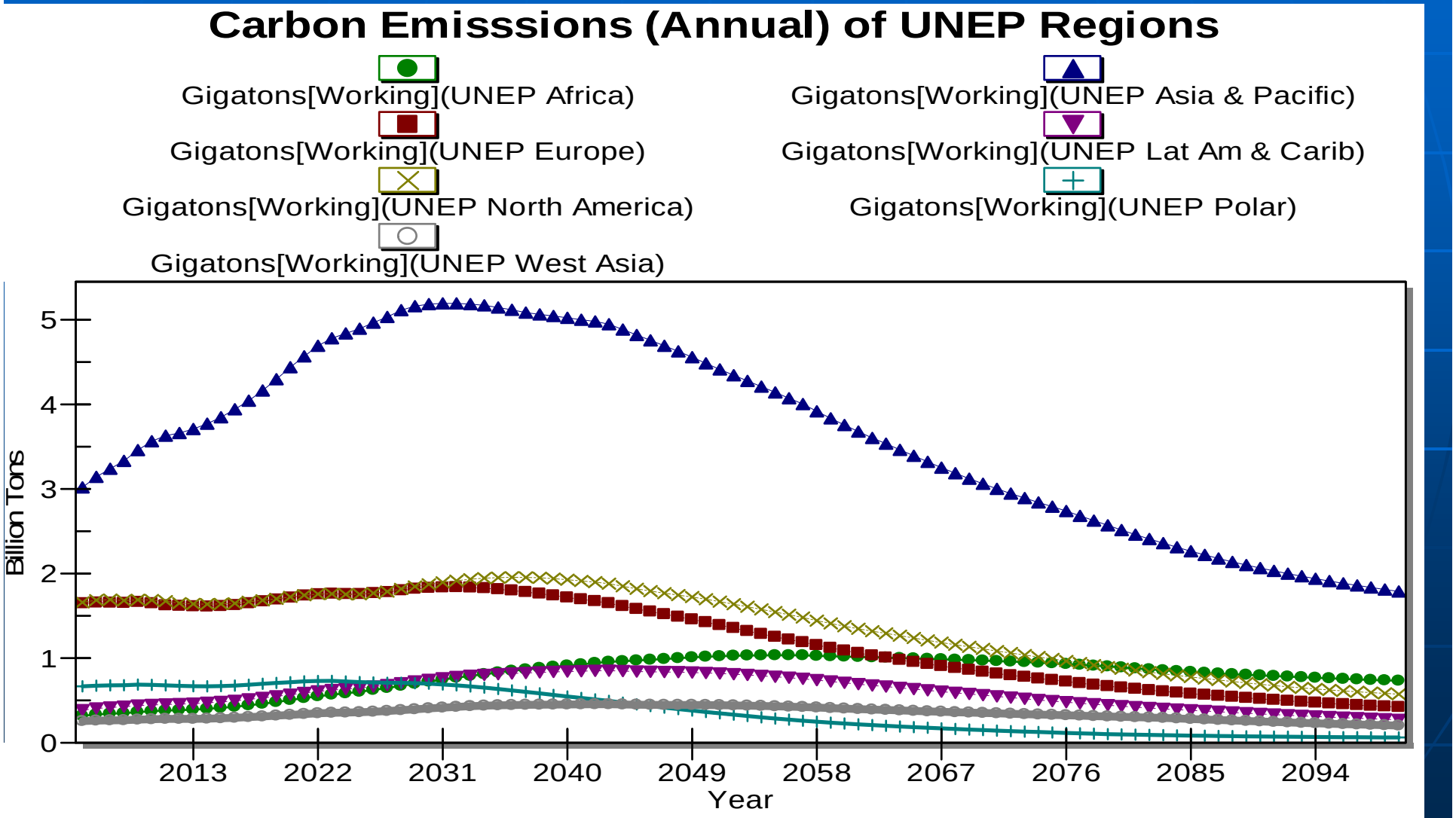
Next examples

- Next futures analyses are examples, which are are based on the IFs model developed by Prof. Barry Hughes and his research team
- This kind of scenario analyses are performed in European Consumer Preferences 2030: Consequences for Science and Policy (EU project in the years2010-2011)

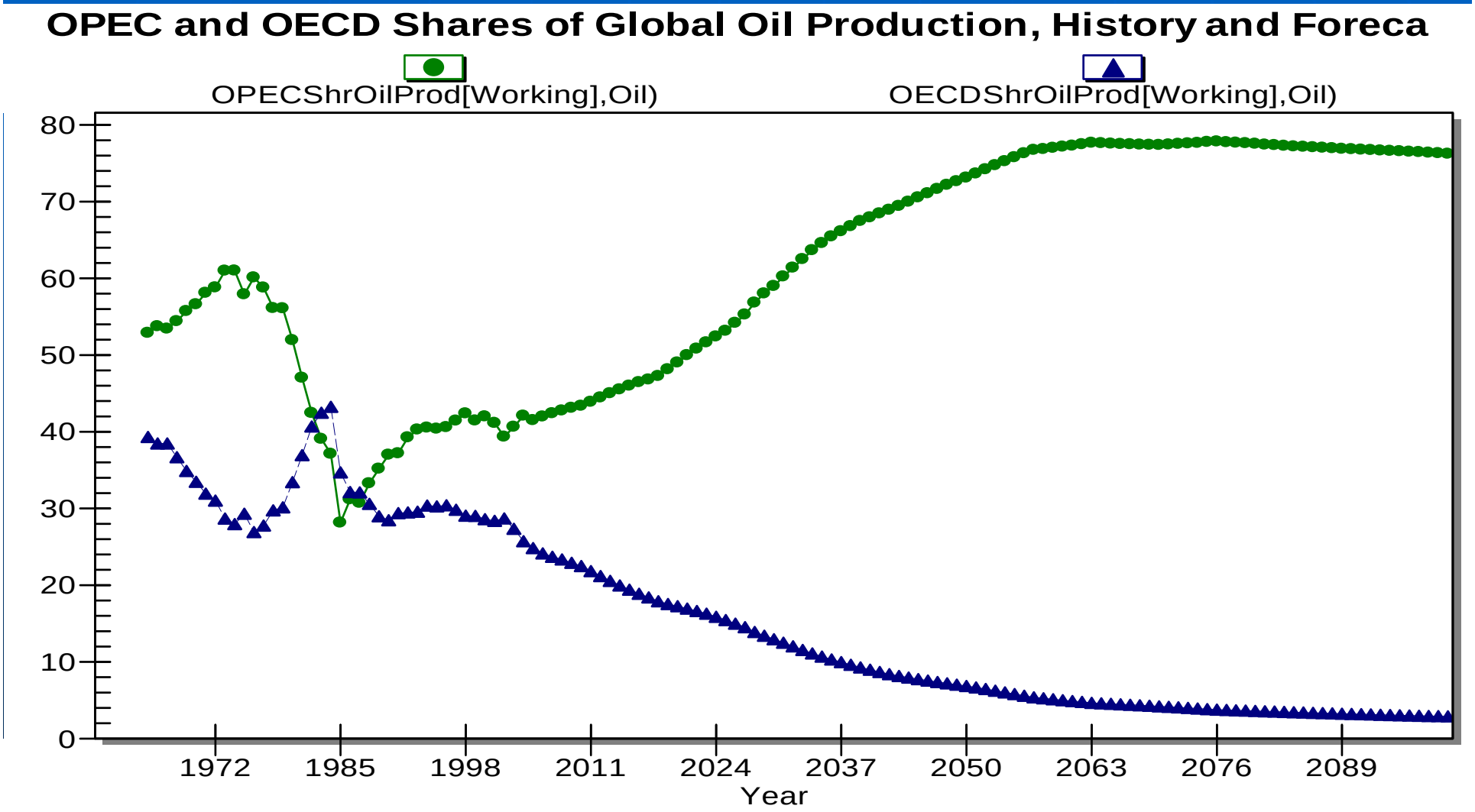
Futures Studies and Industrial Ecology: Many Fermanent Research Areas Relevant for SD

- Example1: CO_2 –emission development in the world regions before the year 2100
- Example2: OPEC vs. OECD countires´shares in the world oil production before the year 2100
- Example 3: Price of oil (in dollars) in the world energy market before the year 2100
- Exaple 4: World energy sources in the future before the year 2100: Baseline scenario analysis
- Example 5: Annual CO2 emissions of the EU25 -countries analyzed by 3 alternative scenarios (one SD scenario) before the year 2100
- Example 6: The use of global water resources in the world analyzed by 3 alternative scenarios (one SD scenario) before the year 2100
- Example 7: Scenario analysis of poverty development (poverty numbers) in the world before the year 2100 if SD policies are adopted
- Example 8: North-South Ratio: Richest 10% over poorest 10% in 3 alternative scenarios (one SD scenario) before the year 2100
- Example 9: Global Gini Index in 3 alternative scenarios (one SD scenario) before the year 2100
- Example10: World population development in 3 alternative scenarios (one SD scenario) before the year 2100

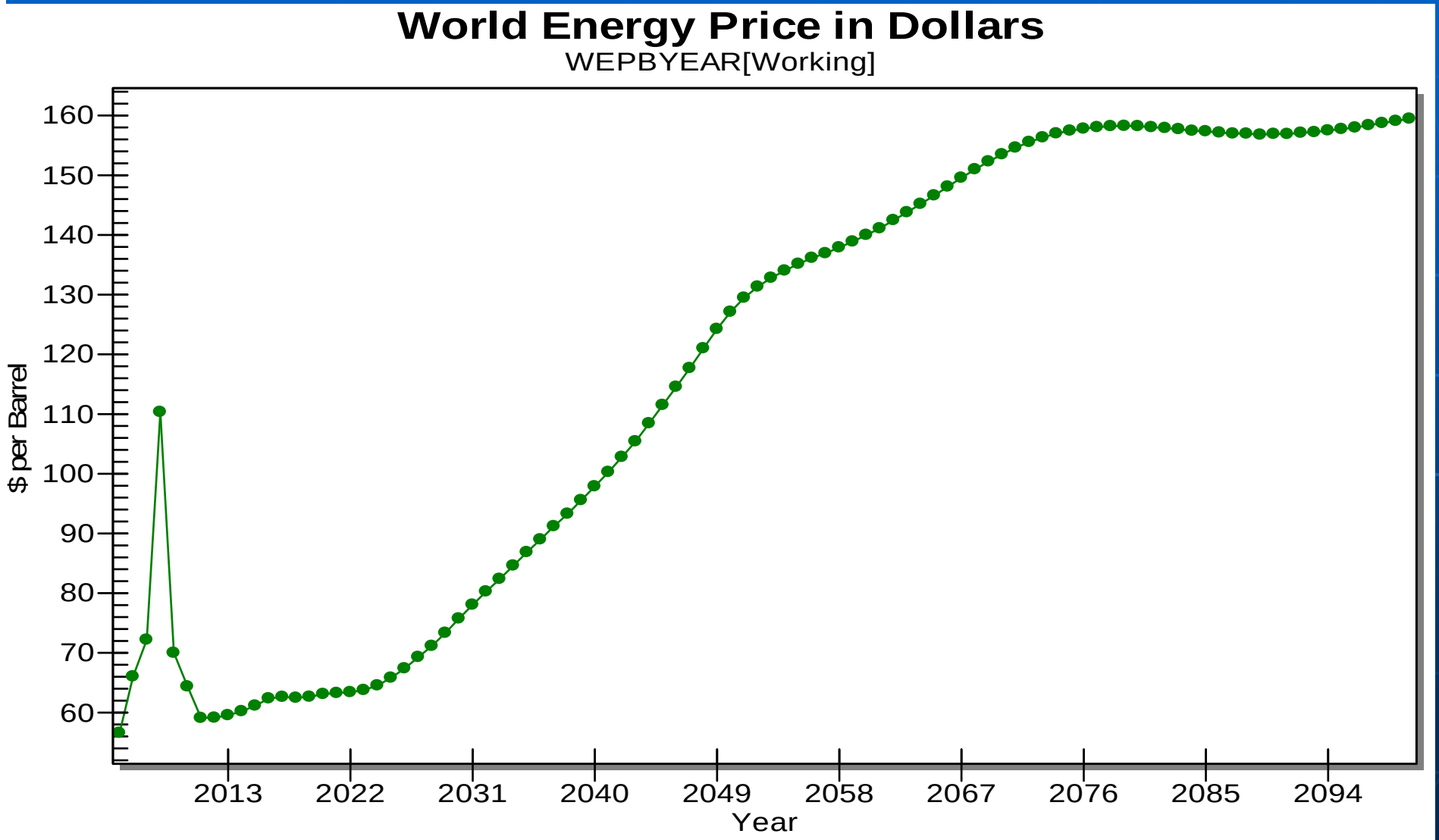
Example 1: CO2 –emissions development in the world regions before the year 2100 in the UNEP regions



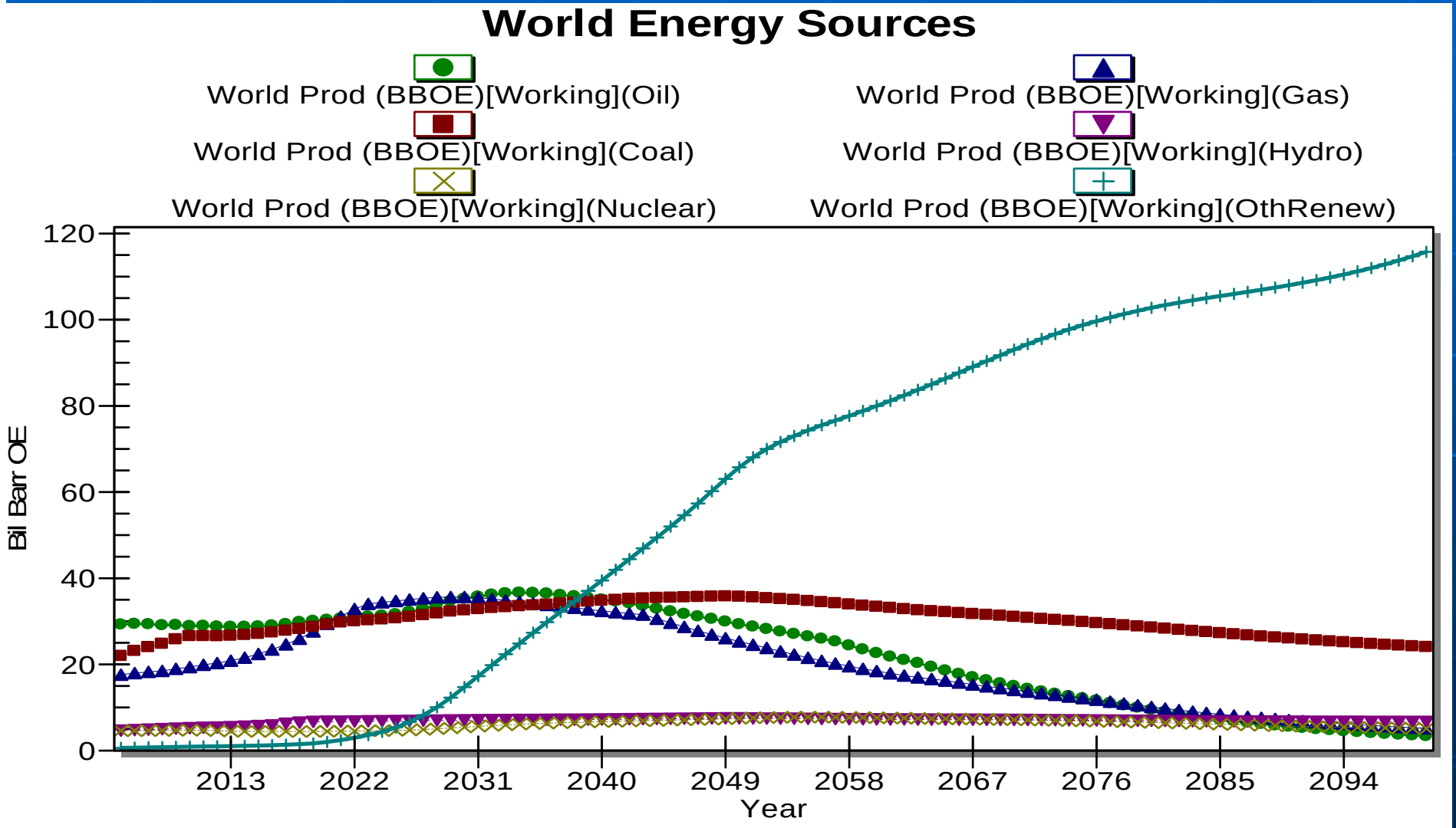
Example 2: OPEC vs. OECD countires´shares in the world oil production before the year 2100



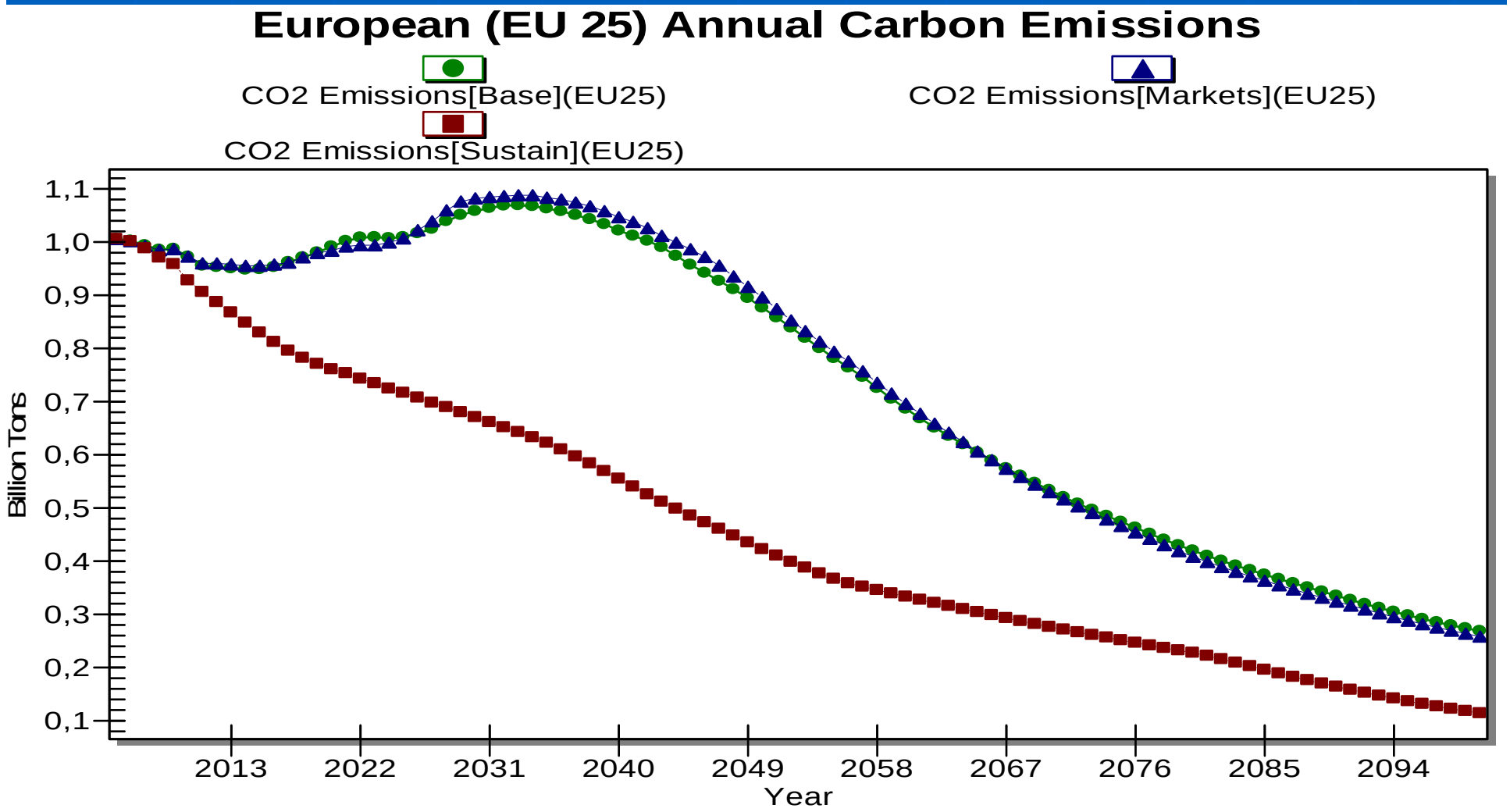
Example 3: Price of oil (in dollars) in the world energy market before the year 2100



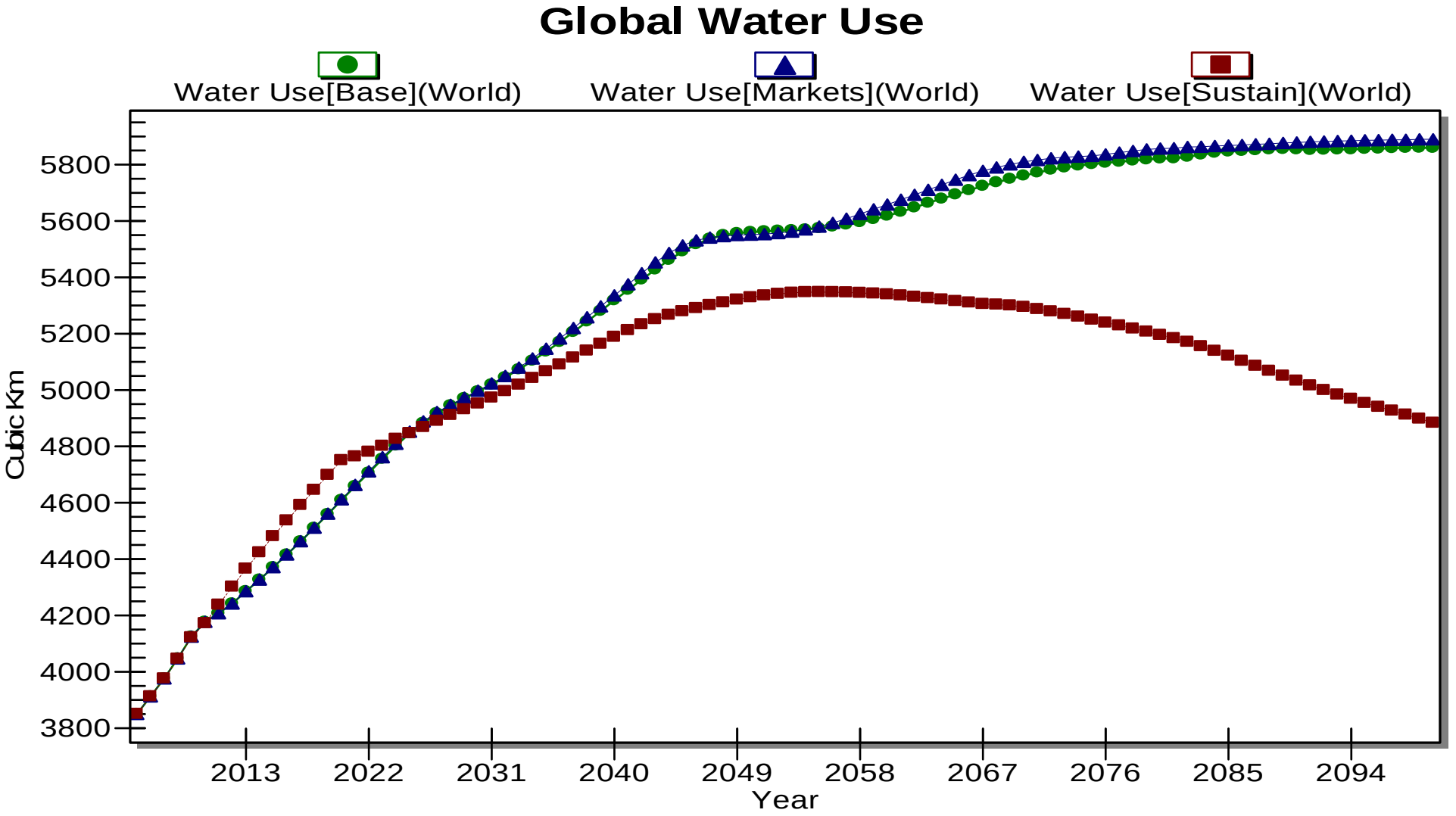
Exaple 4: World energy sources in the future before the year 2100: Baseline scenario analysis



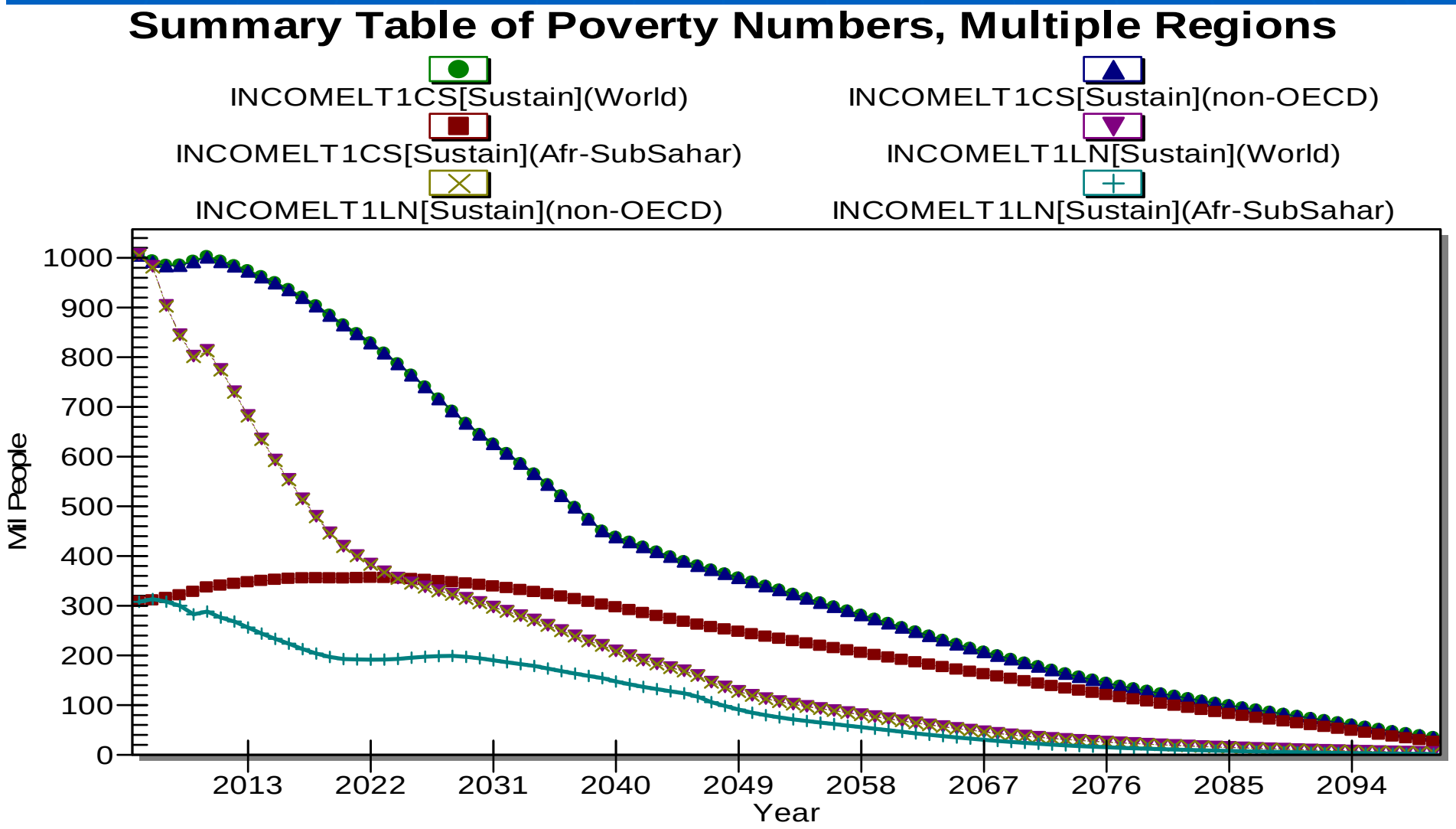
Example 5: Annual CO2 emissions of the EU25 - countries analyzed by 3 alternative scenarios (one SD scenario) before the year 2100



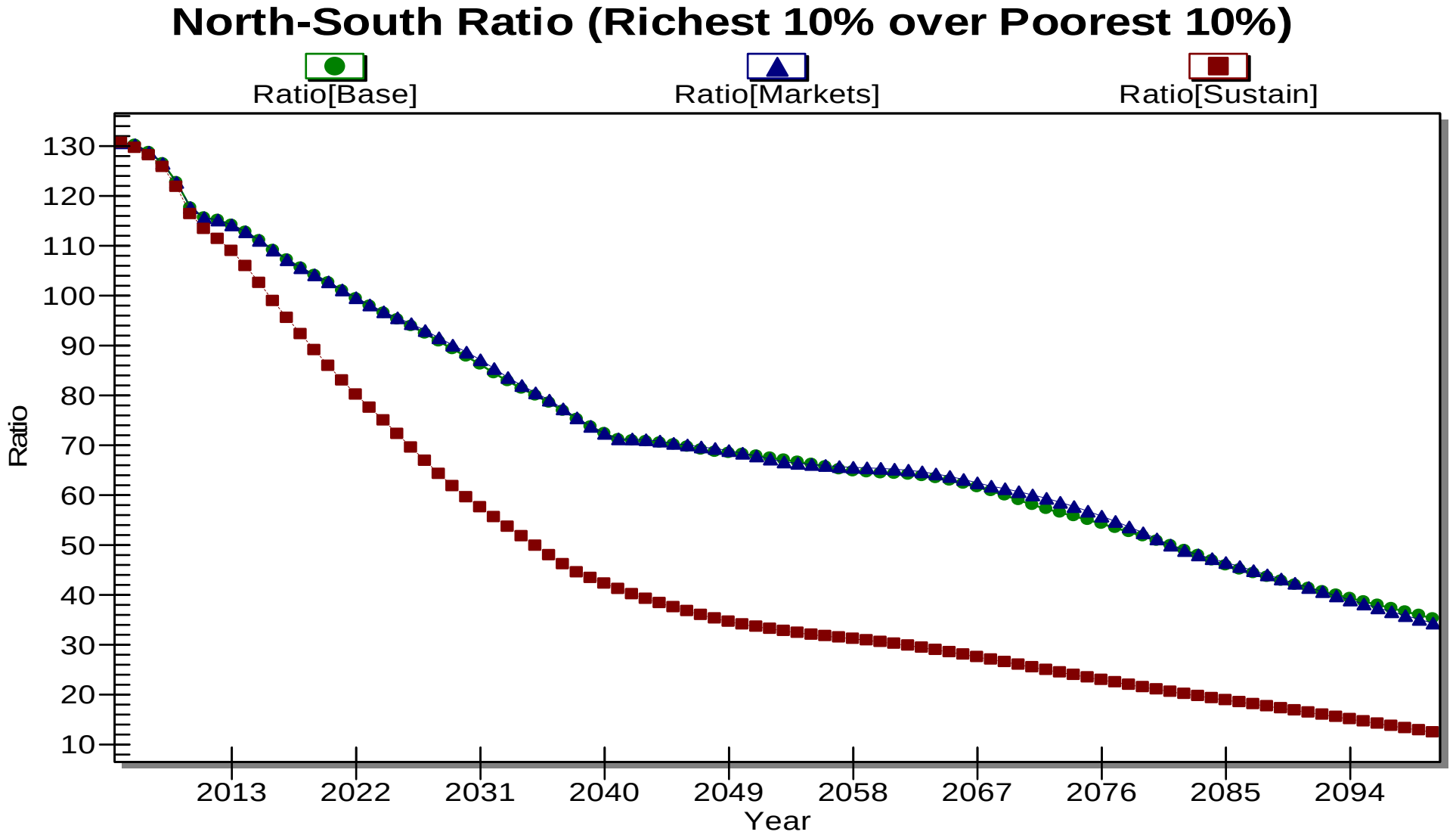
Example 6: The use of global water resources in the world analyzed by 3 alternative scenarios (one SD scenario) before the year 2100



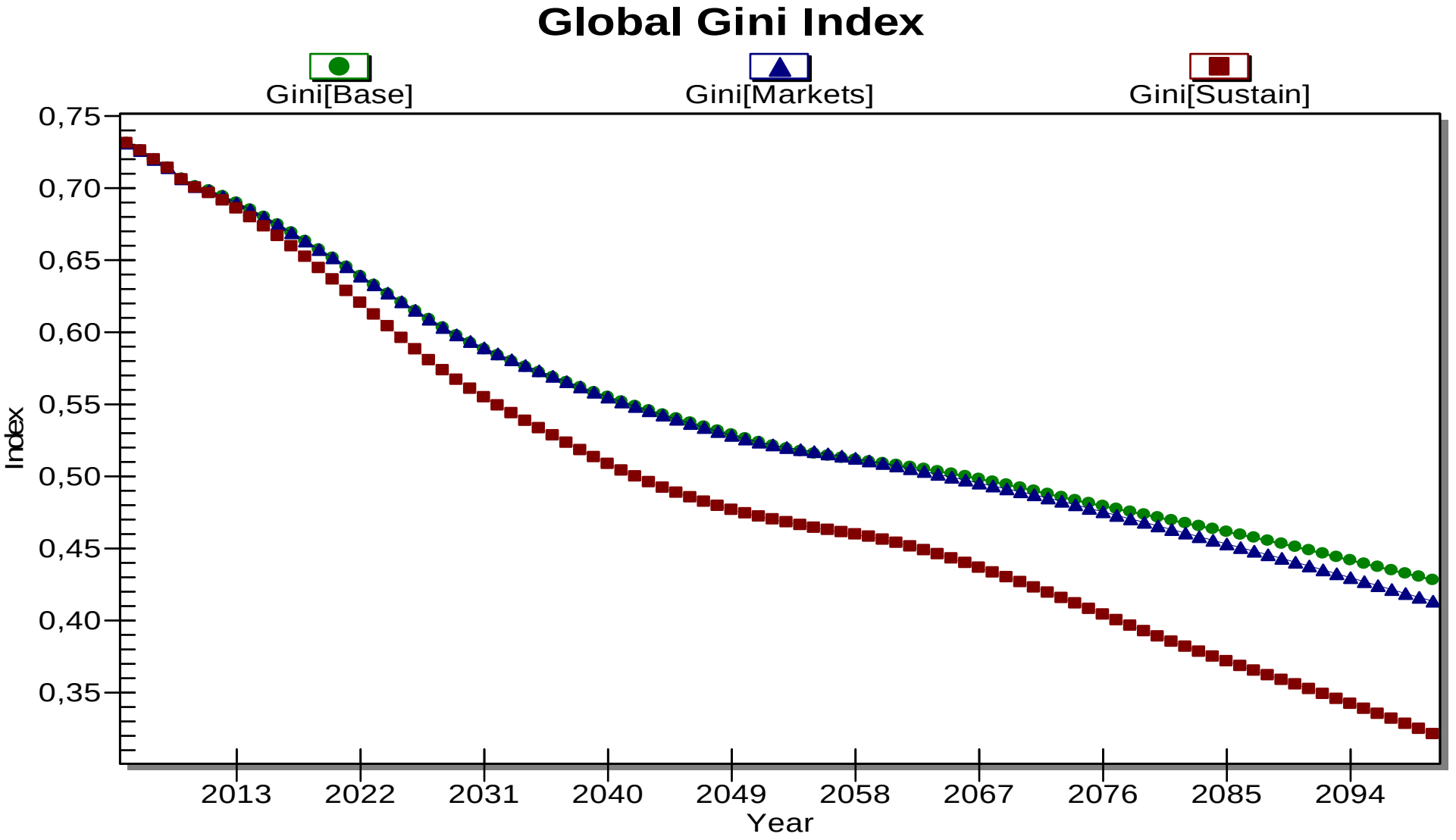
Example 7: Scenario analysis of poverty development (poverty numbers) in the world before the year 2100 if SD policies are adopted



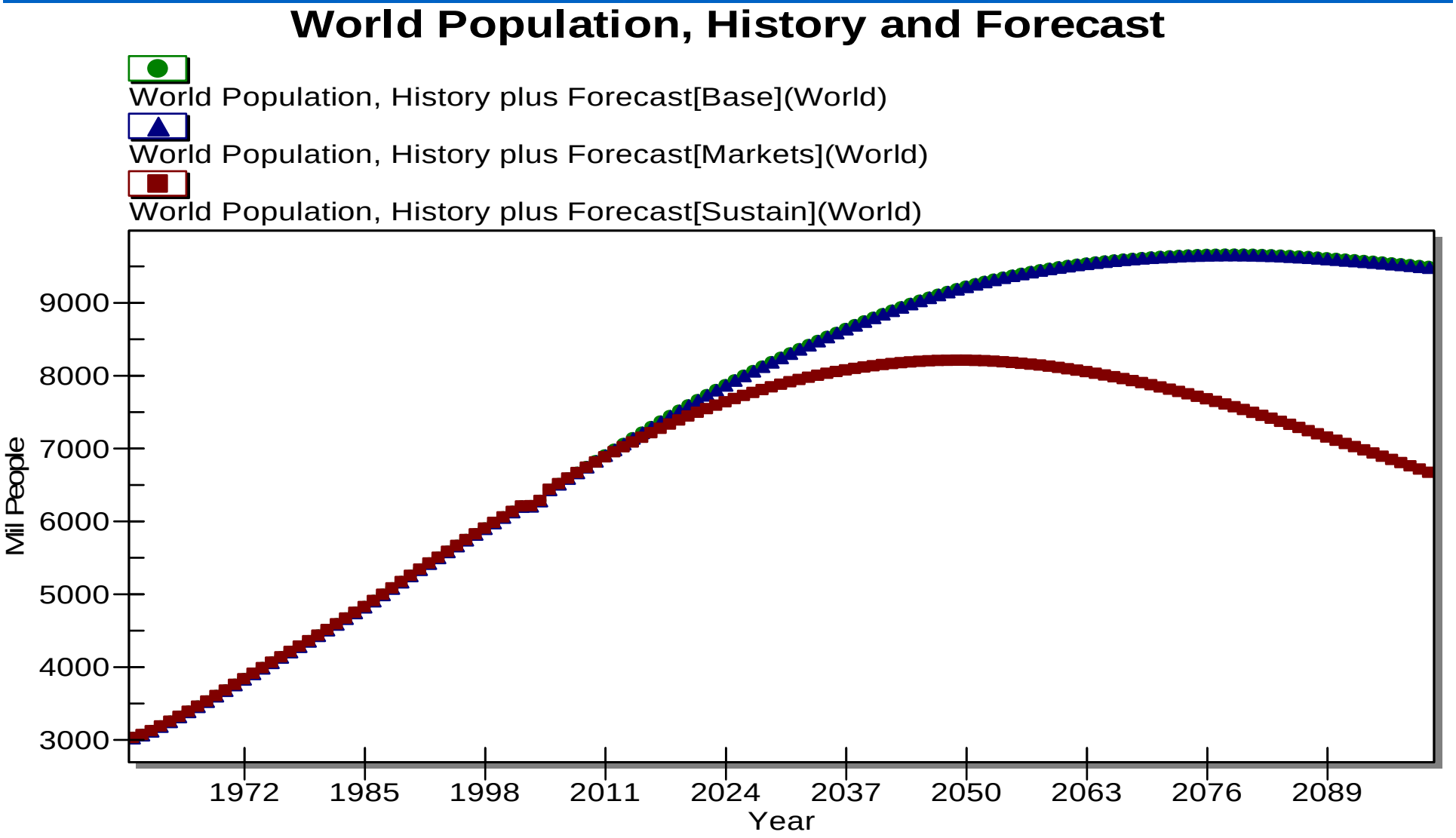
Example 8: North-South Ratio: Richest 10% over poorest 10% in 3 alternative scenarios (one SD scenario) before the year 2100



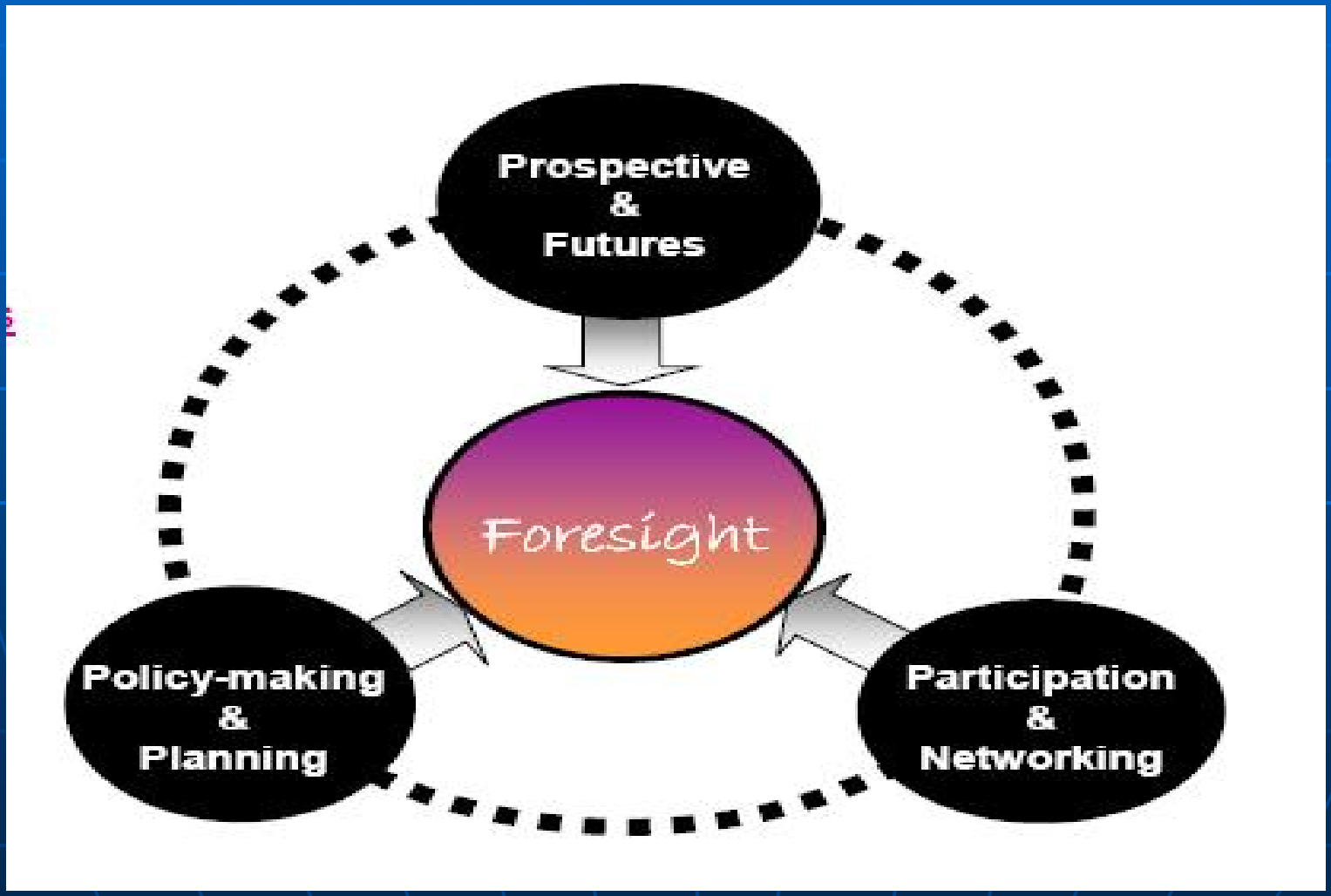
Example 9: Global Gini Index in 3 alternative scenarios (one SD scenario) before the year 2100



Example10: World population development in 3 alternative scenarios (one SD scenario) before the year 2100

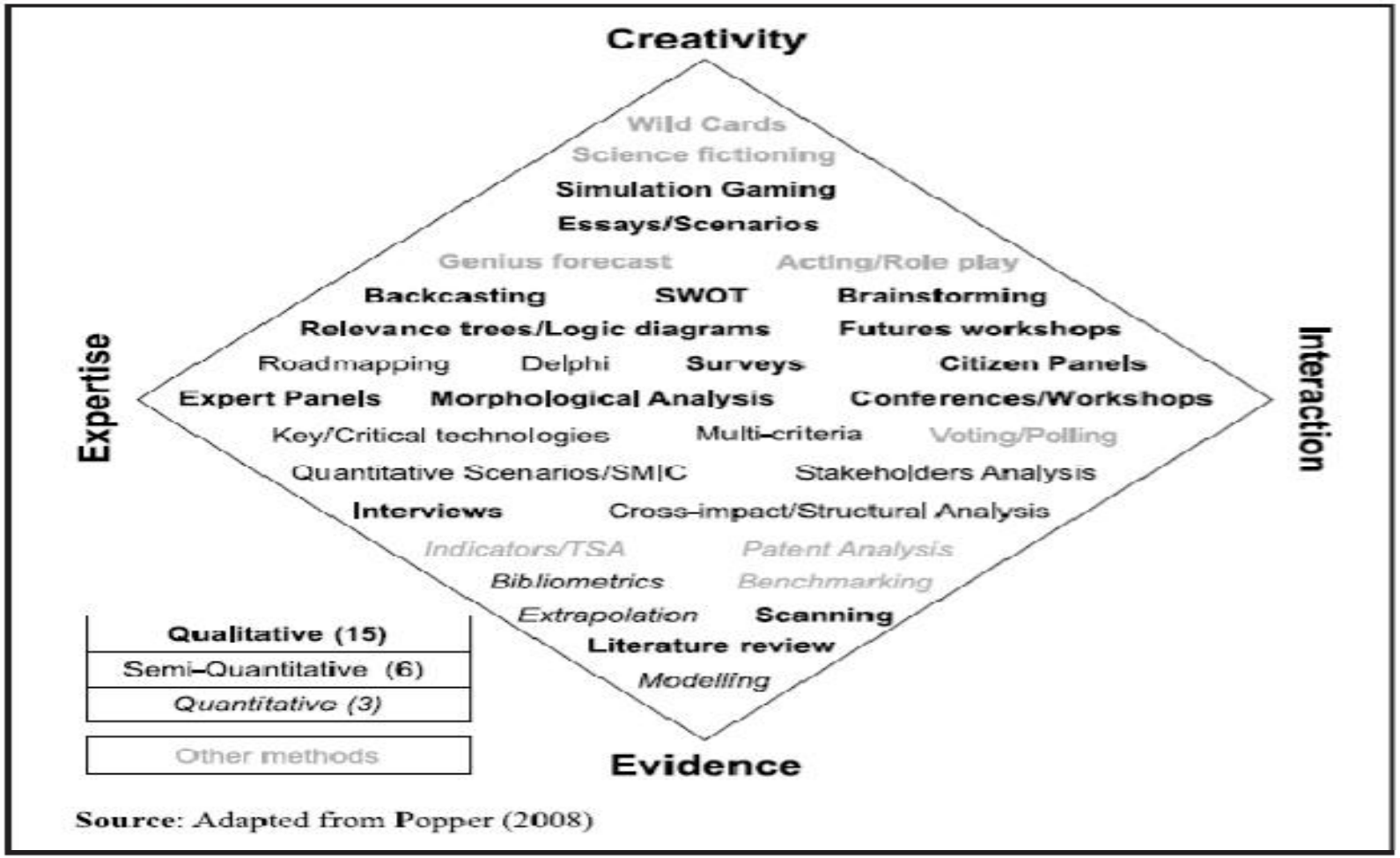


Foresight triangle (Miles 2003)



Popper´s (2008) Foresight Diamond

Figure 1 The Foresight Diamond



Source: Adapted from Popper (2008)

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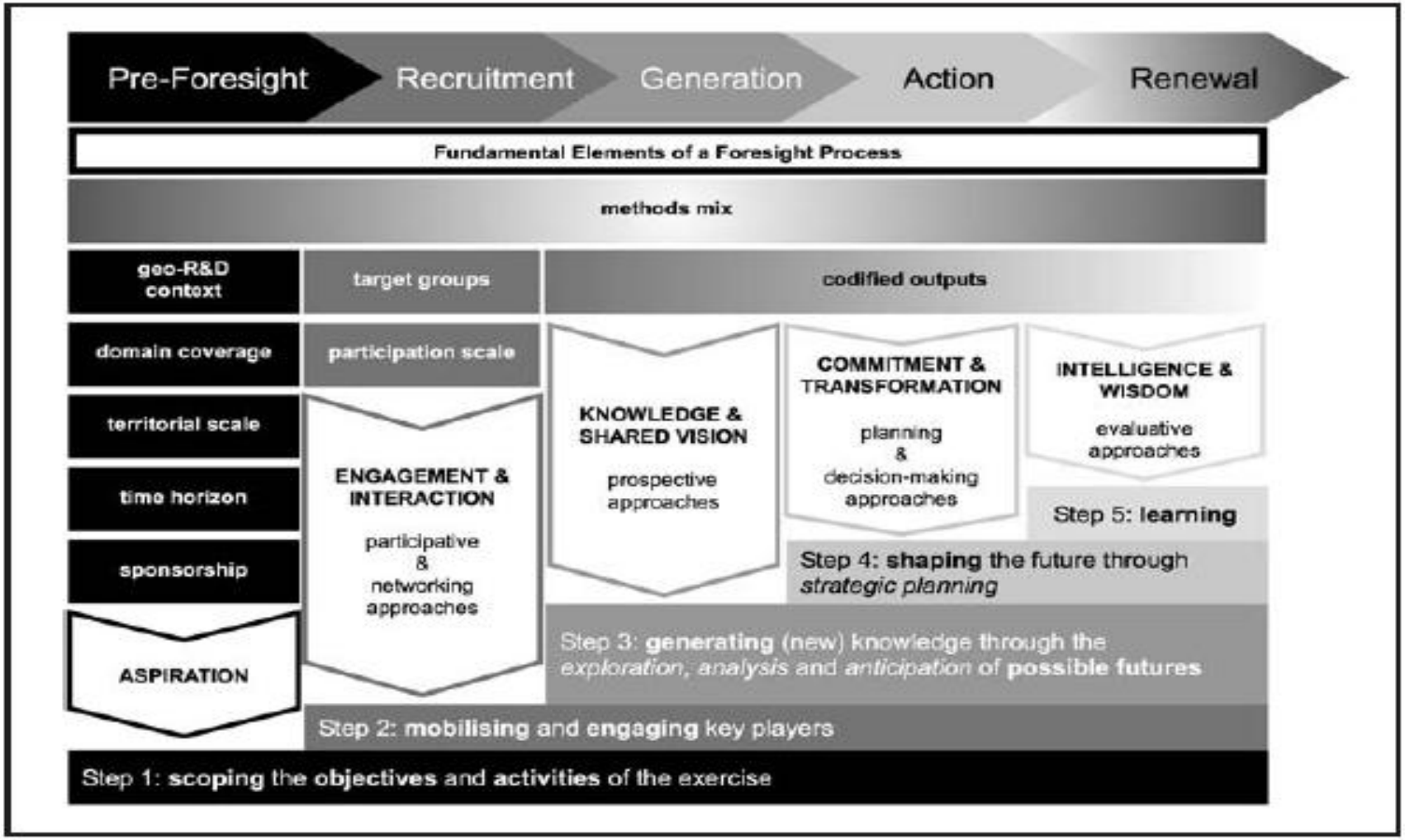
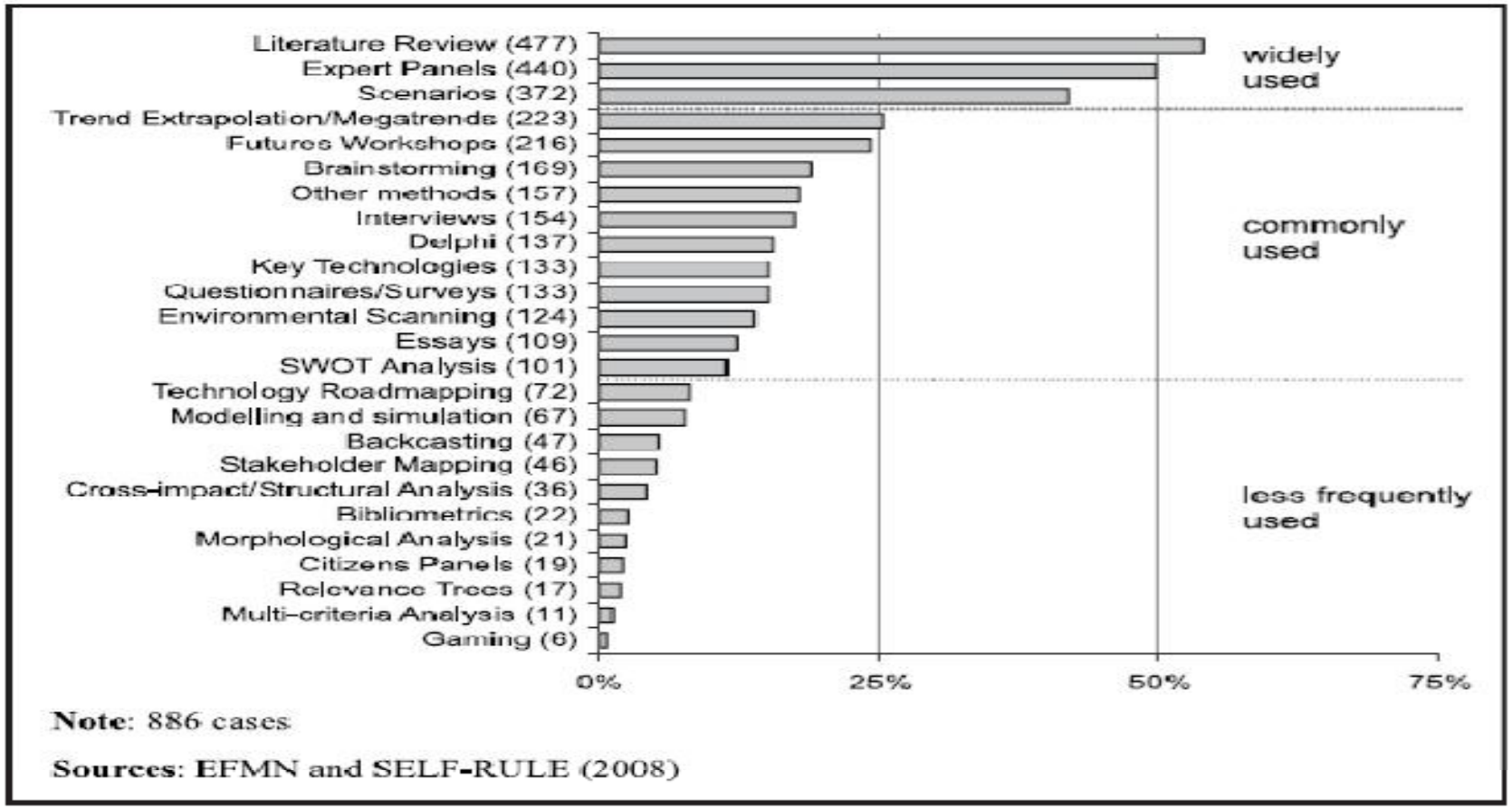
Typical Foresight Process (Popper 2008)

Figure 2 The foresight process



Used Capacity of Foresight Methodology Arsenal (Popper 2008)

Figure 3 Level of use of foresight methods



Note: 886 cases

Sources: EFMN and SELF-RULE (2008)

Foresight & futures studies: Multidisciplinary & multimethod scientific activity (Popper 2008)

Figure 15 Methods mix — or methods combination matrix (MCM)

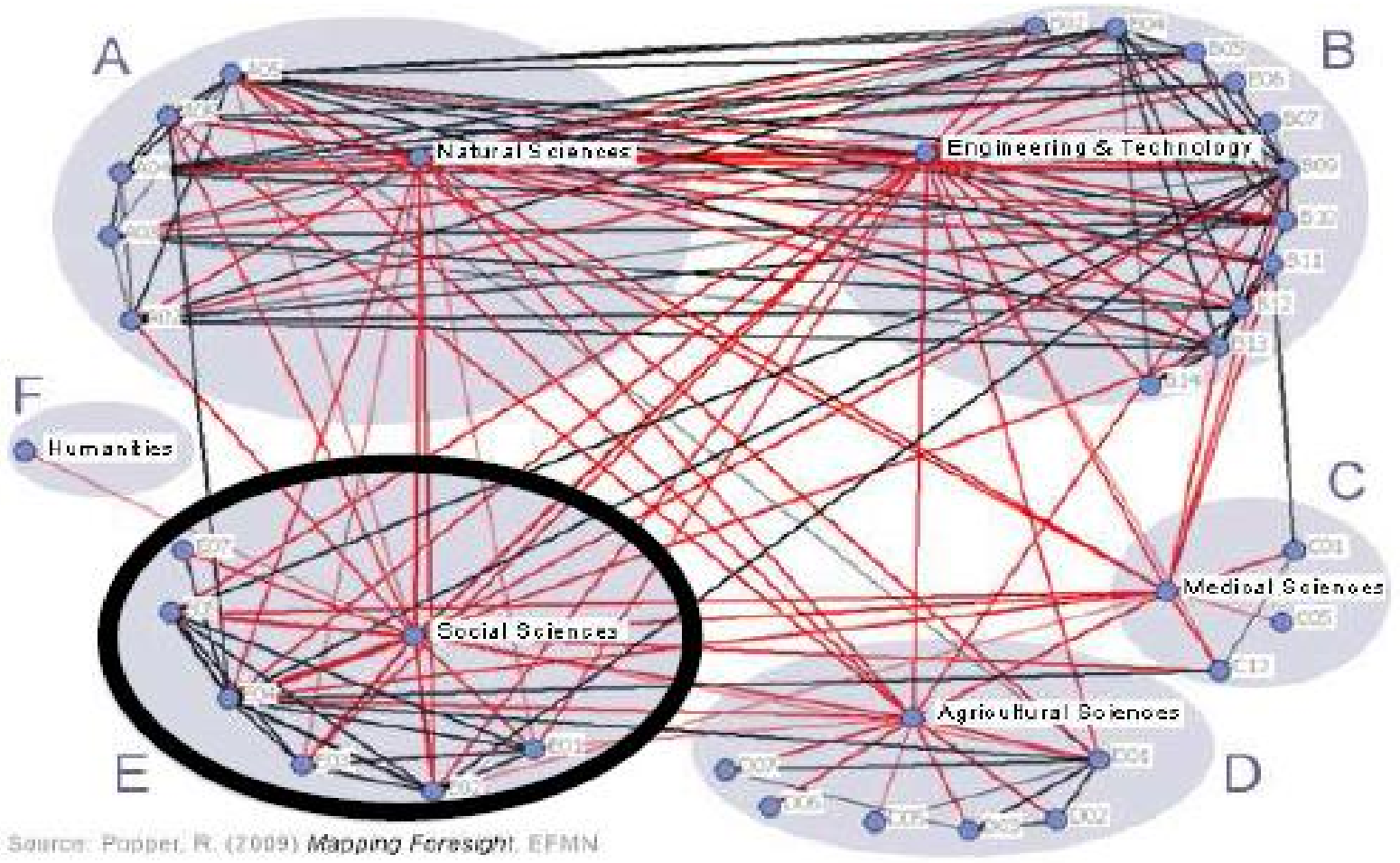
Ranking by frequency of use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Methods Combination Matrix (MCM)	Literature Review	Expert Panels	Scenarios	Trend extrapolation/Megatrends	Futures Workshops	Brainstorming	Other methods	Interviews	Delphi	Key Technologies	Questionnaires/Surveys	Environmental Scanning	Essays	SWOT Analysis	Technology Roadmapping	Modelling and simulation	Backcasting	Stakeholder Mapping	Cross-Impact/Structural Analysis	Bibliometrics	Morphological Analysis	Citizens Panels	Relevance Trees	Multi-criteria Analysis	Gaming
1 **Literature Review**	477	H	H	H	M	M	M	M		M															
2 **Expert Panels**	VH	440	M	M	M	M		M	M	M															
3 **Scenarios**	H	H	372	H	M	M	M																		
4 *Trend Extrapolation/Megatrends*	VH	VH	VH	223	M	M	M	M		M	M	M	M			M									
5 **Futures Workshops**	VH	VH	H	M	216	M	M			M															
6 **Brainstorming**	VH	VH	H	M	H	169	H	M	M	M	M	M		M											
7 Other methods	VH	H	H	M	H	H	157	M	M	M	M	M		M											
8 **Interviews**	VH	VH	H	H	M	M	M	154			H	M		M											
9 Delphi	VH	VH	M	M	M	H	M		137	M	M	M													
10 Key Technologies	VH	VH	M	H	M	M	M	M	M	133		M		M	M										
11 **Questionnaires/Surveys**	H	VH	H	H	M	M	M	H	M		133	M		M											
12 **Environmental Scanning**	VH	VH	H	H	M	H	VH	M	M	M	M	124	M	M				M							
13 **Essays**	H	H	H	H	M	M	M	M				M	109												
14 **SWOT Analysis**	VH	H	H	M	H	H	VH	M	M	M	M	M		101				M	M						
15 Technology Roadmapping	VH	VH	M	M	H					H					72										
16 *Modelling and simulation*	H	M	VH	VH												67									
17 **Backcasting**	H	H	H	H	M	M		M				M				M	47								
18 Stakeholder Mapping	VH	VH	H	VH	H	VH	VH	H		M	M	VH	M	H				46	M	M	M		M		
19 Cross-impact/Structural Analysis	VH	VH	VH	VH	M	VH	VH	VH	M		VH	VH	M	VH				M	36		M				
20 *Bibliometrics*	VH	H	M	VH	M	H	VH	VH		VH	H	VH	H	H				H		22	M		M		
21 **Morphological Analysis**	VH	VH	VH	H	H	VH	VH	VH	M	M	H	H	VH	M			M	H	H	M	21		H		
22 **Citizens Panels**	H	VH	H	M	VH	H	VH	H	M		M	H	M	H				M	M			18			
23 **Relevance Trees**	VH	VH	VH	VH	VH	VH	VH	VH	M	M	H	VH	VH	VH				VH	M	M	H		17		
24 Multi-criteria Analysis	VH	M		VH	M	M	M	M		M	M	M	M			H								11	
25 **Gaming**	VH	VH	VH	VH	VH	VH			M			H				H	M	VH	M						6

Key: Low (blank); moderate (M); high (H); very high (VH); **bold** = qualitative; *italic* = quantitative; normal = semi-quantitative

Note: 886 cases

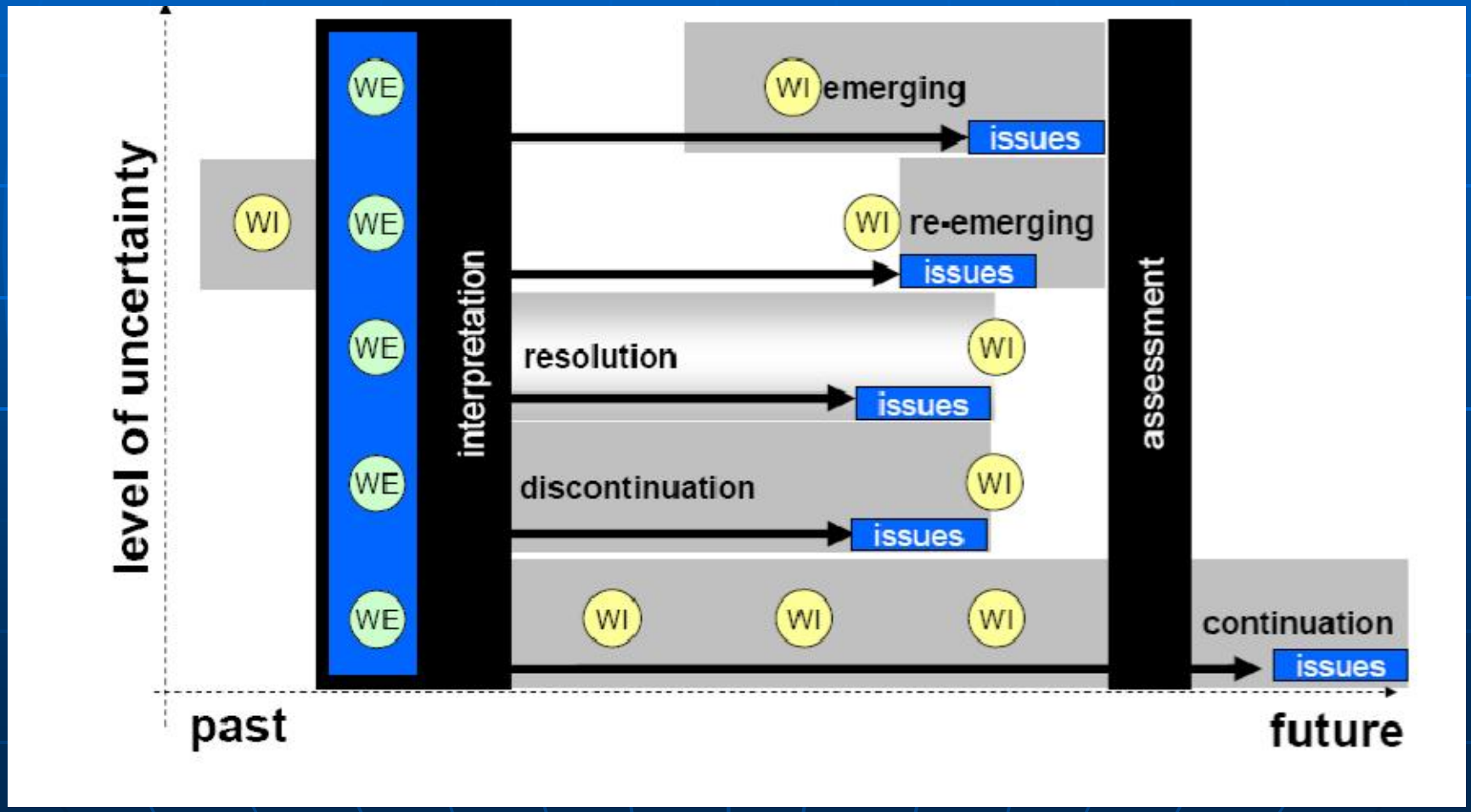
Sources: EFMN and SELF-RULE (2008)

Foresight: Networked bridge between sciences (Popper 2009)



Source: Popper, R. (2009) *Mapping Foresight*. EFMN

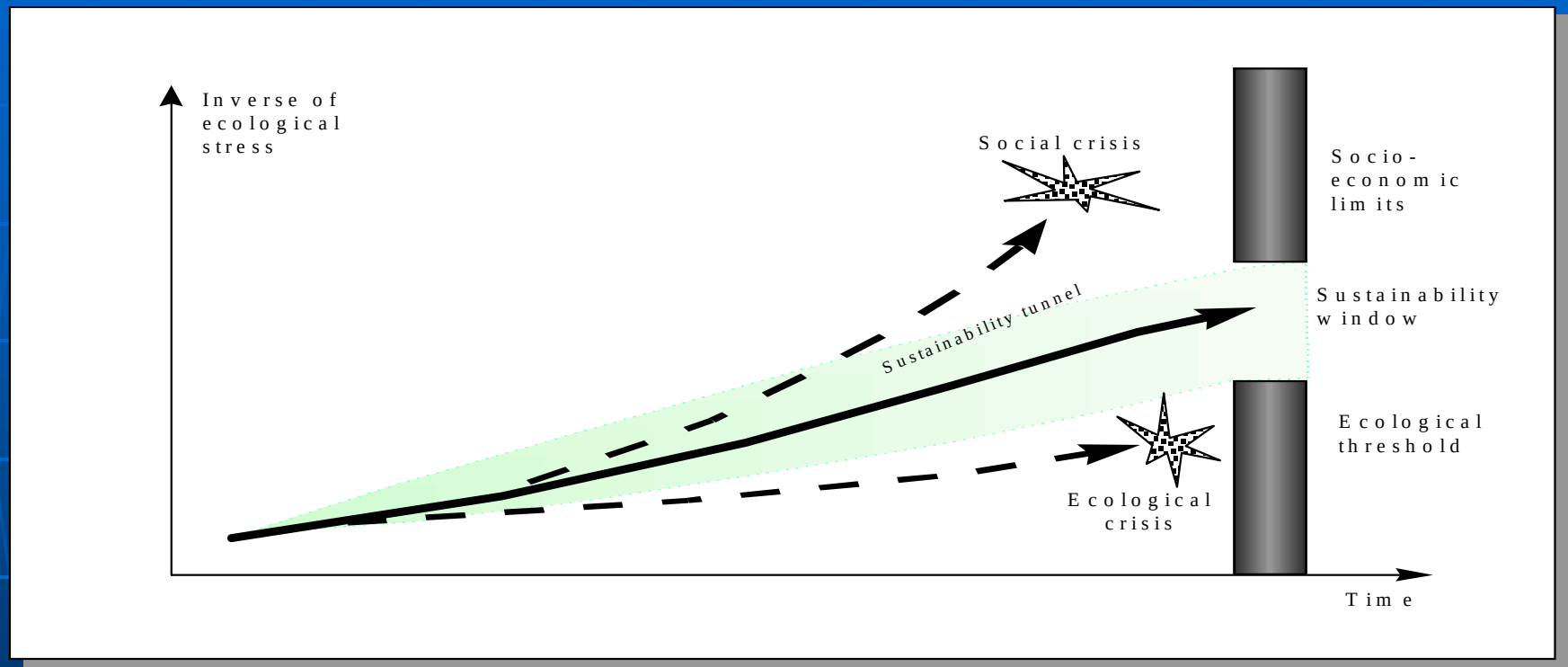
iKnow framework of future issues (Popper 2009): High relevance for current sustainability policy discussion



Economic growth and environment: 4 alternative perspectives

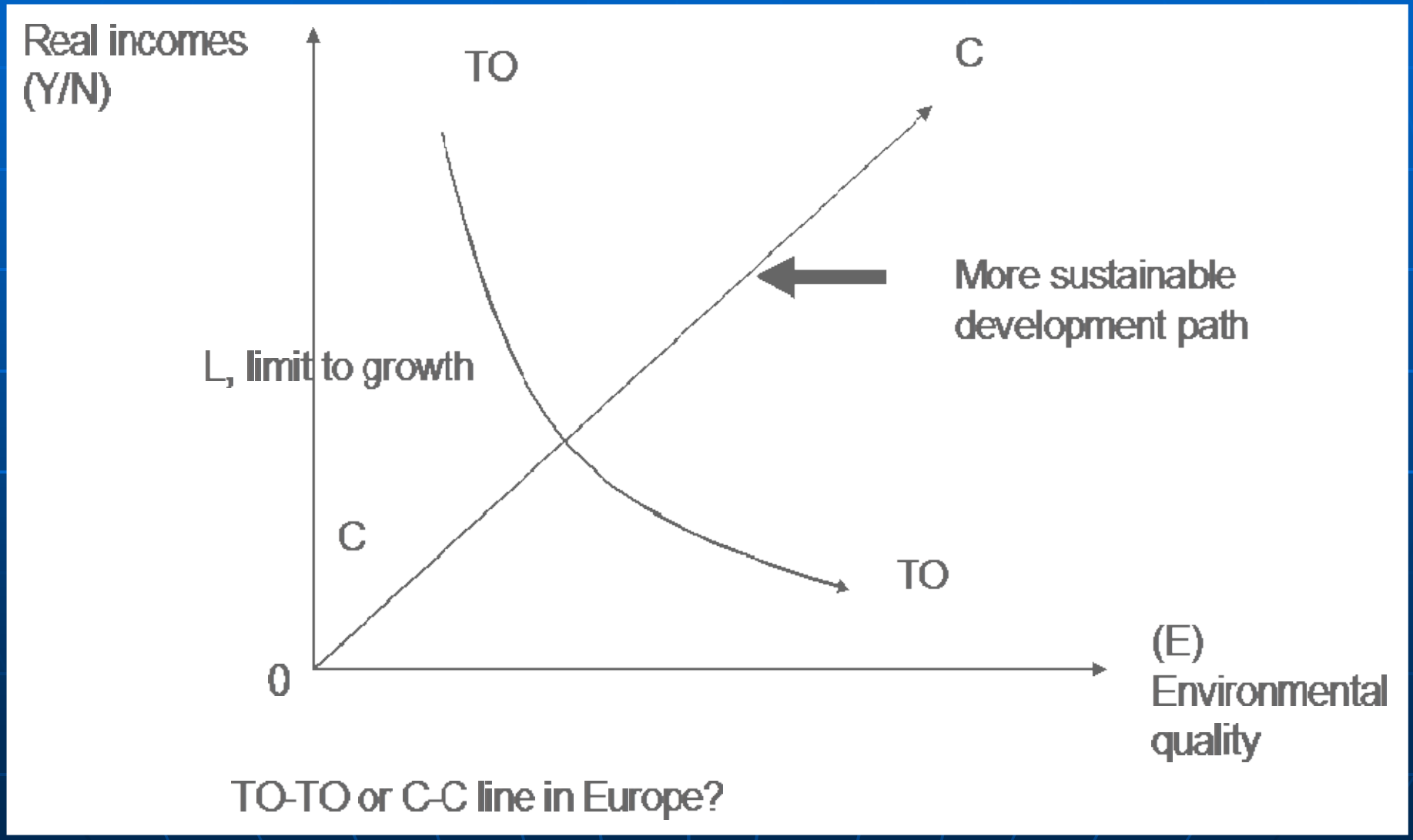
Position	Economic growth is:	Policy suggestions are:
Radical supporter	good for the environment as it is required for R&D and dynamic processes	to stimulate growth and to assure the free functioning of markets
Conditional supporter	good for the environment because required for funding environmental policy	to stimulate growth while Simultaneously implementing environmental policy
Weak antagonist	harmful to the environment because of physical output growth	to implement environmental policies that may reduce growth in “dirty” sectors of the economy
Strong antagonist	harmful to the environment because of physical output growth	to reduce or to abolish economic growth

Sustainability window and tunnel

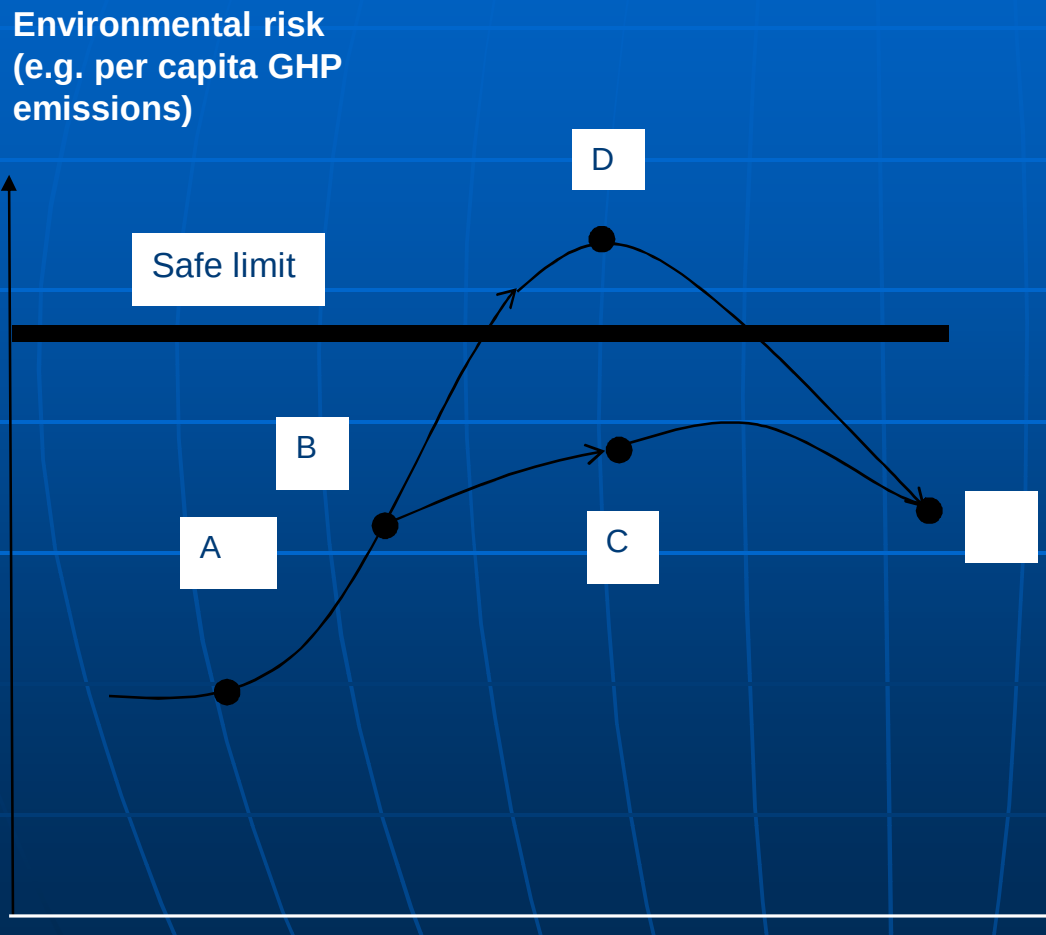


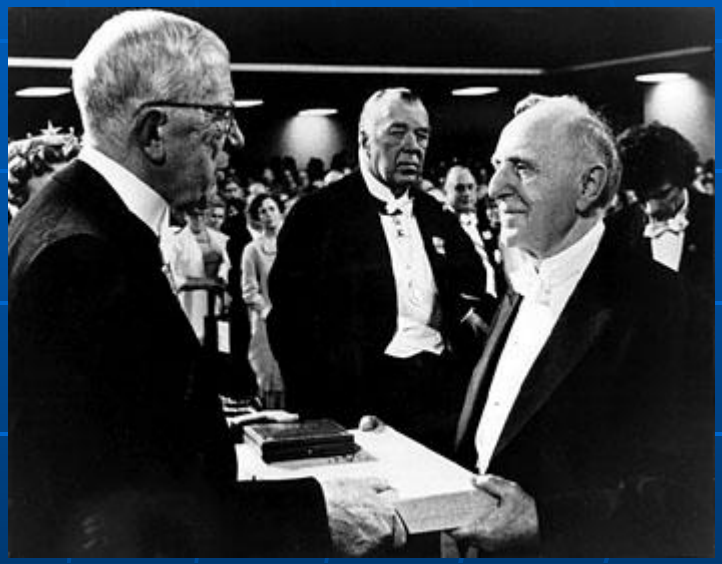
A sustainability window and tunnel. In order to achieve sustainable development environmental stress must be lowered. This means lower energy and material requirements and fewer emissions. On the other hand, too rapid a change in the socio-economic system in order to achieve the environmental goals may cause socio-economic problems such as unemployment, slow growth, loss of competitiveness etc. To map the boundaries of the "tunnel of sustainable development" it is possible, by using the presented theory, to develop indicators of the socio-economic limits such as GDP growth, capital accumulation and unemployment and the environmental limits such as emissions and material use. (Malaska, Luukkanen and Kaivo-oja 1999, 11, see also a figure presented by Spangenberg 1995)

Basic scenario analysis of sustainability

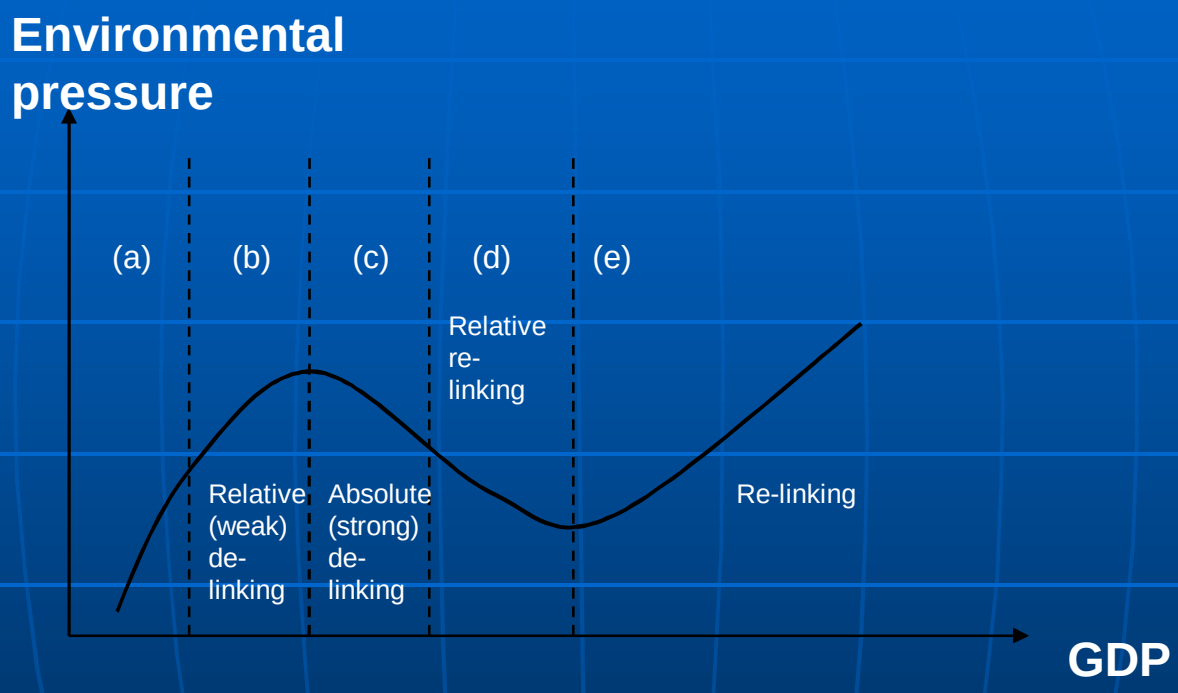


Environmental Kuznets curve hypothesis

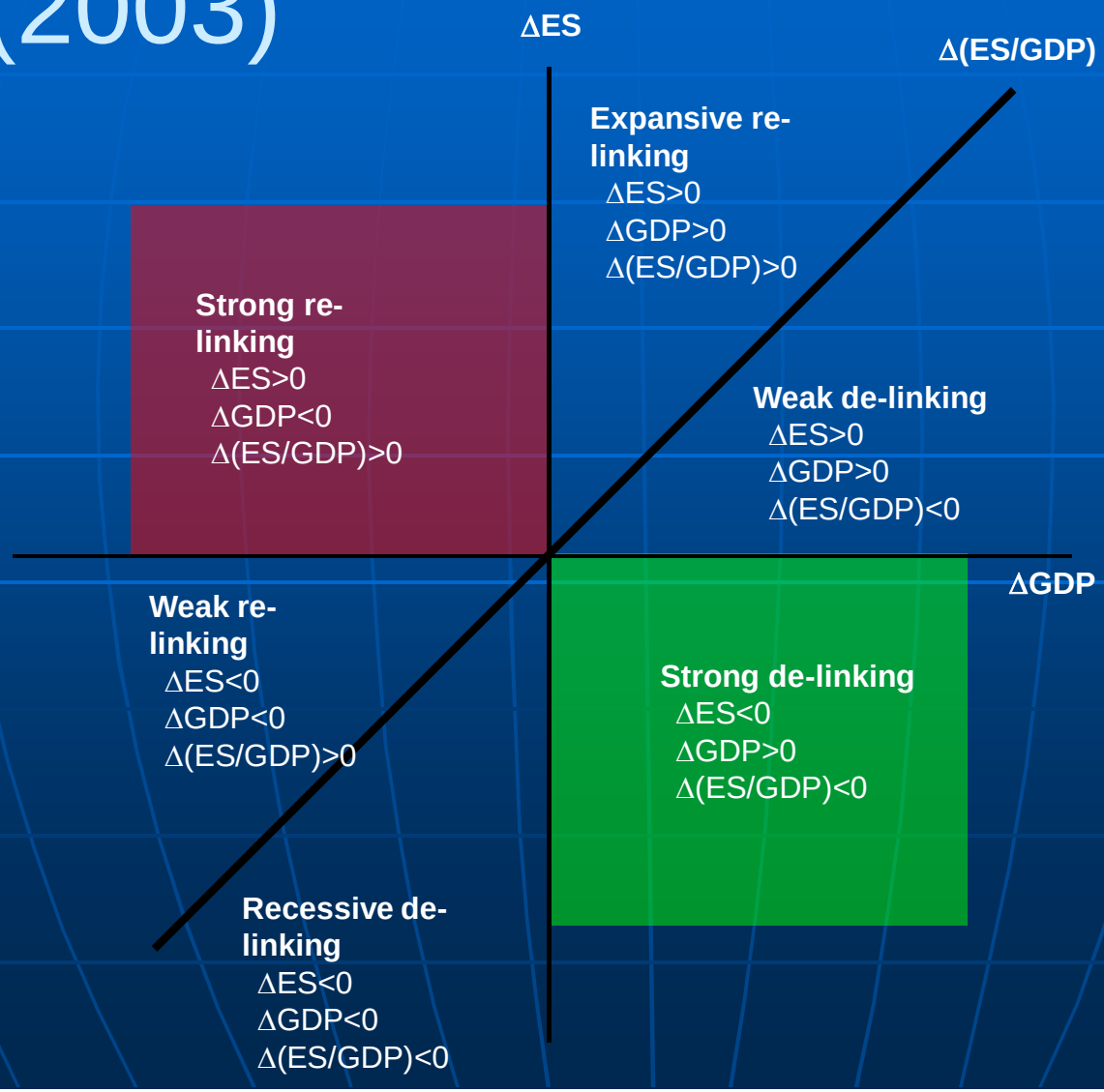




De-linking and relinking hypothesis



Luukkanen-Kaivo-oja-Vehmas De-linking & Re-linking Model (2003)



De-linking and re-linking tests for the European Union, Japan, USA, India, China and Brazil: Weak de-linking dominates

	1973-1980			1980-1990			1990-1999			1973-1999		
	ΔCO_2 Mton	**ΔGDP billion USD**	**$\Delta(CO_2/GDP)$ ton/1000 USD**	**ΔCO_2 Mton**	**ΔGDP billion USD**	**$\Delta(CO_2/GDP)$ ton/1000 USD**	**ΔCO_2 Mton**	**ΔGDP billion USD**	**$\Delta(CO_2/GDP)$ ton/1000 USD**	**ΔCO_2 Mton**	**ΔGDP billion USD**	**$\Delta(CO_2/GDP)$ ton/1000 USD**
EU	-0	948	-0.10	-171	1513	-0.13	4	1177	-0.05	-167	3638	-0.28
Japan	-22	438	-0.14	150	993	-0.09	109	376	-0.01	236	1807	-0.23
USA	-36	854	-0.18	162	1935	-0.22	693	2342	-0.09	819	5130	-0.50
India	93	181	0.04	260	594	0.02	313	877	-0.02	667	1652	0.04
China	513	245	0.15	863	1116	-0.58	672	2796	-0.56	2048	4157	-0.99
Brazil	62	318	-0.00	15	126	-0.01	99	235	0.04	176	279	0.03

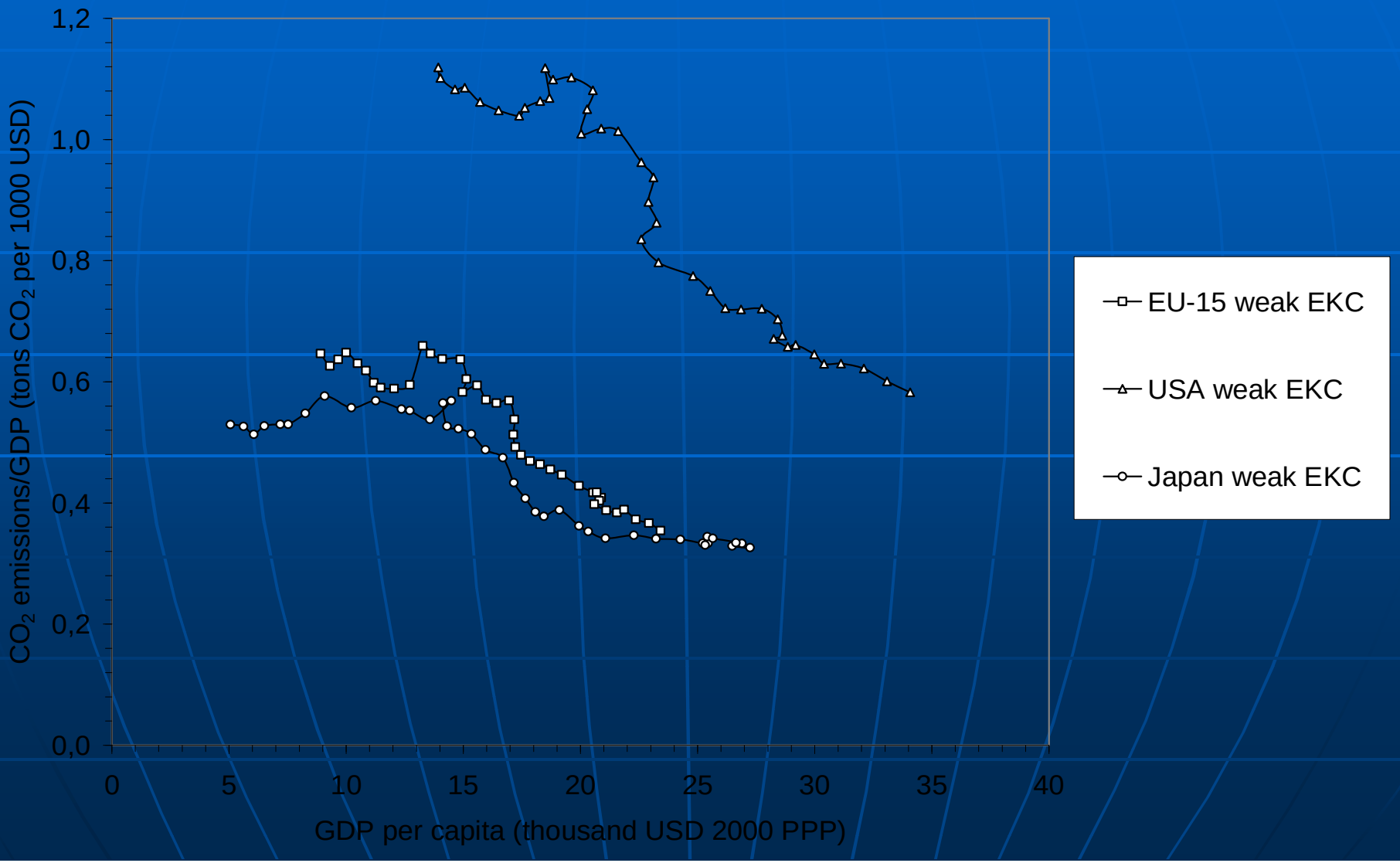
De-linking and re-linking tests for the European Union, Japan, USA, India, China and Brazil

	1973-1980	1980-1990	1990-1999	1973-1999
EU-15	Weak de-linking	Weak de-linking	Weak de-linking	Weak de-linking
Japan	Weak de-linking	Weak de-linking	Expansive re-linking	Weak de-linking
USA	Weak de-linking	Weak de-linking	Weak de-linking	Weak de-linking
India	Weak de-linking	Weak de-linking	Weak de-linking	Weak de-linking
China	Weak de-linking	Weak de-linking	Weak de-linking	Weak de-linking
Brazil	Weak de-linking	Expansive re-linking	Expansive re-linking	Weak de-linking

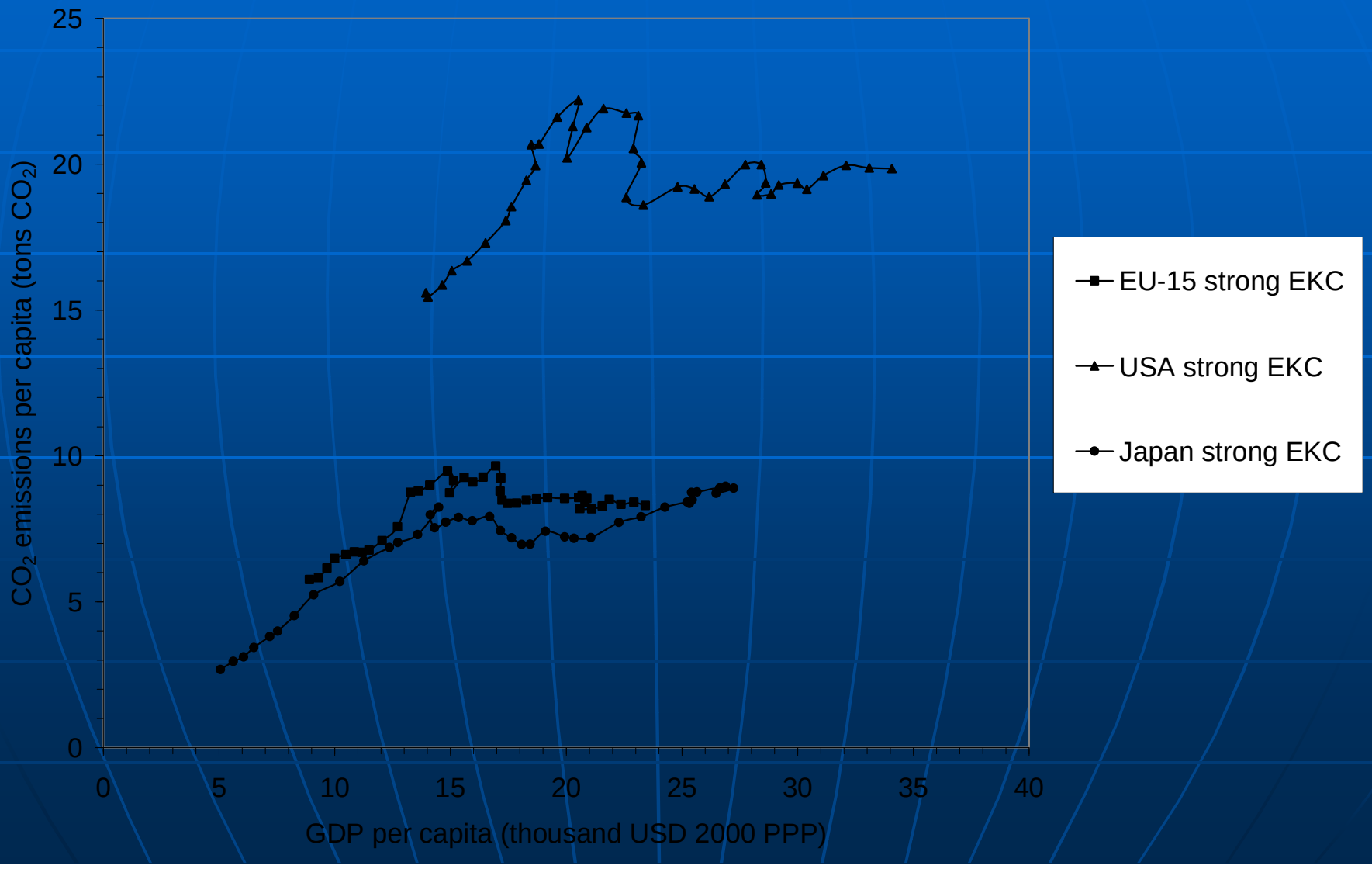
EKC-hypothesis test results for the EU, USA, Japan, China, India and Brazil

Country/region	**CO_2**	**TPES**
EU-15 strong EKC	No	No
EU-15 weak EKC	Yes	Yes
Japan strong EKC	No	No
Japan weak EKC	Yes	Yes?
USA strong EKC	No	No
USA weak EKC	Yes	Yes
China strong EKC	Yes	Yes
China weak EKC	Yes	Yes
India strong EKC	Yes	No
India weak EKC	Yes	Yes?
Brazil strong EKC	No	No
Brazil weak EKC	No	No

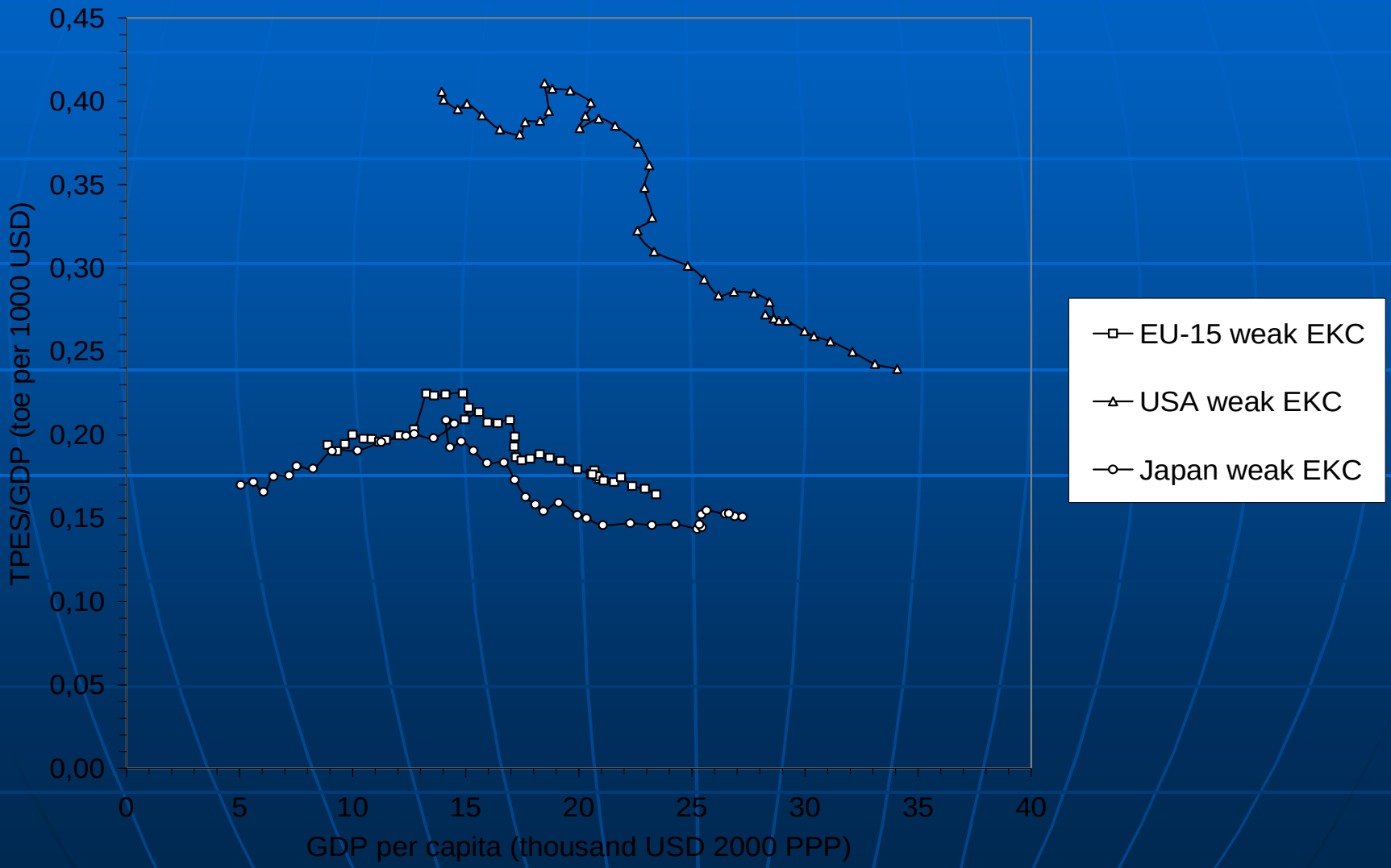
Trends of EKC curves in the EU, USA and Japan, CO_2 emissions per GDP



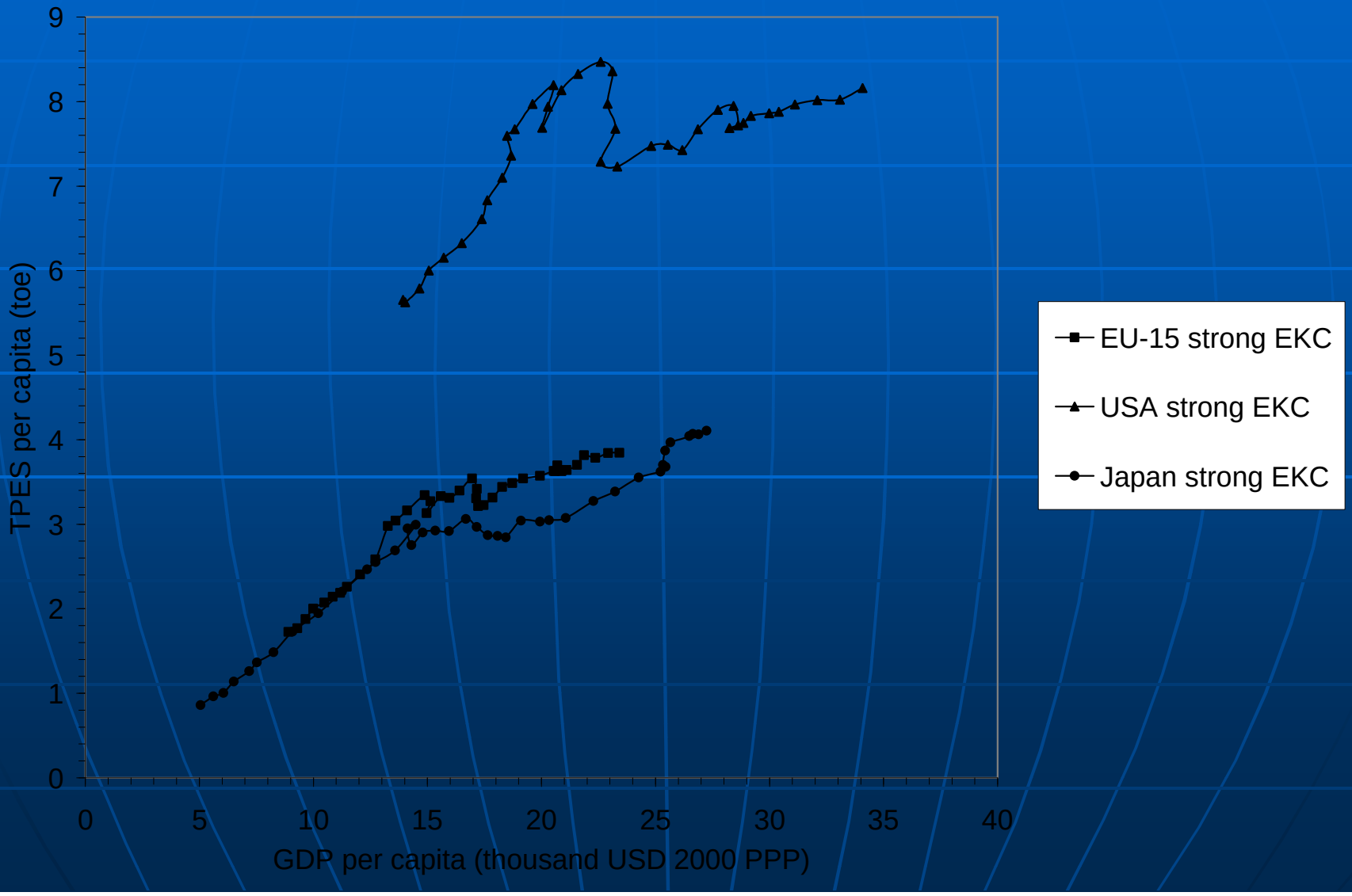
Trends of EKC curves in the EU, USA and Japan, CO_2 emissions per capita



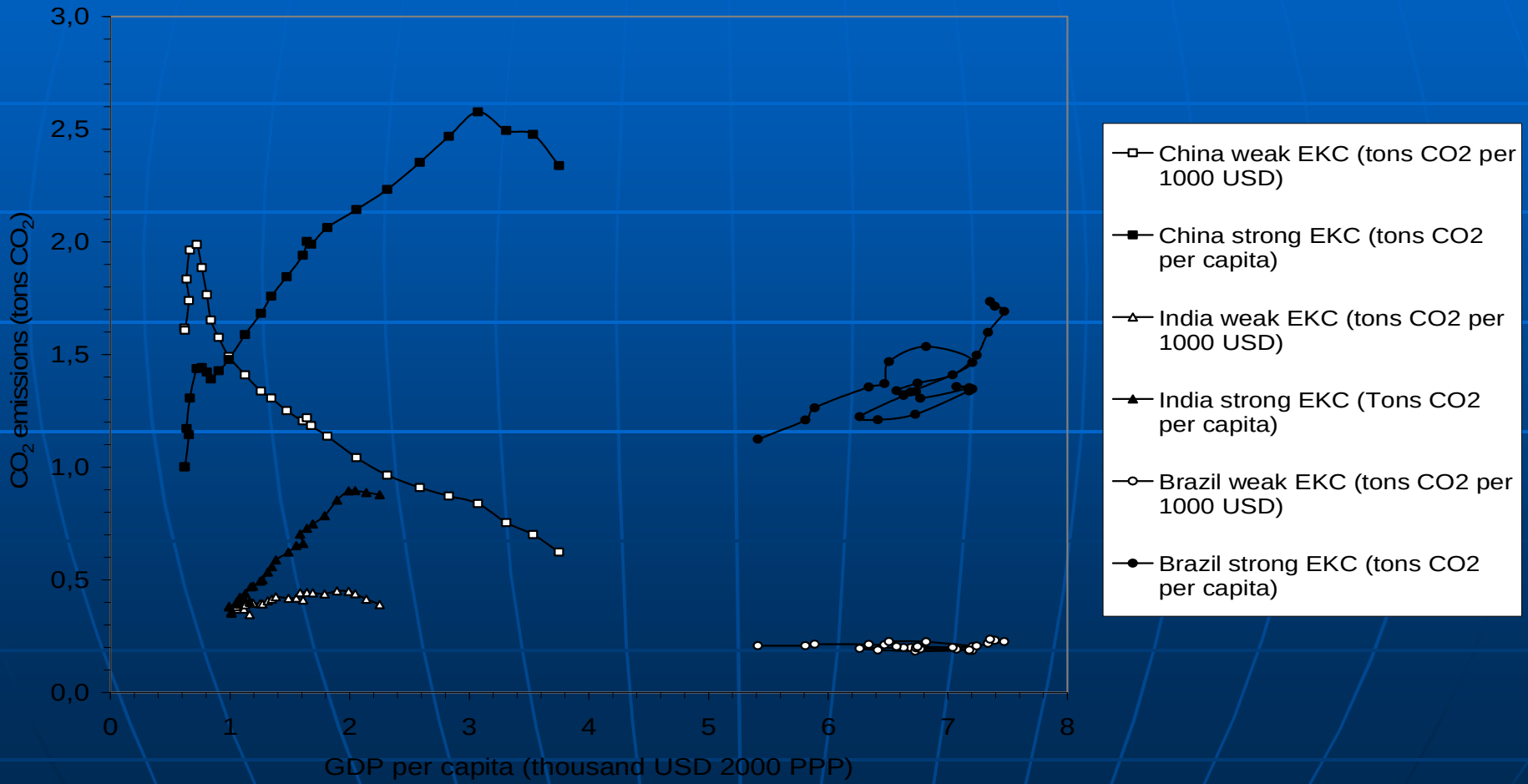
Trends of EKC curves in the EU, USA and Japan, TPES/GDP



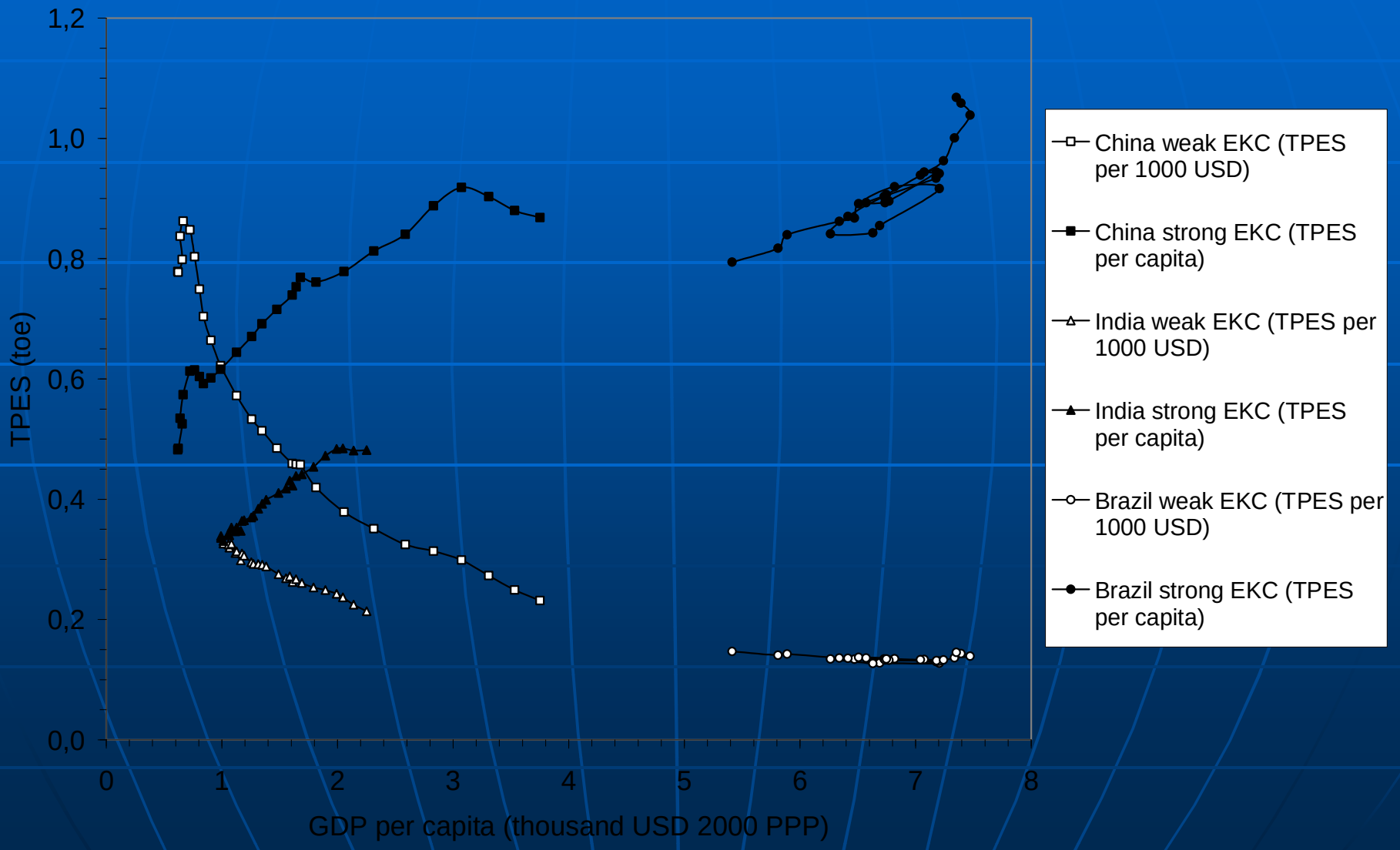
Trends of EKC curves in the EU, USA and Japan, TPES per capita



Trends of EKC curves, CO2 emissions-GDP per capita trade off in China, India and Brazil



Trends of EKC curves, TPES-GDP per cap trade off in China, India and Brazil



Summary

- Futures & foresight research programs are planning and management science programs, which are highly useful for long-range industrial ecology planning
- The interest of futures generations and analytical SD policy requires professional futures analyses
- There are broad co-operation options for foresight and futures studies with different fields of industrial ecology
- Advanced Sustainability Analysis (ASA) is an interesting application to analyse critical trends of SD, today it is also a part of global IFs simulation system
- The FFRC De-linking and Re-linking Analysis Model provides a useful analytical tool for modern scientific sustainability research
- Trend analysis, scenario analysis and wild cards analysis are providing a lot of interesting applications for new SD analyses

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I thank you for attention!