Saving Forests from the Demand Side

Invited remarks by Amory B Lovins
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Including summaries of findings of a working group of the Systems Group on Forests
(RMI, 1995–98, to be published ~1999) and of research by Chris Lotspeich et al.
documented in Natural Capitalism (P G Hawken, A B Lovins, & L H Lovins, 9/99)

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primary energy consumption (quadrillion BTU/year)

"hard path" projected by industry and government around 1975

"soft path" proposed by Lovins in 1976

actual total consumption reported by USEIA

soft technologies (which do not include big hydro or nuclear)
Water withdrawn for U.S. use: declining since 1980 despite rising population (dashed line)
What goes up can come down

- US primary energy/GDP –36% so far: saved $150–200b/y, still wasting >$300b/y
- US 1979–86: GDP +19%, pri energy –6%
- US resumed a comparable (3.2%/y) rate of savings in 1996–99 despite record low & falling prices
- US is saving water twice as fast as energy: in CA, industrial output in ’80s +30%, water withdr –30%
- Even driving/car may stabilize/fall (many reasons)
- Oil endgame now beginning—likely to become uncompetitive even at low prices before unavailable even at high prices; a precedent for wood?
Will alternatives exhibit diminishing returns...
...or expanding returns?
By 2050, an affluent world could meet or beat a 3–4× C reduction goal

\[ C_{\text{energy}} = \frac{\text{population} \times \text{affluence per capita} \times \text{carbon intensity}}{\text{conversion eff.} \times \text{end-use eff.} \times \text{hedonic eff.}} \times 2 \times 3-4 \times \sim 2-4 \]

or ~1.5–12× lower emissions despite assumed 6–8× growth in GWP. (A 1993 UN study* found 1.35× and 8× respectively, 1985–2050.) Great flexibility is thus available. *The future is not fate but choice.*

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What causes the extractive demand upon natural forests?

In a “snapshot” at a given moment, and ignoring important differences between and within societies, it results from seven terms, all of which are not fate but choice, each of which can be increased or decreased, and some of which may interact with each other:

<table>
<thead>
<tr>
<th>human population</th>
<th>× per-capita demand for end-use services now provided by physical artifacts made from forest products</th>
<th>× portion of that service demand that would be actually provided by forest products after substituting other means</th>
<th>× throughput of forest products needed to maintain the desired stock of physical artifacts</th>
<th>÷ efficiency of converting forests into forest products (e.g., round-wood, market pulp, fuel-wood)</th>
<th>÷ efficiency of converting intermediate goods (e.g., dimensional lumber, paper, fuel) into end-use services (e.g., shelter, information, cooked food,...)</th>
<th>÷ efficiency of converting end-use services into human happiness and satisfaction</th>
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<tbody>
<tr>
<td>influenced by:</td>
<td>prices progress metrics values what do we want? how much is enough? equity concerns religious and moral norms</td>
<td>“transparent” or “noticeable” substitutions substitutions at various levels: functionality, materials, purpose,... possibly +/- in other respects</td>
<td>min.-materials design net-shape design &amp; mfg. scrap recovery longevity repair/reuse remanufact’g. recycling downcycling recovery as feedstock or fuel</td>
<td>where/when to log extractive practices field loss transport loss spoilage processing loss</td>
<td>logistical loss transport loss processing loss storage loss spoilage market loss (production/sales mismatches, returns,...)</td>
<td>e.g.: engineered wall (better, ~74% wood, lower-quality wood); duplex copying, electronics, nega-information; efficient cookers &amp; pots, effective solar cookers</td>
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<tr>
<td>long-term flexibility:</td>
<td>unknown, possibly severalfold</td>
<td>much, perhaps most, of current demand</td>
<td>at least severalfold</td>
<td>significant to manyfold</td>
<td>significant to manyfold</td>
<td>severalfold to manyfold</td>
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so the flexibility terms multiply to 1–3 orders of magnitude, mostly from technical fixes!
With a few qualifications...

• Formula is heuristic, not exhaustive
  • *E.g.*, omits such indirect methods as saving forests by using electricity more efficiently instead of flooding forests for hydroelectric dams
  • Ignores complex price & physical interactions
  • Omits other pressures (clearance, fuels, roads, land tenure, social complexities,...)

• Some ambiguities about where a term should go (just count it once and only once)

• Still useful, because it emphasizes many multiplicative options, starting downstream
Some nifty forest-products numbers

• Fiber usually a small fraction of total societal value
• Noncommercial uses (fuelwood) and complex sociopolitical and land-use issues often important
• U.S. fiber harvest mass is >2× metals purchases
• Produces ~half paper/paperboard (fast-growing markets), ~half lumber at ~2–5× higher prices/m³
• Paper is 2% of world trade, 2¹/₂% of ind. prodn.
  • U.S. shipments $132b/y, ~pri. metals/minerals, ~0.9× petrochemicals; ~90% of usage ephemeral, not archival
• 20th-C. US fiber/cap –2.5%/y: GDP × 6, use ×<2
• 5 SGF case-studies found ~75–80% fiber savings
• Biggest leverage starts all the way downstream
Compounding losses...or savings

- Power plant losses 70%
- Transmission and distribution losses 9%
- Motor losses 10%
- Drivetrain losses 2%
- Pump losses 25%
- Throttle losses 33%
- Pipe losses 20%
- 9.5 units of energy output

Electrons for fiber, pixels for paper

- Hard disks sell for a few ¢ per ream-equivalent
- Paperless office: strong cultural barrier, big gains
  - 29% of paper/p’bd; 5 sheets/cap-h, 100–200 lb/cap-y
- “Nega-information”: paper saving as byproduct
  - Dow/Horgen: –30% in 6 weeks, productivity up more
  - Oticon –30–50%, byproduct of better decisionmaking
- Increasing innovations: BoA syndications (pot’l. 5M sheets/y), optical phonebooks / parts catalogs / PDR, web publications (a Sunday NY Times uses 75,000 trees; newsprint is 1/6 of US paper usage)
Dematerializing paper

- Reduced basis weight, higher opacity
- Improved strength/weight cut av. basis wt of US bleached paperboard (packaging) by ~1/5 in 10 y
- Johnson & Johnson: 30-mo effort saved (/y) 2750 t packaging, 1600 t paper, $2.8M, 134+ ha forest
- Eliminate overdesign in packaging (which is the largest US/UK use of paper products; 1/3 of W Eur muni waste, 2/5 of volume into US landfills)
  - 20–50% short-term reductions
  - Big Ger. retailer: 98% of secondary pkg’g unneeded
  - Canada’s goal: 25% packaging reduction 1990–2000
Start downstream for greatest leverage

- Functional efficiency
  - Negainfo., no junk mail (1.5 trees/American-y)
  - WYSIWYG, preview, groupware, E-mail,....
  - –58% paper napkins by putting dispenser at the table
  - 2b people won’t need phone poles (PV + wireless)

- Then end-use efficiency
  - Duplexing (partial use saved AT&T 15% of paper bill)
  - Fax-address stickies, not cover sheets
  - Returnable envelopes save 60–70% of envelope paper
  - Barcoding (esp. 2-D) replaces dossiers
  - E-mail (now >10 trillion words/y)
  - Technology does matter: forms bond stopped growing
    (US ’94–2000 proj’d 0.1%/y vs uncoated freesheet 3.9)
Next, work back all the way upstream

- Then reduce new-materials dependence
  - Reuse the back for drafts/notes
  - Lower-basis-weight paper (EDF –23%, transp, postage)
  - “Detoner” printers/copiers emerging in US & Japan
  - Recycling (saves 1/2 energy = oil w/ 1/2 paper’s mass)
- Then substitute nonwood fiber
  - Some is higher-quality and m³/ha-y than wood fiber
  - Nonwood paper 6%, growing 3× faster; ~80% in PRC
  - 10% straw to agropulp boosts OR farm profits 25–50%
- Then conversion efficiency (many small terms)
- Then field efficiency (~5–6× diffs. observed)
Multiplying savings like loaves and fishes

- Combinations can be powerful
  - Pará (Brazil): 28% better harvesting practice + raising sawmill eff. from 35% to 50% (cf. USSE 60%, best 70–80%) yields same net out, harvesting 45% less forest
  - If Brazil’s sawmills matched best Japanese, field practice improved, & expected 2–3× gains in tree growth occurred, 60–83% fewer ha would deliver same output
  - If each of 10 elements in each of 8 terms saves only 2%, their combined effect is $0.98^{80}$, or an 80% saving!
- Harvesting 5–20% of standing tropical trees can damage a further ~20–50% of surrounding trees & soil, esp. small trees vital to stand regen.; reverse it!
An example of multiplying paper savings

- × 0.90: E-mail, curbing unwanted printouts
- × 0.50: duplexing, scratchpaper reuse,...
- × 0.95: pulp-mill process/eq’t upgrades
- × 0.2: softwood plantations for unmgd forest
- × 0.75: 60- to 45-lb basis wt, better opacity
- × 0.60: supplemental nonwood fiber + recyc.

If no boomerangs, product is × 0.04—a 96% saving (or w/o switch to plantations, × 0.19)

Many of these assumptions are conservative
Structural applications

- Engineered wood products (e.g., TrusJoist MacMillan’s “Parallam”) have ~1.8–2.4× product yield per m³ fiber; use softer, smaller, lower-quality trees.
- Even greater efficiency in structural performance:
  - EWP 1-joists w/44% less fiber—even more because no internal load-bearing walls are needed, higher space eff.
  - EWP framing system saved 70–74% of wood in stud-wall, wood/wall 0.35 to 0.09, –$433, 2× insul’n, stronger.
- Fingerjointing yields 500–700 bd-ft/t wood “waste”.
- Glue 4–5" logs’ trapezoidal blocks into thick boards.
- Novel 1-beam joists, big hollow beams,...
- Bellcomb, Gridcore (~75–85%), C-Glulams (~67%)
Close materials loops

• Pallets use 11% of U.S. lumber, 2/5 of hardwood
  • 1.5b in U.S. (6/cap), + 0.4b/y; waste/y = 300k homes
  • Many firms repackaging, reduce pallets/t shipped (to 0?)
  • Remfg: NYC $130M/y disposal cost; but Big City Forest recovered 50k pallets + furniture in first 20 mo, saving 1,500 t wood (>1M bd-ft) + $500k
  • RAN: 50% remfg = 2,500 inner-city jobs + 765M bd-ft/y = 152k acres timberland
  • German barcoding incentivizes durability, reuse, repair

• Paper: U.S. recyc. > landfill since ’93; nearing 50% of inputs (vs. 96% NL), but 20 Mt/y waste-wood, equivalent to 7% of harvest, still landfilled

• USNW: 1948–73 mill products/ha ×4, residues ÷4!
Process innovations continue

- Green Bay Packaging Co (WI banned paper from landfills in ’95) eliminated effluent from all-recycled paperboard, so could locate far from water
  - Goal: national network of regional minimills
  - Raised fiber recovery from 85–90% to 97–98%, equivalent to avoiding landfilling another 20kt/y
  - Became industry’s low-cost producer
- Recycle copiers (10×), Decopier (5×), polymeric ink (floats off in 55°C water, 10–13× paper life)
- E-paper (>1M trips) soon from Xerox PARC, MIT
With superefficient use, no forest cut?

- Sedjo: current world demand for industrial wood fiber (excl. fuelwood, slightly greater) could come from plantations on good forest land ($8 \text{ m}^3/\text{ha-y}: 2 \times \text{av. US prod’y, } 4-6 \times \text{below fast-growing spp}$) equivalent to 5% of the world’s currently forested land.

- Very-high-yield plantations ($40-70 \text{ m}^3/\text{ha-y}$) on 0.5–1% of current forest areas (23–40 Mha: cf. current plantations’ 100–135, high-yield 14) could meet world wood-fiber demand @ current efficiency.

- Improving downstream efficiency 3–5× in long run (prob. conservative) could cut this to ~0.1–0.3%, the size of Louisiana or Iowa—about the area of tropical forest being lost each year in early 1990s.
Conclusions

• The innovations illustrated by these anecdotal examples, and the far larger potential still unexploited, suggest that efficiency and substitution in all forest-product value chains can profitably displace most/all cutting of natural forests, w/same services

• *Thorough* analysis is needed, including interactions (best protection against rebound: save everywhere)

• This cornucopia is the manual model!

• Some non-fiber values (C, watershed, tourism,...) are starting to be monetized; even in NZ’s exotic softwoods, they’re worth ~1.5× as much as fiber, which has ~6× av. US natural forests’ yield/ha-y
But more juicy questions remain...

- Can saving wood fiber tunnel through cost barrier?
- What would full desubsidization really mean?
- What “barrier-busting” initiatives* can turn implementation obstacles into business opportunities?
- Ga.-Pacific CEO’s remark about eco-accounting—should there be a major FASB/GAAP initiative?
- Business value of biodiversity—even to loggers
- Can Collins Pine’s premium be generalized?
- What would make alts. clearly more profitable? (Example: Oil Era will end bec. it can’t compete)
- Change business model to a Solutions Economy?

To dig deeper...

• All RMI publications can be ordered, and many can be downloaded free, from www.rmi.org
• Publications related to Hypercars (a nega-OPEC), fuel cells, and H₂ are at www.hypercar.com
• Advanced energy efficiency information is sold at www.esource.com (a former RMI subsidiary)
• *Natural Capitalism* has >400 pp. & >800 refs., and will have its own part of the www.rmi.org website by ~9/99 when the book is published by Little Brown (NY) and Earthscan (London)