normal respiratory drive. Among researchers studying this phenomenon are Geoffrey Dawes of the University of Oxford, England, S. Evans Downing of Yale University School of Medicine, and Barry Sessle of the University of Toronto.

Animals apparently have nerve receptors, located just above the larynx, that are sensitive to different chemicals. Contact of some chemicals with the receptors of very young animals can cause prolonged—even fatal—apnea. Dawes, for example, found that bathing the laryngeal receptors with water, glucose solutions, or cow's milk produced sustained apnea in lambs. A salt solution or sheep colostrum (the milklike material secreted by mothers for a few days immediately after they have given birth) had no effect. Cutting the laryngeal nerves that carry the impulses to the brain prevents the response. Conversely, stimulating the nerves electrically produces the response in the absence of chemical stimulation.

Most animals lose the apnea response to chemicals within a few days after birth. In piglets the reflex remains stronger for longer periods of time, according to Downing.

Investigators think that a similar chemosensitive reflex many cause sudden death in some human infants who aspirate water or formula into their upper respiratory tracts. Downing points out, however, that all babies may do that without harm in the vast majority of cases. He hypothesizes that infants who succumb to SIDS have reduced respiratory drives, that is, that the respiratory control centers of the brain are less effective in maintaining respiration in these infants. He has found that the anesthetic chloralose, which depresses the activities of the respiratory centers, increases the sensitivity of piglets to apnea-provoking chemicals. Less chloralose was required to produce a given inhibition in respiration in young animals than in older ones.

During these investigations, Downing discovered that piglets suffering from anemia, which is a common problem in these animals, were exceptionally sensitive to the anesthetic. He thinks that anemia may play a critical role in reducing the respiratory drive. Crib death is more common in infants from poor socioeconomic environments than in those with more affluent backgrounds. The former would be more likely than the latter to be anemic or to be born of mothers who were anemic during pregnancy. Moreover, the red blood cell concentrations of all infants falls progressively after birth, reaching a minimum at about 3 to 4 months of age—the same age at which SIDS incidence is greatest.

Inadequate respiratory control could be a result of delayed or impaired development, or, alternatively, the resultant oxygen lack could cause abnormalities in the brain. Either way, aberrant behavioral patterns could result in the infants. A number of investigators are interested in this possibility because such patterns might be used to identify infants with increased risk of sudden infant death. Naeye, for example, has noted that SIDS victims may differ somewhat from their siblings in the way they cry and feed and in their reactions to many external stimuli. Not all of the infants showed all of the differences, and they are difficult to measure quantitatively in any event. Nevertheless, Naeye, as well as other investigators, thinks that it will be possible to devise some kind of a test predictive for SIDS.

In addition to anemia, a number of alternative suggestions have been made to account for the abnormalities of SIDS victims. They include magnesium deficiency, according to Joan Caddell of St. Louis University School of Medicine, and lead poisoning. Both of these would be more prevalent in individuals from a poor socioeconomic environment than in those from more affluent ones. Henry Lardy of the University of Wisconsin has another hypothesis. He thinks that impaired glucose synthesis from amino acids and consequent failure of the body to maintain adequate glucose levels could contribute to crib deaths.

Most such deaths occur during the winter months and at night, at an age when infants begin to sleep through the night without a feeding. Inability to synthesize glucose might not be a problem while an infant has frequent feedings, but a long interval after eating, combined with the stress of cold weather, might cause a rapid and fatal drop in the concentration of glucose in the blood, according to Lardy. Glucose is the primary source of energy for all tissues, including the brain. Lardy has found that livers from SIDS victims have much lower concentrations of an enzyme required for glucose synthesis than do livers from infants who have died suddenly in accidents.

It is too early to say whether any of these possible mechanisms actually do contribute to sudden infant death, but they are not mutually exclusive; most investigators think that there is more than one cause. For example, only 50 percent of crib death victims show signs of having an upper respiratory infection. Such an infection may be the trigger of death for them, but for the others, different factors must be involved.

Several lines of investigation appear to be converging toward a better understanding of a problem that has long baffled physicians. They include the observations on sleep apnea and its effects on heart rhythm, on respiratory reflexes, and on pathological changes in SIDS victims. There is also a major effort to apply this new information to devise tests that will predict which infants are at risk of dying suddenly. The hope is that such a test will save lives—and spare parents the anguish of losing a child.—JEAN L. MARX

Energy: ERDA Stresses Multiple Sources and Conservation

Issuing its first national plan, the Energy Research and Development Administration has made major changes in the priorities previously espoused in Washington. Solar electric energy has been elevated to the highest priority, as a potentially "inexhaustible" source along with fusion power and the breeder reactor. The breeder is now being called one of several possible sources of energy in the long term, which should not be expected to produce significant power before the turn of the century. And the reduction of energy demand through conservation now has equal priority, at least on paper, with the creation of new sorts of energy supply.

Whether the dramatic shift in priorities will be reflected in budget dollars remains to be seen, since the legacy of energy programs passed on to ERDA was heavily weighted with nuclear energy expenditures. The fossil fuel programs administered by ERDA have been hastily expanded from $85 million to $391 million in the last 3 years, but even those burgeoning programs are still dwarfed by the $775 million expenditure for nuclear energy in fiscal 1976. The agency has requested a budget supplement of $131 million to restructure its priorities in the current fiscal year.

As required by the legislation that enacted ERDA, director Robert Seamans Jr. presented to the Congress (and to President Ford) a comprehensive national energy plan on 30 June. The early deadline, only 5 months after the creation of the new agency, may have hampered Seamans somewhat, especially since the staffing of ERDA is just being completed. Richard W. Roberts, previously head of the National Bureau of Standards, was confirmed as assistant administrator for nuclear ener-

gy on the day of the Washington press briefing on the new energy plan.

Along with an overview, outlined in the first volume of a report entitled "A national plan for energy research, development and demonstration," ERDA presented Congress with its midyear budget supplement for various areas of energy research (Table 1). (ERDA seems intent on replacing R&D with R,D&D in Washington energy-ese.) The specifics of new research expenditures will be explained in a second volume, to follow later.

Since ERDA's biggest problem in achieving popular credibility is to rid itself of the Atomic Energy Commission's image as a pro-nuclear agency, the budget supplement predictably shifted funds away from the breeder reactor and called for additional support for nonnuclear projects. But the $131 million requested cannot go very far toward restructuring the priorities of a $2 billion program. The supplement added $19 million to the $70 million already requested for solar energy in fiscal 1976, and boosted the conservation program by $32 million, to $73 million. Funding for the liquid metal fast breeder reactor was decreased by $60 million as a result of delays in the program and most of that amount was applied to other areas of nuclear research. Studies of the reliability of the present generation of light water reactors were granted an additional $6 million, and studies of nuclear fuel cycles, especially problems with plutonium and thorium, an additional $42 million. The largest allotment in the midyear budget increase went to fusion, for which an additional $38 million was recommended.

The ERDA budget changes are in the directions, but hardly in the amounts, that the Congress would like. The House had already authorized $310 million more for energy research than the Administration originally requested, and the Senate is considering a boost of $413 million. The allocations of the congressional supplements appear to have been unusually well considered, largely as a result of the major role that the new Office of Technology Assessment played in the analysis of the ERDA budget when it arrived at Capitol Hill this year. Congressional obligations for both solar energy and conservation appear certain to be much larger than ERDA has requested, even including the supplement. In the House, the appropriations committee has approved $194 million for solar research and $123 million for conservation. The amounts approved by the Senate are $122 million for solar research and $112 million for conservation.

Table 1. ERDA FY 1976 obligations for energy R&D.

Program	$ million	
	President's budget	Energy amendment
Direct energy programs		
Fossil energy	391	26
Solar energy	70	19
Geothermal energy	24	8
Advanced energy systems	24	20
Conservation	41	32
Fusion power	226	38
(Subtotal)	(776)	(143)
Fission reactors	677	−54
Nuclear fuel cycle	98	42
(Subtotal)	(775)	(−12)
Total	1551	131
Supporting programs		
Environmental effects	146	
Basic research	152	
Total	1849	131

ERDA officials warn, however, that it is too early to expect the substantial changes in priorities to be reflected in budget dollars. The midyear supplement shows the direction in which the agency is moving, and "You will find an even greater shift over the next two or three years," Seamans said at the Washington briefing.

Whether the new agency has, in fact, deemphasized the breeder reactor is questioned by some Washington observers, who note that the breeder still appears to be getting money as fast as the project can use it. Seamans is proceeding cautiously in setting policy for his new agency, and he is not known as a person likely to make radical changes. While it may be too early to tell if the breeder development will be deliberately slowed down to allow other energy programs to catch up, the role pictured for the breeder near the turn of the century has clearly changed. At one time, energy planners in the Nixon Administration were talking about enough breeders to provide half the U.S. energy by the year 2000. But now the most likely time for commercialization of the breeder has slipped into the 1990's, and even in the most optimistic nuclear scenario presented in the ERDA energy projections, a maximum of 80 breeders would produce only about 3 percent of the country's energy in 2000.

There used to be a taboo in the AEC against comparisons between the breeder and fusion, the reason being that the promise of clean energy from fusion could retard the rapid development of the breeder, with its plutonium fuel cycle. Noting that fusion has not been proved scientifically feasible, and that the breeder had not yet been shown to be safe for commercialization, Seamans nevertheless does not hesitate to compare them. "I put them both in the same category as a possible answer for the next century," he said.

The principal message of the ERDA plan is that there isn't any single energy technology that can be guaranteed to meet long-term energy needs, so as many options as possible should be nurtured. The plan was delivered with unusual notes of caution. "Not everything is going to work. Not everything can be made to work. We must allow for the fact that there will be R & D failures," said Roger LeGassie, assistant administrator for planning and analysis.

To stress the urgency of the energy problem, the report points out that the U.S. changed its major source of energy twice previously: from wood in 1850 to coal in 1910, and from coal to oil now. But in both those cases the full transition took 60 years, and much less time is available to make the next switch, the report cautions. As in previous Ford Administration studies, the ERDA report predicted that oil and gas will run out shortly after 2000.

For the first time, the ERDA report made a clear distinction between solar electric power generation and solar heating and cooling. The simpler heating and cooling technologies were termed "important underutilized mid-term resources," along with geothermal energy and heat that is now wasted. But the solar electric technologies, which are not yet commercially proved, were definitely given the nod over their "lower technology" solar peers. Solar electric energy includes a variety of technological options, including wind power, thermal electric plants, photovoltaic systems, and the use of ocean thermal gradients.

The major consideration in making this distinction, according to John Teem, head of the office of solar, geothermal, and advanced energy systems, was that ERDA projections show that there is ultimately a much greater potential in solar electric power than in heating and cooling by the sun. These projections, along with many other elucidations of the details of the ERDA plans for energy research, will be spelled out in more detail when the agency submits its second national report in January. After that the agency will update its projections and accomplishments yearly.—WILLIAM D. METZ