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# Transformative innovation & sustainability transitions

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## A new transitions policy discourse – the low carbon society/green economy

- Change in policy landscape from climate change ‘problem’ to low carbon innovation ‘solution’
  - Incorporation of ambitious targets into national policy agendas
  - Narratives of transformation innovation from margin to mainstream since 2000
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## The UK Prime Minister

*We need to make  
the transition to a  
low carbon  
economy  
urgently*

David Cameron

January 2010



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## European Union



- we will take a historic step towards ...the transition to a low-carbon world economy.

- Manuel Barroso
  - December 2007
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‘the transition to a green and low-carbon economy is essential’ (Nov 2009)



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Beyond rhetoric into durable policy frameworks

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The UK strategy 2009

# The UK Low Carbon Transition Plan

National strategy for climate and energy

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The UK strategy 2011

 HM Government

Enabling the Transition  
to a Green Economy:  
Government and business  
working together



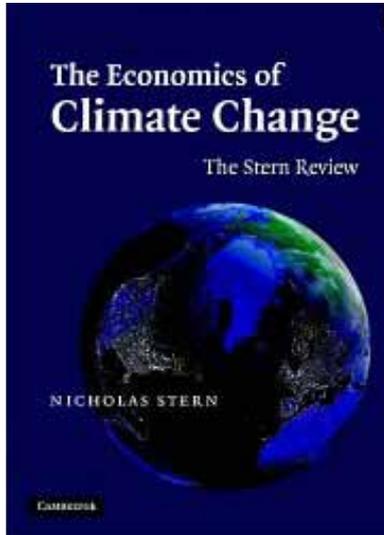
# Carbon Plan



The origins of the concept of transition

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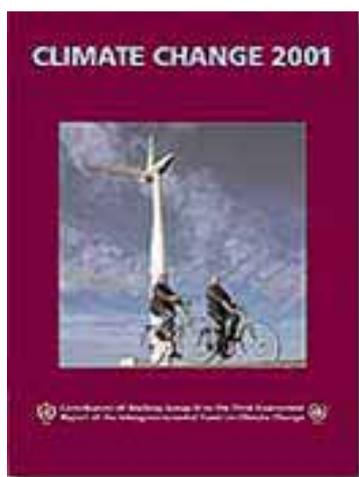
## Stern review 2006



- managing the **transition** to a low-carbon economy
  - radical change may not be delivered by the markets
  - technology-specific early stage deployment support
  - governments must accept that some technologies will fail.
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## Policy roots: IPCC report on mitigation



- **transition strategies** to achieve...long-term social and technological changes
  - **transition** from the world's present energy system towards a less carbon-emitting economy
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## Conceptual roots: the Dutch school

- Kemp, René (1994), 'Technology and the Transition to Environmental Sustainability. The Problem of Technological Regime Shifts', *Futures* 26(10): 1023-46
- Geels, F.W., 1999, 'Technological transitions and socio-technical scenarios', in: Dolfma, W., Geels, F.W., Kemp, R., Moors, E. and Rip, A., 1999, *Management of technology responses to the climate change challenge: Theoretical elaboration of the co-evolutionary 'technology-in-society' Perspective*.

- **Transities vanuit sociotechnisch perspectief**

Frank Geels and René Kemp<sup>1</sup>

Nov 2000

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## Theories of radical innovation

- 2 strands in the interdisciplinary field of Science Technology & Innovation Studies oriented to radical change:
  - Evolutionary theories of epochal transformations - 'technoeconomic paradigm'
  - Interactionist theories of innovation path creation – 'social construction of technology'
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## A synthesis within innovation studies

- Seeks to bridge economic and sociological strands in STIS
- Dynamics of innovation in meso level sociotechnical systems
- Engaged with practice 'managing/governing transitions'

## Sociotechnical networks

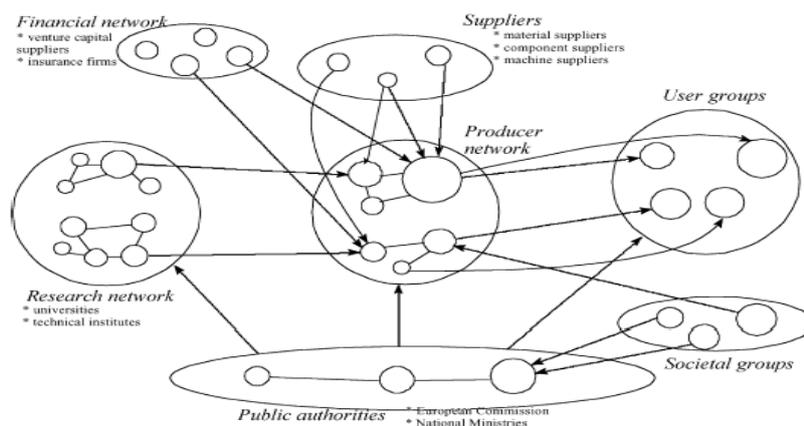


Fig. 2. The multi-actor network involved in sociotechnical regimes.

## Multilevel perspective

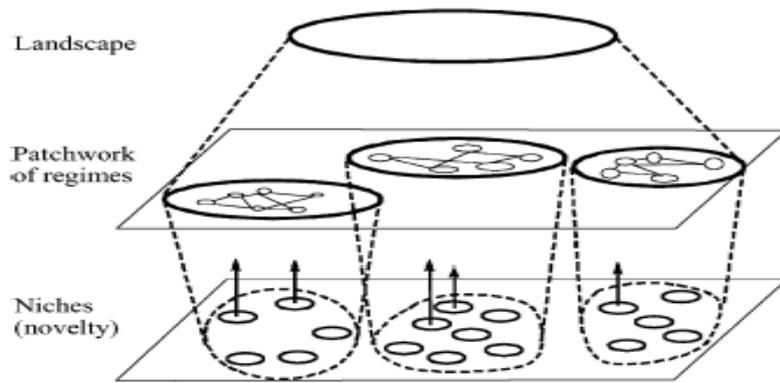


Fig. 3. Multiple levels as a nested hierarchy.

## Disrupting & reconfiguring through niches

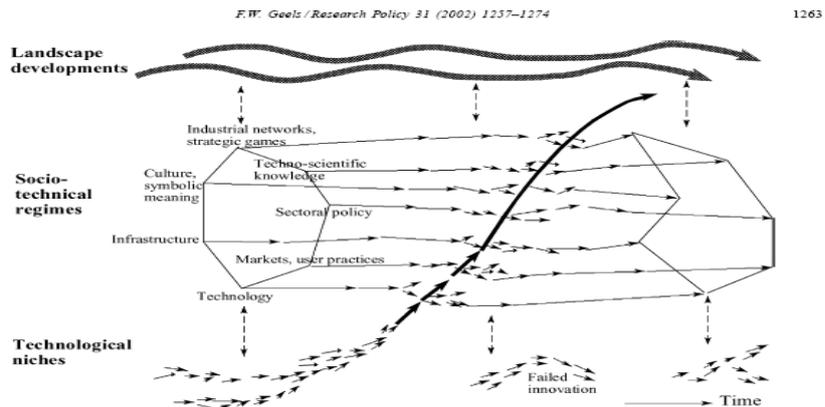


Fig. 5. A dynamic multi-level perspective on TI.

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## A distinct meso level 'lens' or 'gaze'

- Nor a 'macro focus on a new principle of the economic system (mechanisation, information etc)
  - Not a 'micro' focus on the new product or process
  - The 'meso' reveals situated sociotechnical paths and choices
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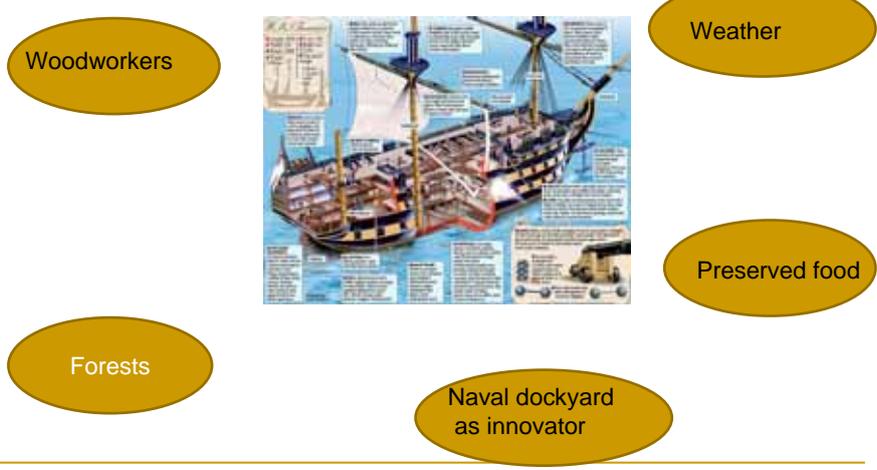
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## Sociotechnical transitions happen

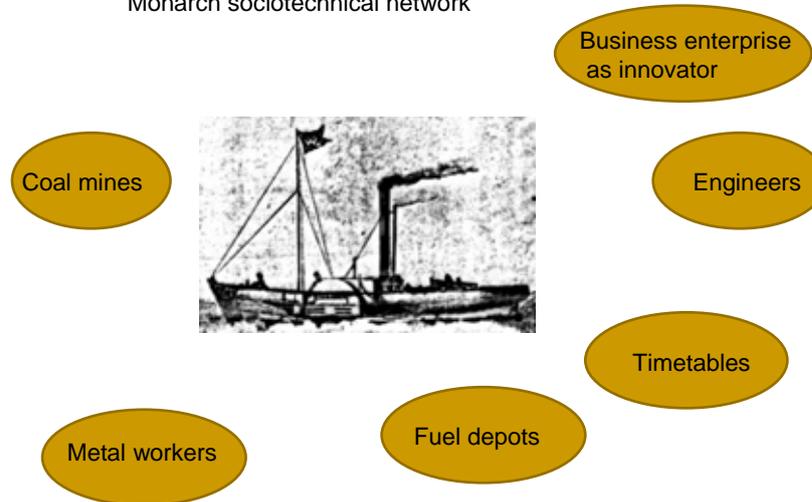
- Intercontinental transport: sail – steam
  - Domestic mobility: horse – automobile
  - Sanitation: home based – civic sewage system
  - Information: notepad – personal computer
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The Temeraire sociotechnical network

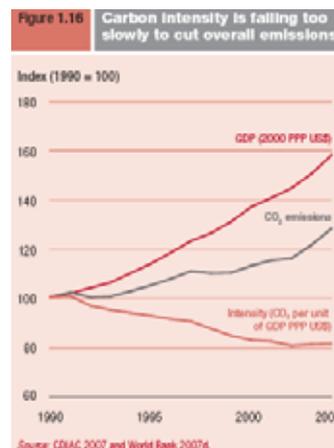


### Monarch sociotechnical network



## Incremental innovation is insufficient

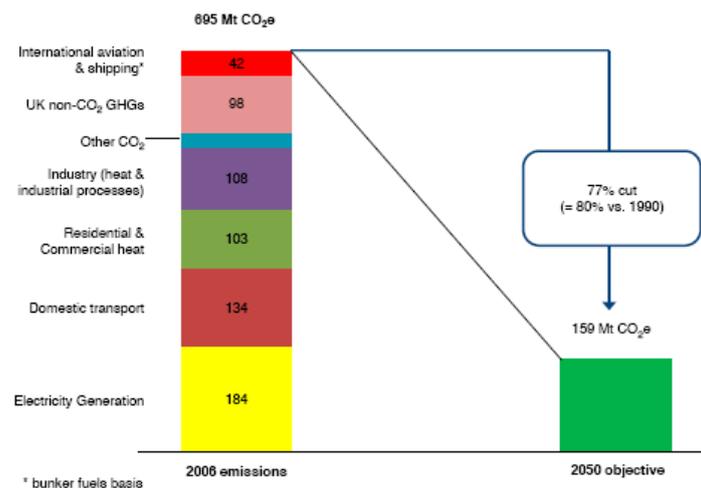
- Relative improvements in resource use & pollution impact eg: household appliances, cars, aeroplanes
- Yet, environmental impact of household and personal transport continue to increase - the 'rebound effect'



## New ambitions

- A variety of national governments are incorporating carbon targets into their economic and social policies
- The targets are highly ambitious given the national track records
- Despite the setback for a new global treaty this represent a highly significant policy domain
- The global challenge remains huge

Figure 2.1 The scale of the challenge



Source: UK National Atmospheric Emissions Inventory (2008).

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## A current paradox

- Pragmatically policy recognises:
    - Transformative change
    - Sociotechnical character
  
  - Yet intellectually remains focused on:
    - Individual (incremental) choice
    - Separation of the technical and the social
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## Power of the past

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## Emerging 'popular' narratives of transformation

- The new consensus over the need for 'revolutionary' change is expressed by new transformative narratives
  - They draw on a narrative repertoire of historical analogies of episodes of 'radical' change
  - They implicitly and selectively engage with professional discourses on the dynamics of innovation and change
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## Popular narrative 1: 'big science'

- Government has made big investments in key areas of science in the past – it should do so again
  - Popular analogies are the research programmes that led to nuclear weapons and human space travel
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## A new 'Manhattan' project

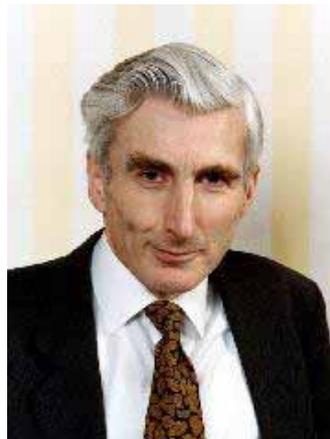
- a 'Manhattan project' for climate change technology research
  - Evidence to US Congress committee, September 2006
  - 5-10 fold increase in energy R&D to \$50-100bn for 10 year programme
- Daniel Kammen (Director, Renewable and Appropriate Energy Laboratory (RAEL) University of California, Berkeley



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## A new 'Apollo' programme

- Martin Rees (President of the Royal Society)
- A 'global response analogous to the Apollo programme'
- Editorial in *Science*, August 2006
- Ambitious public investment in more R&D for new 'far from market' energy technologies



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## Professional innovation discourse

- Linear science push model
  - Innovation arises from radical breakthroughs in basic science
  - Largely abandoned by innovation researchers though still a few advocates
  - Still popular with some scientists
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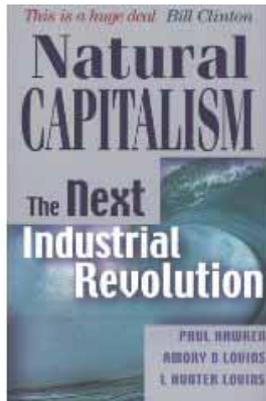
## Narrative 2: 'industrial revolution'

- Low carbon transition is equivalent long term revolution in technology & economics
  - Forces driving it are structural in nature – new technologies, natural limits
  - Policy options are to facilitate national receptiveness and entrepreneurial opportunity
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## Influential advocates

- Amory Lovins – US environmentalist & entrepreneur



- Peter Mandelson, former BIS minister



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## Professional innovation discourse

- 'Technoeconomic paradigm – Freeman & Perez
  - Schumpeterian evolutionary theory of innovation
  - Ecological modernisation – Huber
  - Influential among economic studies of innovation
  - Epochs defined by 'lead technologies'
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## Popular narrative 3: 'social reform'

- Analogies with government led programmes of welfare reform from the 20<sup>th</sup> century eg Roosevelt's New Deal
  - Large scale state investment for societal purposes is possible
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## Advocates – greens, social democrats



**A Green New Deal  
for Europe**

### **A Green New Deal**

Joined-up policies to solve the triple crunch of the credit crisis, climate change and high oil prices

The first report of the Green New Deal Group

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## Professional innovation discourse

- Traditional theories of state action for social purposes
  - Retheorised as social innovation and public innovation
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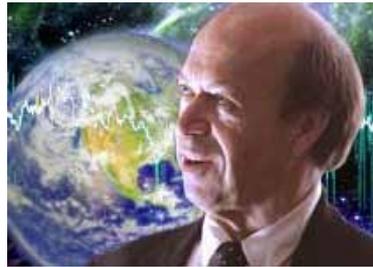
## Popular narrative 4: 'moral crusade'

- Analogies with ethical and moral crusades for reform
  - Wilberforce's campaign for the Abolition of the Slave Trade, and Martin Luther King's leadership of the Civil Rights movement are exemplars
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## Advocates

- Head of NASA Goddard Institute for Space Studies
  - No halfway house on moral principles
  - Carbon dependency moral equivalence
  - Rhetoric of reaction
- James Hansen
  - Leading climatologist



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- Marc Davison, University of Amsterdam

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## Professional innovation discourse

- Individualistic entrepreneurial models of disruptive innovation
  - Psychology based theories of creativity
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## 2x2 matrix – partial narratives

|            |                       |                |
|------------|-----------------------|----------------|
| State      | Big science           | Green new deal |
| Individual | Industrial revolution | Moral crusade  |
|            | Technology            | Society        |

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## Features of these partial narratives

- Powerful narratives with influential advocates
  - Recognise past periods of radical change
  - Tend to inscribe established political positions and guidelines
  - Evocative of actual changes despite problems
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## An alternative?

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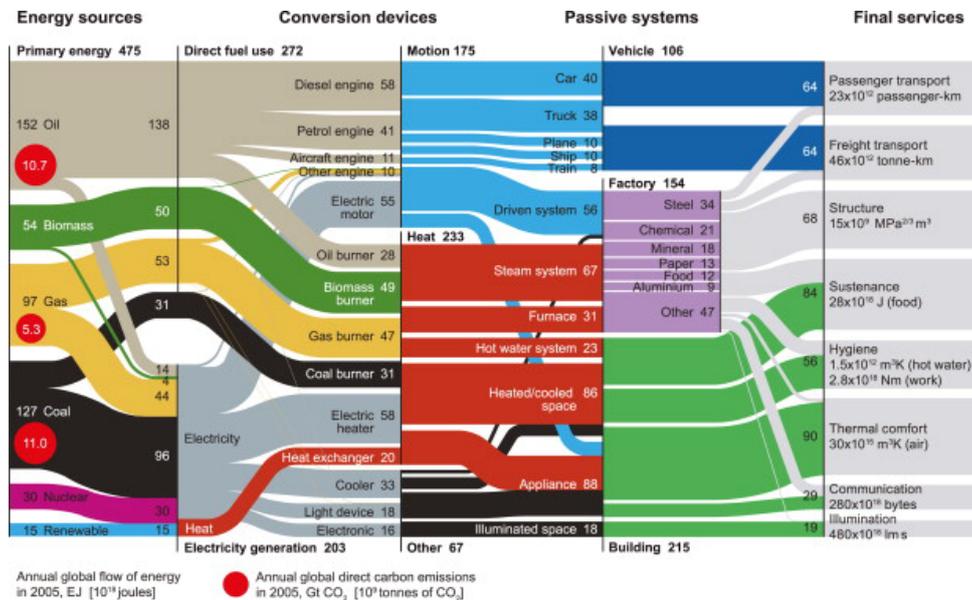
## We need a new narrative

- How social and technological innovation interact with each other
  - New routes for global institutions to effectively interact with established institutions of national governance
  - Intersection of individual and collective
  - Convincing approaches to the urgency of the climate change challenge
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## Transformative innovation – a new focus



- **Incremental innovation**  
small innovations, or improvements to optimise existing systems of knowledge, e.g. reducing packaging waste;
- **Radical innovation**  
partial system redesigns, e.g. improvements in recycling which require innovations in product design and infrastructure for recycling;
- **Transformative innovation**  
full system redesign and culture change in the way people think about products and services, e.g. industrial ecologies or life cycle approaches to product design.



### Global energy flows 2005

Cullen & Allwood 2010

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## A pragmatic policy agenda

- Focus on the domain of innovation policy
  - Explore how new sociotechnical transitions ideas are reshaping policy in practice
  - Rules of thumb, principles for policy makers
  - Pragmatic alternatives to fundamental governance paradigm debates
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## Traditional approaches

- Current interpretation of diversity favours the incumbents:
    - Off shore wind
    - Carbon capture and storage
    - Nuclear
    - Electric car
    - 'silos' or 'networks' ?
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## New systems need stronger voice

- Small local waste into biogas
  - Smart grids
  - Micro generation
  - Combined heat and power
  - Multimodal transport – cycles to buses
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## The new system innovators

- More likely to be:
    - municipal and regional actors
    - infrastructural actors
    - green entrepreneurs
    - civil society third sector actors
  - The sources of variety
  - Equal rights with the incumbents (at least)!
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## A sustainability oriented innovation policy

- Need for system innovation
  - Involves technology & social change
  - Crosses the production & consumption divide
  - The reintroduction of societal mission
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