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Governing the rapid climate mitigation project

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Abstract: Recent climate science studies reveal that emissions trajectory is moving towards 3 to 4°C warming. This new projection most likely requires peaking total global greenhouse gas emissions as soon as possible followed by rapid reductions to near zero. Despite calls to immediately commence a rapid transition of current fossil-fuelled energy into sustainable systems, responses from most governments remain weak and show no sense of urgency. In cases where transition plans are present, these assume that existing governance arrangements are sufficient for the transition. In contrast, I argue that a new governance paradigm is necessary for the transition to be rapid, inclusive, and efficient. Labelled as the ‘rapid transition project’, I elucidate this paradigm using historical accounts of rapid institutional restructurings. Of particular interest are accounts of World War 2 mobilisations where radical, rigorous and rapid institutional changes were conducted. While wartime experience suggests some potential strategies for rapid climate mitigation, I also argue limitations exist in the use of this analogy and should not be construed as a panacea.

Keywords: Rapid transition; rapid climate mitigation; sustainable energy

1. Introduction

Current warming trajectory is headed to 3 to 4°C by the end of the century (New et al. 2011). This means that our state of living ‘as we know it’ would be entirely different if we don’t take rapid, inclusive, and efficient mitigation actions to abate climate change. We, therefore, are in a critical period in which we must turn around this trajectory. There is now little to no chance of maintaining the rise in global mean surface temperature at below 2°C as previously scientifically recognised (Anderson and Bows 2011, New et al. 2011). With the likelihood of a 3 to 4°C warming, the impacts associated with 2°C have been consequently revised upwards (Smith et al. 2009, Mann 2009). Policy advice must therefore shift from the current rhetoric of policy defined by reductions in line with the 2°C threshold to a radical, dramatic and immediate emissions reduction project (Delina and Diesendorf forthcoming, Diesendorf 2010). Such project would require massive deployments of new energy technologies and substantive structural changes in the economy. Within this 3 to 4°C warming narrative, climate mitigation must involve an urgent, rapid and large-scale changes primarily in the way we currently produce and consume energy¹. In this paper, I label this approach as the ‘rapid transition project.’

The ‘project’ involves drafting contingency plans and strategies that will be most likely to be implemented when an emergency occurs. As projected in the scientific literature, the 3 to 4°C warming scenario will most likely bring with it sudden major global impact. Triggered by a climate-related event, ‘tipping points’ include increase precipitation (Allen and Ingram 2002), drought in currently arid and semi-arid areas, wetter tropical areas, and increase in global sea level between 0.5 and 2 meters by the end of the century (Nicholls et al. 2011). Beyond 2100, a warming of 4°C could mean larger sea level rises triggered by the irreversible melting of the Greenland ice sheet and breaking-up of the West Antarctic Ice Sheet (Nicholls et al. 2011, Vaughan 2008, Rignot et al. 2011, Lenton et al. 2008). Most likely, these events will involve social, demographic, economic and security repercussions—something that resembles a crisis and therefore requires an emergency response. For instance, Nichols et al. (2011) estimates that a 2m sea level rise would cost around \$270 billion per annum, displace 182 million people, and lose 1.8 million sq km of area. On the eve of this crisis-like situation, let us assume that governments finally agree on a target of zero emissions particularly from the energy sector. As part of this agreement, countries will adopt strategies requiring technologically advanced countries and countries with substantial renewable energy resources to quickly achieve rapid zero emissions from the energy sector.

Section 2 lists the general technical strategies for the ‘project.’ While this technical component is the easiest aspect of the ‘project’ to envisage since a number of literature had been published on this subject, how they could be rigorously and rapidly deployed to meet the urgency requirement remains problematic. Addressing this seemingly complex question is the primary purpose of this paper. In response, I take the historical by taking cue from the rapid production and deployment of war machines during World War 2. The lessons of wartime mobilisation (presented in Section 3), as I will

¹ The focus on reducing emissions in the energy sector is justified by it being the largest emitter of all sectors, that is, about 66% of the 2005 total (World Resources Institute 2012). Primary climate mitigation literature (such as in Hansen 2009:173, Stern 2008:7, 8, Caldeira, Jain and Hoffert 2003) also mentions the importance of reductions in this sector. Scientific conclusion also tells that if emissions could be quickly and entirely eliminated, temperatures would quickly stabilise or even decrease over time (Matthews and Weaver 2010).

argue, provide a comparatively rich narrative as to how the ‘project’ could take off and be sustained. To that end, I highlight wartime restructurings in the same section to juxtapose the discussion on how rapid deployment of the ‘project’ strategies could be accomplished (Section 4). Based on the war parallel, the suggested approach would be monocentric defined by a government-led, centrally-controlled apparatus. While this argument could yield positive impact, this governance-restructuring proposal should never be construed as a panacea. Its limitations are in fact discussed in Section 5. Section 6 responds to these limitations by presenting an antithesis of the martial argument’s monocentric approach. A conclusion section wraps up this paper.

2. The ‘rapid transition project’

During the past five years, a number of studies and models suggest the possibility of safe, ecologically sustainable energy systems based on a 100% RES in various scales from global to regional and national (see Delina and Diesendorf forthcoming for the list of literature recently published on the subject). These studies point out that most of the technologies required to build these systems are already commercially available, either on a large-scale or in limited mass production. In sum, we are technically prepared to transform the way we produce our energy. Building upon these studies, large scale RES would only be possible if a parallel and series of strategies are built onto the ‘project’ which could include the following components:

- *Legislation and planning*: Setting up of national statutory climate protection and decarbonisation activities that will translate into rapid emissions reductions policy and zero emission targets; drawing up a national RES expansion plan
- *Regulation and planning*: Institution of regulatory and planning frameworks to allow the rapid retirement of conventional fossil-based power plants, fossil fuel-based human transport, and high-temperature industrial heat from coal and gas combustion; immediate phasing out of fossil fuel subsidies; replacing their capacity with RES, and improved public transport fuelled by renewable electricity and biofuels
- *Alternatives to affected sectors*: Offering viable alternatives to affected sectors and regions and exploration of ways to mitigate the negative social effects of structural change; exploring the use of interim fuels (such as natural gas) to minimise system shock
- *Network expansion*: Rapid development, deployment and expansion of new transmission lines for efficient integration of RES with consumers; incentivising transmission system operators and network providers
- *Energy efficiency*: Setting up an absolute electricity demand limit and stabilisation of electricity demand over the long term via strong energy efficiency measures; comprehensive and compulsory demand reduction programs for all appliances, equipment and inhabited buildings
- *Research and development (R&D)*: Accelerating R&D of efficient energy storage, ecologically sustainable biofuel production, and carbon capture and storage technologies
- *Support schemes*: Development of support schemes for RES: Preparation of renewable resource maps, labour preparation and skilling up, identification of new and innovative financial capital and support instruments for each type of renewable energy; incentivising RE industry

The strategies outlined above required rigorous and massive resources, including human and financial

resources. Although studies on the technical feasibilities of the transition (as enumerated in Delina and Diesendorf forthcoming) and the required labour and financial capital have been wide and far-reaching (see for example Wei et al. 2010, and Chapman and Lounkaew 2011 for labour studies; Shellenberger et al. 2008, Olmos et al. 2012 and Delina 2011 for financing studies), literature on how to implement—or ‘govern’—this rigorous undertaking particularly in the national level given the speed and scale requirements remains scarce. While there is no denying that contemporary literature on transition governance exists, their focus has predominantly been towards innovation and niche development of the renewable industry which lacks the specific ingredient, necessity and urgency required in the 3 to 4°C warming scenario. Recognising the scale and scope of this requirement, the ‘project’ suggests one approach by turning to history to seek possible and comparable responses and strategies. It turns out that during the last century, humanity had actually ventured in an analogous project—the massive and rapid mobilisation for war.

3. Wartime restructurings

The comparison between climate change and war is not an entirely new topic. In fact, the analogy between climate mitigation and wartime economic restructuring has been used in recent discourse as a strong political slogan in policy and scientific circles. During the 2009 World Forum on the Enterprise and Development in Oxford, for example, Al Gore likened the ‘battle against climate change [as something] like fighting the Nazis’ (Gore 2009). The comparison has also been discussed in the scholarly literature albeit the treatments are few in number and are scattered into various strategies. Several authors particularly Delucchi and Jacobson 2011, and Brown 2008 utilised the parallel of quick mobilisation of war technology in the 1940s particularly in America to emphasise and bolster the technical case of large-scale RES deployments. Gilding (2011) employed a similar analogy between rapid climate change response and mobilisation for war calling for an international level establishment of a crisis response plan to motivate government policymakers to dedicate adequate resources for addressing climate change. The underlying assumption in these studies is that governments have similar capacity to initiate large-scale endeavours such as those envisaged by the ‘project’ yet fell short of discussing how exactly the rapid transition can be governed.

To provide context on the ability of governments to churn out unprecedented quantities of war munitions, we turn the pages of history and consider mobilisations in America. As a result of America’s formal war participation², the social and economic paradigms in the US shifted from free-market to a government-led system almost overnight. The Roosevelt Government, acting on a legislative mandate, took over vital industries as wartime mobilisation intensified. Military budgets rose as production requirements increased. In 1942, the budget for defence purposes took almost a third of American GNP; in 1944, this share further increased to 42% (Harrison 1998). As a new system emerged, the role of the private sector somehow diminished and brought forth the superiority of public investments. Between 1942 and 1945, public investments in America reached \$128.3 billion compared to private investment of only \$35.1 billion (both figures in current dollars) (computed from Higgs 2004:504, Table 1). This ‘socialisation of investment’ (Higgs 2004:503) emphasises the immediate

² Only in December 1941 with the attack of Pearl Harbour and Manila that the US issued a formal declaration of war against the Axis nations although it had already been supporting the UK and other Allied states through munitions provision.

contribution of public finance not only for financial capital support assurance for munitions production but also for wartime economic growth in America³. How did the US raise these funds? Generally, there are three principal ways by which financial resources are mobilised: printing money, raising taxes, and borrowing. During the war, the latter two became the most common forms of funding resources in America. Total war costs, in fact, was subsidised by bond sales (around 55%) and taxation (around 45 per cent) (Kennedy 1999:625, Lumer 1954:20).

Wartime production results were overwhelming. Between July 1940 and May 1945, American industry produced 299,300 airplanes, 86,700 tanks, more than 100,000 naval vessels, more than 20 million rifles, 2.4 million trucks and jeeps, 41 billion bullets and millions of other war-related items (Cardozier 1995:157, Overy 2006, Smith 1991:3-31). Contributing to this American ‘production miracle’ was the increased supply of labour. By 1944, some 7.7 million more Americans were employed in civilian work than had been in 1939 (Cardozier 1995:149) or an increase of about 35 per cent over previous year (Rockoff 1998:100). As a consequence of intensive labour deployments especially in the manufacturing sector, unemployment rates significantly dropped. In 1944, there were 670 000 unemployed Americans⁴ compared to 10 million during the Depression (Rockoff 1998:101).

Considering the scale and scope of wartime mobilisation and its respective results, it can be inferred that governments have the capacity to call a comparatively rigorous endeavour as the one required by the ‘rapid transition project.’ The wartime analogy for climate response, however, does not end with these quantitative capacities. Wartime rapid mobilisation programs had realised not only ripples but also tsunamis particularly on the approaches that governments employed to make sure that targets are achieved. These tsunami-like wartime changes provide new ways to envisage governance systems in a 3 to 4°C warming scenario.

4. Restructuring governance

An event that imposes clear, acute and direct evidence of threats drives quick response. We saw this panned out during the war when democratic states based on a free market system, responding to immediate threats to security, rapidly converted their national economies into a centrally controlled, government-led structure. The Japanese attack on Pearl Harbour and Manila signalled this shift in the US while the threat of invasion from Japan drove Australians to rapidly change its economic system. In the case of the ‘rapid transition project,’ we have posited that this threat can rise in the form of damaging climate effects such as the collapse of a part of the West Antarctic ice shelf as mentioned earlier. Earlier literature on the climate-war analogy suggests the same. Bartels (2001:229) used the Canadian wartime mobilisation programs to argue a case where ‘a widely-perceived increase in the frequency of extreme weather events leads to massive political support for an international effort to reduce GHG emissions’ through rapid production of renewable energy technologies and non-methane foods.

³ Despite the primacy of public finance during this period, the proportion of government and private investments returned to its 1940 balance in 1946. That year, government investment decreased to \$3.5 billion while private domestic investment increased to \$31.1 billion (both figures are in 1946 dollars) (Higgs 2004:504, Table 1).

⁴ These figures, however, must be approached with caveat as massive military conscriptions had contributed dramatically to decreasing rates of unemployment (see Evans 1982:960-961).

At the occurrence of wartime threats to national sovereignty, governments were obligated to increase their powers to ensure that military hardware manufacture was prioritised and that production moves as quickly as possible. As it happened, rapid munitions production built on a government-centric approach became the defining state motivation during the war. Socio-economic restructurings were imposed in the process. Two substantial dynamics played out: (1) governments took over the market, and (2) governments changed structures and organised new institutions to fit wartime requirements. The monocentric approach to production involve governance components such as (1) prioritising war item production (Plumptre 1941; Walker 1939:75), (2) stopping the production of specific goods and services, (3) forcing manufacturers to accept military contracts (Dickinson 1997), and (4) implementing wartime controls such as prohibitions and rationing, among others. In overseeing these massive efforts, the executive branch particularly in the US and Australia was empowered to create mobilisation agencies and consequently define the functions and powers of these agencies. For example, the War Production Board was created in 1942 to become America's leading war mobilisation agency. A similar establishment, the Department of War Organisation of Industry was established in Australia. Ergo, the task of governing wartime mobilisation efforts rested on the shoulder of one particular agency. This agency received sufficient powers to carry out its task, including the organisation of markets and responding to the challenge of coordinating not only the now bloated wartime bureaucracy but also the private sector.

Wartime reorganisation shows that rapid changes in governance structure fitting the necessity and urgency of the 'rapid transition project' could indeed be possible. This recognises the important and primary role of governments in implementing rigorous strategies listed in Section 2. The suggested monocentric, state-dominated model of governance offers a number of advantages. First, the wartime experience provides a historical precedent regarding the project's application, functionality and convenience. Second, governments continues to be viewed as the main institution of democratic legitimacy that most citizens understand and are willing to accept (Levi 1997)—a crucial asset, especially in this 'project' where sweeping actions are required. Third, central governments have the capacity to distribute powers and responsibilities between the agencies of national government itself, the regional and local governments, and the civil society (Hirst 2000). Fourth and based on the slow pace of previous energy transitions (Smil 2011, Kramer and Haigh 2009), a much stronger role for government may be essential.

To these ends and learning from wartime restructurings, I am re-echoing the proposal of allocating administrative competencies of the 'project' to a federal authority via a cabinet-level *Ministry for Rapid Transition* (Delina and Diesendorf forthcoming). The minister should have the legislative mandate to oversee, coordinate, and lead the efforts to accomplish the strategies of the 'project' outlined in Section 2. Specific administrative roles for the minister include:

- *Planning*. Conducting technology requirement studies, grid needs assessment (including large-scale transmission line route identification), setting and enforcing RE technology production goals and priorities
- *Facilitating*. Instituting efficient and transparent contracting procedures, cutting through the inertia and 'red tape' that currently characterise many public contracts
- *Coordinating*. Serving as the coordinating agency for all transition activities, which include
 - Raising capital, organising funding for the construction of key infrastructure such as transmission spines, railways and pipelines

- Funding R&D in key areas where there are gaps
- Implementing financial incentives for RE industry players (e.g. feed-in-tariffs, loan guarantees, tradable certificates, and other innovative mechanisms) and disincentives to the fossil-fuel industry (e.g. a rapidly increasing carbon price and taxes, and removal of fossil fuel subsidies)
- Providing incentives for the new manufacturing industries to be located in regions where the old are being phased out
- Implementing labour strategies
- Increasing funding for education, training and retraining of key professionals and tradespeople
- Setting and monitoring mandatory energy efficiency standards for buildings, appliances and equipment

5. Limitations

Delina and Diesendorf forthcoming enumerate the central limitations of a monocentric approach highlighting that an all too-powerful executive branch may lead to coercive governments, control of individual activities (Oreskes 2011:224), and extension of emergency powers (Martin 1990). In addition to that, other limitations of the approach exist. Amongst these is issues linked to democracy and its underlying elements such as representativeness and participation. Wartime mobilisation war itself presents one red flag. During the war, it was not only the elected officials who accessed enormous powers but also a privileged few. The executive branch, realising that industrial mobilisation was beyond their capacity, called an elite group of industrialists to lead important agencies and played significant role in mobilisation (Lumer 1954, Cardozier 1995). Donald Nelson, chair of Sears Roebuck, for example, led the powerful War Production Board in America. In Australia, important and powerful divisions of the Department of War Organisation of Industry were also handed in to industrialists. Moreover, a number of huge, massive military contracts went guaranteed to top American corporations such as Ford and General Motors among others. These appointments and privileges opened up and provided an enormous space for a small group of people the power to steer, influence, shape, and regulate wartime mobilisation activities. The oligarchic character of wartime governance, therefore, raises similar issues germane to the democratic character of the government-centric approach.

The question on the democratic character of the monocentric approach drags on. Its strong leaning towards macro-level actions at the top diminishes the importance of micro level actions—remarkably those originating from households, communities, and local levels. Although such ‘small’ actions may not guarantee impressive results in rapid emission reductions, their support is absolutely necessary for guaranteeing success. The war experience actually recorded local level actions as significant element of wartime mobilisation in countries such as Australia. When Australia was at war, local governments were empowered in a number of policy issues including labour, housing, policing and emergency supplies arrangements (Walker 1947). In addition, government need to rely to a great extent on willing cooperation by its citizens for policies to succeed. We saw this crucial dynamics played out when mobilising for war. For example, war bonds were selling like hotcakes and citizens quickly accepted rationing schemes without much questions during the first year of the war. Although wartime

mobilisation strategies did not involve much participatory democracy when they were implemented, inherent public support primarily took over public psyche in light of the consequences of defeat (Walker 1939, 1947).

6. Democratising the transition

In response to the limitations mentioned, avenues for legal redress should be opened up to allow judicial examination of the decisions of the government, particularly the executive branch where the Ministry for Rapid Transition resides. This reiterates the creation of a separate and independent agency can be created through legislation to be called *The Office of the Transition Ombudsman/Ombudswoman* (Delina and Diesendorf forthcoming). In addition to this new statutory institution, citizens, along with media entities and non-government organisations, should serve as meaningful counterbalance (Diesendorf 2009). This involves prompt deliberation proceedings with the corresponding inclusion of scientific expert knowledge and non-professional expertise. This means that the public should be informed at the earliest opportunity—prior to the commencement of the ‘project’—about the strategies and be given the chance to become actively involved in the planning and approval process. The transition should go hand in hand with an open, frank, transparent and pluralistic public discussion of the relevant issues and strategies. It is only through governance built on trust and transparency involving the various levels of governance that the success of the ‘project’ could be ensured. Building public support, enhancing trust, and ensuring transparency for the ‘project’ is a challenge in itself and is beyond the current scope of this paper. Nonetheless, an acute climate emergency would certainly warrant the necessary public support thus, justify the ‘project’ (Delina and Diesendorf forthcoming).

Recognising the merits of micro-level support provides another way of viewing and thinking the structural framework of the ‘project.’ This view expunges overreliance on monocentric approach, and re-focuses the central role of governments. Ostrom (2010) Labelled as the polycentric approach to climate governance (Ostrom 2010), this attendant approach gives due attention to smaller scale activities at the local level as the nucleus of the climate movement. Over time, larger units get involved. As it happens, innovation, learning, adaptation, trust, and levels of cooperation are enhanced (Ostrom 2010). Nonetheless, such micro-level approaches are not without limitations such as free riding, inconsistent policies, and leakage—all of which have already and largely been analysed in climate change literature.

7. Conclusions

Climate mitigation continues to be a highly debated and challenging policy issue. It will persist until an acute climate emergency occurs and governments are forcibly required to take action. A synthesis of knowledge suggests that a variety of ‘tipping points’ could reach their critical point within this century under climate change (Lenton et al. 2008). Greatest among these threats are the collapse of the Arctic sea-ice and the Greenland ice sheet. The 3 to 4°C warming scenario suggests that this could occur within the century. Addressing the climate challenge from the perspective of stronger mitigation, therefore, is a rational and judicious undertaking. Building up an emergency scenario and envisaging a ‘project’ in response to it is therefore prudent. Radical and may seem unrealistic by the standards of

today's debate, the rapid mitigation strategies suggested in this paper could gain ground when climate crisis finally hit us.

There is no perfect governance system. Similarly, there is no panacea for complex problems such as climate change. The 'project' introduced here will still be confronted with major obstacles that it should overcome and limitations to consider. Although the active drive towards the transition within a very short period of time is envisaged as monocentric typified by a government-led effort, fitting the multilevel architecture of contemporary governance structure in the project's narrative should be considered. In this approach, government policy can only claim legitimacy if the public participate in decision-making, rather than being simply expected to give their consent or accept them ex post. This means that the forthcoming changes should concern and activate public support from households to local communities, and all levels of government—from local to state/provincial to national—as well as international agencies and cooperation amongst governments. The 'rapid transition project' therefore should open up avenues for a new culture of public participation grounded and motivated by the idea that every individual should share in greater responsibility for the environment. A successful transition policy should be pursued along these two interconnected levels: institutionally via strong government and procedurally via active citizen participation. Moreover, this policy should be accomplished in a coordinated and democratic manner and built on participation, trust and transparency.

Conflict of Interest

The authors declare no conflict of interest.

References and Notes

Allen, M.R., Ingram, W.J., 2002, 'Constraints on future changes in climate and the hydrologic cycle', *Nature* 419, 224-232.

Anderson, K., Bows, A., 2011, 'Beyond 'dangerous' climate change: emission scenarios for a new world', *Philosophical Transactions of the Royal Society A* 369, 20-44.

Bartels, D., 2001, 'Wartime mobilization to counter severe global climate change', *Human Ecology* 10, 229-232.

Brown, L.R., 2008, *Plan B 3.0: Mobilizing to save civilization*, New York, London, Washington, D.C.: W.W. Norton & Co.

Caldeira, K., Jain, A., Hoffert, M., 2003, 'Climate sensitivity uncertainty and the need for energy without CO₂ emission', *Science* 299, 2052-2054.

Cardozer, V. R., 1995, *The Mobilization of the United States in World War II: How the government, military, and industry prepared for war*, Jefferson, North Carolina: McFarland & Company.

Chapman, B., Lounkaew, K., 2011, 'How many jobs is 23,510, really? Recasting the mining job loss debate', *Centre for Climate Economics & Policy Working Paper 1106*, Canberra: Crawford School of Economics and Government, Australian National University.

Delina, L.L., 2011, 'Asian Development Bank's support for clean energy', *Climate Policy* 11, 1350-1366.

Delina, L.L., Diesendorf, M., forthcoming, 'An inconvenient war: rapid mobilisation for emergency climate mitigation'

Delucchi, M.A., Jacobson, M.Z., 2011, 'Providing all global energy with wind, water, and solar power, Part II: Reliability, system and transmission costs, and policies', *Energy Policy* 39, 1170-1190.

Dickinson, M.J., 1997, *Bitter Harvest: FDR, Presidential Power and the Growth of the Presidential Branch*, Cambridge, UK: Cambridge University Press.

Diesendorf, M., 2010, 'Strategies for radical climate mitigation', *Journal of Australian Political Economy* 66, 98-117.

Diesendorf, M., 2009, *Climate Action: A campaign manual for greenhouse solutions*, Sydney: University of New South Wales Press.

Evans, P., 1982, 'The effects of general price controls in the United States during World War II', *Journal of Political Economy* 90, 944-966.

Gilding, P., 2011, *The Great Disruption: How the Climate Crisis Will Transform the Global Economy*, London: Bloomsbury UK.

Gore, A., 2009, *Closing Remarks at the World Forum on the Enterprise and Development*, Oxford: University of Oxford Smith School of Enterprise and Development.

Hansen, J., 2009, *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity*, New York: Bloomsbury USA.

Harrison, M., 1998, 'The economics of World War II: an overview', in: Harrison, M. (ed), *The Economics of World War II: Six Great Powers in International Comparison*, Cambridge: Cambridge University Press.

Higgs, R., 2004, 'Wartime socialization of Investment: A reassessment of U.S. capital formation in the 1940s', *The Journal of Economic History* 64:500-520.

Hirst, P., 2000, 'Democracy and governance', in: Pierre, J. (ed), *Debating Governance – Authority, Steering and Democracy*, Oxford: Oxford University Press.

Kennedy, D., 1999, *Freedom from Fear: The American people in depression and war, 1929-1945*, New York: Oxford University Press.

Kramer, G. J., Haigh, M., 2009, 'No quick switch to low-carbon energy', *Nature* 462, 568-569.

Lenton, T., Held, H., Kriegler, E., Hall, J. Lucht, W., Rahmstorf, S., Schellnhuber, H.J., 2008, 'Tipping elements in the earth's climate system', *Proceedings of The National Academy of Sciences of the USA* 105, 1786-1793.

Levi, M., 1997, *Consent, Dissent, and Patriotism*, New York: Cambridge University Press.

Lumer, H., 1954, *War Economy and Crisis*, New York: New York International Publishers.

Mann, M.E., 2009, 'Defining dangerous anthropogenic interference', *Proceedings of the National Academy of Sciences* 106, 4065-4066.

Martin, B., 1990, 'Politics after a nuclear crisis', *Journal of Libertarian Studies* 9, 69-78.

Matthews, H.D., Weaver, A., 2010, 'Committed climate warming', *Nature Geoscience* 3, 142-143.

New, M., Liverman, D., Schroeder, H., Anderson, K., 2011, 'Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications', *Philosophical Transactions of The Royal Society A* 369, 6-19.

Nicholls, R.J., Marinova, N., Lowe, J.A., Brown, S., Vellinga, P., de Gusmão, D., Hinkel, J & Tol, R.S.J., 2011, 'Sea-level rise and its possible impacts given a 'beyond 4°C world' in the twenty-first century', *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 369, 161-181.

Olmos, L., Ruester, S., Liang, S., 2012, 'On the selection of financing instruments to push the development of new technologies: application to clean energy technologies', *Energy Policy* 43, 252-266.

Oreskes, N., 2011, 'Metaphors of warfare and the lessons of history: time to revisit a carbon tax', *Climatic Change* 104, 223-230.

Ostrom, E., 2010, 'Polycentric systems for coping with collective action and global environmental change', *Global Environmental Change* 20, 550-557.

Overy, R. J., 1982, 'Hitler's war and the German economy: a reinterpretation', *Economic History Review* 35, 272-291.

Rignot, E., Velicogna, I., van den Broeke, M.R., Monaghan, A., Lenaerts, J., 2011, 'Acceleration of the contribution of the Greenland and Antarctic ice sheets to sea level rise', *Geophysical Research Letters* 38, L05503.

Rockoff, H., 1998, 'The United States: from ploughshares to swords', in: Harrison, M (ed), *The Economics of World War II: Six Great Powers in International Comparison*, Cambridge: Cambridge University Press.

Shellenberger, M., Nordhaus, T., Navin, J., Norris, T., Van Noppen, A., 2008, 'Fast, clean, and cheap: Cutting global warming's Gordian Knot', *Harvard Law and Policy Review* 2, 93-118.

- Smil, V., 2011, *Energy Transitions: History, Requirements, Prospects*, Santa Barbara CA: Praeger.
- Smith, J.B., Schneider, S.H., Oppenheimer, M., Yohe, G.W., Hare, W., Mastrandrea, M.D., Patwardhan, A., Burton, I., Corfee-Morlot, J., Magadza, CH.D., Füssel, H-M., Pittock, A.B., Rahman, A., Suarez, A. & van Ypersele, J-P., 2009, 'Assessing dangerous climate change through an update of the Intergovernmental Panel on Climate Change (IPCC) 'reasons for concern'', *Proceedings of the National Academy of Sciences*.
- Smith, R. E., 1991, *The Army and Economic Mobilization*, Washington, D.C.: Center of Military History, United States Army.
- Stern, N., 2008, 'Richard T. Ely Lecture: the economics of climate change', *American Economic Review: Papers & Proceedings* 98, 1-37.
- Vaughan, D.G., 2008, 'West Antarctic ice-sheet collapse—the fall and rise of a paradigm', *Climatic Change* 91, 65-79.
- Walker, E. R., 1939, *War-Time Economics, With Special Reference to Australia*, Melbourne: Melbourne University Press in association with Oxford University Press.
- Walker, E.R., 1947, *The Australian Economy in War and Reconstruction*, New York: Oxford University Press.
- Wei, M., Patadia, S., Kammen D., 2010, 'Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?', *Energy Policy* 38, 919-931.
- World Resources Institute, 2012, 'Shares of Global GHG emissions by sector, 2005', *Climate Analysis Indicators Tool (CAIT) Version 9.0*, Washington, D.C: World Resources Institute.