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STATEMENT OF
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BEFORE THE
SENATE COMMITTEE ON COMMERCE
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND COMMERCE

SE No 2311

Mr. Chairman and Members of the Subcommittee:

We are releasing today a report to the Congress on "[Federal Materials Research and Development:] Modernizing Institutions and Management." Our study was initiated at the request of the Subcommittee Chairman and ^{William} Senator Brock, Senate members of the National Commission on Supplies and Shortages. DLQ 00705

BACKGROUND

I testified last year at joint hearings by the Senate Committees on Commerce and Government Operations on S. 3209, a bill to establish a National Resource Information System. At that time I pointed out GAO concerns with the implications of materials shortages, and stated that "the systems that do exist are not generally geared to serving broad national program objectives." I specifically recommended that "the U.S. Government should have

- (1) a coordinated system for commodity and resource analysis,

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- (2) a focal point organization for current analysis and policy formulation to cope with short-run commodity supply and demand imbalances,
- (3) longer-run national and international resource policy goals, and
- (4) a central mechanism responsible for future resource planning."

Our current study of Federal materials research and development has served to underscore this need for institutional change relative to materials policy formulation.

A successful materials-oriented R&D program could significantly increase the Nation's ability to deal with materials problems. This potential led to your and Senator Brock's request that GAO:

- analyze Federal funding for materials research and development, and
- assess the effectiveness of Federal materials R&D.

In theory, we should have been able to respond to the request in two ways. The first would involve an appraisal of the distribution and results of individual agency or program expenditures. The second would involve an examination of the outlines of the overall Federal materials R&D effort.

In practice, however, the present state of knowledge and information precludes thorough overall analysis of Federal agency research efforts. Such analysis is dependent upon a context of clear national materials policy goals against which the effectiveness of individual agency R&D activities can be measured. Adequate data on the extent and current status of such activities is similarly critical.

Because neither of these exists, our study efforts focused on, first, the basic steps required to provide an institutional framework for developing materials policy goals and, second, providing the data necessary to adequately evaluate the contribution of materials R&D to their accomplishment.

GAO RECOMMENDATIONS

Our work led us to three basic recommendations. They aim at modernizing the materials policy formulation process and the management of Federal materials R&D activities. First, we continue to recommend that the Congress consider establishment of an institution to analyze national materials issues and provide policy guidance on a continuing basis. We further recommend that the now functioning National Commission on Supplies and Shortages assign a high priority to developing a detailed blueprint for such an institution and provide its input to the Congress.

At a minimum, any institution established should have as two basic responsibilities:

- (1) the analysis of policy options and tradeoff considerations; and
- (2) the provision of definitive guidance to operating agencies in planning for and executing materials policies, including priorities for materials research and development.

Second, we recommend establishment of a comprehensive, unclassified information system for materials research and development. The system should build upon existing information in the Smithsonian Science Information Exchange. The system can be established under existing authorities. We propose that the Commission work with the Executive Office of the President to secure mandatory Federal agency participation in it. We are confident that the R&D information system recommended in our report would fit well within the overall materials information system under study by the Office of Technology Assessment.

Third, we recommend that the Science Information Exchange include in its information system data pertinent to materials research and development which takes place outside of the Federal Government. A properly balanced national materials R&D program cannot be developed

without knowledge of activities on-going in the private sector and university communities.

BASIS OF GAO RECOMMENDATIONS

Let me discuss briefly the underlying basis for each of these recommendations.

Institutional Capability

A national materials R&D program cannot be formulated without a context. The first requirement is to define the basic objectives of national materials policy so that R&D efforts may be oriented to support policy objectives.

We believe that a reasonable overall goal for materials policy is the protection of the domestic economy. This entails, in the short-run, taking actions that will avoid or minimize the impact of severe shocks brought on by abrupt interruption in supply or rapid changes, particularly upward, in price. In the long-run, actions should be geared to the goals of assuring continuity of supply and to minimizing upward movements in materials prices.

Currently, there exists no system for assigning priorities to actions toward achieving national materials goals. There is no established institutional capability to assess alternatives and tradeoff considerations between potential actions. The deficiency persists despite the

fact it has become more difficult to achieve national materials goals for reasons including:

- the diminution of relatively inexpensive, high quality domestic resources;
- the potential constraining effects of necessary environmental regulations and the increased costs of processing remaining domestic resources; and
- the increasing complexity in international producer-consumer relations including an emerging new dimension--income maintenance for developing countries who are exporters of raw materials.

New agreements are being contemplated which could commit the country to use of foreign sources of supply. At the same time, there is growing sentiment for the U.S. to expand its materials production base, particularly through modified use of federally-controlled lands. However, this supply option entails, among other things, significant environmental implications. Clearly, the matter of which supply sources should be put to use has become a highly complex issue, one which illustrates the requirement for continuous assessment and evaluation of policy choices.

Despite critically changed and fluctuating circumstances regarding materials supply and increased requirements for continuing policy guidance, no appropriate institution has yet been devised. We have, therefore, urged the National

Commission on Supplies and Shortages to give priority attention to developing the institutional specifics required to accommodate present and future policy formulation needs.

The building of the needed institutional capability need not necessarily await further legislative action. It could perhaps be developed initially under the supervision of the National Commission on Supplies and Shortages, and begin there to acquire operational experience.

Where the institutional capability should reside permanently is an open question at this time. In our view, considering the many Federal agencies which deal with materials problems, the least desirable option would be to assign the responsibility to a single existing bureau or department. But if a Department of Energy and Natural Resources were established--an action we have suggested on numerous earlier occasions--this would have the effect of enhancing the Federal Government's ability to deal with its materials problems on a coordinated and cohesive basis.

Establishment of a Department of Energy and Natural Resources, alone, would not suffice however, Its creation would have to be coupled with establishment of a Cabinet-level Council on Materials. The Council would be chaired by the Secretary of DENR but would include representation from all agencies having a significant role in meeting national materials

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goals. Only through such a Council could adequate scope be assured for issue analysis and policy formulation. Without a DENR, and related Council, we believe the only other adequate permanent option would be to establish the needed institution within the Executive Office of the President, perhaps as a function of the Council of Economic Advisors.

Federal Materials Research and Development

Research and development is not the solution to all materials problems. Research and development is most appropriate only in relation to the solution of medium to long-range problems of materials supply and efficient use. Research and development efforts can have a major impact upon both demand and supply of individual materials but, with truly rare exceptions, not in the short-term. Our report highlights three aspects of past and present Federal materials research and development:

- program funding in constant dollars is actually decreasing,
- the Federal effort is highly fragmented, and
- data is incomplete and poorly aggregated.

Funding. While current dollar expenditures increased substantially between 1962 and 1972--from \$185 million to \$331 million--growth in real terms (constant dollars) was only about 6 percent. Further, between 1969 and 1974, real expenditures declined from \$249 million to \$206 million,

about 17 percent. Unfortunately, the implications of this decline cannot be assessed in the absence of a clear policy framework. It cannot be demonstrated that more expenditures will give better results, nor is it possible to conclude that lower expenditures would be appropriate.

Fragmentation. There is no overall Federal materials research and development program in the usual sense of the word "program." Rather, there exist a large number of specific mission-oriented R&D activities. In fiscal year 1974, the latest year for which "complete" data are available, there were some 23 agencies and 90 subdivisions sponsoring materials R&D. We believe it is inappropriate to assume that the sum of these activities constitutes a viable national materials R&D program.

Deficient Data. Collection of research and development data over the last 15 years has been sporadic, incomplete, untimely, and insufficient for policy-making purposes. The Smithsonian Science Information Exchange has, at present, the most complete data available on Federally-supported materials research and development. Even there, however, data deficiencies are extensive. For example, only about 50 percent of individual agency reports filed with the Science Information Exchange include any expenditure data. The lack of financial data is even more acute for work being done directly at

the Federal agencies. For that work, only about 20 percent of project reports contain funding information.

Proper management of the research and development component of a national materials program is dependent upon a data-information system which facilitates the assessment of activities from various perspectives. These include product category, sponsoring or performing organization, and phase of the materials cycle. This latter perspective has been urged since the 1973 report of the National Commission on Materials Policy. GAO determined that only the Science Information Exchange had the present capability to develop pertinent data. Using the incomplete information now in the Science Information Exchange, we developed materials research and development data by phase of the materials cycle. To our knowledge, the data had not been analyzed in this fashion before.

We believe the phases-of-cycle display is a highly useful way of portraying materials R&D activity for policy-setting purposes. Let me give an example. The available data indicate that the Federal effort is heavily concentrated in the "use" and "processing" phases of the cycle, as opposed to the "exploration" and "extraction" phases.

Does this represent any significant imbalance in allocation of R&D resources? There can be no a priori answer. Whether additional resources should be applied to the

"exploration" and "extraction" phases should be decided in light of (1) policy decisions on which sources of supply should be used, particularly foreign versus domestic, and (2) knowledge of non-Federal efforts which may be adequate to offset any "imbalance" in the Federal program. In summary, a comprehensive data bank is essential for sound management of Federal materials research and development programs.

The executive branch Committee on Materials is engaged in the most serious effort to date to secure good financial and related data from all involved agencies. We were advised that the Committee anticipates the publication of an inventory of fiscal year 1976 Federal materials research and development before the end of calendar year 1975. If this inventory method proves to be workable, it may be able to serve as a prototype for the data collection process upon which to base the needed expansion of the Science Information Exchange data bank.

Coordinated National Effort

Obviously, many elements outside the Federal Government are engaged in or supporting important materials R&D work. Virtually no data are available, however, to the Federal Government on the scope or size of those efforts.

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Federal and non-Federal materials R&D efforts should complement one another. Knowledge of only the Federal effort will not assure the most productive allocation of Federal resources. The Science Information Exchange can assist formulation of a balanced national program by seeking out the active cooperation of industry trade associations, individual firms, independent R&D contractors, and the university community.

We have discussed this matter with officials of the Science Information Exchange. Both we and they believe useful data can be collected, assembled and used for decision-making purposes without revelation of detailed information considered sensitive or proprietary. We encourage the Science Information Exchange to broaden their data sources accordingly.

That concludes my formal statement, Mr. Chairman. I shall be happy to answer any questions pertaining to our report.

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D I G E S T

The United States is by far the greatest user of non-energy minerals and other materials. The Nation is not and could not easily be self-sufficient for many materials. Each year it becomes more dependent upon imports. For some materials--chromium, tin, and manganese--it is already essentially 100 percent dependent on foreign sources.

This increasing dependence has given rise to anxieties and led to establishment of the National Commission on Supplies and Shortages, consisting of representatives from the Congress, the Executive Branch, and private industry. The Commission has begun assessing the Nation's overall position and the adequacy of its institutions for dealing with materials issues.

Because successful materials-oriented research and development (R&D) could increase the Nation's ability to deal with materials problems, the Senate members of the Commission--Senators John Tunney and William Brock--asked GAO to:

- analyze Federal funding for materials R&D, and
- evaluate the effectiveness of Federal materials R&D.

GAO's analysis led it to conclude that an adequate response to the request could only be made in the context of clear national materials policy goals against which the effectiveness of related R&D activities can be measured and with adequate data on the extent and current status of such activities. Early in its analysis GAO determined that neither of these exists. GAO, therefore,

turned its attention to the basic steps required to provide (1) an institutional framework for developing materials policy goals and (2) the data necessary to adequately assess the contribution of materials R&D to accomplishment of the goals. (See pp. 5-6 and 36-40.)

KEY CONCLUSIONS AND FINDINGS

Institutional Capability

A national materials R&D program cannot be formulated without a definition of basic objectives of national materials policy. R&D efforts can then be directed to support policy objectives.

The overall goal should be the protection of the domestic economy.

In the short-run, this entails actions which will avoid or minimize the impact of severe shocks brought on by abrupt interruption in supply or rapid changes, particularly upward, in price. Long-run action should assure continuity of supply and minimize upward movements in materials prices. (See pp. 3-4.)

Currently, there is no system for assigning priorities to actions toward achieving national materials goals. There is no established institutional capability to assess alternatives and tradeoff considerations between potential actions. (See pp. 5-6.)

Despite changed and fluctuating circumstances, and increased need for continuing policy guidance, no appropriate institution has yet been devised. All that exists is an interagency committee lacking staff and authority to adjudicate differences between agencies and program options.

Federal Materials R&D

Research and development is not the solution to all material problems. R&D activity is appropriate only in relation to solving medium to long-range problems of material supply and efficient use.

R&D efforts can have major impact upon both demand and supply of individual materials commodities but, with rare exceptions, not in the short-term.

GAO's work highlights three aspects of past and present Federal materials R&D.

Program funding in constant dollars is actually decreasing:

While current dollar expenditures increased substantially between 1962 and 1974--from \$185 million to \$331 million--growth in real terms (constant dollars) was only about 6 percent. Between 1969 and 1974, real expenditures declined from \$249 million to \$206 million, or by about 17 percent.

Implications of this decline cannot really be assessed in the absence of a policy framework. It cannot be demonstrated that more expenditures will give better results, nor is it possible to conclude that lower expenditures would be better. (See pp. 15-17.)

Federal R&D effort is highly fragmented:

There is no overall Federal materials R&D program. Rather, there exists a large number of specific mission-oriented R&D activities.

In fiscal year 1974 there were some 23 agencies with 90 subdivisions sponsoring materials R&D. It would be inappropriate to assume that the sum of these activities constitutes a viable national program. (See p. 21.)

Data is incomplete and
poorly gathered:

Collection of R&D data over the last 15 years has been sporadic, incomplete, and insufficient for policy-making purposes. (See pp. 22-24, 41.)

Proper management of the R&D component of a national materials program is dependent upon a data-information system which facilitates the assessment of activities from various perspectives such as product category, sponsoring or performing organization, and phase of the materials cycle. (See p. 29.)

Phase of the materials cycle data has been urged since the 1973 report of the National Commission on Materials Policy. GAO determined that only the Smithsonian Science Information Exchange had existing capability to develop pertinent data. Using the incomplete information now in the Science Information Exchange, GAO developed for the first time data on materials R&D phase of the materials cycle. (See pp. 36-40.)

The Executive Branch Committee on Materials is engaged in the most serious effort to date to secure good financial and related data from all involved agencies. The Committee anticipates publishing an inventory of fiscal year 1976 Federal materials R&D activity before the end of calendar year 1975. If this inventory method proves workable, it may serve as a prototype for data collection upon which to base the needed expansion of the Science Information Exchange data bank. (See pp. 24-25, 43.)

Coordinated National Effort

Obviously, many elements outside the Federal Government are engaged in or supporting important materials R&D work.

Virtually no data on these efforts are available, however.

Federal and non-Federal materials R&D efforts should complement one another. Knowledge of the Federal effort only will not assure the most productive allocation of Federal resources. The Science Information Exchange can assist formulation of a balanced national program by seeking out the active cooperation of industry, trade associations, individual firms, independent R&D contractors and the university community. (See pp. 41-42, 44.)

GAO RECOMMENDATIONS

GAO made three recommendations aimed at modernizing the materials policy formulation process and the management of Federal materials R&D activity. (See pp. 48-49.)

First, the Congress should consider establishing an institution to analyze national materials issues and provide policy guidance on a continuing basis. GAO further recommended that the National Commission on Supplies and Shortages assign a high priority to fleshing out the details of the proposed institution and providing its input to the Congress.

At a minimum, the institution should have as basic responsibilities (1) analyzing policy options and tradeoff considerations, and (2) providing definitive guidance to operating agencies in planning for and executing materials policies, including materials R&D.

Second, a comprehensive unclassified information system for materials R&D should be established, building upon existing information in the Science Information Exchange. The Commission should work with the Executive Office of the President to obtain mandatory Federal agency participation in the system.

Third, the Science Information Exchange should include in its information system data pertaining to materials R&D outside the Federal Government. A properly balanced national materials R&D program cannot be developed without knowledge of activities underway in the private sector and university communities.

AGENCY COMMENTS

The Science Information Exchange agreed that its system could be used in the manner recommended by GAO. In preparing its final report GAO also obtained and considered the informed views of various Federal officials knowledgeable in matters of Federal materials R&D.