Planetary Economics
and the
three domains of sustainable energy development

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Outline

- The Age of Innocence
  - Palty Progress
  - A Crisis of Theory
- The three domains
  - Three conceptions of the challenges
  - Three realms of opportunity
  - Three fields of theory
  - Three pillars of response
- Reframing the challenge and opportunity
- Reprise: the three domains

The Age of Innocence:
from victories over OPEC & communism to financial crisis

- Remember “The End of History”?
- Western dominance based on belief that markets could solve all problems – including resource and environment
- Astonishing neglect of the emerging economies and their significance for global resource, economy and geopolitics
- Debt-based growth:
  - Finance
  - Easy oil
  - Atmosphere

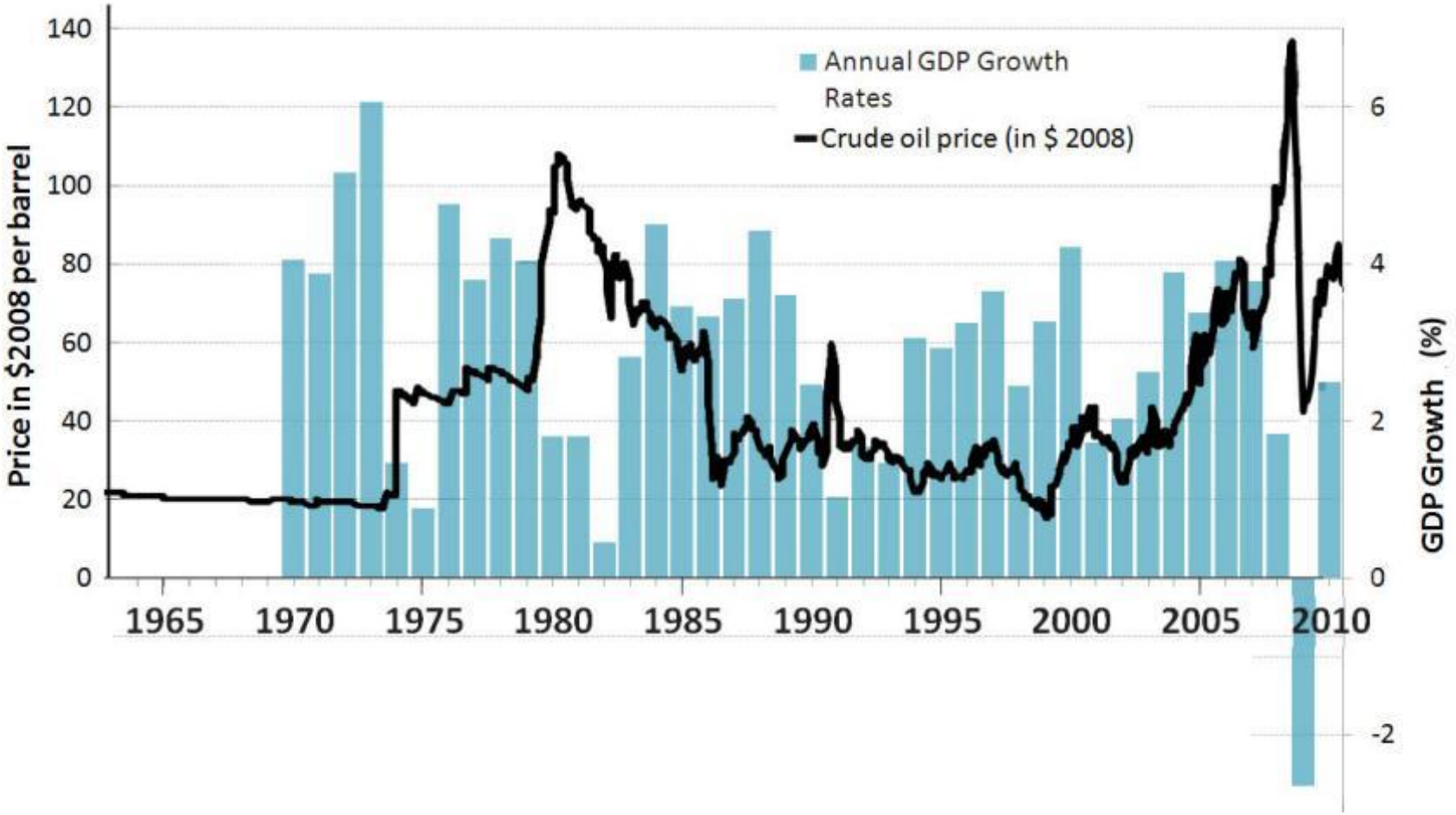
Paltry Progress

- At the end of the Age of Innocence
  - The “rich world” is mired in debt
  - The global economy remains as dependent on fossil fuels as it was at the beginning
  - The world faces geopolitical uncertainty and potential instability not seen for two generations
  - Global CO2 emissions are rising faster than ever before (in absolute terms)
  - Global negotiations are in a tenuous state – the best milestone is agreement to try and solve the fundamental problems in December 2015

The theory: a (slight) caricature applied to energy and climate change problems

- **The basic theory:**
  - The economic challenge is resource allocation, and competitive markets are far better than governments
- **Energy:**
  - Establish markets to ensure least-cost system
  - Acknowledge that for a finite stock resource like cheap oil, the price should rise smoothly to reflect scarcity according to the Hotelling rule
  - Invest accordingly in backstop technologies
- **Climate:**
  - Estimate the 'social cost of carbon emissions (SCC)'
  - Set a carbon price equal to the SCC

Reality 1: Oil price hardly a smooth Hotelling depletion experience!



The issue is not resource exhaustion, but uncertainty, volatility and risks ..

- Systematically poor foresight
  - The Economist's "drowning in oil .. @ $5/bbl?" (2000)
- Energy price fluctuations have substantial economic and social consequences
  - particularly in poorer countries, but sometimes global
- History of 'national catastrophe' in terms of sudden drastic loss of GDP (Nordhaus), major causes were
  - War
  - Natural disasters
  - …. And oil price fluctuations
- 'New frontiers' in Deepwater, Arctic etc
  - No likely decline in price or volatility

Reality 2: At the political "coal-face"

- Actual *progress* on climate policy is very limited
- Hard to motivate publics to incur real costs for addressing impacts that are remote – in both time and space and hence 'personal' connections
- … especially when climate change to most people in the major emitting countries is still not visible in their everyday experience
- .. Difficult for governments politically, and even more so when the experts provide imponderables more than clear quantified numbers

Costing the climate: the Stern Review

- The most concerted (and politically important) attempt to examine and quantify the economic case for action
- Underlined importance of
  - Ethical underpinnings of long-term valuation
  - Uncertainty and risk of extremes
- On each of these, faced important subsequent challenges

The post-Stern debate: (1) 'space-time consistency'

- Nordhaus attacked consistency of low discount rates with the human time preferences as revealed in risk-adjusted market discount rates
- Dasgupta (Review of Environmental Economics & Policy) summarised concerted broader attack on *consistency*:
  - Accepts Stern case for low pure rate of time preference, and rejects Nordhaus' claim to empirical basis for discount rate, ***but***
  - Inequality aversion should apply symmetrically across time (generations) and space (countries/populations): Stern was inconsistent.
  - Yet rejects Schelling attack (ie. "caring more about future poor than present poor") generations, for reasons of 'incentives, governance and responsibility'
  - Resolves the tension by noting that higher inequality aversions (for which there is empirical evidence) can restore significant discount rate but *also makes the valuation (even) more sensitive to uncertainties*
- Concludes that sufficiently high uncertainty can result in '**no optimum policy existing** … consumption discount rates cannot be defined and social cost-benefit analysis of projects becomes meaningless'

Other post-Stern debate focused on risks and extremes

- *what are we actually counting & measuring?*

		Which kind of impacts?		
		Market	Non-market	**Multiple stresses and socially contingent**
What kinds of climate changes?	Projection (trend)	Coastal protection Dryland loss Energy (heating & cooling)	Heat stress Wetland loss Ocean acidification Ecosystem migration / termination	**Displacement from coastal zones** **Regional systemic impacts**
	Climate variability & (bounded) extremes	Agriculture Water Storms	Loss of life Biodiversity Environmental services	**Cascading social effects** **Environmental migration**
	System changes & surprises	**'Tipping point' effects on land, resources**	**Higher order social effects** **Irreversible losses**	**Regional collapse** **Famine** **War**

Figure 2-9 The risk matrix: an assessment framework for evaluating the social cost of climate change

Note: 'Socially contingent' costs may be understood as those that may be amplified by the inability of society to respond to impacts effectively, such as failures of governance , inability to act collectively, or the frictions associated with migration or deeper disturbances

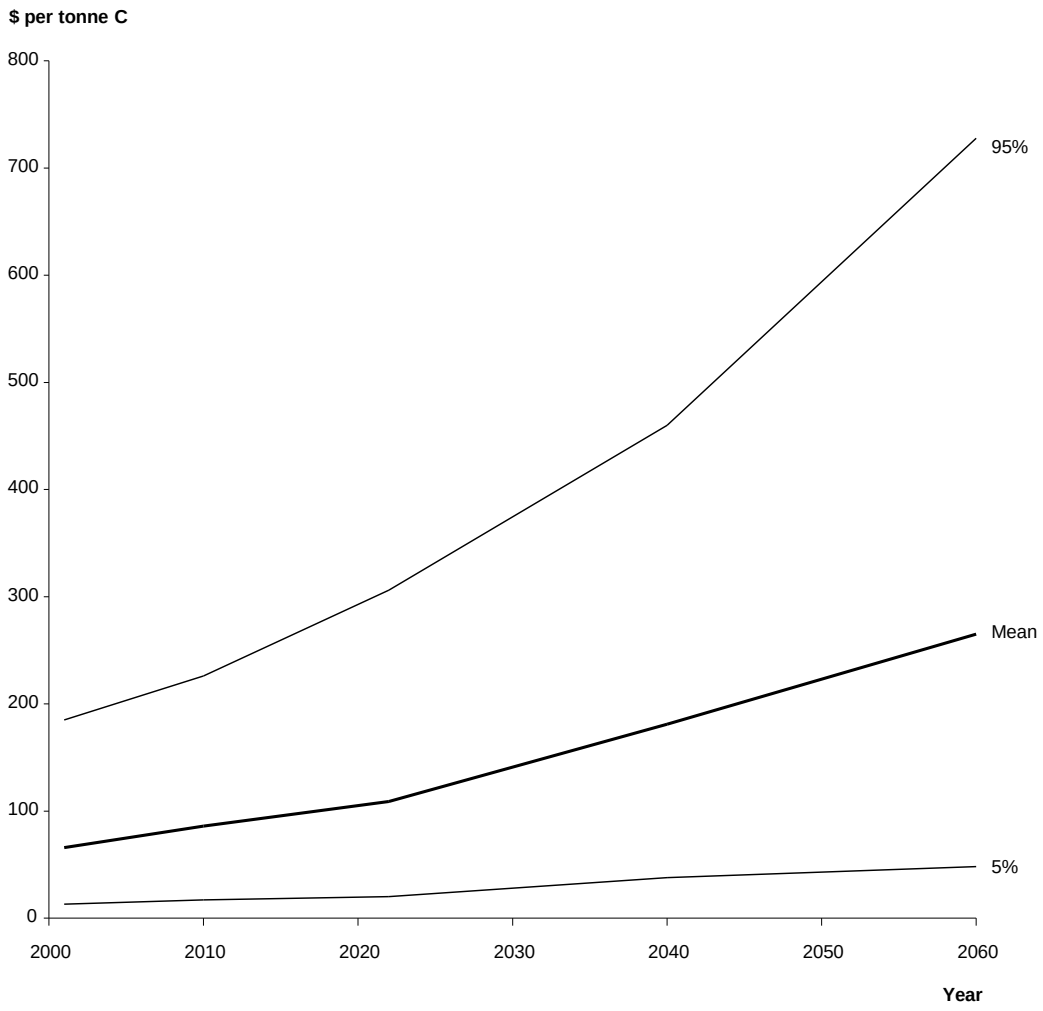
Source: Developed by the author from Downing et al. (2005), Jones, R. and G. Yohe (2006), Downing and Dyszynski (2010).

Post-Stern debate (2): Weitzman's 'Dismal Theorem'

- Uncertainty of impacts is key: traditional treatments (if any) have *assumed 'thin-tailed' distributions* for mathematical convenience
- *But* a rigorous statistical analysis clarifies that we are dealing with 'probability distributions of probability distributions':
  - Inevitably finite data available on extremes
  - Implies a '*thick tailed'* distribution of extreme event probabilities
  - *welfare damage* of extremes most plausibly rises faster than *probability* declines
- Weitzman's "Dismal Theorem"
  - 'No finite sample can assess probability of magnitudes of the most extreme disasters lurking in the distant tails of distributions – expected (impacts) will be driven to an arbitrarily large extent by this unavoidable limitation.. …
  - 'climate change generally and climate sensitivity specifically are prototype examples of this general principle, because we are trying to extrapolate inductive knowledge far outside the range of our limited experience'
  - 'the debate about discounting may be secondary to a debate about the open-ended catastrophic reach of climate disasters'
- The 'economics of the precautionary principle'

The 'social cost of carbon'

cannot be the only – or even principal - guide to policy



- '… somewhere between 10 and 1000 $/tC' [Downing]
- .. because it assumes a single unified decision-maker willing and able to act on the basis of an agreed number
- This bears no relationship to either economic or political reality

Source: Hope & Newbery, in *Delivering a low carbon electricity system*
Figure 2.3: Social cost of carbon over time for δ = 1.5%, and v = 1

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Three conceptions of the challenge

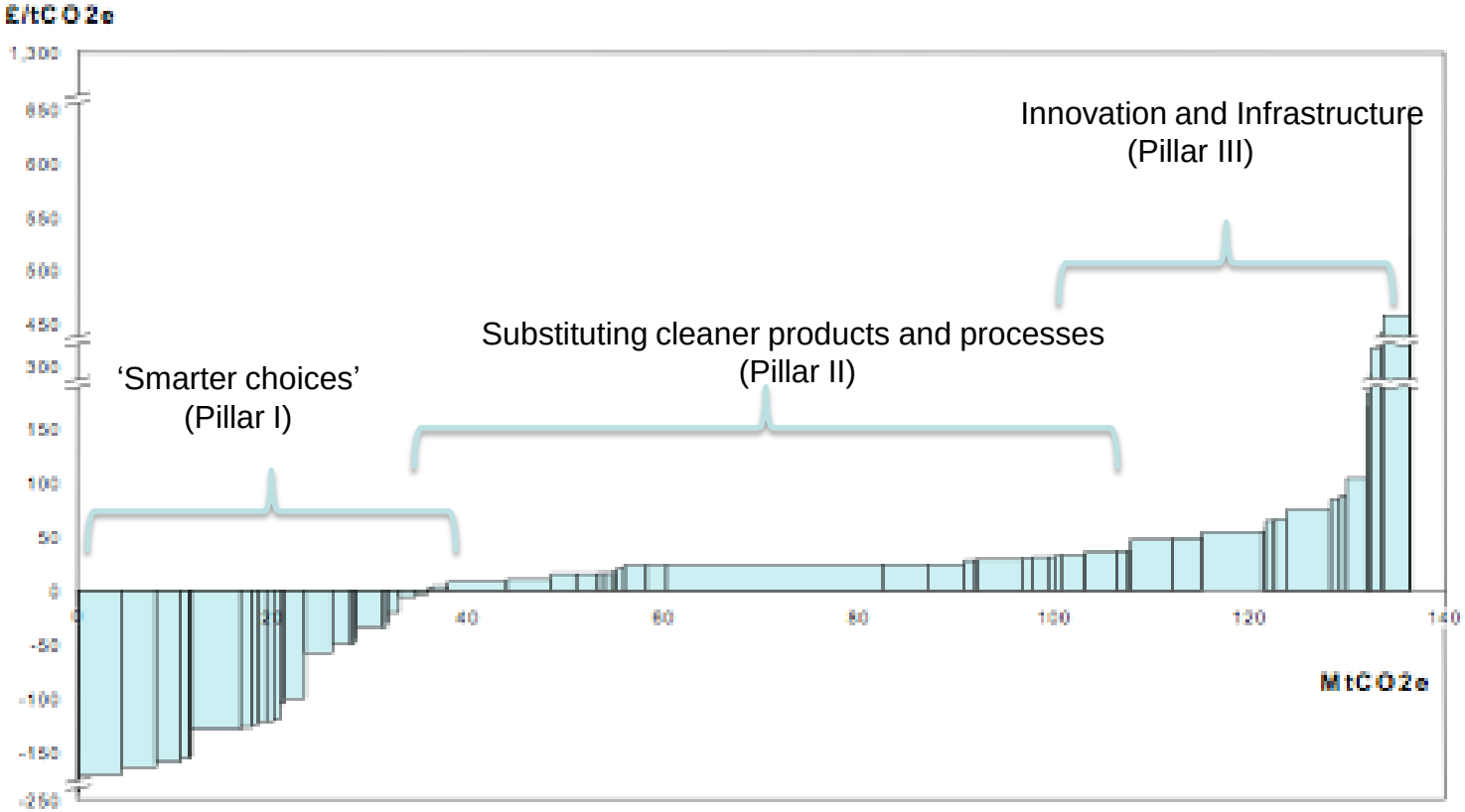
	Stage of perception	Domain of analysis / response
'Don't see, don't know, don't care'	Low / declining energy prices First 'few decades' of climate change	Volatile public concern, easily eclipsed, bored or confused; Environmental group campaigning *vs* resistance lobbying; Expert debate based on science and projections trying to look forward to …
Optimisation & cost-benefit	Tangibility – energy prices, education and/or as CC impacts rise above the noise: lead to deeper public acceptance and knowledge	Cost-benefit framing .. Grappling with the imponderables and values *.. Which will be evaluated differently in different regions*
Strategic security & sustainability	'Security' jeopardised by exposure to energy and climate risks	Challenges as a *security* issue • Ultimately for all (systemic, intergenerational/global risk) • For the most vulnerable, much sooner •.. With international spillovers

Challenge is to develop analytic discourse to help societies in the first stage look ahead to make sense of later stages

Is securitisation of climate impacts analysis helpful?

- **Does** provide a language that helps people understand nature of a problem they do not experience daily, with analogy to personal and national security etc
- **Does *not*** provide a 'carte blanche' for drastic emission reductions: is not the same as 'infinity'
  - Security of *most vulnerable* could be protected in other ways (eg. Tol/Lomborg: but limited ..)
  - Can be set against context of *other security risks* including at personal level eg. energy access, health risks, 'basic needs' - and thus a context for considering equitable contributions
  - .. .Yet also reveals limitations of adaptation
- **Enables** us to align climate debate with discourse about:
  - *strategic* energy dependence, volatility & security of supply chains
  - *Other* geopolitical challenges around state responsibility, ethics & IR
- **BUT** we have lost a unifying estimate of the 'social cost of carbon' – where does this leave 'optimal (or efficient) policy'?
- … and consistency of choices?

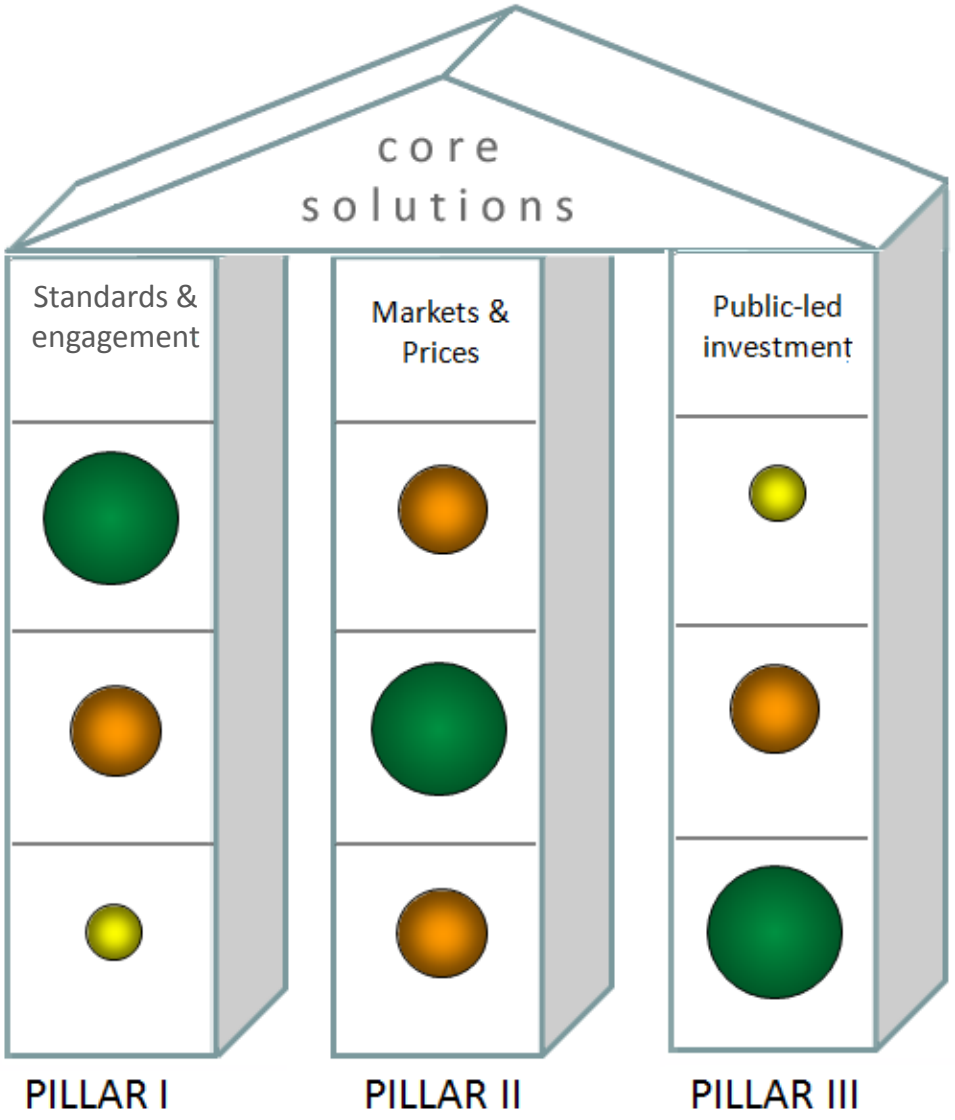
Three realms of (mitigation) opportunity



Three fields of theory

The ‘policy pillars’ required to exploit the realms of opportunity, based on the three fields of theory

Realm of Opportunity	Field of theory
Smarter choices (eg. energy efficiency)	‘Behavioural economics’ (eg. barrier, transaction, psychology & satisficing)
Cleaner products and processes	Rational expectations economics
Innovation and infrastructure investment	Evolutionary & complexity economics



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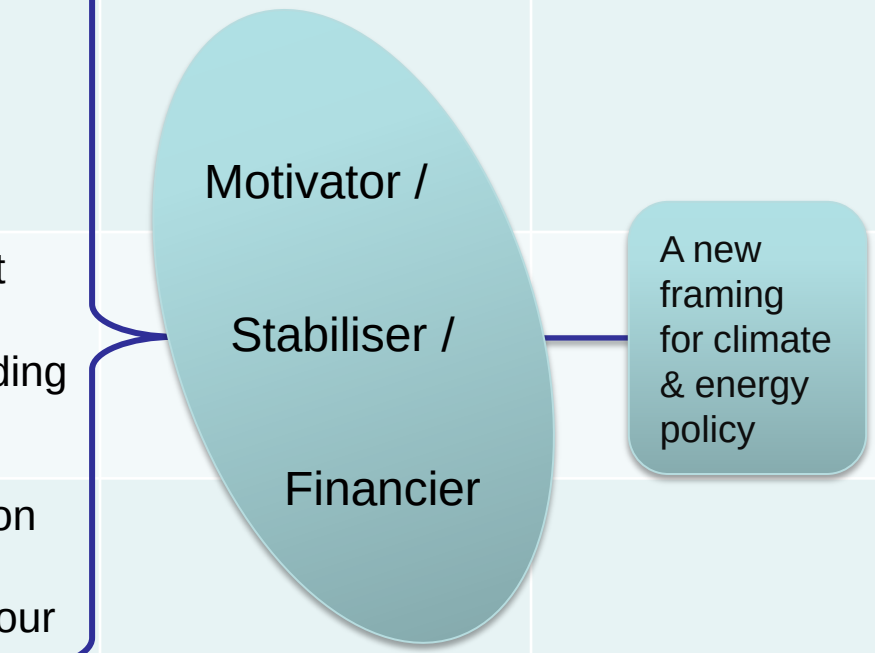
Climate policy is not separable from other policy areas

- And on each pillar, there is potential for co-benefits

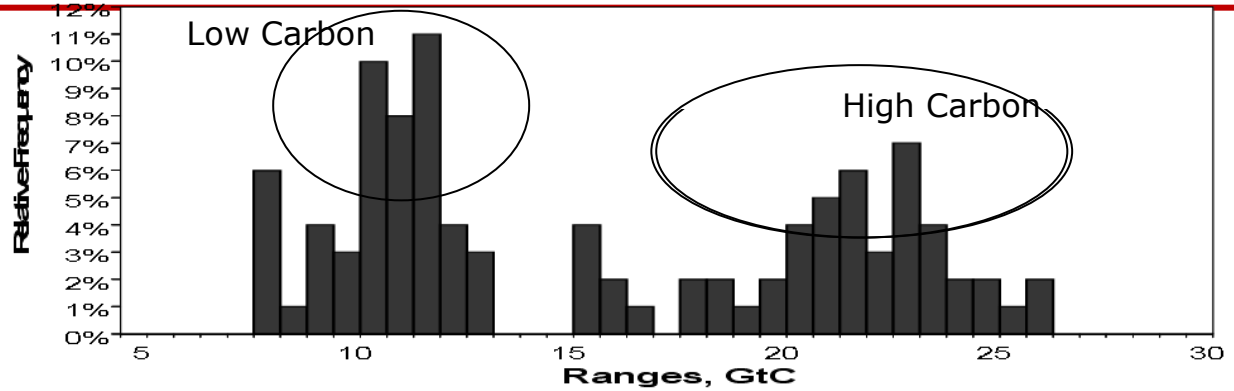
Pillar	Potential co-benefits	Role of climate policy
Standards and engagement for smarter choices	Enhanced energy efficiency, subsidy removal and more 'rational choices'	
Markets & pricing for cleaner products & process	Enhanced investment certainty & optimal revenue raising including energy security	
Investment for innovation and Infrastructure	Accelerating innovation in some of the least innovative sectors in our economies	



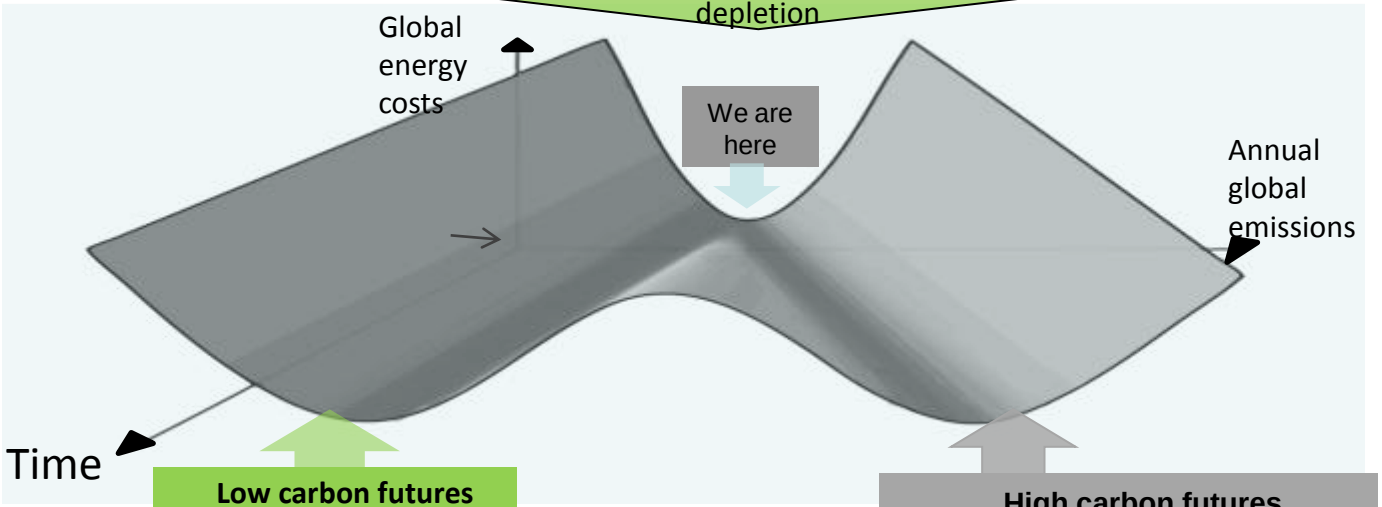
.. And future costs divide on the ridge of oil depletion,

But with fundamentally different capital and risk structures

Number of potential energy futures near 'minimum' cost



The clustering of 'low cost' energy futures around higher and lower emission levels, rather than in the middle, reflects the fundamental options in the face of oil depletion



Low carbon futures

- An integrated energy system
- Electricity in transport
- Low-carbon electricity
- High capital costs….
- ……but low operating costs

High carbon futures

- A continued dependence on fossil fuels
- Unconventional and synthetic oil in transport
- Low capital costs…
- …but high operating costs and a host of environmental issues beyond carbon

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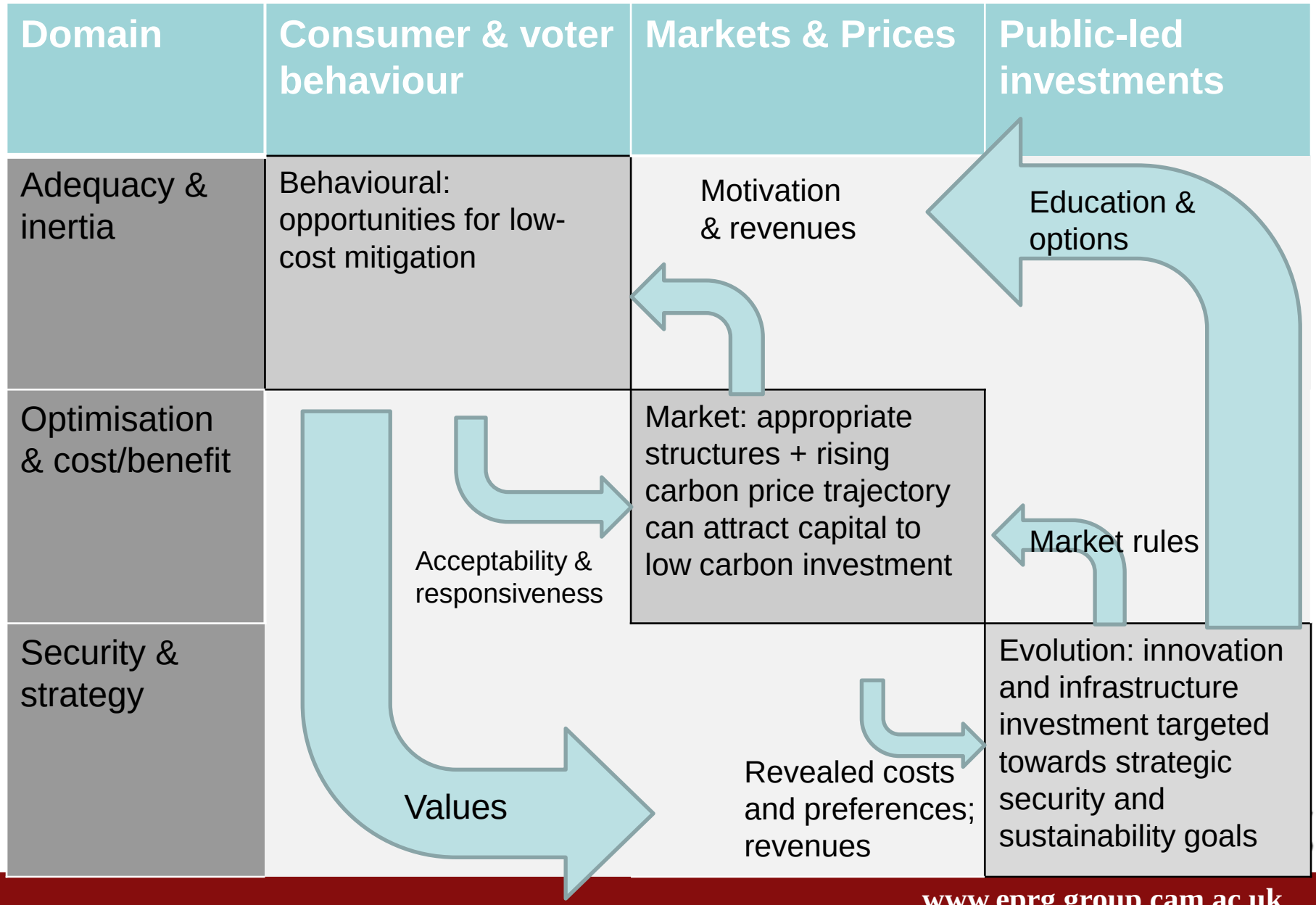
To understand Planetary Economics

We need to abandon idea of a single unified global actor

Decision domains relate to *different actors with different characteristics*

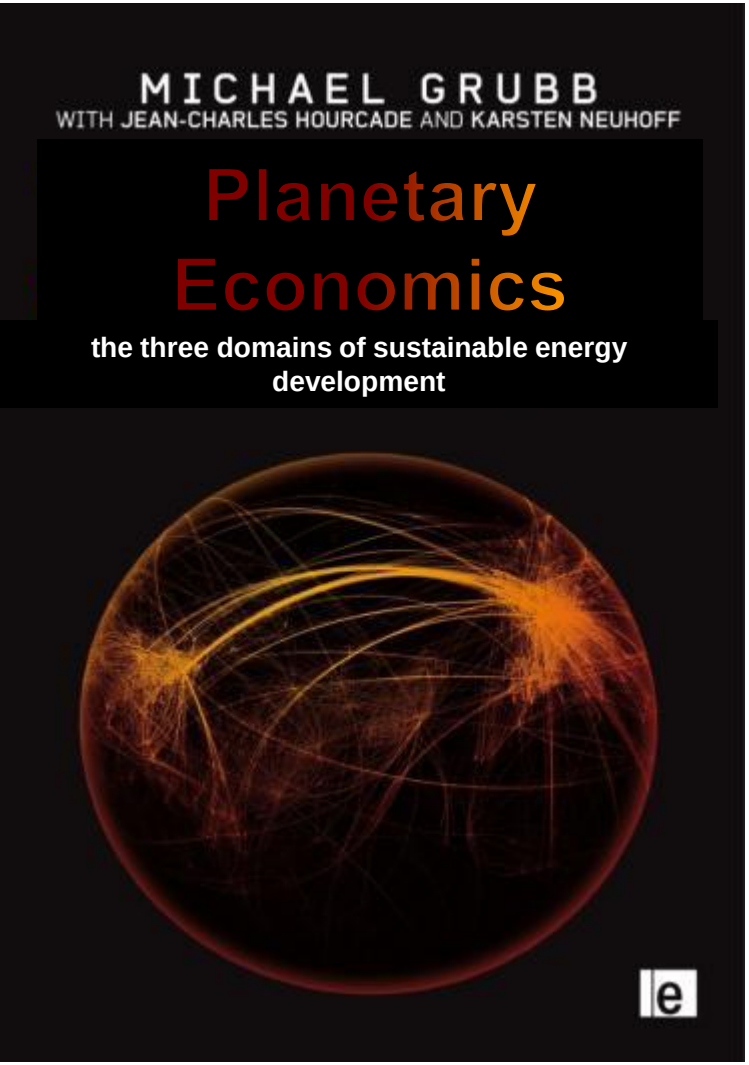
Decision Domain	Actors	How many climate+energy Investment decisions?	What consistent energy/ mitigation decisions?
Adequacy & inertia	**Individuals** in own, employee and social (voter) context **Nimby NGOs**	Tens of millions to billions	Habits & rule of thumb Resistance to change
Optimisation & cost/benefit	**Regulatory authorities** **'The market'**: private sector mainstream investment, financing & purchase	Thousands to millions	Regulation for competition Standard investment & purchase appraisal
Security & strategy	**Government** – rulemaking & own investment **Multinational** energy & engineering firms - strategy **Global NGOs**	A few to hundreds	Public-led investment in R&D, infrastructure Corporate business development

These three types of response relate to *different actors with different behavioural characteristics*



Summing it all up…

Planetary Economics:
the three domains of sustainable energy development



Chapter 1. Trapped?

Pillar I: Standards and engagement *for* smarter choices

Chapter 2: The Energy Efficiency Resource - *Why do we use so much energy?*
Chapter 3 : Tried and Tested – *Three Decades of Energy Efficiency Policy*
Chapter 4 Power to the People **-** *Understanding and empowering behavioural change*

Pillar II: Markets and pricing *for* cleaner production and products

Chapter 5. Pricing Pollution - *Of Truth and Taxes*
Chapter 6. Cap-and-trade & offsets **-** *From Idea to Practice*
Chapter 7. Who's hit? **–** *The Distributional Impacts of Carbon Pricing and How to Handle Them*

Pillar III: Investment and incentives for innovation and infrastructure

Chapter 8. Energy and Emissions – *Technologies and Systems*
Chapter 9. Bridging the Technology Valley of Death - *From Ideas to Use*
Chapter 10. Transforming systems - *Investing in Low Carbon Innovastructures*