‘Innovation, Sustainability, Development: a New Manifesto’:

implications for new practices in research and innovation governance

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presentation to International Seminar on

Progress as Inexorable

“you can’t stop progress” …
- The Economist

“we’ll restore science to its rightful place”…
- President Obama

“Our hope … relies on scientific and technological progress”
- Premier Wen Jiabao

“One can not impede scientific progress.”
- President Ahmadinejad

Science discovers truth about Nature ...
technology change is driven by science
Progress is Self-Evident

Lisbon Strategy for: “pro-innovation action”
- EU Council of Ministers

“we need more pro-innovation policies”
- PM Gordon Brown

“… the Government’s strategy is … pro-innovation”
- PM David Cameron

The public should: “give technology the status it deserves”…
- Royal Academy of Engineering

All innovation is good innovation ...
... being “pro-innovation” is like being ‘pro-policy’
Progress is Linear

Lord Alec Broers, President, RAEng

…“history is a race to advance technology”

Technology:

“will determine the future of the human race”

The challenge of government:

“to strive to stay in the race”...

Blinkered vision:

no distinctions … no alternatives …
no politics … no choice!

A crucial challenge and potential role for internationally driven indicators…
The Economics of Progress

Mainstream view: engineering and markets find ‘optimal’ solutions

A crucial challenge and potential role for internationally driven indicators…
The Economics of Progress

Mainstream view: engineering and markets find ‘optimal’ solutions tends to take underlying direction as given:

‘sound scientific research’
‘pro-innovation strategies’
‘market equilibrium’
‘evidence based policy’
‘technological optimisation’
‘sustainability transition’
The Missing Politics of Direction

Common picture arising in all studies of technology in society –

... the ‘big picture’ is the other way around!

each starting point yields many feasible, viable innovation pathways

‘best path’ not just about ‘optimisation’, but social and political choice

- Ellul, Freeman, Perez, Nelson, Bijker, Mokyr, Karnoe, Geels
Closing Down the Direction of Progress

innovation is ‘vector’ not ‘scalar’

time

social imaginations and expectations
- Jasanoff, van Lente
Closing Down the Direction of Progress

social imaginations and expectations

political ‘autonomy’ and ‘entrapment’

- Winner, Walker
Closing Down the Direction of Progress

social imaginations and expectations

political ‘autonomy’ and ‘entrapment’

historical ‘momentum’ and ‘path dependency’

- Hughes, David
Closing Down the Direction of Progress

social imaginations and expectations

political ‘autonomy’ and ‘entrapment’

historical ‘momentum’ and ‘path dependency’

economic ‘trajectories’ and ‘lock-in’

- Dosi, Arthur
Closing Down the Direction of Progress

Mainstream policy discussion neglects property of direction:

Scope for debate restricted to: yes or no? ... how much? how fast? ... who leads?

innovation is ‘vector’ not ‘scalar’
Closing Down the Direction of Progress

Mainstream policy discussion neglects property of direction:

Scope for debate restricted to:
- yes or no?
- how fast?’
- how much?
- who leads?

Seriously neglects questions over:
- which way?
- says who?
- what alternatives?
- why?
Closing Down the Direction of Progress

Mainstream policy discussion neglects property of direction:

Treats innovation as homogeneous:  
no distinctions ... no alternatives ...  
no politics  ... no choice!

Seriously neglects questions over:  
which way? ...what alternatives?  
says who? ...why?

Only answerable with attention to alternative directions for science and technology in specific sectors (eg: energy, agriculture, health)
Implications for Distribution

Existing innovation paths driven by particular interests & priorities
– incumbent advantage    private profit    military interests
    intellectual property    rich consumers    supply chain rent

Ensuring equitable spread in risks & benefits is hard enough
– ‘trickle down’ for single technological path (eg: nuclear power)

But for different pathways: complexity and stakes rise massively
– community non-electric / distributed integration / continental infrastructures

Innovation paths of marginal people are the most excluded
– co-ops / civil society / ‘bottom of the pyramid’ / community innovation

‘One track race’ development rhetorics undermine least powerful
– denies democratic challenge: accountability, criticism, alternatives
The Value of Diversity

‘Direction’: not about seeking single ‘optimal’ development path but variety of disparate pathways, addressing plural needs and contexts

Diversity in development pathways offers many benefits:
– defends against powerful forces of ‘lock-in’ and ‘crowding out’
– in particular, offers more space for addressing most marginalised needs
– hedges surprise and confers resilience under deep uncertainties
– allows more room for experimental niches and social learning
– encourages social and organisational (as well technical) innovation
– accommodates otherwise irreconcilable values and interests
– foster more socially robust processes of innovation itself

But diversity is not a panacea:
– trade-offs, opportunity / transaction costs, foregone learning and scale threatened by globalisation, harmonisations, standardisation

Which diversity?  – still requires democratic accountable social choice
Possible Implications: Agendas

New Manifesto recommends:
new open, inclusive national and international institutions
(eg: networked Strategic Innovation Fora, Global Innovation Commission)

1 indicators of resource allocation to alternative directions of research and innovation in specific fields
(eg: low carbon energy; sustainable agriculture; public health)

2 indicators of depth and scope of oversight of stakeholders in research and innovation strategies

3 indicators of diversity in stakeholder engagement in research and innovation governance
Possible Implications: Funding

New Manifesto recommends:
progressive rising share towards poverty reduction and environmental protection

4 identification of key poverty alleviation and sustainability goals for research and innovation, to form explicit auditable accounts

5 indicators of resource allocation – direct as well as indirect – to explicit, audited poverty alleviation and sustainability goals

6 indicators of availability and extent of transparent accounting of research and innovation funding support in specific areas
Possible Implications: Capacity Building

New Manifesto recommends:
bridging professions and engagement between science, technology and practice

7 indicators of scale and scope of distributed bridging professions, as well as centres of excellence

8 indicators of engagements in capacity building by excluded groups (eg: local entrepreneurs, communities citizens groups)

9 indicators of user-driven and user-engaged research (eg: provision for extension activities in higher and tertiary education)
Possible Implications: Organising

New Manifesto recommends:
networks linking public, private and civil society

10. indicators of provision for connecting and translating activity between contrasting sectors and upstream / downstream

11. indicators of increasing support (in relation to basic science) for engineering, design, services, and social entrepreneurship
Possible Implications: Monitor, Evaluate, Account

New Manifesto recommends:
new responsibilities for transparent reporting and monitoring

12 indicators of uptake in benchmark criteria for poverty alleviation and environmental protection in research and innovation

13 indicators of proportions of research and innovations systems accountable to new institutions (innovation fora / commissions)

14 convene international stakeholder deliberation over strength and scope of developing suite of indicators
A Close-up on Indicators of Diversity

diversity can be increased in three different ways

capital investments / research projects / technology programmes
scientific disciplines / innovation strategies / stakeholder involvement
comprising any mix of elements
  eg: carbon capture, biogas, nuclear, wind, solar
Different Aspects of Diversity

increasing diversity

variety
number of elements in mix
eg: Norway vs USA
Different Aspects of Diversity

- Increasing diversity
- Variety
  - Number of elements in mix

Balance
- Evenness in contributions
  - Eg: Nuclear – Japan vs France
Different Aspects of Diversity

increasing diversity

balance
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Different Aspects of Diversity

- Increasing diversity
- Variety: number of elements in mix
- Balance: evenness in contributions
- Disparity: degree of differences (e.g., renewables vs. fossil)
Different Aspects of Diversity

- Increasing diversity
- Variety: number of elements in mix
- Balance: evenness in contributions/connectivity
- Disparity: degree of differences (e.g., renewables vs fossil)

Disparity is fundamental to scientific and technological diversity.
Deriving Structures for Scientific Disparity

Any multivariate dataset can be normalised to yield a disparity space. In other words: existing statistics give disparity information for free – eg:

eg: indicators of sectoral relevance

eg: indicators of disciplinary involvement

eg: indicators of user communities
Deriving Structures for Scientific Disparity

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Deriving Structures for Scientific Disparity

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Distances between pairs of elements represent their mutual disparity ($d_{a,b}$)

Disparity of a portfolio of elements is given as a function of these pairwise distances

and…

Variety and balance can be captured by weighting this by the product of the proportional importance in the system of each element in the pair ($p_i, p_j$)
Diversity in Energy Sustainability

Sustainability: multivariate performance yields endogenous disparity metrics

Similar options linked at low values of $d$

Increasing disparity distance, $d$
Conventional Ideas of Energy Diversity

Casual treatment of diversity sees all named options as equally diverse
Conventional Ideas of Energy Diversity

Often, renewables are all grouped together as if one option
Diversity in Energy Innovation

Detailed multicriteria diversity analysis reveals structure of disparities
Diversity in Energy Innovation

Candidate sustainable options for energy diversity

- offshore wave
- large tidal barrage
- tidal stream
- shoreline wave
- hydro
- offshore wind
- geothermal
- solar PV
- terrestrial wind (micro)
- terrestrial wind (large)
- nuclear
- municipal waste
- landfill gas
- coal + CCS
- coal
- biomass
- gas CCGT + CCS - Norway
- gas CCGT + CCS - UKCS
- gas CCGT - Norway
- gas CCGT – UKCS
- gas CCGT – continental
- oil
- gas CCGT – LNG

- marine / hydro renewables
- non-combustion renewables
- combustion renewables and regional fossil fuels
- out-of-region fossil fuels
Empirical Results: Portfolio Trade-offs

\[ \Delta = \sum_{ij (i \neq j)} d_{ij} \cdot p_i \cdot p_j \]
A ‘3D Agenda’: direction, distribution, diversity for global innovation to address poverty & environment

What is needed is nothing short of a vigorous new critical global politics of innovation. As much as other areas of public life, the directions taken by innovation are a matter for legitimate democratic engagement and challenge. This requires fundamental redistributions of attention, resources and power. The result will be a flourishing of a more vibrant and creative diversity of pathways - scientific, technological, organisational and social. It is only in such ways that human ingenuity may truly rise to the imperatives of poverty alleviation, social justice and environmental sustainability.