List of Handouts:

Background paper on IPCC

IPCC Secretariat report to UNGA on IPCC activities

Organization charts of IPCC and RSWG

List of upcoming IPCC meetings

1/20/89 remarks of Secretary Baker at RSWG meeting

5/12/89 statement by the President

Reporting cable and summary report of October 2-6 RSWG meeting

Speech of Assistant Secretary Bernthal on climate change, September 19, 1989

10/17/89

Background Paper on the Intergovernmental Panel on Climate Change

In response to the growing international awareness of the potentially serious consequences of global climate change, the governing bodies of the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC). The IPCC is designed to serve as the primary international forum for assessing the state of knowledge about global climate change and its impacts and considering possible response strategies.

The first session of the IPCC, which was held in Geneva in November 1988, was attended by participants from 30 countries as well as 16 international organizations. At that meeting the Panel agreed that its main mission was to assess available scientific and technical information on the nature of climate change and its potential impacts, and to formulate realistic response strategies for addressing climate change. To carry out these tasks the IPCC established three working groups on science, impacts, and response strategies, chaired, respectively, by the United Kingdom, Soviet Union, and United States.

The U.S.-chaired response strategies working group (RSWG) first met in January 1989 in Washington and agreed on a work plan for developing response options. The RSWG established four subgroups to consider response options in the fields of: energy and industry; agriculture and forestry; coastal zone management; and resource use management. The first two of these subgroups deal with measures for reducing greenhouse gas emissions, while the latter two subgroups deal with measures for adapting to the impacts of climate change. The RSWG is also considering available mechanisms for implementing response strategies. At a workshop in Geneva from October 2-6, 1989, the RSWG reviewed implementation mechanisms in the fields of economic measures; public information and education; financial measures; technology development and transfer; and legal measures, including elements of a framework convention on climate.

The IPCC is scheduled to complete a report, incorporating the work of all three working groups, by September 1990, prior to the U.N. General Assembly meeting and the Second World Climate Conference. President Bush in May 1989 announced U.S. support for negotiations on a framework convention on climate following completion of the IPCC report. Support for a framework convention, based on the work of the IPCC, was also expressed by the Governing Bodies of the UNEP and the WMO and by the leaders of the G-7 countries during the July 1989 Paris summit.

UNITED NATIONS GENERAL ASSEMBLY

REPORT ON THE ACTIVITIES OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

(Submitted by Chairman, IPCC)

1. The Intergovernmental Panel on Climate Change (IPCC) has been established jointly by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP).

2. IPCC has met twice since its formation, once in Geneva (9-11 November 1989) at the WMO Headquarters and once in Nairobi (28-30 June 1989) at the UNEP Headquarters. Thirty countries were present at the first session and forty three at the second.

1. THE STRUCTURE OF THE PANEL

1.1 At its first session:

1.1.1 The Panel elected Prof. B. Bolin of Sweden, Dr. A. Al-Gain of Saudi Arabia and Dr. J.A. Adejokun of Nigeria as its Chairman, Vice-Chairman and Rapporteur respectively. (See annex VI of reference 1 for their duties and terms of office.)

1.1.2 The Panel agreed that its main task was

(a) to assess the scientific information that is related to the various components of the climate change issue, such as increases of major greenhouse gases in the Earth's atmosphere and modification of the Earth's radiation balance resulting therefrom, and that needed to enable the environmental and socio-economic consequences of climate change to be evaluated, and

(b) to formulate realistic response strategies for the management of the climate change issue.

1.1.3 To accomplish its task, the Panel set up three Working Groups: (i) Working Group I for the assessment of available scientific information on climate change, (ii) Working Group II for the assessment of the environmental and socio-economic impacts of climate change and (iii) Working Group III for formulating response strategies. The Working Groups are chaired respectively by the UK, the USSR and the USA. Brazil and Senegal were named as the Vice-Chairs of Working Group I, Australia and Japan as the Vice-Chairs of Working Group II, and Canada, China, Malta, the Netherlands and Zimbabwe as the Vice-Chairs of Working Group III.

1.1.4 Noting the need for co-ordination among the Working Groups, the Panel established a Bureau for the purpose, consisting of the three Officers of the Panel (viz., the Chairman, the Vice-Chairman and the Rapporteur) and the Chairs and Vice-Chairs of the Working Groups.

1.2 At its second session:

1.2.1 The Panel, much concerned about the inadequate participation of the developing countries in its activities and searching for ways and means to promote such participation, and after considering a special report prepared on the subject by its Ad-Hoc Subgroup (see para 4.1(a) below), established a Special Committee on Matters Related to the Developing Countries. This Committee would be chaired by France and will consist of 5 members from the developing countries and 5 from the developed countries (including France).

1.2.2 With regard to the membership in various Working Groups, the Panel decided to do away with the concept of core members. It may be recalled that such members were named during the first session, the underlying idea being that responsibility for the tasks had to be assigned in order to ensure their timely completion. (It may further be recalled that IPCC is open to all member governments of WMO and UNEP, as per the decision made at the first session.)

2. FINANCIAL SUPPORT FOR THE ACTIVITIES OF THE PANEL

2.1 At its first session:

2.1.1 The Panel agreed on the formation of a trust fund to finance its activities. Such a fund, the joint WMO/UNEP IPCC Trust Fund, has since been established and is administered by the Secretary-General, WMO, as agreed to between WMO and UNEP.

2.1.2 The sources of funding to the Trust Fund are WMO, UNEP and voluntary contributions by IPCC member governments and organizations. It should be noted that the contributions are in cash or in kind or both.

2.1.3 WMO contributes the person-year cost of the Secretary of IPCC, the cost of housing the IPCC Secretariat and SF 125,000 per annum. UNEP contributes the person-year cost of the Programme Officer and SF 125,000 per annum. In addition, UNEP provides the equivalent of SF 100,000 per annum in non-convertible currency.

2.2 At its second session:

2.2.1 At the suggestion of the Executive Heads of the two sponsoring organizations, the Panel set a target of $ 1,000,000 for the support of the participation of the developing countries in its activities between now and the release of the draft IPCC first assessment report (see para 5.1 below). It decided that the contributions from IPCC member governments made for this specific purpose would be separately administered from other contributions.

3 THE ACTIVITIES OF THE WORKING GROUPS

3.1 The terms of reference of the Working Groups can be found in annex IV of reference 1.

3.1 WORKING GROUP I (SCIENCE)

3.1.1 Working Group I will complete a review of available scientific assessments of climate warming, with special emphasis on

(i) recent measurements of greenhouse gases and the new information on their chemistry and tropospheric lifetimes,

(ii) critical review of available climate data for detecting trends,

(iii) evaluations of existing disagreements in model calculations of regional scale climate change (for the monsoon region, the Sahel, the Great Plains of N. America, the Mediterranean region and Australia; the results of these evaluations would be used in obtaining and interpreting model predictions of regional scale climate change in all other regions of the world subsequenty),

(iv) transient climate change calculations,

(v) new evaluations of sea level rise,

(vi) biosphere-ecosystems feedback processes, and

(vii) future requirements for climate research and observing systems for monitoring climate change.

3.2 WORKING GROUP II (IMPACTS)

3.2.1 Working Group II (Impacts) will focus its efforts on (the countries shown in paranthses have lead responsibility):

(i) agriculture, forestry and land use (India,UK,USSR)

(ii) natural terrestrial ecosystems (Canada,USSR)

(iii) hydrology and water resources (Algeria,USA,USSR)

(iv) energy, industry, transportation, settlements and human health (Japan,USSR),

(v) world oceans and coastal zones (USA,USSR)

(vi) the cryosphere including permafrost (Canada,USSR).

3.2.2 The Working Group set up a Steering Group composed of the Co-Chairs and contributing organisations for co-ordination purposes.

3.3 WORKING GROUP III (POLICY)

3.3.1 Working Group III (Policy) will concentrate in two broad areas of response strategies:

- Limitation
- Adaptation

3.3.2 Under the former strategy, two subgroups have been formed, one on energy and industry (including transportation) and the other on agriculture and forestry. The first will be primarily concerned with carbon dioxide emissions from industrial activities (the chlorofluoro-carbons and halons being left to the Montreal process) and the second with emissions of methane and nitrous oxide and with emissions and/or uptake of carbon dioxide. The first will be co-chaired by Japan and China (with Canada acting as rapporteur) and the second by the Federal Republic of Germany and Zimbabwe.

3.3.3 Under the latter strategy, two more subgroups have been formed, one on coastal zone management and the other on resource use and management. The first will be co-chaired by the Netherlands and New Zealand and the second by Canada, France and India.

3.3.4 This Working Group set up a Steering Committee to co-ordinate and, as initial tasks,

- to develop base emissions scenarios

- to examine implementation mechanisms (legal instruments, financial measures, public information etc.)

3.3.5 Three base emissions scenarios have since been developed and correspond to the radiative equivalent of a doubling of the atmospheric concentration of carbon dioxide from its pre-industrial value assumed to occur by the year (i) 2030, (ii) 2060 and (iii) 2090 and stabilizing thereafter. Among these, the "2030" scenario can be thought of as "business-as-usual" scenario. Another scenario will be developed which will be radiatively equivalent to a carbon dioxide concentration of less than twice the pre-industrial value.

3.3.6 The Working Group will also develop the elements of a possible framework convention on climate change. To this end, the views of all governments on such elements are being solicited. These views, after collation, will be discussed at a meeting of the Working Group in October 1989. In the process, the Working Group will identify, and suggest measures for the possible strengthening of, existing international legal instruments having a bearing on climate change.

4. THE FIRST SESSION OF IPCC BUREAU

4.1 The Bureau met on 6-7 February in Geneva to review the work outlines prepared by the Working Groups. In the course of approving them, the Bureau:

a. reiterated the need to promote participation of the developing world in the activities of IPCC. It set up a small Ad-Hoc Subgroup (Brazil, Senegal, Zimbabwe, chaired by Saudi Arabia) to make recommendations to the second session of IPCC,

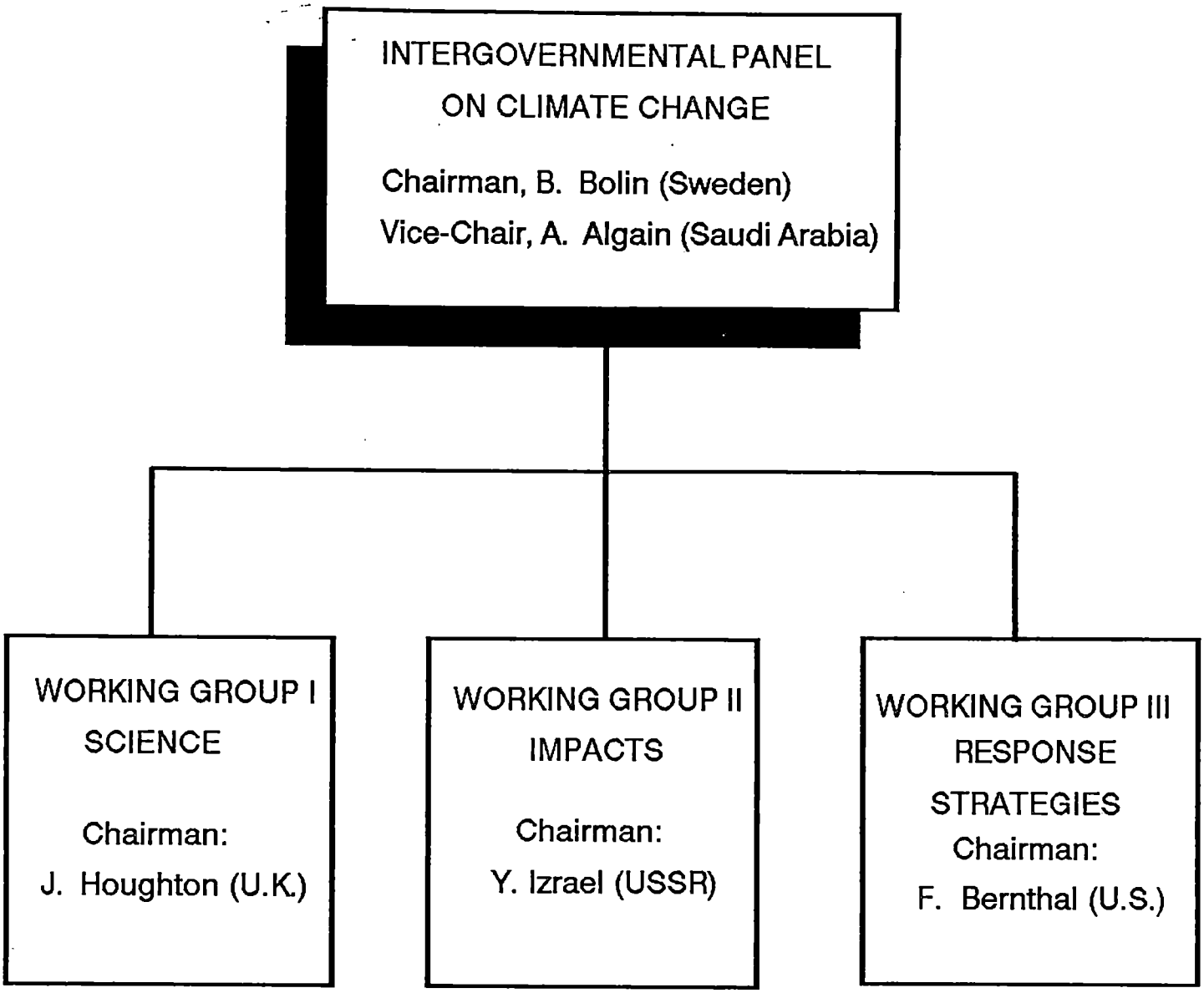
b. instructed the IPCC Secretariat to prepare and disseminate an IPCC Bulletin, with the widest readership in mind, as a measure of promoting public awareness of IPCC activities.

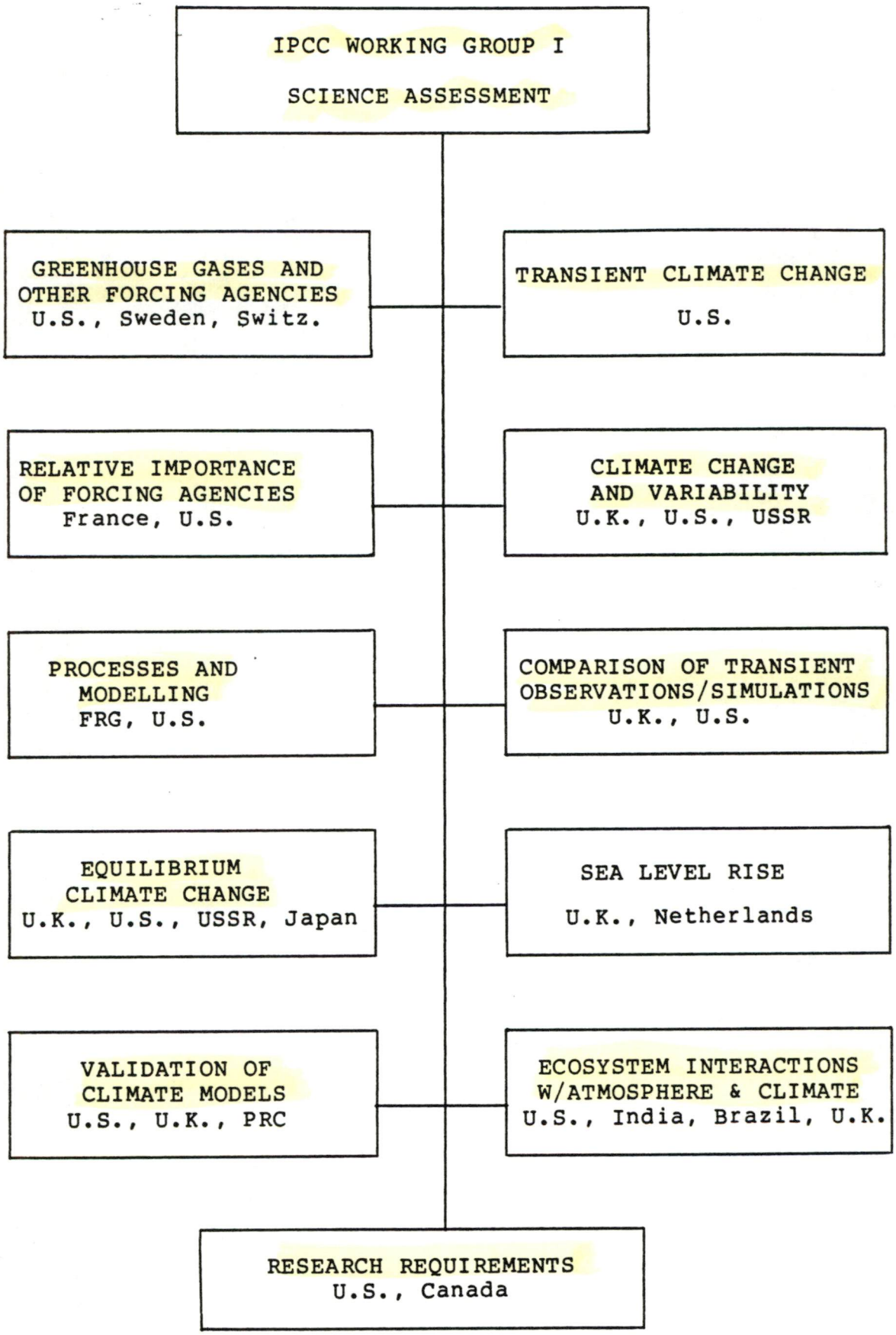
5. IPCC FIRST ASSESSMENT (1990) REPORT

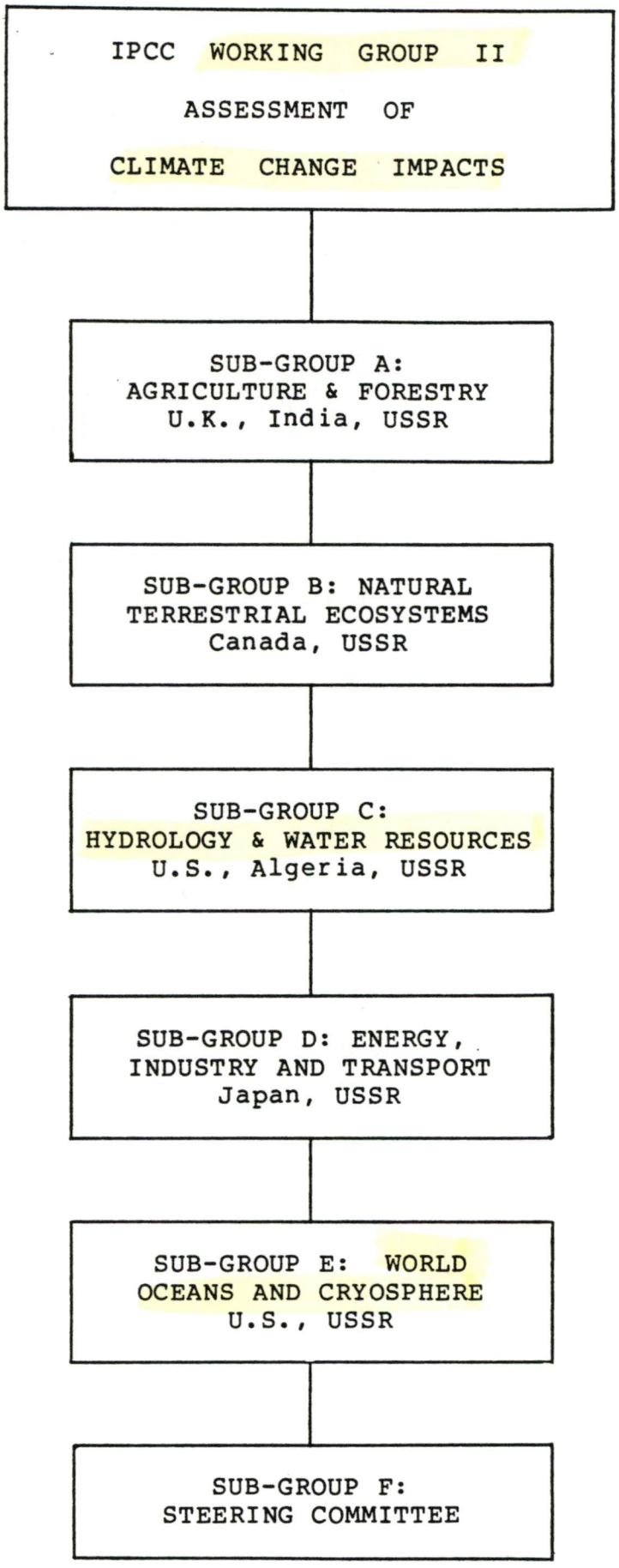
5.1 The target date for completing the first assessment report of IPCC on the climate change issue is late August/early September 1990. The report will consist of (i) the reports of the three Working Groups, each approximately 200 pages long, (ii) 20-page summaries of the these reports written in a fashion understandable to the non-specialist and the policy-maker and (iii) 20-page summary integrating the findings and conclusions of IPCC.

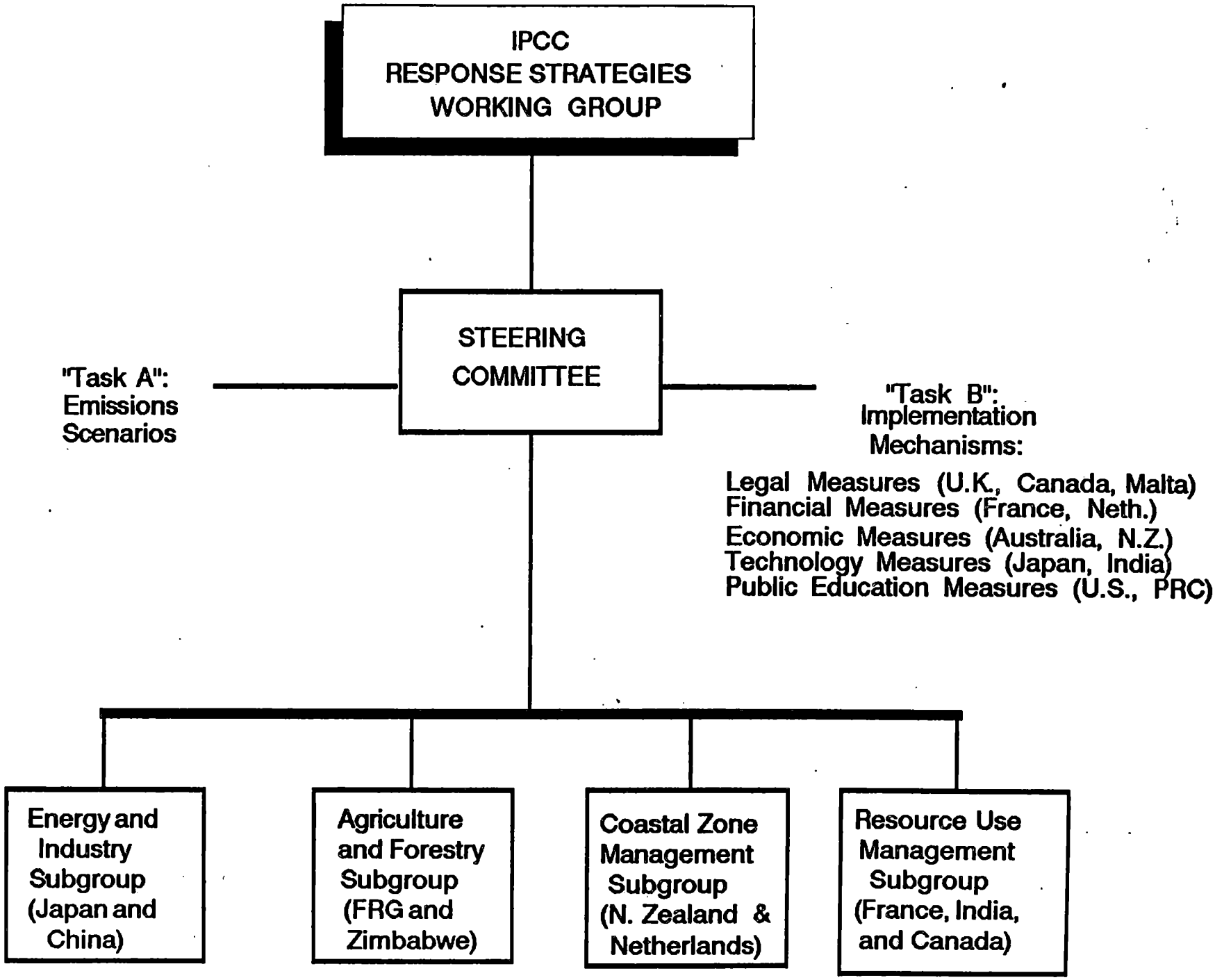
Reference:

IPCC-1, Report of the first session of the Intergovernmental Panel on Climate Change, WMO TD No. 267, World Meteorological Organization, P.O.Box 2300, CH 1211 Geneva 2, Switzerland, 1988.


INTERGOVERNMENTAL PANEL
ON CLIMATE CHANGE
Chairman, B. Bolin (Sweden)
Vice-Chair, A. Algain (Saudi Arabia)
WORKING GROUP I
SCIENCE
Chairman:
J. Houghton (U.K.)
WORKING GROUP II
IMPACTS
Chairman:
Y. Izrael (USSR)
WORKING GROUP III
RESPONSE
STRATEGIES
Chairman:
F. Bernthal (U.S.)


IPCC WORKING GROUP I
SCIENCE ASSESSMENT
GREENHOUSE GASES AND OTHER FORCING AGENCIES
U.S., Sweden, Switz.
TRANSIENT CLIMATE CHANGE
U.S.
RELATIVE IMPORTANCE OF FORCING AGENCIES
France, U.S.
CLIMATE CHANGE AND VARIABILITY
U.K., U.S., USSR
PROCESSES AND MODELLING
FRG, U.S.
COMPARISON OF TRANSIENT OBSERVATIONS/SIMULATIONS
U.K., U.S.
EQUILIBRIUM CLIMATE CHANGE
U.K., U.S., USSR, Japan
SEA LEVEL RISE
U.K., Netherlands
VALIDATION OF CLIMATE MODELS
U.S., U.K., PRC
ECOSYSTEM INTERACTIONS W/ATMOSPHERE & CLIMATE
U.S., India, Brazil, U.K.
RESEARCH REQUIREMENTS
U.S., Canada


IPCC WORKING GROUP II
ASSESSMENT OF
CLIMATE CHANGE IMPACTS
SUB-GROUP A:
AGRICULTURE & FORESTRY
U.K., India, USSR
SUB-GROUP B: NATURAL
TERRESTRIAL ECOSYSTEMS
Canada, USSR
SUB-GROUP C:
HYDROLOGY & WATER RESOURCES
U.S., Algeria, USSR
SUB-GROUP D: ENERGY,
INDUSTRY AND TRANSPORT
Japan, USSR
SUB-GROUP E: WORLD
OCEANS AND CRYOSPHERE
U.S., USSR
SUB-GROUP F:
STEERING COMMITTEE


IPCC
RESPONSE STRATEGIES
WORKING GROUP
STEERING
COMMITTEE
"Task A":
Emissions
Scenarios
"Task B":
Implementation
Mechanisms:
Legal Measures (U.K., Canada, Malta)
Financial Measures (France, Neth.)
Economic Measures (Australia, N.Z.)
Technology Measures (Japan, India)
Public Education Measures (U.S., PRC)
Energy and
Industry
Subgroup
(Japan and
China)
Agriculture
and Forestry
Subgroup
(FRG and
Zimbabwe)
Coastal Zone
Management
Subgroup
(N. Zealand &
Netherlands)
Resource Use
Management
Subgroup
(France, India,
and Canada)

LIST OF IPCC MEETINGS

4/29

Date	Venue	Meeting/activity	Organization
AUGUST			
8	Toronto	Ecosystems subgroups	IPCC WGI/WGII
SEPTEMBER			
11-15	Berne	Workshop: Greenhouse Gases Subgroup	IPCC WGI
18-20 (postponed to 26-27 Oct. 1989)	Geneva	Hydrology and Water Resources Subgroup	IPCC WGII
18-20	Toronto	Meeting of Subgroup on Cryosphere and Permafrost	IPCC WGII
18-21	Tokyo Japan	Subgroup on Energy, Industry, Transportation, Health and Humann Settlements	IPCC WGII
21-22 (postponed)	Paris	Agriculture and Forestry Subgroup	IPCC WGII/OECD*
25-26	Pangbourne, UK	Workshop: Sea level rise Subgroup	IPCC WGI/Univ. of East Anglia
28-29	Paris	IPCC Special Committee on Developing Countries	Govt. of France/ IPCC
28-29	Geneva	Energy and Industry Subgroup	IPCC WGIII
-	Washington	Agricultural Data and Practices: Subgroup on Agriculture and Forestry (AFOS)**	IPCC WGIII
-	Helsinki	Workshop on Boreal Forests: (AFOS)	IPCC WGIII
OCTOBER			
2-6	Geneva	Second session	IPCC WGIII
2-6	Moscow	Climate Change and World Fisheries: Subgroup on World Oceans and Cryosphere	IPCC WGII

---

* OECD - Organization for Economic Co-operation & Development
** AFOS - Agriculture and Forestry Subgroup of WG III
(WCP-478)

18-20	Boston	Workshop: Greenhouse gases (non-CO_2)	IPCC WGI
30-31	Bonn	Workshop on Temperate Forests (AFOS)	IPCC WGIII
30-1 Nov.	Geneva	Resource Use & Management Subgroup	IPCC WGIII
31-3 Nov.	Geneva	Second session	IPCC WGII
NOVEMBER			
2-3	Geneva	Agriculture & Forestry Subgroup	IPCC WGIII
23-24	Egham, UK	Paleo-analogue Climate Forecasting	IPCC WGI/WGII
27-1 Dec.	Miami	Coastal Zone Management Subgroup	IPCC WGIII
29-1 Dec.	Bracknell, UK	Climate Trends Subgroup	IPCC WGI
DECEMBER			
11-14	Washington	Agricultural Emissions Workshop	IPCC WGIII
11-15	Brisbane	Subgroup on Model Predictions and Validation	IPCC WGI
17-19	Berkeley, U.S.	Integrated Energy Analysis, EIS	IPCC WGIII

SECTION B: 1990

JANUARY			
-	Reading, UK	Workshop: Climate Forcing Agencies	IPCC WGI
-	San Diego, USA	Workshop: Comparison Transient Simulations	IPCC WGI
9-12	Brazil	Workshop: Tropical Forests, WGIII (AFOS)	Govts. of USA/ Brazil/IPCC WGIII
FEBRUARY			
5-7	Washington	IPCC third session	Govt. of USA/IPCC
7-8	Washington	IPCC Bureau second session	Govt. of USA/IPCC
26-2 Mar.	UK ?	Meeting Lead Authors	IPCC WG I
- (WCP-478)	Australia	Coastal Zone Management Subgroup	IPCC WGIII
MARCH-APRIL:	Geneva (?)	IPCC WGIII Subgroup Meetings	IPCC WGIII

MAY			
8-10 (tentative)	TBD	Third session, approval or report of WG	IPCC WGIII
23-25	UK	Second session, approval of report of WG	IPCC WGI
JUNE			
-	Moscow	Third session, approval of report of WG	IPCC WGII
AUGUST			
-	Stockholm	IPCC fourth session, approval of first assessment report	Govt. Sweden/IPCC

RESPONSE STRATEGIES WORKING GROUP
of the
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

FIRST MEETING

WASHINGTON, D.C. January 30 - February 1, 1989

Speech I
1/30/89

REMARKS BY
THE HONORABLE JAMES A. BAKER III
SECRETARY OF STATE
BEFORE THE
RESPONSE STRATEGIES WORKING GROUP
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
DEPARTMENT OF STATE
JANUARY 30, 1989

Thank you Fred Bernthal, Professor Bolin, ladies and gentlemen. I am very pleased to have the opportunity to join you this morning, however briefly, and to welcome you to the Department of State. You are the first official group that I've had the pleasure of welcoming to the Department.

I would also like to welcome Bill Reilly, who is here with us this morning -- President of the World Wildlife Fund and the Conservation Foundation. Bill has let President Bush talk him into becoming the nominee for the post of Administrator of the United States Environmental Protection Agency, and it's my fervent hope, Bill, that nothing you hear at this conference this morning will cause you to change your mind.

The truth is, though, as I don't need to tell those of you who are here, we face some very difficult problems. It is also true, though, that we now recognize them to be problems, and in my experience in government that is at least half of the battle.

Some months ago President Bush said, "We face the prospect of being trapped on a boat that we have irreparably damaged -- not by the cataclysm of war, but by the slow neglect of a vessel we believed to be impervious to our abuse."

The establishment of the Intergovernment Panel on Climate Change and this meeting of the Panel's Response Strategies Working Group, I think, shows beyond a doubt that this is a transnational issue. We are all in the same boat. And as I put it in my testimony to the Senate recently, "The tides and the winds can spread environmental damages to continents and hemispheres far removed from the immediate disasters."

So, if I may borrow a phrase from the environmentalists, the political ecology is now ripe for action. We know that we need to act, and we also know that we need to act together. That is what this meeting is all about.

But I would take it even a step further. One of the big advantages of being Secretary of State is that because I am not a scientist, I am, therefore, not called upon to assess the evidence, especially on global climate change. Yet it is also clear, I think, that we face more than simply a scientific problem. It is also a diplomatic problem of when and how we take action. And here, if I might, I would like to make four points.

The first is that we can probably not afford to wait until all of the uncertainties have been resolved before we do act. Time will not make the problem go away.

The second is that while scientists refine the state of our knowledge, we should focus immediately on prudent steps that are already justified on grounds other than climate change. These include reducing CFC emissions, greater energy efficiency and reforestation.

The third is that whatever global solutions to global climate change are considered, they should be as specific and cost-effective as they can possibly be.

The fourth is that those solutions will be most effective if they transcend the great fault line of our times, the need to reconcile the transcendent requirements for both economic development and a safe environment.

Without in any way downgrading the difficulty of the task, I would conclude, ladies and gentlemen, by noting that progress generally results when common interests are joined to a common understanding. This meeting and others like it will play a crucial role in moving us all toward that common understanding of what we must do to protect and to preserve our environment.

Thank you very much for having me this morning, and Godspeed.

* * * *

FB
RJS
WAN
OS
N
CP
ENV
EHC
OSP
NTS
SCT
SAT
EX

THE WHITE HOUSE

Office of the Press Secretary
(College Station, Texas)

For Immediate Release

May 12, 1989

STATEMENT BY THE PRESIDENT

The United States Delegation to the Steering Group of the Response Strategies Working Group on climate change carried instructions to move the international community forward in establishing a process for considering how to respond to climate change. I am pleased to note that the nations meeting in Geneva have agreed to a workshop this fall looking at the range of financial, economic, technical and legal issues for responding to climate change.

The United States looks forward to playing a significant role in efforts to assess and respond to global climate change.

I expect that these efforts will lead to formal negotiations on the establishment of a framework convention on global climate. It is important that this process lead to international scientific consensus on the seriousness of the issue for the environment and for the world economy. At the same time, we should ensure that the interests of developing countries are taken into account in this process.

The United States will host a meeting under the auspices of the Response Strategies Working Group this fall that is intended to advance our understanding and promote consensus. I look forward, personally, to reviewing its results.

# # #

PAGE 01 OF 04 GENEVA 08788 00 OF 05 181038Z 5132
ACTION OES-09

INFO	LOG-00	ADS-00	AID-00	INR-07	EUR-00	SS-00	OIC-02
	CIAE-00	EB-00	DINT-05	DODE-00	H-01	IO-10	NSCE-00
	NSF-02	NSAE-00	COME-00	SSO-00	L-03	PM-10	EPA-04
	INRE-00	ACDA-12	USIE-00	DOEE-00	CEQ-01	PRS-01	E-01
	T-01	/078 W					

------------------055381 181041Z /25 25

O 180928Z OCT 89
FM USMISSION GENEVA
TO SECSTATE WASHDC IMMEDIATE 2319
AMEMBASSY PARIS

UNCLAS GENEVA 08788

DEPT PLS PASS WHITE HOUSE FOR OSTP/DBROMLEY, CEQ/MDELAND, DPC/DBATES; COMMERCE/JKNAUSS; DOE/JEASTON; EPA/WREILLY

E.O. 12356: N/A
TAGS: SENV, EAID, ETRD, NSCE, AORC, IPCC
SUBJ: IPCC WRAP UP CABLE

1. SUMMARY: THE SECOND MEETING OF THE RESPONSE STRATEGIES WORKING GROUP OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE QIPCCQ WAS HELD IN GENEVA OCTOBER 2 TO 6. FORMAT OF THE MEETING WAS A WORKSHOP TO CONSIDER IMPLEMENTATION MEASURES IN 5 TOPIC AREAS: EDUCATION AND PUBLIC INFORMATION, TECHNOLOGY DEVELOPMENT AND TRANSFER, ECONOMIC QMARKETQ, FINANCIAL, AND LEGAL MEASURES. SUMMARIES OF THE TOPIC DISCUSSIONS AT PARAS 4 - 8. FORTY-THREE NATIONAL DELEGATIONS AND 29 OBSERVERS FROM NGOS AND INTERNATIONAL ORGANIZATIONS ATTENDED, REPRESENTING A SIGNIFICANT BROADENING OF PARTICIPATION BY LDCS AND THE EASTERN BLOC IN THE WORK OF RSWG. USSR, POLAND AND GDR SENT REPRESENTATIVES. THIS BROADER PARTICIPATION HAD THE PREDICTABLE EFFECT OF FRAGMENTING WHAT AT THE OUTSET OF THE MEETING HAD APPEARED TO BE A DISCERNIBLE CONSENSUS ON EACH OF THE FIVE TOPICS. THE WORKSHOP SERVED A USEFUL PURPOSE IN REVEALING THE RANGE OF VIEWPOINTS. IN ADDITION TO THE ISSUES OF A CONVENTION, NEW INSTITUTIONS, ADDITIONAL FUNDING AND INTELLECTUAL PROPERTY RIGHTS, THE WORKSHOP REVEALED ADDITIONAL POINTS OF DISAGREEMENT WHICH WILL REQUIRE SUSTAINED DIALOGUE AND NEGOTIATION.
JEAN RIPERT QFRANCEQ REPORTING ON THE SEPTEMBER 28 TO 29 MEETING OF THE SPECIAL COMMITTEE ON PARTICIPATION OF LDCS, CALLED FOR ADDITIONAL RESOURCES TO STRENGTHEN THE IPCC SECRETARIAT'S OUTREACH, AND FOR TRANSLATION OF IPCC WORKING GROUP MEETINGS INTO ADDITIONAL LANGUAGES BESIDES ENGLISH. THESE SUGGESTIONS RECEIVED CONSIDERABLE SUPPORT AND WILL BE ADDRESSED AT THE FEBRUARY PLENARY, AS WILL THE QUESTION OF THE FUTURE ROLE OF THE COMMITTEE.

CHAIRMAN BERNTHAL ENCOURAGED EACH COUNTRY PARTICIPATING IN IPCC/RSWG TO UNDERTAKE A NATIONAL ANALYSIS OF ITS INDIVIDUAL GREENHOUSE GAS EMISSIONS, TO PROVIDE A BASELINE FOR PLANNING NATIONAL AND INTERNATIONAL RESPONSE STRATEGIES. THESE ANALYSES ARE TO BE SHARED WITH THE EIS AND AFOS SUBGROUPS.

VIRTUALLY ALL THE TOPIC COORDINATORS EXPRESSED CONCERN AT THE SPARSE RESPONSE FROM LDCS IN SUBMITTING PAPERS. FOR EXAMPLE, IN ECONOMIC MEASURES, OF THE 7 COUNTRY PAPERS

SUBMITTED, ONLY ONE WAS FROM AN LDC AND NONE WERE FROM CPES. SOME LDCS SAID THEY WERE UNABLE TO PREPARE PAPERS DUE TO THE SHORT LEAD TIME, AND FRANCE SAID IT HAD BEEN HAMPERED BY LANGUAGE DIFFICULTIES AND THE SUMMER VACATIONS. RSWG CHAIRMAN BERNTHAL EMPHASIZED THAT WHILE THE TOPIC PAPERS ARE TO BE TREATED AS LIVING DOCUMENTS THE RSWG SHOULD AIM TO COMPLETE THEM IN TIME FOR THE FEBRUARY 1990 PLENARY. HE INVITED ALL COUNTRIES TO SUBMIT ADDITIONAL COMMENTS/SUGGESTIONS THROUGH THE END OF 1989. INTERIM REPORTS ON THESE TOPICS WILL BE REVIEWED BY THE RSWG CHAIRMAN, VICE CHAIRMAN, TOPIC COORDINATORS, AND SUBGROUP CHAIRMEN AT THE TIME OF THE IPCC PLENARY IN FEBRUARY 1990. END SUMMARY.

2. REPORT ON SPECIAL COMMITTEE ON PARTICIPATION OF LDCS

MR. JEAN RIPERT QFRANCEQ SUMMARIZED THE REPORT OF THE MEETING SEPTEMBER 28-29 IN PARIS OF THE IPCC SPECIAL COMMITTEE ON PARTICIPATION OF LDCS, WHICH HE CHAIRED. NOTING THE NEED FOR IPCC TO STRENGTHEN COMMUNICATION AND DISSEMINATION OF IPCC INFORMATION AND PAPERS TO DEVELOPING COUNTRIES, HE APPEALED FOR ADDITIONAL RESOURCES TO THE IPCC SECRETARIAT, BOTH FINANCIAL AND IN THE FORM OF SECONDED PERSONNEL. HE ALSO URGED THAT IPCC RECONSIDER ITS POLICY OF CONDUCTING WORKING GROUPS IN ENGLISH ONLY, NOTING THAT USE OF ADDITIONAL UN LANGUAGES WOULD MAKE IPCC'S WORK ACCESSIBLE TO A FAR WIDER - POTENTIAL AUDIENCE IN LDCS. HE REPORTED THE COMMITTEE'S GENERAL SUPPORT FOR PROPOSALS MADE IN THE AL-GAIN REPORT, SUCH AS QUOTE CRASH SEMINARS UNQUOTE AND THE ESTABLISHMENT OF FOCAL POINTS AND SOUGHT THE GUIDANCE OF THE WORKSHOP ON THE FUTURE OF THE SPECIAL COMMITTEE. THIS TOPIC WILL BE ADDRESSED AT THE FEBRUARY PLENARY.

3. ACTIVITIES OF ENERGY INDUSTRY SUBGROUP QEISQ

MEMBERS OF THE EIS GROUP CLARIFIED SOME OF THE DECISIONS MADE IN THE EIS SUBGROUP MEETING THE PREVIOUS WEEK. ASSIGNMENTS FOR DRAFTING A FIRST VERSION QANNOTATED OUTLINE FORMATQ OF THE EIS REPORT WERE:

-- A. INTRODUCTION - JAPAN

-- B. ANALYSIS AND SYNTHESIS OF THE NATIONAL CASE STUDIES AND SPECIALIZED STUDIES - U.S.
9758,3 76 38
NOVEMBERQ

-- C. DISCUSSION OF OPTIONS - JAPAN Q31 DECEMBERQ

-- D. ANALYSIS OF POLICY OPTIONS - UK NETHERLANDS Q38 NOVEMBERQ SUPPLEMENTED BY ECONOMIC ANALYSIS - US Q31 JANUARY.

-- E. CONCLUSIONS - UK AND NETHERLANDS Q38 NOVEMBERQ

JAPAN AND US MET TO SET THE TIMING AND PROPOSED VENUE FOR A MEETING OF THE ENERGY AND INDUSTRY SUBGROUP ON THE INTEGRATED ANALYSIS TO BE DONE BY SPECIALISTS. THIS IS SET AS 17 - 19 DECEMBER AT LAWRENCE BERKELEY LABS, CALIFORNIA. THE NATIONAL CASE STUDIES WILL ALSO BE DISCUSSED.

4. PUBLIC EDUCATION AND INFORMATION

THE SYNOPSIS REPORT OF THE TASK GROUP ON PUBLIC EDUCATION AND INFORMATION WAS CONSIDERED IN THE MORNING PLENARY SESSION ON OCTOBER 3. DELEGATES SUGGESTED MEANS FOR STRENGTHENING THE CLARITY AND SUBSTANCE OF THE REPORT. A

DRAFTING GROUP LED BY GARY EVANS GUSQ AND LUO JIBIN QPRCQ PRODUCED A CONSENSUS DOCUMENT REVIEWED BY RSWG III DELEGATES AND RECEIVING APPROVAL WITHOUT SIGNIFICANT CHANGE IN THE AFTERNOON PLENARY SESSION OCTOBER 5. THE CONSENSUS REPORT EMPHASIZED THE NECESSITY OF AN INFORMED GLOBAL POPULATION AND THE IMPORTANCE OF ACCURATE INFORMATION AND EFFECTIVE EDUCATION. THE REPORT PUT A PRIORITY ON INTERNATIONAL AND NATIONAL MEANS OF DEVELOPING INFORMATION AND FORMAL AND INFORMAL EDUCATIONAL STRATEGIES APPROPRIATE TO DIVERSE AUDIENCES, CULTURES, AND COUNTRIES. SPECIFIC SHORT- AND LONG-TERM SUGGESTIONS ARE SET FORTH IN THE REPORT.

5. TECHNOLOGY DEVELOPMENT AND TRANSFER

THE PAPER ON TECHNOLOGY DEVELOPMENT AND TRANSFER CALLED FOR GREATER COOPERATION AMONG ALL NATIONS TO EXCHANGE TECHNOLOGICAL INFORMATION. SOME OF THE LDC'S MADE IT CLEAR THAT THEY EXPECT PREFERENTIAL TREATMENT IN RECEIPT OF INFORMATION. HOWEVER, WITH THE EXCEPTION OF BRAZIL AND INDIA, NO ONE DISPUTED THE NEED TO PROTECT INTELLECTUAL OR OTHER PROPERTY RIGHTS. MANY COUNTRIES AGREED WITH THE U.S. POSITION. THE FINAL VERSION OF THE PAPER STATES THE VIEWS CLEARLY.

-- SOME COUNTRIES NOTED THE NEED TO FOCUS ON GREENHOUSE GAS EMISSION LIMITATION TECHNOLOGIES IN THE NEAR TERM WHILE OTHERS STRESSED THE NEED TO ADDRESS ADAPTIVE TECHNOLOGIES IN THE NEAR TERM AS WELL.

-- MANY LDC'S NOTED THE NEED TO TAILOR TECHNOLOGIES TO LDC DOMESTIC TECHNOLOGICAL AND HUMAN RESOURCE CAPABILITIES AND TO BETTER DEVELOP THOSE CAPABILITIES.

-- IMPEDIMENTS TO TECHNOLOGY TRANSFER AND MECHANISMS TO OVERCOME THOSE IMPEDIMENTS WERE DISCUSSED AT LENGTH AND ENUMERATIVE LISTS DEVELOPED. HOWEVER, NO ENDORSEMENTS OF ANY PARTICULAR MECHANISMS WERE MADE.

6. DISCUSSION OF ECONOMIC MEASURES

THE U.S. DELEGATION IN DISCUSSION OF ECONOMIC MEASURES COVERED THE PRINCIPAL POINTS IN OUR MEASURES PAPER, STRESSING THE IMPORTANCE OF USING MARKET MECHANISMS TOGETHER WITH GOVERNMENT ACTIONS TO ACHIEVE ENVIRONMENTAL OBJECTIVES, AS WELL AS THE NEED FOR COST-BENEFIT ANALYSIS IN SELECTING OPTIONS AND ALLOWING MAXIMUM FLEXIBILITY BY COUNTRIES IN SELECTING RESPONSE STRATEGIES. IT POINTED OUT THAT INEFFICIENT APPROACHES COULD REDUCE FINANCIAL RESOURCES NEEDED FOR SOCIAL PURPOSES AND ECONOMIC ASSISTANCE, AND EMPHASIZED THE NEED FOR INFORMATION AND EDUCATION PROCESSES IN CONNECTION WITH ECONOMIC MEASURES. THE IMPORTANCE OF AVOIDING DISTORTION TO

INTERNATIONAL TRADE AND THE NECESSITY TO ACCORD EFFECTIVE PROTECTION AT INTELLECTUAL PROPERTY RIGHTS WAS ALSO ELABORATED ON.

OF THE MEASURES COVERED IN THE SYNOPSIS PAPER; TAXES, SUBSIDIES, TRADEABLE EMISSIONS PERMITS, AND SANCTIONS, THE LATTER TWO WERE THE MOST CONTROVERSIAL, WITH A NUMBER OF DELEGATIONS EXPRESSING RESERVATIONS TO ONE OR BOTH. BRAZIL STRONGLY OPPOSED SANCTIONS; WITH SUPPORT FROM THE USSR AND AUSTRIA. THE USE OF TRADEABLE EMISSIONS PERMITS WAS QUESTIONED SHARPLY BY JAPAN AND BRAZIL, WITH FINLAND, AUSTRIA, AND SWEDEN ALSO VOICING CONCERN, AT LEAST AT THEIR USE AT THE INTERNATIONAL LEVEL.

ALTHOUGH THEY ACCEPTED THE UTILITY OF SOME MARKET MEASURES, FRANCE, CANADA, THE NETHERLANDS, FRG, AND INDONESIA INDICATED THEY ALSO SAW THE NEED FOR GOVERNMENT INTERVENTION, AND THE GDR STRESSED ITS IMPORTANCE FOR QPES.

MALTA AND THE NETHERLANDS WERE VOCAL ON THE NEED TO ELIMINATE PERVERSE SUBSIDIES, WITH INDIA OBSERVING THAT NOT ALL SUBSIDIES ARE PERVERSE.

REGARDING TAXES, THE WORLD RESOURCES INSTITUTE STRONGLY ADVOCATED THEIR USE, WHILE SWEDEN CAUTIONED THAT THEY MUST BE CAREFULLY ANALYZED AND HARMONIZED AMONG NATIONS.

OBSERVERS FROM THE IEA AND THE OECD STRESSED THE NEED FOR COST EFFECTIVE MEASURES AND THE NECESSITY TO PROVIDE FOR POSITIVE ECONOMIC GROWTH.

THE LDCS GENERALLY EMPHASIZED THE IMPORTANCE OF CONSIDERING THEIR SPECIAL CIRCUMSTANCES, E.G., MALAYSIA POINTED TO THE NEED TO PROVIDE AN ECONOMIC ALTENATIVE TO DEFORESTATION, AND SENEGAL TO ITS NEED FOR MORE FUNDS TO ACQUIRE TECHNOLOGY. PERHAPS THE MOST SWEEPING STATEMENT ON THE LDCS PLIGHT CAME FROM MEXICO, WHICH OPINED THAT CLEANING UP THE ENVIRONMENT WILL BE A VERY COSTLY PROCESS THAT WILL END UP BEING PAID FOR BY THE LDCS.

THE WORKSHOP REPORT ON ECONOMIC MEASURES WAS A BALANCED PRESENTATION OF THE CONCEPTS AND ISSUES COVERED IN THE INITIAL COUNTRY PAPERS AND THE DISCUSSION IN THE MEETING. THE ONLY NOTABLE EVENT IN THE APPROVAL OF THE REPORT WAS AN EXCHANGE BETWEEN THE US DELEGATE ON THE ONE HAND, AND BRAZIL AND INDIA ON THE OTHER HAND, REGARDING PROTECTION OF INTELLECTUAL PROPERTY RIGHTS. THE FINAL REPORT REFLECTS THE OPPOSING VIEWS ON THIS ISSUE.

7. FINANCIAL

THE FINANCIAL MEASURES DISCUSSION AND PAPER EMPHASIZED A COLLABORATIVE APPROACH BY DEVELOPED AND DEVELOPING COUNTRIES. IT WAS GENERALLY AGREED THAT DEVELOPED COUNTRIES SHOULD ATTEMPT TO ASSIST DEVELOPING COUNTRIES IN RESPONDING TO CLIMATE CHANGE AND IN MEETING THEIR RESPONSIBILITIES UNDER A FUTURE CLIMATE CONVENTION OR PROTOCOL. IT WAS ALSO AGREED THAT CLIMATE CHANGE SHOULD NOT BE SEPARATED FROM OTHER ENVIRONMENTAL AND DEVELOPMENT PROBLEMS.

ALL DELEGATIONS AGREED THAT EXISTING INSTITUTIONS SHOULD BUILD CLIMATE CHANGE CONCERNS INTO THEIR PROGRAMS AND BE STRENGTHENED IN THEIR ABILITY TO DEAL WITH THESE ISSUES. AT THIS STAGE OF THE DISCUSSION, THE PLANS OF THE DEVELOPMENT ASSISTANCE COMMITTEE OF THE OECD AND THE COMMUNIQUE FROM THE SEPTEMBER MEETING OF THE WORLD BANK DEVELOPMENT COMMITTEE IN THIS REGARD WERE HIGHLIGHTED. THE U.S. MADE IT CLEAR IT HAD NO ADDITIONAL RESOURCES TO OFFER.

DEVELOPING COUNTRIES, JOINED BY THE NETHERLANDS AND THE NORDIC COUNTRIES, FELT THAT A NEW FINANCIAL MECHANISM WAS ALREADY JUSTIFIED. IN A DEPARTURE FROM PAST POSITIONS, THESE COUNTRIES EMPHASIZED THAT THE NEED WAS PRINCIPALLY FOR NEW MECHANISMS TO GENERATE ADDITIONAL FINANCIAL RESOURCES. THEY INDICATED FLEXIBILITY ON HOW THE FUNDS WOULD BE ALLOCATED. MANY DELEGATIONS EXPRESSED SUPPORT FOR ALLOCATING THESE NEW FUNDS THROUGH A SPECIAL WINDOW WITHIN THE WORLD BANK SYSTEM WHILE A FEW EXPRESSED A PREFERENCE FOR USING THE U.N. SPECIALIZED AGENCIES OR A NEW INSTITUTION. THE DEVELOPING COUNTRIES STRESSED THAT ASSISTANCE RELATED TO CLIMATE CHANGE SHOULD NOT BE SUBJECT TO THE SAME CONDITIONS AS TRADITIONAL WORLD BANK ASSISTANCE. THE U.S. AND OTHERS POINTED OUT THE NEED FOR

SUPPORTIVE ECONOMIC POLICIES AND DIALOGUE AND THAT CONSIDERATION OF NEW MECHANISMS IS PREMATURE.

THE U.S. SUGGESTED THAT DEVELOPING COUNTRIES, WITH THE HELP OF INDUSTRIALIZED COUNTRIES, SHOULD INITIATE STUDIES TO DEFINE THE SCOPE AND SCALE OF FUTURE RESOURCE REQUIREMENTS SIMILAR TO THE APPROACH NOW BEING USED TO ASSESS FINANCIAL NEEDS ASSOCIATED WITH THE IMPLEMENTATION OF THE MONTREAL PROTOCOL. DONORS WERE ENCOURAGED TO PROVIDE ASSISTANCE AND TO HELP COMPLETE THESE STUDIES QUICKLY. THIS DATA WOULD HELP IN ASSESSING THE CAPABILITIES OF EXISTING INSTITUTIONS. IT WOULD ALSO BE ESSENTIAL IN ANALYZING THE NEED FOR NEW MECHANISMS.

TROUBLESOME PROPOSALS FOR GENERATING RESOURCES THROUGH PRIOR OBLIGATION OF FUNDS SUCH AS FROM TAXES ON GREENHOUSE GAS EMISSIONS AND OTHER LEVIES WERE INCLUDED AS OPTIONS TO BE STUDIED. THE FINAL PAPER OUTLINED A SERIES OF PRIORITY AREAS FOR TECHNICAL AND FINANCIAL ASSISTANCE INCLUDING TECHNOLOGY TRANSFER AND SUPPORT FOR THE DESIGN OF POLICIES AND PROGRAMS.

8. LEGAL MEASURES: THE WORKSHOP CONSIDERED, ON THE BASIS OF A SYNOPSIS PREPARED BY THE TOPIC COORDINATORS QUK, CANADA, MALTAQ OF NUMEROUS WRITTEN CONTRIBUTIONS AND VIEWS EXPRESSED AT THE MEETING, WHICH ELEMENTS SHOULD BE INCLUDED IN A FRAMEWORK CONVENTION ON CLIMATE CHANGE; WHAT OTHER INSTRUMENTS QEG., PROTOCOLSQ MIGHT BE EMPLOYED; AND THE INSTITUTIONAL IMPLICATIONS OF A FRAMEWORK CONVENTION.

THE GENERAL VIEW WAS THAT EXISTING LEGAL INSTRUMENTS AND INSTITUTIONS WITH A BEARING ON CLIMATE SHOULD BE FULLY UTILIZED AND FURTHER STRENGTHENED QA LIST OF THE U.S.-COMPILED RELEVANT INSTRUMENTS AND INSTITUTIONS WILL BE ANNEXED TO THE REPORTQ; BUT, THEY WERE IGNORED AS INSUFFICIENT TO MEET THE CHALLENGE OF CLIMATE CHANGE. THE DISCUSSION THEREFORE CONCENTRATED ON THE CONTENTS OF A FRAMEWORK CONVENTION.

BROAD CONSENSUS EMERGED AMONG THE PARTICIPANTS ON THE NEED FOR A FRAMEWORK CONVENTION ON CLIMATE CHANGE AND THAT IT SHOULD GENERALLY FOLLOW THE FORMAT OF THE VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER. THE FRAMEWORK CONVENTION WOULD LAY DOWN GENERAL PRINCIPLES AND OBLIGATIONS, AND PROVIDE FOR A CONTINUING ASSESSMENT OF THE SCIENTIFIC ASPECTS OF CLIMATE CHANGE AND ITS IMPACTS, AND FOR RESPONSE STRATEGIES.

THERE WAS ALSO BROAD AGREEMENT THAT THE FRAMEWORK CONVENTION SHOULD CONTAIN PROVISION FOR SEPARATE PROTOCOLS TO BE NEGOTIATED TO DEAL WITH SPECIFIC OBLIGATIONS, EG., ON THE DIFFERENT GREENHOUSE GASES. MOST DELEGATIONS WHO SPOKE TO THE ISSUE NOTED THE NEED TO GO BEYOND THE VIENNA CONVENTION EITHER IN TERMS OF STRENGTHENING PROCEDURES FOR FINANCIAL AND TECHNICAL ASSISTANCE TO DEVELOPING COUNTRIES, STRENGTHENING RESEARCH AND DEVELOPMENT PROVISIONS, ENHANCED INSTITUTIONAL AUTHORITY OR BY INCORPORATING GENERAL GREENHOUSE GAS QGHGQ EMISSION CONTROL OBJECTIVES IN THE CONVENTION ITSELF. ON THE LATTER POINT, A NUMBER OF DELEGATIONS EXPRESSED THE VIEW THAT ONE OR MORE GHG PROTOCOLS SHOULD BE CONSIDERED SIMULTANEOUSLY WITH THE CONVENTION.

IT WAS RECOMMENDED BY SEVERAL DELEGATIONS THAT EFFORTS BE MADE TO TRY AND CONCLUDE NEGOTIATIONS ON A CONVENTION BY THE END OF 1991 THE DEVELOPING COUNTRIES GENERALLY TOOK THE

VIEW THAT NO TARGETS SHOULD BE SET FOR THEM IN THE CONVENTION, ONLY FOR INDUSTRALIZED COUNTRIESQ. ON THAT POINT, IT WAS ALSO STRESSED THAT THERE SHOULD BE AN APPROPRIATE BALANCE BETWEEN BEING MORE AMBITIOUS IN DEVELOPING A CONVENTION QUICKLY AND OBTAINING A GOOD INSTRUMENT WITH WIDE ACCEPTANCE.

THE REPORT OF THE MEETING CONTAINS A COMPILATION OF POSSIBLE ELEMENTS FOR A FRAMEWORK CONVENTION ON CLIMATE CHANGE PROPOSED BY VARIOUS PARTICIPANTS. THE REPORT EXPLICITLY NOTES THAT THE INCLUSION OF ANY PARTICULAR SUGGESTION DOES NOT IMPLY CONSENSUS WITH RESPECT TO IT, OR THE AGREEMENT OF ANY PARTICULAR GOVERNMENT TO INCLUDE IT IN A FRAMEWORK-CONVENTION. IT ALSO NOTES THAT SOME OF THE PROPOSED ELEMENTS ARE CONTROVERSIAL, BUT HAVE BEEN INCLUDED TO STIMULATE DISCUSSION AT THE NATIONAL AND

INTERNATIONAL LEVELS.

DESPITE BROAD CONSENSUS ON CERTAIN BASIC ISSUES, LEGAL MEASURES DRAFTING COMMITTEE WORK AND FINAL DISCUSSION IN PLENARY DISCLOSED FUNDAMENTAL DIFFERENCES AMONG DIFFERENT GROUPS OF COUNTRIES ON KEY ISSUES. SCANDINAVIANS, FRG AND NEW ZEALAND EXPRESSED CLEAR DESIRE FOR EMISSIONS CONTROL PROVISIONS IN CONVENTION ITSELF. INDIA, BRAZIL AND MEXICO REPEATEDLY MENTIONED NEED FOR LDCS TO INCREASE EMISSIONS OVER SHORT TERM, NEED FOR CLIMATE FUND OR OTHER FINANCIAL ASSISTANCE AND RIGHT TO RECEIVE TECHNOLOGY ON PREFERENTIAL AND NON COMMERCIAL TERMS. INDIA AND BRAZIL PROPOSED LANGUAGE ON INTELLECTUAL PROPERTY RIGHTS IN DIRECT CONFLICT WITH LANGUAGE PROPOSED BY U.S. AT CONCLUSION OF MEETING, SEVERAL DELEGATIONS EXPRESSED DISAPPOINTMENT AT THE LACK OF CONSENSUS DURING FINAL DISCUSSION OF LEGAL MEASURES. JAPAN AND UK GENERALLY SUPPORTED U.S. POSITIONS AND CANADIAN INTERVENTIONS WERE MODERATE AND HELPFUL.

NEXT STEPS

CHAIRMAN BERNTHAL INVITED COUNTRIES TO MAKE ADDITIONAL COMMENTS ON THE DRAFT TEXTS BY THE END OF 1989. COMMENTS SHOULD BE DIRECTED TO THE IPCC SECRETARIAT, WHICH WILL DISTRIBUTE THEM TO THE TOPIC COORDINATORS AND THE RSWG CHAIRMAN. COPIES OF THE TOPIC PAPERS, WITH ANY PROPOSED ADDITIONAL MODIFICATIONS, WILL BE MADE AVAILABLE TO ALL IPCC MEMBERS BY THE SECRETARIAT BEFORE THE IPCC MEETING IN FEBRUARY.

CHAIRMAN BERNTHAL WILL MEET WITH THE TOPIC COORDINATORS, VICE CHAIRMEN, AND SUBGROUP CHAIRMEN FOR ADDITIONAL DISCUSSIONS ON THESE TOPICS AT THE IPCC PLENARY, FEBRUARY 5-8, 1990, IN THE U.S.

IN THE MEANTIME, THE SUBGROUPS, AS THEY MEET, SHOULD CONSIDER THE RECOMMENDATIONS THAT HAVE EMERGED FROM THIS WORKSHOP. PROPOSED MODIFICATIONS TO THE IMPLEMENTATION TOPIC PAPERS WILL BE MADE AVAILABLE TO THE SUBGROUP CHAIRMEN AT THE FEBRUARY MEETING.

FINALLY, ALL RSWG SUBGROUP REPORTS AND TOPIC PAPERS SHOULD BE IN FINAL DRAFT BY APRIL 30, 1990 SO THAT THEY CAN BE INCORPORATED INTO AN OVERALL RSWG REPORT. THE RSWG MEETING IN LATE SPRING 1990 WILL REVIEW AND APPROVE THE RSWG REPORT, WHICH WILL THEN BE SUBMITTED TO THE IPCC DRAFTING COMMITTEE IN JUNE.

ABRAM

INTRODUCTION TO FINAL REPORT

Introduction

As part of the work of the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC), 163 representatives from 43 governments and 25 observers from governmental, intergovernmental and non-governmental organizations met October 2-6 in Geneva, Switzerland, at the second meeting of the Response Strategies Working Group or RSWG (IPCC Working Group III), convened as a multidisciplinary workshop on possible means of implementing response options to deal with potential climate change. The meeting was chaired by Dr. Frederick M. Bernthal, Chairman of RSWG. Participants included a broad spectrum of experts -- from both developed and developing countries, representing both market and centrally planned economies.

The topics considered included: Legal and Institutional Measures, including elements of a framework climate convention; Technology Transfer and Development; Financial Measures (especially assistance to developing countries); Public Education and Information; and Economic and Market Measures.

Views on Workshop topics

Certain views emerged from the group's identification and assessment of potential implementation mechanisms for climate change response strategies:

Legal and Institutional Measures

-- In addition to strengthening existing legal and institutional mechanisms to address climate change issues, a framework convention on climate change is timely and necessary. The 1985 Vienna Convention on the Protection of the Ozone Layer should provide a point of departure for the development of such a convention. At a minimum the convention should set forth principles of cooperation, provide a legal and institutional framework for monitoring and assessing climate change and for developing and implementing responses, and should aim to attract the largest number and widest range of signatory countries. A number of nations suggested that binding commitments and control measures be included in a framework convention. A number suggested that the convention or its protocols deal with the special circumstances of developing countries, and make clear mechanisms for providing financial assistance. Negotiations on a convention should begin as soon as possible after the issuance of the IPCC first assessment report due in September of 1990.

Technology Development and Transfer

-- Sustainable development requires the development of technologies to address climate change, and should be pursued in a wide range of public and private sectors and through active international collaboration. Such development could be promoted by an inventory of priority areas, public/private partnerships, and the creation of information-gathering and -sharing systems. Effective alternatives to

existing technologies must take account of social, environmental and economic variances among countries and regions. Mechanisms for implementing technology transfer include the establishment of incentives for private sector transfer, initiation of pilot programs in developing countries, and creation of an international clearinghouse on relevant technologies and new developments. There should be particular emphasis on the need to identify and enhance the preconditions for technology transfer, such as financial capacity, domestic institutional and technical infrastructure, and resolution of the issues concerning protection of intellectual property.

Financial Measures

-- Industrialized and developing countries share a common responsibility for addressing climate change. The special needs of developing countries, including their vulnerability to climate change impact, and lack of financial resources and technology must be recognized. Some countries suggested that industrialized countries should show leadership by initiating domestic actions to limit and reduce emissions of carbon dioxide and other greenhouse gases and providing financial support to developing countries wishing to take similar actions. Regional and subregional cooperation to limit emissions was encouraged. The need for cooperation at the international, regional and subregional level, as well as the need for assistance in developing adaptation strategies was stressed.

Existing relevant financial institutions should be strengthened and their mandates expanded to address climate change concerns. A number of delegations from both developed and developing countries suggested that parallel action was already justified with respect to creation of new financial mechanisms and facilities. It was agreed that further analysis should be conducted on the nature of projects that might be warranted, the likely magnitude of assistance needs, and the scope and need for new institutions or mechanisms. Proposals for generating resources and mechanisms for administering a new fund should be examined expeditiously to make early decisions possible.

Public Education and Information

-- Public education and information is of paramount importance for dealing with the climate change issue. There is a particular need both for effective international coordination and for national coordination in each country. Mechanisms should be developed to assure efficient compilation and dissemination of up-to-date information to all sectors. In addition, it is desirable to draw upon the expertise of existing international organizations and to assist developing countries in structuring materials and programs appropriate to their particular social, economic, and cultural requirements.

Economic and Market Mechanisms

-- Economic and market mechanisms that might achieve stabilization or reduction in greenhouse gas emissions at minimum cost to society should be reviewed. These mechanisms may be particularly relevant domestically and may also have some international applications. They entail use of adjustment to market forces (or environmentally adjusted market forces) to take account of environmental impacts. Regulations, tradeable emission permits, emission charges, subsidies and sanctions were discussed as possible economic market mechanisms. Some of the proposed mechanisms would require further careful study. Such measures must be sensitive to the needs of developing countries. It may become necessary to use some economic and market mechanisms in tandem with traditional regulatory approaches. Various potential applications of economic and market mechanisms were identified.

Report on LDC participation

A report was submitted by Mr. J. Ripert, Chairman of the IPCC Special Committee on the Participation of the Developing Countries, which held its first meeting in Paris on the 28 and 29 September 1989. The attention of the delegates was drawn to the necessity of quick implementation of short term measures, including crash seminars, establishment of national climate committees, training of experts and establishment of effective means of communication including communication in regard to IPCC activities.

Results of Workshop

The meeting produced a report of its work, which will be further refined and developed within the IPCC process. The workshop report will be used by the four RSWG subgroups in developing recommended response options, and will itself form the basis for a portion of the IPCC first assessment report.

Finally, and perhaps most importantly, the RSWG expects that this report will serve as the basis for much more detailed and intensive study of the many issues here outlined, in a wide variety of national and international, public and private fora. The IPCC (and RSWG) in its work must make use of all relevant work of other organizations and individual countries.

All countries have been invited to make additional comments on the draft texts through the end of this year. The RSWG Chairman, Vice-chairmen, Sub-group Co-chairmen and Topic Coordinators will meet for further consultations just prior to the third session of IPCC in February 1990 in the United States. This session will bring together the members of the IPCC. The first RSWG report to IPCC, after its review and approval in a meeting to be held next spring, will be submitted to the IPCC Drafting Committee by mid-June 1990.

July 28, 1989

MEMORANDUM

Re: 20 Suggested Events Involving Reforestation & Trees

The following is a list of ideas for events involving trees. The suggestions are intended to spur ideas of ways for the President to take advantage of the public's increasing interest in the environment and reforestation, and to continue the momentum that has built up since the successes of our recent environmentally-related events.

One theme of reforestation is that trees symbolically represent the linking of generations. Thus, events involving the planting of trees will be especially effective if they involve children and/or older Americans. Many of the suggestions below reflect this point.

In addition to these suggestions, a list of tree-related dates and anniversaries can be found at Tab 1.

1. While he is on vacation in Kennebunkport, the President could plant a tree on Walker's Point.

   More significantly, the President could plant a tree with Maine's Democratic Senator George Mitchell and his family in a day trip to a state park. Both the Bushes and the Mitchells could be joined by selected Boy Scouts and Girl Scouts, local naturalists, etc. We could arrange for there to be seedlings left over.

   The President and Sen. Mitchell would then ask Senators, particularly those from states having a Senator from each party, to plant trees in their own states, e.g., Sens. Robb and Warner in Virginia, Sens. McConnell and Ford in Kentucky, Sens. Graham and Mack in Florida, etc.

2. Around Bethel, Maine are located a number of studies conducted by state authorities involving the effects of acid rain on maple trees. Bethel is close enough to Kennebunkport to suggest a short day trip.

3. The President could inspect the famous poisoned oak in Austin, Texas in the company of the country's most respected tree expert. Lady Bird Johnson would be natural for this event, as with other national events.

(more)

4. The President could announce the formation of a National Registry of Historic Trees. The setting could be a tour of the White House grounds and Lafayette Park to see the historic trees that were planted by previous Presidents (see Tab 2). Perhaps Mrs. Bush could conduct this walking tour.

   The President should be accompanied by one of the media's avuncular human interest story journalists, e.g., Charles Kuralt, Charles Osgood, or Andy Rooney, as well as by noted writers from the nature magazines, e.g., National Geographic, Nature, the Smithsonian, etc.

   In this connection, we could determine which trees on the White House grounds were planted by the families of the previous Presidents. President Bush could then plant a tree with his own family, thus sending the message that trees are a link between the generations.

5. There is bound to be some latter-day Johnnie Appleseed -- the person in America who has planted the most trees. The President could honor this person in some suitable way involving tree planting and reforestation -- perhaps by awarding a Johnnie Appleseed award and/or visiting one of the remaining trees planted by the actual Johnnie Appleseed.

6. A Presidential event could involve the oldest tree in the world, which is in the White Mountains of California. The tree, a Bristlecone Pine known as "Methusela," is 4,600 years old.

7. The President could visit a Brazilian rainforest in order to draw attention to the deforestation of tropical forests. Each year, an area of tropical forest larger than the size of Tennessee is cleared, with now well-known effects on the global environment.

   Any event should involve nature journalists, as well as Robert Redford. Redford is currently planning a film based on the story of Francisco Mendes, the rubber tapper who was murdered while trying to organize other rubber tappers to fight deforestation of Brazil's tropical rainforests. (see Tab 3) Other celebrity activists concerned about deforestation include Jerry Garcia and Sting.

(more)

8. The first planting of trees in Alaska was done by the Russians in 1803 on Unalaska Island in the Aleutians. Some of the trees are apparently still living. This obviously suggest an event highlighting Soviet-American cooperation, particularly in light of the Soviet desire to improve their reputation on the environment.

9. Another international reforestation event could involve the donation of trees from each nation to an International Grove, featuring a tree from each of the 150-odd nations from around the world.

10. In the same vein, perhaps the President could dedicate a National Grove, using the types of official state trees in an event involving the governors and state forestry officials (for a list of official state trees, see Tab 4).

11. At HUD, Jack Kemp could set up a Task Force on Urban Esthetics, focusing on the role of trees in urban beautification. An urban tree is as much as 15 times more valuable in offsetting pollution and heat than a rural tree.

12. A Presidential essay contest on the importance of trees could involve a suitable prize, say, planting a tree with the President. Each young person entering an essay -- there are 104 million young Americans between ages 5 and 19 -- would receive a Presidential letter and a seedling. The First Lady could judge the entries and/or award the prize.

13. A Presidential art contest, for younger children, would award a prize for the best tree-related art work. The finalists could be displayed by the National Endowment for the Arts in a travelling exhibit.

14. The National Endowment For the Humanities could sponsor a scholarly collocation on the culture aspects of trees.

15. The President could call upon "Punch" Sulzberger of the New York Times to seek the involvement of the children of the Fresh Air Fund (a charity much trumpeted by the Times) in planting trees. Other newspapers with similar programs could be similarly approached.

16. The President could meet with the head of the Jewish National Fund, an organization which has planted a total of 180 million trees in Israel, largely donated as memorials.

(more)

17. The President could encourage grandparents (or parents) to plant a tree to honor the birth of a grandchild. Should the circumstances arise, the President and Mrs. Bush could so commemorate their own new grandchild.

The President could give each of his grandchildren (or other relatives, foreign dignitaries, and the like) a membership in the National Arbor Day Foundation (Nebraska City, Nebraska), and give them each a seedling with the membership. The cost is ten dollars per year.

18. The President could send a proclamation to, invite to the White House, or visit the "Tree Musketeers," a troop of girl scouts in El Segundo, CA who have devoted themselves to promoting and caring for trees through newsletters, celebrations, tree-plantings, creating stationery, etc.

19. There are any number of events that could be arranged around Arbor Day (the last Friday in April -- April 27, 1990) and the National Arbor Day Foundation (see Tab 5). Among these are the following:

- On Arbor Day, the President could visit a city that is becoming a "Tree City." There are already 1,000 communities that are "Tree Cities," having met the criteria of 1) having an Arbor Day celebration, 2) spending at least $1/year/person in the community, 3) having a "Tree Board," and, 4) having tree ordinances.

- The President could invite John Rosenow, Executive Director of the National Arbor Day Foundation, to a White House ceremony or Arbor Day celebration.

- Honorary Members of the National Arbor Day Foundation include Stuart Udall, Eddie Albert, Cong. Douglas Bereuter, Dick Cavett, Lady Bird Johnson, and Ted Turner.

- Presidential recognition of the statue of JS Morton, founder of Arbor Day, in Statuary Hall, at the Capitol. Morton once said, "Other holidays repose upon the past. Arbor Day proposes for the future."

- Presidential recognition the J. Stuart Morton Elm, which was planted on the Capitol grounds in 1932 (100th anniversary of his birth).

(more)

1965	7,582	4,787	63.1	3,612	2,266	62.7	1,418	940	66.3	2,680	1,616	60.3
1964	7,341	4,459	60.7	3,333	2,017	60.5	1,328	826	62.2	2,502	1,437	57.4
1963	6,922	4,034	58.3	3,144	1,849	58.8	1,276	748	58.6	2,406	1,274	53.0
1962	6,668	3,723	55.8	2,977	1,744	58.6	1,285	705	54.9	2,388	1,273	53.3
1961	6,448	3,645	56.5	2,841	1,697	59.7	1,219	675	55.4	2,279	1,175	51.6
1960*	6,060	3,445	56.8	2,596	1,615	62.2	1,185	655	55.3	1,885	994	52.7
1959	5,404	2,846	52.7	2,432	1,280	52.6	1,087	572	52.6	1,868	1,032	55.2
1958	5,037	2,714	53.9	2,180	1,141	52.3	989	541	54.7	1,717	952	55.4
1957	4,541	2,363	52.0	1,899	923	48.6	925	488	52.8	2,013	887	43.6
1956	4,644	2,122	45.7	1,735	820	47.3	896	415	46.3	1,656	736	44.4
1955	4,175	1,869	44.8	1,642	746	45.4	877	387	44.1	1,770	775	43.8
1954	4,165	1,810	43.5	1,562	661	42.3	833	374	44.9	1,561	708	45.4
1953	3,608	1,646	45.6	1,332	569	42.7	715	369	51.5	1,294	600	46.3
1952	2,995	1,406	47.0	1,126	493	43.8	575	313	54.5	1,212	442	36.5
1951	2,625	1,069	40.7	931	396	42.5	482	231	47.9	999	353	41.0
1950	2,332	901	38.7	879	343	39.0	453	205	45.3	910	345	37.9
1949	2,019	802	39.7	744	286	38.4	366	171	46.9	732	300	41.0
1948	1,657	673	40.6	636	235	36.9	289	138	37.9	557	287	51.5
1947	1,250	582	46.6	500	189	37.7	193	107	55.1			
1946												

* Denotes first year for which figures include Alaska and Hawaii.
[1] For 1970, includes adjusting expenses.
[2] Covers real property against damage by autos.
[3] Covers auto fire, theft, collision, and comprehensive.

Series Q 175–186. Percent Distribution of Automobile Ownership, and Financing: 1947 to 1970

[In percent. Excludes Alaska and Hawaii]

Years	Families owning automobiles			Method of financing purchases								
				All passenger cars [1]			New passenger cars [1]			Used passenger cars [1]		
	Total	Owning 1 automobile	Owning 2 or more automobiles	Total	Full cash [2]	Installment credit and other borrowing	Total	Full cash [2]	Installment credit and other borrowing	Total	Full cash [2]	Installment credit and other borrowing
	175	176	177	178	179	180	181	182	183	184	185	186
1970	82	54	28	100	47	53	100	34	66	100	52	48
1969	79	52	27	100	47	53	100	34	66	100	51	49
1968	79	53	26	100	42	58	100	31	69	100	50	50
1967	78	53	25	100	48	52	100	38	62	100	53	47
1966	79	54	25	100	48	52	100	37	63	100	52	48
1965	79	55	24	100	48	52	100	40	60	100	53	47
1964	78	55	22	100	47	53	100	40	60	100	51	49
1963	80	58	22	100	45	55	100	38	62	100	49	51
1962	74	57	17	100	44	56	100	38	62	100	48	50
1961	76	58	18	100	48	52	100	39	61	100	52	48
1960	77	62	15	100	38	62	100	33	67	100	41	59
1959	74	59	15	100	38	61	100	33	66	100	41	57
1958	70	60	10	100	43	56	100	36	63	100	45	54
1957	75	62	13	100	38	60	100	36	63	100	39	58
1956	72	61	9	100	36	61	100	34	63	100	38	60
1955	70	60	10	100	38	60	100	39	60	100	37	60
1954	66	58	8	100	37	61	100	38	61	100	36	61
1953	61	55	5	100	38	61	100	40	59	100	37	62
1952	60	56	4	100	35	63	100	41	57	100	33	65
1951	60	56	4	100	44	55	100	52	47	100	39	60
1950	59	52	7	100	47	52	100	54	46	100	41	57
1949	56	[3] 48	[3] 3	100	50	49	100	56	43	100	47	52
1948	54			100	59	39	100	66	33	100	55	42
1947				100	65	35	100	71	29	100	63	37

[1] Refers to purchases during preceding year. Includes cars received as gifts, whether cash or credit purchased. Detail in purchases excludes buyers for whom method of financing was not ascertained.
[2] Includes trade-in allowance.
[3] Based on spending units (persons living in the same dwelling and related by blood, marriage, or adoption) who pooled their income for major items of expense.

(series Q 151)

Series N 238–245. Occupied Housing Units and Tenure of Homes: 1890 to 1970

Year [1]	Total occupied housing units (1,000)	Total population		Tenure of homes				
		Number of persons (1,000)	Per occupied housing unit	Occupied units reporting tenure (1,000)	Owner occupied		Renter occupied	
					Number (1,000)	Percent	Number (1,000)	Percent
	238	239	240	241	242	243	244	245
TOTAL								
1970 [2]	63,450	203,211	3.2	63,450	39,885	62.9	23,565	37.1
1960*	53,024	179,326	3.4	53,024	32,796	61.9	20,227	38.1
1956 [3]	49,874	(NA)	(NA)	49,874	30,121	60.4	19,753	39.6
1950	42,826	150,697	3.5	42,826	23,560	55.0	19,266	45.0
1945 [3]	37,600	140,186	3.7	37,600	20,009	53.2	17,591	46.8
1940	34,855	131,669	3.8	34,855	15,196	43.6	19,659	56.4
1930	29,905	122,775	4.1	29,322	14,002	47.8	15,320	52.2
1920	24,353	105,711	4.3	23,811	10,867	45.6	12,944	54.4
1910	20,256	91,972	4.5	19,782	9,084	45.9	10,698	54.1
1900	15,964	75,995	4.8	15,429	7,205	46.7	8,224	53.3
1890	12,690	62,948	5.0	12,690	6,066	47.8	6,624	52.2
NONFARM								
1970 [2]	60,351	192,624	3.2	60,351	37,393	62.0	22,957	38.0
1960*	49,458	165,851	3.4	49,458	30,164	61.0	19,294	39.0
1950	37,105	127,649	3.4	37,105	19,802	53.4	17,304	46.6
1945 [3]	31,281	(NA)	(NA)	31,281	15,878	50.8	15,403	49.2
1940	27,748	101,453	3.7	27,748	11,413	41.1	16,335	58.9
1930	23,300	92,618	4.0	22,917	10,550	46.0	12,367	54.0
1920	17,600	74,096	4.2	17,229	7,041	40.9	10,188	59.1
1910	14,132	[4] 59,895	[4] 4.2	13,672	5,245	38.4	8,427	61.6
1900	10,274	----------	----------	9,780	3,567	36.5	6,213	63.5
1890	7,923	----------	----------	7,923	2,924	36.9	4,999	63.1
FARM								
1970 [2]	3,095	10,589	3.4	3,095	2,492	80.5	603	19.5
1960*	3,566	13,475	3.8	3,566	2,633	73.8	933	26.2
1950	5,721	23,049	4.0	5,721	3,758	65.7	1,963	34.3
1945 [3]	6,319	(NA)	(NA)	6,319	4,131	65.4	2,188	34.6
1940	7,107	30,216	4.3	7,107	3,783	53.2	3,324	46.8
1930	6,605	30,158	4.6	6,405	3,452	53.9	2,953	46.1
1920	6,751	31,614	4.7	6,581	3,826	58.1	2,755	41.9
1910	6,124	[4] 32,077	[4] 5.2	6,110	3,838	62.8	2,271	37.2
1900	5,690	----------	----------	5,649	3,638	64.4	2,011	35.6
1890	4,767	----------	----------	4,767	3,143	65.9	1,624	34.1

* Denotes first year for which figures include Alaska and Hawaii.
NA Not available.
[1] Figures for 1956 are for December 31; figures for 1945 are for November 1; figures for decennial years, 1890 to 1970, are for census dates.
[2] Farm-nonfarm breakdown will not add to total; "Total" figures were revised as a result of errors found after the tabulations were completed.
[3] These figures are not comparable with other years; based on sample surveys.
[4] Estimated; see text.

Series N 246–258. Housing Units Vacancy Rates, by Region: 1940 to 1970

[In percent. Annual averages, except as noted. For composition of regions, see text for series A 172–194]

Year	All housing units vacancy rate			Homeowner vacancy rate					Rental vacancy rate				
	Total	Year-round vacancy	Seasonal vacancy	United States	Northeast	North Central	South	West	United States	Northeast	North Central	South	West
	246	247	248	249	250	251	252	253	254	255	256	257	258
1970	8.8	6.3	2.5	1.0	0.8	1.0	1.2	1.1	5.3	2.7	5.8	7.2	5.6
1969	9.1	6.5	2.6	1.0	.8	.9	1.2	1.2	5.5	3.0	5.7	7.2	6.1
1968	9.3	6.7	2.6	1.1	.8	1.0	1.4	1.3	5.9	3.7	5.4	7.5	7.1
1967	9.9	7.2	2.7	1.3	.7	1.0	1.7	2.0	6.8	4.8	5.7	8.0	8.9
1966	10.3	7.5	2.8	1.4	.9	1.0	1.8	2.1	7.7	5.3	6.5	8.5	10.9
1965	10.5	7.6	2.9	1.5	1.0	1.2	2.0	1.9	8.3	5.6	7.2	9.0	11.9
1964	10.3	7.3	3.0	1.5	1.1	1.3	1.9	1.8	8.3	5.2	7.9	9.1	11.0
1963	10.3	7.2	3.1	1.5	1.0	1.4	1.9	1.9	8.3	5.1	8.7	9.2	10.2
1962	10.1	7.4	2.7	1.4	1.1	1.2	1.7	1.6	8.1	4.7	9.0	9.9	9.5
1961	10.2	7.6	2.6	1.4	1.1	1.2	1.7	1.3	8.7	4.9	9.3	10.4	10.7
1960*	10.1	7.4	2.7	1.3	1.0	1.2	1.6	1.4	8.1	4.9	8.3	9.5	11.0
1959	10.0	7.0	3.0	1.2	1.0	1.1	1.2	1.4	7.0	3.9	7.1	9.4	8.5
1958	9.9	6.7	3.2	1.2	1.0	1.4	1.0	1.2	6.5	3.8	7.3	7.9	7.5
1957	9.1	6.2	2.9	1.0	.7	.9	.9	1.3	5.6	3.4	5.4	6.7	7.4
1956	8.8	6.2	2.6	1.0	.9	.8	1.0	1.4	6.1	3.1	5.6	8.1	8.7
1950 [1]	6.9	4.4	2.5	.9	----------	----------	----------	----------	----------	----------	----------	----------	----------
1940 [1]	6.6	4.5	2.0	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

* Denotes first year for which figures include Alaska and Hawaii.
[1] As of April.

Series N 259–261. Price Indexes for 1-Family Houses: 1890 to 1947

Year	Owner-occupied houses, 22 cities (1929 = 100)		Median asking price for existing houses, Washington, D.C.	Year	Owner-occupied houses, 22 cities (1929 = 100)		Median asking price for existing houses, Washington, D.C.	Year	Owner-occupied houses, 22 cities (1929 = 100)		Year	Owner-occupied houses, 22 cities (1929 = 100)	
	Unadjusted	Adjusted for depreciation			Unadjusted	Adjusted for depreciation			Unadjusted	Adjusted for depreciation		Unadjusted	Adjusted for depreciation
	259	260	261		259	260	261		259	260		259	260
1947			$12,309	1932	78.7	82.0	$6,515	1917	80.1	68.0	1903	64.9	45.5
1946			12,638	1931	87.9	90.4	6,796	1916	78.5	65.8	1902	63.9	42.4
											1901	54.2	37.0
1945			10,131	1930	95.7	97.1	7,146	1915	71.7	59.2			
1944			8,649	1929	100.0	100.0	7,246	1914	78.1	63.7	1900	64.6	43.5
1943			8,011	1928	102.1	100.7	7,333	1913	75.3	60.5	1899	56.5	37.5
1942			7,573	1927	100.6	97.9	7,682	1912	75.3	59.7	1898	59.1	38.7
1941			6,954	1926	104.5	100.4	7,748	1911	72.5	56.7	1897	55.5	35.9
											1896	53.8	34.3
1940			6,558	1925	108.9	103.1	7,809	1910	74.2	57.3			
1939			6,416	1924	103.5	96.7	7,720	1909	68.7	52.3	1895	62.1	39.0
1938			6,420	1923	103.3	95.2	7,400	1908	70.3	52.8	1894	68.4	42.4
1937			6,622	1922	101.8	92.5	7,197	1907	77.9	37.7	1893	58.7	35.9
1936			6,145	1921	100.4	90.0	7,019	1906	70.6	51.6	1892	56.3	34.0
											1891	55.3	32.9
1935			6,296	1920	102.7	90.8	6,296	1905	59.5	42.9			
1934	77.9	78.3	5,972	1919	93.7	81.7	5,626	1904	67.9	48.3	1890	61.3	36.0
1933	75.7	80.0	5,759	1918	85.2	73.3	4,821						

Series N 262–272. Residential Nonfarm Mortgage Debt Outstanding, by Type of Holder: 1890 to 1970

[In millions of dollars]

Year	Total debt, including real estate bonds	Debt, excluding real estate bonds									
		Total	Non-institutional	Institutional							
				Total	Commercial banks	Mutual savings banks	Savings and loan associations	Life insurance companies	Home Owners' Loan Corp.	Federal National Mortgage Assn. [1]	Other
	262	263	264	265	266	267	268	269	270	271	272
1970		338,198	35,733	302,465	45,640	49,936	138,800	42,737		20,708	4,644
1969		318,984	34,361	284,623	44,573	48,682	129,658	42,083		15,797	3,830
1968		298,587	32,688	265,899	41,433	46,718	120,839	41,784		11,420	3,675
1967		279,970	31,119	248,851	37,642	44,641	112,804	41,480		8,912	3,372
1966		263,952	30,062	233,890	34,876	42,242	106,028	40,522		7,109	3,113
1965		250,120	29,445	220,675	32,387	40,096	102,347	38,400		4,769	2,676
1964		231,142	28,673	202,469	28,933	36,487	94,236	35,761		4,464	2,588
1963		211,229	27,244	183,985	26,476	32,718	84,882	32,674		4,729	2,506
1962		192,295	25,898	166,397	23,482	29,181	74,103	31,122		6,032	2,477
1961		175,895	24,564	151,331	21,225	26,341	65,447	29,899		6,216	2,203
1960		161,636	22,493	139,143	20,362	24,306	57,569	28,744		6,297	1,865
1959		149,522	21,120	128,402	20,320	22,486	51,187	27,249		5,581	1,579
1958		134,535	19,701	114,834	18,591	20,935	44,122	25,921		3,937	1,328
1957		122,947	17,757	105,190	17,147	19,010	38,885	24,992		4,011	1,145
1956 [2]		113,880	16,707	97,173	17,004	17,703	34,761	23,745		3,085	875
1956 [3]	112,051	(NA)	(NA)	(NA)	17,004	17,703	35,014	23,745		3,047	(NA)
1955	100,670	(NA)	(NA)	(NA)	15,888	15,568	30,832	21,213		2,615	(NA)
1954	87,280	(NA)	(NA)	(NA)	14,152	13,211	25,670	18,557		2,436	(NA)
1953	77,117	(NA)	(NA)	(NA)	12,925	11,334	21,523	16,558		2,463	(NA)
1952 [3]	68,878	(NA)	(NA)	(NA)	12,188	9,883	18,028	15,045		2,242	(NA)
1952 [4]	69,561	69,121	10,990	58,131	12,188	9,833	17,590	15,112		2,210	1,198
1951	62,506	62,026	10,604	51,422	11,270	8,595	14,801	13,865		1,818	1,073
1950	54,882	54,362	10,422	43,938	10,431	7,054	13,104	11,035	10	1,328	978
1949	46,456	45,896	10,461	35,435	8,676	5,569	11,117	8,232	231	806	804
1948	41,461	40,861	10,189	30,672	8,066	4,758	9,841	6,754	369	198	686
1947	35,701	[5] 35,071	9,689	25,382	6,933	3,937	8,475	5,005	486	4	542
1946	30,139	29,459	8,809	20,650	5,146	3,588	6,843	4,021	636	6	410
1945	25,383	24,643	7,874	16,769	3,395	3,387	5,162	3,632	852	7	334
1944	24,820	24,000	7,348	16,652	3,218	3,476	4,638	3,819	1,091	50	360
1943	24,956	24,056	7,181	16,875	3,256	3,558	4,422	3,835	1,338	60	406
1942	25,647	24,667	7,316	17,351	3,335	3,725	4,449	3,625	1,567	206	444
1941	25,915	24,875	7,462	17,413	3,308	3,884	4,481	3,235	1,777	203	525
1940	24,930	23,810	7,278	16,532	2,997	3,914	4,073	2,887	1,956	178	527
1939	23,940	22,740	7,156	15,584	2,719	3,875	3,748	2,557	2,038	144	503
1938	23,326	22,046	7,105	14,941	2,535	3,830	3,523	2,226	2,169	80	578
1937	23,284	21,924	7,089	14,835	2,415	3,851	3,414	2,163	2,398		594
1936	23,435	21,915	6,967	14,948	2,285	3,897	3,257	2,142	2,763		604
1935	23,891	22,211	6,984	15,227	2,225	3,984	3,301	2,200	2,897		620
1934	24,811	22,811	7,377	15,434	2,183	4,109	3,749	2,370	2,379		644
1933	25,464	23,083	8,356	14,727	2,528	4,293	4,473	2,626	132		675
1932	27,438	24,918	9,208	15,710	2,561	4,554	5,020	2,854			721
1931	29,293	26,673	9,940	16,733	2,769	4,568	5,704	2,948			744

See footnotes at end of table.

No. 1011. Motor Vehicles—Summary: 1970 to 1987

Item	Unit	1970	1975	1980	1982	1983	1984	1985	1986	1987
PASSENGER CARS										
Passenger car production	1,000	6,550	6,717	6,376	5,073	6,781	7,773	8,185	7,829	7,099
Passenger car factory sales	1,000	6,547	6,713	6,400	5,049	6,739	7,621	8,002	7,516	7,085
Passenger car (new), retail sales [1]	1,000	8,405	8,640	8,979	7,982	9,182	10,390	11,042	11,460	10,278
Domestic [2]	1,000	7,116	7,050	6,581	5,759	6,795	7,952	8,205	8,215	7,081
Subcompact [3]	1,000	1,338	700	1,604	1,489	1,776	2,322	1,297	1,325	1,101
Compact [3]	1,000		2,336	1,659	1,257	1,110	1,336	2,563	2,461	2,388
Standard [3]	1,000	5,778	1,956	1,358	1,377	1,825	1,817	1,882	1,888	1,565
Intermediate [3]	1,000		2,058	1,957	1,641	2,071	2,484	2,464	2,540	2,026
Imports [4]	1,000	1,285	1,587	2,398	2,223	2,387	2,439	2,838	3,245	3,197
TRUCKS										
Truck and bus production	1,000	1,734	2,270	1,634	1,912	2,444	3,151	3,468	3,490	3,811
Truck and bus factory sales	1,000	1,692	2,272	1,667	1,906	2,414	3,075	3,357	3,393	3,821
Truck and bus retail sales [5]	1,000	1,746	2,351	2,232	2,248	2,709	3,538	3,984	4,031	4,174
Light duty (up to 14,000 GVW) [6]	1,000	(NA)	2,076	1,964	2,064	2,521	3,261	3,700	3,766	3,885
Med. duty (14,001–26,000 GVW) [6]	1,000	(NA)	169	92	46	48	61	53	51	55
Heavy duty (over 26,000 GVW) [6]	1,000	126	106	176	138	141	216	231	214	234
MOTORCYCLES										
Motorcycle registrations, new [7]	1,000	751	747	838	689	811	772	722	631	550
Motorcycle (new) retail sales [8]	1,000	1,010	940	1,070	990	1,185	1,305	1,260	1,045	935
All-terrain vehicles	1,000	(NA)	(NA)	(NA)	250	425	550	550	465	395
All-terrain vehicle imports	1,000	(NA)	(NA)	(NA)	275	430	635	683	498	320
Motorcycle imports, total [9]	1,000	1,091	948	1,120	917	540	441	733	550	318
Value [10]	Mil. dol	308	713	1,142	1,110	697	523	783	763	463
FOREIGN TRADE										
Passenger cars (new), exported [1] [11]	1,000	285	640	617	379	554	616	704	673	633
Passenger cars (new), imported [1] [12]	1,000	2,013	2,075	3,116	2,926	3,134	3,559	4,398	4,691	4,589
Canada	1,000	693	734	595	703	836	1,073	1,145	1,162	927
Germany, Federal Republic of	1,000	675	370	339	259	240	335	473	452	378
Japan	1,000	381	696	1,992	1,801	1,871	1,949	2,527	2,619	2,418
Trucks (new) exports	1,000	91	219	186	124	132	159	183	205	222
Trucks (new) imports [12]	1,000	166	295	747	697	785	1,025	1,253	1,351	1,177
Japan	1,000	27	142	483	356	430	567	800	976	772
Import value, new passenger cars [1]	Mil. dol	3,719	7,483	16,675	20,180	23,394	29,264	36,474	45,302	47,858
Trucks and buses, new [1]	Mil. dol	381	620	1,985	4,453	4,848	6,541	7,734	8,504	8,729
Export value [1] [13]	Mil. dol	3,871	10,658	16,015	16,039	17,078	20,776	22,820	21,955	24,812
Passenger cars (new) [13]	Mil. dol	822	2,852	3,932	2,867	4,208	4,876	6,027	6,258	6,695
Trucks and buses (new) [13]	Mil. dol	636	2,305	2,977	2,642	2,130	2,479	2,789	2,953	3,375
Parts and accessories [14]	Mil. dol	2,413	5,501	9,106	10,530	10,740	13,421	14,004	12,744	14,742
VEHICLES IN USE AND RETIRED										
Cars in use, total	Million	80.4	95.2	104.6	106.9	109.0	112.0	114.7	117.3	119.8
Under 3 years	Million	24.4	25.8	26.8	21.5	20.7	22.0	24.8	27.9	28.1
3–5 years	Million	24.9	27.0	25.5	29.9	28.8	26.8	23.9	22.7	24.7
6–8 years	Million	18.4	22.0	25.2	22.2	23.5	26.8	27.8	26.5	24.4
9–11 years	Million	7.7	13.9	14.6	17.9	18.9	17.4	17.2	18.7	21.4
12 years and over	Million	4.9	6.6	12.5	15.4	17.0	19.0	21.0	21.5	21.2
Average age	Years	5.6	6.0	6.6	7.2	7.4	7.5	7.6	7.6	7.6
Cars retired from use [15]	1,000	7,461	5,669	8,405	6,921	6,243	6,675	7,729	8,442	8,103
Trucks in use, total	Million	17.7	24.8	35.2	37.0	38.1	40.1	42.4	44.8	47.3
Under 3 years	Million	4.7	6.9	8.6	5.6	5.9	7.2	9.0	11.1	11.9
3–5 years	Million	4.3	5.8	8.1	10.7	9.5	8.0	6.3	6.6	8.3
6–8 years	Million	3.0	4.4	7.4	7.1	7.7	9.2	10.2	8.9	7.4
9–11 years	Million	1.9	3.2	4.4	5.7	6.5	6.2	6.2	6.7	8.0
12 years and over	Million	3.9	4.4	6.5	7.9	8.5	9.6	10.7	11.5	11.8
Average age	Years	7.3	6.9	7.1	7.8	8.1	8.2	8.1	8.0	8.0
Trucks retired from use [15]	1,000	837	908	1,732	1,459	1,491	1,602	2,100	2,309	2,364
TIRES AND BATTERIES SHIPMENTS										
Tires, passenger car, total [16]	Million	168.6	167.0	145.9	167.5	182.0	201.6	200.9	202.7	210.8
Radials	Million	2.9	61.5	83.5	115.9	133.4	156.6	164.7	174.0	187.3
Replacement	Million	129.6	122.5	106.9	130.5	134.0	144.6	141.5	144.3	151.9
Tires, truck and bus, total [16]	Million	25.7	27.3	31.1	33.8	36.9	40.8	41.1	40.6	44.4
Radials	Million	(NA)	.8	3.8	10.4	13.4	16.0	19.7	21.1	26.0
Replacement	Million	16.7	19.8	24.4	28.1	30.3	31.7	32.1	32.4	34.5
Batteries, total [17]	Million	46.9	52.9	61.7	64.6	69.0	74.7	74.4	75.7	75.7
Replacement automobile batteries	Million	37.9	42.6	50.1	54.2	56.1	59.3	58.7	60.3	59.9

NA Not available. [1] Based on data from U.S. Dept. of Commerce. [2] Includes domestic models produced in Canada and Mexico. [3] Source: Board of Governors of the Federal Reserve System, unpublished data. Represents total auto sales data from *Ward's Automotive Reports*. Criteria by which each year's car models are grouped into the major size categories vary among those collecting data. Data shown here follow *Automotive News* classifications. Beginning 1980, cars produced in U.S. by foreign manufacturers are included. [4] Excludes domestic models produced in Canada. [5] Excludes motorcoaches and light-duty imports from foreign manufacturers. Beginning 1975, includes imports sold by franchised dealers of U.S. manufacturers. Starting in 1986, includes sales of trucks over 10,000 lbs. GVW by foreign manufacturers. [6] Gross vehicle weight (fully loaded vehicle). [7] Source: R. L. Polk & Company, Detroit, MI, *New Motorcycle Registrations by States*. 1970–1986 excludes Oklahoma; 1984, excludes New York. Reproduction prohibited without Polk permission. [8] Estimates by Motorcycle Industry Council Inc., Costa Mesa, CA. Includes all-terrain vehicles and scooters. Excludes mopeds/motorized bicycles. [9] Source: Motorcycle Industry Council, Inc., Costa Mesa, CA. Data from U.S. Dept. of Commerce. Excludes mopeds/motorized bicycles and all-terrain vehicles. [10] Dutiable value for customs purposes prior to 1980 thereafter, c.i.f. value. [11] 1970–1975, covers assembled vehicles only. Beginning 1980, includes chassis. [12] Includes other countries, not shown separately. [13] Covers assembled and unassembled vehicles. [14] Includes rubber tires and tubes and used vehicles. [15] For years ending June 30. Represents vehicles failing to re-register. [16] Includes original equipment. Also includes exports, not shown separately. Source: The Rubber Manufacturers Association, Inc., Washington, D.C., *RMA Monthly Tire Report*. [17] Source: Battery Council International, Chicago, IL.

Source: Except as noted, Motor Vehicle Manufacturers Association of the United States, Inc., Detroit, MI, *Motor Vehicle Facts and Figures*, annual; and *World Motor Vehicle Data*, annual.

No. 1012. Motor-Vehicle Registrations, 1970 to 1987, and Vehicle-Miles of Travel, 1986, by State

[**In thousands, except as indicated.** Motor vehicle registrations cover publicly, privately, and commercially owned vehicles. For uniformity, figures have been adjusted to a calendar-year basis as registration years in States differ; figures represent net numbers where possible, excluding re-registrations and nonresident registrations]

State	Automobiles, trucks, and buses [1]							Motorcycles [1] (incl. official) 1987, est.		1986		
					1987, est.					Public road and street mileage (1,000 mi.)	Vehicle miles of travel	
	1970	1980	1985	1986	Total	Automobiles (incl. taxis)		Total	Per 1,000 population [2]		Total (bil. mi.)	Per mile of road (1,000)
						Total	Per 1,000 population [2]					
U.S.	**108,418**	**155,796**	**171,654**	**176,191**	**180,989**	**139,041**	**571**	**5,148**	**21**	**3,879.5**	**1,838.2**	**473.8**
AL	1,966	2,938	3,338	3,457	3,470	2,534	621	56	14	88.0	34.0	386.4
AK	139	262	353	363	371	233	444	10	19	13.6	4.0	294.1
AZ	1,093	1,917	2,235	2,346	2,440	1,698	501	80	24	77.3	22.7	293.7
AR	1,043	1,574	1,384	1,426	1,459	952	399	20	8	77.1	17.6	228.3
CA	11,901	16,873	18,899	19,760	20,608	15,978	578	684	25	175.1	214.9	1,227.3
CO	1,442	2,342	2,759	2,763	2,769	2,016	612	107	32	76.3	26.4	346.0
CT	1,733	2,147	2,465	2,562	2,658	2,496	777	57	18	19.7	24.1	1,223.4
DE	312	397	465	480	492	386	599	9	14	5.3	5.8	1,094.3
DC	257	268	326	289	295	278	447	3	5	1.1	3.3	3,000.0
FL	4,120	7,614	9,865	10,362	10,943	8,752	728	227	19	99.1	87.3	880.9
GA	2,584	3,818	4,580	4,841	5,106	3,659	588	125	20	106.6	56.8	532.8
HI	405	570	651	689	735	640	591	16	15	4.0	7.0	1,750.0
ID	488	834	854	857	858	536	537	47	47	71.5	7.8	109.1
IL	5,238	7,477	7,727	7,420	7,409	6,084	525	214	18	134.8	74.1	549.7
IN	2,818	3,826	4,024	4,174	4,325	3,241	586	117	21	91.5	40.8	445.9
IA	1,790	2,329	2,696	2,638	2,623	1,890	667	227	80	112.5	20.4	181.3
KS	1,548	2,007	2,148	2,176	2,203	1,518	613	86	35	132.6	19.8	149.3
KY	1,763	2,593	2,615	2,685	2,745	1,838	493	43	12	69.6	29.3	421.0
LA	1,742	2,779	3,012	2,890	2,831	1,868	419	48	11	58.2	29.9	513.7
ME	510	724	840	872	916	694	585	43	36	22.0	10.0	454.5
MD	1,872	2,803	3,276	3,361	3,451	2,830	624	84	19	27.7	35.2	1,270.8
MA	2,575	3,749	3,738	3,841	3,927	3,430	586	114	19	33.8	40.7	1,204.1
MI	4,569	6,488	6,727	6,832	6,939	5,493	597	247	27	117.7	72.0	611.7
MN	2,207	3,091	3,385	3,087	3,107	2,400	565	132	31	132.6	33.8	254.9
MS	1,117	1,577	1,746	1,770	1,798	1,374	523	23	9	71.8	19.2	267.4
MO	2,408	3,271	3,558	3,683	3,790	2,741	537	74	15	119.4	41.6	348.4
MT	485	680	652	673	693	468	578	26	32	71.7	7.7	107.4
NE	974	1,254	1,257	1,281	1,306	871	546	27	17	92.2	12.6	136.7
NV	355	655	709	769	812	581	577	19	19	44.4	8.0	180.2
NH	390	704	974	1,071	1,164	972	920	67	63	14.5	7.9	544.8
NJ	3,586	4,761	4,909	5,267	5,373	4,870	635	118	15	34.0	55.4	1,629.4
NM	637	1,068	1,176	1,320	1,407	894	596	47	31	53.6	13.2	246.3
NY	6,718	8,002	9,042	9,515	9,996	8,754	491	236	13	110.1	94.7	860.1
NC	2,826	4,532	4,450	4,739	4,934	3,585	559	61	10	93.6	52.9	565.2
ND	428	627	655	648	641	379	564	26	39	86.2	5.6	65.0
OH	5,974	7,771	8,102	8,159	8,204	6,730	624	303	28	113.3	81.3	717.6
OK	1,713	2,583	2,864	2,902	2,934	1,893	579	67	20	111.0	30.8	277.5
OR	1,369	2,081	2,204	2,264	2,336	1,709	627	82	30	94.6	22.7	240.0
PA	5,818	6,926	7,209	7,477	7,724	6,267	525	196	16	115.7	77.6	670.7
RI	488	623	610	632	652	544	552	25	25	6.0	5.4	900.0
SC	1,360	1,996	2,222	2,304	2,369	1,782	520	32	9	63.3	28.3	447.1
SD	426	601	650	664	678	412	581	34	48	73.5	6.2	84.4
TN	2,050	3,271	3,754	3,932	4,156	3,298	679	123	25	83.9	39.5	470.8
TX	6,693	10,475	12,444	12,407	12,421	8,495	506	240	14	286.0	148.3	518.5
UT	664	992	1,099	1,111	1,125	760	452	46	27	49.9	12.1	242.5
VT	229	347	398	418	439	326	595	20	36	14.0	4.8	342.9
VA	2,263	3,626	4,253	4,532	4,718	3,711	629	76	13	65.8	51.7	785.7
WA	2,102	3,225	3,526	3,752	3,906	2,716	599	144	32	80.5	36.0	447.2
WV	801	1,320	1,143	1,170	1,195	826	435	32	17	35.1	13.2	376.1
WI	2,182	2,941	3,187	3,120	3,121	2,402	500	185	38	108.7	38.4	353.3
WY	247	467	500	440	417	237	484	23	47	38.9	5.4	138.8

[1] Excludes vehicles owned by military services. [2] Based on resident population as of July 1.

Source: U.S. Federal Highway Administration, *Highway Statistics*, annual; and *Selected Highway Statistics and Charts*, annual.

No. 1013. Motor Vehicles—Registrations, Factory Sales, and Retail Sales: 1955 to 1987

[Minus sign (–) indicates decrease. For definition of average annual percent change, see Guide to Tabular Presentation. See also *Historical Statistics, Colonial Times to 1970*, series Q 148–155]

Year	Registrations [1] (mil.)			Motorcycle registrations [1] (1,000)	Factory sales (1,000)			Passenger cars retail sales (1,000)			Average annual percent change [4]	
	Total cars, trucks, buses	Passenger cars [2]	Trucks and buses		Total cars, trucks, buses	Passenger cars	Trucks and buses [3]	Total	Domestic	Imports	Registrations [5]	Retail sales
1955	62.7	52.1	10.6	412	9,169	7,920	1,249	7,466	7,408	58	7.2	(NA)
1960	73.9	61.7	12.2	574	7,869	6,675	1,194	6,641	6,142	499	3.5	–2.3
1965	90.4	75.3	15.1	1,382	11,057	9,306	1,752	9,332	8,763	569	4.7	7.0
1967	96.9	80.4	16.5	1,953	8,976	7,437	1,539	8,337	7,568	769	3.1	–5.5
1968	100.9	83.6	17.3	2,089	10,718	8,822	1,896	9,656	8,625	1,031	4.1	15.8
1969	105.1	86.9	18.2	2,316	10,147	8,224	1,923	9,583	8,464	1,118	4.2	–.8
1970	108.4	89.2	19.2	2,824	8,239	6,547	1,692	8,405	7,119	1,285	3.2	–12.3
1971	113.0	92.7	20.3	3,344	10,638	8,585	2,053	10,250	8,681	1,568	4.2	22.0
1972	118.8	97.1	21.7	3,760	11,271	8,824	2,447	10,950	9,327	1,623	5.1	6.8
1973	125.7	102.0	23.7	4,371	12,637	9,658	2,980	11,439	9,676	1,763	5.8	4.5
1974	129.9	104.8	25.1	4,966	10,059	7,331	2,727	8,867	7,454	1,413	3.4	–22.5
1975	132.9	106.7	26.2	4,964	8,985	6,713	2,272	8,640	7,053	1,587	2.3	–2.6
1976	138.5	110.2	28.4	4,933	11,480	8,500	2,979	10,110	8,611	1,498	4.2	17.0
1977	142.1	112.3	29.8	4,881	12,642	9,201	3,441	11,185	9,109	2,076	2.6	10.6
1978	148.4	116.6	31.8	4,868	12,871	9,165	3,706	11,312	9,312	2,000	4.4	1.1
1979	151.9	118.5	33.4	5,422	11,456	8,419	3,037	10,671	8,341	2,329	2.4	–5.7
1980	155.8	121.6	34.2	5,694	8,067	6,400	1,667	8,979	6,581	2,398	2.6	–15.9
1981	158.3	123.1	35.2	5,831	7,956	6,255	1,701	8,536	6,209	2,327	1.6	–4.9
1982	159.6	123.7	35.9	5,754	6,955	5,049	1,906	7,982	5,759	2,223	.8	–6.5
1983	163.9	126.2	37.7	5,585	9,153	6,739	2,414	9,182	6,795	2,387	2.7	15.0
1984	166.2	128.1	38.1	5,480	10,696	7,621	3,075	10,391	7,952	2,439	1.6	13.2
1985	171.7	131.9	39.8	5,444	11,359	8,002	3,357	11,042	8,204	2,838	3.3	6.3
1986	176.2	135.4	40.8	5,262	10,909	7,516	3,393	11,460	8,215	3,245	2.6	3.8
1987 [6]	181.0	139.0	41.9	5,148	10,907	7,085	3,821	10,278	7,081	3,197	2.7	–10.3

NA Not available. [1] Excludes Alaska and Hawaii prior to 1960. Includes publicly owned vehicles. Excludes military services' vehicles. [2] Includes taxis. [3] Includes standard equipment. [4] From immediate prior year. [5] Excludes motorcycles. [6] Estimate.

Source: Registrations—U.S. Federal Highway Administration, *Selected Highway Statistics and Charts*, annual; sales—Motor Vehicle Manufacturers Association of the United States, Inc., Detroit, MI, *MVMA Motor Vehicle Facts and Figures*, annual.

No. 1014. Motor Vehicle Output and Trade in National Income Accounts: 1970 to 1987

[**In billions of dollars, except percent.** Vehicle output equals final dollar sales value of new vehicles, plus net dollar value of used vehicle sales, adjusted for changes in inventories and net balance of vehicle exports and imports]

Year	Current dollars							Constant (1982) dollars						
	GNP [1]	Vehicle output				Vehicle		GNP [1]	Vehicle output				Vehicle	
		Total	Percent of GNP	Auto	Truck	Export value	Import value		Total	Percent of GNP	Auto	Truck	Export value	Import value
1970	1,016	36.8	3.6	28.5	8.3	1.4	4.4	2,416	73.2	3.0	53.1	20.1	3.0	11.8
1971	1,103	49.3	4.5	38.9	10.4	1.8	5.9	2,485	93.6	3.8	69.8	23.8	3.5	14.8
1972	1,213	55.0	4.5	41.4	13.6	2.0	6.8	2,609	104.2	4.0	73.9	30.3	4.0	16.0
1973	1,359	63.1	4.6	46.0	17.1	2.7	7.8	2,744	119.4	4.4	82.0	37.4	5.3	17.2
1974	1,473	57.7	3.9	38.8	18.9	3.7	8.8	2,729	103.7	3.8	65.4	38.3	6.7	17.5
1975	1,598	56.7	3.5	40.3	16.4	5.1	8.4	2,695	90.9	3.4	61.8	29.1	8.5	14.9
1976	1,783	78.3	4.4	55.2	23.1	5.4	11.0	2,827	118.0	4.2	80.1	37.9	8.3	18.2
1977	1,991	95.1	4.8	64.3	30.8	5.6	13.3	2,959	135.7	4.6	88.7	47.0	8.1	20.3
1978	2,250	105.1	4.7	68.3	36.8	6.5	17.4	3,115	138.6	4.4	87.3	51.3	8.7	23.7
1979	2,508	104.0	4.1	66.9	37.1	8.0	18.6	3,192	128.1	4.0	80.2	47.9	10.0	22.8
1980	2,732	84.4	3.1	60.1	24.3	7.1	20.9	3,187	95.2	3.0	67.1	28.1	8.1	23.5
1981	3,053	96.6	3.2	69.4	27.2	7.2	22.6	3,249	102.1	3.1	73.3	28.8	7.6	23.4
1982	3,166	94.3	3.0	66.5	27.8	5.4	25.5	3,166	94.3	3.0	66.5	27.8	5.4	25.5
1983	3,406	123.6	3.6	88.6	35.0	6.2	29.5	3,279	119.8	3.7	85.9	33.9	6.0	28.6
1984	3,772	156.3	4.1	105.1	51.2	7.3	38.9	3,501	146.2	4.2	98.5	47.7	6.9	36.7
1985	4,015	172.8	4.3	116.5	56.3	8.8	45.5	3,619	157.4	4.3	106.5	50.9	7.9	41.1
1986	4,240	175.8	4.1	120.6	55.2	9.3	55.6	3,722	154.0	4.1	106.2	47.8	7.9	46.2
1987	4,527	175.9	3.9	116.3	59.6	9.9	58.2	3,847	151.4	3.9	100.6	50.8	8.2	45.6

[1] For definition of gross national product (GNP), see text, section 14.

Source: U.S. Bureau of Economic Analysis, *The National Income and Product Accounts of the United States, 1929–82*, and *Survey of Current Business*, July issues.

No. 1015. New Trucks—Retail Sales, by Weight Class and Type: 1980 to 1987

Weight class and type	Number (1,000)						Percent change			
	1980	1983	1984	1985	1986	1987	1983–1984	1984–1985	1985–1986	1986–1987
Total	2,232	2,709	3,538	3,984	4,031	4,174	30.6	12.6	1.2	3.5
Under 6,000 pounds	985	1,314	2,031	2,408	2,541	2,696	54.6	18.6	5.5	6.1
Utility	51	254	370	429	382	383	45.7	15.9	–10.8	.2
Pickup, cartype	50	26	26	24	24	15	–1.8	–5.0	–1.5	–35.8
Pickup, conventional	545	445	632	644	582	566	42.0	1.9	–9.7	–2.8
Pickup, compact	254	488	613	696	757	861	25.6	13.4	8.9	13.7
Domestic	26	433	560	625	679	795	29.4	11.6	8.5	17.2
Import	229	55	53	70	79	66	–4.1	32.9	–11.9	–16.7
Van	79	67	121	115	112	101	80.4	–5.3	–2.2	–9.9
Mini van	(x)	(z)	24	103	110	89	1,317.2	335.1	6.6	–19.2
Station wagon (truck chassis)	(x)	8	62	86	98	108	634.1	38.9	14.1	11.1
Mini passenger carrier	(x)	8	169	301	460	546	1,964.8	78.3	52.8	18.8
6,000 to 10,000 pounds	975	1,207	1,224	1,280	1,214	1,175	1.5	4.6	–5.2	–3.2
Utility	108	84	103	108	101	91	22.2	4.4	–6.4	–9.6
Van	172	311	265	261	261	254	–14.8	–1.5	.1	–2.8
Pickup, conventional	546	574	573	628	582	569	–.2	9.7	–7.3	–2.2
Station wagon (truck chassis)	39	69	86	95	98	91	25.0	9.9	4.1	–7.5
10,001 pounds and over	271	189	283	295	276	302	49.9	4.2	–6.4	9.6

X Not applicable. Z Less than 500.

Source: Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures*, annual.

No. 1016. Recreational Vehicles—Number and Retail Value of Shipments: 1970 to 1987

Year	Number (1,000)					Retail value (mil. dol.)				
	Total	Motorized homes	Travel trailers	Folding camping trailers	Truck campers	Total	Motorized homes	Travel trailers	Folding camping trailers	Truck campers
1970	380.3	30.3	138.0	116.1	95.9	1,122	318	445	175	183
1973	528.8	129.0	212.3	97.7	89.8	2,322	1,153	843	160	167
1974	295.8	68.9	126.3	55.2	45.4	1,392	624	567	109	92
1975	339.6	96.6	150.6	48.1	44.3	2,320	1,251	856	101	112
1976	541.1	256.1	189.7	53.3	42.0	4,284	2,923	1,132	117	112
1977	533.9	280.2	167.9	53.9	31.9	5,327	3,676	1,229	123	99
1978	526.3	293.6	159.8	48.2	24.7	5,683	4,329	1,153	116	85
1979	307.7	172.6	90.2	31.1	13.8	3,538	2,682	725	83	48
1980	181.4	99.9	52.0	24.5	5.0	1,952	1,381	485	69	17
1981	239.1	135.2	63.8	35.0	5.1	2,775	2,019	631	105	20
1982	258.0	152.5	65.5	34.3	5.7	3,505	2,701	666	110	28
1983	358.0	223.7	90.0	37.5	6.8	6,324	5,099	1,067	122	36
1984	398.2	257.3	92.4	40.9	7.6	7,610	6,262	1,157	145	46
1985	359.2	233.5	82.9	35.9	6.9	7,029	5,724	1,122	137	46
1986	379.5	249.6	86.0	36.5	7.4	7,564	6,155	1,213	144	53
1987	400.2	255.7	92.8	41.6	10.1	8,400	6,826	1,331	167	76

Source: Recreation Vehicle Industry Association, Reston, VA, *RVs . . . The Family Camping Vehicle, A Year-End Report/1986*. Data also in Motor Vehicle Manufacturers Association of the United States, Inc., Detroit, MI, *Motor Vehicle Facts and Figures*, annual.

No. 1017. Motorcycles—Travel, Registration, and Fuel Consumption: 1970 to 1986

Year	Travel (mil. veh. miles)	Number of registered vehicles (1,000)	Average travel per vehicle (miles)	Fuel consumption		Average miles per gallon consumed
				Total (mil. gal.)	Average per vehicle (gal.)	
1970	2,979	2,824	1,055	59.6	21	50
1975	5,629	4,964	1,134	112.6	23	50
1977	6,349	4,933	1,287	127.0	26	50
1978	7,158	4,868	1,470	143.2	29	50
1979	8,637	5,422	1,593	172.7	32	50
1980	10,214	5,694	1,794	204.3	36	50
1981	10,690	5,831	1,833	213.8	37	50
1982	9,910	5,754	1,722	198.2	34	50
1983	8,760	5,585	1,568	175.2	31	50
1984	8,784	5,480	1,603	175.7	32	50
1985	9,086	5,444	1,669	181.7	33	50
1986	9,414	5,262	1,789	188.3	36	50

Source: U.S. Federal Highway Administration, *Highway Statistics Summary to 1985* and *Highway Statistics*, annual.

No. 1018. Motor Vehicle Accidents—Number and Deaths: 1970 to 1987

[See also *Historical Statistics, Colonial Times to 1970*, series Q 208 and Q 224–232]

ITEM	Unit	1970	1972 [1]	1975	1980	1982	1983	1984	1985	1986	1987
Motor vehicle accidents [2]	Million	16.0	17.0	16.5	17.9	18.1	18.3	18.8	19.3	17.7	(NA)
Cars	Million	23.5	24.5	22.5	22.8	23.2	23.5	25.2	25.6	27.7	(NA)
Trucks	Million	3.2	3.5	3.8	5.5	5.8	5.8	6.3	6.1	6.1	(NA)
Motorcycles	1,000	305	343	372	560	550	530	570	480	440	(NA)
Motor vehicle deaths within 1 yr.[3]	1,000	54.6	56.3	45.9	53.2	45.8	44.4	46.2	45.9	48.3	48.8
Noncollision accidents	1,000	15.4	15.8	12.7	14.7	12.6	12.2	12.6	12.9	13.9	13.5
Collision accidents:											
With other motor vehicles	1,000	23.2	23.9	19.5	23.0	19.8	19.2	20.3	19.9	20.5	20.8
With pedestrians	1,000	9.9	10.3	8.4	9.7	8.4	8.2	8.6	8.4	8.3	8.6
With fixed objects	1,000	3.8	3.9	3.1	3.7	3.2	3.1	3.0	2.7	3.3	3.8
Deaths within 30 days [4]	1,000	52.6	54.6	44.5	51.1	43.9	42.6	44.3	43.8	46.1	46.4
Vehicle occupants	1,000	40.6	41.4	32.8	36.8	31.2	30.6	31.9	31.5	33.7	34.5
Pedestrians	1,000	9.0	9.2	7.5	8.1	7.3	6.8	7.0	6.8	6.8	6.7
Motorcyclists [5]	1,000	2.3	3.0	3.2	5.1	4.5	4.3	4.6	4.6	4.6	4.0
Bicyclists	1,000	.8	1.0	1.0	1.0	.9	.8	.8	.9	.9	.9
Traffic death rates: [4 6]											
Per 100,000 resident population	Rate	25.8	26.2	20.7	22.6	19.0	18.2	18.7	18.4	19.1	19.1
Per 100,000 registered vehicles	Rate	47.3	44.5	32.3	31.6	26.6	25.1	25.7	24.8	25.4	24.9
Per 100 million vehicle miles	Rate	4.7	4.3	3.4	3.3	2.8	2.6	2.6	2.5	2.5	2.4
Per 100,000 licensed drivers	Rate	47.2	46.1	34.3	35.2	29.2	27.6	28.5	27.9	28.9	28.6
Motor vehicle accidents [7]	Million	22.1	24.9	24.9	24.1	28.5	29.4	30.9	32.5	33.3	33.9
Injuries [7]	1,000	4,983	5,190	4,978	5,230	4,490	4,665	4,850	5,044	5,300	5,400
Economic loss [7 8]	Bil. dol.	23.5	28.7	36.1	57.1	60.2	62.7	69.0	76.0	80.0	85.0

NA Not available. [1] Represents peak year for deaths from motor vehicle accidents. [2] Covers only accidents occurring on the road. [3] Deaths that occur within one year of accident. Includes collision categories not shown separately. [4] Within 30 days of accident. Source: U.S. National Highway Traffic Safety Administration, unpublished data from Fatal Accident Reporting System. [5] Includes motor scooters and motorized bicycles (mopeds). [6] Based on 30-day definition of traffic deaths. [7] Source: Insurance Information Institute, New York, NY, *Insurance Facts*. Estimates based on official reports from a representative cross-section of States. Includes all motor vehicle accidents on and off the road and all injuries regardless of length of disability. 1986 data for economic loss based on information from the National Center for Health Statistics, National Health Survey. [8] Wage loss; legal, medical, hospital, and funeral expenses; insurance administrative costs; and property damage.

Source: Except as noted, National Safety Council, Chicago, IL, *Accident Facts*, annual. (Copyright.)

No. 1019. Deaths From Motor Vehicle Accidents, by State: 1970 to 1986

[Data differ from table 1018 because data are based on date of death, not date of accident. Data reflect State where death occurred. Includes deaths of nonresidents of U.S. Beginning 1980, deaths classified according to the ninth revision of the *International Classification of Diseases*, for earlier years classified according to the revision in use at the time; see text, section 2. Data based on Vital Registration System, see Appendix III. For composition of regions, see fig. I, inside front cover]

REGION, DIVISION, AND STATE	1970	1972 [1]	1975	1980	1985	1986
U.S	54,845	56,528	46,032	53,476	46,159	48,140
Region:						
Northeast	8,850	8,992	7,431	8,255	6,797	7,090
Midwest	14,629	14,670	11,293	12,244	9,760	10,115
South	20,792	21,964	18,029	21,014	19,250	20,189
West	10,574	10,902	9,279	11,963	10,352	10,746
N.E	2,095	2,180	1,953	2,246	1,873	1,880
ME	288	252	235	264	224	218
NH	182	172	155	192	198	181
VT	116	126	124	131	117	105
MA	918	1,042	895	933	761	773
RI	143	144	140	142	124	155
CT	448	444	404	584	449	448
M.A	6,755	6,812	5,478	6,009	4,924	5,210
NY	3,117	3,140	2,277	2,717	2,121	2,183
NJ	1,289	1,352	1,099	1,130	986	1,059
PA	2,349	2,320	2,102	2,162	1,817	1,968
E.N.C	9,623	9,514	7,361	8,000	6,602	6,754
OH	2,488	2,336	1,652	1,976	1,581	1,609
IN	1,587	1,578	1,139	1,213	1,045	1,077
IL	2,267	2,216	1,816	1,985	1,594	1,633
MI	2,172	2,236	1,811	1,817	1,605	1,666
WI	1,109	1,148	943	1,009	777	769
W.N.C	5,006	5,156	3,932	4,244	3,158	3,361
MN	1,028	1,052	798	900	657	608
IA	946	904	714	662	478	446
MO	1,479	1,500	1,105	1,239	1,005	1,205
ND	194	206	183	184	117	120
SD	240	312	216	238	142	152
NE	435	504	385	406	259	311
KS	684	678	531	615	500	519
S.A	9,796	10,600	8,358	9,767	9,389	9,986
DE	158	130	129	164	119	160
MD	809	852	686	822	766	796
DC	140	100	91	79	96	86
VA	1,251	1,256	1,069	1,111	1,021	1,141
WV	561	578	499	583	461	470
NC	1,801	2,026	1,560	1,588	1,553	1,727
SC	1,070	1,148	837	895	943	1,077
GA	1,825	1,940	1,420	1,558	1,462	1,604
FL	2,181	2,570	2,067	2,967	2,968	2,925
E.S.C	4,850	4,972	3,881	3,995	3,664	4,166
KY	1,081	1,114	885	865	749	829
TN	1,525	1,526	1,280	1,280	1,219	1,372
AL	1,297	1,356	1,087	1,054	1,005	1,180
MS	947	976	629	796	691	785
W.S.C	6,146	6,392	5,790	7,252	6,197	6,037
AR	595	750	577	607	580	624
LA	1,194	1,136	993	1,261	1,011	987
OK	787	792	748	1,006	781	725
TX	3,570	3,714	3,472	4,378	3,825	3,701
Mt	3,549	3,764	3,206	4,071	3,409	3,589
MT	340	408	294	339	233	240
ID	320	324	291	345	268	273
WY	210	196	210	246	145	163
CO	697	746	621	783	628	657
NM	568	588	556	617	561	539
AZ	782	858	713	983	942	1,073
UT	354	354	285	370	335	370
NV	278	290	236	388	297	274
Pac	7,025	7,138	6,073	7,892	6,943	7,157
WA	902	836	804	1,048	786	763
OR	739	774	582	698	605	649
CA	5,114	5,300	4,414	5,860	5,294	5,523
AK	107	64	120	91	124	98
HI	163	164	153	195	134	124

[1] Represents peak year for deaths from motor vehicle accidents.

Source: U.S. National Center for Health Statistics, *Vital Statistics of the United States*, annual; and unpublished data.

No. 1020. Fatal Motor-Vehicle Accidents—Number of Accidents and Fatalities, by Type of Vehicle: 1980 to 1986

[Based on data from the Fatal Accident Reporting System]

TYPE OF VEHICLE	ACCIDENTS [1]						OCCUPANT FATALITIES					
	1980	1982	1983	1984	1985	1986	1980	1982	1983	1984	1985	1986
Total [2]	45,284	39,092	37,976	39,631	39,195	41,090	41,927	35,646	34,843	36,284	36,043	38,229
Passenger cars [3]	31,550	27,548	26,698	27,745	27,142	28,752	27,449	23,330	22,979	23,621	23,214	24,947
Mini-compact	3,263	3,559	3,753	4,001	3,973	4,346	2,966	3,194	3,278	3,470	3,429	3,647
Subcompact	4,875	4,649	4,884	5,275	5,445	6,006	4,158	3,881	4,000	4,346	4,422	4,770
Compact	1,118	1,565	1,936	2,670	3,445	4,374	927	1,210	1,499	2,081	2,635	3,312
Intermediate	5,224	5,305	5,352	5,976	6,064	6,555	3,878	3,919	3,985	4,287	4,391	4,763
Full size	7,026	5,691	5,361	5,199	4,906	5,094	4,831	3,651	3,489	3,269	2,974	3,191
Largest size	10,817	8,343	7,524	7,334	6,452	6,339	6,746	4,779	4,470	4,160	3,612	3,662
Unknown	5,134	3,863	3,264	2,905	2,699	2,053	3,943	2,696	2,258	2,008	1,751	1,602
Motorcycles	4,879	4,201	4,045	4,378	4,342	4,209	4,961	4,270	4,104	4,431	4,417	4,309
Moped, mini bike	180	177	158	172	151	250	183	183	161	177	147	257
Light trucks [2]	10,841	9,597	9,347	10,255	10,470	11,179	6,566	5,590	5,395	5,773	5,834	6,390
Pickup	8,796	7,842	7,698	8,285	8,375	8,526	5,463	4,677	4,579	4,873	4,886	5,090
Van	2,009	1,722	1,615	1,737	1,807	1,952	1,000	814	712	764	791	879
Medium trucks	1,076	666	672	680	654	661	285	154	172	153	157	145
Heavy trucks [2]	4,036	3,754	3,968	4,185	4,217	4,171	976	789	807	920	814	781
Single-unit [4]	377	283	323	271	370	305	89	52	60	83	48	42
Two-unit [5]	3,396	3,072	3,144	3,359	3,411	3,351	812	663	648	758	692	689
Multi-unit	148	129	168	188	182	179	41	25	36	37	31	50
Buses	329	288	305	302	304	282	46	35	53	45	55	39

[1] Each accident involving multiple types of vehicles is recorded in each category; therefore, the aggregate of all types will exceed the total number of accidents. [2] Includes other types and unknown, not shown separately. [3] Mini-compact wheel base less than 95 in.; subcompact, 95 in. to 99 in.; compact, 100 in. to 104 in.; intermediate, 105 in. to 109 in.; full size, 110–114 in.; and largest size greater than 115 in. [4] Gross vehicle weight greater than 26,000 lbs. [5] Tractor-trailer combination.

Source: U.S. National Highway Traffic Safety Administration, *Fatal Accident Reporting System*, annual.

No. 1021. Highway Mileage, Vehicle Miles of Travel, Accidents, and Fatalities, 1975 to 1986, and by Type of Highway System, 1986

YEAR AND TYPE OF SYSTEM	Highway mileage (1,000)	Vehicle miles of travel (bil.)	Daily vehicle miles per-mile	FATAL ACCIDENTS		NONFATAL INJURY ACCIDENTS		FATALITIES [2]	
				Number	Rate [1]	Number (1,000)	Rate [1]	Number	Rate [1]
1975, total	3,838	1,328	948	39,993	3.01	1,861	140	45,500	3.43
1980, total	3,857	1,527	1,082	45,284	2.96	2,008	131	51,091	3.35
1982, total	3,866	1,595	1,130	39,092	2.45	1,966	123	43,945	2.76
1983, total	3,880	1,653	1,167	37,976	2.30	2,005	121	42,589	2.58
1984, total	3,892	1,720	1,208	39,631	2.30	2,137	124	44,257	2.57
1985, total	3,862	1,774	1,259	39,168	2.21	2,219	125	43,795	2.47
1986, total	3,880	1,838	1,298	41,062	2.23	2,254	123	46,056	2.51
Urban	702	1,088	4,250	18,740	1.72	1,577	145	20,307	1.87
Rural	3,178	750	647	22,322	2.98	677	90	25,749	3.43
Interstate	44	391	24,411	3,716	.95	144	37	4,251	1.09
Urban	11	231	57,266	1,908	.83	107	46	2,139	.93
Rural	33	160	13,327	1,808	1.13	37	23	2,112	1.32
Noninterstate	3,836	1,447	1,034	37,346	2.58	2,110	146	41,805	2.89
Urban	691	857	3,401	16,832	1.96	1,470	172	18,168	2.12
Rural	3,145	590	514	20,514	3.47	640	108	23,637	4.00
Federal-aid highway system, total	847	1,483	4,795	30,757	2.07	1,498	101	34,794	2.35
Urban	190	880	12,678	14,565	1.66	1,102	125	15,858	1.80
Rural	657	603	2,514	16,192	2.69	396	66	18,936	3.14
Interstate	44	391	24,411	3,716	.95	144	37	4,251	1.09
Other primary arterial	259	537	5,677	12,584	2.34	512	95	14,579	2.71
Urban	33	251	20,891	4,014	1.60	317	126	4,408	1.75
Rural	226	286	3,461	8,570	3.00	195	68	10,171	3.56
Urban (arterial and collector)	146	398	7,450	8,643	2.18	677	170	9,311	2.34
Secondary (collector)	398	157	1,083	5,814	3.69	165	105	6,653	4.23
Non–Federal-aid highway system, total	3,032	355	321	10,305	2.90	756	213	11,262	3.17
Urban	511	208	1,116	4,175	2.01	476	229	4,449	2.14
Rural	2,521	147	160	6,130	4.16	280	190	6,813	4.63
Collector	349	70	553	2,061	2.92	101	143	2,301	3.26
Urban	19	19	2,799	309	1.57	20	102	332	1.68
Rural	330	51	422	1,752	3.45	81	159	1,969	3.88
Local	2,672	257	263	7,742	3.01	634	247	8,391	3.27
Urban	483	165	932	3,466	2.11	437	266	3,680	2.24
Rural	2,189	92	116	4,276	4.63	197	214	4,711	5.10

[1] Rate per 100 million vehicle miles of travel. [2] Represents fatalities occurring within 30 days of accident. Excludes nontraffic

No. 1022. Motor Vehicle Safety Defect Recalls, by Domestic and Foreign Manufacturers: 1975 to 1987

[Covers manufacturers reporting to U.S. National Highway Traffic Administration under section 151 of National Traffic and Motor Vehicle Safety Act of 1966, as amended]

MANUFACTURER	Unit	1975	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Motor vehicles:												
Total recall campaigns [1]	Number	217	271	275	167	156	135	140	164	173	174	199
Domestic	Number	190	199	218	129	128	107	110	127	137	139	150
Foreign	Number	27	72	57	38	28	28	30	37	36	35	49
Total vehicles recalled	1,000	2,109	9,063	8,919	4,863	9,405	1,914	6,114	7,220	5,629	2,880	9,091
Domestic	1,000	1,829	7,921	6,997	3,939	7,379	1,401	3,090	6,283	4,995	1,731	7,297
Vehicles recalled by 4 leading auto manufacturers	1,000	1,602	7,670	6,989	3,730	7,247	1,324	3,021	6,148	4,811	1,382	6,944
Foreign	1,000	280	1,141	1,922	924	2,026	513	3,024	937	634	1,149	1,793
Motor vehicle tires:												
Recall campaigns [1]	Number	22	31	42	24	25	17	21	16	19	14	16
Tires recalled	1,000	72	14,686	235	7,070	125	131	95	81	28	164	43

[1] A recall campaign is the notification to the Secretary of the U.S. Dept. of Transportation and to owners, purchasers, and dealers, of a motor vehicle safety defect.

Source: U.S. National Highway Traffic Safety Administration, *Motor Vehicles Defect Recall Campaigns*, annual.

No. 1023. Licensed Drivers and Estimated Arrests for Driving Under the Influence, by Age: 1975 and 1986

[**Total drivers and arrests in thousands.** Represents licensed drivers and arrests for those 16 years old and over]

AGE	1975			1986			Percent change in rate, 1975–86
	Drivers	Arrests	Arrests per 100,000 drivers	Drivers	Arrests	Arrests per 100,000 drivers	
Total	129,671	946	729	158,494	1,792	1,130	55
Percent distribution	100.0	100.0	(X)	100.0	100.0	(X)	(X)
16–17 years old	3.7	1.8	352	2.6	1.5	647	84
18–24 years old	18.9	25.3	979	15.7	28.8	2,075	112
25–29 years old	12.9	15.0	847	13.0	22.0	1,909	125
30–34 years old	10.3	12.2	867	12.2	15.8	1,471	70
35–39 years old	8.5	10.6	909	10.9	11.1	1,158	27
40–44 years old	7.9	9.8	904	8.5	7.2	968	7
45–49 years old	8.0	8.9	812	6.9	4.9	805	−1
50–54 years old	7.9	7.3	675	6.3	3.4	609	−10
55–59 years old	6.8	4.6	490	6.3	2.4	434	−11
60–64 years old	5.7	2.7	347	5.9	1.6	299	−14
65 years old and over	9.5	1.8	141	11.9	1.2	118	−16

X Not applicable.

Source: U.S. Bureau of Justice Statistics, *Drunk Driving, Special Report.*

No. 1024. Licensed Drivers, Fatal Motor-Vehicle Accidents, and Alcohol Involvement, by Age of Driver: 1987

ITEM	Unit	Total	AGE OF DRIVER							
			16–17 years	18–21 years	22–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years and over
Licensed drivers (estimated) [1]	1,000	161,975	4,202	12,400	11,583	40,738	32,369	21,367	19,339	19,880
Percent distribution	Percent	100.0	2.6	7.7	7.2	25.2	20.0	13.2	11.9	12.3
Licensed drivers involved in fatal accidents	Number	[2] 61,434	3,326	8,874	6,513	16,554	9,774	5,472	4,221	5,078
Percent distribution	Percent	[2] 100.0	5.4	14.4	10.6	26.9	15.9	8.9	6.9	8.3
Drinking drivers involved in fatal accidents	Number	[2] 20,384	798	3,534	2,966	6,889	3,067	1,225	767	511
Percent distribution	Percent	[2] 100.0	3.9	17.3	14.6	33.8	15.0	6.0	3.8	2.5

[1] Source: U.S. Federal Highway Administration, *Selected Highway Statistics and Charts*, annual. [2] Includes ages unknown and less than 16 years old.

Source: Except as noted, U.S. National Highway Traffic Safety Administration, unpublished data from the Fatal Accident Reporting System.

No. 1025. Motor Vehicle Travel, by Type of Vehicle; and Speed: 1970 to 1986

[**Travel in billions of vehicle-miles, except as indicated.** Travel estimates based on automatic traffic recorder data. Speed trend data for 1970–1975 were collected by several State highway agencies, normally during summer months; beginning Oct. 1975 all States have monitored speeds at locations on several highway systems as part of 55 mile per hour Speed Limit Monitoring Program. See also *Historical Statistics, Colonial Times to 1970*, series Q 199–207]

YEAR	VEHICLE-MILES OF TRAVEL (bil.)				AVG. MILES PER VEHICLE (1,000)			MOTOR VEHICLE SPEED [2]				
	Total	Cars [1]	Buses	Trucks	Passenger vehicles		Trucks	Vehicles recorded (1,000) [3]	Avg. speed (miles per hour)	Percent of vehicles exceeding—		
					Cars [1]	Buses				55 m.p.h.	60 m.p.h.	65 m.p.h.
1970	1,110	920	4.5	186	10.0	12.0	9.9	200	63.8	87	69	44
1974	1,281	1,013	5.7	262	9.2	12.7	10.6	203	57.6	65	29	9
1975	1,328	1,040	6.1	282	9.3	13.1	10.9	102	57.6	68	27	7
1976	1,402	1,084	6.3	312	9.4	13.1	11.2	515	58.2	69	32	10
1977	1,467	1,116	5.8	346	9.5	11.9	11.8	500	58.8	74	35	10
1978	1,545	1,154	5.9	385	9.5	11.6	12.3	468	58.8	74	36	10
1979	1,529	1,122	5.9	401	9.1	11.3	12.2	506	58.3	72	32	9
1980	1,527	1,122	6.1	399	8.8	11.5	11.9	667	57.5	66	25	7
1981	1,553	1,142	6.2	405	8.9	11.5	11.7	3,048	57.9	68	30	9
1982	1,595	1,176	5.8	413	9.1	10.4	11.7	4,895	59.0	73	40	14
1983	1,653	1,207	5.2	441	9.1	8.9	12.0	7,856	59.1	74	41	15
1984	1,720	1,234	4.6	482	9.2	8.0	12.8	8,067	59.3	75	43	16
1985	1,774	1,270	4.9	500	9.2	8.2	12.7	8,449	59.5	75	44	17
1986	1,838	1,313	5.1	520	9.3	8.6	13.0	8,549	59.7	76	46	18

[1] Includes motorcycles. [2] Represents speed on rural interstate highways. For 1970–1979, based on free flow speed of vehicles recorded on level, straight sections of rural interstate highways during off-peak hours; beginning 1980, based on all vehicles on rural interstate highways. Beginning 1976, for year ending Sept. 30. [3] Citations issued for 55 mph violations.

No. 1026. Domestic Motor Fuel Consumption, by Type of Vehicle: 1970 to 1986

[Comprises all fuels (gas, diesel, or other fuels) used for propulsion of vehicles under State motor fuels laws. Excludes Federal purchases for military use. Minus sign (−) indicates decrease. See also *Historical Statistics, Colonial Times to 1970*, series Q 156–162]

YEAR	FUEL CONSUMPTION					AVERAGE FUEL CONSUMPTION PER VEHICLE (gal.)				AVERAGE MILEAGE PER GALLON			
	All vehicles (bil. gal.)	Avg. annual percent change [1]	Cars [2] (bil. gal.)	Buses [3] (bil. gal.)	Trucks [4] (bil. gal.)	All vehicles	Cars [2]	Buses [3]	Trucks [4]	All vehicles	Cars [2]	Buses [3]	Trucks [4]
1970	92.3	5.4	67.8	.8	23.6	830	760	2,172	1,257	12.02	13.52	5.54	7.85
1973	110.5	6.2	78.7	1.0	30.7	850	771	2,326	1,321	11.89	13.30	5.86	8.34
1974	106.3	−3.8	75.1	1.0	30.1	788	716	2,159	1,224	12.05	13.42	5.89	8.70
1975	109.0	2.5	76.4	1.1	31.4	790	716	2,279	1,217	12.18	13.52	5.75	8.99
1976	115.7	6.2	79.7	1.0	34.8	806	723	2,188	1,250	12.12	13.53	5.98	8.95
1977	119.6	3.4	80.4	1.0	38.1	814	716	1,984	1,301	12.26	13.80	5.98	9.06
1978	125.1	4.5	81.7	1.0	42.3	816	701	1,957	1,349	12.35	14.04	5.95	9.11
1979	122.1	−2.4	77.3	1.0	43.6	776	653	1,891	1,326	12.52	14.41	5.97	9.19
1980	115.0	−5.9	71.9	1.0	41.9	712	591	1,926	1,243	13.29	15.46	5.95	9.54
1981	114.5	−.4	71.0	1.1	42.2	697	576	1,938	1,219	13.57	15.94	5.92	9.59
1982	113.4	−.9	70.1	1.0	42.1	686	566	1,756	1,191	14.07	16.65	5.93	9.80
1983	116.1	2.4	69.9	.9	45.1	686	553	1,507	1,229	14.24	17.14	5.92	9.77
1984	118.7	2.3	68.7	.8	49.0	691	536	1,359	1,308	14.49	17.83	5.85	9.83
1985	121.3	2.2	69.3	.8	51.0	685	525	1,407	1,302	14.62	18.20	5.84	9.79
1986	125.2	3.2	71.2	.9	52.9	690	525	1,500	1,318	14.68	18.32	5.71	9.83

[1] From prior year shown. For 1970, change from 1965. [2] Includes taxicabs. [3] Includes school buses. [4] Includes combinations.

Source of tables 1025 and 1026: U.S. Federal Highway Administration, *Highway Statistics Summary to 1985*, and *Highway Statistics*, annual.

No. 1027. Domestic Motor Gasoline Supply: 1974 to 1987

[**In 1,000 barrels per day, except as noted**]

YEAR	SUPPLY [1]			Production	Net imports	Stocks [2] (mil. bbls.)	YEAR	SUPPLY [1]			Production	Net imports	Stocks [2] (mil. bbls.)
	Total	Unleaded						Total	Unleaded				
		Total	Percent						Total	Percent			
1974, avg	6,537	(NA)	(NA)	6,360	202	218	1981, avg	6,588	3,264	49.5	6,405	155	253
1975, avg	6,675	(NA)	(NA)	6,520	182	235	1982, avg	6,539	3,409	52.1	6,338	177	235
1976, avg	6,978	1,508	21.6	6,841	128	231	1983, avg	6,622	3,647	55.1	6,340	237	222
1977, avg	7,177	1,976	27.5	7,033	215	258	1984, avg	6,693	3,987	59.6	6,453	293	243
1978, avg	7,412	2,521	34.0	7,169	189	238	1985, avg	6,831	4,406	64.5	6,419	371	223
1979, avg	7,034	2,798	39.8	6,852	181	237	1986, avg	7,034	4,854	69.0	6,752	293	233
1980, avg	6,579	3,067	46.6	6,506	139	261	1987, avg	7,206	5,470	75.9	6,841	349	226

No. 1028. Household Vehicles: Annual Mileage, Fuel Consumption, and Fuel Expenditures: 1985

[See headnote, table 1029]

Household and vehicle characteristics	Number of—			Miles driven		Gallons consumed		Expenditures	
	Households (millions)	Vehicles (millions)	Vehicles per household	Total (billion)	Percent	Total (billion)	Percent	Total (bil. dol.)	Percent
Total	**77.7**	**137.3**	**1.8**	**1,353**	**100.0**	**83.9**	**100.0**	**99.1**	**100.0**
Metropolitan status:									
Metropolitan	59.0	103.0	1.7	1,029	76.1	62.6	74.6	73.8	74.5
Central city	25.5	41.0	1.6	383	28.3	23.9	28.5	28.3	28.5
Outside central city	33.6	62.0	1.8	646	47.8	38.7	46.1	45.6	46.0
Nonmetropolitan	18.7	34.3	1.8	324	23.9	21.3	25.4	25.2	25.5
Origin of householder: White	68.1	122.3	1.8	1,204	89.0	74.3	88.5	87.7	88.5
Black	7.2	11.0	1.5	112	8.3	7.4	8.9	8.8	8.8
Hispanic descent: Yes	3.5	6.0	1.7	58	4.3	3.6	4.3	4.3	4.3
No	74.3	131.3	1.8	1,295	95.7	80.3	95.7	94.8	95.7
Household size: 1 person	15.9	19.0	1.2	162	12.0	10.0	11.9	11.8	12.0
2 persons	24.5	41.3	1.7	386	28.6	23.5	28.0	27.8	28.0
3 persons	14.6	29.0	2.0	293	21.7	18.2	21.7	21.5	21.7
4 persons	12.9	26.6	2.1	281	20.8	17.8	21.3	21.0	21.2
5 or more persons	9.9	21.3	2.2	230	17.0	14.4	17.1	16.9	17.1
Family income 1985:									
Less than $5,000	3.7	4.4	1.2	34	2.5	2.4	2.8	2.8	2.8
$5,000–$9,999	9.7	12.5	1.3	98	7.2	6.7	8.0	7.8	7.9
$10,000–$14,999	10.7	15.8	1.5	149	11.0	9.8	11.7	11.5	11.6
$15,000–$19,999	9.7	15.8	1.6	141	10.4	9.0	10.7	10.5	10.6
$20,000–$24,999	9.5	16.9	1.8	165	12.2	10.4	12.3	12.2	12.3
$25,000–$34,999	14.7	28.2	1.9	289	21.4	17.8	21.3	21.0	21.2
$35,000 or more	19.8	43.7	2.2	477	35.2	27.9	33.2	33.3	33.6
Number of drivers (fall 1984): 1	24.7	29.6	1.2	257	19.0	16.1	19.1	19.0	19.2
2	39.1	73.1	1.9	730	53.9	45.3	54.0	53.5	54.0
3 or more	12.5	32.9	2.6	352	26.0	21.7	25.9	25.7	25.9
Type of fuel: Leaded	(x)	42.0	(x)	332	24.5	24.5	29.2	27.3	27.6
Unleaded	(x)	92.8	(x)	990	73.2	57.8	68.9	69.9	70.6
Type of vehicle: Automobile	(x)	106.6	(x)	1,059	78.3	61.7	73.5	73.4	74.1
Jeep-like vehicle	(x)	3.7	(x)	39	2.9	3.1	3.6	3.6	3.6
Van	(x)	4.7	(x)	49	3.6	3.7	4.4	4.3	4.4
Pickup truck	(x)	21.2	(x)	199	14.7	14.7	17.5	16.9	17.1
Number of cylinders: 4	(x)	39.9	(x)	445	32.9	19.6	23.4	23.5	23.7
6	(x)	35.6	(x)	362	26.8	22.7	27.0	26.9	27.2
8	(x)	61.0	(x)	536	39.6	41.1	49.0	48.1	48.5
Air conditioning: Yes	(x)	86.3	(x)	885	65.4	55.2	65.8	65.6	66.2
No	(x)	51.0	(x)	468	34.6	28.7	34.2	33.5	33.8
Type of transmission:									
Automatic	(x)	99.0	(x)	954	70.5	63.2	75.4	74.7	75.4
Manual	(x)	38.3	(x)	399	29.5	20.7	24.6	24.4	24.6
Vehicle used on the job: Yes	(x)	17.3	(x)	203	15.0	12.6	15.0	15.0	15.2
No	(x)	120.0	(x)	1,150	85.0	71.3	85.0	84.0	84.8

X Not applicable.

No. 1029. Household Motor Vehicle Transportation, by Vehicle Model Year: 1985

[Preliminary. Household vehicles include all motorized vehicles used for personal transportation, excluding motorcycles, mopeds, large trucks, and buses. The reporting unit for 1985 is all households which owned a vehicle at any time during 1985. Based on the Residential Transportation Energy Consumption Survey; subject to sampling variability]

Household characteristics	Households with motor vehicles (mil.)	Vehicles (millions)					Miles per gallon				
		Total	Model year				Average	Model year			
			1973 and earlier	1974 to 1978	1979 to 1982	1983 and later		1973 and earlier	1974 to 1978	1979 to 1982	1983 and later
Total	**77.7**	**137.3**	**26.9**	**43.3**	**37.8**	**28.7**	**16.1**	**13.4**	**13.8**	**17.9**	**19.3**
Northeast	15.0	24.8	3.0	8.1	7.6	6.1	17.0	13.6	14.0	18.8	20.2
Midwest	19.5	34.1	6.4	11.4	9.0	7.0	15.6	12.6	13.2	17.6	19.1
South	27.0	48.5	9.2	15.0	13.8	10.5	15.8	12.9	13.5	17.4	18.9
West	16.1	29.8	8.3	8.9	7.3	5.1	16.5	14.4	15.0	18.3	19.2
Family income in 1985:											
Less than $5,000	3.7	4.4	1.4	1.7	.7	.6	14.2	12.5	13.7	17.5	15.6
$5,000–$9,999	9.7	12.5	4.3	4.4	2.4	1.4	14.6	13.3	12.7	16.8	19.9
$10,000–$14,999	10.7	15.8	4.4	5.8	3.8	1.8	15.2	13.4	13.8	17.5	18.9
$15,000–$19,999	9.7	15.8	3.5	5.7	3.9	2.6	15.7	12.9	13.4	18.1	20.4
$20,000–$24,999	9.5	16.9	3.1	5.5	4.7	3.4	16.0	13.3	14.0	17.9	18.9
$25,000–$34,999	14.7	28.2	4.5	9.2	8.5	5.9	16.2	13.2	14.0	18.2	19.0
$35,000 or more	19.8	43.7	5.7	11.0	13.7	13.1	17.1	13.9	14.3	17.9	19.4

Source of tables 1028 and 1029: U.S. Energy Information Administration, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles*, 1985.

No. 1030. Cost of Owning and Operating an Automobile: 1975 to 1987

Item	Unit	1975	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Cost per mile [1]	Cents	18.31	20.19	19.57	23.97	27.95	31.92	32.35	33.42	31.32	27.20	29.59	32.64
Cost per 10,000 miles [1]	Dollars	1,831	2,019	1,957	2,397	2,795	3,192	3,235	3,342	3,132	2,720	2,959	3,264
Variable cost	Cents/mile	6.45	5.80	5.65	5.86	7.62	8.17	8.37	8.36	7.86	8.04	6.52	7.20
Gas and oil	Cents/mile	4.82	4.11	3.89	4.11	5.86	6.27	6.74	6.64	6.19	6.16	4.48	4.80
Maintenance	Cents/mile	.97	1.03	1.10	1.10	1.12	1.18	1.00	1.04	1.04	1.23	1.37	1.60
Tires	Cents/mile	.66	.66	.66	.65	.64	.72	.63	.68	.63	.65	.67	.80
Fixed cost	Dollars	1,186	1,439	1,392	1,811	2,033	2,375	2,398	2,506	2,346	2,441	2,596	2,782
Insurance:													
Fire and theft [2]	Dollars	53	80	57	74	70	76	53	80	80	92	86	87
Collision [3]	Dollars	141	188	138	168	172	180	153	201	200	198	191	196
Property damage [4] and liability	Dollars	189	250	229	241	248	254	243	222	225	213	232	252
License and registration	Dollars	30	74	74	90	82	88	54	102	106	115	130	140
Depreciation	Dollars	773	847	894	942	1,038	1,287	1,356	1,343	1,207	1,253	1,320	1,506
Finance charge	Dollars	(NA)	(NA)	(NA)	296	423	490	539	558	528	570	637	601
Average fixed cost per day	Dollars	3.25	3.94	3.81	4.96	5.57	6.51	6.57	6.87	6.43	6.69	7.11	7.62

NA Not available. [1] Beginning 1985, not comparable to previous data. [2] $50 deductible 1975 and 1977, and $100 deductible 1978 through 1987. [3] $100 deductible 1975 and 1977, and $250 deductible 1978 through 1987. [4] Coverage: $100,000/$300,000.

Source: Motor Vehicle Manufacturers Association of the United States, Inc., Detroit, MI, *Motor Vehicle Facts and Figures*, annual.

No. 1031. Passenger Transit Industry—Summary: 1970 to 1987

[Includes Puerto Rico. Comprises all privately and publicly owned organized local passenger transportation agencies except taxicabs and sightseeing and school buses. Covers (*a*) local motorbus systems, (*b*) light rail systems, (*c*) heavy rail systems, (*d*) trolley coach systems, and (*e*) automated guideway, inclined plane, cable car, and aerial tramway systems. Beginning 1984, data also include suburban railroads, urban ferry boats, rural fixed-route non-intercity motorbus systems, vanpools and demand response systems. Thus, all data are non-continuous between 1983 and 1984. Based on financial and statistical reports received by American Public Transit Association from transit systems representing more than 85 percent of the industry. See also *Historical Statistics, Colonial Times to 1970*, series Q 238–250]

Item	Unit	1970	1975	1980	1981	1982	1983	1984	1985	1986, prel.	1987, prel.
Operating systems	**Number**	**1,079**	**947**	**1,044**	**1,035**	**1,036**	**1,036**	**4,938**	**4,973**	**5,019**	**5,048**
Motorbus systems [1]	Number	1,075	941	1,040	1,030	1,031	1,031	2,604	2,632	2,654	2,672
Publicly owned systems [1]	Number	144	333	576	578	581	599	(NA)	1,435	(NA)	(NA)
Passenger vehicles owned [2]	**Number**	**61,428**	**62,261**	**71,018**	**72,098**	**73,838**	**73,813**	**95,603**	**88,691**	**91,218**	**91,115**
Motorbuses [2]	Number	49,700	50,811	59,411	60,393	62,114	62,093	63,497	57,265	58,000	57,687
Heavy rail [2]	Number	9,286	9,556	9,641	9,749	9,815	9,891	9,083	9,326	10,386	10,168
Other electric [2 3]	Number	2,442	1,894	1,966	1,956	1,909	1,829	1,527	1,623	1,519	1,581
Suburban rail	Number	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	4,075	4,035	4,440	4,656
All other	Number	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	17,421	16,422	16,873	17,023
Total revenue	**Mil. dol**	(NA)	**3,451**	**6,510**	**7,366**	**8,044**	**8,526**	**11,623**	**12,195**	**13,147**	**13,968**
Passenger revenue	Mil. dol	1,639	1,861	2,557	2,701	3,077	3,172	4,448	4,575	5,011	5,156
Other operating revenue [4]	Mil. dol	68	183	248	344	380	333	780	702	743	771
Operating assistance	Mil. dol	(NA)	1,408	3,705	4,321	4,587	5,023	6,395	6,918	7,393	8,041
Federal	Mil. dol	(NA)	302	1,094	1,095	1,005	827	996	940	912	894
State and local	Mil. dol	(NA)	1,106	2,611	3,226	3,582	4,195	5,399	5,978	6,481	7,147
Total expense	**Mil. dol**	**1,996**	**3,752**	**6,711**	**7,623**	**8,314**	**8,736**	**12,957**	**14,077**	**15,080**	**15,997**
Operating expense	Mil. dol	(NA)	3,537	6,246	7,024	7,553	7,956	11,574	12,381	13,353	13,967
Transportation	Mil. dol	(NA)	1,877	3,248	3,596	3,882	3,931	5,142	5,655	6,106	6,019
Maintenance	Mil. dol	(NA)	814	1,774	1,946	2,168	2,392	3,062	3,672	3,965	4,310
Administration	Mil. dol	(NA)	846	1,224	1,482	1,503	1,634	3,370	3,054	3,282	3,638
Reconciling expense	Mil. dol	(NA)	215	464	597	761	780	1,383	1,696	1,727	2,030
Capital expenditure, Federal	**Mil. dol**	(NA)	**1,287**	**2,787**	**2,946**	**2,544**	**3,162**	**2,876**	**2,510**	**3,137**	**2,476**
Vehicle-miles operated	**Million**	**1,884**	**1,989**	**2,094**	**2,134**	**2,129**	**2,117**	**2,749**	**2,791**	**2,890**	**2,962**
Motorbus	Million	1,409	1,526	1,677	1,685	1,669	1,678	1,845	1,863	1,896	1,927
Heavy rail	Million	407	423	385	420	429	408	436	451	476	490
Other electric [3]	Million	68	40	32	29	31	31	32	33	33	34
Suburban rail	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	168	183	186	189
All other	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	268	261	299	322
Passengers carried [5]	**Million**	**7,361**	**6,988**	**8,249**	**7,976**	**7,755**	**7,903**	**8,851**	**8,659**	**8,801**	**8,340**
Motorbus [5]	Million	5,034	5,084	5,837	5,594	5,324	5,422	5,908	5,675	5,748	5,207
Heavy rail [5]	Million	1,681	1,673	2,108	2,094	2,115	2,167	2,231	2,290	2,333	2,402
Other electric [3 5]	Million	446	231	304	290	316	314	329	303	304	300
Suburban rail	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	267	275	303	311
All other	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	116	116	113	120
Avg. revenue per passenger	**Cents**	**22.4**	**26.7**	**31.0**	**33.9**	**39.7**	**40.2**	**50.3**	**52.8**	**56.9**	**61.8**
Employees, number (avg.)	**1,000**	**138**	**160**	**187**	**192**	**194**	**195**	**263**	**270**	**276**	**275**
Payroll, employee	Mil. dol	1,274	2,236	3,281	3,494	3,731	3,921	5,488	5,843	6,228	6,540

NA Not available. [1] Includes systems with combined services including motorbuses, heavy rail cars, light rail cars, trolley coaches, cable cars, and inclined plane cars. Beginning 1984, combined services also include suburban rail cars, urban ferry boats, vanpools, aerial tramways, automated guideways, and demand response vehicles. [2] Beginning 1984, includes active vehicles only. [3] Includes light rail, trolley coach, cable car, inclined plane, aerial tramway, and automated guideways. [4] Includes other operating revenue, non-operating revenue, and auxiliary income. [5] Data for 1970 and 1975 not comparable with later years.

Source: American Public Transit Association, Washington, DC, *Transit Fact Book*, annual.

No. 55. Interracial Married Couples: 1970 to 1987

[In thousands. 1970 data as of April; 1980 and 1987 data as of March. 1970, persons 14 years old and over; 1980 and 1987 persons 15 years old and over. 1980 and 1987 based on Current Population Survey; see headnote, table 49]

ITEM	1970	1980	1987	ITEM	1970	1980	1987
Total married couples	**44,597**	**49,714**	**52,286**	**Other interracial married couples**	**245**	**484**	**622**
Interracial married couples	310	651	799	Husband Black	8	20	33
All Black-White married couples	65	167	177	Wife Black	4	14	8
Husband Black, wife White	41	122	121	Husband White	139	287	358
Wife Black, husband White	24	45	56	Wife White	94	163	223

Source: U.S. Bureau of the Census, *Census of Population: 1970, Marital Status,* PC(2)-4C; *Current Population Reports,* series P-20, No. 424 and earlier reports.

No. 56. Unmarried Couples, by Selected Characteristics, 1970 to 1987, and by Marital Status of Partners, 1987

[In thousands. As of March, except 1970, as of April. An "unmarried couple" is two unrelated adults of the opposite sex sharing the same household. See headnote, table 58]

PRESENCE OF CHILDREN AND AGE OF HOUSEHOLDER	1970	1980	1985	1987	MARITAL STATUS OF MALE	Total	MARITAL STATUS OF FEMALE			
							Never married	Divorced	Widowed	Married, husband absent
Unmarried couples	**523**	**1,589**	**1,983**	**2,334**	**Total, 1987**	**2,334**	**1,286**	**731**	**171**	**146**
No children under 15 yr.	[1] 327	1,159	1,380	1,614	Never married	1,315	950	269	60	37
Some children under 15 yr.	[1] 196	431	603	720	Divorced	762	261	389	46	65
Under 25 yr. old	55	411	425	524	Widowed	88	11	24	46	7
25–44 yr. old	103	837	1,203	1,414	Married, wife absent	169	63	49	20	38
45–64 yr. old	186	221	239	252						
65 yr. old and over	178	119	116	143						

[1] Children in unmarried-couple households are under 14 years old.

Source: U.S. Bureau of the Census, *1970 Census of Population,* vol. II, part 4B, and *Current Population Reports,* series P-20, No. 423 and earlier reports.

No. 57. Householder and Marital Status of Population, 15 Years Old and Over: 1987

[In thousands, except percent. As of March. See headnote, table 51]

HOUSEHOLDER AND MARITAL STATUS	Total, 15 yrs. and over[1]	MALE					FEMALE				
		Total[1]	20–24 years	25–44 years	45–64 years	65 yr. and over	Total[1]	20–24 years	25–44 years	45–64 years	65 yr. and over
Total persons	**186,688**	**89,368**	**9,499**	**37,671**	**21,428**	**11,578**	**97,320**	**9,859**	**38,597**	**23,472**	**16,397**
Householder	89,479	61,735	2,884	28,861	19,304	10,487	27,744	1,915	10,346	6,774	8,511
Single	12,071	5,985	1,224	3,514	734	391	6,086	1,356	3,365	601	603
Married, spouse present	51,537	48,573	1,523	22,405	16,371	8,197	2,964	239	1,630	817	260
Married, spouse absent	4,206	1,569	59	815	506	188	2,638	152	1,535	709	227
Widowed	11,291	1,721	–	41	363	1,317	9,570	5	362	2,385	6,819
Divorced	10,374	3,887	77	2,087	1,331	393	6,487	164	3,455	2,261	603
Not householder	97,209	27,634	6,615	8,809	2,124	1,091	69,575	7,944	28,252	16,698	7,887
Single	37,114	20,801	6,155	5,058	514	135	16,313	4,634	2,622	411	295
Married, spouse present	53,035	3,713	277	1,966	960	479	49,322	2,999	24,203	15,566	6,165
Married, spouse absent	1,847	1,021	106	639	183	67	825	156	423	141	62
Widowed	1,952	399	11	25	59	305	1,553	3	59	239	1,252
Divorced	3,261	1,699	66	1,121	406	104	1,562	151	944	342	111
PERCENT DISTRIBUTION											
Total persons	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Householder	47.9	69.1	30.4	76.6	90.1	90.6	28.5	19.4	26.8	28.9	51.9
Single	6.5	6.7	12.9	9.3	3.4	3.4	6.3	13.8	8.7	2.6	3.7
Married, spouse present	27.6	54.4	16.0	59.5	76.4	70.8	3.0	2.4	4.2	3.5	1.6
Married, spouse absent	2.3	1.8	.6	2.2	2.4	1.6	2.7	1.5	4.0	3.0	1.4
Widowed	6.0	1.9	–	.1	1.7	11.4	9.8	.1	.9	10.2	41.6
Divorced	5.6	4.3	.8	5.5	6.2	3.4	6.7	1.7	9.0	9.6	3.7
Not householder	52.1	30.9	69.6	23.4	9.9	9.4	71.5	80.6	73.2	71.1	48.1
Single	19.9	23.3	64.8	13.4	2.4	1.2	16.8	47.0	6.8	1.8	1.8
Married, spouse present	28.4	4.2	2.9	5.2	4.5	4.1	50.7	30.4	62.7	66.3	37.6
Married, spouse absent	1.0	1.1	1.1	1.7	.9	.6	.8	1.6	1.1	.6	.4
Widowed	1.0	.4	.1	.1	.3	2.6	1.6	–	.2	1.0	7.6
Divorced	1.7	1.9	.7	3.0	1.9	.9	1.6	1.5	2.4	1.5	.7

– Represents or rounds to zero. [1] Includes 15–19 year olds.

Source: U.S. Bureau of the Census, *Current Population Reports,* series P-20, No. 423 and earlier reports.

No. 58. Households, Families, Subfamilies, Married Couples, and Unrelated Individuals: 1960 to 1988

[In thousands, except as indicated. As of March. Based on Current Population Survey; includes members of Armed Forces living off post or with their families on post, but excludes all other members of Armed Forces; see text, section 1 and Appendix III. For definition of terms, see text, section 1. Minus sign (–) indicates decrease. See also *Historical Statistics, Colonial Times to 1970,* series A 288–319]

TYPE OF UNIT	1960	1970	1975	1980	1984	1985	1986	1987	1988	PERCENT CHANGE	
										1970–1980	1980–1988
Households	**52,799**	**63,401**	**71,120**	**80,776**	**85,407**	**86,789**	**88,458**	**89,479**	**91,061**	**27.4**	**12.7**
Average size	3.33	3.14	2.94	2.76	2.71	2.69	2.67	2.66	2.64	(x)	(x)
Family households	44,905	51,456	55,563	59,550	61,997	62,706	63,558	64,491	65,133	15.7	9.4
Married couple	39,254	44,728	46,951	49,112	50,090	50,350	50,933	51,537	51,809	9.8	5.5
Male householder [1]	1,228	1,228	1,485	1,733	2,030	2,228	2,414	2,510	2,715	41.1	56.7
Female householder [1]	4,422	5,500	7,127	8,705	9,878	10,129	10,211	10,445	10,608	58.3	21.9
Nonfamily households	7,895	11,945	15,557	21,226	23,410	24,082	24,900	24,988	25,929	77.7	22.2
Male householder	2,716	4,063	5,912	8,807	9,752	10,114	10,648	10,652	11,305	116.8	28.4
Female householder	5,179	7,882	9,645	12,419	13,658	13,968	14,252	14,336	14,623	57.6	17.7
One person	6,896	10,851	13,939	18,296	19,954	20,602	21,178	21,128	21,884	68.6	19.6
Families	**45,111**	**51,586**	**55,712**	**59,550**	**61,997**	**62,706**	**63,558**	**64,491**	**65,133**	**15.4**	**9.4**
Average size	3.67	3.58	3.42	3.29	3.24	3.23	3.21	3.19	3.17	(x)	(x)
Married couple	39,329	44,755	46,971	49,112	50,090	50,350	50,933	51,537	51,809	9.7	5.5
Male householder [1]	1,275	1,239	1,499	1,733	2,030	2,228	2,414	2,510	2,715	39.9	56.7
Female householder [1]	4,507	5,591	7,242	8,705	9,878	10,129	10,211	10,445	10,608	55.7	21.9
Unrelated subfamilies	**207**	**130**	**149**	**360**	**504**	**526**	**505**	**566**	**537**	**176.9**	**49.2**
Married couple	75	27	20	20	53	46	45	37	38	(B)	(B)
Male reference persons [1]	47	11	14	36	63	85	63	77	46	(B)	(B)
Female reference persons [1]	85	91	115	304	388	395	397	452	452	234.1	48.7
Related subfamilies	**1,514**	**1,150**	**1,349**	**1,150**	**2,198**	**2,228**	**2,256**	**2,286**	**2,396**	**–**	**108.3**
Married couple	871	617	576	582	722	719	726	712	765	–5.7	31.4
Father-child [1]	115	48	69	54	113	116	131	123	152	(B)	(B)
Mother-child [1]	528	484	705	512	1,363	1,392	1,399	1,451	1,479	5.8	188.9
Married couples	**40,200**	**45,373**	**47,547**	**49,714**	**50,864**	**51,114**	**51,704**	**52,286**	**52,613**	**9.6**	**5.8**
With own household	39,254	44,728	46,951	49,112	50,090	50,350	50,933	51,537	51,809	9.8	5.5
Without own household	946	645	596	602	775	764	771	749	803	–6.7	33.4
Percent without	2.4	1.4	1.3	1.2	1.5	1.5	1.5	1.4	1.5	(x)	(x)
Unrelated individuals	**11,092**	**14,988**	**19,100**	**26,426**	**29,497**	**30,518**	**31,506**	**31,914**	**33,120**	**76.3**	**25.3**
Nonfamily householders	7,895	11,945	15,557	21,226	23,410	24,082	24,900	24,988	25,929	77.7	22.2
Secondary individuals	3,198	3,043	3,543	5,200	6,087	6,436	6,606	6,926	7,191	70.9	38.3
Male	1,746	1,631	2,087	3,006	3,531	3,743	3,764	3,947	4,081	84.3	35.8
Female	1,451	1,412	1,456	2,194	2,556	2,693	2,842	2,978	3,110	55.4	41.8

– Represents zero. B Not shown; base less than 75,000. X Not applicable. [1] No spouse present.

Source: U.S. Bureau of the Census, *Current Population Reports,* series P-20, No. 432.

No. 59. Households, by Type—Projections: 1989 to 2000

[In thousands. As of July. Series A reflects the assumption that the recent moderation in marriage and divorce trends will continue but that historical changes spanning the last 25 years must be taken into consideration. Series A assumes a continuation of past trends in householder proportions but changes in recent years are given more weight. Series B reflects assumptions intermediate between series A and C, namely changes in marriage and divorce will slow considerably, but will not cease during the next 15 years. Series C reflects the assumption that the rapid change in marriage and divorce may have come to an end, and householder proportions will remain constant for the next 15 years]

YEAR AND SERIES	Total	FAMILY				NONFAMILY		
		Total	Married couple	Male householder [1]	Female householder [1]	Total	Male householder	Female householder
1989: Series A	93,622	65,403	51,521	2,616	11,266	28,219	12,403	15,816
Series B	92,847	66,034	52,554	2,508	10,972	26,814	11,583	15,231
Series C	92,126	66,653	53,562	2,410	10,681	25,473	10,802	14,671
1990: Series A	95,243	65,964	51,704	2,723	11,538	29,279	13,008	16,270
Series B	94,227	66,758	53,012	2,581	11,165	27,469	11,946	15,523
Series C	93,297	67,535	54,282	2,455	10,798	25,762	10,949	14,814
1995: Series A	102,785	68,219	52,178	3,276	12,765	34,565	16,102	18,463
Series B	100,308	69,787	54,863	2,940	11,984	30,520	13,666	16,854
Series C	98,180	71,294	57,410	2,667	11,217	26,887	11,490	15,396
2000: Series A	110,217	70,024	52,263	3,845	13,916	40,193	19,471	20,722
Series B	105,933	72,277	56,294	3,282	12,701	33,656	15,452	18,204
Series C	102,440	74,449	60,080	2,855	11,515	27,991	11,985	16,006

[1] With no spouse present.

Source: U.S. Bureau of the Census, *Current Population Reports,* series P-25, No. 986.

No. 60. White, Black and Hispanic Households, by Type: 1970 to 1987

[As of March, except as noted. Based on Current Population Survey, except as noted; see headnote, table 58. See also *Historical Statistics, Colonial Times to 1970*, series A 292-295 and A 320-334]

Characteristic	Number (1,000)					Percent distribution				
	1970	1975	1980	1985	1987	1970	1975	1980	1985	1987
White										
Total	56,602	62,945	70,766	75,328	77,284	100.0	100.0	100.0	100.0	100.0
Family households	46,166	49,334	52,243	54,400	55,676	81.6	78.4	73.8	72.2	72.0
Married couple	41,029	42,951	44,751	45,643	46,410	72.5	68.2	63.2	60.6	60.1
Male householder[1]	1,038	1,257	1,441	1,816	2,038	1.8	2.0	2.0	2.4	2.6
Female householder[1]	4,099	5,126	6,052	6,941	7,227	7.2	8.1	8.6	9.2	9.4
Nonfamily households	10,436	13,612	18,522	20,928	21,608	18.4	21.6	26.2	27.8	28.0
Male householder	3,406	5,038	7,499	8,608	9,034	6.0	8.0	10.6	11.4	11.7
Female householder	7,030	8,574	11,023	12,320	12,574	12.4	13.6	15.6	16.4	16.3
Black										
Total	6,223	7,262	8,586	9,480	9,922	100.0	100.0	100.0	100.0	100.0
Family households	4,856	5,468	6,184	6,778	7,096	78.0	75.3	72.0	71.5	71.5
Married couple	3,317	3,343	3,433	3,469	3,742	53.3	46.0	40.0	36.6	37.7
Male householder[1]	181	211	256	344	386	2.9	2.9	3.0	3.6	3.9
Female householder[1]	1,358	1,915	2,495	2,964	2,967	21.8	26.4	29.1	31.3	29.9
Nonfamily households	1,367	1,793	2,402	2,703	2,826	22.0	24.7	28.0	28.5	28.5
Male householder	564	791	1,146	1,244	1,313	9.1	10.9	13.3	13.1	13.2
Female householder	803	1,002	1,256	1,459	1,513	12.9	13.8	14.6	15.4	15.2
Hispanic[2]										
Total	2,303	(NA)	3,684	4,883	5,418	100.0	(NA)	100.0	100.0	100.0
Family households	2,004	(NA)	3,029	3,939	4,403	87.0	(NA)	82.2	80.7	81.3
Married couple	1,615	(NA)	2,282	2,824	3,118	70.1	(NA)	61.9	57.8	57.5
Male householder[1]	82	(NA)	138	210	253	3.6	(NA)	3.7	4.3	4.7
Female householder[1]	307	(NA)	610	905	1,032	13.3	(NA)	16.6	18.5	19.0
Nonfamily households	299	(NA)	654	944	1,015	13.0	(NA)	17.8	19.3	18.7
Male householder	150	(NA)	365	509	521	6.5	(NA)	9.9	10.4	9.6
Female householder	148	(NA)	289	435	494	6.4	(NA)	7.8	8.9	9.1

NA Not available. [1] No spouse present. [2] Hispanic persons may be of any race. 1970 data as of April.

Source: U.S. Bureau of the Census, *Census of Population: 1970, Persons of Spanish Origin*, PC(2)-1C; *Current Population Reports*, series P-20, No. 424 and earlier reports.

No. 61. Households by Characteristic of Householder and Size of Household: 1970 to 1987

[As of March. Based on Current Population Survey; see headnote, table 58. See also *Historical Statistics, Colonial Times to 1970*, series A 335-349]

Characteristic of householder and size of household	Number (mil.)							Percent distribution				
	1970	1975	1980	1984	1985	1986	1987	1970	1975	1980	1985	1987
Total[1]	63.4	71.1	80.8	85.4	86.8	88.5	89.5	100.0	100.0	100.0	100.0	100.0
Age of householder:												
15-24 years old[2]	4.4	5.8	6.6	5.5	5.4	5.5	5.2	6.8	8.2	8.1	6.3	5.8
25-29 years old	6.1	7.8	9.3	9.8	9.6	9.8	9.7	9.6	11.0	11.5	11.1	10.8
30-34 years old	5.6	7.1	9.3	10.0	10.4	10.6	10.9	8.8	10.0	11.5	12.0	12.1
35-44 years old	11.8	11.9	14.0	16.6	17.5	18.0	18.7	18.6	16.7	17.3	20.1	20.9
45-54 years old	12.2	12.9	12.7	12.5	12.6	13.1	13.2	19.5	18.2	15.7	14.6	14.8
55-64 years old	10.8	11.3	12.5	13.1	13.1	12.9	12.9	17.1	15.9	15.5	15.1	14.4
65-74 years old	7.7	8.9	10.1	10.7	10.9	11.2	11.3	12.1	12.5	12.5	12.6	12.6
75 years old and over	4.8	5.4	6.4	7.2	7.3	7.4	7.7	7.6	7.6	7.9	8.4	8.7
Male	50.0	54.3	58.0	59.4	60.0	61.0	61.7	78.9	76.4	71.8	69.2	69.0
Female	13.4	16.8	22.8	26.0	26.8	27.4	27.7	21.1	23.6	28.2	30.8	31.0
White	56.6	62.9	70.8	74.4	75.3	76.6	77.3	89.5	88.5	87.6	86.8	86.4
Black	6.2	7.3	8.6	9.2	9.5	9.8	9.9	9.8	10.2	10.6	10.9	11.1
Hispanic[3]	(NA)	(NA)	3.7	4.3	4.9	5.2	5.4	(NA)	(NA)	4.6	5.6	6.1
Person	10.9	13.9	18.3	20.0	20.6	21.2	21.1	17.1	19.6	22.7	23.7	23.6
Male	3.5	4.9	7.0	7.5	7.9	8.3	8.2	5.5	6.9	8.7	9.1	9.2
Female	7.3	9.0	11.3	12.4	12.7	12.9	12.9	11.5	12.7	14.0	14.6	14.4
Persons	18.3	21.8	25.3	26.9	27.4	27.7	28.6	28.9	30.6	31.4	31.6	32.0
Persons	10.9	12.4	14.1	15.1	15.5	16.1	16.2	17.3	17.4	17.5	17.8	18.1
Persons	10.0	11.1	12.7	13.6	13.6	13.8	14.0	15.8	15.6	15.7	15.7	15.6
Persons	6.5	6.4	6.1	6.1	6.1	6.3	6.2	10.3	9.0	7.5	7.0	6.9
Persons or more	3.5	3.1	2.5	2.4	2.3	2.1	2.2	5.6	4.3	3.1	2.6	2.4
	3.2	2.5	1.8	1.4	1.3	1.3	1.3	5.0	3.5	2.2	1.5	1.4

Not available. [1] Includes other races, not shown separately. [2] 1970 and 1975, persons 14 to 24 years old. [3] Hispanic persons may be of any race.

Source: U.S. Bureau of the Census, *Current Population Reports*, series P-20, No. 424 and earlier reports; and unpublished data.

No. 62. Household Characteristics, by Race, Hispanic Origin and Type: 1987

[As of March. Based on Current Population Survey; see headnote, table 58. For composition of regions, see fig. I, inside front cover]

Characteristic	Number of households (1,000)						Percent distribution						Persons per household			
	Total	Black	Hispanic[1]	Family households		Nonfamily households	Total	Black	Hispanic[1]	Family households		Nonfamily households	Total	Black	Hispanic[1]
				Total[2]	Married couple	Female householder[3]				Total[2]	Married couple	Female householder[3]				
Total	89,479	9,922	5,418	64,491	51,537	10,445	24,988	100.0	100.0	100.0	100.0	100.0	100.0	2.66	2.91	3.42
Age of householder:																
15-24 years old	5,197	671	524	2,939	1,858	843	2,258	5.8	6.8	9.7	4.6	3.6	9.0	2.31	2.62	3.00
25-29 years old	9,652	1,159	845	6,695	5,170	1,257	2,957	10.8	11.7	15.6	10.4	10.0	11.8	2.65	2.92	3.31
30-34 years old	10,850	1,382	805	8,417	6,708	1,460	2,433	12.1	13.9	14.9	13.1	13.0	9.7	3.08	3.20	3.77
35-44 years old	18,704	2,109	1,300	15,476	12,157	2,675	3,228	20.9	21.3	24.0	24.0	23.6	25.6	3.37	3.44	3.97
45-54 years old	13,211	1,604	807	10,998	8,947	1,614	2,213	14.8	16.2	14.9	17.1	17.4	15.5	3.07	3.15	3.70
55-64 years old	12,868	1,301	589	9,738	8,240	1,196	3,130	14.4	13.1	10.9	15.1	16.0	11.5	2.37	2.56	2.98
65-74 years old	11,250	1,038	354	6,937	5,935	772	4,313	12.6	10.5	6.5	10.8	11.5	7.4	1.88	2.34	2.39
75 years old and over	7,748	658	192	3,292	2,522	628	4,456	8.7	6.6	3.5	5.1	4.9	6.0	1.57	1.90	2.09
Region:																
Northeast	18,873	1,766	1,097	13,367	10,504	2,262	5,505	21.1	17.8	20.2	20.7	20.4	21.7	22.0	2.62	2.79	3.11
Midwest	21,973	1,905	325	15,844	12,817	2,458	6,129	24.6	19.2	6.0	24.6	24.9	23.5	24.5	2.67	2.88	3.54
South	30,620	5,305	1,785	22,536	17,964	3,824	8,084	34.2	53.5	32.9	34.9	34.9	36.6	32.4	2.66	3.02	3.34
West	18,014	945	2,211	12,744	10,252	1,900	5,269	20.1	9.5	40.8	19.8	19.9	18.2	21.1	2.70	2.61	3.63
Size of household:																
One person	21,128	2,499	810	(X)	(X)	(X)	21,128	23.6	25.2	15.0	(X)	(X)	(X)	84.6	1.00	1.00	1.00
Two persons	28,602	2,440	1,170	25,519	19,645	4,501	3,084	32.0	24.6	21.6	39.6	38.1	43.1	12.3	2.00	2.00	2.00
Three persons	16,159	1,951	1,048	15,667	11,713	3,257	492	18.1	19.7	19.3	24.3	22.7	31.2	2.0	3.00	3.00	3.00
Four persons	13,984	1,500	1,132	13,783	12,013	1,532	200	15.6	15.1	20.9	21.4	23.3	14.7	.8	4.00	4.00	4.00
Five persons	6,162	797	695	6,097	5,330	645	66	6.9	8.0	12.8	9.5	10.3	6.2	.3	5.00	5.00	5.00
Six persons	2,176	374	307	2,165	1,833	282	10	2.4	3.8	5.7	3.4	3.6	2.7	(Z)	6.00	6.00	6.00
Seven persons or more	1,268	361	257	1,259	1,002	228	8	1.4	3.6	4.7	2.0	1.9	2.2	(Z)	7.89	8.19	8.08
Marital status of householder:																
Single (never married)	12,071	2,202	781	2,932	(X)	2,155	9,138	13.5	22.2	14.4	4.5	(X)	20.6	36.6	1.78	2.41	2.50
Married, spouse present	51,537	3,742	3,118	51,537	51,537	(X)	(X)	57.6	37.7	57.5	79.9	100.0	(X)	(X)	3.27	3.68	4.03
Married, spouse absent	4,206	1,136	543	2,221	(X)	1,831	1,985	4.7	11.4	10.0	3.4	(X)	17.5	7.9	2.33	2.68	2.96
Separated	3,292	990	426	1,902	(X)	1,595	1,390	3.7	10.0	7.9	2.9	(X)	15.3	5.6	2.47	2.76	3.03
Widowed	11,291	1,373	350	3,043	(X)	2,604	8,248	12.6	13.8	6.5	4.7	(X)	24.9	33.0	1.56	2.31	2.38
Divorced	10,374	1,468	625	4,758	(X)	3,854	5,616	11.6	14.8	11.5	7.4	(X)	36.9	22.5	2.03	2.44	2.53
Tenure:																
Owner occupied	57,258	4,505	2,198	46,287	40,057	4,755	10,972	64.0	45.4	40.6	71.8	77.7	45.5	43.9	2.82	3.17	3.72
Renter occupied	32,221	5,417	3,220	18,205	11,480	5,690	14,016	36.0	54.6	59.4	28.2	22.3	54.5	56.1	2.39	2.70	3.22

X Not applicable. Z Less than .05 percent. [1] Hispanic persons may be of any race. [2] Includes male householder, no spouse present. [3] No spouse present.

Source: U.S. Bureau of the Census, *Current Population Reports*, series P-20, No. 424 and series P-60, No. 159.

No. 63. Households—States: 1980 to 1987

[1980, as of April 1; thereafter, as of July 1. For definition of household, see text, section 1. For composition of regions, see fig. I, inside front cover]

Region, division, and state	Number (1,000)			Persons per household	
	1980	1985	1987	1980	1987
U.S	80,390	87,489	90,031	2.75	2.64
Region:					
Northeast	17,471	18,424	18,768	2.74	2.61
Midwest	20,859	21,758	22,153	2.75	2.62
South	26,486	29,859	30,899	2.77	2.65
West	15,574	17,448	18,211	2.71	2.66
. Eng	4,362	4,674	4,791	2.74	2.59
ME	395	432	447	2.75	2.57
NH	323	366	391	2.75	2.61
VT	178	196	204	2.75	2.58
MA	2,033	2,156	2,190	2.72	2.58
RI	339	359	369	2.70	2.57
CT	1,094	1,165	1,189	2.76	2.62
id. Atl	13,109	13,749	13,976	2.74	2.61
NY	6,340	6,634	6,722	2.70	2.58
NJ	2,549	2,740	2,807	2.84	2.68
PA	4,220	4,375	4,447	2.74	2.62
No. Cent	14,654	15,204	15,495	2.78	2.64
OH	3,834	3,963	4,035	2.76	2.61
IN	1,927	2,011	2,049	2.77	2.63
IL	4,045	4,212	4,271	2.76	2.65
MI	3,195	3,266	3,355	2.84	2.68
WI	1,652	1,751	1,785	2.77	2.62
. No. Cent	6,205	6,554	6,658	2.68	2.57
MN	1,445	1,546	1,585	2.74	2.60
IA	1,053	1,074	1,072	2.68	2.55
MO	1,793	1,895	1,940	2.67	2.56
ND	228	248	247	2.75	2.62
SD	243	260	264	2.74	2.59
NE	571	605	608	2.66	2.54
KS	872	926	943	2.62	2.54

Division and state	Number (1,000)			Persons per household	
	1980	1985	1987	1980	1987
So. Atl	13,160	14,940	15,655	2.73	2.59
DE	207	227	238	2.79	2.64
MD	1,461	1,587	1,656	2.82	2.68
DC	253	248	248	2.40	2.35
VA	1,863	2,076	2,171	2.77	2.63
WV	686	710	707	2.79	2.63
NC	2,043	2,294	2,390	2.78	2.60
SC	1,030	1,154	1,199	2.93	2.77
GA	1,872	2,138	2,258	2.84	2.69
FL	3,744	4,506	4,787	2.55	2.46
E. So. Cent	5,051	5,438	5,580	2.83	2.68
KY	1,263	1,344	1,366	2.82	2.65
TN	1,619	1,759	1,820	2.77	2.61
AL	1,342	1,444	1,483	2.84	2.69
MS	827	890	909	2.97	2.81
W. So. Cent	8,276	9,481	9,665	2.80	2.72
AR	816	875	895	2.74	2.61
LA	1,412	1,556	1,566	2.91	2.78
OK	1,119	1,252	1,244	2.62	2.55
TX	4,929	5,797	5,960	2.82	2.75
Mt	3,986	4,589	4,780	2.79	2.70
MT	284	305	303	2.70	2.60
ID	324	354	357	2.85	2.74
WY	166	182	177	2.78	2.72
CO	1,061	1,222	1,255	2.65	2.56
NM	441	510	533	2.90	2.77
AZ	957	1,143	1,240	2.79	2.68
UT	449	505	518	3.20	3.19
NV	304	368	397	2.59	2.49
Pac	11,587	12,859	13,431	2.68	2.65
WA	1,541	1,691	1,761	2.61	2.51
OR	992	1,044	1,074	2.60	2.48
CA	8,630	9,619	10,076	2.68	2.68
AK	131	175	175	2.93	2.89
HI	294	330	345	3.15	3.02

Source: U.S. Bureau of the Census, *Current Population Reports*, series P-25, No. 1024.

No. 64. Households, 1980 and 1987, and Persons in Households, 1987, by Type of Household and Presence of Children

[As of March. Based on Current Population Survey; see headnote, table 58. Minus sign (−) indicates decrease]

Type of household and presence of children	Households: Number (1,000)		Households: Change, 1980–1987		Households: Percent distribution		Persons in households, 1987		Persons per household, 1987
	1980	1987	Number (1,000)	Percent	1980	1987	Number (1,000)	Percent distribution	
Total households	80,776	89,479	8,703	10.8	100.0	100.0	238,261	100.0	2.66
nily households	59,550	64,491	4,941	8.3	73.7	72.1	207,772	87.2	3.22
With own children under 18	31,022	31,898	876	2.8	38.4	35.6	124,642	52.3	3.91
Without own children under 18	28,528	32,593	4,065	14.2	35.3	36.4	83,130	34.9	2.55
larried couple family	49,112	51,537	2,425	4.9	60.8	57.6	168,302	70.6	3.27
With own children under 18	24,961	24,645	−316	−1.3	30.9	27.5	102,134	42.8	4.14
Without own children under 18	24,151	26,892	2,741	11.3	29.9	30.1	66,168	27.8	2.46
lale householder, no spouse present	1,733	2,510	777	44.8	2.1	2.8	7,232	3.0	2.88
With own children under 18	616	955	339	55.0	.8	1.1	2,767	1.2	2.90
Without own children under 18	1,117	1,554	437	39.1	1.4	1.7	4,465	1.9	2.87
emale householder, no spouse present	8,705	10,445	1,740	20.0	10.8	11.7	32,238	13.5	3.09
With own children under 18	5,445	6,297	852	15.6	6.7	7.0	19,741	8.3	3.13
Without own children under 18	3,261	4,147	886	27.2	4.0	4.6	12,497	5.2	3.01
family households	21,226	24,988	3,762	17.7	26.3	27.9	30,489	12.8	1.22
Living alone	18,296	21,128	2,832	15.5	22.7	23.6	21,128	8.9	1.00
ale householder	8,807	10,652	1,845	20.9	10.9	11.9	14,303	6.0	1.34
Living alone	6,966	8,246	1,280	18.4	8.6	9.2	8,246	3.5	1.00
emale householder	12,419	14,336	1,917	15.4	15.4	16.0	16,186	6.8	1.13
Living alone	11,330	12,881	1,551	13.7	14.0	14.4	12,881	5.4	1.00

urce: U.S. Bureau of the Census, *Current Population Reports*, series P-20, No. 424 and earlier reports; and unpublished data.

No. 65. Living Arrangements of Persons 15 Years Old and Over, by Selected Characteristics: 1987

[As of March. Based on Current Population Survey which includes members of Armed Forces living off post or with families on post, but excludes other Armed Forces; see text, section 1 and Appendix III]

Age and sex	All races [1]: Total (1,000)	All races [1]: Percent living— Alone	With spouse	With other relatives	With nonrelatives	White persons percent living— Alone	With spouse	With other relatives	Black persons percent living— Alone	With spouse	With other relatives
Total	186,688	11.3	56.0	27.0	5.7	11.4	58.6	24.4	11.9	36.2	46.1
15–19 years old	18,186	.5	2.8	93.5	3.2	.5	3.2	92.9	.4	.9	96.4
20–24 years old	19,358	6.0	26.0	54.8	13.2	6.3	28.5	51.5	4.5	12.8	73.7
25–44 years old	76,267	8.5	65.8	18.4	7.3	8.4	68.7	15.7	9.3	44.7	38.5
45–64 years old	44,901	10.8	75.1	11.4	2.7	10.2	77.8	9.6	17.4	51.6	26.4
65 years old and over	27,975	30.4	54.0	13.2	2.4	30.4	55.1	12.1	33.0	41.7	22.7
65–74 years old	17,232	24.1	63.7	10.2	2.0	23.9	65.2	9.0	29.0	47.4	20.7
75 years old and over	10,743	40.5	38.5	17.9	3.1	40.8	39.0	17.1	39.8	31.9	25.9
Male	89,368	9.2	58.5	25.3	7.0	9.0	60.9	23.4	11.6	40.4	39.3
15–19 years old	9,193	.4	1.2	95.6	2.8	.4	1.3	95.3	.4	.4	97.4
20–24 years old	9,499	6.6	18.9	60.1	14.3	6.9	20.8	57.8	4.6	9.3	75.1
25–44 years old	37,671	10.3	64.7	15.5	9.5	10.1	67.0	13.8	12.1	47.4	28.3
45–64 years old	21,428	8.9	80.9	6.9	3.4	8.1	82.9	6.1	17.1	61.2	14.3
65 years old and over	11,578	15.6	74.9	6.9	2.6	14.9	76.0	6.5	22.8	63.9	10.1
65–74 years old	7,608	12.3	79.7	5.6	2.5	11.7	81.1	5.0	20.0	65.9	9.9
75 years old and over	3,970	21.8	65.9	9.6	2.7	21.3	66.4	9.5	28.0	60.1	10.6
Female	97,320	13.2	53.7	28.6	4.4	13.6	56.6	25.3	12.2	32.7	51.6
15–19 years old	8,994	.5	4.5	91.3	3.6	.6	5.1	90.5	.4	1.3	95.6
20–24 years old	9,859	5.5	32.8	49.6	12.0	5.7	36.2	45.3	4.5	15.7	72.5
25–44 years old	38,597	6.8	66.9	21.2	5.0	6.8	70.5	17.6	7.0	42.4	47.1
45–64 years old	23,472	12.6	69.8	15.6	2.0	12.2	73.0	12.8	17.6	44.0	35.9
65 years old and over	16,397	40.9	39.2	17.6	2.3	41.4	40.2	16.1	39.8	26.7	31.1
65–74 years old	9,624	33.5	51.0	13.9	1.6	33.6	52.6	12.2	35.4	34.0	28.6
75 years old and over	6,773	51.5	22.4	22.8	3.3	52.1	23.1	21.5	46.7	15.3	34.9

[1] Includes other races not shown separately.

Source: U.S. Bureau of the Census, *Current Population Reports*, series P-20, No. 423.

No. 66. Living Arrangements of Young Adults: 1970 to 1987

[1970 and 1980, as of April. Beginning 1985, as of March and based on Current Population Survey, see headnote, table 65]

Living arrangements and sex	Persons 18–24 years old: 1970	1980	1985	1986	1987	Persons 25–34 years old: 1970	1980	1985	1986	1987
Total (1,000)	22,357	29,122	27,844	27,111	26,462	24,566	36,796	40,857	42,053	42,636
Percent distribution:										
Child of householder [1]	47.3	48.4	53.6	52.6	54.3	8.0	8.7	10.6	11.1	11.1
Family householder or spouse	37.9	28.9	24.3	24.9	23.3	82.8	72.3	67.9	66.6	66.6
Nonfamily householder	4.8	9.5	8.2	8.5	8.5	4.9	12.0	12.9	13.1	12.6
Other	10.0	13.2	13.8	14.0	14.0	4.3	7.0	8.6	9.2	9.7
Male (1,000)	10,398	14,278	13,695	13,324	13,029	11,929	18,107	20,184	20,956	21,142
Percent distribution:										
Child of householder [1]	54.3	54.3	59.7	58.8	61.3	9.5	10.5	13.3	14.2	14.5
Family householder or spouse	30.0	21.3	16.4	17.1	15.3	79.3	66.4	60.1	58.2	58.1
Nonfamily householder	5.4	11.1	9.6	9.5	9.5	6.5	15.3	16.1	16.6	15.7
Other	10.3	13.3	14.3	14.6	14.0	4.8	7.9	10.5	10.9	11.7
Female (1,000)	11,959	14,844	14,149	13,787	13,433	12,637	18,689	20,673	21,097	21,494
Percent distribution:										
Child of householder [1]	41.3	42.7	47.8	46.7	47.5	6.6	7.0	8.0	8.0	7.7
Family householder or spouse	44.7	36.2	32.0	32.4	31.2	86.1	78.1	75.5	74.9	74.9
Nonfamily householder	4.2	8.1	6.9	7.5	7.5	3.5	8.8	9.7	9.6	9.7
Other	9.7	13.1	13.3	13.4	13.9	3.9	6.2	6.7	7.5	7.7

[1] Includes unmarried college students living in dormitories.

Source: U.S. Bureau of the Census, *1970* and *1980 Census of Population*, PC(2)-4B and *Current Population Reports*, series P-20, No. 423 and earlier reports.

Order Code IB89010

CRS Issue Brief

Tropical Deforestation: International Implications

Updated March 22, 1989

by
Susan R. Fletcher
Environment and Natural Resources Policy Division

CONTENTS

Tropical Deforestation: International Implications

SUMMARY

Tropical forests are being cut down and permanently lost at a rapid pace in many parts of the world. Most such forests are found in developing countries where poverty and economic pressures are key factors. Results of deforestation include significant releases of carbon dioxide, a "greenhouse" gas, with possible consequences for global climate; rapid loss of thousands of plant and animal species, many of which may have potential medical or chemical values; flooding of adjacent countries as watersheds lose their capacity to store water; loss of coastal and riverine fisheries and resources as soil erosion washes sediment into rivers and the sea; and the failure of economic development efforts as poor farmers attempt to farm marginal deforested soils that cannot support sustained agriculture.

Congress has addressed this issue over the past several years primarily in legislation guiding United States foreign assistance programs. Laws have been passed guiding the U.S. Agency for International Development (AID) and establishing requirements for environmental protection in U.S. participation in multilateral development banks (MDBs) such as the World Bank. Congressional concern over tropical deforestation, especially its contributions to the greenhouse effect and resulting warming of the climate, grew rapidly during the 100th Congress and has continued in the 101st. Several comprehensive bills to deal with climate change contain sections on protection of tropical forests.

ISSUE DEFINITION

Tropical forests are being cut down at a rapid pace in many areas of the world. Among the international consequences are: loss of biological diversity and impacts on global climate change. The major issue for U.S. policymakers is what can be done to influence other countries to reduce deforestation and to avoid actions that will contribute to deforestation?

BACKGROUND AND ANALYSIS

Protection of tropical forests is largely an international issue for the United States, since there are almost no tropical forests within U.S. borders. Only in Hawaii and Puerto Rico are such forests found, and only in Puerto Rico is there direct Federal jurisdiction.

Moist Tropical Forests: A Special Concern

Loss of forests is a concern around the world. Trees contribute to healthy functioning of many types of ecosystems and provide important "services" in agriculture in temperate areas, savannah areas, and at most latitudes. However, moist tropical forests, known as "rainforests" are of special concern for several reasons:

1. They occur in extensive systems that stretch uninterruptedly over large territories; these massive areas of forest are thought to play a key role in climate patterns, influencing moisture/rainfall cycles far from their location.

2. They are among the most chemically dynamic of the earth's ecological types, and their role in atmospheric chemistry, particularly the greenhouse effect, is thought to be significant.

3. They contain the richest store of biological diversity on earth, harboring more than half of the species on earth, many of which have made ingenious adaptations to unique surroundings and thereby offer clues to possible medical cures and genetic puzzles. Modern medicine includes many critically important medicines that originated among the unusually specialized plant and animal species of the rainforest. Many of these species are found only in very small niches within these rainforests, and as tracts of any significant size are cut, they can be permanently lost through extinction.

4. The clearing of tropical moist forests for agricultural development is frequently uneconomic, since the soils underlying such forests are often infertile and lateritic (such soils harden and become barren when

exposed). This unsustainable conversion of the land can have tragic results for the poverty stricken people who attempt such marginal agricultural operations.

Extent of Rain Forests and Rate of Depletion

Tropical rainforests are found primarily in a "belt" around the globe on either side of the equator. In South America there are several countries that contain such forests, but the vast majority are found in the Amazon Basin, which comprises a large area of Brazil as well as parts of Ecuador and other countries. In Africa, the Congo Basin and several West African countries share the bulk of the rainforest. In Southeast Asia, such forests are found in several large island countries such as Indonesia and New Guinea, as well as in Malaysia and others. In other countries, tropical forests were once widespread, but have now been cut back to small proportions of their previous range. India and countries in Central America, among others, are in this category.

One reason the Amazon, particularly in Brazil, is of such concern with regard to deforestation is that it is sustaining the most rapid loss of forest. Brazil contains by far the largest area under tropical moist forest cover. It contains nearly twice as much forest area than the second and third largest areas -- Indonesia and Zaire respectively -- combined.

Precise data on the exact extent of tropical rainforest on the earth do not exist, nor do data on the rate of deforestation that is occurring. The numbers commonly used, though often based on the best available information, may differ because of varying definitions, methods, and purposes. Despite differing estimates, however, there is wide agreement among scientists and analysts that tropical forests are being subjected to rapid cutting and burning and are being permanently lost at an increasingly rapid rate. The following summary uses figures developed from several sources, primarily the Tropical Forest Action Plan (discussed below).

Of the 4 billion hectares of forest covering the earth (one-third of the earth's land surface), some 58% is in developing countries, mostly tropical; 42% is in developed countries and is mainly temperate forests. Thus tropical forests cover an estimated 2.3 billion hectares. These forests can be divided into two main types: closed forest in which trees and undergrowth cover the ground, such as in the humid forests, and open forests with continuous grass cover and intermittent tree cover.

It is estimated that each year some 7.5 million hectares of closed forest and 3.8 million hectares of open forest are cleared in the tropics. The United Nations Food and Agriculture Organization (FAO) completed a worldwide forest survey at the end of the 1970s that established the extent and location of existing forest cover. However, no systematic plans for a follow-up survey to establish rates of change in forest cover were made. Most of the data in the FAO survey resulted from reports by each country on its forest cover, which makes the results uneven and somewhat unreliable on a worldwide basis.

Satellite data are now being analyzed on a yearly basis for areas in Brazil, and baseline studies are underway for areas in Africa, in a small program in the National Aeronautics and Space Administration (NASA). Results from these analyses indicate that the forest loss in the Brazilian Amazon from burning and clearing of the land is much more rapid than had been thought.

Agreement on precise amounts of deforestation in Brazil is difficult to find; however, there is agreement on the very large magnitude and seriousness of deforestation there. The Brazilian Space Research Center has been conducting analyses of remote sensing data over the past several years, as has NASA. Researchers in these institutions collaborate in efforts to measure deforestation, but some differences in interpretation do exist between them. This is partly because only limited field work to provide "ground truth" has been done, and detailed analysis of Landsat data is only now being completed. Recent information, based on interviews with officials from Brazil and NASA researchers, is as follows:

Legal Amazonia covers nearly 5 million square kilometers in Brazil. This area contains both forested and non-forested areas. Within this area, remote sensing data show some over 204,000 square km. burned in 1987, according to the Brazilian Space Research Agency. This agency estimates some 300,000 sq. km. burned in 1988. However, because these figures reflect burning of both forested and non-forested land, the amount of forest burned is considerably less. The Brazilian agency estimates that some 80,000 of the 204,000 sq. km. in 1987 was primary forest being cleared for the first time; NASA researchers estimate it may be 50,000 sq. km of the total that was first-time burning of a forested area.

Protected areas, designated as parks or reserves, total only some 10, 825,141 hectares (2.47 acres per hectare) or 2.04% of Legal Amazonia. However, protective status has not been effectively implemented, so even these figures do not represent areas that are well studied or adequately protected from human encroachment.

Types and amounts of burning and deforestation vary greatly among the states of Amazonia. The Brazilian Space Research Agency reports the following amounts of area burned for the various states in 1987:

Acre	7,274 sq. km.
Amazonas	1,094
Para	19,365
Rondonia	45,452
Mato Grosso	78,718
Goias	38,940
Maranhao	13,765

In the more developed states, more of the burning was on nonforested lands; in the less developed state of Amazonas, the largest in Brazil, for example, the burning was probably mostly forest, and was about 1% of the forest area in that state. In Rondonia, where development is more extensive, of the 45,452 sq. km. burned, between 6,000 and 8,000 is estimated to be forest. However, this may represent up to 18% of the forest of that state.

Rapid deforestation is also occurring in Southeast Asia. In Africa, the humid closed forests are believed to be under less severe pressure in most countries, but in some African countries tropical rainforest has already been largely lost.

Causes of Deforestation

The causes of deforestation in the humid tropics are complex, and the amounts of forest loss attributable to each cause are not precisely known. However, most observers believe that land clearing for marginal agriculture, often through the use of slash-and-burn practices, is the most widespread cause of deforestation. In large areas, conversion to pasture is blamed for tropical deforestation.

Today, in addition to direct clearing for pasture, there is a widespread cycle of activity found in tropical rainforests that begins with road construction, followed by an influx of poor peasants who have often been encouraged by government policies to seek lands for farming. After the trees are felled and when the soils are depleted, often after only two or three seasons, or when subsistence agriculture fails for other reasons, peasants move again, and the land is sold or abandoned, then used for cattle pasture. In this way large areas are converted to grazing lands, despite the unsuitability of much of the land for grazing and its susceptibility to compaction under grazing pressure. When large areas are converted from tropical rainforest in these ways, it may be difficult or impossible for the forest to regenerate; many of the native species that created the complex cycle of life in the rainforest become extinct.

Considerable attention has been paid to the United States "hamburger connection" to tropical deforestation. The concern is that beef exported to the U.S. market is being raised on land cleared from tropical rainforest. Although beef for export may have been an early incentive for the cattle industry in many countries in Latin America, currently domestic consumption in those countries accounts for a large portion of the beef production there. The United States presently imports little or no beef from countries where tropical deforestation is occurring. The vast majority of beef imports to the United States are from Australia and New Zealand.

Another cause of forest degradation and loss is commercial logging, often carried out for export to obtain scarce foreign exchange, under pressure of enormous international debt loads in many developing countries. The sight of huge logs being transported along jungle highways is familiar in some severely deforested countries; however, commercial logging is a minor contributor to the overall problem, compared to land clearing for other uses. Brazil recently banned the export of round logs in its new Forest Protection Law; however, some estimate that only 5% of deforestation of the Amazon is attributable to commercial timber operations.

Major Impacts of Deforestation

Greenhouse effect. Deforestation makes a contribution to the greenhouse effect and resultant global warming through emissions of carbon dioxide in burning or decay of forests, and loss of a carbon dioxide "sink" provided by large forests (see CRS Issue Brief 89005, Global Climate Change). The National Aeronautics and

Space Administration (NASA) currently is sponsoring research on the chemistry of carbon dioxide exchanges above the Amazonian forest in an effort to understand the dynamics of this "sink" and the extent to which forests produce and absorb greenhouse gasses such as carbon dioxide and nitrogen compounds. The Worldwatch State of the World 1987 report estimated that the amount of carbon added to the atmosphere annually from deforestation is between 1.0 and 2.6 billion tons. This is between 20% and 50% of the amount added by fossil fuels. All but 100 million tons of this comes from tropical forests, mainly due to burning or decay.

Biological diversity. Tropical moist forests contain the greatest diversity of life found in any type of ecosystem on earth. They harbor innovative adaptations to conditions that may prevail in only a small area. Whenever a tract of any significant size is cut down, species adapted to that specific area can be lost.

These diverse biological components have been the sources of critically important medicines and chemicals that contribute to daily life in the developed world. Just as bioengineering is becoming increasingly important, the "raw material" for this science is being eliminated by the rapid loss of tropical forest habitat. Some half of all medical prescriptions have their origins in wild organisms. If all pharmaceuticals are counted, the yearly commercial value of products derived from organisms found in the wild is over $40 billion.

Scientists are in substantial agreement that the world is experiencing an unprecedented wave of extinctions as the tropical rainforest habitats are reduced in size. However, since only a small proportion of the world's species has been identified or studied, it is not known how many species do indeed exist, or exactly how many are being lost. Estimates vary widely, but some put the number of species on earth at 30 million. However, only some one and a half million of them have been identified or studied. If deforestation rates continue in the Amazon Basin at rates prevailing in the mid-1980s, some estimates are that 15% of all plant species will be lost by the turn of the century.

Weather circulation patterns. Possible impacts on regional weather systems as moisture circulation patterns change over large areas are also being studied by NASA researchers. Tropical forests recycle enormous amounts of water as the dense vegetation absorbs rainfall, transpiration occurs, clouds form over the forest, and the cycle repeats itself. When an area is deforested, this cycle is eliminated, with possible effects not only in the denuded forest area, but far away as well.

Watershed protection. An important ecological "service" provided by all forests is watershed protection, in which the trees anchor and shield the soil and prevent it from being washed away by rainfall or blown by wind. Soil erosion and increased downstream flooding are two major consequences of deforestation. In some tropical countries, rivers that once ran clear are mud-filled with silt from previously forested areas; consequences include the silting up of dams along the river, and damages to riverine and coastal aquatic life. Spawning areas for economically important fisheries may be destroyed in some instances. In hilly or mountainous areas, runoff from rainstorms is greatly increased after deforestation removes the trees that used to hold soil in place and absorbed water. Recent floods in Bangladesh and Northern India are dramatic examples of increased flooding due to deforestation in the nearby Himalayan Mountains and their foothills.

Sustainable Development. Despite their lush appearance, tropical forests often grow on some of the world's poorest and most problematic soils. These forests are tremendously efficient at recycling nutrients through interdependent plant, animal, and insect species; and few of the necessary nutrients reside in the soils. In addition, many of these soils are "lateritic" in nature, which means that as they are deprived of vegetation and exposed to the elements without protective cover, they become hardened and dry. Rainfall runs off such hardened soil and does not soak in to nurture regeneration of forest plants. Thus, deforestation in some areas may cause irreversible degradation of the life-sustaining capacity of the soil.

When economic development efforts involve clearing of tropical forests in such areas, the farming or cultivation that results may be unsustainable, sometimes with dire consequences for the farmers, usually poor to begin with, who make the attempt. Even projects that do not have farming as their objective, such as road construction through tropical forests, may result in the influx of settlers who attempt to practice agriculture. Unproductive soils may be only one factor, among a spectrum of difficulties including poor social support services, lack of markets, health problems, and lack of nonfarm income opportunities. However, environmental conditions that involve problem soils and climate can create additional burdens on already poor colonists.

In many tropical forest areas, indigenous people have developed complex systems for making productive use of forest plant and insect and animal species. These people may be displaced by colonists, and both their livelihood and their knowledge of productive use of forest resources may be eliminated. Scientists and activists are concerned that valuable knowledge of the practical application of forest resources and products are being lost as this occurs.

The other problems attendant upon deforestation such as soil erosion, silting of dams, and increased flooding also put at risk the sustainability of economic development efforts based on irrigation dams, coastal development, and downstream settlements. In all of these cases, development will be more sustainable over the long term if the ecological support services of forests are recognized and built into the project planning.

Congressional Responses

Congress has passed a number of laws and held numerous hearings on tropical deforestation and related issues. To date, most such legislation and hearings have focused on bilateral and multilateral foreign economic development assistance.

Bilateral Aid

U.S. bilateral aid programs are administered primarily through the Agency for International Development (AID), although a wide array of domestic agencies contribute to these efforts or may work in other countries on a reimbursable basis. The basic authorizing legislation for AID programs is the Foreign Assistance Act of

1961 as amended. This Act has been amended many times, several times to add environmental protection provisions. Such provisions for AID focus strongly on tropical forests and biological diversity, and many of the more general directives to assure that environmental deterioration is avoided apply to protection of forests or watersheds. In addition to authorizing legislation, in recent years foreign operations appropriations laws have contained environmental protection requirements for AID and U.S. agencies engaged in foreign assistance activities.

Most recently, the Foreign Assistance Act was amended in the 99th Congress by P.L. 99-529, substantially augmenting the environmental protection provisions applying to U.S. foreign assistance. At present, Section 117 of the Act, Environment and Natural Resources, notes that the world faces enormous, urgent problems with respect to natural resources, and that it is "in the economic and security interests of the United States to provide leadership... and in cooperating extensively with developing countries in order to achieve environmentally sound development." This Section directs that special efforts be made to maintain and restore the land and resources in developing countries, and that environmental impact assessments or statements be done on all projects that significantly affect the environment and natural resources of developing countries.

Section 118, titled Tropical Forests, states that "Congress is particularly concerned about the continuing and accelerating alteration, destruction and loss of tropical forests in developing countries, which pose a serious threat to development and the environment." It requires a high priority for recommendations of the United States Interagency Task Force on Tropical Forests. In providing assistance to developing countries, the United States is to put a high priority on conservation and sustainable management of tropical forests. AID is to facilitate exchanges of information with countries receiving U.S. aid on the importance of long-term economic and other benefits of forest conservation and on the irreversible losses associated with forest destruction. Section 118 details a long list of specific measures to be undertaken in foreign assistance to provide economic alternatives to forest clearing, and to help developing countries better manage tropical forest resources. In addition, assistance is to be denied for a list of activities that would destroy forests.

Section 118 further requires that private voluntary organizations and other nongovernmental organizations be used whenever feasible. An annual report on activities under this section is required as part of the foreign assistance annual report.

Section 119, Endangered Species, provides for protection of biological diversity.

In June 1988, U.S. AID produced a combined report on *Progress in Conserving Tropical Forests and Biological Diversity in Developing Countries*, as required by Sections 118 and 119. This 120-page report provided extensive details on forestry and biological diversity programs carried out by the agency; it reported 146 forestry projects or projects with forestry components in 46 developing countries for FY87, and funding for these activities of $56.2 million. AID's biological diversity activities in 1987 included obligations of $2.4 million for 21 new activities in 15 countries, with another $2.5 million obligated for biodiversity in other agency projects.

This represents a considerable increase in the priority extended to tropical forest and biological diversity efforts by AID. However, the majority of its forestry efforts remain on agroforestry, or the use of trees in agriculture, rather than protection of or productive use of existing forests.

Multilateral Aid

Beginning in 1983, various committees of Congress have held numerous hearings and investigated the operations of the multilateral development banks (MDBs), focusing extensively on the World Bank and examining the impacts of MDB projects on the environment of recipient countries. Much of this interest focused on the extensive deforestation occurring in Brazil, a majority of it occurring around roads constructed with MDB loans.

Each year for the past 4 years, the foreign operations appropriations legislation has contained extensive language directing U.S. participation in the multilateral development banks (MDBs) such as the World Bank to be based on assurances that environment received a high priority, including such evidence as hiring additional trained environmental staff. While some of this legislation specified protection of tropical forests as a goal, language was often more general, urging that MDB projects should avoid environmental degradation. In most cases, these more general goals would be relevant to efforts to protect tropical forests. Most recently, P.L. 100-461, passed in October 1988, specified a number of environmental concerns, including promotion of policies that minimize greenhouse gases and promotion of conservation of biological diversity through existing and new mechanisms.

Legislative Proposals

In the 100th Congress, greatly heightened concern about climate change as a result of the "greenhouse effect" resulted in a number of comprehensive bills to deal with greenhouse gases. Some of these bills contained extensive provisions to protect and study tropical forests because of their contributions to the greenhouse effect. Other bills, H.R. 3010, the Tropical Forest Protection Act, and S. 1538, the Tropical Forest and Wetlands Protection Act, focused specifically on forests.

In the 101st Congress, a number of the comprehensive bills directed at climate change and greenhouse effect issues contain extensive sections or titles on tropical forest protection. The measures proposed deal with forest resource assessments, bilateral and multilateral assistance programs to assist countries in preserving tropical forests, international timber trade-related measures, debt reduction or debt-for-nature measures, and others. (The provisions of these bills relevant to tropical forests are listed below under the Legislation section hereafter.) In addition, it is expected that specific tropical forest protection bills will again be introduced.

International Responses

Tropical Forestry Action Plan

In June 1987, the Tropical Forestry Action Plan was released by the four organizations that produced it: the United Nations Food and Agricultural Organization (FAO), the United Nations Development Programme (UNDP), the World Bank, and the World Resources Institute (WRI). The Plan details the economic consequences of tropical deforestation and identifies several priority action areas: improving land use and integrating forestry into various kinds of land uses; developing appropriate forest-based industries; restoring fuelwood supplies in developing countries; conservation of tropical forest ecosystems; and building institutional capacity in developing countries for optimal forest resource management. Among others, U.S. AID has made use of this plan in assisting aid recipients to engage in appropriate tropical forest management.

International Tropical Timber Organization

In 1983 the International Tropical Timber Agreement was signed by both timber producing and consuming nations, and the International Tropical Timber Organization (ITTO) was established to carry out the agreement (see CRS Report 87-795, Tropical Deforestation: The International Tropical Timber Agreement). The emphasis of ITTO is on timber production and management of timber resource production, but it has increasingly adopted the term "sustainable management" and helping timber producing countries to maintain ecological balance is among its purposes. In ITTO's June 1988 meeting, three areas of priority action identified for ITTO activities were: (1) sustainable management of tropical timber resources, including appropriate harvesting methods; (2) further processing; and (3) market transparency and trade diversification.

LEGISLATION

H.R. 1078 (Schneider)

Global Warming Prevention Act of 1089. Contains 12 titles dealing with a large number of energy and natural resources management issues. Title VIII on Forest and Agricultural Policies deals primarily with domestic forest and agricultural concerns. Title IX on Development Assistance contains several sections dealing with tropical forest resource assessment and protection. The relevant sections are on Bilateral Tropical Forestry and Agroforestry Program; Multilateral programs; Trade in Wood and Wood Products; and Environmental Conservation and Debt Reduction. Introduced Feb. 22, 1989; referred to more than one committee.

S. 201 (Gore)

World Environment Policy Act of 1989. Covers a wide range of international environmental issues, focused strongly, but not exclusively, on protection of the atmosphere. Of the ten titles of this bill, those which address or are relevant to tropical deforestation are Title VI - The World Bank and Sustainable Economic

Development; Title VIII - Conservation of World Biodiversity; Title IX - Replanting and Conserving the World's Forests; and Title X - International Cooperation. Introduced Jan. 25, 1989; referred to Committee on Environment and Public Works.

S. 324 (Wirth)

National Energy Policy Act of 1989. Focused on global climate change, this bill includes tropical deforestation among the concerns it addresses. Of its 15 titles, sections particularly relevant to tropical deforestation are in Title XIII - Development Assistance, including bilateral aid, multilateral assistance, trade and debt related sections focused on forest protection. Introduced Feb. 2, 1989; referred to Committee on Energy and Natural Resources.

S. 603 (Boschwitz)

Contains extensive provisions relating to tropical forest protection. Introduced Mar. 16, 1989; referred to Committee on Foreign Relations.

FOR ADDITIONAL READING

Mahar, Dennis. Government policies and deforestation in Brazil's Amazon region. The World Bank policy and planning staff, Environment Department working paper no. 7. June 1988. 42 p.

United Nations Food and Agriculture Organization. The tropical forestry action plan. June 1987. 32 p.

United States Agency for International Development. Progress in conserving tropical forests and biological diversity in developing countries. The annual report to Congress on the implementation of Sections 118 and 119 of the Foreign Assistance Act, as amended. June 1988. 120 p.

U.S. Congress. Office of Technology Assessment. Technologies to sustain tropical forest resources. March 1984.

U.S. Department of Energy. Office of Energy Research, Office of Basic Energy Sciences. Carbon Dioxide Research Division The prospect of solving the C02 problem through global reforestation. Washington, D.C. February 1988. DOE/NBB-0082

U.S. Library of Congress. Congressional Research Service. Tropical deforestation: The international tropical timber agreement, by Ross Gorte. [Washington] Sept. 30, 1987. 8 p. CRS Report 87-795

No. 1028. Household Vehicles: Annual Mileage, Fuel Consumption, and Fuel Expenditures: 1985

[See headnote, table 1029]

Household and vehicle characteristics	Number of—			Miles driven		Gallons consumed		Expenditures	
	Households (millions)	Vehicles (millions)	Vehicles per household	Total (billion)	Percent	Total (billion)	Percent	Total (bil. dol.)	Percent
Total	**77.7**	**137.3**	**1.8**	**1,353**	**100.0**	**83.9**	**100.0**	**99.1**	**100.0**
Metropolitan status:									
Metropolitan	59.0	103.0	1.7	1,029	76.1	62.6	74.6	73.8	74.5
Central city	25.5	41.0	1.6	383	28.3	23.9	28.5	28.3	28.5
Outside central city	33.6	62.0	1.8	646	47.8	38.7	46.1	45.6	46.0
Nonmetropolitan	18.7	34.3	1.8	324	23.9	21.3	25.4	25.2	25.5
Origin of householder: White	68.1	122.3	1.8	1,204	89.0	74.3	88.5	87.7	88.5
Black	7.2	11.0	1.5	112	8.3	7.4	8.9	8.8	8.8
Hispanic descent: Yes	3.5	6.0	1.7	58	4.3	3.6	4.3	4.3	4.3
No	74.3	131.3	1.8	1,295	95.7	80.3	95.7	94.8	95.7
Household size: 1 person	15.9	19.0	1.2	162	12.0	10.0	11.9	11.8	12.0
2 persons	24.5	41.3	1.7	386	28.6	23.5	28.0	27.8	28.0
3 persons	14.6	29.0	2.0	293	21.7	18.2	21.7	21.5	21.7
4 persons	12.9	26.6	2.1	281	20.8	17.8	21.3	21.0	21.2
5 or more persons	9.9	21.3	2.2	230	17.0	14.4	17.1	16.9	17.1
Family income 1985:									
Less than $5,000	3.7	4.4	1.2	34	2.5	2.4	2.8	2.8	2.8
$5,000–$9,999	9.7	12.5	1.3	98	7.2	6.7	8.0	7.8	7.9
$10,000–$14,999	10.7	15.8	1.5	149	11.0	9.8	11.7	11.5	11.6
$15,000–$19,999	9.7	15.8	1.6	141	10.4	9.0	10.7	10.5	10.6
$20,000–$24,999	9.5	16.9	1.8	165	12.2	10.4	12.3	12.2	12.3
$25,000–$34,999	14.7	28.2	1.9	289	21.4	17.8	21.3	21.0	21.2
$35,000 or more	19.8	43.7	2.2	477	35.2	27.9	33.2	33.3	33.6
Number of drivers (fall 1984): 1	24.7	29.6	1.2	257	19.0	16.1	19.1	19.0	19.2
2	39.1	73.1	1.9	730	53.9	45.3	54.0	53.5	54.0
3 or more	12.5	32.9	2.6	352	26.0	21.7	25.9	25.7	25.9
Type of fuel: Leaded	(x)	42.0	(x)	332	24.5	24.5	29.2	27.3	27.6
Unleaded	(x)	92.8	(x)	990	73.2	57.8	68.9	69.9	70.6
Type of vehicle: Automobile	(x)	106.6	(x)	1,059	78.3	61.7	73.5	73.4	74.1
Jeep-like vehicle	(x)	3.7	(x)	39	2.9	3.1	3.6	3.6	3.6
Van	(x)	4.7	(x)	49	3.6	3.7	4.4	4.3	4.4
Pickup truck	(x)	21.2	(x)	199	14.7	14.7	17.5	16.9	17.1
Number of cylinders: 4	(x)	39.9	(x)	445	32.9	19.6	23.4	23.5	23.7
6	(x)	35.6	(x)	362	26.8	22.7	27.0	26.9	27.2
8	(x)	61.0	(x)	536	39.6	41.1	49.0	48.1	48.5
Air conditioning: Yes	(x)	86.3	(x)	885	65.4	55.2	65.8	65.6	66.2
No	(x)	51.0	(x)	468	34.6	28.7	34.2	33.5	33.8
Type of transmission:									
Automatic	(x)	99.0	(x)	954	70.5	63.2	75.4	74.7	75.4
Manual	(x)	38.3	(x)	399	29.5	20.7	24.6	24.4	24.6
Vehicle used on the job: Yes	(x)	17.3	(x)	203	15.0	12.6	15.0	15.0	15.2
No	(x)	120.0	(x)	1,150	85.0	71.3	85.0	84.0	84.8

X Not applicable.

No. 1029. Household Motor Vehicle Transportation, by Vehicle Model Year: 1985

[Preliminary. Household vehicles include all motorized vehicles used for personal transportation, excluding motorcycles, mopeds, large trucks, and buses. The reporting unit for 1985 is all households which owned a vehicle at any time during 1985. Based on the Residential Transportation Energy Consumption Survey; subject to sampling variability]

Household characteristics	Households with motor vehicles (mil.)	Vehicles (millions)					Miles per gallon				
		Total	Model year				Average	Model year			
			1973 and earlier	1974 to 1978	1979 to 1982	1983 and later		1973 and earlier	1974 to 1978	1979 to 1982	1983 and later
Total	**77.7**	**137.3**	**26.9**	**43.3**	**37.8**	**28.7**	**16.1**	**13.4**	**13.8**	**17.9**	**19.3**
Northeast	15.0	24.8	3.0	8.1	7.6	6.1	17.0	13.6	14.0	18.8	20.2
Midwest	19.5	34.1	6.4	11.4	9.0	7.0	15.6	12.6	13.2	17.6	19.1
South	27.0	48.5	9.2	15.0	13.8	10.5	15.8	12.9	13.5	17.4	18.9
West	16.1	29.8	8.3	8.9	7.3	5.1	16.5	14.4	15.0	18.3	19.2
Family income in 1985:											
Less than $5,000	3.7	4.4	1.4	1.7	.7	.6	14.2	12.5	13.7	17.5	15.6
$5,000–$9,999	9.7	12.5	4.3	4.4	2.4	1.4	14.6	13.3	12.7	16.8	19.9
$10,000–$14,999	10.7	15.8	4.4	5.8	3.8	1.8	15.2	13.4	13.8	17.5	18.9
$15,000–$19,999	9.7	15.8	3.5	5.7	3.9	2.6	15.7	12.9	13.4	18.1	20.4
$20,000–$24,999	9.5	16.9	3.1	5.5	4.7	3.4	16.0	13.3	14.0	17.9	18.9
$25,000–$34,999	14.7	28.2	4.5	9.2	8.5	5.9	16.2	13.2	14.0	18.2	19.0
$35,000 or more	19.8	43.7	5.7	11.0	13.7	13.1	17.1	13.9	14.3	17.9	19.4

Source of tables 1028 and 1029: U.S. Energy Information Administration, *Residential Transportation Energy Consumption*

No. 1030. Cost of Owning and Operating an Automobile: 1975 to 1987

Item	Unit	1975	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Cost per mile [1]	Cents	18.31	20.19	19.57	23.97	27.95	31.92	32.35	33.42	31.32	27.20	29.59	32.64
Cost per 10,000 miles [1]	Dollars	1,831	2,019	1,957	2,397	2,795	3,192	3,235	3,342	3,132	2,720	2,959	3,264
Variable cost	Cents/mile	6.45	5.80	5.65	5.86	7.62	8.17	8.37	8.36	7.86	8.04	6.52	7.20
Gas and oil	Cents/mile	4.82	4.11	3.89	4.11	5.86	6.27	6.74	6.64	6.19	6.16	4.48	4.80
Maintenance	Cents/mile	.97	1.03	1.10	1.10	1.12	1.18	1.00	1.04	1.04	1.23	1.37	1.60
Tires	Cents/mile	.66	.66	.66	.65	.64	.72	.63	.68	.63	.65	.67	.80
Fixed cost	Dollars	1,186	1,439	1,392	1,811	2,033	2,375	2,398	2,506	2,346	2,441	2,596	2,782
Insurance:													
Fire and theft [2]	Dollars	53	80	57	74	70	76	53	80	80	92	86	87
Collision [3]	Dollars	141	188	138	168	172	180	153	201	200	198	191	196
Property damage [4] and liability	Dollars	189	250	229	241	248	254	243	222	225	213	232	252
License and registration	Dollars	30	74	74	90	82	88	54	102	106	115	130	140
Depreciation	Dollars	773	847	894	942	1,038	1,287	1,356	1,343	1,207	1,253	1,320	1,506
Finance charge	Dollars	(NA)	(NA)	(NA)	296	423	490	539	558	528	570	637	601
Average fixed cost per day	Dollars	3.25	3.94	3.81	4.96	5.57	6.51	6.57	6.87	6.43	6.69	7.11	7.62

NA Not available. [1] Beginning 1985, not comparable to previous data. [2] $50 deductible 1975 and 1977, and $100 deductible 1978 through 1987. [3] $100 deductible 1975 and 1977, and $250 deductible 1978 through 1987. [4] Coverage: $100,000/$300,000.

Source: Motor Vehicle Manufacturers Association of the United States, Inc., Detroit, MI, *Motor Vehicle Facts and Figures*, annual.

No. 1031. Passenger Transit Industry—Summary: 1970 to 1987

[Includes Puerto Rico. Comprises all privately and publicly owned organized local passenger transportation agencies except taxicabs and sightseeing and school buses. Covers (*a*) local motorbus systems, (*b*) light rail systems, (*c*) heavy rail systems, (*d*) trolley coach systems, and (*e*) automated guideway, inclined plane, cable car, and aerial tramway systems. Beginning 1984, data also include suburban railroads, urban ferry boats, rural fixed-route non-intercity motorbus systems, vanpools and demand response systems. Thus, all data are non-continuous between 1983 and 1984. Based on financial and statistical reports received by American Public Transit Association from transit systems representing more than 85 percent of the industry. See also *Historical Statistics, Colonial Times to 1970*, series Q 238–250]

Item	Unit	1970	1975	1980	1981	1982	1983	1984	1985	1986, prel.	1987, prel.
Operating systems	**Number**	1,079	947	1,044	1,035	1,036	1,036	4,938	4,973	5,019	5,048
Motorbus systems [1]	Number	1,075	941	1,040	1,030	1,031	1,031	2,604	2,632	2,654	2,672
Publicly owned systems [1]	Number	144	333	576	581	599	(NA)	1,435	(NA)	(NA)	(NA)
Passenger vehicles owned [2]	**Number**	61,428	62,261	71,018	72,098	73,838	73,813	95,603	88,691	91,218	91,115
Motorbuses [2]	Number	49,700	50,811	59,411	60,393	62,114	62,093	63,497	57,285	58,000	57,687
Heavy rail [2]	Number	9,286	9,556	9,641	9,749	9,815	9,891	9,083	9,326	10,386	10,168
Other electric [2 3]	Number	2,442	1,894	1,966	1,956	1,909	1,829	1,527	1,623	1,519	1,581
Suburban rail	Number	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	4,075	4,035	4,440	4,656
All other	Number	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	17,421	16,422	16,873	17,023
Total revenue	**Mil. dol**	(NA)	3,451	6,510	7,366	8,044	8,526	11,623	12,195	13,147	13,968
Passenger revenue	Mil. dol	1,639	1,861	2,557	2,701	3,077	3,172	4,448	4,575	5,011	5,156
Other operating revenue [4]	Mil. dol	68	183	248	344	380	333	780	702	743	771
Operating assistance	Mil. dol	(NA)	1,408	3,705	4,321	4,587	5,023	6,395	6,918	7,393	8,041
Federal	Mil. dol	(NA)	302	1,094	1,095	1,005	827	996	940	912	894
State and local	Mil. dol	(NA)	1,106	2,611	3,226	3,582	4,195	5,399	5,978	6,481	7,147
Total expense	**Mil. dol**	1,996	3,752	6,711	7,623	8,314	8,736	12,957	14,077	15,080	15,997
Operating expense	Mil. dol	(NA)	3,537	6,246	7,024	7,553	7,956	11,574	12,381	13,353	13,967
Transportation	Mil. dol	(NA)	1,877	3,248	3,596	3,882	3,931	5,142	5,655	6,106	6,019
Maintenance	Mil. dol	(NA)	814	1,774	1,946	2,168	2,392	3,062	3,672	3,965	4,310
Administration	Mil. dol	(NA)	846	1,224	1,482	1,503	1,634	3,370	3,054	3,282	3,638
Reconciling expense	Mil. dol	(NA)	215	464	597	761	780	1,383	1,696	1,727	2,030
Capital expenditure, Federal	**Mil. dol**	(NA)	1,287	2,787	2,946	2,544	3,162	2,876	2,510	3,137	2,476
Vehicle-miles operated	**Million**	1,884	1,989	2,094	2,134	2,129	2,117	2,749	2,791	2,890	2,962
Motorbus	Million	1,409	1,526	1,677	1,685	1,669	1,678	1,845	1,863	1,896	1,927
Heavy rail	Million	407	423	385	420	429	408	436	451	476	490
Other electric [3]	Million	66	40	32	29	31	31	32	33	33	34
Suburban rail	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	168	183	186	189
All other	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	268	261	299	322
Passengers carried [5]	**Million**	7,361	6,988	8,249	7,978	7,755	7,903	8,851	8,659	8,801	8,340
Motorbus [5]	Million	5,034	5,084	5,837	5,594	5,324	5,422	5,908	5,675	5,748	5,207
Heavy rail [5]	Million	1,881	1,673	2,108	2,094	2,115	2,167	2,231	2,290	2,333	2,402
Other electric [3 5]	Million	446	231	304	290	316	314	329	303	304	300
Suburban rail	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	267	275	303	311
All other	Million	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	116	116	113	120
Avg. revenue per passenger	**Cents**	22.4	26.7	31.0	33.9	39.7	40.2	50.3	52.8	56.9	61.8
Employees, number (avg.)	**1,000**	138	160	187	192	194	195	263	270	276	275
Payroll, employee	Mil. dol	1,274	2,236	3,281	3,494	3,731	3,921	5,488	5,843	6,228	6,540

NA Not available. [1] Includes systems with combined services including motorbuses, heavy rail cars, light rail cars, trolley coaches, cable cars, and inclined plane cars. Beginning 1984, combined services also include suburban rail cars, urban ferry boats, vanpools, aerial tramways, automated guideways, and demand response vehicles. [2] Beginning 1984, includes active vehicles only. [3] Includes light rail, trolley coach, cable car, inclined plane, aerial tramway, and automated guideways. [4] Includes other operating revenue, non-operating revenue, and auxiliary income. [5] Data for 1970 and 1975 not comparable with later years.

Source: American Public Transit Association, Washington, DC, *Transit Fact Book*, annual.

ML

CLOSE HOLD

THE WHITE HOUSE

WASHINGTON

January 29, 1990

MEMORANDUM FOR THE GLOBAL CHANGE WORKING GROUP

FROM: D. ALLAN BROMLEY
Chairman

SUBJECT: Meeting of the Global Change Working Group

There will be a meeting of the Global Change Working Group on Tuesday, January 30, 1990 from 2:00 to 3:00 p.m. in the Roosevelt Room for principals only. Please call Dean Schultheiss at 456-6722 if you are able to attend.

The issues to be discussed include (1) the guidelines for the U.S. delegation to the plenary meeting of the IPCC, (2) the President's speech to the IPCC and suggestions for the text of his remarks, and (3) the dates for the White House Conference on Science and Economics Research on the Environment.

Enclosed is a copy of the guidelines to the U.S. IPCC delegation. The guidelines were prepared by an interagency working group headed by OES at the State Department and reflect consensus working level recommendations for U.S. policy. Two points warrant specific consideration as you review the document:

(1) The first is the structure of negotiations of a climate convention (see "Preparations for Negotiation of a Climate Convention" on pages 8-11). The U.S. position has consistently been that any climate convention, and the negotiation process leading thereto, would follow the model used in dealing with the stratospheric ozone problem -- a broad framework convention calling for research and the exchange of data (the Vienna Convention), followed by targeted protocols (such as the Montreal Protocol on CFCs). Alternatives to this approach are (a) the negotiation of a comprehensive framework convention that itself contains specific provisions spelling out emissions reductions or (b) the negotiation of a general framework convention accompanied by concurrent negotiation of specific protocols.

(2) The second is the future of the IPCC (see "Future of IPCC" on pages 13 and 14) and whether it should be the forum for climate convention negotiations or whether those negotiations will be conducted in another forum (e.g., the U.N. General Assembly.

Please review the guidelines carefully and be prepared to make any specific comments at Tuesday's meeting, as it is essential that the Working Group act at that time. Also please be advised that both documents are close hold. Please refrain from making additional copies.

Guidelines for U.S. Delegation to IPCC Plenary

Background:

The Third Plenary Meeting of the Intergovernmental Panel on Climate Change (IPCC) will take place in Washington from February 5-7, 1990. While the meeting will focus on the status of efforts to complete the IPCC's First Assessment Report (Annotated Provisional Agenda Item 3), a number of additional issues will also form the basis for plenary discussions. These include:

- Possible additional tasks that should be undertaken by the IPCC based on recent international meetings (e.g., Noordwijk) (Annotated Provisional Agenda Item 2.1)
- Resolution(s) of the 44th (1989) session of the United Nations General Assembly related to IPCC activities (Annotated Provisional Agenda Item 2.2)
- Preparations for the Second World Climate Conference (Annotated Provisional Agenda Item 2.3)
- Preparations for Negotiation of a Framework Climate Convention (Note: This item has been deleted from the Annotated Provisional Agenda, but we understand that Dr. Bolin will raise it in his opening remarks at the IPCC Plenary and at the RSWG Officers' Meeting on February 2)
- Report of the IPCC Special Committee on the Participation of the Developing Countries (Annotated Provisional Agenda Item 4)
- The IPCC's 1990 Budget, specifically the shortfall between anticipated expenses and funding pledged to date (Annotated Provisional Agenda Item 5)
- IPCC activities after completion of the IPCC First Assessment Report (Annotated Provisional Agenda Item 6)

In addition, the President or another high-level Administration official may address the opening plenary session and restate the President's proposal to Chairman Gorbachev at the Malta Summit (that the United States is prepared to host "a conference next fall to negotiate a framework treaty on global climate change, after the working groups of the UN-sponsored Intergovernmental Panel on Climate Change submit their final report.")

The following provides guidance to the U.S. delegation on each of the items identified.

Additional IPCC Tasks

The United States successfully steered the Noordwijk Ministerial Conference on Atmospheric Pollution and Climate Change (November 6-7, 1989) to the IPCC as the appropriate forum for international consideration of issues related to global climate change. In so doing, the Noordwijk Declaration mentions a number of issues for further consideration by the IPCC. These "remands" to the IPCC are likely first to be discussed at the RSWG officers' meeting on February 2 that will precede the plenary. At that meeting and in the plenary itself, the United States should:

1) Agree that the IPCC should examine estimates of reductions in global anthropogenic greenhouse gas (GHG) emissions, based on the best scientific knowledge as to the options for containing climate change within tolerable limits (see Noordwikj Declaration, para. 8); the United States should propose that such examination take place first by Working Groups I and II (in view of the references to "best scientific knowledge" on the one hand and "tolerable limits" on the other) and subsequently by the RSWG (all subgroups, i.e., EIS, AFOS, CZMS and RUMS);

2) Agree that the IPCC should consider the necessity and efficiency of the introduction of the concept of CO2 equivalence (see Noordwijk Declaration, para. 10) and stress that this is a high-priority task; stress also that CO2 equivalence must be based on full equivalence, i.e., on the entire life-cycle of each gas; and propose that this task be taken up by Working Group I;

3) Agree that the IPCC should investigate the feasibility of achieving targets to limit or reduce CO2 emissions including for example a 20 percent reduction of CO2 emission levels by the year 2005 (see Noordwijk Declaration, para. 16) but propose that CO2 emissions be taken to mean "net" CO2 emissions and that this investigation be extended to the feasibility of achieving such targets with respect to all GHGs; propose that "feasibility" be taken to include "technological and socio-economic feasibility and the trade-offs involved among these;" could agree that the IPCC investigate the feasibility of stabilizing net GHG emissions in various timeframes, including the year 2000; could also agree that the IPCC investigate several options for short, medium and long-term targets for limiting or controlling GHG emissions and the trade-offs involved among such targets; should propose that these investigations be undertaken by the RSWG, specifically by the EIS and the AFOS, in consultation with the CZMS and the RUMS;

4) Agree that the IPCC should consider the feasibility of achieving a world net forest growth of 12 million hectares a year in the beginning of the next century as a provisional aim (see Noordwijk Declaration, para. 21); should propose that such consideration be undertaken by the RSWG, specifically by the AFOS and the RUMS;

5) Request that the RSWG develop a workplan for analysis of target options resulting from further investigation of quantitative emission targets to limit or reduce CO2 emissions (and, as will be proposed by the United States, emissions of all GHGs); the workplan should indicate what analysis can be included in the IPCC's First Assessment Report due in 1990 (see Noordwijk Declaration, para. 15), what analysis can be presented to the Second World Climate Conference in November 1990 (see Noordwijk Declaration, para. 18), and what analysis can be presented after the Second World Climate Conference.

Resolution(s) of the 44th UNGA Session

Among the resolutions adopted by the U.N. General Assembly at its 44th Session, the resolution concerning "Protection of the Global Climate for Present and Future Generations of Mankind" (adopted December 17, 1989) will be directly relevant to IPCC Plenary discussion. In addition, the resolution concerning "International Cooperation in the Field of the Environment" will also be relevant to this discussion. While both resolutions express support for the IPCC, both also contain a specific recommendation that the U.N. General Assembly should take a decision early in its 45th session "recommending ways and means and modalities for further pursuing these negotiations (negotiations on a framework convention on climate), taking into account the work of the preparatory committee for the conference on environment and development to be held in 1992...." The U.S. UNEP Mission in Nairobi has indicated (see Nairobi 01051, 11 JAN 90) that "This is clearly intended to assert General Assembly (and G-77) control over the process after the IPCC presents its report in October."

In addition, the resolution (also adopted at the 44th Session) concerning the 1992 Conference on Environment and Development will also be relevant. In that resolution, the General Assembly, inter alia:

- o Decides to convene a United Nations Conference on Environment and Development of two weeks' duration to coincide with World Environment Day, 5 June 1992;
- o accepts Brazil's offer to host the Conference;
- o affirms that protection of the atmosphere by combating climate change, depletion of the ozone layer and transboundary air polution is among the environmental issues of major concern in maintainiing the quality of the Earth's environment and especially in achieving environmentally sound and sustainable development in all countries;
- o decides to establish a Preparatory Committee of the General Assembly open to all States Members of the United Nations or members of the specialized agencies;

o decides that the Preparatory Committee shall hold an organizational session of two weeks' duration in March 1990 and a final session, both at United Nations Headquarters, in New York, and three additional substantive sessions, the first in Nairobi and the following two in Geneva, the timing and duration of which shall be determined by the Preparatory Committee at its organizational session;

o decides that the Preparatory Committee shall: (a) draft the provisional agenda of the Conference; b) adopt guidelines to enable States to take a harmonized approach in their preparations and reporting; c) prepare draft decisions for the Conference and submit them the the Conference for consideration and adoption.

While the United States joined in the consensus with respect to the resolution concerning "Protection of Global Climate for Present and Future Generations of Mankind," U.S. Special Adviser to the 44th Session of the U.N. General Assembly Edward Marks made a statement following its adoption, which reads in pertinent part:

> "We support the proposal in operative paragraph 10 that negotiations on a framework convention on climate begin as soon as possible after adoption of the interim report of the Intergovernmental Panel on Climate Change. In order to ensure that these negotiations be conducted in a focused, efficient manner. We believe that they should take place independently from the important work to be done by the Preparatory Committee for the 1992 Conference on Environment and Development."

As noted by the U.S. UNEP Mission in Nairobi, these resolutions demonstrate that an effort is underway to shift control over the process of negotiating a framework climate convention to the U.N. General Assembly.

Consequently, in IPCC plenary discussions of the U.N. resolutions adopted at its 44th Session, the United States should:

1) Reiterate the view expressed by U.S. Special Adviser Marks that "We believe that negotiations

toward a framework convention on climate should take place independently from the important work to be done by the Preparatory Committee for the 1992 Conference on Environment and Development;"

2) Alternatively, propose that work currently taking place within the IPCC and preparations being undertaken by UNEP Executive Director Tolba and WMO Secretary General Obasi in accordance with UNEP Governing Council Resolution 15/36 and WMO EC-XLI Resolution 4 (requesting them to "begin preparations for negotiations" for a framework climate convention should constitute the arm of the Preparatory Committee responsible for initiating and conducting negotiations toward a framework convention on climate (see also item 3 on page 10 of these Guidelines).

Preparations for Second World Climate Conference

Under this item, the Annotated Provisional Agenda notes that, "The Chairman of the International Organizing Committee and/or the Co-ordinator for SWCC will be invited to inform the Panel of the preparations for, and the activities planned during, the Conference." (Note: The Second World Climate Conference will take place from October 29 to November 9, 1990, in Geneva.)

WMO EC-XLI Resolution 4 and U.N. Resolution 43/53 provide that the IPCC's First Assessment Report should be provided "to the governing bodies of WMO and UNEP, through the Secretary-General and the Executive Director, not later than September 1990, be ready for its first presentation at the Second World Climate Conference in November 1990" and that the "Secretary-General and the Organizing Committee for the Second World Climate Conference, in consultation with the Chairman of the IPCC, (should) ensure that this conference provides the first international forum for discussion of the September 1990 report of the IPCC." The U.N. Secretary-General is requested "to report to the General Assembly at its 44th session on the implementation of the present resolution" (43/53).

Assuming that the IPCC's Fourth Plenary in Sweden in August 1990 adopts the IPCC's First Assessment Report by the close of the session, the final version of the First Assessment Report should be ready and printed by the end of September. The Report can be given to the WMO Secretary-General and the UNEP Executive Director by the Chairman of the IPCC at the end of

September 1990. The WMO Secretary-General and the UNEP Executive Director can then present it to the WMO President, acting on behalf of the WMO Executive Council, and the Chairman of the UNEP Governing Council for the UNEP Governing Council. The WMO President and the Chairman of the Governing Council can distribute the First Assessment Report to Members of WMO and UNEP about two to four weeks before the Second World Climate Conference begins.

The IPCC's First Assessment Report does not have to be presented by the U.N. Secretary-General to the General Assembly. The U.N. Secretary-General can report that the First Assessement Report has been distributed to WMO and UNEP Members, but he may wish to submit the report of the results of the Second World Climate Conference to the General Assembly.

There has been some discussion internationally concerning the procedures that will be followed in submitting the IPCC's First Assessment Report to the Second World Climate Conference. Since the IPCC's First Assessment Report has been requested by the WMO Executive Council and the UNEP Governing Council, it should go to these bodies through the Secretary-General of WMO and the Executive Director of UNEP. These governing bodies do not meet, however, during the period between finalization of the First Assessment Report and the Second World Climate Conference. Therefore, the WMO President and the Chairman of the UNEP Governing Council should act on behalf of their governing bodies to receive it and distribute it before the Second World Climate Conference.

In some international discussions, there have been suggestions that the IPCC's First Assessment Report should be made confidential or embargoed against release until the Second World Climate Conference. Both ideas are impractical since the final drafts as well as the text agreed at the IPCC's Fourth Plenary will have had wide prior distribution. In addition, media interest in the recommendations or conclusions of the First Assessment Report will be intense, and any effort to withhold distribution will be very difficult.

However, in keeping with the spirit of WMO EC-XLI Resolution 4, the IPCC could agree to have no press conferences or lengthy interviews or intervening meetings with respect to the First Assessment Report before the Second World Climate Conference.

It is highly desirable that the IPCC's First Assessment Report be circulated to all U.N. Members for review and internal discussion prior to the Second World ClimateConference so that scientists and ministers can discuss it knowledgeably at the Conference.

At the IPCC Plenary the United State should:

1) Support presentation of the First Assessment Report by the IPCC Chairman to the WMO Secretary-General and the UNEP Executive Director as soon as possible following the Fourth IPCC Plenary in August 1990;

2) Support presentation of the First Assessment Report by the WMO Secretary-General and the UNEP Executive Secretary to the WMO President, acting on behalf of the WMO Executive Council, and the Chairman of the UNEP Governing Council, acting on behalf of the Governing Council, respectively, for distribution to WMO and UNEP Members as soon as possible thereafter and prior to the Second World Climate Conference;

3) If proposed at the IPCC Plenary, discourage press conferences, lengthy interviews or intervening meetings after submission of the First Assessment Report and prior to the Second World Climate Conference; but

4) Oppose any effort to embargo the IPCC's First Assessment Report or classify it between its submission and the Second World Climate Conference.

Preparations for Negotiation of a Climate Convention

On November 17, 1989, UNEP Executive Director Tolba and WMO Secretary General Obasi sent a letter to foreign ministers outlining their own thoughts on possible elements of a future convention on climate change and asking for national views on this issue by January 15. The U.S. response indicated that substantive exchanges on possible elements of a framework convention should take place in the IPCC and noted that the RSWG has already begun an extensive review of this issue and is

seeking to develop an international consensus on possible elements of a convention. The U.S. response further indicated that U.S. views on this question were delivered to the RSWG last October and that additional comments were provided in December 1989.

The U.S. response to the Tolba/Obasi letter also welcomed the input that will be provided to the RSWG from the UNEP/WMO Task Group by the RSWG observers Mr. Beetham (of the U.K.) and Mr. Cordeiro (of Brazil).

At the IPCC plenary, the United States should:

1) Support the effort of IPCC Chairman Dr. Bolin to have representatives of WMO and UNEP inform the IPCC of the activities to date of the UNEP/WMO Task Group, and of their plans for further activity;

2) Encourage that the work of this Task Group be provided to the RSWG as soon as possible so that the RSWG, specifically the Topic Coordinators on Legal Measures, may take it into account in finalizing their report.

It is our understanding that the Legal Measures Topic Coordinators (the U.K., Canada and Malta) are preparing another attempt at a consensus elements paper, drawing on the October RSWG meeting. They are planning to get comments on the paper from key countries before the upcoming IPCC Plenary. Given the lack of consensus with respect to legal measures at the RSWG October Workshop in Geneva, the United States has informally encouraged efforts on the part of the Topic Coordinators to move forward on this issue.

At the RSWG Officers' Meeting, and in the IPCC Plenary, the United States should:

1) Support the efforts of the RSWG Legal Measures Topic Coordinators to refine further the Legal Measures Paper, making sure that the recent U.S. comments are included;

2) Oppose any effort to take final action on any of the RSWG October Papers at the IPCC Plenary,

especially any paper dealing with the issue of a framework convention, urging instead that final action be taken at the June RSWG meeting;

3) Seek IPCC agreement to recommend that negotiations on a framework convention take place under UNEP/WMO auspices, the first session to be held as soon as possible after submission of the IPCC's First Assessment Report;

4) Remain within the bounds of the U.S. legal measures paper prepared for the Geneva Workshop, including the U.S. position that it is currently premature to consider the subject of possible protocols and other agreed response measures, the order in which they might be taken up, and whether there will be linkage between various agreed measures.

In this latter connection, questions may arise with respect to the additional U.S. comments submitted to the IPCC Secretariat and the Topic Coordinators of the RSWG October Legal Measures Paper. In the comments, the United States proposed to add additional ticks in section 3 (General Obligations). Specifically, the United States proposed to add the following:

"-- Development as soon as possible of a protocol addressing all adequately scientifically understood greenhouse gases, their sources and sinks (with appropriate treatment of substances subject to control under the Montreal Protocol), in a comprehensive approach to controlling net emissions of greenhouse gases through national performance targets, leaving to each country the choice of domestic policy responses to achieve its net greenhouse gas emissions target; keep under continuing review the set of greenhouse gases, their sources and sinks, and revise the set, according to evolving understanding of the science, economics, and technological advancement. (This approach is further elaborated in Appendix __.)"

Should the question arise in the RSWG Officers' Meeting or in the IPCC Plenary as to whether, in light of the additional U.S. comments, the United States is now prepared to consider possible protocols, the United States should:

1) Make clear that the call for development as soon as possible of a protocol in the U.S. additional comments must be read in the context of the Legal Measures Paper that grew out of the RSWG October Workshop;

2) Indicate that, by including its proposed additional language as an additional tick in the General Obligations Section of the Legal Measures Paper, the United States sought to preserve the comprehensive approach to GHGs as an option for further consideration by the RSWG and the IPCC; and

3) Reiterate that the United States continues to believe that it is currently premature to consider the subject of possible protocols and other agreed response measures, the order in which they might be taken up, and whether there will be linkage between various agreed measures.

LDC Participation

At the IPCC Plenary, the Chairman of the Special Committee on the Participation of Developing Countries, Mr. Ripert (of France), will be asked to present the report of the Committee for consideration by the Panel.

The United States should:

1) Support the broadest possible participation of developing countries in the work of the IPCC, so as to make the IPCC truly representative of the world community of nations and thereby strengthen its First Assessment Report;

2) Reaffirm U.S. commitment to the two-track (phase) approach developed in Geneva and endorsed at Noordwijk on financial measures, i.e., a first stage involving assessing needs in the developing countries and the availability and potential of existing assistance mechanisms on an industry-by-industry basis, followed by consideration of a new funding mechanism as a second stage, if warranted;

3) Reaffirm U.S. belief that, before a new mechanism is created, existing institutions and mechanisms, reoriented if necessary to take account of climate change, should be utilized as fully as possible, and that use of existing institutions would make resources available more rapidly with better integration with ongoing development programs in each country;

4) Note that, if significant action is required to prevent or slow potential climate change, developed countries alone will not be able to accomplish it;

5) Emphasize the need for global action to deal with potential climate change, particularly in view of projections of likely increases in GHG emissions on the part of developing countries in the near future; and

6) Note, that the United States is committed under the Montreal Protocol to providing technical assistance, and indicate that, if significant action is ultimately required to deal with the potential for climate change, the United States will likewise undertake to provide appropriate assistance.

IPCC's 1990 Budget

The IPCC Secretariat projects 1990 expenses totaling SFR 1,363,000 (approximately $909,880 converting SFR to U.S. dollars at a rate of 1.4980 SFR to the dollar -- New York Times January 16, 1990, conversion rate). The IPCC Secretariat further projects receipts in 1990 to total SFR 864,000 (approximately $576,769). Of the receipts anticipated, SFR 538,000 (approximately $359,146) constitute pledges from members, including $150,000 from the United States.

(FYI: The United States has not yet transferred its pledged amount, but should be able to do so later this spring, both from the $100,000 that the Department of State has sought to collect from U.S. agencies to support the IPCC Trust Fund and from additional amounts contained in the International Organizations and Programs (IO and P) portion of the Foreign Assistance Appropriation. End FYI.)

The IPCC Secretariat thus anticipates a shortfall of SFR 499,000 (approximately $333,111) in 1990.

Under Revised Provisional Agenda Item 6, the Secretary of the IPCC will summarize the expenditures for 1989 and present the budget request for 1990 for the consideration of the Panel. To date, it would appear that only the United States and the following countries have made pledges to the IPCC for 1990: Japan, Italy, Finland, FRG and France.

In the plenary discussion under this item, the United States should:

1) Await indications from other members of the IPCC who may be willing to pledge amounts to help meet the 1990 budget;

2) If appropriate, point to the rather significant pledge made by the United States for 1990;

3) Make no further U.S. commitment to help meet the IPCC's 1990 budget at the plenary, although it is possible that, the United States may ultimately exceed its pledge if (for information of U.S. delegation only): (1) all U.S. agencies who have been asked to contribute to the IPCC Trust Fund by the Department of State ultimately do so; (2) the Department of State's authorization and appropriation for FY 1990 ultimately include the amount requested for the IPCC; and (3) the United States receives credit toward its pledge from providing interpretation for the IPCC plenary and subsequent meeting of the IPCC Bureau.

Future of IPCC

Under this agenda item (Annotated Provisional Agenda item 6), it is noted that "The delegations may wish to take the opportunity to express their views on the role and possible activities of the Panel after it completes its first assessment report."

In the IPCC Plenary discussion the United States should:

1) Support continuation of the work of the IPCC after submission of its First Assessment Report in the fall of 1990;

2) Provide, by way of example, a number of specific tasks that should be taken up or continued by the IPCC's Working Groups; and

3) Support efforts within the IPCC to develop a specific list of tasks and schedules (workplan) that the IPCC views as necessary to undertake or continue after October 1990.

Finally, with regard to the specific mandate of the IPCC after submission of the First Assessment Report, the United States should:

1) Note that, eventually, we anticipate that the IPCC will become the Conference of the Parties; and

2) Urge that the governing bodies of UNEP and WMO be asked to adopt resolutions at their meetings this summer specifying the IPCC's mandate after submission of its First Assessment Report.

IPCC Endorsement of President's Proposal

If appropriate in the view of the U.S. delegation, it may be useful to seek endorsement by the IPCC of the President's proposal to host "a conference next fall to negotiate a framework treaty on global climate change, after the working groups of the UN-sponsored Intergovernmental Panel on Climate Change submit their final report."

Informal reactions solicited to date from foreign governments indicate, however, that there may be some confusion with respect to the President's offer. Specifically, some countries have expressed confusion at whether the United States plans to host its own conference or simply provide a venue for the first international negotiating session. They have also indicated that it is not clear whether New York, and thus the UNGA, falls within the scope of the proposal.

In addition, at least one country (the FRG) has informally urged that the United States not seek IPCC endorsement for the President's proposal at the forthcoming plenary, since to do so would risk "politicizing" the IPCC.

At the plenary, the U.S. delegation should make clear in informal discussions with other delegations that:

1) The President has proposed simply to provide a venue (and thus support) for the first international negotiating session; and

2) That while the President's proposal did not specifically mention a site, we understand that it contemplated a location in the United States other than New York, and definitely not the UNGA.

If the President or another high-level Administration official should make opening remarks on behalf of the United States at the plenary which reiterate the President's proposal at the Malta Summit, the U.S. delegation may choose to:

Seek IPCC endorsement of the President's proposal, which endorsement should be communicated by the IPCC Chairman to the UNEP and the WMO.

UNCLASSIFIED

CLASSIFICATION

CIRCLE ONE BELOW

IMMEDIATE

PRIORITY

ROUTINE

MODE

SECURE FAX #

ADMIN FAX # 227

PAGES 2

DTG 152230Z

RELEASER

FROM/LOCATION

1. DAVE BENFORADO

TO/LOCATION/TIME OF RECEIPT

1. PEGGY DOOLEY

2.

3.

4.

5.

6.

7.

INFORMATION ADDEES/LOCATION/TIME OF RECEIPT

1. TOR: 152237Z

2.

SPECIAL INSTRUCTIONS/REMARKS:

UNCLASSIFIED

CLASSIFICATION

3M ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL

FACSIMILE TRANSMITTAL FORM

PLEASECALL PEGGY

TO: Peggy Dooley (phone 202/456-7750)

FAX PHONE NUMBER: 202/456-6218

COMPANY: White House Staff

FROM: Dave Benforado (phone 612/778-5189)

DATE: 9/15/89 **PAGES TO FOLLOW:** 1

COMMENTS: Please call if you have any questions —

3M EE&PC
Bldg. 21-2W-05
900 Bush Avenue
P.O. Box 33331
St. Paul, MN. 55133-33331
Fax phone # 612-778-7203
Direct call # 612-778-5543
Machine Type: Harris/3M 2110

3M

David M Benforado
3M Benforado
612/778-5189

POLLUTION PREVENTION PAYS

Status Report

APRIL 1989

Creative technical innovation which eliminates or reduces pollution at source, before cleanup problems occur, continues to pay off for 3M operations worldwide. Since the Pollution Prevention Pays (3P) Program was begun in 1975, these first-year only cumulative results have been obtained:

TOTAL WORLDWIDE SAVINGS - $482 MILLION

Pollution Prevented Annually

	U.S.		International
Air Pollutants	111,000 tons	112,000 T	11,000 tons
Water Pollutants	15,000 tons	15,000 T	1,100 tons
Wastewater	1 billion gal.		600 million gal.
Sludge/Solid Waste	388,000 tons	400,000 T	12,000 tons

The $482 million savings include $408 million from U.S. Operations and $74 million from International Operations. The pollution prevented statistics are total for U.S. Operations and partial for International Operations, as not all subsidiaries reported these figures.

Pollution Prevention Pays Projects

United States	718
International	1,726
TOTAL	2,444

Participating Countries

Argentina	New Zealand
Australia	Philippines
Belgium	South Africa
Brazil	Spain
Canada	Sweden
France	Switzerland
France (Riker)	Thailand
Germany	United Kingdom
Italy	United Kingdom (Health Care)
Japan	United States
Mexico	Venezuela

Employees at all 3M locations are encouraged to participate in the 3P Program. Recognition of individuals responsible for 3P products is an intrinsic part of this successful program. The worldwide use of the 3P concept - elimination of pollution at the source - is essential.

4/89
JNB:3P (1.51)

NOTICE TO CONTRIBUTORS

Articles offered to FOREIGN POLICY should be original and should not be submitted simultaneously to any other publication.

All manuscripts should be typewritten, double-spaced, with 25 lines per page and margins of at least one inch. Full names of authors, addresses with zip codes, and telephone numbers should be given. All manuscripts must be fully documented to facilitate fact checking. Authors must provide copies of complete English translations for all non-English source materials. A standard length for FOREIGN POLICY articles is 4,000–6,000 words. For spelling, punctuation, and style, refer to the *American Heritage Dictionary* and the *Chicago Manual of Style.*

Address all correspondence to the Editor, FOREIGN POLICY, 11 Dupont Circle, NW, Washington, DC 20036. For manuscript return, include a postpaid, self-addressed envelope.

The copy deadline for the Fall 1989 issue is June 1.

FOREIGN POLICY (ISSN 0015-7228) *is published quarterly by the Carnegie Endowment for International Peace, 11 Dupont Circle, N.W., Washington, D.C., 20036, which bears no responsibility for the editorial content; the views expressed in the articles are those of the individual authors.*

Subscription department: P.O. Box 984, Farmingdale, NY 11737. Subscriptions: $23.00, one year; $37.00, two years; $53.00, three years. Outside USA add $5.00 for surface, $20.00 for air mail, payable in U.S. funds. Second-class postage paid at Washington, DC, and at additional mailing offices. Postmaster: Send change of address to FOREIGN POLICY *magazine, P.O. Box 984, Farmingdale, NY 11737.*

National distributor for newsstands and bookstores: Eastern News Distributors, 1130 Cleveland Rd., Sandusky, OH 44870.

Syndication requests should be addressed to the New York Times Syndication Sales Corporation, 130 Fifth Ave., New York, NY 10011; (212) 645-3000.

For authorization to photocopy individual articles, contact the Copyright Clearance Center, 27 Congress St., Salem, MA 01970, using item-fee code 0015-7228/89/$.50 + .10.

CLIMATE CHAOS

by David A. Wirth

For the past several years scientists have issued ominous warnings about the future of the earth's climate. Predictions of dramatic global change arising from the continued dumping of industrial by-products into the atmosphere and forest loss of massive scale can no longer be ignored. Compelling scientific evidence now strongly suggests that world climate patterns, previously regarded as reliably stable, could be thrust into a state of turmoil. Emissions of natural and synthetic gases are increasing the heat-trapping capacity of the atmosphere through a phenomenon known as the greenhouse effect.

The projected effects of this worldwide climatic disruption dwarf many of the environmental problems of the past and augur political, economic, and social disruptions on an enormous scale. Global warming could have catastrophic consequences for the habitability and productivity of the whole planet. The accompanying strain and upheaval on the international scene in turn could have serious foreign-policy consequences for all countries.

Broad scientific agreement exists on the underlying theory of climate change, although the nature and magnitude of future effects from greenhouse warming as predicted by computer models remain in debate. Some of these, such as a rise in the sea level, have been established with greater certainty than others. Nonetheless, the range of consequences is sufficiently clear and the magnitude of the resources at stake so enormous that policy action is required sooner rather than later. Once a crisis has been reached, it will be too late to act.

The international political and legal system remains ill-equipped to offer a solution that will assure the integrity of the earth's climate.

DAVID A. WIRTH *is a senior attorney at the Natural Resources Defense Council and former attorney-adviser for Oceans, International Environmental and Scientific Affairs in the State Department's Office of the Legal Adviser.*

Although the greenhouse theory of warming has been accepted for about a century, policymakers have only recently become aware of its significance for the global environment. The international community cannot afford to continue to delay elevating the greenhouse effect to the top of the foreign-policy agenda. Arresting the impending climate instability will require a concerted international agenda and a reorientation of energy and development priorities in virtually all countries of the world. Heading this agenda for action should be a global multilateral agreement that sets strict, binding standards for national emissions of greenhouse gases.

Human activities since the Industrial Revolution have dramatically altered the composition of the global atmosphere. A number of gases, emitted in small but significant amounts, absorb infrared radiation reflected from the surface of the earth. As the concentrations of these heat-absorbing gases increase, average global temperatures will rise.

Emissions of carbon dioxide (CO_2) are the single largest cause of elevated terrestrial temperatures from the greenhouse effect, accounting for approximately one-half of the problem. Concentrations of CO_2 in the range of 280 parts per million (ppm), together with water vapor in the atmosphere, established the preindustrial equilibrium temperature of the planet. Since the middle of the 19th century atmospheric CO_2 levels have increased by about 25 per cent to approximately 350 ppm and are continuing to rise by approximately .4 per cent per year. Elevated CO_2 concentrations result primarily from the intensified burning of fossil fuels—coal, oil, and natural gas—which liberates the chemical in varying amounts. Coal burning releases the most CO_2, while the combustion of quantities of natural gas and oil needed to produce the same amount of energy results in only about 57 per cent and 83 per cent as much CO_2, respectively.

The world's forests are vast storehouses or "sinks" for carbon. Worldwide loss of forest cover, by releasing this vast stockpile of carbon into the atmosphere as CO_2, aggravates the greenhouse problem. Deforestation in

Third World countries is particularly severe, with the destruction of tropical forests in developing countries like Brazil and Indonesia exceeding 27 million acres annually from activities such as burning, logging, and conversion to agricultural and pastureland. Indeed, the release of CO_2 into the atmosphere as a result of deforestation amounts to 2–10 billion tons annually.

Concentrations of a second important greenhouse gas, nitrous oxide (N_2O), have also been rising, probably because of heavier fossil-fuel use, greater agricultural activity, and other ecological disturbances. Average global atmospheric levels of N_2O at the end of 1985 were approximately 300 parts per billion (ppb) and are increasing at an annual rate of .2 per cent. Both CO_2 and N_2O, unlike some conventional pollutants, are very stable compounds. CO_2 remains in the upper atmosphere for decades after its release and N_2O for considerably more than a century. Consequently, without major reductions in emissions of these gases with long atmospheric lifetimes, their concentrations will continue to grow.

The international community cannot afford to delay elevating the greenhouse effect to the top of the foreign-policy agenda.

A group of volatile chemicals known as chlorofluorocarbons (CFCs) is believed to be currently responsible for 15–20 per cent of the global warming trend. These chemicals, unlike CO_2, are strictly synthetic and are not known in nature. They have a number of uses as refrigerants, propellants, solvents, and thermal insulators. A related class of bromine-containing chemicals called "halons" are found in fire-extinguishing systems. Average global atmospheric concentrations of CFC-11 and CFC-12, two of the most commercially important chlorofluorocarbons, in 1985 were approximately .22 ppb and .38 ppb, respectively. Atmospheric concentrations of CFC-11 and CFC-12 are growing at a rate of more than 7

per cent annually as a result of increased world production in recent years.

Although their concentrations are small relative to that of CO_2, CFCs are up to 10,000 times more potent in absorbing infrared radiation. After release, CFCs and halons reside in the atmosphere for close to a century, or sometimes more, because of their great chemical stability at low altitudes. Consequently, an immediate 85 per cent reduction in emissions of CFC-11 and CFC-12, for example, would be necessary merely to stabilize their atmospheric concentrations. With their long atmospheric lifetimes, CFCs and halons eventually reach the upper atmosphere. There, they are the principal culprits in the worldwide loss of the protective stratospheric ozone layer, which shields life on earth from harmful levels of ultraviolet solar radiation.

Methane, the principal component of natural gas, is another significant climate-modifying chemical. It has an atmospheric residence time of about 11 years. Average global concentrations of methane were approximately 1,700 ppb at the end of 1985 and are increasing by about 1 per cent per year, the highest rate of any naturally occurring greenhouse gas, for reasons that are not now clear. Animal husbandry and rice cultivation have been identified as major sources of increased methane emissions. Coal mining and landfills are also significant sources, with large potential for rapid growth in the future.

Low-level ozone is another greenhouse gas. Although ozone in the stratosphere is beneficial, this highly unstable chemical is the leading component of photochemical smog pollution at the earth's surface.

While greenhouse gases are dispersed relatively quickly throughout the global atmosphere after release, industrial emissions of these heat-absorbing chemicals are highly concentrated in the developed world. In 1985, 23 per cent of total global CO_2 emissions of more than 20.5 billion tons of CO_2 originated in the United States—the single largest emitting country and the highest per capita contributor among industrial countries to the greenhouse problem. The second biggest contribution came from the Soviet Union, with 19 per cent

of total CO_2 emissions. Western Europe emitted 15 per cent of the total, Japan 5 per cent, and the People's Republic of China 11 per cent. Other developing countries together accounted for only 20 per cent of total industrial CO_2 emissions.

Emissions of CFCs are even more strongly skewed. In 1980 the United States produced roughly 28 per cent of the global total of approximately 817,300 tons of CFC-11 and CFC-12. Western Europe produced about 30 per cent, industrialized Asian countries 12 per cent, and the East-bloc countries an estimated 14 per cent. The entire developing world accounted for just slightly more than 2 per cent of this amount.

Consequences of Greenhouse Warming

An international scientific consensus now supports the assertion that the accumulation in the atmosphere of CO_2, N_2O, CFCs, methane, and low-level ozone could have sweeping and far-reaching effects on the earth's climate.[1] By as early as the year 2030, the heat-retaining capacity of the atmosphere may have increased by an amount equivalent to doubling preindustrial concentrations of CO_2. By

[1] *Much of the scientific information in this article is drawn from the following reports: World Meteorological Organization and United Nations Environment Programme,* Developing Policies for Responding to Climatic Change *(Summary of workshops held in Villach, Austria, 28 September–2 October, 1987, and Bellagio, Italy, 9–13 November 1987 under the auspices of the Beijer Institute, Stockholm), 1988; International Council of Scientific Unions, United Nations Environment Programme, and World Meteorological Organization,* Report of the International Conference on the Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts *(Report of a conference held under the auspices of the World Climate Program at Villach, Austria, 9–15 October 1985), 1986; U.S. Environmental Protection Agency and United Nations Environment Programme,* Effects of Changes in Stratospheric Ozone and Global Climate *(Proceedings of a conference held at Leesburg, Virginia, 16–20 June 1986); U.S. Environmental Protection Agency,* Assessing the Risks of Trace Gases That Can Modify the Stratosphere, *vol. 3: chaps. 6–18, prepared for the Office of Air and Radiation by John S. Hoffman (Washington, D.C., 1987); and Irving M. Mintzer,* A Matter of Degrees: The Potential for Controlling the Greenhouse Effect *(Washington, D.C.: World Resources Institute, 1987).*

the middle of the next century, average global temperatures may have risen by as much as 3°F–9°F. The absolute magnitude of these temperatures, as well as the rapidity of temperature change, will exceed any previously experienced in human history.

The effects of a greenhouse-driven climate disruption will be characterized with complete certainty only after significant damage has already occurred. However, among the most dramatic effects likely to ensue from greenhouse warming is an unprecedented rise in sea level resulting from thermal expansion of the oceans and melting of glaciers and polar ice. Over the past century the average global sea level has increased less than 6 inches. By contrast, the sea level will have accelerated considerably, producing a total increase of up to 1–7 feet by 2075, depending on the degree of global warming that occurs.

The impact of sea-level rise in the United States is likely to be severe. The anticipated increase in the elevation of the oceans could permanently inundate low-lying coastal plains, accelerate the erosion of shorelines and beaches, increase the salinity of drinking-water aquifers and biologically sensitive estuaries, and increase the susceptibility of coastal properties to storm damage. An increase of 5–7 feet in sea level would submerge 30–80 per cent of America's coastal wetlands, which are crucial to the productivity of commercially important fisheries. Extensive existing coastal development may prevent the widespread formation of new wetlands. Even in undeveloped coastal areas, the rapidity of the predicted sea-level rise will mean that existing wetlands would be lost faster than new ones can be created.

The increase in elevation of the oceans will also seriously affect the approximately 50 per cent of the earth's population that inhabits coastal regions. Entire countries, such as the Maldives, could disappear. A rise in sea level of only 3 feet could flood an area of the Nile Delta that constitutes 12–15 per cent of Egypt's arable land, produces a similar portion of the Egyptian annual gross national product (GNP), and is home to a comparable percentage of the country's 51.4 million people. In Bangladesh, a 3-foot rise would inundate 11.5 per cent of the country's land area, displace 9 per cent of the 112.3 million people in this densely populated country, and threaten 8 per cent of the annual GNP.

The range of uncertainties associated with local climatic changes is substantially larger than for global averages. The dramatic anticipated increases in global temperature are virtually certain to cause a wide variety of modifications in regional climates. In middle latitudes, where the continental United States lies, summertime temperature increases are expected to exceed the global average by 30–50 per cent. Forests, many of them economically productive, could begin to die off as early as the year 2000 if they prove unable to adjust to rapidly shifting climatic zones. Regions of agricultural productivity could shift at the expense of the American Midwest, which currently has some of the most fertile soils in the world. A warming of only 3.6°F could decrease wheat and cereal yields by 3–17 per cent. Computer models predict continental drying in middle latitudes, which means that parched soils, scorching droughts, and massive heat waves, like those that devastated crops in the Midwest in summer 1988, could become commonplace. Water levels in the Great Lakes could drop by a foot, interfering with navigation for ocean-going vessels. Extreme temperatures have been shown to elevate human mortality. Some models also project disruptions in atmospheric and ocean circulation patterns. The impact of these changes is highly unpredictable.

Countries with tropical climates could experience especially severe consequences. Semiarid areas like much of sub-Saharan Africa might suffer from even lower rainfall. Many semiarid areas are already marginal for agriculture, are highly sensitive to changes in climate, and have had severe droughts and famines for the last several decades. Tropical humid climates could become hotter and wetter, with an increase in the frequency and severity of tropical storms. Floods, which between 1968 and 1988 killed more than 80,000 people and affected at least 200 million more, could worsen. Natural disasters such as floods,

now unusual, could become increasingly common.

Indeed, climate disruption caused by the greenhouse effect may already be evident. Global temperatures in 1988 were again at or near the record for the period of instrumental data, with temperatures elevated by .7°F relative to the average for the 30-year period beginning in 1950. The five warmest years in this century all occurred during the 1980s. Moreover, the rate of global warming for the past two decades was higher than any in recorded history. Whether the planet is already experiencing greenhouse-driven warming as measured against a background of natural temperature variability is still a subject for debate. However, because there is a lag on the order of decades between emissions of greenhouse gases and their effects, the level of heat-absorbing chemicals already released into the atmosphere has irrevocably committed the world to an additional .9°F–2.7°F increase over the next 50 years even if the atmosphere's composition were stabilized today.

The greenhouse effect, if unchecked, is likely to cause unpredictable disruptions in the balance of power worldwide, exacerbating the risk of war. The projected climate disturbance and its accompanying impacts are sufficiently dramatic in quality, magnitude, and rapidity that policymakers should give the most serious consideration to the security implications of the ongoing failure to anticipate and arrest greenhouse warming. The oil crises of the 1970s were widely perceived as a national security issue because excessive dependence on foreign oil threatened the American economy. Prevention of global climate disruption demands the immediate attention of U.S. leaders for the same reason. But so far, the implications of the greenhouse phenomenon have not played the slightest role in long-term strategic planning by the government.

The odds are strongly stacked against every country in the game of climate roulette. Contrary to some speculation, it is very unlikely that any region of the world will be a net "winner" from climate change. The very concept of "winning" implies the existence of a stable warmer climate, which will not occur

unless the warming trend is halted. Even the limited goal of a steady-state warmer climate will require major policy reform. Otherwise, greenhouse-gas concentrations and global temperatures will continue to increase indefinitely, nullifying any short-term benefits.

Even if a stable warmer climate were identified as a policy goal, the rate of climate change resulting from greenhouse gases already in the atmosphere would be faster than ever experienced in human history. This climate alteration would undoubtedly result in decades of destruction resulting from an inability to alter human behavior, such as agricultural techniques, fast enough to take advantage of new weather patterns. The transition to warmer climates is expected to be highly disruptive and accompanied by an increase in the frequency, intensity, duration, and geographic extent of extreme weather events like droughts and storms. Moreover, sea-level rise would be certain to entail net harm the world over. No region or individual country should place the health and well-being of its public and environment at stake in what amounts to a crapshoot.

While all countries are likely to be losers in the global climate gamble, some countries have more at stake than others. The United States has a particularly large investment in the status quo. Its current pre-eminence in world affairs ultimately derives from the strength of the country's economy. The productivity of the country's natural resources, such as the incomparably valuable farmland of the Midwest, was an essential prerequisite to America's elevation as a dominant superpower in the latter half of the 20th century. Impending climate change means that this productivity can no longer be taken for granted. The greenhouse effect threatens the overall health of the American economy and could require a massive diversion of resources to nonproductive adaptive activities.

The United States has one of the most productive agricultural sectors on earth, producing nearly 50 per cent of the world's corn and nearly 60 per cent of its soybeans. The United States is also the world's leading exporter of wheat and corn. By contrast, the

USSR is now the planet's largest importer of wheat and its second largest importer of corn. Climate models, however, suggest that this pattern could change dramatically if the Midwest became 10–20 per cent drier and crop yields were reduced. The drought of 1988 demonstrated that falling crop yields are a very real possibility. U.S. Department of Agriculture forecasts for the 1988–89 marketing year project that domestic consumption and exports of U.S. grain and soybeans will exceed production by approximately 4.2 billion bushels. At the same time, Soviet agricultural areas, located considerably farther north, could suffer smaller losses in productivity relative to their American counterparts. The difference between last summer's events and the effects of greenhouse-induced climate change would be that the latter is permanent and worsening, not just an isolated calamity.

Adapting to future climate change is also likely to require significant resources in the United States. Fighting the effects of a rising sea level on the heavily developed coasts of the United States, where about 75 per cent of the U.S. population will reside by 1990, will be phenomenally expensive. Maintaining threatened shorelines just on the American East Coast by measures such as diking cities could cost $10–$100 billion for a 3-foot rise. Seven out of the 10 most populous cities in the United States are located either on the coasts or on coastal estuaries that would be severely affected by sea-level rise. By contrast, the USSR, which has relatively less exposed shoreline and considerably less investment in expensive coastal infrastructure, would suffer little damage. Only 1 of the 10 largest Soviet cities—Leningrad— would face significant problems from an elevation in sea level. Moreover, the Soviet Union could benefit greatly from improved navigability in its polar coastal areas as Arctic ice melts.

The effects of greenhouse warming will also be felt in other parts of the world, potentially fueling turbulent regional conflicts that could upset the existing global balance of power. Loss of low-lying territory could create refugee problems of an unprecedented scale. Inundation of just the tiny island country of the

Maldives would require the relocation of nearly 200,000 people. Competition over territory and natural resources launched by those displaced by sea-level rise could create or exacerbate regional strife. Pressure from the 10 million individuals in Bangladesh that would be uprooted by a 3-foot sea-level rise could heighten regional tensions. Famine created by greenhouse-driven crop failures could also generate regional clashes that might encourage the major powers to take sides. Such an acceleration in showdowns among the superpowers would destabilize the world political balance in highly unpredictable ways, tempting those countries that already have a tendency toward global adventurism and placing U.S. security interests at risk.

Arresting Climate Change

The worst effects of a greenhouse-induced climate cataclysm can be averted. And the sooner action is taken, the more effective it will be. Conversely, the longer a policy response is delayed, the greater the warming that will have accumulated "in the bank" and the more radical the measures that will be required to prevent further climatic upheaval.

CFCs and halons are by far the easiest component of the greenhouse problem to eliminate. Motivated by concern over the pivotal role these chemicals play in depleting the stratospheric ozone layer, 45 countries and 1 international organization have signed the Montreal Protocol on Substances That Deplete the Ozone Layer, which took effect at the beginning of 1989 after negotiations sponsored by the United Nations Environment Programme. The agreement overcame a serious lapse of concern about this issue by U.S. and European policymakers in the early 1980s and a complete breakdown of negotiations in 1985. Aside from representing a diplomatic milestone for international cooperation on environmental problems, the Montreal Protocol is also an important precedent for a multilateral strategy on the more challenging issue of greenhouse warming.

The Montreal Protocol requires an incremental 50 per cent reduction in the consumption of five ozone-depleting CFCs by the end

of this century. Beginning in July 1989 consumption of these substances must be frozen at 1986 levels. A reduction of 20 per cent must be achieved beginning 4 years later and an additional 30 per cent beginning in July 1998. The agreement permits each country to implement these requirements as it chooses through recycling, destruction, or abandonment of unnecessary uses of these chemicals. However, the overall strategy is to stimulate the development of alternatives to existing CFCs by constricting supply. The Montreal Protocol contains ground-breaking trade incentives for broad participation, including a ban on imports of controlled substances from countries that are not party to the accord. Its provisions dealing specifically with developing countries resolve delicate equity issues by allowing Third World countries a 10-year grace period to make required reductions.

Despite the precedential importance of the Montreal Protocol, the agreement is inadequate. Because of loopholes and leakages built into the document, the actual reductions in emissions of substances controlled by the protocol will be only about one-third under even the most optimistic assumptions. Consumption of halons, which are up to 10 times as destructive of ozone as the strongest CFC, is merely leveled off and not reduced. The agreement explicitly specifies that production—as distinct from consumption—of CFCs and halons may actually increase by as much as 10 per cent over the 1986 level.

It is now clear that emissions of CFCs and halons must be virtually eliminated because of the overwhelming risks these chemicals pose to climate and stratospheric ozone. Soon after the Montreal Protocol was signed in September 1987, a seasonal thinning of 50 per cent of the ozone layer over Antarctica—the ozone "hole"—was conclusively connected to CFCs. New and widely accepted scientific evidence documents that average global losses in stratospheric ozone of about 3 per cent—two to three times that previously predicted by computer models—have already occurred.[2] Even

[2]*U.S. National Aeronautics and Space Administration, "Executive Summary of the Ozone Trends Panel," 1988.*

if CFCs and halons are phased out within 5–7 years, the long atmospheric lifetimes of these chemicals mean that the environment could take up to a century to recover. Moreover, even if production of these dangerous chemicals were to be eliminated altogether, they would continue to seep out of the existing stock of refrigerators, air conditioners, insulation, and other repositories.

To stabilize global concentrations of CO_2 gas it will be necessary to cut global emissions of CO_2 by at least one-half. Burning fossil fuels releases most of the excess CO_2 in the atmosphere. Because no economical technology for removing CO_2 from waste-gas streams is now available, cutting back releases of CO_2 will require a lower total energy consumption and a shift in energy sources toward low- or non-CO_2-emitting technologies. Greenhouse impacts should be an explicit part of all future decision-making processes in the energy sector. Reductions in fossil-fuel use will also help to ease other environmental problems associated with current patterns of energy use, such as acid rain and local air pollution.

Even with the most optimistic assumptions about economic growth, major reductions in CO_2 emissions from industrialized countries can be achieved with energy conservation, efficiency technologies, and renewable energy sources. For example, the 1,200 kilowatt-hours per year used by a typical frost-free refrigerator can be reduced to only 500 with a state-of-the-art model. Current technology can light an office building with an expenditure of only .55 watts per square foot, as little as one-fifth of today's average. It is now possible to produce motor vehicles—which currently account for more than one-fourth of greenhouse gases released in the United States—that have fuel economies of up to 98 miles per gallon, 2–5 times as efficient as those now on the road.

Efficiency improvements have meant that the amount of energy used in the United States today is about the same as in 1973, despite a 40 per cent increase in GNP during the same period. Application of existing efficiency technologies could reduce U.S. CO_2 emissions by 14–18 per cent by the end of the century. In California alone, a steady improve-

ment in efficiency of 3.4 per cent per year has been achieved over the past 12 years with only mild encouragement from state and local governments through policy measures to encourage conservation and efficiency. Through a strategy involving efficiency improvements, national progress could be much faster.

Nuclear energy has been proposed in some quarters as the preferred solution to the problem of greenhouse warming. Although atomic power is a CO_2-free technology, its other risks currently make it the least attractive alternative to fossil fuels. Nuclear energy carries the inherent danger of weapons proliferation. The current generation of nuclear reactors still entails the unacceptable danger of accidents and suffers from a critical lack of public confidence in an increasingly large number of countries. The problem of disposing of waste that will remain hazardously radioactive for many hundreds of thousands of years has yet to be adequately solved. Of the alternative strategies for reducing CO_2 emissions, nuclear energy is among the most expensive. Moreover, to reduce CO_2 emissions by 50 per cent by the year 2020 solely through the expansion of the nuclear industry would require bringing a new plant on line somewhere in the world at the rate of almost one a day starting in the mid-1990s—clearly a practical impossibility. While the nuclear option may be worthy of consideration as part of the public debate on ultimate solutions to the greenhouse problem, increased reliance on nuclear power at present would be both politically infeasible and irresponsible when major, cheap reductions in CO_2 emissions are available with existing technologies.

Reversing deforestation and creating new forested areas will help to offset current levels of CO_2 emissions. New forests, in absorbing CO_2 from the air during photosynthesis, will contribute to climate stabilization by serving as supplementary reservoirs for carbon. Aggressive policies to conserve existing forests and create new forested areas will yield other significant environmental benefits, including erosion control and the preservation of a rich diversity of species whose genetic potential is only now becoming accessible to humankind.

The fundamentals of the greenhouse phenomenon are now well understood and the need for swift policy responses firmly established. While these responses are being implemented, the development and dissemination of technologies to combat climate disturbance—such as CFC-free, energy-efficient refrigerators and low-methane strains of rice—should be a high priority. Increased basic research to resolve remaining uncertainties concerning the magnitude, rate, and effects of greenhouse warming should also be undertaken.

The Role of Developing Countries

An equitable response to the special needs of developing countries is crucial to removing greenhouse threats to the global climate. On the one hand, developing countries have caused little of the problem and industrialized countries must bear the bulk of the blame. On the other hand, as economic development accelerates, Third World countries may account for the preponderance of greenhouse-gas emissions by the middle of the next century. An international solution that provides incentives for the participation of developing countries while fairly distributing the responsibility for implementing solutions is essential to a successful global strategy for combating greenhouse warming.

The consequences of the greenhouse effect strongly suggest that it is in the self-interest of Third World countries to re-examine expeditiously their energy priorities. Developing countries, with fewer resources to adapt to environmental disturbances, stand to suffer disproportionately from a rapid climate change. For example, the productivity of common rice varieties falls off dramatically at temperatures just a few degrees higher than those currently prevailing in many rice-growing areas.

Tapping the tremendous potential for conservation and improved end-use efficiency in the developing world would contribute to a solution for greenhouse warming while meeting much of the Third World's growing energy needs. This strategy also avoids other serious environmental and social problems, such as land degradation, local air pollution,

at controlling trade in tropical woods and compensate exporting countries for lost revenues through alternative investments.

The Third World debt crisis presents major opportunities for encouraging better forest management in developing countries. As the market value of such debt has fallen, a number of private banks have sold debt owed to them by Third World governments to private conservation organizations, which have then forgiven the debt in return for specific promises by the governments concerned, such as a commitment to conserve a particular area and to support its maintenance with a stream of payments in local currency. Such "debt for nature" swaps are already in place in Bolivia, Costa Rica, and Ecuador, and more are under negotiation. Governments can adopt policies, such as tax incentives, that encourage creditor banks to sell debt for swaps. Creditor governments can reduce interest or principal on sovereign debt in return for promises of policy reform in this critical sector.

Coordinating policies on the international level to fight greenhouse warming will maximize environmental and foreign-policy benefits. Unilateral reductions in releases of greenhouse gases by large emitters such as the United States and the Soviet Union will go a long way toward arresting global climate disruption. However, a multilateral consensus strategy will further the crucial goals of creating incentives for universal participation and establishing an equitable balancing of responsibility for solving the problem.

Existing international mechanisms are an important part of such a strategy. A reassessment of the Montreal Protocol, a process that is provided for by the document itself, is the most expeditious way to eliminate the contributions CFCs and halons make to the global warming problem. The World Bank's institutional structure also includes mechanisms for member countries to redirect priorities in the critical energy and forest sectors.

The remainder of the greenhouse problem could be handled most effectively through a multilateral treaty, with standards binding under international law that would require each country to take prescribed actions to

reduce and halt greenhouse warming. Considerable precedent is now in place for multinational environmental agreements containing strict regulatory standards. In addition to the Montreal Protocol, which is an ancillary agreement to the 1985 Vienna Convention for the Protection of the Ozone Layer, several other international agreements establish requirements for controlling emissions of specific air pollutants. The Protocol on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by at Least 30 Percent and the Protocol Concerning the Control of Emissions of Nitrogen Oxides or Their Transboundary Fluxes—both auxiliary agreements to the 1979 Convention on Long-Range Transboundary Air Pollution—set out precise regulatory limitations on releases of specified chemicals. Principles established in the case law of international tribunals and in the 1972 Stockholm Declaration adopted by the United Nations Conference on the Human Environment also discouraged countries from acting in ways that could harm the environment in another's territory.

A multilateral treaty designed to arrest global climate change should satisfy several basic requirements. First, it must require reductions in releases of greenhouse gases of a magnitude and speed sufficient to stabilize the earth's climate. The most important gas to control is CO_2, for which global reductions of at least 50 per cent are necessary. Participating countries should accomplish these reductions by means of environmentally and economically sound technologies that do not present unacceptable risks to public health or global security. The creation of new forested areas might be encouraged by allowing credits against reductions of CO_2 emissions that would otherwise be required and by provisions establishing or promoting forestry programs. Because the agreement could be expected to cover a large number of emissions sources, it should mandate strict mechanisms for enforcement through reporting of emissions, on-site audits, and internationally controlled remote sensing.

Second, the responsibility for making reductions must be distributed equitably.

Among the criteria that could be applied is relative national wealth as measured by per capita GNP. Another test could be per capita emissions of CO_2, with the highest reductions required of those countries with the highest emissions per unit of population. Another possibility would be to require the imposition of a fee for carbon emissions, either as a primary mechanism for achieving reductions or as a supplementary measure. Any of these formulas would require proportionally greater cutbacks by the wealthiest countries and leave the poorest countries with the fewest constraints on CO_2 emissions. All countries would be encouraged to use existing energy supplies more efficiently.

A treaty should also require a commitment from the wealthier countries for increased research into non-CO_2 energy supply technologies and development assistance to help poorer countries meet the requirements imposed on them by the agreement. One mechanism for generating the necessary capital is to require countries to contribute to a fund in proportion to their CO_2 emissions. Restricting access to this fund to those countries that accepted the obligations of the treaty would create incentives for broad participation.

Considering the importance of the resources at risk, it would be nothing short of reckless to continue with business as usual. A failure to respond to the threat of greenhouse warming would amount to an affirmative decision to wager the health and well-being of current and future generations against overwhelming odds.

ENVIRONMENT AND SECURITY

by Norman Myers

The world is increasingly interdependent environmentally as well as economically. Pollution, whether air- or waterborne, is readily transported from one country to another, as is the case between the United States and Canada, between the Soviet Union and its neighbors, among the countries of Western Europe, and across the Mediterranean basin. The effects of soil erosion on agricultural productivity are a legitimate cause for international concern, whether the erosion occurs in India or in Indiana. Mass extinction of species affects all countries through agriculture, medicine, and industry, all of which depend to varying degrees on the genetic resources inherent in wild plants and animals. The global atmosphere is shared by all as well. Following the build-up of carbon dioxide and other gases that increase the retention of the sun's radiant energy in the earth's atmosphere—known as the greenhouse effect—all countries will suffer the vagaries of changed climate. If the ozone layer continues to be depleted, exposure to enhanced ultraviolet radiation will pose serious health threats to all populations. Similar observations can be made with regard to tropical deforestation and the spread of deserts. These two latter problems, like certain others, are closely connected to rapid population growth in the Third World, a problem related in turn to pervasive poverty and to associated issues of massive unemployment, overburdened cities, and refugees from environmental degradation.

Some of these problems affect the United States directly and immediately. For example, acid rain from the United States and Canada destroys animal and plant ecosystems in both countries, and refugees flee environmental

NORMAN MYERS *is an independent scientist and consultant in environment and development. He has worked with the World Bank, the U.S. National Academy of Sciences, and the State Department.*

DRAFT

DRAFT
COVER to PAMPHLET FOR INFORMAL SEMINAR 2/3/90

DRAFT COVER LETTER

February 2, 1990

Dear Participant:

Tomorrow morning, Saturday, February 3, 1990, an "Informal Seminar" will be held to discuss approaches that might be taken to address potential global climate change. In particular, the Seminar will focus on the two approaches recently suggested by the United States for consideration by the IPCC/RSWG:

- a "comprehensive" approach in which all greenhouse gases, their sources and sinks would be treated together, leaving to each nation the choice of its internal policies to achieve its net emissions target through a mix of policies covering the various gases, sources and sinks; and

- an "emissions trading" approach in which the total amount of pollution emitted would be limited or reduced (just as in traditional regulation), in which emitters are required to hold allowances for their pollution, and in which allowances may be transferred among emitters.

Each of these approaches deserves serious consideration. Each holds the promise of important advantages in any effort to address potential global climate change. Each also raises scientific, technological, economic and environmental questions which must be explored. We hope that discussion at tomorrow's Informal Seminar and in meetings to come will advance the understanding and analysis of these approaches. Although consideration of specific protocols implementing any such approaches would be premature before the negotiation of a framework convention, informed discussion of relevant concepts

and ideas can improve our shared understanding and can help ensure that any eventual negotiations toward an international agreement incorporate the best thinking on the subject.

Tomorrow's Informal Seminar will be chaired by _____, and will begin with short presentations by _____ and _____. Audience discussion will follow. Attached please find:

- Agenda for the Informal Seminar, February 3, 1990

- Introductory Discussion Paper, with References Suggested for Further Reading

In addition, photocopies of papers on related topics will be available to you at the Informal Seminar.

These materials are provided to suggest fruitful areas of discussion; they do not necessarily represent the official views of the United States nor of the participants in the Informal Seminar. Our hope is that through these materials, and more importantly, through our conversations at the Seminar, we will be more informed about possible approaches to possible international agreement on global climate change issues, and more understanding of each others' experiences and views on these subjects.

DRAFT

DRAFT
AGENDA for INFORMAL SEMINAR, 2/3/90

DRAFT AGENDA for INFORMAL SEMINAR

February 3, 1990

U.S. Department of State, Room XXXX

10:00 a.m. - 12:00 noon

SCHEDULE

10:00 a.m. Coffee

10:10 a.m. Welcome
State Dept.

10:20 a.m. Brief Presentations

Moderator: State Dept.

Remarks:

(one or two speakers; some combination of representatives from:)
Office of the White House Counsel
CEA
EPA
DOJ

11:00 a.m. Break

11:10 a.m. Audience Discussion

Moderator: State Dept.

(Additional U.S. Agencies interested in participating)

(Other nations)

(NGOs?)

(Congress?)

12:00 noon Conclusion

DRAFT

DRAFT
PAMPHLET for INFORMAL SEMINAR, 2/3/90

INTRODUCTORY DISCUSSION PAPER:

"COMPREHENSIVE" AND "EMISSIONS TRADING" APPROACHES TO GLOBAL CLIMATE CHANGE

SUMMARY

In its submission of a "Concept Paper" to the IPCC/RSWG on December 29, 1989, the United States proposed consideration of two approaches to any international agreement on potential global climate change:[1] a "comprehensive" approach and an "emissions trading" approach. This paper briefly surveys each approach.

Under a comprehensive, performance-based approach, all greenhouses gases, sources and sinks would be addressed together. Each international legal instrument produced -- whether convention or protocol -- would deal, to the maximum extent possible, with the entire array of gases, their sources and sinks. This approach employs the concept of a parameter, such as an "index," to enable comparison of the contributions of different gases, their sources and sinks, to total global climate change. It also employs the concept of "net emissions" to fashion performance targets that would not be limited to any one gas or source or sink, but would permit attainment of the target through policies aimed at reducing sources or expanding sinks or both. Such net emissions performance targets would be set, at least initially, for each nation,[2] and would leave to each nation the choice of internal policies desired to attain the target. Thus, employing the parameter or "index," each nation could devise a set of policies that would focus on one or more gases of its choice and thereby reduce its "net emissions," through restriction of sources or expansion of sinks or both, to meet the target. Such an approach would provide maximum flexibility for developing diverse, innovative, cost-effective measures.

---

[1]The term "potential global climate change" is used in this paper to refer to possible changes in global and regional climate that may result from increased concentrations of substances in the atmosphere that alter the atmosphere's thermal radiation budget.

[2]In appropriate circumstances, targets might be set for groups of nations, such as regional affiliations.

The "emissions trading" approach is conceptually separate from, but compatible with, the "comprehensive" approach. Emissions trading, which is one form of transferable allowances, is simply a tool to implement regulations on pollution or other uses of scarce resources. In a traditional regulatory scheme, the government sets the proper total amount of emissions (and its growth or decline over time), and then requires every emitter to meet the same standard, or to apply the same control technology. In emissions trading, the government sets the same total limits on emissions, but then permits emitters to allocate among themselves who will emit how much. This allocation is accomplished through issuing allowances to emitters, which they may trade among each other. The total amount of allowances is set equal to the total amount of emissions the government has chosen. The government supervises trades to ensure accurate reporting, and may take steps to facilitate trades as well. An emissions trading system can be designed to meet diverse circumstances: for example, allowances could be tradeable at specified ratios, or auctioned, or depositable in a bank for future withdrawal, or other variations.

The United States has used emissions trading to implement a variety of environmental protection programs, and has developed practical experience in the design and functioning of trading systems. This experience indicates that emissions trading is a pragmatic tool for protecting the environment at substantially lower costs to society than traditional regulatory approaches. An emissions trading approach could be highly advantageous to nations seeking to regulate their greenhouse gas emissions: limits on such emissions will be economically and socially costly, and choosing cost-effective methods that both achieve environmental goals and encourage diversity and innovation will be of great importance. Emissions trading programs could be used domestically by nations under the "comprehensive" approach just described, or under a system in which only one greenhouse gas is regulated; and, if desired, a trading system could be adapted for use among nations.[3]

---

[3]The RSWG Economic and Market Measures Paper has discussed allowing international trades (on a bilateral, regional or multilateral basis, and possibly conducted by governmental or private sector actors) as a method for attaining national net emissions targets, in order to achieve further environmental and economic benefits from the use of the trading principle.

DISCUSSION

A. "Comprehensive" Approach.

1. Description.

A comprehensive performance-based approach stands in contrast to a piecemeal pollutant-by-pollutant approach, such as those that focus on adopting targets for one greenhouse gas, carbon dioxide (CO2), alone.[4] The comprehensive approach would treat all greenhouse gases[5] collectively: each nation would be obligated to meet a target for its total combined contribution to greenhouse gas emissions. The total contribution would be the sum of the emissions of each greenhouse gas, weighted by the incremental contribution each different gas makes to total climate change. The weights assigned to the various gases would be measured by a parameter, such as an "index," expressing the comparative contribution of each gas (and, in turn, useful for estimating the comparative role played by any given source or sink).[6] Further, the "comprehensive" approach would set a target for each nation's "net emissions" of greenhouse gases, allowing:

---

[4]For example, the November 1989 Noordwijk Declaration appeared to urge pollutant-by-pollutant control rules, starting with CO2. On the other hand, it did suggest (in paragraph 10) possible development of a method for comparing the effects of other gases to the effects of CO2, similar to the parameter for comparing gases discussed here.

[5]The term "greenhouse gases" is used in this paper to refer to substances that, when present in the atmosphere, act to trap thermal radiation.

[6]For example, analysts have discussed a "global warming potential index," and the Noordwijk Declaration referred to "the concept of CO2 equivalence" in paragraph 10. Such a parameter is a system for computing the contribution to total atmospheric warming of any alteration in the emissions of any particular greenhouse gas. It assigns a value to each greenhouse gas describing the contribution of each additional molecule of that gas to the total warming of the atmosphere. The value depends on variables such as the molecular composition of the gas and its attendant capacity for radiative forcing, the lifetime of such molecules in the atmosphere, the existing atmospheric concentration of the gas and related gases at the time the additional molecule reaches the atmosphere, and the discount rate at which future warming is compared to present warming.

compliance to be achieved by reductions in sources[7] of greenhouse gases, or expansion of sinks,[8] or both. The targets would be "performance-based," in the sense that they would obligate nations to achieve certain net emissions levels by whatever means, rather than "design standards" that obligate parties to adopt specified technological applications or undertake specified response activities. The targets could, for example, consist of a cap or a phased-in cap, possibly followed by subsequent reductions.

2. United States Experience: the Environmental Advantages of a Comprehensive Approach

In the United States we have followed a medium-by-medium and pollutant-by-pollutant approach for the last several decades. Our environmental laws, such as the Clean Air Act, the Clean Water Act, the hazardous waste statutes, were each written to address one kind of pollution. Often, these statutes required separate regulations for each different type of source of that kind of pollution: thus, for example, there are separate regulatory programs for air pollutants from large utility plants, from smaller industrial plants, and from mobile sources. Breaking pollution control down into these piecemeal categories may initially seem logical, but we have learned through frustrating experience that it has a serious drawback: pollution or other undesirable residual effects of economic activity regulated in one category may simply shift to another, unregulated or less regulated, category. Shifts from one environmental medium -- air, water, land -- to another have thwarted attempts to reduce pollution, and these "cross-media" shifts have played a part in the evolution of new (though still piecemeal) laws aimed at the new manifestations of pollution. For example, stringent regulations on water pollution have induced industry to convert liquid pollutants into sludge, in turn creating toxic waste disposal problems. Statutes regulating solid waste pollution were not enacted until several years after the initial air and water laws were put in place.[9]

---

[7] "Sources" of greenhouse gases include anthropogenic, biogenic and other sources of greenhouse gases emitted into the atmosphere.

[8] "Sinks" of greenhouse gases include anthropogenic, biogenic and other activities, processes, and phenomena that remove greenhouse gases from the atmosphere. Examples of sinks are forests and oceanic plankton.

[9] Other examples include [EPA please suggest items].

Moreover, restrictions on emissions from one kind of source of a pollutant can result in compliance strategies that, while adhering to the law, fail to reduce environmental degradation, and may even make it worse. For example, laws regulating smokestack air pollution were written to require that the ambient air quality in the locality of the smokestack not fall below certain levels. One industry response to this approach was to build taller smokestacks, so that the pollutant plumes were fed into higher wind currents and were dispersed more rapidly from the local area. Pollutants continued to degrade the environment farther downwind. Later, the laws were amended to try to prevent such circumvention.

Recognizing the inherent and recurring problems in the piecemeal approach, the U.S. Environmental Protection Agency is now devising a more integrated strategy to address the "cross-media" and "cross-source" difficulties of our system of environmental control. Preliminary versions of a unified environmental statute have been drafted. Dealing with all environmental impacts in a comprehensive fashion will, we hope, lead to better reduction in deleterious pollution while avoiding environmentally troublesome and economically wasteful compliance strategies that merely shift pollution around.

This experience is particularly apt for the problems of potential global climate change. Such change is thought to be the result of numerous pollutants: several different greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs) and tropospheric ozone (O_3); gases like carbon monoxide (CO) that chemically generate greenhouse gases in the atmosphere; and other substances (e.g. soot and aerosol pollutants like sulfur dioxide (SO_2)) that may alter the atmospheric thermal budget in other ways. In turn, each of these gases is produced by a variety of sources on the earth's surface. Imposing narrow controls on one greenhouse gas alone, or on one source of such gases, is likely to be ineffective and possibly even counterproductive. Limits on CO_2 alone, for example, could encourage industry to shift to production and combustion processes, alternative fuel sources, and other activities that emit other greenhouse gases, possibly including CO and CH_4. Narrow limits on one source of CO_2, such as coal combustion in utility power plants, could encourage development of alternative combustion methods (e.g., coal gasification). The end results of these kinds of shifts might even be greater contributions to total greenhouse gas emissions per unit of economic output or per capita. A comprehensive approach to all greenhouse gases, their sources and sinks would

limit total impacts on global climate change, while avoiding undesirable cross-pollutant and cross-source shifts.[10]

3. Additional Considerations in Applying the "Comprehensive" Approach

There are several additional advantages to applying the "comprehensive" approach to an international agreement on potential global climate change.

First, the comprehensive approach would allow each nation to use that combination of source and sink controls and other measures that is best adapted to its economic and other circumstances, achieving greenhouse environmental protection at significantly lower cost than a pollutant-by-pollutant strategy. This approach maximizes the opportunity for and encourages the adoption of diverse, flexible, innovative, and cost-effective solutions to global climate change. For example, an approach that mandated specific percentage reductions in each gas -- such as a 20% reduction in CO2 and a 30% reduction in methane -- would be more costly than an approach that required a reduction in each nation's contribution to total warming (as measured by the gas-: comparison parameter) and permitted each nation to adopt its least-cost mix of choices achieving the target overall. Some nations might be able to reduce CO2 emissions much more than 20% through substitution of non-fossil fuels, but be unable to reduce methane output (e.g., a nation importing oil and dependent on rice crops, but endowed with untapped solar power opportunities). Those nations would meet their net targets by reducing CO2 more rapidly than methane; reducing each the same amount would prove much more costly (perhaps in terms of higher taxes, or reduced

---

[10]Although a "comprehensive" approach to greenhouse gases would avoid shifts within the realm of greenhouse factors, it still might be said to be focused on the "single medium" of atmospheric temperature change. The problem of the environmental "second-best" could then persist even in our "comprehensive" approach: the adoption of a comprehensive greenhouse gas agreement might lead to previously undiscovered non-greenhouse environmental impacts. An extreme analog is the history of chlorofluorocarbons (CFCs): enthusiastically introduced to replace chemicals that were highly toxic to humans, CFCs later proved to have serious effects on the stratospheric ozone layer.

Nevertheless, a "comprehensive" approach to greenhouse gases, sources and sinks is a vast improvement over pollutant-by-pollutant or source-by-source control of greenhouse factors. Meanwhile, the IPCC or other appropriate body could be directed to monitor possible non-greenhouse environmental impacts of any agreement and to report to the international community at regular intervals.

rice production) and would leave available CO2 reductions unexploited. Other nations might find themselves in the opposite situation, able to reduce methane more than CO2 (e.g., a nation dependent on coal reserves but able to reduce its ruminant animal husbandry).[11] The economic and social costs of policy responses to global climate change are likely to be great. It is thus particularly important in this context to use institutional strategies that will maximize the incentives and opportunities for development of new technologies and other innovative responses that will reduce these costs. A comprehensive approach employing performance-based standards will contribute substantially to achieving this goal.

Second, this approach reserves to each nation the freedom to employ whatever institutional mechanisms it wishes to use to achieve its target objective. This flexibility takes account of the widely varying legal and cultural systems present in different nations, and avoids the obstacles to international agreement among sovereign states that would be raised by dictating to each nation how it must institutionally manage its climate-related policies and industries. A free market economy would not be required to employ strict command and control regulations; by the same token, a centrally planned economy would not be required to employ market measures.

Third, a comprehensive approach would be more equitable. An approach that set targets first for one gas, or for certain sources or sinks, and progressed to others only later would unfairly put the onus of compliance disproportionately upon those nations whose economies are comparatively more burdened by the initial measure. For example, an approach that first mandated 20% reductions in CO2 emissions would place much greater burdens on those heavily committed to using fossil fuels, and on those whose economies depend on exports of fossil fuels; alternatively, an approach that first mandated 20% reductions in methane emissions would place much greater burdens on those heavily dependent on rice crops and ruminant animal husbandry. A comprehensive approach gives nations a more equal obligation to shoulder the costs of compliance. The comprehensive approach is consequently likely to avoid some of the obstacles to international agreement that would be faced by a pollutant-by-pollutant approach. The latter approach could engender

---

[11]A similar analysis applies to approaches mandating specific changes in sources alone or sinks alone, rather than combining them in a "net emissions" requirement that leaves the domestic policy mix to each nation.

opposition from nations who feared that the initial burden would fall on them; the comprehensive approach would ease such fears.[12]

There are, however, important caveats to a comprehensive approach that should be reviewed. First, the calculation of proper gas-comparison parameter or "index" values will require effort. Scientific study of this calculation has made progress, but more needs to be done before consensus values are obtained. As mentioned above, the parameter values depend on a variety of complex and sometimes interrelated variables.[13] So far, efforts to define a parameter have reached somewhat different results. In addition, if the parameter values are to be useful in assessing the comparative contributions of different sources and sinks, there remains the practical problem of assigning values sensitive enough to yield efficient environmental policy.[14]

---

[12]Moreover, a comprehensive approach reduces the ability of nations to manipulate the design of international regulatory measures to their own competitive or other economic advantage. A pollutant-by-pollutant command and control approach is vulnerable to attempts by nations to "game" the standard-setting agenda in their favor. For example, a nation reliant on non-fossil fuel energy sources, and whose chief rival earns its income from fossil fuel exports, could press for reductions in CO2 emissions not for their environmental value but to improve its competitive standing relative to its rival. Or a wheat-growing nation could press for methane emission reductions at the expense of its rice-growing neighbor. Such attempts would hinder international agreement on reductions of any particular pollutant. Such attempts to "game" the design of international regulatory controls are also likely to distort trade and reduce global welfare, as well as impede environmental improvement. By leaving the mix of compliance policies to each nation's discretion so long as the overall target is achieved, the comprehensive approach greatly reduces the potential for such gaming.

[13]For example, the atmospheric lifetimes of some important gases are not yet completely understood. In addition, parameter values for each gas are usually expressed as constants, whereas their dependence on such variables as the changing ambient concentrations of related gases suggests that mapping a continuous function could be helpful for policy analysis.

[14]As sources and sinks are assigned performance values for their contributions to emissions of gases and thus to total climate change, those values must be sensitive and flexible enough to take account of numerous variables, such as diverse and improving combustion techniques and scrubbing methods, and the varying regional characteristics of forests. Otherwise, the

(continued...)

Finally, the policy ramifications of assigning different parameter values to different gases -- effectively altering the costs to different nations of achieving their performance targets -- mean that the parameter values obtained must be carefully derived and highly accurate. The committee conducting this work should be composed of the best experts, and must produce methods and conclusions that are legitimate in the eyes of the world.

Second, pursuit of the "comprehensive" approach might appear to some critics to delay the process of reaching international agreement on global climate change issues. Some may believe that the fastest approach is to adopt protocols quickly for substances we can agree on now, and then proceed to thornier issues as we go. On the other hand, the comprehensive approach could in fact proceed more quickly, because (as discussed above) it raises the probability of broad consensus by eliminating the divisive inequitable effects of single-pollutant protocols. In addition, the comprehensive approach may achieve better overall environmental protection than a single-pollutant protocol, even if it does take slightly longer to achieve than the first single-pollutant protocol would take, because it will prevent cross-pollutant shifts.[15]

---

[14](...continued)
values set will entrench existing practices and discourage investment in advances that could further reduce net greenhouse gas emissions. For example, if "coal combustion" were assigned a constant parameter value regardless of combustion technique, industry would have no incentive to adopt innovative combustion techniques that reduce the quantity of greenhouse gases emitted per BTU (indeed, the incentive could operate in the opposite direction). A similar analysis would apply to assigning a parameter value to, say, "trees" generally, whereas different types of trees, and trees in different settings, remove greenhouse gases from the atmosphere at different rates.

The source and sink values should also be able to take account of long-term investments in emissions-affecting policies, such as sink development, which may have inherently long lead times.

[15]Efforts might also be directed to accelerating work on the scientific issues raised by the comprehensive approach, in order not to waste time. A different tack would be to consider including in a framework convention, depending on the status of development of the first protocol, a requirement that within a specified period after the convention enters into force the parties will agree on the scope and timetable for the first protocol. It may, however, be infeasible to ask parties to bind themselves to future agreement; and specifying too early a date might hinder efforts to achieve an intelligent resolution of difficult issues.

Third, the comprehensive approach requires a decision on which greenhouse gases to include. (Although the same question could be faced at several junctures in a pollutant-by-pollutant approach, the comprehensive approach depends upon an overall decision earlier in the process.[16]) For example, it may be difficult to decide how to treat chlorofluorocarbons (CFCs) and other greenhouse gases already regulated under the Montreal Protocol on Substances Depleting the Ozone Layer. Options for addressing CFCs in a greenhouse gas agreement include:

(a) giving credit for reductions in CFCs that go beyond the reductions required under the Montreal Protocol;

(b) giving credit for all reductions in CFCs; and

(c) not giving credit for reductions in CFCs.

Each of these options would have different effects on CFC consumption.[17] Other options might also be suggested. A related question is the treatment of the existing reservoir of CFCs trapped in such containers as abandoned refrigerators. Venting such CFCs could be counted as greenhouse gas emissions, thus giving incentives to store or recycle such gases safely.

Fourth, the comprehensive approach will also require decision on what treatment to give past practices, such as investments in fossil and non-fossil fuel energy sources; energy conservation; efforts at controlling pollutants that reduce greenhouse gas emissions; and deforestation. This question must be faced, of course, under a single-pollutant approach as well.

Fifth, a multi-pollutant agreement may complicate the task of monitoring compliance, because it covers many more gases and sinks which must be watched. This concern points to the need to ensure scientifically credible methods of monitoring emissions

---

[16]Limitations in data and scientific understanding may preclude inclusion, at least at the outset, of "all" greenhouse gases, sources and sinks, even in a comprehensive approach. An ideal comprehensive approach would include all factors influencing global climate change. If that is infeasible, a comprehensive approach could begin with the set of major, scientifically understood gases, their sources and sinks, and proceed to add other gases as they become understood.

[17]For example, option (c), no credit, would provide no additional incentive to nations producing CFCs to achieve further reductions. Option (a) would provide such an incentive. Option (b) would provide such an incentive and recognize the value to potential global climate change of reductions made in CFCs under the Montreal Protocol.

of various sources, changes in sinks, and their effects on global climate.[18] In this respect, a comprehensive approach reinforces the need to base response agreements on sound science and data. (It is also possible that the effects of certain gases, sources and sinks may not be sufficiently well understood to include them in an initial agreement limiting net emissions. The ideal of total comprehensiveness may thus be limited by gaps in knowledge. As scientific knowledge advances, however, additional gases, sources and sinks could be included in the basic agreement.)

B. "Emissions Trading" Approach.

The second approach suggested for consideration is "emissions trading" in greenhouse gas emissions. This paper discusses emissions trading systems that nations could choose to employ in their domestic implementation of environmental protection goals, such as for curtailing greenhouse gas emissions. The paper surveys how emissions trading works in principle, and what experience the United States has had in employing trading systems for environmental protection.

1. Description.

Emissions trading is one system for employing transferable allowances to ration the use of scarce resources, such as land, air, or water. These systems are not methods for increasing the amount of resource exploitation permitted. They are simply methods for implementing the same limit on total resource use that would be imposed under a traditional regulatory scheme. Under a traditional scheme, every resource user must reduce its use by the same percentage or to the same uniform level. For some users, that will be very expensive; for others, even further reductions would be feasible, but there is no incentive to achieve further reductions. Under a trading system, the total target limit (or reduction) is the same, but the resource users are able to reallocate who uses more and who uses less -- that is, to trade allowances among the users. They will do so according to how valuable it is to each user to continue using the resource. Those users for whom reducing resource use is very expensive can purchase allowances from those users for whom reductions are less expensive. Allowance sellers then must reduce their use of the regulated resource even further, but they gain the sale price of their allowances. The result is that those best able to reduce resource use do so the most. Overall,

---

[18]For example, in many nations data on methane emissions from diverse non-point sources, such as rice fields, landfills and animal herds, are not well developed.

the aggregate resource use target is achieved at lower total cost than if all users were required to meet the same target regardless of differences in their costs.

To put the point more concretely: say that the government determines to reduce total emissions of a pollutant to Level X, which works out to an average reduction from present levels of 20 units per polluter.[19] Initially, the government instructs each polluter to reduce its emissions to a target level of 20 units less than current emissions; or, stated in other words, each polluter is allowed to pollute up to the target level, 20 units less than its current emissions. Allowances are distributed to polluters which, in total, add up to Level X. No pollution may be emitted by each polluter above its target, or, in other words, unless it is accompanied by an allowance. So far, this system is identical to the traditional scheme. Some polluters will find it inexpensive to meet the 20 unit reduction, and could even reduce further, while others will find it very costly -- possibly ruinous. Now, we add the simple change that polluters are permitted to trade the allowances they hold. Then emitters would find mutual advantages to trading. For example, one emitter of the pollutant might find it more costly to reduce its own emissions 20 units than to reduce its own emissions only 10 units and to purchase allowances worth the remaining 10 units (those it will still be producing above its target level) from another emitter -- so that the second emitter must reduce its emissions 30 units (the initial 20 units plus an additional 10 units to account for the allowances it is selling). This decision is a good choice for the second emitter if it is able to reduce the extra 10 units at less cost than the price the first emitter is paying it for the accompanying allowances. The net result is the same average 20 unit reduction sought by the government, achieving Level X overall, but at less total cost to society, because the sum of the price paid for the allowance trade and the second emitter's reduction expenses is less than the sum of expenses if each emitter had to reduce 20 units. The "cost" society saves is resources that can be put to good use on other activities.

The payment for the allowances could be in cash. For example, a large emitter might meet its allowance limit by paying a landowner to plant trees. Or the payment could be in-kind; thus, the second emitter might receive some service from the first emitter. For example, the first emitter might be a large farming company which could give the second emitter, a town's public utility plant, harvested grain in return for the extra 10 units of allowances. Whatever the mode of payment, both sides

---

[19]The analysis is similar for a certain percentage reduction per polluter, or for a rule limiting each polluter's emissions to a certain maximum.

would gain, at no loss to society in pollution prevention. Indeed, the gains from trade in allowances are similar to the gains from trade when two parties voluntarily exchange other things of value, such as when two neighbors have different jobs (e.g., farmer and doctor) and rely on each other's services, or when nations with different economic strengths trade different goods with each other. It is less costly to everyone for the parties to produce goods according to their own strengths and to trade, than for each party to be self-sufficient in every needed item.

Trading in emissions allowances has several advantages over nontransferable emissions limits. As just described, it enables society to achieve pollution reductions at lower total cost. Given the likely high cost of reducing greenhouse gas emissions in most societies, a trading system could be a critical tool in implementing greenhouse gas emissions limits. In addition, emissions trading gives incentives for energy conservation and other forms of fuel efficiency and pollution prevention, whereas regulations that direct firms to employ a certain pollution control technology do not. Moreover, emissions trading encourages innovation in technologies, processes and social systems that reduce emissions at least cost over the long term, whereas regulations that direct firms to employ a certain pollution control technology do not.

There would be no requirement that every regulated emitter "take part" in the trading system; those who saw no economic need to engage in trades, or who were philosophically opposed, could refrain. At the same time, other organizations who wanted to reduce total pollution further -- such as a philanthropic foundation or the government -- could purchase allowances and hold them without emitting pollutants. (The government could also announce in advance that the value of allowances would be reduced over time, or that tiers of allowances would expire in time, or that allowances must be repurchased periodically.)

Implementation of such a system would require a role for government, as discussed further below. The government could monitor emissions, as it would under a traditional regulatory scheme, and it could monitor the trades themselves, to ensure accurate accounting. The government could facilitate trading, by acting as an auctioneer or broker, and by establishing "banks" to trade in allowances. To avoid unregulated increases in pollution, the government would not permit pollution without accompanying allowances. Allowances could expire and be issued or auctioned annually, in revised total amounts that reflect the government's desired rate of decline or growth in total pollution. To avoid forcing new entrants to the market to purchase their allowances directly from their competitors, the

government could retain some of the allowances for issuance or auction to new businesses.

2. U.S. Experience with "Emissions Trading" Approaches

Emissions trading is not just a concept; it is a practical method now operating in the United States in several different areas of environmental policy. A growing literature has analyzed these efforts.[20] Trading has been used, for example, to implement controls on air pollution, water pollution, use of fuels and hazardous substances, and land development. For the most part, these efforts have been highly successful, but we have learned as well from the few trading systems that have not functioned well. Experience with trading systems has been sufficiently impressive to encourage the Administration to employ an emissions trading approach in its ambitious proposal to reduce acid rain; this proposal is now being debated in Congress.

Examples of U.S. experience with emissions trading and related systems include:

(a) Emissions trading under the Clean Air Act. Under the Clean Air Act, each region of the country must attain ambient air quality standards. Existing, modified, and new sources of pollution are all regulated to achieve the ambient standards and to prevent deterioration once standards are attained. Depending on the type of source and whether the area is "in attainment" or not, sources must employ a range of pollution controls. The U.S. Environmental Protection Agency (EPA) has implemented the ambient air quality requirements and the pollution control requirements through several different emissions trading systems. "Offsets" allow new or modified sources to be created in nonattainment areas so long as they obtain corresponding decreases in emissions from existing sources in the same area. The new source must still employ the most stringent pollution control technologies. "Netting" allows a source modification to occur without employing the most stringent pollution control technology if it obtains a corresponding decrease in emissions from other parts of the same plant. "Bubbles" allow existing plants with multiple sources to reallocate emissions within the plant, so long as total emissions

---

[20]See the articles cited in the "References" section at the end of this paper. Experience with several specific trading systems is surveyed by Dudek & Palmisano, "Emissions Trading: Why is this Thoroughbred Hobbled?" 13 Colum. J. Envtl. L. 217 (1988); and Hahn & Hester, "Marketable Permits: Lessons for Theory and Practice," 16 Ecol. L. Q. 361 (1989). The discussion of trading system examples in this section draws from these articles and other sources.

do not increase. In addition, a banking program lets existing sources store extra reductions in emissions for future use.

Experience has been different under each of these programs, but in general, there have been significant cost savings to industry from the netting and bubble programs. There have been numerous netting trades, yet fairly few bubble program trades. There have been a number of offset trades, but it is difficult to assess the cost savings obtained. No overall environmental effects have been observed; that is consistent with the design of the trading programs to permit reallocation of emissions among and within plants but to maintain the same aggregate emissions level.

Yet observers believe that these trading programs could be more successful. First, trading is limited but some non-transferable emissions reduction duties; for example, new sources are not permitted to avoid employing the most stringent pollution control technologies, even if they can find an existing source willing to reduce its emissions commensurately. This situation prevents trading that could reduce costs while maintaining constant total emissions. Second, the combination of technology-based emissions control rules and emissions trading often adds costs. Firms that have installed control technology are in compliance, but they must separately measure actual past and present emissions if they want to trade. Trading would be relatively less costly if the law regulated emissions directly, not technology. Similarly, standards for ambient air quality do not mesh well with emissions trading, because allowances traded may subject to confiscation if the region as a whole fails to meet its ambient quality standard. Third, the variety of trading systems, and the variety of attendant regulatory oversight, favor some kinds of trades (chiefly trades internal to a firm, such as netting) over others.

Moreover, some specific trading programs have not worked well. For example, the agency operating the Los Angeles program has authorized additional pollution from new sources without requiring the sources to obtain emissions allowances. That kind of waiver or loophole effectively expands the limit on total pollution; it is as though the overall emissions target set by the government had been relaxed. The agency's action permits pollution to rise and simultaneously undercuts the allowance market (and lowers allowance prices) by making allowances effectively unnecessary.

(b) Acid rain reduction proposal. The Administration has proposed, and Congress is now considering, new Clean Air Act legislation to reduce emissions of pollutants which contribute to acid precipitation. A key feature of the Administration proposal is a system of transferable emission allowances. The proposal sets a permanent cap of 10 million tons per year on emissions of sulfur dioxide (one of the main precursors of acid precipitation) from certain fossil fuel-burning electric utilities (the primary source of SO2 emissions in the U.S.) The proposal requires each

utility to hold an allowance for each ton of SO2 it emits. Allowances for 10 million tons of emissions per year would be allocated among the utilities by multiplying each utility's historic power output levels by an average SO2 emissions rate. Under this formula, most utilities would not be allocated enough allowances to cover their emissions at historic levels. To make up this allowance shortfall, utilities could reduce their emissions by installing additional pollution control equipment or taking conservation measures, or could purchase additional allowances. Utilities that could afford to reduce their emissions below the average emission rate (i.e. below the number of allowances they had been allocated) would be able to sell those "extra" allowances to other utilities.

This system provides flexibility for each utility to choose the compliance strategy that is most cost-effective for it. Each utility can adopt the mix of emission reductions and allowance sales or purchases that best minimizes its own costs. It also creates a strong financial incentive for all utilities to minimize their emissions; thus, it encourages energy conservation and technological innovation, either of which would be encouraged by a rule requiring utilities to adopt specific pollutant control mechanisms such as scrubbers. And by permitting trading, it ensures that the overall environmental objective -- limiting utility SO2 emissions to 10 million tons per year -- is achieved at the lowest possible cost to the economy as a whole.

(c) Lead phasedown. Also under the Clean Air Act, the EPA issued regulations reducing the allowable lead content of gasoline. In 1982 EPA instituted limits on lead content and permitted trading within and among refiners: leaded gasoline producers and importers could transfer (i.e., buy and sell) lead content credits freely among themselves through 1986, or could apply such credits to their own gasoline. But such credits expired quarterly if unused. In 1985, EPA substantially reduced the lead content limit further; the content was required to decline, in phases, from 1.10 grams of lead per gallon (gpg) to no more than 0.10 gpg by the end of 1985. To provide leaded gasoline producers and importers with some flexibility in complying with the new limits, EPA also issued regulations in 1985 permitting producers and importers whose gasoline in 1985 contained less lead per gallon than the applicable standard, to "bank" lead content credits (i.e., to avoid the expiration of credits). The "banking" regulations then permitted gasoline producers and importers to "withdraw" those lead content credits through the end of 1987 and to apply them to help meet the new, more stringent lead content standards that took effect in 1985.

The banking and trading system helped the industry as a whole to comply with the new lead limits, while ensuring that the total amount of lead content did not exceed the maximum that otherwise would have been allowed under the lead content standards in the absence of the banking provisions. Data

indicate that banking and trading were active, and that they resulted in substantial cost savings (on the order of hundreds of millions of dollars).

The design of the lead phasedown system facilitated widespread trading. Firms were not required to apply to the EPA for permission to enter into trades; they simply reported their trades to the government, as part of their regularly required reports of the lead content in their gasoline. Each firm was simply required to have a net balance of lead content credits greater than or equal to zero in each quarter. In addition, because gasoline refiners and importers were accustomed to trading feedstocks and other commodities with each other, trades in lead content credits did not require new information networks. In sum, the lead phasedown was highly successful.

(d) CFCs reduction. In order to implement national and international requirements that production and use of CFCs be reduced in the 1990s, the EPA has issued regulations limiting total U.S. CFC production and requiring a 50% reduction in production by the end of the decade. The EPA regulations implement these phased reductions by issuing allowances to each producer of CFCs. These allowances may be traded among producers. Analysts expect this system to work well. EPA is able to monitor emissions of CFCs, and to keep track of allowance trades. Producers are aware of potential buyers and sellers and can trade allowances freely. One important question is whether EPA will issue initial allowances free of charge, or sell them at fixed prices or at an auction. Free issuance is administratively simpler, but selling the allowances -- especially at an auction -- would provide a natural method for allocating the allowances to start the program, and would give producers an incentive to develop CFC substitutes even sooner.

(e) Pinelands development. A somewhat different kind of allowance system has been used successfully by the State of New Jersey to regulate development of the Pinelands, a forest zone the State wishes to protect from excessive development. Here the allowances are not for emissions of a pollutant, but for rights to develop certain property. Property in parts of the Pinelands is slated for preservation, and the owners of that property may agree to be prohibited from developing their land. In return, they are issued "transferable development rights" (TDRs) which they may sell to others wishing to develop land in the other areas of the Pinelands. Different amounts of TDRs are issued to each owner, depending on the value to society of preserving that owner's property. In areas in which development is permitted, landowners must hold TDRs to develop their property. Thus, the total amount of development in the Pinelands is capped, and the regional distribution is partly restricted; but the precise allocation of development on permissible properties is left to the market for TDRs. In addition, no current landowner is entirely deprived of the former market value

of his or her land, because those who are barred from developing their own land receive TDRs to sell to others. Because anyone may purchase the TDRs, landowners in high-growth areas who wish to block further development may buy TDRs to retire them. The government has established a TDR exchange to facilitate trades: the exchange buys TDRs from willing sellers and sells them to interested buyers.

(f) Fox River water pollution. Under the Clean Water Act, sources of water pollution must meet water quality standards. The State of Wisconsin adopted a pollution discharge limit system for the Fox River that set the limit for each source, but also permitted sources to devise new discharge limits, by mutual agreement, so long as the total discharge did not rise. In principle, the system implements a market in transferable emissions allowances. In practice, however, the system has proved cumbersome. Sources hold five-year permits from the state, and trades may expire at the close of a permit cycle, impairing their use for reallocations that involve long-term investments in capital equipment. No allowances or credits are actually issued to sources; instead, each agreement between sources must be submitted for approval to the state agency. Parties must demonstrate to the state that they "need" to make changes in their permits. Review by the agency can be complex and time-consuming. And there is no broker to help arrange trades. Thus, transaction costs are high and the market is sluggish. Agency review of proposed trades is necessitated, moreover, by the fact that agreements between sources can yield very low discharges of toxic substances in one local area and very high discharges of toxics in another, placing too great an ecological burden on the latter area. Hence the spectrum of possible trades is limited.

(g) Dillon Reservoir water pollution. In the state of Colorado, economic growth was adding pollutants to the Dillon Reservoir, endangering drinking water supplies. Pollutants came from both point sources (e.g. factory discharge pipes) and nonpoint sources (e.g. runoff). The government issued annual discharge allowances to all sources. It then requires that sources may increase their discharges only if they acquire allowances from nonpoint sources, at a ratio of 2:1. That is, for each pound of discharges a source wishes to add, it must reduce discharges by two pounds from nonpoint sources. Because control of point sources is about seven times as expensive as control of nonpoint sources, the 2:1 trading ratio leaves dischargers considerable room for cost-saving trades. Thus, trading will both save costs and reduce pollution. Although the program is just getting under way, observers expect active trading and significant cost savings.

(h) Other related programs. Transferable allowances and related systems are also being used in other environmental

protection programs. Some truck and automobile manufacturers are being permitted to trade internally in different types of emissions. That is, a manufacturer is instructed to achieve total or average emissions for its fleet, but permitted flexibility to allocate those emissions among its vehicles. A similar program is being developed for trading between different pollutant gases (nitrogen oxides and particulates) emitted from truck engines. A trading program for reducing asbestos emissions has also been discussed.

3. The Fruits of Experience.

U.S. experience with these and other trading systems has yielded several insights. They are summarized here.

Creating a market. Trading systems work when a resource -- such as stock in a corporation, or available land for development, or the ability to emit a substance while keeping the environment healthy -- is in demand, and when the supply of the resource is finite. Thus, it is essential for a trading system to work that there be a limit, or "cap," on the total amount of allowances. In an emissions trading system, this cap will be the total amount of pollution the government wants to allow, and it may change over time (say, as the government reduces the total amount of allowed pollution). In addition, it is essential that the market include participants with diverse interests in holding the allowances -- that is, some who will want to buy and some who will want to sell. Thus, emissions allowances should not be distributed only to the worst polluters; they should also be distributed to firms that historically have been "clean," and to firms for whom pollution reduction is inexpensive as well as firms for whom it is expensive. In the Administration acid rain bill described above, the system will include a large number of utility plants, with a wide spectrum of pollution reduction costs, so that a robust trading market develops.

Preventing evasion. At the same time, trading systems will fail to achieve their overall environmental protection goals if pollution is permitted in the absence of allowances, or if the total amount of pollution is permitted to rise through the issuance of unrestricted allowances (as in the Los Angeles bubble). The agency supervising the trading system must maintain the integrity of the market for allowances, monitor to prevent cheating, and issue allowances according to the desired overall limit on pollution.

Facilitating trades. In some systems, such as the lead phasedown described above, trading occurs easily. In others, the allowance holders are not sufficiently able to trade with each other. This may occur because each holder lacks information

about other holders and cannot find or communicate with them. Government can facilitate trades by furnishing such information; by acting as a broker, arranging buyers and sellers; by acting as an auctioneer; or by creating a "bank" which buys and sells (or borrows and lends) allowances. The New Jersey TDR exchange for Pinelands development is a good example of such a bank.

Monitoring trades. Some monitoring must occur lest participants in the market overstate their trades or the allowances they hold. Monitoring trades could be accomplished through reporting requirements, spot checks, or designated periods in which trading is conducted. Other markets, such as securities ("stock") markets, function well in the presence of careful government monitoring. But requiring trades to be submitted to regulators for prior approval, or requiring them to meet special criteria, may tend to discourage effective trading.

Monitoring emissions. In addition, the government must monitor the emissions of pollutants to be sure that emitters do not understate their emissions. This task would be necessary whether or not a trading approach is employed. If monitoring emissions is infeasible, effective regulation -- whether implemented through a trading system or not -- is difficult.

More than local significance. A trading system is most effective when the problem it is applied to has significance beyond local areas. That is, the resource being preserved (such as clean air or water) should be of at least regional significance. For example, trading works well in reducing air pollution dispersed over a wide area from numerous source points. The potential greenhouse effect is just such a regional issue.

One problem encountered in some trading programs is that too many pollution allowances (and hence too much pollution) could be concentrated in one locality, or "hot spot"; if the pollution has direct toxic effects, this concentration could excessively endanger the local population. This type of danger, and attendant agency review, inhibited trading in the Fox River program. Even if such concentrations did occur in a trading system for greenhouse gases (and given the wide variety of gases, sources and sinks and their wide geographic distributions, such concentrations seem unlikely), "hot spots" are not generally a problem for the important greenhouse gases, because those gases may have global thermal effects but do not usually have local toxic effects.

Moral issues. Some observers have criticized trading systems as "immoral licenses to pollute," because trading allows emitters to pay others for permits to allow their own emissions to grow. A system without trading, however, involves the same "license" to pollute within the same total target; trading only allows emissions to be reallocated within the overall limit. That is, nontransferable regulatory limits on pollution give

polluters the very same "license" to pollute up to the regulated limit; trading does not change the overall limit. Moreover, if trading is effective at reducing pollution at less cost, then it is unclear what moral concern is applicable to the difference between a trading system and a non-trading system. The central concern should be which system better achieves desirable environmental protection at least cost.[21]

Some critics have also argued that if a firm is able to achieve additional pollution reductions beyond regulated standards, those extra reductions should "benefit society" and should not be sold to another firm to raise the second firm's pollution level. First, such criticism is really directed at the government's initial standard: if less total pollution is desired, the standard may be tightened, but once the standard is set, further reductions are not legally obligated. Second, such criticism fails to note that firms only reduce pollution when given an incentive to do so (such as threat of punishment or promise of financial benefit). Trading, appropriately designed and monitored, provides the incentive -- the market for extra allowances -- to firms to reduce their emissions beyond the standard; simply setting a standard does not. It is only in a trading system (or a similar system of emissions charges) that the "extra" reduction is induced among firms who find it in their interest to do so.

4. Potential Elective Use of Trading Among Nations.

Just as trading is a useful tool for implementing domestic environmental policies, one or more nations could elect to participate in trading internationally, to meet global environmental protection goals. As with domestic trading, such a system would not be mandatory; only those wishing to participate need do so. Such a trading system could provide the mechanism for international financial and technological assistance to nations who seek to grow economically, to preserve their forests, and to avoid the use of technologies that imply greenhouse gas emissions. An international agency and/or national governments would monitor the trades and perhaps facilitate them. Indeed, using trading systems to implement environmental protection is already a feature of the world economy. "Debt-for-nature" swaps are perhaps the best-known example. The Montreal Protocol on Substances Depleting the Ozone Layer contains "industrial rationalization" provisions allowing limited substance trading among the parties. And the concept of "trading" in the global

---

[21]It is worth noting in this regard that, in comparison with a comprehensive approach, a single-pollutant approach is an even larger "license" because it begins by permitting unrestricted emissions of the as-yet-unregulated gases, which might increase even faster as industry shifts to systems producing them.

climate context has been discussed in the RSWG as part of the topic discussion of "Economic (Market) Measures."

CONCLUSION

Addressing the potential problems of global climate change will require creative policy thinking. Attacking the causal factors of global climate change one at a time, pollutant-by-pollutant and source-by-source, could jeopardize sound environmental protection, squander scarce resources, and impose inequitable burdens and unreasonably uniform requirements on nations with diverse needs and capabilities. A "comprehensive" approach would avoid these problems while addressing the potentially serious environmental goals of global climate policy.

In addition, nations may choose to implement environmental policy through various means. Some may choose to adopt uniform standards, or even dictate which technologies businesses must employ. Others may choose more flexible systems, such as transferable allowances. United States experience with "emissions trading" and other transferable allowance systems suggests that they could be quite useful means of implementing global climate change policy.

References

and

Suggestions for Further Reading

Ackerman & Stewart, "Reforming Environmental Law," 37 Stan. L. Rev. 1333 (1985).

Ackerman & Stewart, "Reforming Environmental Law: The Democratic Case for Market Incentives," 13 Colum. J. Envtl. L. 171 (1988).

Assarsson [or Levander ?], "The Importance of Greenhouse Gases other than Carbon Dioxide and Other Possible Differences Between Various Fuels," Swedish National Energy Administration (Heat & Electricity Production Div.) memorandum dated Sept. 14, 1989 presented to delegates of the OECD Group on Energy and Environment, Oct. 13, 1989.

Dudek, "Marketable Instruments for Managing Global Atmospheric Problems," paper presented to the Annual Meeting of the Western Economics Assn., Vancouver, BC, July 7-11, 1987.

Dudek, "Offsetting New CO2 Emissions: A First Rational Greenhouse Policy Step," paper presented at the Annual Meeting of the Western Economics Assn., Lake Tahoe, CA, June 18-22, 1989.

Dudek & Palmisano, "Emissions Trading: Why is this Thoroughbred Hobbled?" 13 Colum. J. Envtl. L. 217 (1988).

Grubb, "Alternative Approaches to International Agreements," in The Greenhouse Effect: Negotiating Targets, chapter 5 (Energy & Envtl. Programme, Royal Institute of Int'l Affairs, London, 1989)

Hahn, "An Evaluation of Options for Reducing Hazardous Waste," 12 Harv. Envtl. L. Rev. 201 (1988).

Hahn, "Economic Prescription for Environmental Problems: How the Patient Followed the Doctor's Orders," 3 J. Econ. Persp. 95 (1989).

Hahn, "Marketable Permits: What's All the Fuss About?" 2 J. Pub. Policy 395 (1982).

Hahn & Hester, "Marketable Permits: Lessons for Theory and Practice," 16 Ecol. L. Q. 361 (1989).

Hahn & Hester, "Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program," 6 Yale J. Regulation 109 (1989).

Hahn & Noll, "Barriers to Implementing Tradable Air Pollution Permits: Problems of Regulatory Interactions," 1 Yale J. Regulation 63 (1983).

Hahn & Noll, "Designing a Market for Tradeable Emissions Permits," in Reform of Environmental Regulation (Magat ed. 1982).

Hahn & Noll, "Implementing Tradeable Emission Permits," in Reforming Social Regulation: Alternative Public Policy Strategies (1982).

Heffernan & Lave,"Adjusting to Greenhouse Effects: Exploring the Economic Costs to Rich and Poor Countries," paper presented at the Workshop on Energy and Environmental Modeling and Policy Analysis, MIT Center for Energy Policy Research (July-Aug. 1989).

Jorgenson & Wilcoxen, "Environmental Regulation and U.S. Economic Growth," paper presented at the Workshop on Energy and Environmental Modeling and Policy Analysis, MIT Center for Energy Policy Research (July-Aug. 1989).

Kaya, "Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios," paper submitted to IPCC/RSWG, May 8, 1989.

Lashof & Ahuja, "Relative Global Warming Potentials of Greenhouse Gas Emissions," paper submitted to Nature, as revised Dec. 6, 1989.

Manne & Richels, "CO2 Emission Limits: An Economic Analysis for the USA," paper presented at the Workshop on Energy and Environmental Modeling and Policy Analysis, MIT Center for Energy Policy Research (July-Aug. 1989).

Nordhaus, "The Economics of the Greenhouse Effect," paper presented at the Workshop on Energy and Environmental Modeling and Policy Analysis, MIT Center for Energy Policy Research (July-Aug. 1989).

Roberts, "Some Problems of Implementing Marketable Pollution Rights Schemes: The Case of the Clean Air Act," in Reform of Environmental Regulation (Magat ed. 1982).

Stavins, "Harnessing Market Forces to Protect the Environment," 31 Environment 5 (1989).

Stewart, "Controlling Environmental Risks Through Economic Incentives," 13 Colum. J. Envtl. L. 153 (1988).

Stewart, "Economics, Environment, and the Limits of Legal Control," 9 Harv. Envtl. L. Rev. 1 (1985).

Swisher & Masters, "International Carbon Emission Offsets: A Tradeable Currency for Climate Protection Services," TEchnical Report No. 309, Civil Engineering Dept., Stanford Univ., Feb. 28, 1989.

Tripp & Dudek, "Institutional Guidelines for Designing Successful Transferable Rights Programs," 6 Yale J. Regulation 369 (1989).

U.S. Environmental Protection Agency, "Emission Trading Policy Statement," 51 Fed. Reg. 43,814 (1986).

U.S. Environmental Protection Agency, "Protection of Stratospheric Ozone," 53 Fed. Reg. 30,566 (1988) (to be codified at 40 C.F.R. pt. 82) (Final Rule) (capping CFC production with marketable permits); 53 Fed. Reg. 30,604 (1988) (Advance Notice of Proposed Rulemaking) (proposing allocation of permits).

Langer —

Back from the Georgetown walk-thru... I'm @ my desk.

Jim found good stuff @ Lib. of Cong.

Thought you'd like to read this article.

—C²

Likely candidates for handouts at seminar:

Dudek & Palmisano, Colum. J. Envtl. L.

Hahn & Hester, Ecol. L. Q.

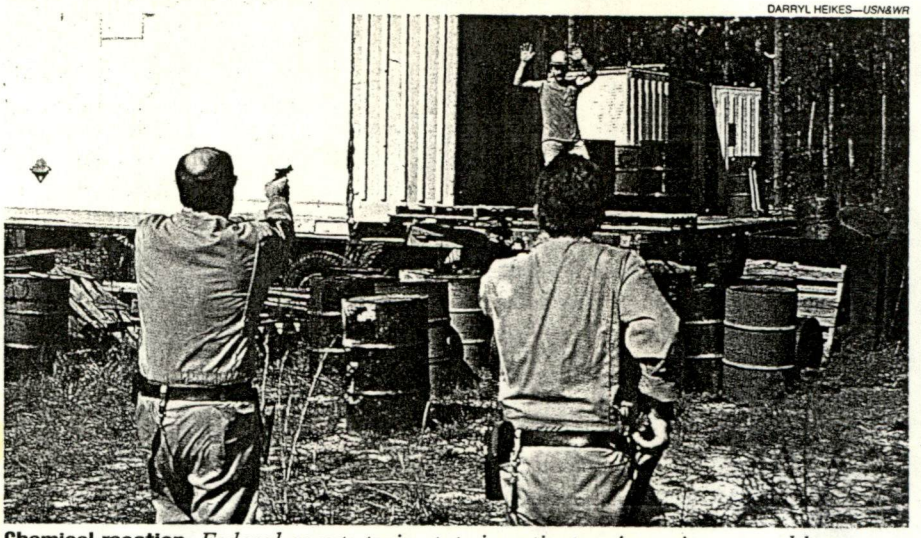
Stavins, Environment

Stewart, Colum. J. Envtl. L.

Enviro-cops on the prowl for polluters

With halfhearted backing, a new corps of E-men probes the Energy Department and other environment foulers

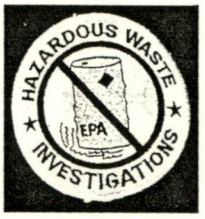
DARRYL HEIKES—*USN&WR*



Chemical reaction. *Federal agents train state investigators in environmental busts*

It was the FBI that drew the attention early one morning last June when 70 federal agents swarmed into Rocky Flats, a federal nuclear-weapons facility near Denver, and declared the place under criminal investigation. It is *always* the FBI that draws attention, it seems. But marching alongside the G-men were 17 agents from a special force of 48 criminal investigators whose specialty is bringing polluters to justice—the E-men of the Environmental Protection Agency. The unit was set up seven years ago as an experiment and has since won the backing of many environmentalists. But it has only a few ardent supporters within the EPA.

The E-men may provide the kind of prosecutorial punch the Bush administration, busily trying to build its environmental credentials, could use. In its first six years, the force has won 385 indictments and 279 convictions, with about 100 cases still to be tried. Their targets have run the gamut from a Winchester, N.H., leather-tanning company that illegally dumped solvents and greases into the Ashuelot River to W. R. Grace & Company, which was charged with making false statements about chemical solvents used at its Woburn, Mass., plant and concealing the illegal dumping of chemicals on nearby grounds. The company pleaded guilty to one count and was fined $10,000. Lately, the targets have included the government itself. The raid on the Department of Energy's Rocky Flats, a joint EPA-FBI fraud investigation focusing on the illegal dumping and burning of hazardous wastes, was the E-men's most ambitious effort so far. They have opened similar investigations into the DOE's uranium-refining center at Fernald, Ohio, and at its West Valley nuclear-waste site near Buffalo, N.Y. And more probes of once secretive DOE facilities are soon to come. "It's no holds barred now," says Marty Wright, chief of the EPA's National Enforcement Investigations Center. "There's almost an open-door policy for us."



Midnight dumpers. In a nation that produces 265 million metric tons of hazardous wastes a year, wastes that increasingly are lacing rivers, creek beds, woods and fields, there is no shortage of work for the E-men. Agents say tougher regulations have actually spawned large numbers of midnight dumpers, companies that cannot afford to dispose of wastes properly. In Illinois, for instance, the manager of an industrial plant was caught dumping a 55-gallon drum of polychlorinated biphenyls, a suspected carcinogen, at a forest preserve. He pleaded guilty. Larger companies are just as culpable. Last year, Ocean Spray Cranberries, Inc., pleaded guilty to spewing undertreated waste water into the Nemasket River at Middleboro, Mass. Most cases begin with tips from troubled employes, which means that the agents nearly always are dealing with crimes that have already been committed. There is not enough manpower to put agents undercover, and there is nothing simple in proving crimes the agents do learn about. Chemicals do not leave fingerprints; illegal substances quickly wash away or are absorbed by soil. When agents do find the goods, they often must don oxygen masks and protective "moon suits" to collect samples of deadly substances.

The deployment of criminal investigators to environmental cases has bucked a long tradition of punishing polluters with hefty civil fines. Congress actually made fouling the environment a crime when it passed the 1899 Rivers and Harbors Act, but few prosecutors applied the act. Even a wave of tough environmental laws passed in the 1970s spurred only "haphazard" environmental enforcement, according to Judson Starr, former head of the Justice Department's environmental enforcement unit. That changed in 1982, when Starr and colleagues at Justice and the EPA persuaded their bosses to fund criminal investigators with the necessary expertise to enforce the tougher laws. The prosecutors did not want EPA technicians but street-tough detectives who knew how to collect evidence, follow leads and make arrests.

State side. The upstart E-men, with their law-and-order approach, made few friends at the EPA. Not all the agency's leaders were convinced they should be in the law-enforcement business. The squad grew slowly, from an initial 23 investigators to 48 by 1986. Fifteen more slots are expected under the 1990 federal budget, which still would mean just a handful of agents in each of the EPA's 10 regions. To bridge the gap, the E-men have offered training to state law-enforcement and environmental officers as well as to Drug Enforcement Administration and FBI agents. Bush's EPA administrator, William Reilly, has promised that the agency "will get tougher on enforcement, which is the cornerstone of EPA's environmental program. We expect to see even more activity in the future."

It is not clear whether that means even greater emphasis on enviro-cops' criminal investigations. There are still plenty of officials around Washington who think that the best environmental-enforcement work is done through the EPA's civil inspectors or individual states. Those arguments raise the stakes of high-profile cases like the Rocky Flats investigation. The agents are betting that a new administration, one that has promised a crackdown on environmental criminals, will back up its tough talk with action that could turn attention to the E-men for a change. ■

by Stephen J. Hedges

New Models Chill Some Predictions of Severely Overheated Earth

By William Booth
Washington Post Staff Writer

The most dire predictions about global warming are being toned down by many experts, who now predict that temperatures and sea levels in the next century will not rise as dramatically as once feared.

While climate researchers tend to agree that our grandchildren will inherit a warmer world, many scientists are now betting on an average warming of only 3 or 4 degrees Fahrenheit by the middle of the next century, the low end of a range that prognosticators once put as high as 9 degrees.

A rise in sea level, one of the most feared consequences of global warming, also is expected to be far less drastic than previously thought, largely because of the surprising observation that the polar ice sheets are not melting, but growing in size. According to Mark Meier of the Institute of Arctic and Alpine Research at the University of Colorado, the consensus now is that sea level will rise by about a foot in the next century, rather than the three feet that had been suggested in previous studies.

But even if the revised forecast is correct, there would be major effects, the scientists warn. A one-foot rise in sea level would inundate some shorelines, moving the water's edge inland by hundreds or thousands of feet. And a global warming of only a few degrees might upset communities of plants and animals that have developed over millennia. Weather patterns also could change, meaning more frequent droughts and severe storms.

Yet along with the new forecasts are indications that not all changes will be bad. Some researchers have begun to stress that a warmer, wetter world might be welcome in some regions.

"It is an interesting point that people ought to think about more. By and large, there are positive effects. More wheat in the Ukraine. Thinner ice in Arctic. Better winters in Moscow. But at the same time, you're building up a bigger time bomb that is becoming harder and harder to dismantle," said John Perry, staff director of the Board of Atmospheric Sciences and Climate at the National Research Council.

Perry points to a recent study by the climate office of National Oceanic and Atmospheric Administration (NOAA) that concluded that a slightly warmer, wetter world would increase food production, enhance forest growth and enlarge water supplies. An obvious drawback was that billions of dollars would have to be spent protecting coastal areas from rising seas.

The great uncertainty in predicting global warming and its effects is making life difficult for government policy-makers. The computer models upon which all forecasts are based are generated by a small group of scientists who acknowledge that they do not understand or even recognize all the variables that affect their predictions, thus compounding policy uncertainties.

"The things we can say with confidence, the policy-makers are not interested in. And the things the policy-makers are interested in, we don't know with much confidence," said Jerry Mahlman, director of NOAA's Geophysical Fluid Dynamics Laboratory at Princeton University.

"Modelers have been thrust into the limelight way too soon," said Richard Cooper, an economist from Harvard University. "They don't have models today you can build public policy on."

The frustration was evident at a meeting Cooper and Mahlman attended last week at the National Academy of Sciences, where an expert panel was grappling with the policy implications of global warming. After a long afternoon, during which the invited scientists displayed graphs with past and future temperatures bouncing up and down like rubber balls, they were finally begged to put aside the carefully hedged forecasts and simply make a "best guess." While the ranges of guesses varied, the favorite seemed to be a 4-degree increase by the middle of the next century, when concentrations of carbon dioxide gas—which contributes to the "greenhouse effect"—are expected to double.

One reason many researchers are shying away from the worst-case scenarios so popular a year ago has to do with climate record itself. While researchers argue that the oldest records are highly suspect, in general they agree that temperatures have risen over the past 100 years by about 1 degree. But there are tremendous arguments over whether or not this increase is due to an accumulation of greenhouse gases such as carbon dioxide and methane, which trap heat close to Earth. Instead it may be the result of some other climatic cycle unrelated to human activity. But whatever its cause, the temperature record is more consistent with a rise of 4 degrees, rather than 9 degrees, by the middle of the next century.

"The new runs do favor the lower estimate," said Warren Washington of the National Center for Atmospheric Research, who is another top climate modeler.

Two of the most recent climate simulations, done by the National Center for Atmospheric Research in Boulder, Colo., and the Geophysical Fluid Dynamics Lab in Princeton, suggest slightly lower temperature increases, according to the scientists who run them.

Both models showed uneven warming in the Northern and Southern hemispheres. In one run, the region around the Southern Ocean that surrounds Antarctica did not warm at all. The model showed it cooling, thanks to improved simulations of how the ocean currents circulate and mix. Another world-class model, run by the United Kingdom Meteorological Office, cuts temperature rises in half when the researchers change the way raindrops are represented.

Of course, not all the climate modelers agree with the lower estimates. One exception is James Hansen of National Aeronautics and Space Administration's Goddard Institute for Space Studies in New York. Hansen said he thinks his model and the observed temperature record are still in keeping with a greater future increase in temperatures. At the meeting at the National Academy of Sciences, Hansen stated again that he thinks warming associated with increased greenhouse gases has already begun and that the Earth will warm by more than 4 degrees on average in the next century.

All the modelers stress how uncertain the forecasts are. "People are hedging," Washington said. "You get put into a defensive position, because everyone wants the lower estimates."

Given all the uncertainities, what is known for sure? It is agreed that carbon dioxide has increased over the last 100 years. Since 1958, when accurate surveys were begun, carbon dioxide has increased from 316 parts per million parts of air to 353 parts per million today, an 11 percent increase. This accumulation is attributed primarily to the burning of fossil fuels, of which the United States is the largest user.

The basic phenomena of the greenhouse effect are also agreed upon. It has been operating for millions of years and is one reason Earth is as warm as it is. In the last few months, the greenhouse effect was actually measured for the first time by University of Chicago researchers who used satellites to measure the radiation coming into the atmosphere and bouncing back out to space.

So it is almost universally agreed that Earth probably will warm as carbon dioxide and other greenhouse gases accumulate. How much it warms is the question. Richard Lindzen, one of the most outspoken critics of current projections, conceded at last week's meeting that temperatures probably will rise, but not by much. The Massachusetts Institute of Technology professor said he thinks that the planet will respond to the buildup of greenhouse gases by producing "negative feedbacks," such as high, dry clouds, that will lift warmed air from the ground toward the upper atmosphere where its heat will radiate into space, counteracting a warming trend.

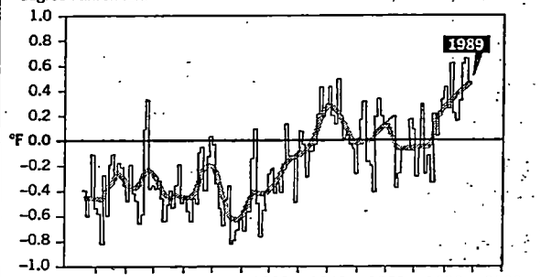
But researchers tend to think that while Hansen's projections may be too hot, Lindzen's are definitely too cold.

Researchers say it may take another decade or more to settle the issues. At present, the most common response by government officials and scientists has been a call for more research and a push to reduce emissions of carbon dioxide by increasing energy efficiency—a painless remedy that would provide benefits regardless of future temperatures.

THE WARMING WORLD

LONG-RANGE TEMPERATURE

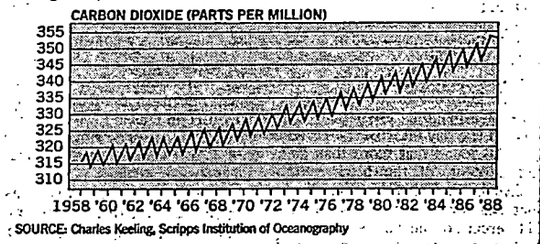
Variation of annual surface temperatures for the world. The shaded line shows long-term trends. The planet has warmed on average by almost 1 degree Fahrenheit.



SOURCE: United Kingdom Meteorological Office

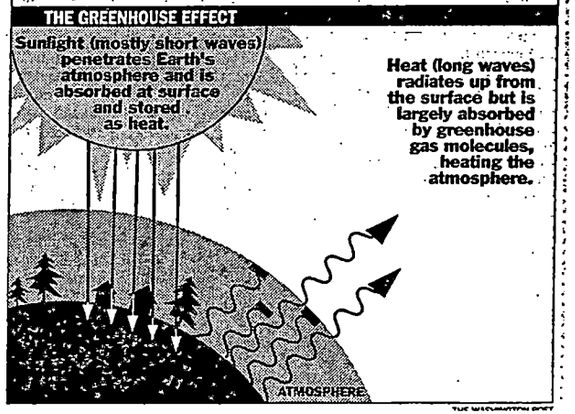
GREENHOUSE GAS

Carbon dioxide concentrations monitored at Mauna Loa, Hawaii. The gas traps heat close to the Earth's surface.



SOURCE: Charles Keeling, Scripps Institution of Oceanography

THE GREENHOUSE EFFECT



"All the News That's Fit to Print"

The N

VOL. CXXXIX . . . No. 48,083

Skeptics Are Challenging Dire 'Greenhouse' Views

By WILLIAM K. STEVENS

As governments try to come to grips with what is widely depicted as a potentially catastrophic warming of the Earth's surface, dissenting scientists are challenging what they see as unnecessarily gloomy predictions.

The skeptics contend that forecasts of global warming are flawed and overstated and that the future might even hold no significant warming at all. Some say that if the warming is modest, as they believe likely, it could bring benefits like longer growing seasons in temperate zones, more rain in dry areas and an enrichment of crops and plant life.

Split Forecast
Dissent on Global Warming
A special report.

In any case, they argue, it would be a mistake to take drastic and costly steps to limit emissions of carbon dioxide and other gases that trap the sun's heat in the earth's atmosphere until more is known about the problem. These "greenhouse" gases are building up as a result of human activity, especially the burning of fossil fuels.

Most Have No Firm Position

Exactly how many scientists are involved in serious climatic research is unclear, but experts in the field say it includes fewer than 300 climatologists, meteorologists, geophysicists and people in related fields. Many of them, perhaps the majority, have not taken a firm position in the debate; they say that while the greenhouse theory is valid in general, there are too many uncertainties about its future effects.

Both of the other factions — those who believe global warming to be a clear and definite threat and those who say there is likely to be no significant warming — appear to be in a minority. Authorities on weather and climate can be found in all three groups.

Much of the dissenters' criticism is aimed at computerized mathematical models of the world's climate on which forecasts of global warming are largely based. The critics also cite data on past climatic trends, and they say the theory of greenhouse warming has not yet been fully explored.

"It's not that we have a bad theory," said Reid A. Bryson of the University of Wisconsin, a leading climate theorist. "It's that we have an incomplete theory with a lot of bad science being done."

Forecast and Its Basis

Most of the dissenters' assertions are being challenged in turn by scientists who adhere to the better-known view of global warming. This view holds that increasing concentrations of greenhouse gases are likely to cause the average temperature of the air at the Earth's surface to increase by three to eight degrees Fahrenheit some time in the next century, from the current global average level of 57 degrees. That amount of increase is generally accepted by a number of national and international scientific

Continued on Page B12, Column 3

Skeptics Challenge Forecasts of Global Warming

Continued From Page A1

groups that have sought a consensus on the issue, including various panels of the National Academy of Sciences.

The forecast is based largely on what the forecasters see as the inherent scientific logic of the greenhouse theory and on the computerized simulations of the future atmosphere. The forecasters expect the warming to raise sea levels, through the expansion of warming water and the melting of ice around the world; to change the climate of the globe, and to disrupt weather, human society and balances among plants and animals.

Both the dissenters and those who call for action have been pressing their arguments in Washington as the Bush Administration grapples with pressures to reduce the burning of fossil fuels like coal and oil, which are the main source of human-produced atmospheric carbon dioxide.

Current forecasts of global warming "are so inaccurate and fraught with uncertainty as to be useless to policymakers," Richard S. Lindzen of the Massachusetts of Institute of Technology and Jerome Namias of the Scripps Institution Oceanography in La Jolla, Calif., wrote in a letter to President Bush in late September. The two authorities on meteorology are both members of the National Academy of Sciences.

Their warning was one of several cautionary pleas now coming forth in the aftermath of months of speeches, writings and testimony to Congress by scientists and environmentalists who urge prompt countermeasures. Some important officials in the Administration, including John H. Sununu, the White House chief of staff, have also urged caution until further research is performed.

A Diversity of Views

Although many scientists have predicted dire consequences from global warming, skeptics contend that such views are flawed and overstated.

The New York Times/Rick Friedman

Richard S. Lindzen
Massachusetts Institute of Technology

Current forecasts of global warming "are so inaccurate and fraught with uncertainty as to be useless to policy makers."

The New York Times/Don Hogan Charles

James E. Hansen
Goddard Institute for Space Studies

Helped propel the issue to the forefront last year by testifying before Congress that global warming was under way.

The New York Times/Michael Shavel

Robert D. Cess
State University of New York at Stony Brook.

"Common physical sense tells us something is going to be happening" to the world's climate because of the greenhouse effect, he says, but argues that current models cannot be used to predict global warming.

Arguments and Evidence

Computer Models' Accuracy Debated

Some of the dissenters, including Dr. Lindzen, say the scientific uncertainty could be reduced through a decade or less of intensive research, perhaps in three to five years. They counsel against drastic action to cut fossil-fuel emissions until then.

"The expense is patently obvious," said one of the most outspoken skeptics, Patrick Michaels, a professor of environmental sciences at the University of Virginia and a former president of the American Meteorological Society. "If the policy is going to be that expensive, the science should be much less murky than it is now," he said.

Other scientists have long acknowledged the uncertainties of global warming predictions, but argue that they will not be eliminated in time for effective action to be taken.

"My feeling is that the uncertainty will always remain," said Syukuro Manabe of the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory at Princeton University, a leading climatologist. Dr. Manabe's laboratory runs one of the major mathematical models of the global climate on which attempts to forecast future warming are mostly based. "We have to make decisions based on uncertain information," he said. "I don't think we have any other choice."

In view of the uncertainty, some scientists favor taking actions that would bring major benefits in their own right, like increasing energy efficiency and pressing the development of alternative power sources.

The Theory's Backers

Among those who oppose dissenters like Dr. Bryson, Dr. Lindzen, Dr. Namias and Dr. Michaels are, for example, James E. Hansen of the Goddard Institute for Space Studies in New York City; Michael Oppenheimer, a senior scientist with the the Environmental Defense Fund; George M. Woodwell, director of the Woods Hole Research Center, and Stephen H. Schneider of the National Center for Atmospheric Research.

Dr. Hansen helped propel the issue of global warming to the forefront last year when, at the height of the 1988 heat wave and drought, he testified before Congress that global warming caused by increasing concentrations of greenhouse gases was already under way.

The climate models that draw much of the dissenters' criticism are mathematical equations that simulate the physical workings of the atmosphere. Scientists can insert any set of conditions they like — a given concentration of greenhouse gases, for instance — and a computer calculates how the climate would change, including changes in the average global temperature.

Global warming theorists maintain that a relatively small increase in the temperature can have major consequences. For example, they point out, the average temperature since the end of the last ice age has increased by nine degrees.

But the computer models "are seriously exaggerating the warming by at least two to threefold," said Hugh W. Ellsaesser, a meteorologist at Lawrence Livermore Laboratory in California who retired in 1986. He has been working on the question of global warming since 1972.

Complicating Factors

Clouds and Oceans Poorly Understood

All the models, said Dr. Lindzen, contain flaws that "could easily reduce the predictions for warming to well under a degree" centigrade, or 1.8 degrees Fahrenheit. Not least among the flaws, he and others say, is that the models fail to properly reflect the climatic effects of water vapor and clouds, which can each overwhelm the effect of the greenhouse gases.

Skeptics say that clouds might well reduce the warming by reflecting sunlight back into space, but some of the model experts say they could also, through a complex set of feedback mechanisms, increase the warming.

Clouds are poorly simulated in all the models, most climatologists agree. A team at the United Kingdom Meteorological Office in England reported in September that by representing clouds more realistically, its model had reduced the projection of expected warming from about nine degrees to about five. The British model has usually produced the highest estimates.

The findings have been cited by the skeptics as evidence that they are probably right in their contention that the warming has been overstated. But John F. B. Mitchell, the chief scientist on the British project, said the result did not mean that the group was cutting its forecast in half.

So little is known about the characteristics of clouds, he said, that even this latest simulation cannot be taken as realistic. Rather, he said, the result "essentially illustrates our uncertainty" and underscores a serious lack of data on how clouds behave. Without better data, he said, "we can go on doing numerical experiments till we're blue in the face and we won't reduce the uncertainties."

Oceans' Moderating Effects

The models have only recently begun to reflect the enormous capacity of the oceans to absorb heat, a factor that scientists believe will slow down global warming substantially. Scientists studying a model at the National Center for Atmospheric Research in Boulder, Colo., recently completed a simulation that included the ocean's influence. It resulted in a warming of nearly three degrees when carbon dioxide in the atmosphere doubled, as against about seven degrees in an earlier model run.

This was also seen by some dissenters and Government officials as a one-half reduction in the models' warming estimates, but Warren Washington, one of the chiefs of the Boulder experiment, said that was a misinterpretation. The modeling exercise was not fully played out because of lack of computer access, and the simulation was carried only 30 years into the future, he said. If it had continued to the point where full effects were felt, he said, the warming would have been substantially larger.

Models and Measurements

Both Sides Claim Support in Data

To some scientists who see themselves as neither dissenters nor backers of specific warming predictions, the uncertainties are perplexing and frustrating.

"Common physical sense tells us something is going to be happening" to the world's climate because of the greenhouse effect, said Robert D. Cess, a professor of atmospheric sciences at the State University of New York at Stony Brook, who heads an international group that assesses the models. But he said the group's conclusion, soon to be published, is that "we don't know what those models are doing." He said the models "as presently formulated" cannot be used to predict future global warming, and that "whether they can ever be used for that purpose is problematical."

Dr. Hansen defends the models, pointing out that even as they have become more sophisticated, their conclusions about global warming have generally remained within the range predicted in the 1970's. Some defenders of the models say they doubt that another decade of refinements would substantially alter the range.

Defenders also say the models have validated themselves by successfully simulating the waxing and waning of ice ages, present-day seasonal variations and the workings of the atmospheres of Venus and Mars.

But the critics say that the models have not done well at matching the climatic trends on the scale of a century. In the last century, according to some studies of temperature records, the average global temperature has risen by about one degree. Simulations by some models show that it should have risen by about twice that much.

To the dissenters, this gap casts doubt on the models' credibility. To some environmental scientists it shows the opposite. "We should be flabbergasted that the models can come that close, given the uncertainties," said Dr. Oppenheimer of the Environmental Defense Fund, a research and advocacy organization. The dispute on this point is muddied by the variations in temperature profiles for past decades that emerge from different studies. Some studies suggest little or no warming over the last century, depending on the data and methods used, and this has occasioned argument.

Positive Views

Some See Benefits In Warmer Earth

Few scientists believe greenhouse warming can now be detected amid the normal swings of climate. But if it can, says Dr. Michaels, the evidence might be emerging from data collected by a team headed by Thomas Karl, a climate-change analyst at the Government's climatic data center at Asheville, N.C.

Studies there found that since the mid-1950's, nighttime temperatures in much of the United States have risen in fall, summer and winter, while daytime temperatures have dropped slightly. There is evidence of the same pattern in China and Australia, Mr. Karl said. He said the reasons are unclear, although increasing cloudiness appears to have contributed to it in this country.

"If nature is declaring her greenhouse with a relative rise in the nighttime rather than the daytime," said Dr. Michaels, "then the severity of the problem is drastically reduced." In fact, he said, warmer nights in temperate regions would lengthen growing seasons.

This could especially benefit northern regions, in the Northern Hemisphere, some scientists believe, and southern regions in the Southern. Some say, in fact, that countries like the Soviet Union and Canada might well benefit from even a high degree of warming.

Russians Predict Benefits

Two Soviet scientists, M. I. Budyko and Y. S. Sedunov, have said in a paper that increased rainfall over all the continents, along with the "fertilizer" effect on plants of carbon dioxide, "will considerably enhance" plant productivity, increase harvests, make large barren territories suitable for agriculture and permit the expansion of crops in other regions.

But Dr. Woodwell of the Woods Hole Institute argues that global warming would produce even more atmospheric carbon dioxide by speeding the decay of organic matter and accelerating the respiration of plants. This new source of carbon dioxide, he believes, would more than offset the amount absorbed by plants in photosynthesis. It could easily exceed the amount from fossil-fuel burning, he says, and cause the planet to warm up even more.