ing head of the scientific projects department at ESA's European Space Research and Technology Centre in Noordwijk, the Netherlands.

Another mission-saving maneuver was to involve the Russians: STARSEM, a joint venture between launch company Arianespace and the Russian Space Agency, will launch the spacecraft using two Soyuz launchers, keeping launch costs down to about $70 million. "Without the proposal of STARSEM, the project would not have got off the ground," says ESA spokesperson Roger Elaerts. The three new spacecraft will be built by a European industrial consortium led by DASA/Daimler Benz Aerospace in Germany.

Most of the instruments have to be rebuilt, and the research teams immediately started hammering out plans to have their instruments ready by mid-1999. "The current schedule is quite tight, and it will really be a question of how quickly the national agencies will be able to make the funds available for us to start up," says principal investigator André Balogh of Imperial College London. But after almost a year of uncertainty, Cluster project scientists are delighted. Says Donald Gurnett of the University of Iowa, lead investigator on a NASA-funded radio interferometer project using Cluster: "I'm very excited."

–Alexander Hellemans

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INDUSTRIAL RESEARCH

Slower Road for Clean-Car Program

An ambitious U.S. program to design efficient automobiles by the year 2000 will not reach its first big milestone, predicts a new report from the National Research Council (NRC). This peer-reviewed analysis of the flagship industrial-development program begun in 1993 by the Clinton Administration argues that it is premature to promote any specific clean-car technology at this time. Instead, the NRC panel recommends that government and industry continue their funding of R&D on new ideas, such as cars powered by gas turbines, flywheels, and fuel cells (see table).

The program, known as the Partnership for a New Generation of Vehicles (PNGV), began with a bang at a White House Rose Garden press conference in September 1993. President Clinton announced that he had forged a pact with leaders of the U.S. car companies to revitalize the industry for the next century. The goal was to create within a decade automobiles that would both meet stringent clean-air standards and get 80 miles to the gallon (34 km/l). (U.S. cars now average 20 to 30 miles per gallon.) Since then, government and industry have been spending roughly $600 million a year to develop futuristic autos, according to the Commerce Department. This year, the program was supposed to begin choosing technological "winners" that would be developed into "concept vehicles" by 2000 and manufactured starting in 2004.

But the NRC review, chaired by Trevor Jones of the Echlin auto-parts company in Cleveland, says it is unrealistic to adhere to PNGV's original schedule. While PNGV has developed many new high-tech auto components, the report says, researchers haven't integrated them into car designs that could compete in the market. It "no longer appears to be tenable," says the NRC report, to try to pick winners in 1997. And if PNGV were to do so, the report says, "nonconventional technologies [would] run the risk of being discontinued or discarded." Everyone realized from the beginning, Jones says, that it would be a "very big stretch" to meet these deadlines; now, he says, it's time to acknowledge that the R&D program must be lengthened and expanded.

At present, the NRC panel says, none of the proposed new designs "will come close to meeting the cost objectives" within initial deadlines. And the one innovation with the "highest potential" for meeting the original goals is not so radical: It's an advanced diesel engine known as the compression ignition direct injection engine (CIDI). While lightweight CIDIs might satisfy the program's cost and efficiency requirements, the report notes, they might not meet new limits on airborne particles being considered by the Environmental Protection Agency. (Diesel engines emit more particles than do gasoline engines.) But unless the partners step up their R&D investments in CIDI technology, the report warns, even these engines won't be ready for mass production by 2004. However, the report does praise the partnership for developing many innovations, such as automobile fuel cells that can run on more than one type of fuel, high-power lithium batteries, and lightweight composite materials.

The Commerce Department and the industry coalition that oversee PNGV issued a joint statement on the NRC report, agreeing that "some technologies are not progressing at a pace consistent with the established program timetable." But Commerce spokesperson Virginia Miller emphasized that PNGV has pushed industry to move faster. As evidence, she cites announcements since January by Detroit's three big auto companies that over the next 2 years they plan to develop demonstration cars that will achieve a 50% increase in mileage. General Motors is testing several ideas, including a CIDI-powered car and two hybrid propulsion systems. Chrysler is planning a gasoline-fed fuel-cell car. And Ford is building a diesel-electric vehicle. But none of these is a finalist in the PNGV competition, says Ron Beeber, spokesperson for USCAR, the coalition of auto companies involved in the project. The companies "haven't said 'This is what our concept for 2000 will look like,' " Beeber explains. "These are just examples of projects they've been doing and [proof] that progress is being made."

–Eliot Marshall

NRC'S RANKING OF NEW CAR TECHNOLOGIES

Major subsystems	Critical technical barriers	Likelihood of meeting technical objectives	Likelihood of meeting cost	Likelihood of meeting schedule	Overall potential regardless of schedule
Propulsion					
Advanced diesel (CIDI)	Combustion control NO_x catalyst	●	▲	●	●
Fuel cell	Fuel processor/reformer	■	■	■	▲
Turbine	Structural ceramics Exhaust heat recovery	■	■	■	▲
Stirling engine	Heat exchangers Leakage control	▲	■	■	▲
Energy Storage					
Li-ion battery	Scale-up, system safety	●	▲	▲	▲
Ni hydride battery	Efficiency, power density	▲	▲	▲	▲
Ultracapacitor	Efficiency, self-discharge, safety	■	■	■	■
Flywheel	Safety	▲	▲	■	●
Power electronics	Efficiency	▲	▲	●	●

● High ▲ Medium ■ Low

SOURCE: NRC