exploration of the solar system."

The two teams are to report back to NASA leaders in early April at which point tough decisions will be made. Goldin, if confirmed, will preside over all such decisions except the one involving AXAF. TRW is the prime contractor for AXAF, and Goldin is TRW's top manager on the contract. Sensibly, he has vowed to recuse himself from all TRW business for 1 year after being sworn in.

Some NASA officials would argue that not everything on the new director's plate will be of nouvelle cuisine proportions. NASA science official Alexander predicts there will be growth in a new category of small, less complex projects called the "Discovery" probes. The goal, Alexander says, is to provide a steady flow of fresh new data on the solar system over the next decade. Discovery missions will cost no more than $150 million each. And NASA has already begun to put more funding into very small explorer satellites to collect data on Earth's electromagnetic environment. Other low-cost exploratory missions to the moon and Mars may be in the offing (see box). But getting them onto the agenda, and moving other outdated proposals off, will require some skillful negotiating among all the interested parties: scientists, congressional leaders, and industry.

Goldin, in fact, got a premature invitation to join in some of this horse trading during his confirmation hearing. Several senators brought up a politically hot subject known as the Advanced Solid Rocket Motors (ASRMs). These are a new version of the external rockets that strap onto the shuttle, completely redesigned to eliminate the O-rings that caused the Challenger accident. The factory that's supposed to manufacture them is being built now with federal funds in the district of House Appropriations Committee chairman Jamie Whitten (D–MS), right next to Tennessee. NASA's safety advisory panel has said repeatedly that the new motors won't do much to improve the safety. But NASA backed the project anyway, arguing that they would increase the shuttle's lifting power.

Suddenly this January, in a money-saving gesture that also seemed aimed at provoking Representative Whitten, NASA reversed itself and asked Congress to kill the ASRMs. Half of the $3 billion planned for the project might be saved, NASA argued, and spent on more meritorious programs.

When the subject of ASRMs came up in Goldin's confirmation hearing, the senators' handling of it illustrated how difficult it will be for any one person to rewrite NASA's agenda. Senator Trent Lott (R–MS) stated flatly that he wanted the ASRMs built. Hollings and Al Gore (D–TN), despite their warnings about the need for budget austerity, said they favored the project, too. Goldin—welcome to Washington—was pressed for his own views. Ever so gingerly he said that this was something "worthy of evaluation." He would "get on that issue" right away, he said...if confirmed.

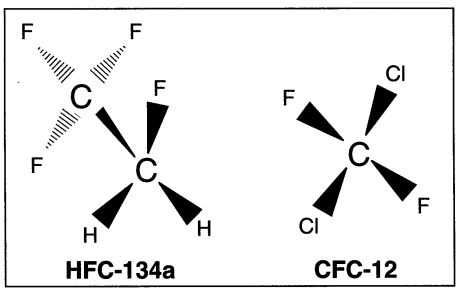
–Eliot Marshall

OZONE DEPLETION

Warm Reception for Substitute Coolant

In the modern American supermarket, you're happy to encounter greens that haven't wilted in the room-temperature produce department. Shoppers at the Hannaford Brothers' Shop 'n Save in Glens Falls, New York, have a leg up on most of us in this respect: The produce and meat they purchase has not only been kept cool but the system doing the cooling may help preserve the tattered ozone layer. The secret is hydrofluorocarbon (HFC), a coolant that might replace ozone-eating chlorofluorocarbons (CFCs) in the cooling systems all around us. If the experiment works—and there are still some worries about the ability of HFCs to contribute to global warming—then a new industry may be born that will not threaten the environment but improve it.

You've heard of pesticide-safe produce. Now, Thomas Mathews, energy manager for Hannaford Brothers, offers ozone-safe shopping—the first time, he says, that a supermarket has used refrigeration and air conditioning systems breathing HFC-134a (tetra-fluoroethane). The key to HFC-134a's ozone-friendly nature is that it's dechlorinated—no chlorine there to seep into the stratosphere. Hence its obvious attractions to a variety of industries.



Plug for the ozone hole. HFCs lack the ozone-eating chlorine carried by the CFCs.

In addition to the grocery industry, which, according to Raymond Albrecht, an engineer at the New York State Energy Research and Development Authority who helped develop the HFC refrigeration system for the Glens Falls supermarket, consumes about 20% of the total CFCs that are used in the United States, there's the automobile industry. Already manufacturers are offering cars with HFC-134a air conditioners. And there are chemical manufacturers such as DuPont and Allied Signal, which are developing HFCs to supplant CFC refrigerants and solvents.

So HFCs are in vogue. Last month Environmental Protection Agency (EPA) researchers announced that from hundreds of candidates, they had culled 11 chemicals worth further investigation as alternatives to CFCs. Nine were HFCs. One EPA researcher, developmental engineer Dean Smith, has been studying HFCs at EPA's Air and Energy Engineering Research Laboratory in Research Triangle Park, North Carolina. "People are coming to the conclusion that no single compound will do all the jobs of CFCs," he says. Together, several properties of CFCs make them hard to duplicate, Smith says—their nonflammability, low toxicity, and such performance characteristics as boiling point, heat capacity, and thermal conductivity. As a family of chemicals, however, HFCs might have all the right stuff. "HFCs seem to be the best substitute that anyone's identified," Smith says.

So much for the unadulterated good news. Arjun Makhijani, an electrical engineer and president of the Institute for Energy and Environmental Research, a nonprofit think tank based in Takoma Park, Maryland, is just a tad worried about HFC hype. They may be ozone-friendly, he agrees, but hydrofluorocarbons are also greenhouse gases. Yet, even in that respect, they're better than CFCs—HFC-134a is only about one-fourth as potent a contributor to global warming as some CFCs. But to Makhijani, "this may be a sleeper of a problem," because the steady-state calculations currently used to calculate global warming might underestimate HFCs' contribution to that problem. Use HFCs in the short term, Makhijani concludes, but keep doing research on the possible effects of an increased buildup of fluorine in the stratosphere that might accompany HFC usage.

And then there's the possibility—albeit remote—that HFCs carry with them long-term toxicity. Everyone is waiting for results—not available until early next year—but a battery of short-term toxicity tests conducted by the Program for Alternative Fluorocarbon Toxicology Testing Activities, run by an international consortium of CFC producers, indicates that HFC-134a has "low toxicity." Still, HFC-134a "is only the answer to half our problems," says Bob Bittner, engineering manager for Landover, Maryland-based Giant Food, Inc. Because HFC-134a doesn't work in freezers, the Glens Falls store must also use HCFCs, an ozone-depleting CFC substitute. And that's enough to suggest that, although HFCs are useful, they aren't a complete solution to global problems.

–Richard Stone