That conclusion is, however, challenged on economic grounds by several contributors to the environmentalists' case.

Dr Charles J. Ciccetti and Dr John V. Krutilla, members of the staff of Resources for the Future Inc., for example, argue that differences in prices and demand for oil between the East and Midwest on the one hand and the West Coast on the other, tip the balance in favour of the Canadian route. The trans-Canada pipeline would deliver oil directly to the markets where it is most needed rather than to the West Coast, where an initial surplus could even be created by the influx of Alaskan oil, they argue. Their analysis of the impact statement suggests that the Department of Interior had used incorrect assumptions about the refinery process to be used on Alaskan crude oil, that there were inconsistencies in the derivation of oil prices in the midwest markets and that market imbalances were not taken into account.

As for national security considerations, the department's impact statement suggests that the sooner Alaskan oil is brought to market, the better it will be for national security because it would reduce US reliance on potentially insecure Arab sources. But Mr S. David Freeman, former energy policy advisor to both President Johnson and to President Nixon, believes that the issue is not quite that simple. He argues, along with Dr Richard B. Mancke of the University of Michigan and Thomas B. Stoel of the Natural Resources Defense Council, that the period between 1980 and 1985 will be more critical for national security because it has been estimated that during that period non-Canadian oil imports into the US would climb from 38 per cent to more than 50 per cent of total US consumption. Before 1980, Freeman argues that any realistic threat to oil supplies could be offset by increased domestic production and imports from secure sources.

Freeman argues that the best policy would be to encourage development of other known, secure supplies of crude oil such as the Canadian deposits in the Northwest Territories. Building the trans-Alaska pipeline would clearly not encourage such development because it would be routed away from the Canadian deposits, whereas a pipeline routed from the North Slope through the Mackenzie Valley would help stimulate production of oil in the Canadian Arctic. Moreover, it is argued several times in the environmentalists' report that the benefits to national security that derive from pressing ahead with the trans-Alaska pipeline can be realized, even if a decision were delayed, by increasing the quota of oil imported from Canada. Only last month, for example, Donald Macdonald, Canada's Minister of Energy, Mines and Resources, told Mr Morton that the Canadian government is prepared to supply additional quantities of oil to the United States while the route is under study.

Although the environmentalist groups' report has turned out to be something of a *post mortem* on Mr Morton's decision to grant permits for the trans-Alaska pipeline, the arguments it contains will undoubtedly be raised in court. The day after the decision was announced, the Environmental Defense Fund, the Wilderness Society and Friends of the Earth, filed suit in federal court asking for a permanent injunction against construction of the pipeline. The organizations intend to pursue their case to the Supreme Court if necessary.

SHUTTLE

A Successful Launching

by our Washington Correspondent

THE space shuttle has overcome its second Congressional hurdle with considerable ease, and it should now survive the rest of the budget process with little difficulty. Last week's hurdle was approval by the Senate of the authorization bill for NASA, when powerful opponents of the project including Edmund Muskie, majority leader Mike Mansfield, Walter Mondale and William Proxmire lined up in support of an amendment to delete funding for the shuttle from NASA's budget. The move to shoot down the shuttle was, however, defeated by 61 votes to 21 and since a similar attempt in the House of Representatives failed even more ignominiously, there seems to be no prospect that anti-shuttle forces in Congress will be able to make a dent in the project when appropriations bills come up for acceptance.

The Senate's approval for the shuttle came on the same day that the Federation of American Scientists, a small but intellectually heavyweight group of scientists which lobbies chiefly for arms control, released a bruising critique of the arguments used by NASA to justify the project, prepared by Dr George W. Rathjens of MIT and Dr Von Eshelman of Stanford University.

The basis for the attack on NASA's cost estimates for the shuttle lies in the estimates for the total payload that the vehicle will place in orbit each year. According to the space agency, each launch with the shuttle will cost $10.5 million, and the cost of delivering payloads into near Earth orbit will be reduced from $1,000 to $160 per pound. Rathjens and Eshelman point out that the figure of $160 per pound is derived simply by dividing total launch costs of $10.5 million by the maximum payload capacity of the shuttle, which is 65,000 pounds, but they contend that "there is not the slightest basis" for assuming that the shuttle will carry a full payload on each flight. A more realistic estimate, FAS report suggests, would be 5,000 pounds per flight, a figure which would result in launch costs of $2,000 per pound, or double present launch costs. And these figures take no account of the research and development costs of the shuttle itself. If development costs are included, Rathjens and Eshelman suggest, launch costs would be doubled.

The FAS study therefore comes to the conclusion that "talk of reducing transportation costs by an order of magnitude through the use of the shuttle is irresponsible". Real economies in transport can be realised, Rathjens and Eshelman argue, only if the intention is to expand the manned space flight programme or the military space programme—which generally requires heavy satellites to be placed in geosynchronous orbits. "If the former is envisaged, that is the question the country should be debating, not whether to build the shuttle", the FAS report tartly suggests. On the other hand, if the idea is to increase the military space programme, then "the Department of Defense and not NASA should be paying the bulk of the costs and defending the shuttle programme".

Rathjens and Eshelman base their suggestion that the shuttle will carry an average payload of 5,000 pounds on a study carried out for NASA by Mathematica Inc., and on the fact that in 1969, a productive year in space, the total weight of scientific and applications satellites excluding Apollo launches, was only 11,400 pounds. For a full payload on each of the 30 to 50 launches that NASA is predicting each year, the total shuttle-launched payload would amount to between 1.8 and 3.2 million pounds a year, a figure that is so much greater than present launch rates that it would represent a radically different type of space programme.

The FAS study therefore concludes that the cost estimates that are challenged are peripheral to the main issue, which is "the question of the kind of space programme the country wants and should have". Rathjens and Eshelman are fearful that once built, the shuttle will be used to justify launching payloads that may otherwise not be considered, and that it will be used to maintain the momentum of the manned space programme. "The true case for the shuttle, if there is one", the study concludes, "is in manned flight (or in military programmes). To play down these aspects of the shuttle, as has been done, and to attempt to sell it as a cost-effective instrument for a civil programme to be dominated by unmanned missions involving only modest levels of public expenditures is to mislead."