Tyndall°Centre
for Climate Change Research

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Adaptation and Mitigation Strategies:
Supporting European Climate Policy

The Global Deal:

treating anthropogenic climate change as an economic internality

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Outline: *The Global Deal*

- Summary: the global deal as an immediate solution to the twin climate and financial crises
- Contrasting “new economics” with “traditional economics”
  - interpreting the “evidence” from equilibrium modelling
- A new economics understanding
  - the twin crises and their common solution (in the short term)
  - the whole-systems concept of “internalities”
- The global deal
  - transforming the global energy and economic systems through internationally-coordinated climate policy portfolios
  - air-quality and climate-change synergies
  - the role of technology policies (standards and fiscal incentives)
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Summary

- The twin climate and financial crises require solutions that reduce systemic risks of wild weather and global depression
- The G8 50% target or 450ppmv CO2-eq are probably not stringent enough to avoid dangerous climate change (AR4)
  - a zero-carbon global target is required by at least 2050
- Current monetary and fiscal policies are rapidly worsening the credit crunch, by eroding trust in money
- An urgent and strong global fiscal reflation, based on new investment justified by social values and discount rates, will take up resources left unemployed by the credit crunch, and kick-start the much delayed shift towards decarbonising the global economy
  - costs critically depend on international co-ordination

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Climate change policy and economics:
traditional models are "past their sell-buy date"

Critical differences	Traditional economics	New economics
ethics and society	Utilitarian: optimising rational self-interested individuals	Observed: satisficing altruistic punishers in evolving social groups
time and equilibrium	Full employment forever: higher GDP growth ruled out by assumption; no double dividend for policy	Path-dependency: many unused resources and new business plans in response to threats
uncertainty	Normal: distributions derived from the past; use of "certainty equivalence"	Non-linear: catastrophic surprises are inherent in complex systems
technology	Exogenous: CGE and growth models have no feedbacks via technology	Induced: by climate policies

Treatment of values

traditional

- individual independent preferences
- monetized social welfare
- an optimal solution
- value of human life from economic theory and observation

new

- values formed by social groups
- multiple values
- no optimum
- value of human life from social consensus depending on context

Treatment of location effects

traditional

- no treatment of place in elementary theory
- all activity at points in space
- no transport costs
- no diffusion effects

new

- place of pollution and transmission of effects over distance is critical
- climate and geography matter
- diffusion of effects usually makes clean-up impossible

Treatment of temporal effects

traditional

- existence of equilibrium assumed
- no treatment of time lags in elementary theory
- static analysis
- implicit symmetry in timing, and reverse flows if costs

new

- non-linear systems assumed with chaotic behaviour
- time and duration of pollution and effects intrinsic to problem
- dynamic analysis
- irreversibilities (through accumulation of stocks)

Theoretical consistency

traditional

- based on coherent theory
- generally applicable to many problems
- draws on massive body of economic theory

new

- highly context specific
- maturing but fragmented theory
- draws on practical solutions of ecological problems

New economics is better than traditional in explaining the characteristics of the global economy

- Specialising production & generalising consumption
  - increasing trade leading to more currency unions, lower trade barriers
  - global branding and life-styles
  - markets increasing in numbers, scale and specialisation with associated reduction in costs
- Competitive innovation & obsolescence
  - information costs falling rapidly
- Persistent long-term trends in all regions
  - rural to urban
  - agriculture to manufacturing to services
  - more human & product mobility (travel to work, tourism, migration)

New economics is better than traditional in explaining the characteristics of the global energy system

- Increasingly unequal distribution of oil & gas resources
  - proven oil reserves concentrated in OPEC
  - gas supplies increasing insecure
- Plentiful coal, limited proven oil and gas
  - escalating costs for oil extraction
- Transport costs falling
  - economies of scale in pipelines and tankers
- No clear trend in oil price volatility

Most equilibrium models are unsuitable for analyses of the economy, the energy system or climate stabilisation

- Use of one year's data for 100-year projection
  - all dynamic characteristics of responses are assumed
  - lack of attention to trends leads to incoherent GDP projections
- Assumption of constant returns to scale
  - no treatment of systemic changes across all sectors, led by technological change and increasing returns to scale e.g. computing and telecoms technologies
- Based on inappropriate theory
  - in general CGEs have no stable or unique equilibria (Ackerman, 2002; DeCanio, 2003) (see notes for literature)

BUT: equilibrium models dominate quantitative sustainability analysis

- IPCC IAM SRES/TAR/AR4 models – all use economic cost components based on DICE/CGE-type models e.g. MARKAL-MACRO
- EMF16/19/21 studies: nearly all models are equilibrium (both aggregate and CGE)
- World Bank: CGE appears to be methodology of choice for structural analysis
- In summary it is a very popular methodology
  - extensive CGE literature and many applications for policy
  - flourishing world-wide CGE community
  - solution software (GAMS) and specially-constructed CGE database and parameters of standard forms are available (GTAP)
  - cheap or even free DICE/FUND/CGE models (just 1 week of your time to build one, but garbage-in-garbage-out)

E.g. characteristics of the EMF21 models:

(1) most models are equilibrium-based

(2) but the equilibrium approach is misleading if not wrong

Model	Model type (a)	Representation of NCGG emission reduction options (b)	NCGG contribution method (c)	Solution concept (d)	Time horizon (e)	Colour code
AMIGA	MSGE	RFPF	GWPs	RD	2100	1
GTEM	MSGE	RFPF	GWPs	RD	2030	1
GEMINI-E3	MSGE	RFPF	GWPs	RD	2050	1
EU-PACE	MSGE	RFPF	GWPs	RD		1
EDGE	MSGE	RFPF	GWPs	RD	2030	1
EPPA	MSGE	RFPF	GWPs	RD	2100	1
IPAC	MSGE	RFPF	GWPs	RD	2100	1
SGM	MSGE	RFPF	GWPs	RD	2050	1
WIAGEM	MSGE	RFPF	GWPs	RD	2100	1
Combat	AGE	RFM	RF	INTOP	2100	2
FUND	AGE	RFM	RF	INTOP	2100	2
MERGE	AGE	RFM	RF	INTOP	2100	2
GRAPE	AGE	SM	RF	INTOP	2100	2
IMAGE	ISM[a]	SM	GWPs	RD	2100	3
MESSAGE	ISM	SM-2	GWPs	RD	2100	3
AIM	ISM	SM-2	GWPs	RD	2100	3
MiniCAM	ISM	SM-2	GWPs	RD	2100	3
POLES/AgriPol	ISM	SM	GWPs	RD	2030	3

NCGG—non-CO_2 GHG gases.

(a) MSGE—Multi-Sector General Equilibrium; AGE—Aggregate Gen Equilibrium; ISM—Integrated Structural Model.

(b) RFPF—Reduced Form Adjustment to Production Functions; RFM—Red Form MACs; SM—Structural Models; SM-2 indicates models that have included individual reduction measures.

(c) RF—Radiative Forcing; GWPs—Global Warming Potentials.

(d) RD—Recursive Dynamic; INTOP—Inter-temporal Optimization.

(e) Groups only refer to the colour coding used in the figures.

[a] The term Integrated Structural Model (ISM) is used here to indicate the group of models that include relatively detailed structural models of the sectors that emit non-CO_2 greenhouse gases. Most of the models in this group can also be classified as Integrated Assessment Models.

Source: Van Vuuren, D.P., J. Weyant, and F. de la Chesnaye, 2006a. Multi-gas scenarios to stabilize radiative forcing. *Energy Economics*, 28, pp. 102-120.

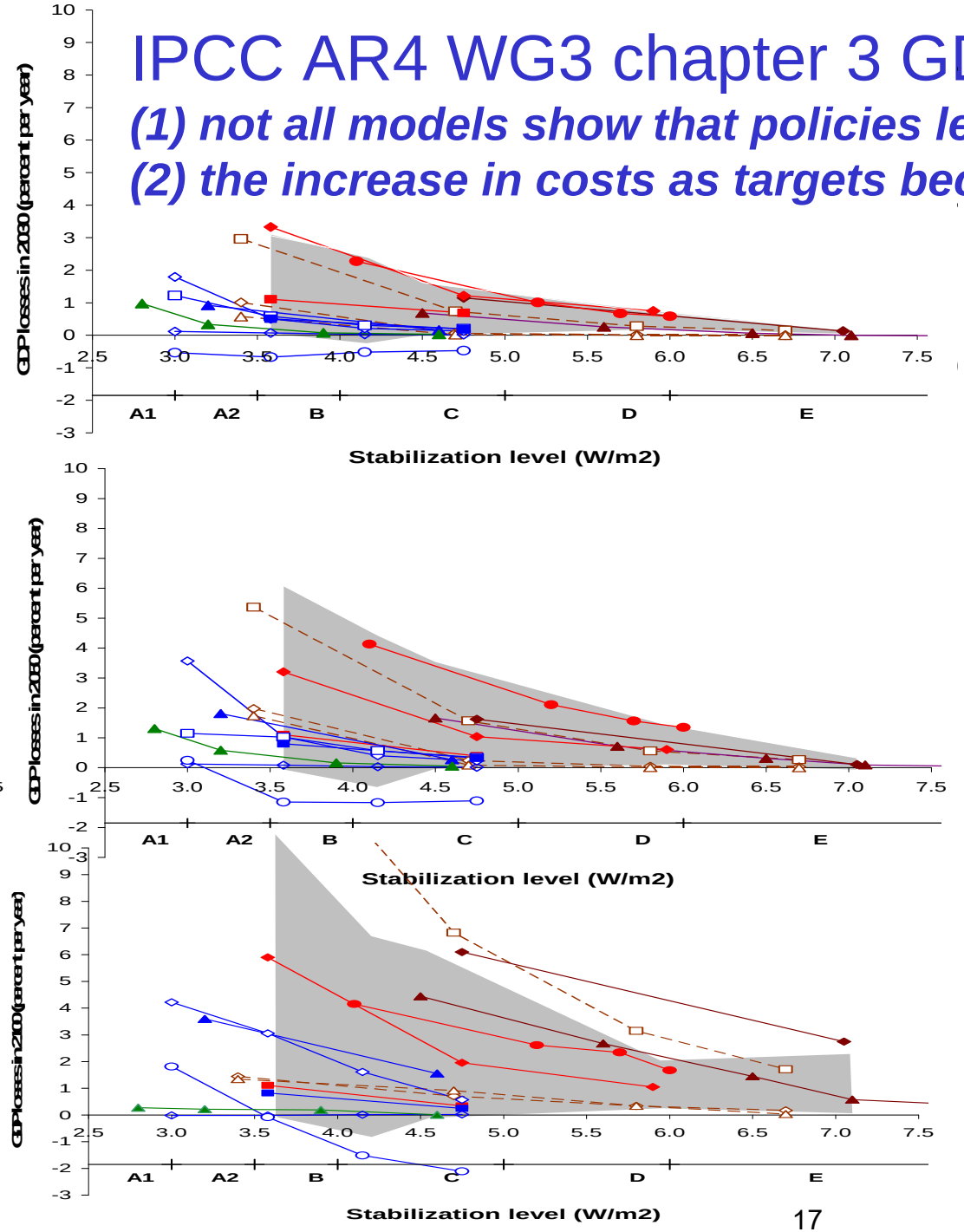
Macroeconomic modelling of mitigation policies 2009-2020

- Sectoral approach helpful (c/f aggregate models such as DICE or FUND)
  - substitution by gas is an important mitigation option
  - fuel-using sectors (power, transport, residential) have different costs of mitigation
  - carbon-saving capital can use very different technologies and life-times (CCGT's, car engines, dwellings)
- Use of fuels depends on capital stock, so short-term price responses may be low: therefore CGE models can be very misleading for annual analysis

IPCC AR4 WG3 chapter 3 GDP losses:

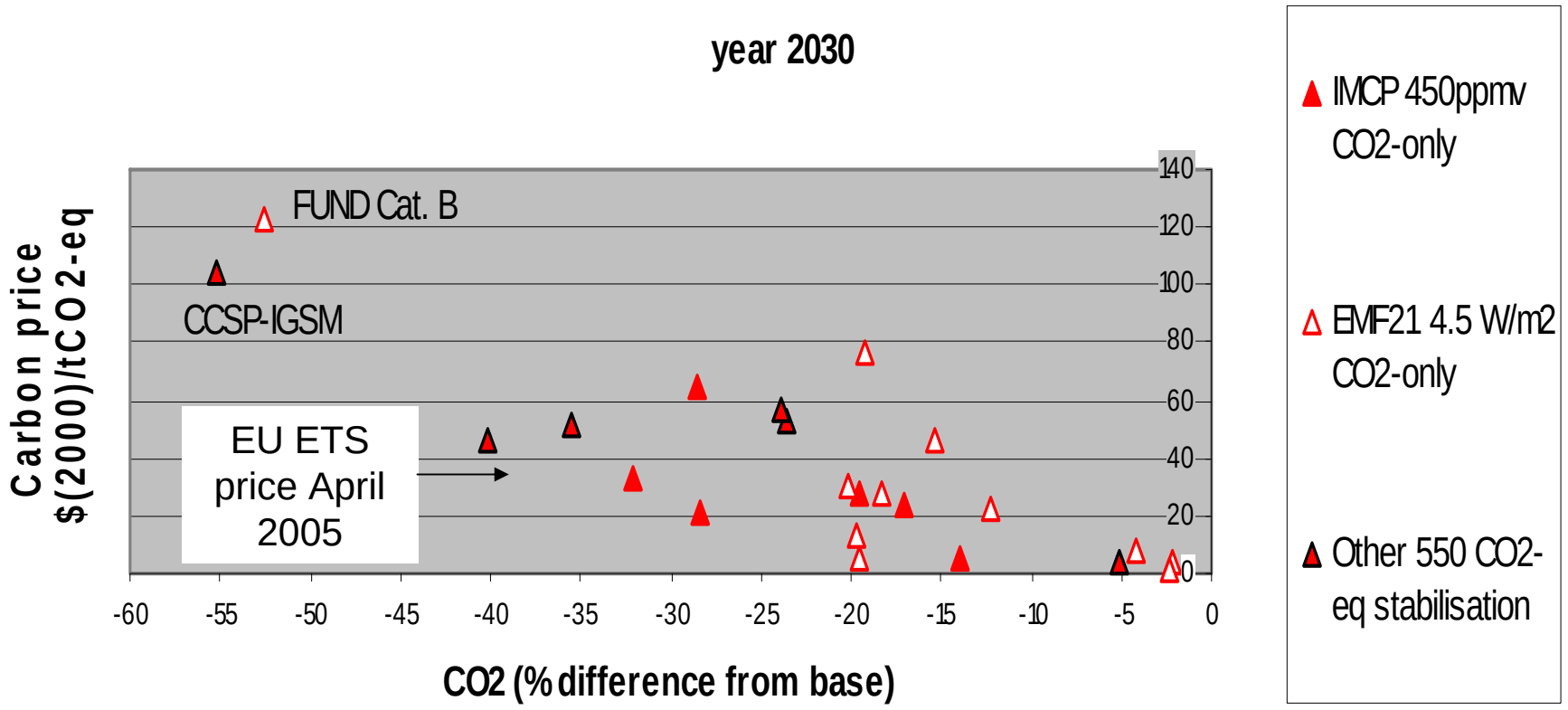
(1) not all models show that policies lead to GDP costs

(2) the increase in costs as targets become more stringent is illusory



Carbon prices and CO_2 effects for 550ppm CO_2-eq stabilisation from modelling studies:

outliers can lead to mis-representative results



Note that to achieve the stabilisation target, non-CO_2 GHGs are also assumed to be reduced by the CO_2-equivalent prices for all scenarios shown.

New economics

- all economic activities are specific to a place and a time (representative agent assumption is not just wrong but misleading)
- the presumption is that all people and social groups are different (different location, different history)
- econometrics is about averaging & finding tendencies
- ecological “whole systems” economics dominates the individual utility-maximising rational economic man-molecules of 19thC energetics-based general equilibrium

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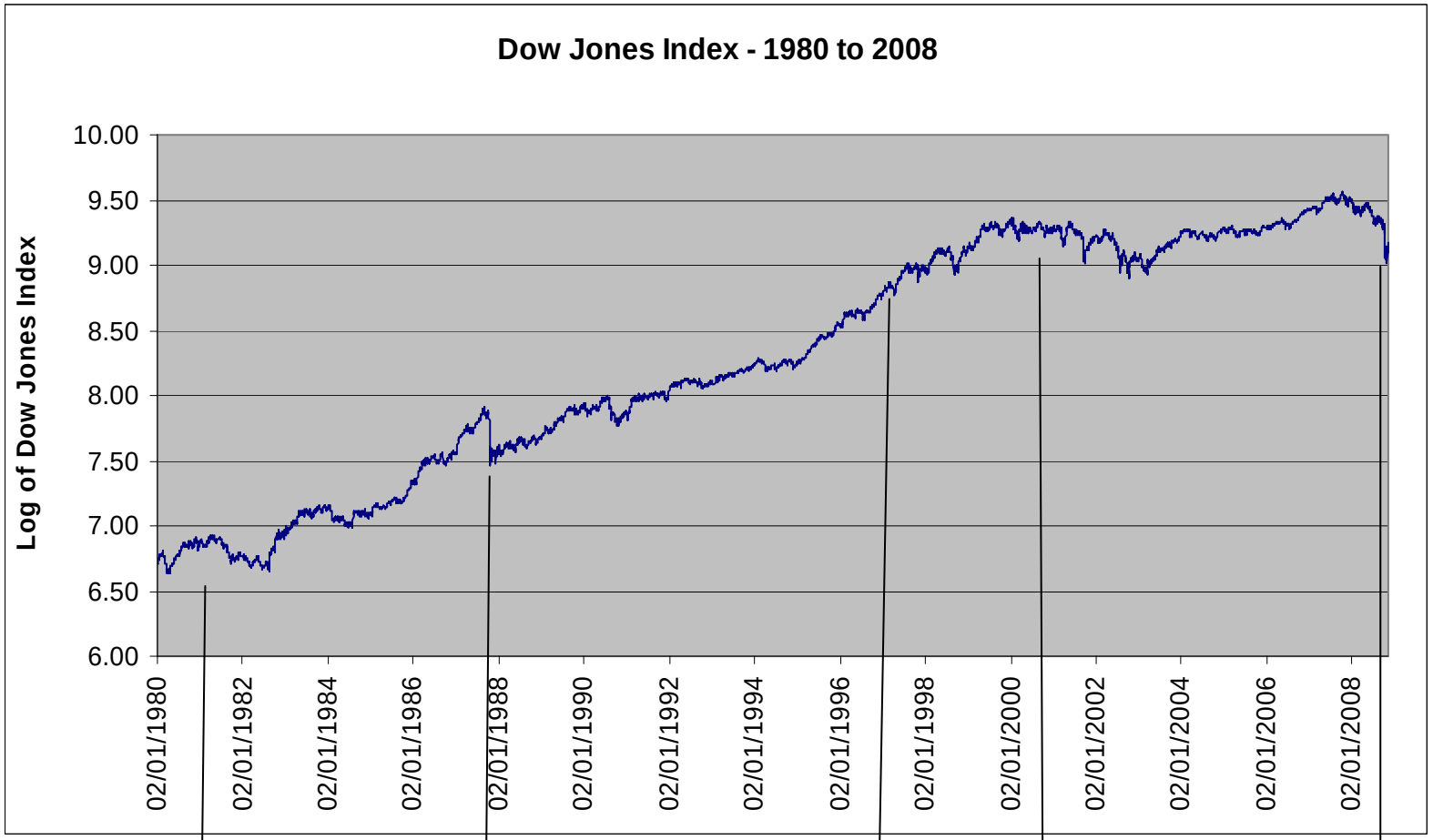
Assessing risk **and** return

- Risks are different for climate change, adaptation, mitigation and the financial crisis
  - for countries and time periods
  - outcomes are not smooth, but can be abrupt and irreversible
  - risks can be asymmetrical: e.g. (unbounded?) risks of higher rather than lower temperatures and sea level rise
- There are possibilities of catastrophe (IPCC WG1 Box 10.2: approx. 3% probability of climate sensitivity leading to > 8ºC).
  - conventional cost-benefit analysis is "*especially and unusually* misleading" (Wietzman, 2007)
  - and a sea level rise of several meters over this century cannot be ruled out (Hansen *et al*, 2008)
- Assets such as the Amazon rainforest or coral reefs cannot be substituted by money, partly because their loss is effectively irreversible
- Economic assessment should cover both costs & benefits *and* such risks, e.g. of collapse of banks

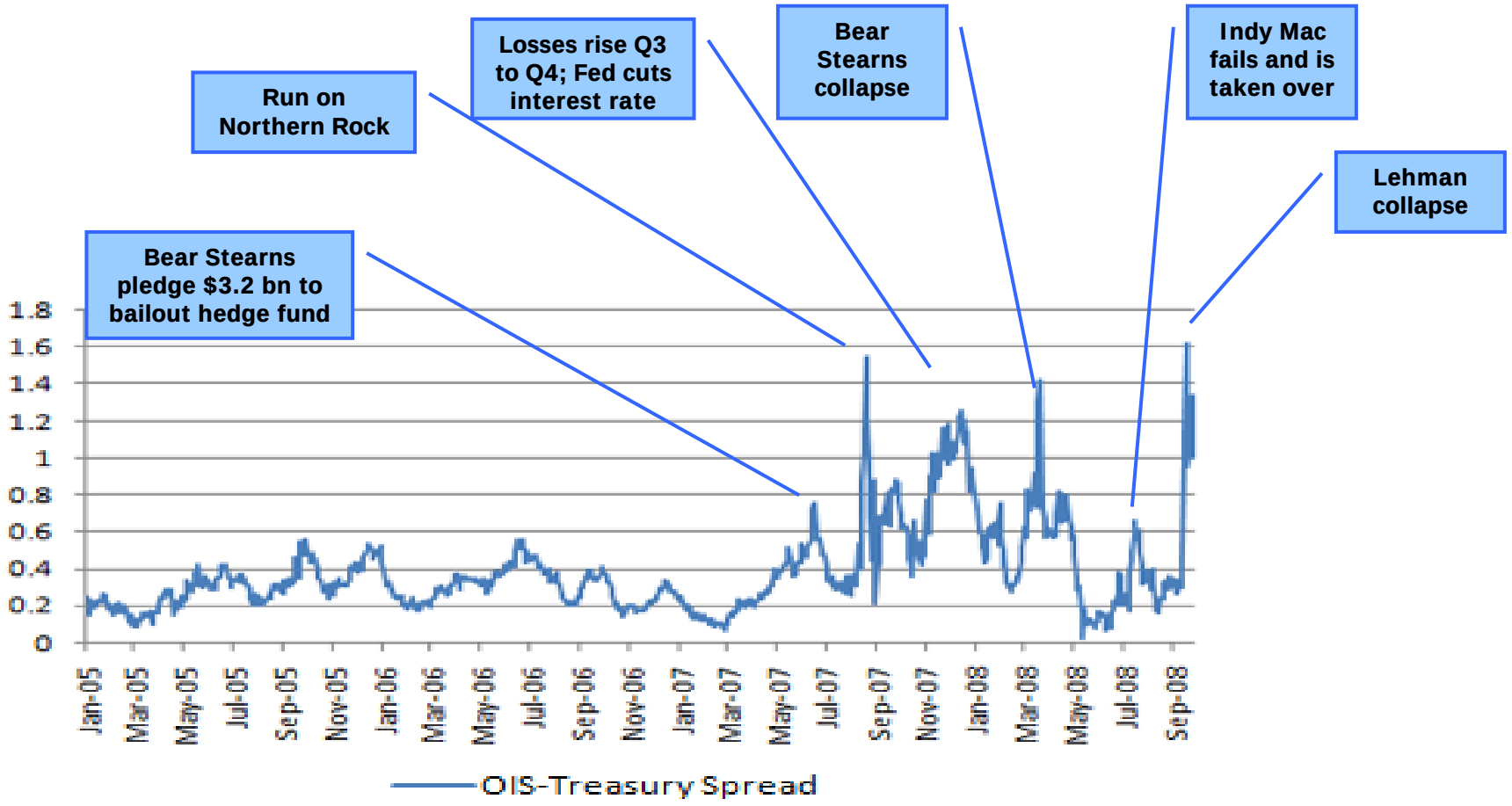
The Big Crunch

- With the bankruptcy of Lehman Brothers (15/09/08), the global money stock was abruptly reduced by an unknown amount
- Many if not all banks with substantial exposure to “toxic” debt may now be insolvent, depending on stock market valuations
- The crisis became apparent when banks ceased to trust one another in summer of 2007, but has been concealed by creative accounting and failure to value assets at realizable values
- The crisis is one of international money: the banks have been creating new forms of money that are now seen to have a highly uncertain worth, i.e. “bad money”
- The Fed’s proposal (19/09/08) was to exchange the bad money for good government-backed money, then gradually liquidate the underlying debt
- On 12/11/08 the Fed abandoned plans to buy toxic assets in favour of recapitalisation

The Big Crunch: history 1980 to present



The Big Crunch: history of the OIS spread



OIS: Overnight Indexed Swap

Swap spreads reflect expectations of credit risks and of interbank lending risks

Source: to be confirmed.

The Big Crunch changes everything: ***economic activity is based on trust, and trust in money has gone***

- Trust underlies our use of money
- Private banks lost some of our trust
- No trust = no banking
- No banking means no bank loans for real investment (or consumption)
- The Big Crunch = global financial catastrophe
  - Non-linear event with extreme outcomes
  - Unprecedented in economic history in its scale
  - Unlike the tulip mania or South Sea Bubble, it is not primarily based on speculation, but on banks creating money
  - The bail-outs deepen and prolong the depression

The Big Crunch and Global Warming

- Similarities
  - Both arise out of the pursuit of self-interest
  - Both are market failures associated with systemic risk and, arguably, both are the greatest market failures the world has ever seen
  - Both are highly nonlinear systems' failures leading to extreme events (economic and climatic)
  - Both threaten the economy with catastrophic collapses
  - Both require strong regulation for efficient economic outcomes

- Differences
  - Timing: big crunch happened in a day, arguable a week, year, or even two decades; global warming is a four-century process
  - Risks: big crunch risks are to trust in money and global deflation; global warming risks are wild weather and floods/droughts
  - Solutions: big crunch requires and supports immediate solution (banks reputations destroyed; global warming solutions can be delayed and subverted more easily by special interests

Anthropogenic climate change as a whole-system internality

- Proposed new macro definition (c/f/ Wikipedia's behavioural economics micro definition of personal "types of behaviours that impose costs … in the long-run that are not taken into account when making decisions in the present.")
- **Whole-systems internalities are "social behaviours (such as those leading to emissions of greenhouse gases) that impose costs on future generations, which do not take into account these costs when decisions are made by present generations."**
- For example, at the level of global economic activity, greenhouse gas emission (GHG) is an internality affecting crops and real estate, but solar activity is an externality affecting the biosphere and radio communication.
- Traditional economics treats GHG emissions as an externality assuming that the organisations, such as oil companies, take into account the effects of their actions on themselves, but not on others. In fact, because such social groups are myopic, they do not take any such effects into account and therefore the Pigouvian tax/permit rate are too low, even in the traditional approach.

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The Big Crunch: implications for climate policy

- The period of the creation of the bad money has seen a massive mis-allocation of investment funds towards the financial services
- The real investments supported by these services and the incomes from them (buildings, luxury goods etc) will stop and engender a global recession
- The gap in global effective demand could be closed by a massive effort to invest in decarbonising the real economy, but requires
  - Recognition of the opportunity
  - Rapid development and deployment of mitigation policies aimed at raising investment especially where real resources are becoming unemployed (construction, vehicle manufacture)

Solution: a seven-point plan

1. Allow markets to work and bankrupt bad banks, whilst maintaining their institutional knowledge
2. Co-ordinate an global interest-rate cut to zero
3. Temporarily fix exchange rates (implement capital controls) and fix key international prices (e.g. carbon, coal, oil, gas)
4. Consolidate the bad debt into regional banks
5. Reflate via an agreed global investment plan, supported by the good banks and scaled to maintain effective demand
6. Reduce the risks of regulatory capture by a global regulatory authority having the power to “name and shame”
7. Reform international company law and standards to reduce costs of decarbonising the global economy

Point (5)
Reflate via a global investment plan

- Investment should be justified by cost-benefit analysis, allowing for all risks
- The programme should be co-ordinated on a global, macro scale but tailored by governments to regional needs and conditions
- Investment backed by good banks may restore banks and the “real” economy
- Opportunity of the century to scale-up investment in decarbonisation (AR4 WG3 chapters 4 to 11)

Air quality and climate change synergies:IPCC conclusions, 2007

- Near–term health benefits from reduced air pollution may offset a substantial fraction of mitigation costs
  - Mitigation can also be positive for: energy security, balance of trade improvement, provision of modern energy services to rural areas and employment
  - Mitigation in one country or group of countries could lead to higher emissions elsewhere (“carbon leakage”) or effects on the economy (“spill-over effects”)
- These co-benefits for human health and crop productivity are especially high in developing countries

The role of technology policies

- Third to Fourth Assessment report
  - “remarkable progress has been achieved in applying approaches based on induced technological change to stabilisation studies; however, conceptual issues remain” (SPM, p. 28) (EMF19, IMCP)
  - technology is now responsive to carbon prices in many models
- In the models that adopt these approaches, projected costs for a given stabilization level are reduced
  - the reductions are greater at lower stabilisation levels.
- Although most models show GDP losses, some show GDP gains
  - because they assume that baselines are non-optimal and mitigation policies improve market efficiencies
  - or they assume that more technological change may be induced by mitigation policies.

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“New engineering” – an economist’s view of new modelling for decarbonisation

- Problem: how to decarbonise whole systems at lowest costs as soon as possible with a trade-off between doing a good job and doing it even faster
- Conditions today
  - technologies being developed (e.g. CCS, electric vehicles, expert systems)
  - relative prices (oil, carbon) fluttering
  - national and international policies rapidly evolving
  - but with inertia in human and physical systems
- Problem separable into interacting engineered systems
  - Electricity, vehicles, dwellings, offices, steel, cement, etc
  - can be decarbonised separately, but a fit between them required
- Enabling structures and networks for low-cost solution
  - direct current grid
  - guaranteed global carbon and fossil-fuel prices
  - technological agreements and standards

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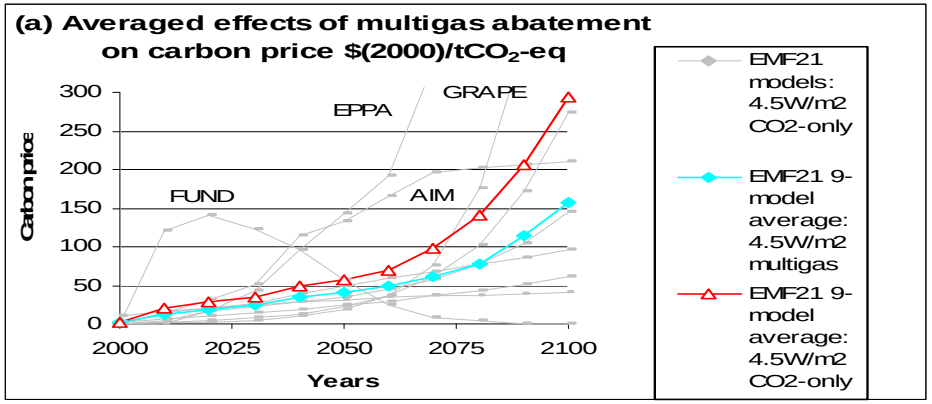
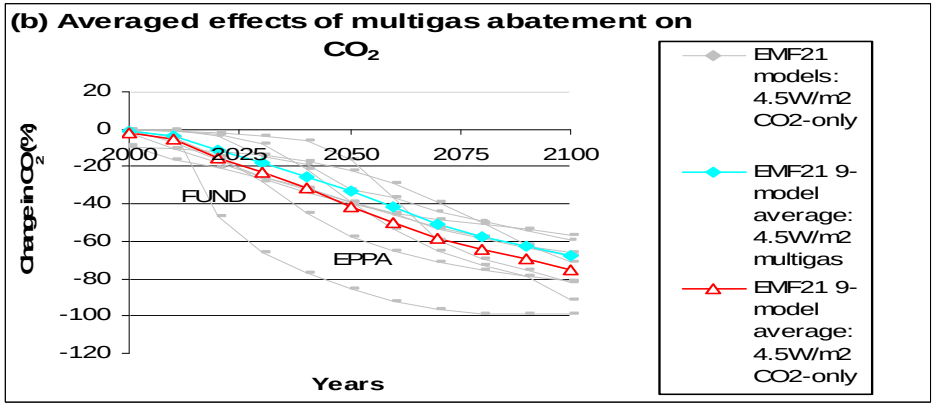
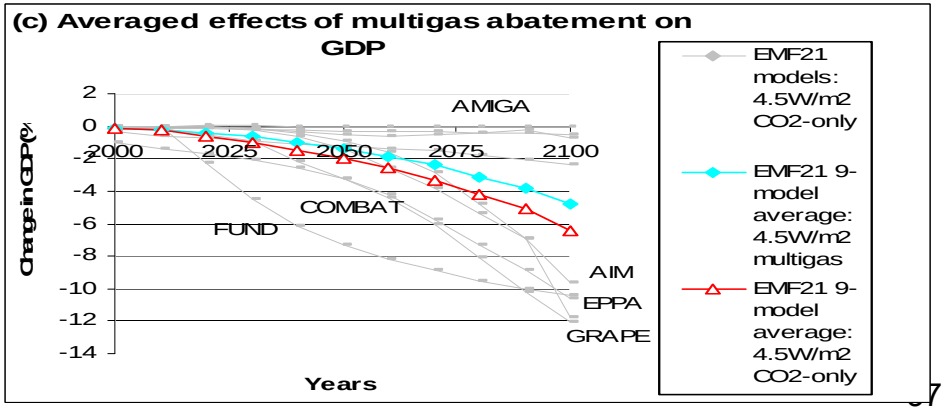
Average effects on carbon prices, CO2 and GDP of stabilization targets:

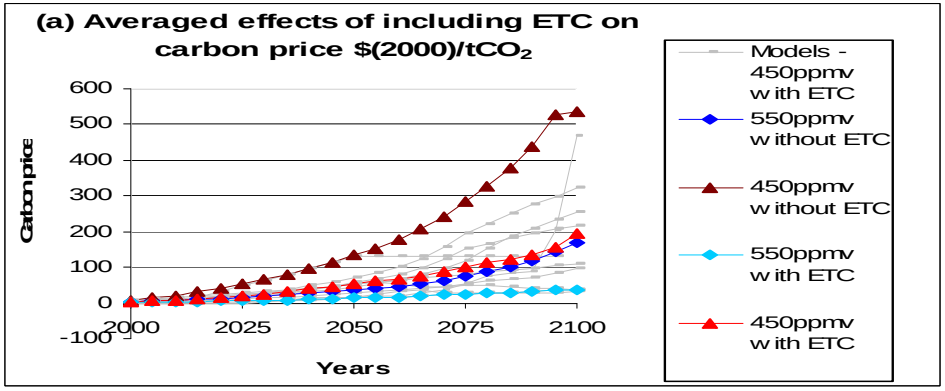
EMF21 Reduction in costs: multigas abatement

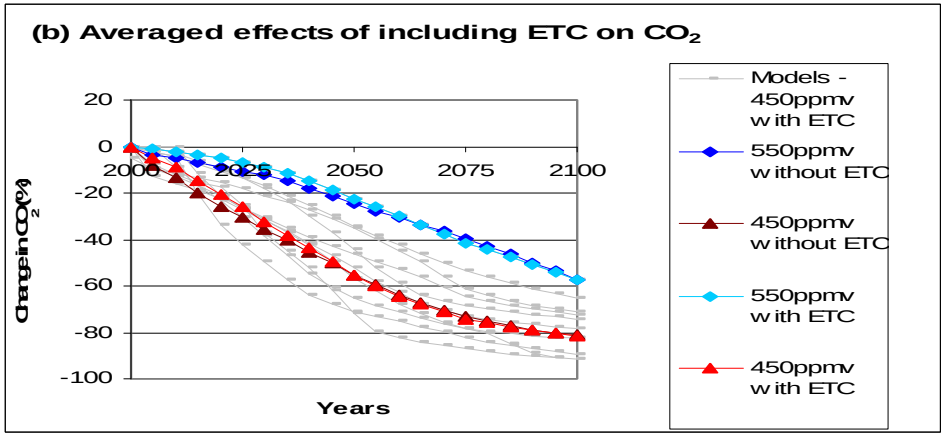
IMCP induced technological change

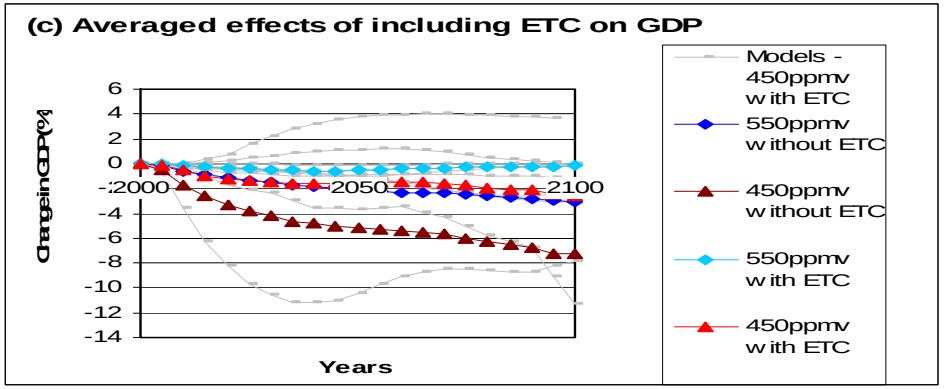






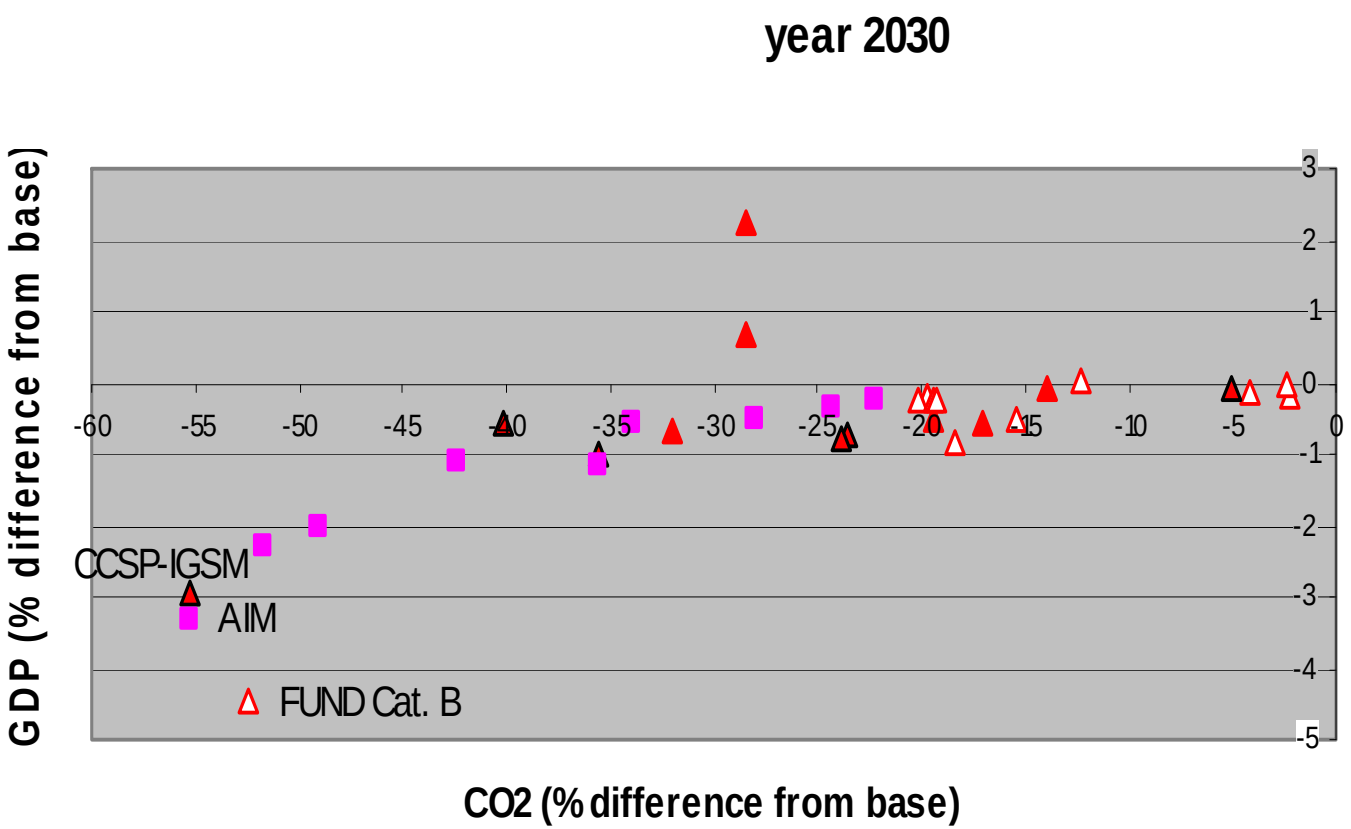






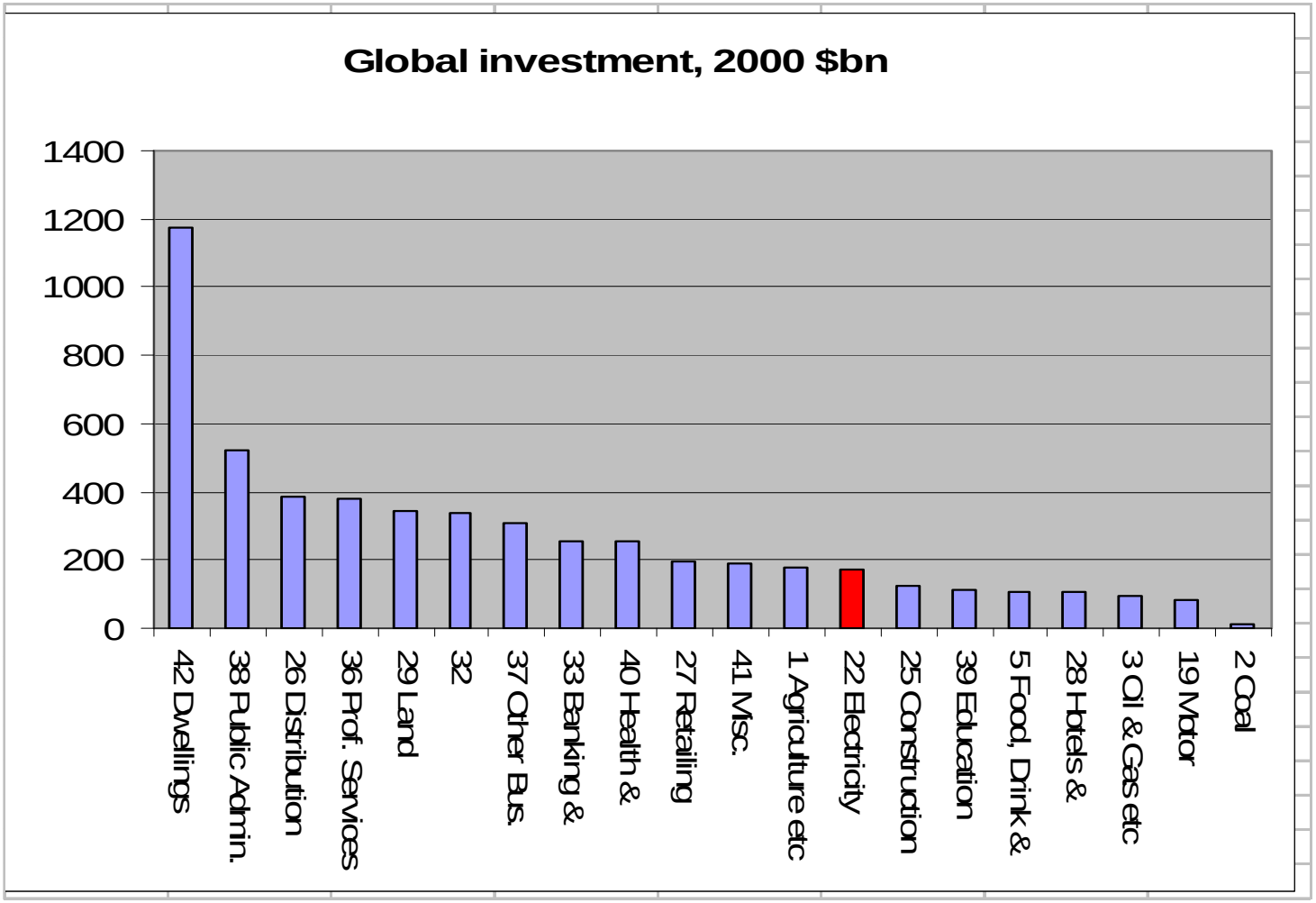
GDP and CO_2 effects for 550ppm CO_2-eq stabilisation from modelling studies:

outliers can provide interesting alternative views



Note that to achieve the stabilisation target, non-CO_2 GHGs are also assumed to be reduced by the CO_2-equivalent prices for all scenarios shown.

Electricity investment in context: global investment, 2000 $bn



Conclusions: elements of the global deal

- Governments are meeting in Poznan 8-12 December 2008 (COP/MOP 14) and will consider policies to resolve the climate and financial crises: negotiating groups are OECD, China, India, OPEC, Russia
- Seven-point plan can resolve both crises, with the main benefit being rapid employment recovery in all countries
- A Global Emission Trading Scheme (GETS) for international transportation will decarbonise the sector and fund developing country mitigation and adaptation programmes