# MAKING MARKETS IN RESOURCE EFFICIENCY

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Most economists view the economic process as a closed loop of production and consumption -- an endless, circular, disembodied flow of exchange value. In fact, however, that loop is embedded in the physical reality of a negentropic flux from resource depletion to pollution. Yet today, both these thefts from the future are not priced, so they bear little or no penalty. Resources are conventionally valued at only their cost of extraction, not their long-run replacement cost; pollution, at zero.

As economics Professor Herman Daly notes[1], ignoring the throughput of matter-energy

> **...is as if biology tried to understand animals only in terms of their circulatory system, with no recognition of the fact that they also have digestive tracts. The metabolic flow is not circular. The digestive tract firmly ties the animal to its environment at both ends. Without digestive tracts animals would be self-contained perpetual motion machines. Likewise for an economy without an entropic throughput.**

By ignoring throughput, most economic policymakers can "treat the world as a business in liquidation,"[2] counting depletion of capital as income -- notwithstanding the late J.R. Hicks's classic definition of income as "the maximum amount that a person or community [can] consume over some time period and still be as well off at the end of the period as at the beginning." Depleting or polluting natural capital stocks that yield flows of resources and services, whether priced or "free," undermines the ability to produce artificial capital -- including the artificial capital meant to substitute (supposedly reversibly) for losses of natural capital.

Most successful economies use market mechanisms to pursue this self-deception more efficiently -- and thereby add dangerous new layers of confusion. Optimal allocation of resources, as Daly points out, has nothing to do with optimal scale of operations, and "A boat that tries to carry too much weight will still sink even if that weight is optimally allocated." Nor does optimal allocation embody any feedback about when to stop: it does not reveal when growth becomes "anti-economic," the National Product becomes too gross, and basic needs become sacrificed to extravagant wants. Nor, finally, are markets meant to address such central needs as community, beauty, integrity, or justice. Markets are meant to be *ef*ficient, not *suf*ficient; greedy, not fair. If they benefit whales, wilderness, God, or grandchildren, that is purely coincidental. Markets are very good at what they do, but their purpose is far from the whole purpose of a human being.

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[1] H.E. Daly (World Bank), "Steady-State versus Growth Economics: Issues for the Next Century," Hoover Institution Conference on Population, Resources and Environment, Stanford University, 1-3 February 1989.

[2] H.E. Daly, "Sustainable Development: Some Basic Principles," keynote address, id. The present paper's opening section is much indebted to Daly's many seminal writings.

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Nonetheless, a partial substitute for ethics in guiding economic activity can be to price depletion and pollution at considerably more than zero. This is a desirable, though perhaps not a necessary and certainly far from a sufficient, condition for morally acceptable economic behaviour: certainly it is much better than treating depletion and pollution as free goods, because if people don't pay what a thing really costs, they'll never know how much is enough. Pricing depletion and pollution encourages doing more with less, substituting resource efficiency for throughput, and thereby abating depletion and pollution simultaneously. This often saves money too, so one can do well by doing good.

*Prices without markets*

That much is now widely accepted. The "polluter pays principle" (if not also its essential counterpart, the "depleter disburses doctrine") is already reflected in some nations' law and custom, at least partly, and is gaining further force as rising concern over *Waldsterben* and global warming favours serious consideration of carbon and sulfur taxes.

Much less attention, however, has been given to helping people respond to those corrected price signals by using market mechanisms *to make a market in saved resources* (or in abated pollution). Merely pricing depletion or pollution does not bring together buyers with sellers; it does not take advantage of the power of market mechanisms fully exploited by many dispersed actors. Prices without markets are as if shares had quoted values but no bourse; or as if commodity prices could be negotiated only face-to-face between single dealers in small transactions in the bazaar but not acted upon by diverse parties elsewhere. This narrow vision of prices' potential pauperizes what could and should be a rich field for creative action. It imposes a penalty for, say, pollution *without providing a corresponding opportunity to escape that penalty by translating one person's potential loss into another's profit* -- thereby eliciting actors who can achieve important economies of scale in supplying "hassle-free" packaged responses to the price signal.

Making markets in saved resources and in avoided pollution holds much practical promise as a complement to, and in many cases a substitute for, regulatory intervention to mandate or prohibit particular behaviour. My colleagues and I have for some years been developing ways to apply this market approach to the efficient use of energy and water. This idea is now rapidly starting to catch on: many concepts which, a year ago, were only a gleam in the eye are now entering successful use by conservative, hard-headed, profit-making, and far from altruistic corporations.

*The efficiency revolution*

The underlying premise of this discussion is that efficient technology which wrings more work out of resources is generally cheaper, even in private internal cost, than making or mining more of them. (This is empirically true virtually everywhere for marginal electricity, fuels, and water, and probably applies to many other resources too.) Producers thus have an economic incentive to sell less of the resource and more efficiency in using it -- before someone else does. This changed mix of factor inputs to produce a desired service -- less of the costly intermediate good (the resource) and more of the cheap one (the resource productivity) -- reduces the total factor cost of providing the service. The producer then saves operating costs or capacity costs or both[3], reduces financial and po-

[3] In U.S. regulatory practice, however, the normal process of price formation unfortunately rewards utilities for selling more electricity and penalizes them for selling less. This perverse incentive has been successfully corrected by a simple balancing-account mechanism in California. In July 1988, the Conservation Committee of the National Association of Regulatory Utility Commissioners unanimously endorsed two new regulatory principles now starting to enter state practice: that by this or other means, utilities' profits should be decoupled from their

litical risks (including those arising from externalities), manages uncertainty so as to minimize regret, and can sell cheap efficiency more profitably than costly resources. Often the producer's business opportunity can be said to be arbitrage on the difference between the producer's and the customer's discount rate: a difference which, in the case of energy, is typically about tenfold.

The opportunity to profit from selling efficiency is real, pervasive, and arrestingly large. Our research has shown in detail a full practical potential, by equipping today's U.S. factories and buildings with the best equipment now on the market, to save about three-fourths of all electricity now used, at an average cost (~0.6¢/kW-h) far below the cost of just *operating* a coal or nuclear station, even if building it cost nothing.[4] The potential is probably rather similar in Western Europe, and even larger and cheaper in most socialist and developing countries. Similarly, full use of the best technologies already demonstrated, but not yet all on the market, could save nearly four-fifths of U.S. oil at an average cost (~$3/bbl) well below that of simply *finding* new domestic oil.[5]

Most of the best of these efficiency technologies are less than a year old; their cost-effectiveness has improved, in the case of electricity, by roughly sixfold in the past five years and by nearly thirtyfold in the past ten years. And thanks to a corresponding *cultural* revolution within the U.S. utility industry, many electric companies *are in fact* making more money at less risk -- and, importantly, are also having more fun and hence attracting more talented people -- by selling less electricity and more efficiency. These ideas are still quite new in Europe, but seem to be falling on fertile ground.

### *Negawatt markets*

How can one harness the business incentive to save a resource more cheaply than it can be produced? The electric utility industry provides an illuminating example.

Since the mid-1970s, many U.S. providers of electricity or natural gas have realised that a saved watt (which we may call a "negawatt") is just like a generated watt, only cheaper, cleaner, safer, and faster to produce. Such utilities have therefore helped their customers to save electricity (or gas) through such specific programmes as information, technical design support, concessionary loans, leases, gifts, and rebates for buying efficient equipment. Such programmes are widely used, well understood, and highly successful: they can and do actually yield large, fast, cheap savings with high confidence.

Today, however, a complementary set of more market-oriented approaches is emerging from work at Rocky Mountain Institute and elsewhere. In essence, these techniques make saved electricity (or other saved resources) *into a commodity* subject to all the features of modern markets in wheat, copper, and sowbellies. Applied to saving electricity, for example, this can mean:

- **Local fungibility.** Saved electricity can be traded between *customers*: customer A, wanting cheap electricity, can privately arrange to invest on customer B's premis-

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sales, so they become indifferent to whether they sell more or less electricity; and that any utility which reduces customers' energy-service bills should be allowed to keep part of that saving as extra profit.

[4]This potential is documented in encyclopaedic detail by Rocky Mountain Institute's Competitek update service, currently provided to approximately 80 utilities and other organisations in 18 countries.

[5]A.B. Lovins, "DRILL RIGS AND BATTLESHIPS ARE THE ANSWER! (But What Was the Question?)," in R. Reed & F. Fesharaki, eds., The Petroleum Market in the 1990s, Westview (Boulder, Colorado), 1989, or Rocky Mountain Institute Publication #S88-6.

es to save electricity there. The utility, acting as a negawatt broker, can then resell to A the amount of electricity just saved at B's facility, but at a discount, so that the utility's saved operating costs (because the saving generally costs less than short-run marginal generating cost) is split between A and other customers.

- **National fungibility.** Saved electricity can be traded between *utilities*: utility A can pay utility B to save electricity in B's territory and then sell it back to A at a mutually advantageous price. The first such contracts were recently signed.[6]

- **International fungibility.** Saved electricity can even be traded between *countries*. For example, Hydro-Québec's proposal to build a very costly hydroelectric dam and sell to Vermont 450 megawatts of its output, at a price which over time works out to about 9¢/kW-h, is unattractively expensive. But Vermont's suggested counteroffer is to go to Montréal, fix up buildings there to save 450 MW, and then b uy it back for (say) 3¢/kW-h. The total cost to Vermont -- perhaps 1¢/kW-h to save the electricity, then 3¢/kW-h to buy it back -- will be far below Hydro-Québec's 9¢/kW-h asking price. But Hydro-Québec would make more money by accepting the counteroffer, because the 3¢/kW-h power is from an old dam amortized decades ago, so that price is almost pure profit, and comes without the financial and environmental risks of the new dam. If 3¢/kW-h isn't the right price, there is plenty of room to negotiate.

  This is pure arbitrage on the difference between the cost of making and the cost of saving electricity. The scope for such profitable arbitrage is very large, especially within the logic of the post-1992 internal market in Europe. Competition between megawatts and negawatts will soon teach utilities and nations that electricity is almost always worth more saved and resold than wasted at home.

- **Derivative instruments.** Markets in saved electricity can be not only spot markets but also futures and options markets -- an ideal way to hedge planning risks. A "negawatt future" would be an underwritten promise to deliver a certain amount of saved electricity at a certain time, place, and price. That contract would have a market value. This concept is now under serious discussion.

- **Peak-load covenants and secondary markets.** Another marketable instrument could be a binding covenant that a given factory or facility will never use electricity at more than a certain peak rate, so the utility needn't go on planning as if it were going to, and can avoid costly capacity. This "capped demand covenant" would have a value in a secondary market. It is like the U.S. Environmental Protection Agency's present practice of regulating air pollution under the "bubble concept": someone wanting to open a polluting factory in a place with dirty air must first abate that much pollution somewhere else in the same airshed. In practice this is done, not by physically finding and cleaning up another plant, but by buying from a broker, at market value, a previously earned certificate of decreased air pollution. Buying stabilized or reduced electrical demand should be no different.

  A special case, already widely practiced, is the "curtail-to-threshold tariff": a customer expresses willingness, in rare power emergencies, to receive less electricity than usual, down to a certain "threshold" mutually chosen in advance. The utility then pays the customer monthly for each peak kilowatt by which such curtailment is available, whether it is actually exercised or not.

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[6] Electricity saved at the point of use requires no transmission, but rather frees up transmission capacity to "wheel" the cheapest power around the grid; so negawatts, rather than paying a wheeling fee, deserve a wheeling credit.

- **Auctions.** Saved electricity can be bought by competitive bid to minimize its cost. A utility (or an independent broker) wanting a certain number of megawatts can simply solicit bids for that much electricity, or less, to be made *or saved or displaced* by anyone, by any means, at a series of increasing prices, until the target is reached; or the auctioneer can simply ask for bids and choose the lowest ones. Such "all-source bidding" is now required in eight of the United States and is spreading rapidly. Efficiency bids generally undercut power plants, beating even industrial cogeneration and otherwise competitive renewable energy sources.

  As a special case, one U.S. utility offered industrial modernisation grants -- cash given to help adopt more efficient processes or equipment which would save electricity more cheaply than the utility could make it. The grants simply went to those firms which bid to save the most electricity per dollar of grant.

- **Cross-marketing.** Electricity is usually supplied by monopolists operating in a specifically franchised territory. But there is no monopoly on electric *efficiency*; it may be freely sold anywhere.[7] Thus about a dozen investor-owned utilities already sell efficiency, for fun and profit, in the territory of *other* utilities less alert to their opportunities. One U.S. utility sells electricity in a single state but efficiency in six states. (Before long, I daresay, German utilities will be investing to save electricity in France, Greece, and the Soviet Union as routinely as in the Federal Republic itself.) It is even possible for a natural-gas utility to make a large profit selling *electric* efficiency -- and thereby change the behaviour of buildings in ways which open up new gas markets.

- **Sliding-scale hookup fees.** A useful adjunct to these market-making methods is to internalize some of the social costs of inefficient buildings by charging, before connecting any substantial new building to the grid, a fee which is positive *or negative* depending on the efficiency of the building. This has major advantages for all parties -- builders, financiers, buyer/occupants, utilities, and other customers. Such a scheme is halfway through being passed into law in one state, and half of it is in use (with the other half proposed shortly) in four others.

  One state is seeking to apply a similar concept to new automobiles by adjusting its normal 5% sales tax upward or downward, over a range of 0-10%, depending on efficiency. It would be even better to have a *negative* tax for the most efficient cars -- the more efficient, the bigger the rebate -- for buyers who scrap their old, inefficient cars so nobody will ever drive them again. (Bring in a death certificate -- or two bumpers and a fender? -- and get your rebate. Or scrap your old car, *don't* replace it, and collect a bounty.)

Such methods can make negawatt markets in which everyone can play, promoting bounty-hunters who go looking for opportunities to invest in correcting inefficiency wherever they find it. That is surely a faster -- and, thanks to the resulting competition, a cheaper -- way to wring out inefficiencies than relying on a few large institutions alone.

### *Other resources*

Similar methods are already being applied to saving water in dry parts of the United States and in places facing costly expansions of wastewater-treatment capacity to abate pollution. Sliding-scale hookup fees, giveaways, mass retrofits, rebates, arbitrage, inter-

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[7] "Selling efficiency" means selling any required mix of advice, design services, project management, financing (usually the most important part), equipment, installation, commissioning, operation, maintenance, and monitoring. It is essentially an informational/financial product.

utility trades of saved water -- all are rapidly entering standard practice. In fact, one water-short town has invented a new method: any builder wanting to construct a new house must first install water-saving equipment (or fix leaky water mains) to save that much water elsewhere. The result: builders equipped a third of all the houses in town with efficient fixtures in the first two years.

Could not similar methods apply also to other scarce resources? Could not the social value of not burning oil, for example, be reflected in prices signalled by spot, futures, and options markets in *saved* oil, so that arbitrageurs can exploit the spread between barrels and negabarrels? Could not "negatons" of saved or recycled metals be traded alongside tons of virgin metals? Might not one firm or country use brokers to find others with whom resource efficiency improvements and pollution abatements could be profitably traded? Why not acquire resources by auctions which establish the functional equivalence of new with saved resources, of pollution with abatement? How much is it worth paying people to stay *off* the roads so we needn't build and mend them so much? As with subatomic particles, for every resource there is an equal and opposite "anti-resource," for every activity an abatement, each arguably meriting a value and a market.

Making markets in resource efficiency and environmental protection has even wider implications. Consider, for example, the analogy between energy and security. People don't want kilowatt-hours; they want energy services such as comfort, light, mobility, and torque. But if the only way they know to get the services is by buying electricity, then a choice to use less electricity and more efficiency cannot be expressed in the market; utilities will therefore have an effective monopoly in providing the final services; and price elasticity of demand for electricity will appear to be very small. The solution is to articulate, make available, and make markets in the efficient use of electricity, so that electricity must openly compete with electrical productivity.

Analogously, people don't want weapons; they want to be safe and feel safe. But if the only way they know to get security is through weapons, then the weapons vendors will have an effective monopoly in providing security services, and price elasticity of demand for weapons will appear to be very small (reinforced by the monopoly, monopsony, and often corrupt political process through which the weapons are bought). That is why Rocky Mountain Institute is trying to articulate and bring to market the specific, practical elements of an alternative concept of security -- so that other ways to achieve freedom of fear from privation or attack will become more available as alternative intermediate goods with which weapons must compete in the political marketplace.

Putting a proper price on depletion and pollution cannot replace a proper regard for our moral obligations to beings in other places, forms, and times. But prices imaginatively *combined with flexible, accessible markets* can at least apply to corrective mechanisms the same vigour and ingenuity -- the same genius of the market -- the same diversity and adaptability -- that have got us into this mess. Markets that *apply* the new price signals, and focus them into action, will at least help make the struggle between destroying the future and creating it a more nearly equal contest whose issue is less in doubt.