

# POST CARBON PATHWAYS

REVIEWING POST CARBON ECONOMY  
TRANSITION STRATEGIES

**SUMMARY**

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The authors would welcome your comments on this report, suggestions for other post carbon transition strategies that we could review, and ideas on how to strengthen public understanding of post carbon pathways. We also invite you to visit the *Post Carbon Pathways* website which provides a platform for ongoing information sharing and debate about the most promising pathways towards a just and sustainable post carbon future.

<http://postcarbonpathways.net.au>

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All conclusions and any errors that remain are the authors' own.

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**Full report available for download from <http://cpd.org.au/2012/03/post-carbon-pathways> or <http://www.sustainable.unimelb.edu.au/content/pages/post-carbon-pathways>**

## Key Messages

1. Around the world, detailed policy and research initiatives are demonstrating that a rapid transition to a post carbon economy is both technologically and economically feasible. However, the latest climate science shows that the window for effective action is rapidly closing. Strategies to reduce emissions at the required scale and speed will need to be implemented in the next five to ten years if they are to significantly reduce the risk of runaway climate change.
2. A fair and swift transition to a sustainable post carbon economy will require:
  - rapid reductions in energy consumption and improvements in energy efficiency
  - rapid replacement of fossil fuels by renewable energy
  - the drawdown and sequestration of carbon into sustainable carbon sinks
  - game changing investment in social and technological innovation
  - economic policies which recognise the full costs of failing to reduce emissions and of the multiple co-benefits of the transition program
  - a significant shift towards economic paradigms and priorities which focus on improving social and ecological wellbeing rather than unconstrained growth in material consumption.
3. The difficulty of securing and sustaining broad social and political support is widely recognised as the greatest barrier to a swift transition to a post carbon economy. The lack of detailed game plans for mobilising the required level of political leadership and public support is the most significant gap in post carbon economy transition strategies.
4. The crucial difference between transition strategies that advocate a pragmatic and evolutionary approach and those that advocate more rapid and transformational change highlights two challenging and urgent questions:
  - For less ambitious plans and strategies (generally government-led): Given that the proposed actions do not match the physical requirements of action needed to prevent runaway climate change, what can be done to bridge this gap?
  - For more ambitious plans and strategies (generally non-government authored): Given that political and social support for the rapid implementation of these proposals remains challenging, what can be done to bridge this gap?
5. A rapid transition to a post carbon economy will require strong leadership by national and local governments in setting and achieving clear long term emissions reduction targets, combined with broad grassroots mobilisation and enhanced global cooperation. It will be crucial to develop and communicate inspiring stories of a just and sustainable post carbon future.
6. The Australian Government's 2020 emissions reduction target (a 5 per cent decrease on 2000 levels) is clearly still far from the level required for Australia to make a responsible and fair contribution to global emissions reductions. While Australia's 2050 target (an 80 per cent decrease on 2000 levels) is more robust, there is no detail as yet as to how this target will be achieved.
7. Key policy and research priorities include further clarification and communication of scientifically informed knowledge on:
  - the scale and speed of the global, national and local emissions reductions required to significantly reduce the risk of runaway climate change
  - the most effective strategies for encouraging, sharing and deploying large-scale technological and social innovation
  - robust, transparent methodologies for calculating the net costs of large-scale transition strategies and fair mechanisms for mobilising the necessary resources
  - political, social and cultural change strategies that could lead to rapid implementation of the policies needed to drive a swift transition to a post carbon economy.

## Summary

### 1. Project Aim

- 1.1. This report provides a concise overview of the key goals and priorities of eighteen of the most promising and innovative large-scale post carbon economy transition plans and strategies, from both government and non-government sources. The report is the first stage in an ongoing *Post Carbon Pathways* project, which aims to strengthen understanding of ways to overcome barriers to the rapid implementation of large-scale post carbon economy transition strategies.
- 1.2. The *Post Carbon Pathways* project is informed by the view that while increased public acceptance of the *necessity* of urgent climate change action is crucial, the transformational changes required to rapidly reduce greenhouse gas emissions also depend on broad recognition that alternative, more desirable futures and pathways are indeed *possible*.
- 1.3. The conceptual framework and language of ‘post carbon pathways’ and ‘post carbon economy transition strategies’ are being used in an increasingly broad range of settings and contexts to emphasise the importance of systemic transformations leading to ‘a world in which we are no longer dependent on hydrocarbon fuels, and no longer emitting climate-changing levels of carbon into the atmosphere.’<sup>i</sup>

### 2. Scope

- 2.1. This report focuses particularly on large-scale post carbon economy transition plans and strategies, which are defined, for the purposes of this report, as ‘documents which identify one or more integrated, plausible pathways for achieving dramatic reductions in greenhouse gas emissions, within a national or supra-national jurisdiction’.
- 2.2. Although this report has focused on large-scale, integrated strategies, the authors are conscious that there are also a wide variety of innovative and influential post carbon transition strategies that are being developed and implemented at local and regional levels, as well as in specific metropolitan contexts. While they are beyond the scope of this report, they should be the subject of further comparative research and analysis.
- 2.3. Nine strategies from non-government sources and nine from government sources have been analysed. **Tables 1 and 2** provide an overview of the post carbon economy transition strategies summarised in this report.
- 2.4. The selected strategies differ in the geographic jurisdiction and sectors of the economy with which they are concerned. They have been organised according to whether they focus on: (i) the global economy as a whole; (ii) the global energy sector only; (iii) a multi-country, regional economy (European Union); (iv) a national economy; (v) a national energy sector only; and (vi) a large, sub-national economy (California, US).

Table 1: Post carbon economy transition strategies - Non-government sources

<b>NON-GOVERNMENT POST CARBON ECONOMY TRANSITION STRATEGIES</b>			
<b>Scope</b>	<b>Strategy or plan</b>	<b>Source</b>	<b>Link</b>
<b>Global – All sectors</b>	World in Transition: A Social Contract for Sustainability	German Advisory Council on Global Change	<a href="http://www.wbgu.de/en/flagship-reports/fr-2011-a-social-contract/">http://www.wbgu.de/en/flagship-reports/fr-2011-a-social-contract/</a>
	World on the Edge: How to Prevent Environmental and Economic Collapse	Lester R. Brown, Earth Policy Institute	<a href="http://www.earth-policy.org/books/wote">http://www.earth-policy.org/books/wote</a>
	Our Choice: A Plan to Solve the Climate Crisis	Al Gore	<a href="http://ourchoicethebook.com/">http://ourchoicethebook.com/</a>
	One Degree War Plan	Paul Gilding and Jorgen Randers	<a href="http://www.emeraldinsight.com/journals.htm?articleid=1860356">http://www.emeraldinsight.com/journals.htm?articleid=1860356</a>
<b>Global – Energy sector only</b>	Powering a Green Planet: A Path to Sustainable Energy by 2030	Mark Z. Jacobson and Mark A. Delucchi	<a href="http://www.scientificamerican.com/article.cfm?id=a-path-to-sustainable-energy-by-2030">http://www.scientificamerican.com/article.cfm?id=a-path-to-sustainable-energy-by-2030</a>
	The Energy Report: 100% Renewable Energy by 2050	WWF International	<a href="http://wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions/renewable_energy/sustainable_energy_report/">http://wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions/renewable_energy/sustainable_energy_report/</a>
<b>National – All sectors</b>	Zero Carbon Britain 2030	Centre for Alternative Technology	<a href="http://zerocarbonbritain.org/">http://zerocarbonbritain.org/</a>
	Low Carbon Growth Plan for Australia	Climate Works Australia	<a href="http://www.climateworksaustralia.org/Low%20Carbon%20Growth%20Plan.pdf">http://www.climateworksaustralia.org/Low%20Carbon%20Growth%20Plan.pdf</a>
<b>National – Energy sector only</b>	Zero Carbon Australia 2020 – Stationary Energy Plan	Beyond Zero Emissions and Energy Research Institute, The University of Melbourne	<a href="http://beyondzeroemissions.org/zero-carbon-australia-2020">http://beyondzeroemissions.org/zero-carbon-australia-2020</a>

Table 2: Post carbon economy transition strategies - Government sources

<b>GOVERNMENT POST CARBON ECONOMY TRANSITION STRATEGIES</b>			
<b>Scope</b>	<b>Strategy or plan</b>	<b>Source</b>	<b>Link</b>
<b>Regional – All sectors</b>	A Roadmap for Moving to a Competitive Low Carbon Economy in 2050	European Commission	<a href="http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF">http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF</a>
<b>National – All sectors</b>	The Carbon Plan: Delivering our Low Carbon Future	Government of the United Kingdom	<a href="http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx">http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx</a>
	National Strategy for Green Growth	Government of the Republic of Korea	<a href="http://www.greengrowth.go.kr/english/en_main/index.do">http://www.greengrowth.go.kr/english/en_main/index.do</a>
	China's 12th Five-Year Plan and White Paper of China's Policies and Actions in Responding to Climate Change	Government of the People's Republic of China	<a href="http://cbi.typepad.com/china_direct/2011/05/chinas-twelfth-five-new-plan-the-full-english-version.html">http://cbi.typepad.com/china_direct/2011/05/chinas-twelfth-five-new-plan-the-full-english-version.html</a> and <a href="http://www.gov.cn/english/official/2011-11/22/content_2000272.htm">http://www.gov.cn/english/official/2011-11/22/content_2000272.htm</a>
	National Action Plan on Climate Change and Low Carbon Strategies for Inclusive Growth: An Interim Report	Government of India	<a href="http://pmindia.nic.in/Pg01-52.pdf">http://pmindia.nic.in/Pg01-52.pdf</a> and <a href="http://planningcommission.nic.in/reports/genrep/Inter_Exp.pdf">http://planningcommission.nic.in/reports/genrep/Inter_Exp.pdf</a>
	Securing a Clean Energy Future	Government of Australia	<a href="http://www.cleanenergyfuture.gov.au/clean-energy-future/our-plan/">http://www.cleanenergyfuture.gov.au/clean-energy-future/our-plan/</a>
<b>National – Energy sector only</b>	Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply	Government of Germany	<a href="http://www.bmu.de/files/english/pdf/application/pdf/energiekonzept_bundesregierung_en.pdf">http://www.bmu.de/files/english/pdf/application/pdf/energiekonzept_bundesregierung_en.pdf</a>
	Our Future Energy	Government of Denmark	<a href="http://www.ens.dk/Documents/Netboghandel%20-%20publikationer/2011/our_future_energy_%20web.pdf">http://www.ens.dk/Documents/Netboghandel%20-%20publikationer/2011/our_future_energy_%20web.pdf</a>
<b>Sub-national – All sectors</b>	Climate Change Scoping Plan and California's Clean Energy Future	Government of California	<a href="http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm">http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm</a> and <a href="http://www.cacleanenergyfuture.org/">http://www.cacleanenergyfuture.org/</a>

### 3. Post carbon economy transition strategies: Lessons and implications

Comparative analysis of the key features of the post carbon economy transition strategies considered in this report leads to the following key lessons and implications.

#### **3.1. Emissions reduction, energy demand and energy supply targets**

- 3.1.1. The most ambitious strategies produced by non-government sources aim for emissions reduction and renewable energy targets that are broadly consistent with limiting global temperature rise to below 2°C above pre-industrial levels. Further work is required to sharpen understanding of the relationship between emissions reductions and global temperatures and to specify detailed policy priorities and implementation strategies.
- 3.1.2. While some government-authored strategies (from industrialised countries) include 2050 emissions reduction targets of 80–100 per cent, few of them yet provide a clear pathway for achieving the scale and scope of emissions reductions required by 2050 in order to meet 2050 goals.
- 3.1.3. The Australian Government’s current target of reducing GHG emissions by 5 per cent by 2020 on 2000 levels clearly remains far from the speed and scale required, and from the targets being set by a range of comparable industrialised economies. It is unclear how its immediate actions relate to the longer term target of 80 per cent emissions reductions by 2050.
- 3.1.4. The wide variety of terms used to communicate emissions reduction and energy targets makes comparison between strategies difficult and is an ongoing barrier to effective communication to broader, non-technical audiences. It may be particularly useful for transition strategies to consistently report on periodic ‘carbon budgets’ and annual rates of decarbonisation.
- 3.1.5. Key research priorities include further clarification and communication of scientifically informed knowledge about the global, national and local emissions reduction, energy consumption, renewable energy and carbon sequestration targets required to significantly reduce the risk of runaway climate change.

#### **3.2. Technology and innovation implications and priorities**

- 3.2.1. Technological barriers are not the major obstacles to the transition to a post carbon economy at the speed and scale required to significantly reduce the risk of runaway climate change.
- 3.2.2. The overall suite of technological and systemic changes needed to achieve a just and sustainable post carbon future is now well understood. It includes:
  - rapid reductions in energy consumption and improvements in energy efficiency
  - rapid replacement of fossil fuels by renewable energy
  - drawdown and sequestration of carbon into sustainable carbon sinks
  - implementation of policies needed to ensure fair and timely adaptation.
- 3.2.3. It will be vital to tailor energy efficiency and energy supply solutions to maximise their potential in specific national and regional contexts.
- 3.2.4. Important differences in approaches between strategies include the extent to which they assume that behavioural and cultural change can drive large-scale reduction in consumption and energy usage, and the assumptions made about the potential speed and scale of innovation and commercialisation of different technologies.
- 3.2.5. While most non-government-authored strategies do not support nuclear energy, some government-authored strategies continue to assume a transitional, ongoing or expanded role for nuclear energy.

- 3.2.6. While some strategies (especially government-authored) continue to prioritise carbon capture and storage (CCS) as a way of continuing to use fossil fuels, there is increasing scepticism about the extent to which CCS is likely to become technologically and financially viable in the near future.
- 3.2.7. The most promising solutions for reducing energy consumption and increasing energy efficiency include:
- information, education and social marketing programs
  - zero waste economy and ‘cradle to cradle’ product design systems
  - energy efficient buildings and planning
    - retrofit existing buildings to maximise energy efficiency
    - zero emissions standards for new buildings
    - maximise insulation
    - wide rollout of passive solar, combined heat and power and decentralised heating and cooling systems
    - improve efficiency of all heating, cooling, lighting and appliances
    - integrated land use, housing and transportation planning to reduce distances travelled and facilitate the shift to energy efficient transport.
  - energy efficient industry
    - investment in resource and energy efficient industrial processes and equipment
    - reduce impact of energy intensive industries (e.g. aluminium, cement, iron, plastics)
    - upgrade inefficient electric motors, lighting and heating systems
    - recycle heat energy from electricity generation through co-generation
    - reduce fugitive methane emissions from mining
    - improve recycling and abatement technologies for non-CO<sub>2</sub> emissions.
  - energy efficient transport
    - set and achieve higher vehicle fuel economy standards
    - reduce carbon intensity of transportation fuels
    - reduce distances travelled through urban planning, traffic congestion taxes, increased use of video conferencing, etc
    - replace fossil fuel cars with electric and plug-in hybrid vehicles
    - improve access to electric vehicle charging stations
    - encourage a shift from private cars to public transport, high-speed rail, bicycles and walking
    - expand the use of second-generation biofuels (e.g. algal biodiesel and lingo-cellulosic ethanol)
    - hydrogen (from renewable electricity) to be used for some shipping
    - significantly reduce airline travel.
- 3.2.8. The most promising solutions for promoting a rapid shift from fossil fuels to renewable energy include:
- significantly expanding innovation, investment and deployment in the following energy sources:
    - solar: concentrated and photovoltaic (PV)
    - wind: on- and off-shore
    - wave and tidal
    - hydroelectricity
    - geothermal: directly to heat buildings and at high temperatures for electricity generation
    - bioenergy: traditional biomass; sustainable residues and waste; sustainable energy crops; and sustainable algae
    - the use of spare wind, water and solar energy to produce electrolytic hydrogen
    - liquefied hydrogen combustion for aircraft.
  - designing and building interconnected ‘smart’ grids.
- 3.2.9. The most promising solutions for reducing land use emissions and improving the role of land use in carbon sequestration include:
- reducing livestock production and consumption
  - increasing local food production and distribution

- reducing cropland soil emissions: reducing tillage; improving fertiliser and nutrient management; and restoring degraded farmland
- improving pasture and grassland management: optimising grazing intensity; expanding planting of deep-rooted perennial grasses; and improving fire management
- reducing livestock emissions: active livestock feeding; anti-methanogenic treatments; and improving manure management
- bio-gasification of organic manure; capture or burning of agricultural methane
- more efficient use of on-farm energy and fuel
- cropland carbon sequestration
- ending and reversing deforestation
- improving forest management (weed and pest control).

### **3.3. Economic policy and financial implications and priorities**

- 3.3.1. The financial costs and social impacts of economic and industry restructuring represent significant but not insurmountable obstacles to the transition to a post carbon economy at the speed and scale required to significantly reduce the risk of runaway climate change.
- 3.3.2. Many strategies note the importance of strengthening understanding of the financial, economic and social costs of failing to take action to reduce emissions, and of the multiple employment, health and social equity co-benefits of a swift transition to a post carbon economy.
- 3.3.3. All of the strategies considered in this report include some mix of market-based and regulatory policies. Most also include a range of more direct government incentives and actions to improve energy efficiency and shift energy production and consumption away from fossil fuels to renewable energy.
- 3.3.4. Regulatory, taxation and financial incentive policies commonly recommended include:
- regulations and/or taxes designed to reduce fossil fuel use in transport (e.g. cars, aviation and shipping) and fossil fuel-intensive industries (e.g. aluminium, cement, iron and plastics)
  - strong, binding energy efficiency standards for buildings, vehicles and energy consuming products
  - tax incentives, low interest loans and loan guarantees to encourage investment in renewable energy enterprises and R&D.
- 3.3.5. There is strong ongoing support for both ‘cap and trade’ and carbon tax policies for setting a price on carbon. A number of strategies that are more focused on science-based timeframes for transition note that a rapid increase in the global carbon price (towards US\$100–US\$200 a tonne) is likely to be required if the price of carbon is to be the primary mechanism driving the transition to a post carbon economy.
- 3.3.6. Some strategies remain cautious of over-reliance on carbon pricing, placing stronger emphasis on additional measures to drive a rapid transition from fossil fuels to renewable energy, including:
- elimination of all fossil fuel subsidies
  - introduction of feed-in tariffs
  - regulation, and sometimes funding, to close fossil fuel power stations
  - binding renewable energy targets.
- 3.3.7. Those strategies that call for rapid renewable energy deployment highlight the fundamental difference in the economics of renewable energy compared to existing fossil-fuel-based energy systems, particularly when considered in the medium to long term. Building renewable energy infrastructure requires significant upfront investment, but costs are rapidly decreasing and will continue to do so over time, while fossil fuel prices are likely to continue to increase.
- 3.3.8. Strategies with emissions reductions targets that are more strongly informed by climate science generally include a strong emphasis on the need to rethink and reframe current assumptions about the nature and level of economic growth, and to rapidly explore alternatives to current economic paradigms and policy settings.

- 3.3.9. The strategies analysed differ in their assumptions about the possibility and desirability of maintaining current material consumption levels and ensuring continuing economic growth. Some place greater emphasis on rapid reduction in emissions (at the required scale and speed), while others only consider levels of emissions reductions that will not cause significant changes to, or limitation of, material consumption.
- 3.3.10. Strategies concerned with developing country economies, such as China, India and South Korea, all assume an important role for continued economic growth in helping to meet human development goals. These strategies highlight concepts of 'green growth' and 'low carbon growth', and emphasise the need for economic development to be linked to, or driven by, development in 'low carbon' industries and programs.
- 3.3.11. Costing of policies to achieve global and national emissions reductions at the required scale and speed remains an inexact science. The strategies reveal a wide variety of approaches to calculating and reporting the financial costs of post carbon economy transition policies. Key differences and variables include:
- time frames over which costs and benefits are considered (see point 3.3.12 below).
  - assumptions about future trends in prices of different technologies and fuel sources (e.g. fossil fuel resource availability and prices, cost trajectories for renewable energy technology and deployment)
  - the extent to which they factor in the costs of inaction and incorporate savings from avoiding climate change impacts.
  - the way cost estimates are reported (e.g. total amount, amount per year, as a proportion of GDP, investment additional to current levels, etc.) and who they are attributed to (e.g. overall cost to society, public funding, private investment, total investment, etc).
- 3.3.12. While most strategies emphasise the importance of 'cost effectiveness' there is considerable diversity in the time frames over which costs and benefits are calculated. For example, the UK *Carbon Plan* notes the significant implications of prioritising 'static' cost effectiveness of particular technologies (based on short-term conditions, such as the current carbon price) and 'dynamic' cost effectiveness' (considering actions required to meet longer term targets). A longer term view may require higher upfront investments in order to optimise longer term impacts and savings.
- 3.3.13. Noting the wide variation in scope and costing assumptions, ballpark estimates of the costs of actions required to rapidly decarbonise the global economy include:
- World in Transition: US\$200 to US\$1,000 billion p.a. to 2030
  - World on the Edge: US\$200 billion p.a.
  - One Degree War Plan: US\$2,500 billion p.a.
  - Powering a Green Planet: US\$100 trillion over twenty years
  - The Energy Report: €1,000 billion p.a.
- 3.3.14. Indicative national level costings (again, noting significant differences in the scale and speed of proposed actions and costing assumptions) include:
- Europe (European Commission): €270 billion p.a. over 40 years (1.5 per cent of EU GDP p.a. above overall 2009 investment levels)
  - UK (Zero Carbon Britain): £50 billion p.a.
  - UK (UK Government): Average cost between 0.4 and 0.6 per cent of UK GDP p.a.
  - Australia (Zero Carbon Australia): AU\$37 billion p.a. over ten years (approx. 3 per cent of Australian GDP)
  - Germany (German Government): €20 billion p.a. over 40 years
  - South Korea (South Korean Government): \$US 83 billion over five years
  - Denmark (Danish Government): \$US 952 million to 2020 (net costs of 0.25 per cent of Danish GDP).
- 3.3.15. To give some sense of perspective, the US Government funds allocated to the 2011 Troubled Asset Relief Program (TARP), supporting the 'bail-out' of the US banking system, was \$700 billion. The UK Independent Commission on Banking estimates that as of July 2011 the total amount committed to provide financial support to UK banks was €456 billion. In September 2011 the amount allocated to the European Financial Stability Facility was €780 billion, with Germany alone pledging €253 billion.

3.3.16. Strategies for raising the required level of funding include:

- global, national or regional carbon price schemes (with strategies that are more focused on science-based timeframes for transition noting the need for a carbon price of between US\$100 and \$200 a tonne).
- collection of a 'Tobin tax' on international financial transactions
- redirection of current taxation revenue
- a variety of national and local level 'green bond' schemes
- for developing economies, financial assistance from developed countries.

**Table 3** on the following page summarises key targets and technology, economic and financial elements of the strategies.

Table 3: Post carbon economy transition strategies: Summary of key features

Strategy or plan	Energy and emissions targets	Energy supply assumptions and priorities	Significant questioning of current economic paradigm	Approximate cost of transition policies
<b>World in Transition</b>	Decarbonise global energy system by 2050	Renewables; no nuclear; possibly CCS	Yes	Additional net investment US\$200 and \$1000 billion p.a. by 2030
<b>World on the Edge</b>	Cut global CO <sub>2</sub> emissions by 80% by 2020 (on 2006 levels)	Renewables; no nuclear or CCS	Yes	Net cost US \$200 billion p.a.
<b>Our Choice</b>	Rapid reduction to 350ppm atmospheric CO <sub>2</sub> concentration	Renewables, nuclear, CCS all considered	Yes	Does not include detailed costings
<b>One Degree War Plan</b>	Cut global GHG emissions to zero over 15 years; negative emissions for rest of century	Renewables. Low possibility of nuclear and CCS	Yes	Carbon tax expected to generate US\$2,500 billion p.a. by year 5 to spend on transition
<b>Powering a Green Planet</b>	Switch global energy system to 100% renewable energy (wind, water, solar) by 2030	100% renewables: wind, water and solar sources only	No	Ballpark figure of US \$100 trillion over 20 years in gross investment to construct global renewable energy systems. BAU will cost approx US\$10 trillion (not inc. mounting social costs)
<b>The Energy Report</b>	Peak and decline global GHG emissions within five years, reduce by 80% by 2050 (on 1990 levels); 100% renewable energy by 2050	Renewables; no nuclear or CCS; 5% fossil fuels	No	Total cost of achieving targets approx €1 trillion p.a. Investment expected to have paid itself off by around 2040 at latest
<b>Zero Carbon Britain 2030</b>	Reduce net UK GHG emissions to zero by 2030	Renewables; no CCS; no <i>new</i> nuclear	Yes	Ballpark figure of £50 billion p.a. required for initial investment program
<b>Climate Works Low Carbon Growth Plan for Australia</b>	Reduce Australian GHG emissions by 25% by 2020	Fossil fuels; CCS; renewables	No	AU\$1.8 billion per year. Strong emphasis on net savings to business.
<b>Zero Carbon Australia Stationary Energy Plan</b>	Reduce net Australian GHG emissions to zero by 2020; 100% of stationary energy from renewables by 2020	100% renewables	No	AU\$37 billion p.a. for ten-year period, or approx 3% of Australian GDP. Net present costs over longer time period (2010–40) roughly equiv to BAU (not inc. transport savings)

Strategy or plan (continued)	Energy and emissions targets	Energy supply assumptions and priorities	Significant questioning of current economic paradigm	Approximate cost of transition policies
<b>European Commission: Roadmap 2050</b>	Reduce EU GHG emissions by 20% by 2020 and 80–95% by 2050 (on 1990 levels)	Renewables; CCS; nuclear	No	Approx. €270 billion p.a. over 40 years (approx 1.5% of EU GDP p.a. above 2009 investment levels). Savings between €175–320 billion p.a. (not incl. saving on social costs)
<b>UK: Carbon Plan</b>	Reduce UK GHG emissions by 34% by 2020 and 80% by 2050 (on 1990 levels)	Fossil fuel (shift to gas); nuclear; CCS; renewables	No	Total net present cost over lifetime of policies in past carbon budget periods approx £9 billion. Average cost approx 0.4% of UK GDP p.a. in period 2008–22 and 0.6% of UK GDP per year over 2023–27
<b>South Korea: Green Growth Strategy</b>	Reduce Korean GHG emissions by 30% below projected 2020 levels (equivalent to 4% reduction on 2005 levels)	Fossil fuels; nuclear; renewables	No	Total investment announced as part of Five-Year Plan (2009–13) US\$83.6 billion
<b>China: 12th Five-Year Plan &amp; Climate Change White Paper</b>	Reduce Chinese CO <sub>2</sub> emissions per unit of GDP by 40–45% by 2020 (on 2005 levels)	Fossil fuels (incl. unconventional oil and gas); CCS; nuclear; renewables	No	Total investment (both public and private) in ‘new energy’ of approx RMB 5 trillion (US\$760 billion) over next 10 years
<b>India: National Action Plan &amp; Low Carbon Growth Report</b>	Reduce India’s emissions intensity of GDP by 20–25% by 2020 (on 2005 levels)	Fossil fuels; possibly CCS; nuclear; renewables	No	Does not include detailed costings
<b>Australia: Clean Energy Future</b>	Reduce Australian GHG emissions by 5% by 2020 and 80% by 2050 (on 2000 levels)	Fossil fuels; CCS; renewables	No	Carbon price and related measures to raise approx AUD\$25.5 billion in the period 2011–15. Further \$3.9 billion public funds to augment
<b>Germany: Energy Concept</b>	Reduce German GHG emissions by 40% by 2020 and at least 80% by 2050 (on 1990 levels)	Renewables; possibly CCS; phase-out nuclear	No	Additional investment €20 billion p.a., offset by energy cost savings
<b>Denmark: Our Future Energy</b>	100% renewable energy in all Danish energy supply by 2050	100% renewables	No	Cost to 2020 approx DKK 5.6 billion (US\$952 million). Immediate net costs of < 0.25% GDP in 2020. Average additional costs to Danish households approx DKK 1,700 (US\$289) in 2020
<b>California: Scoping Plan &amp; Clean Energy Future Plan</b>	Reduce GHG emissions to 1990 levels by 2020 and 80% of 1990 levels by 2050; 33% of electricity from renewable energy by 2020	Fossil fuels; possibly CCS; renewables	No	Ongoing costs approx US\$ 36 million p.a. Benefits by 2020 (compared to BAU) inc. increases in economic production of US\$33 billion and overall gross state product of US\$7 billion

### **3.4. Social equity implications and priorities**

- 3.4.1. While all strategies are informed by some implicit commitment to improving outcomes for future generations there is a surprising absence of explicit or detailed discussion of intergenerational equity or of future discounting assumptions and trade-offs. This suggests that there is a need for more robust frameworks for understanding how a socially just approach to climate change translates into actions at national and international levels, in order to hold the strategies and their authors accountable to claims of concern for equity.
- 3.4.2. There is widespread recognition that broad political support for a rapid transition to a post carbon economy will depend on the implementation of policies that address and overcome key social equity challenges. The primary concern of many of the government-led strategies is on overcoming social equity at the national rather than international level.
- 3.4.3. Many strategies note the potentially severe impacts on disadvantaged and low income communities and individuals of failing to take timely and effective action to reduce the risks of runaway climate change.

### **3.5. Governance implications and priorities**

- 3.5.1. A rapid transition to a post carbon economy is likely to require strong leadership by national governments in setting and achieving clear long-term emissions reduction targets, combined with strengthened grassroots mobilisation, active support from the private sector, and enhanced global cooperation.
- 3.5.2. Some of the strategies focused on science-based timeframes for transition emphasise the unprecedented scale of action required and consider dramatic shifts in current governance arrangements, with a particular emphasis on strengthened global institutions and cooperation (see *World in Transition*, for example). Less ambitious (typically government-led) strategies appear to assume that existing governance arrangements will suffice.
- 3.5.3. While many strategies note an important role for government in encouraging and driving investment in key infrastructure and green economy projects (e.g. smart grids, high-speed rail and electric vehicle recharging stations), a number of strategies also emphasise the importance of encouraging distributed and decentralised energy systems and reinvigorating local economies.
- 3.5.4. Most strategies emphasise the importance of an integrated mix of market-based and government-led policy initiatives.
- 3.5.5. Promising options for strengthening national government leadership include:
  - national climate protection targets enshrined in constitutions and legislation
  - climate protection and decarbonisation objectives embedded in all national and local government policies and programs
  - deliberative 'future' chambers of parliament providing an opportunity for informed consideration of the impact of policy decisions on future generations.
- 3.5.6. Promising options for strengthening global cooperation include:
  - a commitment to continue to work towards a global climate change action compact committing all nations to an internationally verifiable decarbonisation road map and a shared approach to carbon pricing
  - the development of sub-global, regional alliances and collaborations involving nation states and sub-national regions, provinces and cities
  - the design and construction of international smart electricity grids and networks
  - a strengthened role for international governance institutions, such as the International Energy Agency and the International Renewable Energy Agency

- renewable energy investment priorities embedded at the heart of all international aid and development programs.
- 3.5.7. Promising options for strengthening grassroots citizen mobilisation include:
- an extension of opportunities for citizen participation, including legislative obligation for governments to provide citizens with opportunities to participate in informed debate
  - an increased role for local government and local community organisations in exploring and implementing innovative post carbon economy transition solutions
  - increased support for decentralised local systems of economic production and distribution and for distributed energy systems.
- 3.5.8. Key policy and research priorities include clarification and implementation of the most effective governance strategies for achieving:
- binding and verifiable emissions reduction agreements at global, regional, national and local levels
  - informed public debate about climate change challenges and solutions
  - the encouragement and mobilisation of local community innovation and activism.

### **3.6. Political and social change assumptions and priorities**

- 3.6.1. The need to secure and sustain broad social and political support is widely recognised as the greatest obstacle to taking the actions needed to drive a rapid and effective transition to a post carbon economy.
- 3.6.2. The lack of strategies for achieving broad social and political support and for driving transformational social change is the most significant gap in most post carbon economy transition plans and strategies. This frequently reflects an implicit assumption of a reasonably rational policy-making process in which the objective merits of the strategy provide a sufficient basis for driving change.
- 3.6.3. There is a crucial difference between those post carbon economy transition strategies that emphasise the need for a pragmatic and evolutionary approach (generally government-led) and those that prioritise the need for more rapid and transformational change (generally non-government authored). This highlights two challenging and increasingly urgent questions:
- For less ambitious plans and strategies (generally government-led): Given that the proposed actions do not match the physical requirements of action needed to prevent runaway climate change, what can be done to bridge this gap?
  - For more ambitious plans and strategies (generally non-government authored): Given that political and social support for the rapid implementation of these proposals remains challenging: what can be done to bridge this gap?
- 3.6.4. Most strategies are informed by a strong recognition of the importance of finding a complementary balance between the design and implementation of integrated, 'top-down' strategic plans and the encouragement and facilitation of more diverse and diffuse, 'bottom-up' approaches to social and technological innovation.
- 3.6.5. The most common theories of transformational change emphasise the need for visionary political leadership combined with broad community mobilisation. Many also highlight the potential for one or more dramatic 'tipping point' events, whether directly arising from climate change or not, to trigger a swift, large-scale shift in political values and responses.
- 3.6.6. Of all the strategies presented in this report, the *World in Transition* report from the German Advisory Council on Global Change (WBGU) presents the most comprehensive assessment of the social change dynamics that could underpin broad public acceptance and support for transition. It emphasises:

- knowledge-based, shared visions and the importance of advocating desirable futures, rather than triggering anxiety
- the important role of change agents, social and economic megatrends and ‘shocks’
- proactive states and supportive global governance structures.

3.6.7. The lack of detail within existing strategies about how to achieve the political leadership and public support for rapid transitions is problematic, particularly in the context of the unprecedented threat that runaway climate change presents to economic and social wellbeing.

**Table 4** summarises the theories of social and political change contained within the selected post carbon transition strategies.

**Table 4: Post carbon economy transition strategies: Theories of social and political change**

Strategy or plan	Theories of social and political change
<b>World in Transition</b>	<p>Key conditions for creating social dynamics for change: knowledge-based, shared visions of desirable future; strong and effective change agents and champions; social and economic ‘shocks’; proactive state and supportive global governance structures.</p> <p>Strategic opportunities for overcoming barriers to transformational change: rapid advances in low carbon technology innovation; recognition that required investments are viable when compared with greater costs of inaction; changing values towards sustainability; global knowledge networks; and recognition of co-benefits of transformational change.</p>
<b>World on the Edge</b>	<p>Transition requires decarbonisation at ‘wartime speed’. Three social change models:</p> <ul style="list-style-type: none"> <li>• Pearl Harbor: Dramatic event leads to fundamental change (too risky?)</li> <li>• Berlin Wall: Social tipping point reached after gradual change in thinking and attitudes (too slow?)</li> <li>• Sandwich: Grassroots movement strongly supported by political leadership (preferred).</li> </ul>
<b>Our Choice</b>	<p>Overcoming social, political and attitudinal barriers to climate action requires visionary leadership combined with broad community mobilisation. Need to hold self-interested corporations to account and ensure higher standards in media.</p>
<b>One Degree War Plan</b>	<p>Prevention of catastrophic climate change requires broad support for comprehensive and integrated action at scale and speed comparable to Second World War mobilisation. At some point (before 2020?) one or more critical ecological, economic or social tipping point events likely to occur, leading to shift in public support for action required.</p>
<b>Powering a Green Planet</b>	<p>Obstacles to implementation of 100% global renewable energy system by 2030 ‘primarily social and political, not technological’; need for strong leadership to avoid dominance of industry-preferred technologies.</p>
<b>The Energy Report</b>	<p>Reduction in energy demand from energy efficiency savings, rather than restrictions on human activities; emphasis on human ingenuity, technological innovation and behaviour change as key drivers of transition.</p>

<b>Zero Carbon Britain 2030</b>	Notes dynamic nature of politics and role of sudden, unexpected events in driving dramatic political shifts; importance of having plans in place to avoid predictable, but uncertain, shocks (e.g. peak oil). Importance of behaviour change plus promotion of wider societal dialogue on values, structures and processes that have led to overconsumption, climate change and resource depletion.
<b>Climate Works Low Carbon Growth Plan for Australia</b>	Focus on winning support from key industry sectors as a basis for winning broader social and political support.
<b>Zero Carbon Australia Stationary Energy Plan</b>	Need for 'decisive leadership' from government, business, academia and the wider community to implement the plan. Focus on contributing to settling debate on technical feasibility of 100% renewable energy in Australia to enable social and political changes to occur.
<b>Strategy or plan (continued)</b>	<b>Theories of social and political change</b>
<b>European Commission: Roadmap 2050</b>	Political and social change factors not covered in detail, although notes importance of policy innovation, behaviour change and public education programs.
<b>UK: Carbon Plan</b>	Importance of UK Government, industry and citizens to be 'pulling in the same direction' in order to achieve low carbon transition.
<b>Korea: Green Growth Strategy</b>	Emphasis on education and raising public awareness about need for lifestyle change needed to support green growth.
<b>China: 12th Five-Year Plan &amp; Climate Change White Paper</b>	Underlying assumption of strong and ongoing role for co-ordinated government planning and intervention, consistent with overall Chinese economic and political governance arrangements.
<b>India: National Action Plan &amp; Low Carbon Growth Report</b>	Political and social change factors not covered in plans considered. Interim report notes need for the final report to include discussion of barriers to implementation or adoption by people and firms of Indian climate change policies.
<b>Australia: Clean Energy Future</b>	Carbon price as central driver of change. Strong emphasis on limited impact of policy measures on Australian economy and lifestyles.
<b>Germany: Energy Concept</b>	Importance of public understanding and support for transition to ensure its success. Measures include provision of comprehensible information, transparent decision making and opportunities for public dialogue.
<b>Denmark: Our Future Energy</b>	Elements contributing to social and political acceptance of Denmark's energy transition not covered in the plan. Assumes strong ongoing role for government in encouraging innovation and community education.
<b>California: Scoping Plan and Clean Energy Future Plan</b>	Active public participation essential. Emphasis on role for market forces and growing environmental awareness to shift individual choices and attitudes. Calls for targeted public outreach, marketing and education programs.

## 4. Implications for Australian climate change policies and strategies

- 4.1. The Australian Government's 2020 emissions reduction target (a 5 per cent decrease on 2000 levels) is clearly still far from the level required for Australia to make a responsible and fair contribution to global emissions reductions at the scale and speed required to significantly reduce the risk of runaway climate change. Australia's 2050 target (an 80 per cent decrease on 2000 levels) is more robust, but no detailed proposals have yet been produced outlining how this target might be achieved.
- 4.2. A high level of political leadership will be required in order to drive an Australian climate change debate informed primarily by scientific evidence about the required speed and scale of emissions reductions rather than short-term calculations of political and economic costs.

## 5. Future research and policy development priorities

- 5.1. The aim of this report is to provide an overview of the key assumptions, priorities and lessons from the most promising large-scale post carbon economy transition strategies developed by government and non-government organisations.
- 5.2. Key policy and research priorities arising from the analysis of transition strategies considered in this report include further clarification and communication of scientifically-informed knowledge on:
  - the scale and speed of global, national and local emissions reductions required to significantly reduce the risk of runaway climate change
  - economic and social policies providing the most effective and fair basis for achieving emissions reductions at the required speed and scale
  - political and social change strategies leading to rapid implementation of the policies needed to drive a swift transition to a just and sustainable post carbon economy.
- 5.3. The second phase of the *Post Carbon Pathways* research project will focus on the following questions:
  - Which large-scale post carbon economy transition strategies have been most effective in:
    - influencing public debate
    - influencing the attitudes and actions of key stakeholders and decision makers
    - driving rapid implementation of post carbon economy policies
    - and driving rapid reductions in GHG emissions?
  - What have been the major barriers limiting the effectiveness and preventing the rapid implementation of large-scale post carbon economy transition strategies?
  - What have been the most effective strategies for overcoming these barriers?

**Full report available for download from**  
<http://cpd.org.au/2012/03/post-carbon-pathways> or  
<http://www.sustainable.unimelb.edu.au/content/pages/post-carbon-pathways>

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<sup>1</sup> Post Carbon Institute (ND) 'Issues and definitions', accessed Jan 2012 at: <http://www.postcarbon.org/about/faqs/>