

# What can we do to fix the climate problem?

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Climate protection, like the Hubble Space Telescope's mirror, got spoiled by a sign error: in fact, climate solutions are *not costly but profitable*, because saving fuel costs less than buying fuel. Many leading companies are making billions of dollars' profit by cutting their carbon intensity or emissions at rates of 5–8%/y.<sup>1</sup> When politicians who lament climate protection's supposed costs, burdens, and sacrifices join the parallel universe of practitioners who routinely achieve profits, jobs, and competitive advantage by wasting less fuel, the political obstacles will dissolve.

Stabilizing carbon emissions requires only increasing energy productivity (\$ GDP per GJ) by 2%/y rather than the canonically assumed 1%/y; stabilizing climate needs only ~3%/y. The U.S. has long achieved ~3%/y; California, a point faster; China, a point faster still for >20 y (until 1997, then nearly 8%/y to 2001, then a temporary reversal). Raising global adoption to ~3%/y will be profitable and not so difficult if we pay careful attention to “barrier-busting”—turning the 60–80 known market failures in buying energy efficiency into business opportunities.<sup>2</sup>

Energy efficiency is not the only, but certainly the main, tool for profitable climate protection, and indeed could suffice if pursued to its full modern potential, typically with expanding rather than diminishing returns (*i.e.*, radical savings at *lower* capital cost, now demonstrated in a couple of dozen sectors but awaiting a revolution in design pedagogy and practice).<sup>3</sup> Detailed assessments show how to save half of U.S. oil and gas at respective average costs of \$12/bbl and \$0.9/GJ (2000 \$),<sup>4</sup> and three-fourths of U.S. electricity at ~\$0.01/kWh<sup>5</sup>—all below short-run marginal cost. For example, tripled-efficiency but safer and uncompromised cars<sup>6</sup>, trucks, and planes using current technology would respectively repay their extra capital cost in 2, 1, and 4–5 years at current U.S. fuel prices.<sup>4</sup>

Now add alternative supplies. Global fossil-fuel carbon emissions come about 2/5 from burning oil and 2/5 from making electricity (the remaining gas and coal are analogous). Redoubled U.S. oil efficiency at \$12/bbl plus substituting saved natural gas and advanced biofuels (together averaging \$18/bbl) can eliminate U.S. oil use by the 2040s.<sup>4</sup> Since the average cost of getting completely off oil is ~\$15/bbl—a fifth the recent price—this transition will be led by business for profit. Innovative public policies can support, not distort, the business logic without needing new fuel taxes, subsidies, mandates, or national laws.<sup>4</sup> Early implementation is encouraging.

As for electricity, “micropower”—low-carbon combined-heat-and-power plus carbon-free decentralized renewables—provided<sup>7</sup> 1/6 of the world's electricity and 1/3 of its new electricity in 2005, meeting from 1/6 to over 1/2 of all electrical needs in 13 industrial countries. Micropower thus added four times the electricity and 8–11 times the capacity that nuclear power added globally in 2005, now exceeds it in both respects, and is financed by private risk capital (unlike any new nuclear project; they're bought only by central planners). Micropower plus “negawatts,” which are probably about as big, now provide upwards of half the world's new electrical services, and their 207 “distributed benefits,” when counted, will widen their already decisive economic advantage<sup>8</sup> by about another tenfold.<sup>9</sup>

These dramatic market shifts in technology and scale are largely unnoticed but well underway (“clean energy” got around \$63 billion of global investment in 2006). The new technologies for both supply and efficiency, being cheaper and faster (hence doubly lower in financial risk) than traditional competitors, will continue to wallop them in the marketplace—and to buy more climate solution per dollar and per year. Conversely, when central planners continue to buy costlier and slower options, they reduce and retard climate protection—by ~2–10-fold, for example, when new nuclear power is bought instead of micropower and efficiency.<sup>8</sup>

In short, the climate problem is neither necessary nor economic, but is an artifact of not using energy in a way that saves money. Climate change can be prevented by taking markets seriously—letting all ways to save or supply energy compete fairly, at honest prices, no matter which kind they are, what technology they use, where they are, how big they are, or who owns them. Internalizing carbon and other environmental costs will be correct and helpful but not essential.

Fair competition can simultaneously solve many other problems. For example, saving electricity needs about 1,000 times less capital, and repays it about 10 times faster, than supplying more electricity.<sup>10</sup> This ~10,000-fold capital leverage can turn the power sector (now gobbling about a fourth of global development capital) into a net funder of other development needs. Profitably eliminating oil use would certainly make the world better and safer. A more efficient, diverse, dispersed, renewable energy system can make major supply failures, whether caused by accident or malice, impossible by design rather than (as now) inevitable by design.<sup>11</sup>

The inevitable demise of nuclear power—already stricken by a fatal attack of market forces—can belatedly stem nuclear proliferation too<sup>12</sup>, by removing from ordinary commerce a vast flow of ingredients of do-it-yourself bomb kits and their innocent-looking civilian disguise. That would make those ingredients harder to get, more conspicuous to try to get, and politically far costlier to be caught trying to get, because for the first time, the motive for wanting them would be unmasked as unambiguously military. Focusing intelligence resources on needles, not haystacks, would also improve the odds of timely warning. All this wouldn’t make proliferation impossible, but would certainly make it far more difficult for both recipients and suppliers.

Had my analyses of these opportunities been adopted when first published<sup>13</sup>, we would not now all be worrying about climate change, oil dependence, or Iran and North Korea. But it’s not quite too late. As the late Donella Meadows said, “We have exactly enough time—starting now.”

So what are we waiting for? *We* are the people we have been waiting for. And as Raymond Williams wrote, “To be truly radical is to make hope possible, not despair convincing.”

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<sup>1</sup> A.B. Lovins, “More Profit with Less Carbon,” *Sci. Amer.* **293**(III):74–82, Sep 2005, RMI Publ. #C05-05, [www.sciam.com/media/pdf/Lovinsforweb.pdf](http://www.sciam.com/media/pdf/Lovinsforweb.pdf).

<sup>2</sup> A.B. & L.H. Lovins, “Climate: Making Sense *and* Making Money,” Rocky Mountain Institute (Snowmass, CO), 1997, [www.rmi.org/sitepages/pid173.php#C97-13](http://www.rmi.org/sitepages/pid173.php#C97-13), esp. pp. 11–20.

<sup>3</sup> A.B. Lovins, “Energy End-Use Efficiency,” white paper for InterAcademy Council (Amsterdam), 19 Sep 2005, [www.rmi.org/sitepages/pid171.php#E05-16](http://www.rmi.org/sitepages/pid171.php#E05-16); P. Hawken, A.B. & L.H. Lovins, *Natural Capitalism: Creating the Next Industrial Revolution*, Little Brown (NY) and Earthscan (London), 1999, 415 pp., ≥7 translations, 6 in preparation; book and summary

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article “A Roadmap for Natural Capitalism,” *Harv. Bus. Rev.* **77**(3):145–158 (May/June 1999), [www.natcap.org](http://www.natcap.org); see also [www.10xE.org](http://www.10xE.org) for a forthcoming casebook.

<sup>4</sup> A.B. Lovins, E.K. Datta, O.-E. Bustnes, J.G. Koomey, & N.J. Glasgow, *Winning the Oil Endgame*, Rocky Mountain Institute (Snowmass, CO), 2004, free download (or \$40 hard-copy order) from [www.oilendgame.com](http://www.oilendgame.com) with all supporting documentation and calculations.

<sup>5</sup> A.P. Fickett, C.W. Gellings, & A.B. Lovins, “Efficient use of electricity,” *Sci. Am.* **263**(3):64–74 (1990), relying on empirical cost and performance of ~1,000 technologies compiled in RMI/COMPETITEK *State of the Art* series, 6 vols., 1986–92, 2,509 pp., 5,135 notes, later summarized in *Technology Atlas* series from E SOURCE, Boulder CO, [www.esource.com](http://www.esource.com)); A.B. Lovins, “Negawatts: Twelve Transitions, Eight Improvements, and One Distraction,” *En. Pol.* **24**(4):331–343 (Apr 1996), [www.rmi.org/sitepages/pid171.php#U96-11](http://www.rmi.org/sitepages/pid171.php#U96-11); for similar European findings, A.B. & L.H. Lovins, “Least-Cost Climatic Stabilization,” *Ann. Rev. En. Envnt.* **16**:433–531 (1991), [www.rmi.org/sitepages/pid171.php#E91-33](http://www.rmi.org/sitepages/pid171.php#E91-33).

<sup>6</sup> A.B. Lovins & D.R. Cramer, “Hypercars<sup>®</sup>, Hydrogen, and the Automotive Transition,” *Intl. J. Veh. Design* **35**(1/2):50–85 (2004), [www.rmi.org/sitepages/pid175.php#T04-01](http://www.rmi.org/sitepages/pid175.php#T04-01).

<sup>7</sup> A.B. Lovins & N.J. Glasgow, [www.rmi.org/sitepages/pid171.php#E05-04](http://www.rmi.org/sitepages/pid171.php#E05-04).

<sup>8</sup> A.B. Lovins, “Mighty Mice,” *Nucl. Eng. Intl.* 44–48, Dec 2005, [www.rmi.org/sitepages/pid171.php#E05-15](http://www.rmi.org/sitepages/pid171.php#E05-15); “Nuclear Power: Economics and Climate-Protection Potential,” RMI Publ. #E05-14, 6 Jan 2006,

[www.rmi.org/sitepages/pid171.php#E05-14](http://www.rmi.org/sitepages/pid171.php#E05-14); “Nuclear Power: Competitive Economics and Climate-Protection Potential,” Royal Academy of Engineering lecture (London), 13 May 2006, [www.rmi.org/sitepages/pid171.php#E06-04](http://www.rmi.org/sitepages/pid171.php#E06-04).

<sup>9</sup> A.B. Lovins, E.K. Datta, T. Feiler, K.R. Rábago, J.N. Swisher, A. Lehmann, & K. Wicker, *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*, 2002, Rocky Mountain Institute (Snowmass CO), [www.smallisprofitable.org](http://www.smallisprofitable.org).

<sup>10</sup> A.J. Gadgil, A.H. Rosenfeld, D. Aresteh, & E. Ward, “Advanced Lighting and Window Technologies for Reducing Electricity Consumption and Peak Demand: Overseas Manufacturing and Marketing Opportunities,” LBL-30890 Revised, *Procs. IEA/ENEL Conf. Adv. Technols. El. Demand-Side Mgt.* **3**:6-135–6-152 (Sorrento, 2–5 Apr. 1991), Lawrence Berkeley National Lab.

<sup>11</sup> A.B. & L.H. Lovins, *Brittle Power: Energy Strategy for National Security*, DOD/CEQ/Brick House (Andover, MA), 1981/82, 499 pp., reposted by RMI 2001 in OCR .PDF version at [www.rmi.org/sitepages/pid533.php](http://www.rmi.org/sitepages/pid533.php).

<sup>12</sup> A.B. & L.H. Lovins & L. Ross, “Nuclear Power and Nuclear Bombs,” *For. Aff.* **58**:1137–77 (Summer 1980), [www.foreignaffairs.org/19800601faessay8147/amory-b-lovins-l-hunter-lovins-leonard-ross/nuclear-power-and-nuclear-bombs.html](http://www.foreignaffairs.org/19800601faessay8147/amory-b-lovins-l-hunter-lovins-leonard-ross/nuclear-power-and-nuclear-bombs.html), and **59**:172 (1980).

<sup>13</sup> A.B. Lovins, “Energy Strategy: The Road Not Taken?,” *For. Aff.* **55**(1):65–96 (1976), [www.foreignaffairs.org/19761001faessay10205/amory-b-lovins/energy-strategy-the-road-not-taken.html](http://www.foreignaffairs.org/19761001faessay10205/amory-b-lovins/energy-strategy-the-road-not-taken.html); *Soft Energy Paths: Toward a Durable Peace*, Ballinger/FOE (Cambridge/SF), 1977, Pelican (UK), 1977, Harper & Row (NY), 1979, 256 pp., numerous translations; A.B. & L.H. Lovins, F. Krause, & W. Bach, *Least-Cost Energy: Solving the CO<sub>2</sub> Problem*, Brick House (Andover MA), 195 pp., 1982, reprinted by Rocky Mountain Institute (Snowmass, CO), 1989, summarized in *Clim. Chg.* **4**:217–220 (1982); A.B. & L.H. Lovins, *Energy/War: Breaking the Nuclear Link*, Friends of the Earth (San Francisco), 1980, Harper & Row (NY), 172 pp., several translations.