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# Energy research within the UNFCCC: A proposal to guard against ongoing climate-deadlock

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## Abstract

We propose that an international ‘Low-Emissions Technology Commitment’ should be incorporated into the United Nations Framework Convention on Climate Change (UNFCCC) negotiation process in order to promote innovation that will enable deep decarbonisation. The goal is to accelerate research, development and demonstration of safe, scalable and affordable low-emissions energy technologies. Such a commitment should be based on three elements. First, it should operate within existing UNFCCC negotiations so as to encourage developed states to offer directed funding for energy research as part of their national contributions. Second, pledges should be binding, verifiable and coordinated within an international energy-research plan. Third, expert scientific networks and participating governments should collaborate to design a coordinated global research and technology-demonstration strategy and oversee national research efforts. To this end an Intergovernmental Panel on Low-Emissions Technology Research might be established. This proposal offers some insurance against the risk that the political impasse in international negotiations cannot be overcome. The higher costs associated with low-emissions alternatives to fossil fuels currently creates significant economic and political resistance to their widespread adoption. To breach this impasse, a mechanism supporting accelerated energy research is needed that seeks to reduce future abatement costs, share experience and ‘learning-by-doing’ in first-of-a-kind demonstrations, and thus facilitate future widespread deployments. These actions will also assist in addressing inequalities in energy access.

## Policy Relevance

Over the past decade, global fossil-fuel use and associated carbon emissions have risen steadily, despite the majority of nations agreeing, in principal, to work to limit global warming to less than 2°C above pre-industrial conditions (IPCC, 2014). Accelerated research, development and demonstration of low-emissions technologies will be required for successful and economically efficient decarbonisation of the global economy, but how can the current deadlock be broken? The UNFCCC does not contain adequate mechanisms to promote increased investment in research, so climate-governance institutions are not capturing the gains that could be achieved through a globally coordinated approach. Here we outline reform proposals that would enhance both the economic effectiveness of global abatement efforts and the political feasibility of accelerated innovation.

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## Energy research within the UNFCCC: A proposal to guard against ongoing climate-deadlock

Over the last two decades, the United Nations Framework Convention on Climate Change (UNFCCC) negotiation process has made important progress on many fronts, but on the most critical benchmark—reversal of the trend of increasing annual emissions of greenhouse gases—it is yet to deliver. If the current negotiation impasse is not overcome, and future carbon dioxide emissions from fossil fuels and cement continue to increase at >2% annually (the current decadal average), the indicative ‘safe’ cumulative carbon budget of 527 gigatonnes CO<sub>2</sub> for the period 2012–2050 will be exhausted in just over a decade (Baer et al., 2013). Working from the assumption that an improved regime design can create effective incentives to pursue abatement efforts, a number of recent proposals have sought to “break the climate impasse” (See e.g., Grasso & Roberts, 2014; Eckersley, 2012). Reforms that seek to secure ambitious abatement commitments and practical action (e.g., deployment of existing and demonstration of new low-emissions technologies) are vital and signs of cooperation between China and the United States give grounds for hope. However, insurance also should be taken against the possibility that ambitious near-term mitigation action might prove politically impossible given the current high cost of supplying reliable energy from low-emissions sources compared to traditional fossil-fuel alternatives. For this reason we propose that a ‘Low-Emissions Technology Commitment’ (LETC) should be incorporated into UNFCCC negotiations as part of states’ national commitments (see Garnaut, 2008, pp. 219-223). Since accelerated energy research and associated technology demonstration would lower the future cost of emissions abatement and increase investor confidence, adoption of this proposal would improve the prospects that an ambitious agreement will be achieved (Fischer & Newell, 2008). Moreover, negotiation of a LETC would also enhance the economic efficiency of, and encourage technology sharing within, any future global mitigation agreement.

Recent experience has shown that achieving an effective global response to climate change is inherently challenging—a classic ‘wicked problem’ of how scientific bases can fail to effect practical social policy (Rittel & Webber, 1973).

Moreover, for complex target systems like the climate system, normative assessment cannot be disentangled from the scientific enterprise (Douglas, 2000). This further complicates climate policy making. Carbon dioxide's properties as a stock pollutant (Frame et al., 2014), the long life and high capital costs of energy infrastructure, the cooperation challenges inherent in providing a global public good in the absence of global government, and the distant connection (temporally and geographically) between emissions and their most wide-reaching consequences, all create political barriers to action. Moreover, effective international action will require cooperation between China and the United States, which are responsible for approximately 29% and 17% of global emissions respectively (Olivier et al., 2013). Yet, for so long as the political or economic costs of climate action are high, a competitive dynamic akin to a 'prisoner's dilemma' may undermine rational cooperation for mutual benefit (Rapoport, 1967; Terhalle & Depledge, 2013).

These factors suggest that the global politics of emissions reductions will be immensely challenging for so long as scalable, low-emissions, dispatchable energy sources are more costly and technologically uncertain compared to traditional, emissions-intensive power sources. This argument seems to be confirmed by the fact that the carbon intensity of global electricity production has remained virtually static since the negotiation of the UNFCCC in 1988 (there has been less than a 1% shift since 1990: OECD/IEA, 2013). While recent cost reductions mean wind and photovoltaic energy may be competitive in the absence of carbon pricing at modest levels of grid penetration, intermittent renewables still depend on government support for widespread uptake and face particular challenges in dense cities with high electricity demand and grid reliability standards (Davis & Socolow, 2014). For this reason it is reasonable to anticipate that most rapidly industrialising countries will continue using existing coal-fired power plants and constructing new emissions-intensive energy infrastructure unless the higher costs of low-emissions infrastructure is financed internationally (IEA, 2014). While some international support has been provided for developing world decarbonisation (e.g. via the Clean Development Mechanism), existing mechanisms are susceptible to 'gaming' and lack sufficient ambition to forestall ongoing increases in global GHG emissions (Fenton et al., 2014; IEA, 2014). While achieving a binding and effective climate mitigation agreement is of paramount importance, we argue that it is prudent to also consider the likelihood that no sufficiently ambitious agreement will be forthcoming.

Innovation and technology policies based on multilateral agreements are, when compared to planetary scale interventions such as some climate engineering measures, relatively uncontroversial forms of insurance against failure to negotiate an ambitious mitigation agreement. Most major analyses of decarbonisation pathways have concluded that technology policy must be used to correct market failures that result in insufficient basic research, and that this implies increased (and better targeted) support for research and development of low-emissions technologies (e.g., Goulder et al., 1999, Stern, 2006; Garnaut, 2008, 2011; SDSN & IDDRI, 2014). The IPCC Fifth Assessment Report (2014) finds that technology policy is “complementary” to the role of “policies aimed directly at reducing current GHG emissions” (15.6.1); that development of “new technologies is crucial for the ability to realistically implement stringent carbon policies”; that support for energy research is most effective if it is predictable and increases steadily (15.6.3); and that data collection for programme evaluation should be built into technology policy programmes (15.6.5). However, public energy-related research and development (R&D) expenditures among IEA member-states today account for about 5% of total government R&D, compared to 11% observed in 1980 (even in absolute terms expenditure has been declining since 2009) (IPCC, 2014, 7.12.4).

Given the broad consensus that increased energy research would improve the prospects for effective mitigation, innovation policy deserves a higher profile in climate negotiations. While Article 4(c) of the UNFCCC commits all parties to “[p]romote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases,” the reality is that the UNFCCC process, the Technology Mechanism and the associated Technology Executive Committee (on which the majority of representatives are from developing states) have focused on financing and supporting technology transfer and boosting the innovation capacity of developing states, rather than on actions aimed at driving energy innovation more generally. For example, as at September 2014, the Climate Technology Centre and Network had secured only USD 26.6 million from bilateral sources, which is a tiny fraction of the funding required for meaningful research and development (UNFCCC, 2014, p.15). Our proposal seeks to rectify this inattention. Specifically, research funding commitments should be incorporated explicitly into Intended Nationally Determined Contributions to be incorporated into a new

international climate agreement to be finalised at the 2015 Paris conference of the parties to the UNFCCC. In 2015 national commitments might detail total state investment, private-sector funding mobilisation targets, priority research areas, and broader mechanisms of state support. In the longer term states might work toward the more challenging goal of harmonising these research commitments into an international research plan designed in collaboration with expert bodies, such as National Academies of Engineering.

The phrase ‘Low-Emissions Technology Commitment’ is drawn from two economic reports prepared for the Australian government by economist Ross Garnaut (2008, pp. 219-223; 2011, p.118). Garnaut argues that an economically efficient global climate response would involve both internationally linked emissions trading and a coordinated increase in research funding (Garnaut suggested commitments of about \$100 billion per annum, globally). Whereas Garnaut advocated accelerated research across all relevant sectors, we judge that a LETC should initially avoid unnecessary complication by focusing on energy, the sector that is responsible for the largest share of emissions. A LETC would seek to both lift aggregate investment and to coordinate national research efforts. While Garnaut broke new ground in arguing that affluent states should partially discharge their climate leadership obligations by setting goals for increased research support within a formal international commitment, his focus on innovation and technology policy as prerequisites of decarbonisation confirmed much earlier work. Formal game-theoretical analysis (Urpelainen, 2012) suggests that states are more likely to commit to an international energy research and development treaty than to ambitious climate action that seeks to cut emissions across the economy, both because the near-term national benefits of energy research are much greater (in contrast, most benefits of mitigation accrue only in the distant future and thus may be more uncertain) and because if states make reciprocal commitments to simultaneously increase energy research and development then they will benefit from the positive externalities arising from the global effort. A well-designed research treaty would also increase the efficiency of the aggregate research effort by facilitating international coordination and specialisation (Victor, 2011, pp. 154-162). Although the value of an international energy research treaty is commonly recognised, its incorporation into the UNFCCC negotiation process is not often discussed (see de Coninck, 2008).

## **Element One: Integrating energy research commitments into UNFCCC negotiation process**

Integrating ‘research, development and demonstration’ (RD&D) commitments into the UNFCCC negotiation process is our key innovation in this proposal (See, Stepp & Nicholson, 2014). Admittedly, this would surrender one of the widely noted advantages of a stand-alone research treaty: that it could be successfully negotiated among only a small number of parties and thus avoid the UNFCCC’s political gridlock (Victor, 2011). Since national investment in innovation is heavily concentrated in only a few states (e.g. United States, Japan, Germany, France, Korea, United Kingdom and China) a research treaty involving only a small number of high capacity states could be effective. Moreover, some leading advocates of an energy research treaty (similar to a LETC), such as David Victor, have argued that design flaws in the UNFCCC are so serious that an entirely new architecture of climate governance is required (Prins et al., 2010, Victor, 2011). In this view an energy research treaty is more likely to be successful if its design is controlled by those states that are capable of making a major contribution.

Despite the strong conceptual case for a stand-alone energy research treaty, the incorporation of LETC into the UNFCCC process would be beneficial because it would 1) harness the UNFCCC’s legitimacy and political momentum to support speedy negotiation of a research agreement; 2) assist with breaking the international deadlock in climate negotiations; and 3) nurture domestic political engagement with innovation policy as a form of climate action. Most significant are the questions of legitimacy. While the theoretical case for a stand-alone research treaty is compelling, the idea has not been strongly advocated by any influential state or civil society group. If it is to become a near-term reality a LETC needs to be placed on the agenda of an established forum, like the G20 or the UNFCCC. In our judgement the UNFCCC’s relative legitimacy makes it the best existing institutional candidate (see Symons, 2011; Slaughter, 2013). While it is already very late in the day for energy research to be incorporated into the Paris agreement, the political difficulties that confound UNFCCC negotiations create openings for eleventh hour compromise proposals; for example, the Copenhagen COP outcome was transformed by the unorthodox introduction of a “Copenhagen Accord” that had little connection to the previous negotiations and yet still allowed for some commitments and actions to

proceed (Christoff, 2010). It is possible that strong advocacy by an influential state or group (most likely the informal UNFCCC negotiating group known as the Umbrella Group, which includes Japan, Australia and Canada) would be sufficient to rapidly incorporate research pledges as an additional component of the UNFCCC agenda. In short, although UNFCCC negotiations might compromise treaty design, a LETC is most likely to eventuate if it is incorporated as part of a broader climate treaty, rather than being petitioned *de novo*.

A second set of advantages arise because research pledges could complement wider UNFCCC negotiations by prompting an increase in aggregate commitments and ameliorating north-south tensions. Domestic polarisation over climate politics causes some states' willingness to contribute to mitigation and international financing to fluctuate. The involvement of climate laggards, which currently include Japan, Canada and Australia, risks undermining the international cooperative mitigation effort since other states are reluctant to be exploited by those they perceive as free riders. However, if those states that refuse to accept ambitious emission-abatement targets have the option of compensating with increased research pledges, this might lessen their negative impact. The option of making a contribution to the global mitigation effort via a RD&D-driven domestic response might also increase the political appeal of the UNFCCC process among groups (some states and domestic constituencies) that oppose emissions pledges or carbon pricing for ideological reasons. It is no coincidence that the George W. Bush Administration prioritised energy research or that Japan, under Shinzo Abe, announced increased funding for energy research at the same time as it walked away from its ambitious Copenhagen pledge at the Warsaw COP in 2013.

Of course there is a danger that if research pledges are perceived to be a substitute for action, rather than additional to abatement pledges, this will undermine the legitimacy of a LETC. Nevertheless, research commitments complement the existing agenda supporting financing of technology transfer provided they are additional to transfer funding; for this reason research commitments might potentially ameliorate the north-south tensions that currently contribute to negotiation gridlock. By providing opportunities for leadership not only to developed countries but also to ambitious developing states that are interested in expanding their research and innovation capacity, a LETC could create an opening for 'inclusive minilateralism' (Eckersley, 2012). Moreover, a LETC might potentially minimise the negative

impact of great power rivalry by prompting China and the US to cooperate in order to share in the benefits of energy innovation, building on the momentum achieved at the recent APEC meeting in Beijing. Where mitigation pledges are often perceived as imposing an economic cost that reduces relative power, pledges to accelerate innovation can be anticipated to prompt technological competition that may have the positive externality of reduced greenhouse-gas emissions. Certainly, China's current investments in a tranche of new commercial nuclear plants, and funding for RD&D into next-generation systems such as thorium and modular pebble-fueled reactors, appear intended to address energy security as well as climate and air quality concerns. For a great power such as the United States or China, being less constrained by emissions reduction targets than a peer competitor and achieving breakthroughs in energy innovation should both increase relative material power, but only the latter produces positive environmental externalities.

While China (like the United States) has thus far failed to sign on to legally binding emissions reduction agreements, it does set national targets as a part of its five-year plans and now hopes for emissions to plateau after 2030. China's leadership role in the G77 also makes it highly sensitive to issues of north-south justice, which indicate that the cooperative surplus arising from any agreement should be distributed in a way that benefits rather than stymies the socio-economic goals of developing states (Stone, 2004). Of course, addressing international energy inequality is a very important part of the decarbonisation challenge (Bazilian & Pielke, 2013; Tawney, Miller & Bazilian, 2013)—globally approximately 1 billion people lack any access to electricity, and about one third of the global population is dependent on biomass for cooking, resulting in indoor air pollution with particularly serious chronic-health implications for women (Gordon et al., 2014). However, least-cost efforts to address energy inequality, by following a traditional fossil-fuel development pathway, will increase global CO<sub>2</sub> emissions and demands to address historical injustices in global climate negotiations have the potential to reduce the total ambition if differing perceptions of justice are used to justify inaction (Heyward, 2007). These tensions between states' self-interest and justice will only be eliminated when low-emission energy sources enjoy a considerable cost advantage. It follows that one goal of research should be reducing energy costs on a global basis (Karlsson & Symons, 2015).

A third advantage of incorporating an energy research commitment into the UNFCCC process is that it might broaden the domestic political constituencies that support energy research and build stronger links between energy researchers, engineers and environmental activists. The argument for aggressive energy research has not generally been embraced by environmental organisations or social movements (Till & Chang, 2011) in part because the mass environmental movement has often been distrustful of technical solutions (often pejoratively called ‘techno-fixes’), and in part because of a suspicion that ‘energy research’ will become an excuse for inaction. Such suspicions were not allayed by the Bush-era “Asia Pacific Partnership on Clean Energy and Development” (APP), which was touted as a research-based alternative to the Kyoto Protocol, but which was wound up in 2011 because it had produced no significant achievements. The APP’s poor design and implementation suggests that it was in part a political diversion. Those domestic constituencies that are most committed to climate action are rightly suspicious that the strong intellectual case for energy research will again be marshalled as an excuse for inaction. If an energy research commitment forms part of a universal climate agreement, however, then it is likely that civil society groups will be better positioned to monitor and critique domestic implementation of RD&D commitments.

Given that there is no significant political constituency supporting negotiation of a LETC, it is unlikely that our proposal will be adopted. While we argue that the UNFCCC is the most promising forum for a successful LETC, we recognise that many of the advantages of increased attention to energy research could be achieved through agreements negotiated by the G20, under a stand-alone treaty or through bilateral agreements.

### **Element Two: binding and verifiable commitments.**

The advantages of formulating research commitments as treaty obligations are widely noted. One of the key reasons why states acting alone can be anticipated to under-invest in research is that many of the benefits of innovation policy are positive externalities that cannot be captured locally. Yet if multiple states enter into binding and verifiable commitments, including technology sharing, then this boosts the anticipated benefits that will be derived by each and also enlarges the anticipated market for advanced technologies (Victor, 2011). Formulating commitments as

international treaty obligations also has the advantage of binding successor governments and thus increasing efficiency by stabilising research funding through time (Hawkins et al., 2006:124). Nevertheless, it is likely the states might put forward a combination of binding commitments and non-binding pledges. A combination of bottom-up pledges linked to national priorities, and revision in the light of global goals may be best suited to maximise commitment and coordination and would follow the broader Intended Nationally Determined Contribution process.

It should be emphasised that the early stages of a LETC should not require shifting decision-making to a supranational level, as this would tend to reduce national support. However, if information sharing about national research efforts increases this is likely to prompt productive coordination. The experience (good and bad) of a variety of coordinated international research projects, including CERN (fundamental research in particle physics), ITER (applied research in nuclear fusion) and ITER's predecessor project JET, and processes for achieving a political consensus on scientific standards, including the IPCC and the WTO's Committee on Sanitary and Phytosanitary Measures (CSPM), will be instructive in this coordination process (Victor, 2011, p. 155). Since energy research is inherently uncertain and many projects will inevitably fail, delegating some responsibility for project selection to expert assessment could also provide some protection for risk-averse national policy-makers against being unfairly held to account for projects that are not ultimately commercialised.

Controversy might arise around some energy options, such as nuclear fission (or carbon capture and storage/utilisation). While some states are already engaged in accelerated research and investment in next-generation nuclear technologies, much of the global environmental movement may be opposed. This controversy is unlikely to be a major problem as most states will be content for others already involved in nuclear-related RD&D to pursue this effort. However, a LETC would likely be critiqued by some civil society groups if it appeared to endorse nuclear energy or CCS as a preferred climate response. While incorporation of nuclear innovation appears essential to maximise any research treaty's contribution to future mitigation (Brook, 2012), it may undermine its legitimacy within civil society. This is an example of the type of conundrum that such an energy RD&D agreement would need to broker.

### **Element Three: An Intergovernmental Panel on Energy Research**

One way to cut through political impasses and to promote deeper coordination of international research will be to marshal fully the supporting science and engineering experience that could support rational decision making on energy RD&D investments – much like the mandate of the IPCC on climate science and impacts. Coordinating research efforts in this way (like harmonising international approaches to intellectual property rights and commercialisation) involves broader and more complex challenges than simply quantifying national contributions. Here, we offer only some preliminary comments on how a LETC might be structured so as to promote its central goal of ‘directed technological change’ toward safe, scalable, affordable low-emissions energy systems.

Given the varied political agendas involved, the complexity of research needs, the potential for pure ‘blue sky’ research to make unpredictable contributions and the need to coordinate innovation with incentives for demonstration and pathways to wider deployment (including international regulation of intellectual property and barriers to trade) design of a LETC will be complex. An Intergovernmental Panel on Energy Research, composed of scientific experts nominated by participating states, might usefully inform treaty negotiations but work independently of them. This Panel would probably need to be an independent organisation that operates separately from the IPCC. While this Panel’s mandate would need to go far beyond reviews and forecasting, it might partially displace the current role of the IPCC’s Working Group III (which reviews progress in, and projections for, energy pathways). It will be difficult for this body to avoid the kinds of problems (including politicisation) that have plagued the IPCC, but what is needed is a technically expert body that is capable of facilitating international agreement on issues including the strategic selection and coordination of energy-technology projects and of mechanisms to support technologies through the ‘valley of death’ to demonstration (Victor, 2011).

The design of such an intergovernmental panel and its relationship to IPCC WGIII cannot be prescribed theoretically, but would need to be negotiated by states. Since national commitments are likely to be greatest if there is considerable autonomy to pursue national priorities, the purpose of expert assessment should be to promote international transparency and coordination, including partnership investment in new infrastructural facilities (again, ITER and CERN are relevant examples, as are the Human Genome Project and the Galileo navigation satellite system (Lindström &

Gasparini, 2003)). An overly prescriptive approach risks discouraging contributions and inviting politicisation. Nevertheless, expert assessment would be valuable to outline research priorities appropriate for global decarbonisation, to set research timelines that support UNFCCC decarbonisation goals, to assess whether national research proposals are sufficiently aligned with LETC objectives to be counted toward a state's funding commitments, to assisting to verify national compliance with agreed research targets, to review performance, boost the legitimacy of the energy research commitment and minimise rent-seeking which might see research funding captured as subsidies for particular industries (Helm, 2010). Moreover, involvement of international scientific bodies and scientific communities would create an extra process of deliberation on global objectives. Nevertheless, ultimate control should remain at a national (or regional) level in order to preserve state commitment to the research agenda. The international diversity of innovation systems, and differing roles of state and private-sectors actors and networks in each, should also mean that there is no single model under which RD&D should be financed and promoted (see Mazzucato, 2013).

It is essential for reasons of both justice and effectiveness that the innovation challenges associated with energy access in the developing world should be considered alongside the challenges of decarbonisation of developed economies. However, since the purpose of a LETC is to address global energy needs it must move beyond the mandate of the the Climate Technology Centre and Network, and the Poznan strategic programme on technology transfer. Expert assessment might provide a forum for developing country perspectives to influence research design and geographical locations for demonstration facilities (e.g. the prime large-scale solar thermal sites are typically situated in developing countries, as envisaged within the African-to-Europe 'TREC' power-network concept), even if these nations do not make significant research commitments themselves. While it is inevitable that developing states will seek to ensure that treaty funding also supports a technology transfer programme, separating the two issues (so that a LETC considers global needs including developed world decarbonisation challenges, while the Technology Mechanism focuses on technology transfer and developing world innovation capacity) is likely to maximise research contributions, and thus maximise positive externalities. There is also a plausible argument that expert assessment should take on a broader role and address the challenges of integrating research with measures to promote

diffusion and deployment of proven but yet-to-be-scaled energy technologies. Internationally, these might include harmonisation of intellectual property rules and elimination of barriers to trade. However, the political complexities of these issues mean that they should probably be addressed sequentially. While many institutional reforms would be desirable, a LETC is most likely to be implemented if it is not unnecessarily linked with complex and politically challenging issues.

### **A prerequisite for stabilisation**

It is now too late to hope that harmful consequences of anthropogenic climate change can be avoided altogether even in the unlikely event that all the ‘pledge and review’ commitments from Copenhagen and Cancun are implemented fully. In climate policy there are no silver bullets; the challenges that have created gridlock in climate negotiations over the last 20 years, especially with respect to emissions reduction targets, will only be overcome with great difficulty if at all. Our proposal—although an important policy advance—will also not produce rapid results, but we argue that if adopted it would increase the efficiency and possible ambition of future climate agreements. Many people who understand the scale of the threat posed by climate change will likely view incorporating energy research into UNFCCC commitments as a distraction from the urgent task of commencing decarbonisation using already available technologies. We agree that decarbonisation should be the highest priority of global climate policy. However, the international community’s ongoing failure to stabilise, let alone reduce, greenhouse gas emissions, suggests the need for new approaches. Since energy research, development and associated technology demonstration promise to reduce both the economic and political barriers to deep decarbonisation, a LETC could improve the chances of an ambitious international agreement being reached in 2015. At the same time it provides insurance against failure of direct emissions-reduction agreements by improving the political prospects for ambitious and lower-cost abatement in later years.

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