Audubon's energy plan: More for less

With money so tight these days, everyone is hunting ways to get more for less. The National Audubon Society is no exception. According to a study it has just released, energy consumption in the United States can be held at 1980 levels through the year 2000 without sacrificing the nation's economic growth or requiring major changes in lifestyle. And Audubon's energy plan purports to blueprint actions required to achieve this.

Even with a 25 percent population increase by the end of the century, Audubon claims U. S. energy consumption can be held to roughly 80 quadrillion Btus (quads)—the 1980 level. What's more, the environmental group adds, maintaining current energy consumption levels would permit a two to three percent annual growth in the economy and result in a potential 50 to 80 percent increase in the quantity of goods and services achievable on the nation's current energy diet.

Audubon does, however, advocate changing the menu. And not surprisingly, conservation would become a staple. Solar technologies are targeted to supply 25 percent of the total energy budget by 2000, with biomass contributing most. (Audubon's plan avoids the potential food-or-fuel dispute [SN: 1/10/81, p. 21] by depending, with small exception, on use of nonfood-quality biomass.) Near-term reliance on both coal and nuclear power would increase "modestly" — though less than the federal government and most energy industries now project.

Perhaps most notable, the plan offers to reduce oil imports 75 percent from 1980 levels — to 20 percent of total oil consumption — by the year 2000. "If we use energy more efficiently," the plan contends, "especially in those areas where liquid fuels are consumed, and if we accelerate the substitution of solar heat for oil-fired space and water heaters, and make modest use of synthetic fuels plus alcohol from biomass, the potential will exist to eliminate U. S. dependence on foreign oil at a total cost to society which appears to be lower than any other known option."

But by any reckoning, the investment for conservation equipment and technologies and solar technologies that would be required throughout the next two decades is massive. Audubon figures conservation investments would total \$675 billion — roughly the equivalent of \$150 per capita per year — for a savings to society of at least \$300 billion. Another \$570 billion would be spent on solar—\$130 per capita per year — potentially saving several hundred billion dollars more than other energy-supply strategies.

Massive as these projected outlays are, Audubon claims they are smaller than those necessary to produce the equivalent energy from new oil and gas supplies, from synthetic fuels or from new coal and nuclear plants. "In short, the efficiency path has become a better investment than the supply path." And "if capital markets cannot supply the capital for solar equipment and increased energy productivity, they will not be able to supply the capital for other domestic energy sources." Audubon justifies its claims with cost comparisons.

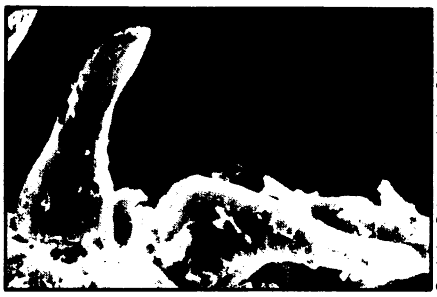
While Audubon's energy plan is an original creation, its energy-demand projections come largely from the National Academy of Sciences' CONAES study (SN: 1/19/80, p. 36). Other supply/demand strategies, energy-growth projections and relationships are culled from or checked against research from sources such as Harvard University, Exxon Corp. and the Edison Electric Institute. □

AUDUBON ENERGY PLAN

Energy Supply	Annual Use (in quads) 2000	1980	Percent of total in year 2000
NONRENEWABLES			
Coal	22.4	15.6	28.1
Oil			
Domestic	12.5	20.5	15.7
Imported	3.0	13.8	3.8
Natural Gas	15.0	20.4	18.8
Nuclear	6.6	2.7	8.3
SOLAR RENEWABLES			
Biomass	8.9	2.1	11.1
Low-Temp. Collectors	2.6	—	3.2
Medium-Temp.Collectors	1.7	—	2.1
Hydropower	4.0	3.1	5.0
Windpower	2.4	—	3.0
Photovoltaics	0.7	—	0.9
Total (Rounded)	80	80	100.0

A quad — 10^{15} Btus — roughly equals the energy used annually by 3,000,000 people.

Snakes flex their teeth


Savitzky, Science, scale bar 0.1 mm

Tongue-side view of the erect and reclined teeth in Liophidium rhodogaster.

Skink for dinner day after day can be hard on a snake's teeth. That's because skinks, which are cylindrical lizards, are armored with stiff, overlapping body scales that contain cores of bone. Even so, some snakes subsist entirely or predominately on a skink diet. Alan H. Savitzky, now at Cornell University, suggests that these snakes have developed fold-back teeth to facilitate feeding on hard-bodied prey.

In six types of snakes, representing three to five lineages, Savitzky found evidence of hinged teeth that fold back against the jaws. While the structural details vary, each hinge consists of connective tissue fibers attached to the tooth and jaw bone. In the April 17 SCIENCE Savitzky says, "Such teeth fold when forces are applied to their leading surfaces, but lock in an erect position when the forces come from behind, as would occur during the retraction movements of ingestion or when a prey item struggles to escape." The snakes also have long rows of teeth; some species have 40 teeth on each jaw. Such rows provide a gliding surface over which prey may be drawn, as well as a ratchet mechanism for guarding against escape.

Hinged teeth have been observed previously in a variety of fish and amphibia, but not in reptiles, birds or mammals. Savitzky divides the snakes with hinged teeth into three groups based on differences in head structure and tooth shape. The most advanced hinged-tooth mechanisms appear to correlate with a preponderance of hard-bodied prey in the diet.

Compared to other snakes, two of the three hinged-tooth groups have greater bilateral jaw motion, while maximizing contact between tooth rows and prey. The third group has an arched jawbone that appears to act as a rocker arm, first lowering large fixed teeth to pierce the prey and then engaging the row of hinged teeth.

The functioning of the hinged teeth needs to be confirmed by observations of naturally feeding snakes, Savitzky says. Nevertheless, he says the existence of these teeth in independent lineages of snakes is "an unusual and dramatic adaptation." □