

# Appendix B.—Conservation in World War II: 1933-45

## INTRODUCTION

Over 35 years ago, the United States had to mobilize for a global war. The demand for war material such as aircraft, ammunition, ships, and tanks, plus the loss of foreign sources of supply, created threats of shortages for materials such as: aluminum, chromium, copper, iron and steel, manganese, nickel, tungsten, and others. Strong production and conservation measures had to be established to meet the threats of shortage. This appendix examines the production and conserva-

tion strategies and their implementation, and the technical and institutional impediments and associated impacts. This appendix is developed in a scenario format to allow for easy comparisons with future scenarios of materials shortages, and is based primarily on information from the historical publication *Industrial Mobilization for War, Vol. I, Program and Administration*, Bureau of Demobilization, U.S. Civilian Production Administration (1947).

## ELEMENTS OF THE WORLD WAR II SCENARIO

Table B-1 provides basic information describing the World War II period. War production rose from 2 percent of total output in 1939 to 40 percent of total output in 1943 and 1944, as shown in figure B-1. Expansion of total output was so great that consumer purchases of goods increased by 12 percent. The impact of the war on civilians, in spite of the human misery, was an economic improvement over the great depression.

### Strategic and Critical Materials

Table B-2 lists the materials “strategic” to the Nation’s military needs in World War II. Listed as “critical” are other materials that were less difficult to procure than the strategic materials. Table B-3 shows the materials stockpiled just before the war erupted.

### Military Requirements for Selected Materials

Table B-4 list the maximum percentages of selected materials allocated to military and foreign requirements. Although 90 percent of the aluminum was used to meet military and foreign de-

mands, sufficient capacity was reached in 1943 to make aluminum more generally available than it was before the war. The high use of copper for the military did not seriously harm the civilian sector, although supply fluctuations were a source of irritation. Originally, drastic cuts for iron and steel were proposed in the civilian sector, but the actual maximum amount used by the military never exceeded 57 percent.

### National Objectives and Policies

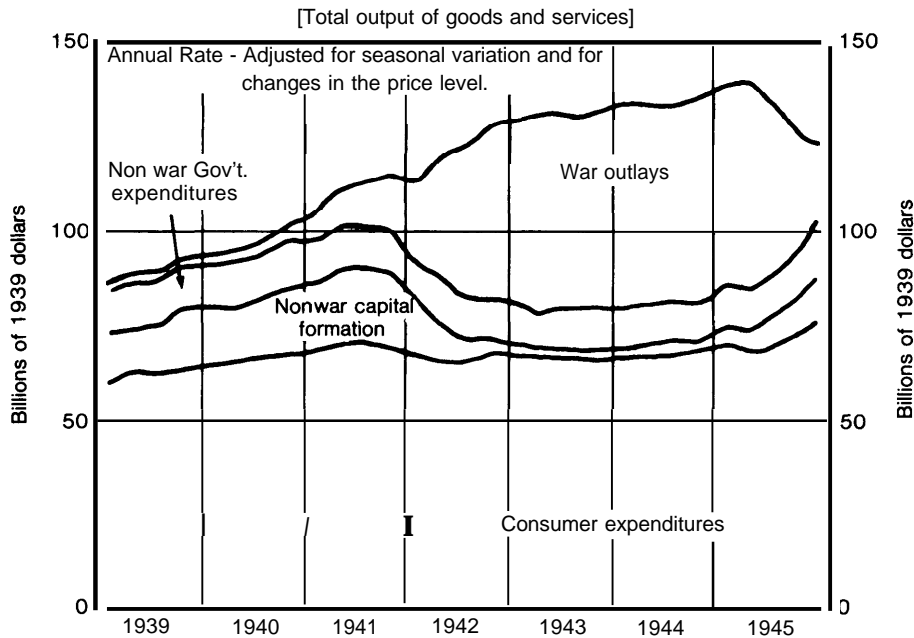
The general war objective was to supply the United States and its allies with war materials as a first priority. Second priority went to basic civilian needs for public services, food, clothing, and health care. The remainder went to other civilian consumer needs. Table B-5 lists major national objectives based on the January 1942 Address of the President. For comparison purposes, the actual production of munitions in 1945 dollars for the war period is shown in table B-6. Table B-7 describes the production of selected materials prior to 1942. At the beginning of the war in 1942, expansion of production capacity was of greater importance than conservation.

**Table B-1.—Elements of the World War II Scenario**

Elements	Remarks	Elements	Remarks
Overall economic conditions . . . . .	Recent turnaround from the Great Depression.	Domestic policies . . . . .	Recently established social security and labor laws. Isolationist pressures before the war were followed by strong war emphasis with attempts to maintain civilian democratic relationships in war production efforts.
Availability of materials, Energy . . . . .	Critical (see table B-2). Generally abundant except for 100-octane gasoline.	Environment concern . . . . .	Little concern, smoke, etc., meant production.
Weather/climate . . . . .	Favorable (some droughts affected hydroelectric power supply).	Education trends . . . . .	Crash training programs in war-related areas. Education for veterans followed the War.
Labor . . . . .	Full employment, labor scarce.	Technology trends . . . . .	Steel industry was healthy before the War. Synthetic rubber was in pilot plant status. War needs spurred innovation. Atomic energy unleashed. Radar introduced and expanded. Basic materials industries generally expanded with known technology.
Patterns of social values	Strong group achievement efforts to meet war needs.	Foreign relationships . . . . .	Strong ties with England to supply war goods. Conquest of friendly countries changed supply relationships. Russia became an ally.
GNP . . . . .	(See figure B-1.)		
Inflation . . . . .	Inflationary pressures held down by price controls with some two-tier pricing.		
Interest rates . . . . .	Low-rate Government financing (60-percent private financing).		
Population . . . . .	137,000,000.		
Population distribution	Northeastern States concentration.		
Concentration of businesses . . . . .	Northeastern States with emerging aircraft industry on the West Coast.		
Leisure and recreation . . . . .	Limited by long work weeks and military service.		
Crime . . . . .	Limited by high employment and military service.		

SOURCE: OTA, based on data supplied from Civilian Production Administration

**Figure B-1.—Gross National Product, World War II**



SOURCE: Civilian Production Administration.

**Table B-2.—Strategic and Critical Materials (World War II)**

<b>Strategic (essential to defense)</b>
Aluminum for aircraft
Copper for ammunition
Carbon steel for weapons
Alloys steel for weapons
Also: Antimony, chromium, manganese, coconut shell char, manila fiber, mercury, mica, nickel, quartz crystal, quinine, silk, tin, tungsten
<b>Critical<sup>1</sup> (less difficult to procure but essential to the Nation)</b>
Steel in the form of shapes, plate, tubing rail, shell, tin plate
Zinc
Aluminum (other than aircraft purposes)
Magnesium
Copper (other than for ammunition purposes)
Brass
Bronze
Tin
Nickel
Rubber
Also: asbestos, cork, graphite, hides, iodine, kapok, opium, optical glass, phenol platinum, tanning materials, toluol, vanadium, wool

<sup>1</sup>Conservation controls were imposed on all materials critical enough to warrant stockpiling

SOURCE: OTA, based on data supplied from Civilian Production Administration

**Table B-3.—Status of Government Stockpiles (12/27/41)**

Commodity	Percent of objective on Objective hand 12/27/41
<b>Metals and minerals</b>	
Antimony . . . . .	27,000 short tons <b>29</b>
Beryllium ore . . . . .	3,000 metric tons 0
Cadmium . . . . .	6,000 short tons 1
Chrome ore . . . . .	1,950,000 long tons 16
Cobalt . . . . .	2,500 short tons 0
Iridium . . . . .	7,750 troy ounces 0
Lead . . . . .	200,000 short tons 9
Manganese ore . . . . .	3,300,000 long tons 16
Mercury . . . . .	25,500 flasks 25
Tin . . . . .	207,434 long tons 24
Tungsten ore . . . . .	27,209 short tons 28
Zinc concentrates . . . . .	150,000 short tons 59
Asbestos . . . . .	30,700 short tons 2
Corundum ore . . . . .	3,000 long tons 0
Diamonds, industrial . . . . .	6,410,000 carats 13
Graphite . . . . .	34,000 short tons 1
Kyanite . . . . .	3,000 short tons 0
Mica . . . . .	13,850 short tons 20
Nitrate of soda . . . . .	300,000 short tons 67a
Quartz crystals . . . . .	702,000 pounds ?b
<b>Miscellaneous</b>	
Rubber . . . . .	1,200,000 long tons 30

<sup>a</sup>Stored in Chile

<sup>b</sup>Considerable quantity delivered, but not yet tested against Government specifications.

SOURCE: WPB Dec. 30, Feb 24, 1942, file 025

**Table B-4.—Supply to the Military and Relevant Materials Policies**

Material	Maximum percent to military and export	Relevant materials policies
Aluminum . . . . .	90	Policy of production expansion solved basic supply problem by 1943 with some remaining shortages in shapes and forms.
Copper . . . . .	90	Policy of heavy foreign purchases from South America. Little U.S. expansion made until a premium price system established. Erratic supply problems.
Iron and steel . . . . .	<b>57</b>	Policy of expansion relieved shortages later in the war with a 30-percent increase in capacity.
Alloy materials:		
Chromium . . . . .	60	Policy to buy as much ore as possible from all sources. Domestic low-grade production established as an insurance policy, but less than 2 percent of that produced was used.
Manganese . . . . .	Same as steel	Policy of stockpiling worked well with 1-year supply available throughout the war. Manganese was used as a substitute for more critical materials. Conservation attention only to high-grade ores.
Nickel . . . . .	Approximately all to military	Policy of strict conservation controls on use and distribution. Overconfidence in Canadian supply resulted in early shortages. Substitutions, leaner alloys, and recycling improved materials flow.
Tungsten . . . . .	Same as steel	Policy of expansion in domestic mining plus price supports and assistance to foreign producers. Miscalculations resulted in excess of supply and inventory surpluses at the end of the war.
Rubber . . . . .	60	Policy of expansion of synthetic rubber production as 90 percent of natural rubber was unavailable.
Other important metals not included in the chart: magnesium, cobalt, molybdenum, vanadium; an important fuel was 100-octane gasoline.		

SOURCE: OTA, based on data supplied from Civilian Production Administration

**Table B-5.—National Objectives (1942), Presidential Goals**

1. To increase our production rate of airplanes so rapidly that in this year, 1942, we shall produce 60,000 planes, 10,000 more than the goal set a year and a half ago. This includes 45,000 combat planes—bombers, dive bombers, pursuit planes. The rate of increase will be continued so that next year, 1943, we shall produce 125,000 airplanes, including 100,000 combat planes.
2. To increase our production rate of tanks so rapidly that in this year, 1942, we shall produce 45,000 tanks; and to continue that increase so that next year, 1943, we shall produce 75,000 tanks.
3. To increase our production rate of antiaircraft guns so rapidly that in this year, 1942, we shall produce 20,000 of them; and to continue that increase so that next year, 1943, we shall produce 35,000 antiaircraft guns.
4. To increase our production rate of merchant ships so rapidly that in this year, 1942, we shall build 8 million dead-weight tons as compared with a 1941 production of 1.1 million. We shall continue that increase so that next year, 1943, we shall build 10 million tons.

SOURCE: 77th Cong., 2d sess., *Address of the President of the United States*, H. Doc. 501, pp. 3-4, Jan. 6, 1942

**Table B-6.—Munitions Production by Type (July 1940 to August 1945)  
(in millions of standard 1945 munitions dollars)**

Item	1940	1941	1942	1943	1944	1945	Total	Percent of total
	(July-December)					(January-August)		
Munitions total <sup>a</sup> .....	2,047	8,442	30,168	51,745	57,594	33,153	183,149	100.0
Aircraft.....	370	1,804	5,817	12,514	16,047	8,279	44,831	24.5
Ships.....	391	1,852	6,957	12,498	13,429	6,011	41,138	22.5
Guns and fire control.....	78	355	1,794	3,180	2,926	1,471	9,804	5.3
Ammunition.....	87	427	2,743	4,908	5,768	4,173	18,106	9.9
Combat and motor vehicles.....	238	1,285	4,778	5,926	4,951	3,138	20,316	11.1
Communicant ion and electronic equipment.....	27	226	1,512	3,043	3,739	2,212	10,759	5.9
Other equipment and supplies.....	856	2,493	6,567	9,676	10,734	7,869	38,195	20.8

<sup>a</sup>Excludes net increases in naval stock fund value of goods in store and stock in transit between supply offices, as follows: July-December 1940 (28); 1941 (194); 1942 (320); 1943 (613); 1944 (148); 1945(68); cumulative, July 1940-August 1945 (1,326)  
SOURCE: War Production Board, Program and Statistics Bureau.

**Table B-7.—Production of Selected Metals (July 1940 to December 1941)**

Metal	Total	Third	Fourth	First	Second	Third	Fourth
		quarter	quarter	quarter	quarter	quarter	quarter
		1940	1940	1941	1941	1941	1941
Aluminum (thousand pounds) .	848,254	108,390 <sup>a</sup>	121,553 <sup>a</sup>	127,085 <sup>b</sup>	147,888 <sup>b</sup>	164,939 <sup>b</sup>	178,399 <sup>b</sup>
Copper (tons).....	1,596,750	254,089	276,394	282,816	267,637	253,858	261,356
Lead (tons).....	954,971	143,651	176,432	177,782	164,819	145,049	147,238
Steel (tons).....	120,416,094	17,967,529	19,609,306	20,277,275	20,592,070	20,622,050	21,347,864
Zinc (tons).....	1,120,050	178,620	190,154	186,604	188,277	188,198	188,197

<sup>a</sup>Letter J. L. Honey to G. C. Bateman, Apr. 29, 1941, file 523.4.  
<sup>b</sup>Report "The Aluminum situation," table VII, files 523.01 and 523.4.

SOURCE: Metal Statistics, 1945, New York: American Metal Market, 1946, except where otherwise noted.

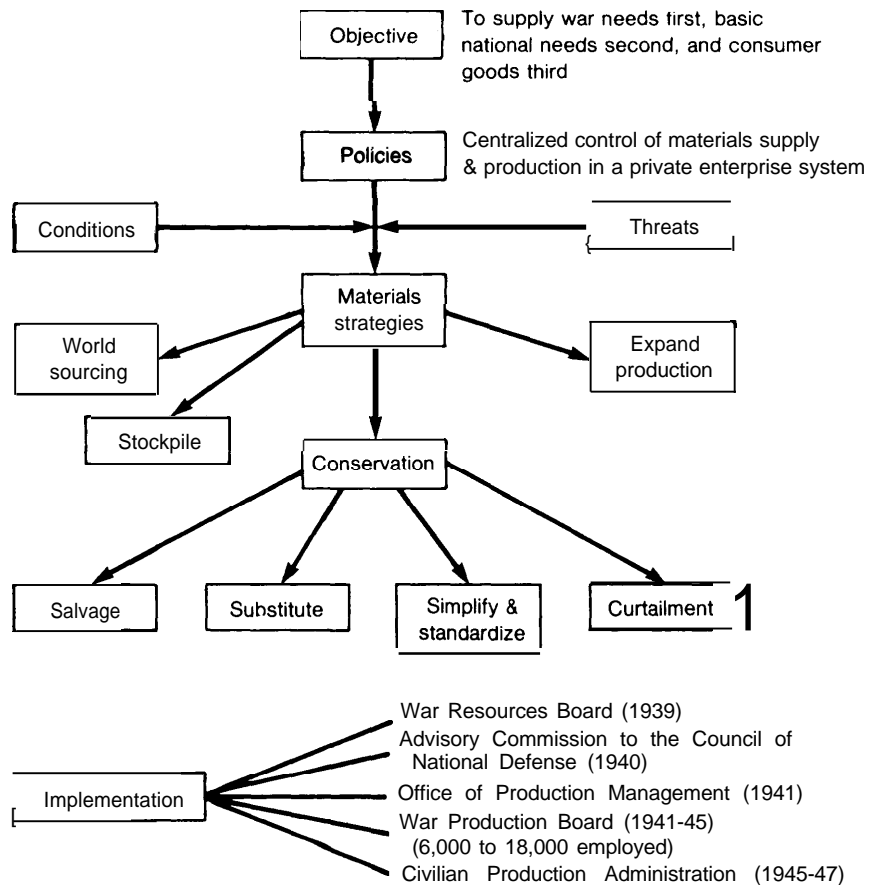
## CONSERVATION APPROACHES

Figure B-2 presents a schematic flow of conservation policy in World War II. Although the policies varied as the war emerged, peaked, and subsided, the general conservation policy was centralized Government control of materials supply and production in the basic framework of a private enterprise system. Conservation was just one tool among several for meeting the objectives of supplying the United States and its allies with needed goods for war as well as providing basic needs for

the civilian sector. The prominent conservation options implemented were substitution, simplification and standardization, curtailment, and salvage.

Conservation options such as design efficiency, life extension of products, reducing exports, and reducing dissipative uses were not given much attention because of the crisis conditions and lack of leadtime and advance planning.

Figure B-2.—Conservation Policies During World War II



SOURCE OTA, based on data supplied from Civilian Production Administration

## Substitution

The largest substitution project in World War II was the substitution of synthetic rubber for natural rubber. Ninety percent of the supplies of natural rubber were cut off. Just before Pearl Harbor, the synthetic rubber process was in a semiexperimental state. Six companies hoped to produce 10,000 tons by 1941. For war expansion, businessmen estimated that each 100,000-ton requirement would involve a 12- to 18-month leadtime and \$50 million in costs. In 1942, a rubber "Czar" was given production and conservation powers to increase production and meet supply requirements. By early 1943, 241,000 long tons were produced. By late 1943, 850,000 long tons were produced. By March 1944, 50 plants had been either built or converted to rubber production. Table B-8 shows the estimated economics of the substitution of synthetic for natural rubber.

Conservation was emphasized in greater degrees as the war progressed and resources became taxed to the utmost. In the early stages of the con-

servation program, substitution was the method most commonly used. Excessively heavy demands on certain materials, for which there was insufficient supply, frequently made substitution the quickest and easiest way to relieve the problem. Many of the substitutes used in these crisis times proved unsatisfactory.

Three substitution methods were prominent: (a) complete materials change, for example, steel cartridge cases substituted for brass cartridge cases, (b) changes to reduce the use of the critical material, for example, substituting a different production process, and (c) downgrading the same material for the same product, for example, downgrading the use of compositions in production of tube bushings.

## Simplification and Standardization

Simplification was the elimination of items, types, sizes, and colors of products that might hinder the flow of essential products in periods of

**Table B-8.—Estimated Economics of Substitution**

Material or product. . . . .	Synthetic rubber for natural rubber World War II period.
Make v. buy . . . . .	The choice to buy was not possible because of the loss of Asian sources during the war. Only 10 percent of the natural rubber supply was available.
Required capital investment. . . . .	<p>Before the war, in 1940, the synthetic rubber process was in a semiexperimental state requiring new process development including learning curve experiences with input materials and operating characteristics. Existing capacity was 5,000 tons/yr. Six companies expected to have a combined capacity of 10,000 tons/yr by 1941.</p> <p>Financial estimates were \$50 million for providing each 100,000 ton/yr of capacity with 12- to 18-month leadtimes.</p> <p>Ultimate production desired was 877,000 long tons/yr including:</p> <p>40,000 tons neoprene rubber (raised later to 60,000)</p> <p>132,000 tons butyl-rubber</p> <p>705,000 tons buna-S-rubber (raised later to 877,000)</p> <p>In early 1943, there were 241,000 tons/yr. produced. In later 1943, there were 850,000 tons/yr. produced. By early 1944, the program was complete with 50 plants in operation.</p> <p>Assuming \$50 million/100,000 tons time approximately 1 million tons gives an estimate of total expansion cost of one-half billion dollars (1945 dollars).</p>
Operating and maintenance costs. . . . .	Assuming 50 plants were in operation with approximately 1,000 employees estimated per plant making \$3,000 per year, then the annual operating costs were probably around \$150 million per year.
Cost increase/decrease due to the substitution. . . . .	<p>Standard tire cost—Approximately the same to the buyer but he couldn't get a natural rubber tire.</p> <p>Total cost of the synthetic rubber—The Defense Plant Corporation provided the financing and the costs were subsidized making comparisons difficult.</p> <p>Total cost to the customer—The cost is mixed because of the amount directly paid does not include general taxes to the war effort.</p>

SOURCE: OTA, based on data supplied from Civilian Production Administration

short supply. It was a means to break the wasteful use of critical materials and facilities. It was also a means to protect the buying public against excessively low quality. Standardization included building in the feature of interchangeability. As an example, through standardization, electrical indicating instruments could be transferred from one combat vehicle to another with substantial increases in production and elimination of waste.

Simplification and standardization were not effective early in the war because of the hurried startup production efforts. Around 1943, the production efforts smoothed sufficiently to allow the refinements necessary to simplify and standardize. The driving force for simplification and standardization was the taxing of nearly every type of resource to the utmost, in order to meet the enormous war production goals and maximize facilities, manpower, and materials usage.

The Office of Civilian Requirements took the leadership in establishing minimum standards of essential consumer goods and limiting production of higher priced luxury goods or unnecessary models and sizes that were wasteful of scarce resources. Attention was given to: (a) the quantities and types of goods and services needed by civilians; (b) the materials required to produce them; and (c) the broad price ranges in which the bulk of production would be sold.

### **Curtailment**

In a war time mood, it was possible to have a program of direct orders from Washington for conservation by curtailment. Curtailment involved preference rating orders, allocation orders, conservation orders, limitation orders, and inventory control.

**a. Preference Rating Orders.** The preference rating order was a priority rating given to manufacturers whose products were vital to the defense program, but entered only indirectly into military items. Some examples of industries receiving blanket preference ratings were building materials, mining machinery, farm machinery, chemicals, and health and medical supplies. Military production had an A-1 rating. The preference rating system was difficult to administer for two basic rea-

sons: 1) quantities were not included in the ratings and hence only A-1 really meant anything; and 2) the paper work was excessive. Over 7,000 pieces of mail came in each day, and applications arrived at about twice the rate at which they could be processed.

**b. Allocations.** Allocations were a mandatory form of distribution. Manufacturers were directed to fill all defense orders in preference to non-defense uses. Rating provisions were included, but went further toward actual allocation by requiring that complete booking of orders be submitted once a month from manufacturers. Nondefense uses were divided into categories, and each was allowed a quantity of metal equal to a percentage of an amount used for the same purpose before the war. Deliveries were contingent upon receipt of a sworn statement of inventory and a sworn statement that no other order had been placed with another supplier for metal for the same purpose. The system did not work well because of the extensive paper-work involved.

The system later evolved into primarily focusing on three key materials: 1) carbon and alloy steel, 2) copper, and 3) aluminum.

Seven claimant agencies dealt directly with the War Production Board: the War Department, the Navy Department, the Maritime Commission, the Aircraft Scheduling Unit, the Office of Lend Lease, the Board of Economic Welfare, and the Office of Civilian Supply. The claimants broke down their requirements by major programs and related them to monthly production schedules. Requirements included not just raw materials, but also specific forms and shapes. The requirements were earmarked as to programs for: production, construction, and maintenance. The sum of the materials requirements of all the agencies were to make up the total demand. On receiving their allotment, each claimant agency had to bring its programs and schedules into line with its allotment. Allotment numbers were then given to contractors and were in effect a "certified check" to obtain materials needed.

**c. Limitation Orders.** These orders were curtailment directions to the civilian manufacturers to limit the production or use of consumer goods and

services. There were two reasons for the curtailment: 1) to add pressure on industry to convert to war production, and 2) to conserve scarce materials. For example, a truck manufacturer would be given assistance by the Government in getting scarce material if the manufacturer would agree to cut back on the amount of civilian vehicles produced. A percent of the average annual output of a selected prewar period might be the quota set in the limitation order. These limitation orders applied not only to manufactured goods like vehicles and refrigerators, but also applied to energy conservation. Drought conditions, for example, reduced the amount of hydroelectric power for aluminum production. Limitation orders had to be issued to restrict electrical consumption.

**d. Conservation Orders.** These were orders to eliminate scarce materials in products or to reduce the amount of such natural use in products. As an example, in order to conserve copper, the use of copper in building construction was prohibited and specific articles containing copper were given quotas based on 60 percent of previous usage before the war. In the case of tool steels,

substitution compelled the use of molybdenum alloying element in place of scarce tungsten alloying element.

**e. Inventory Control Orders.** Inventory control orders attempted to curb overbuying of materials and hoarding in anticipation of future scarcities. Under the orders, suppliers were forbidden knowingly to deliver any of the named metals considered critical in amounts that would increase the customer's inventory for any calendar month beyond the quantity necessary. The basis for determining quantities was the customer's usual method and rate of operation, and his required deliveries for products produced.

### Salvage

The War Production Board had a Salvage Group in its Conservation Division. The group conducted campaigns for the salvage of cutting tools, cordage, twine, fuel, and paper. Salvage was encouraged for all critical materials. As the war began to wind down, the Salvage Division watched only tin and paper, which were still in short supply.

## IMPLEMENTATION OF PRODUCTION AND CONSERVATION POLICIES

The implementation of war production and conservation policies started slowly with limited contingency planning by advisers just before the war, building into a super operating agency during the war, and finally, shrinking to a demobilization agency for peacetime preparations. At its peak, 6,000 to 18,000 people were directly engaged in carrying out the national materials policies for the war effort. In 1939, a War Resources Board consisting of Government, industry, and labor advisers attempted to determine possible wartime needs. Through its efforts, a limited stockpile of material was accumulated to meet contingencies. In 1940, an attempt was made to create a stronger organization. Civilian isolationist pressures allowed only a modest change with the establishment of an Advisory Commission to the Council of National Defense. This council had no single leader. Efforts were geared at converting segments of industry to

producing war goods. Resistance was met from industry, labor, and local government, for example, when curtailment of civilian automobile production hurt brisk sales.

In 1941, a stronger organization was formed with two leaders, one from industry and one from labor. The organization was called the Office of Production Management (OPM). Large orders from England were coming into the United States for war goods when the lend-lease program was initiated. The OPM had to balance production for these war goods against civilian requirements. Efforts were aimed at increasing productive capacities and building the stockpile. This organization had the authority to apply priorities for needed materials and goods.

After the war broke out in late-1941, the Nation was in total war effort mood, and a centralized



superagency was established, called the War Production Board (WPB). By 1943, the superagency was in firm control, and production and conservation procedures were fairly well established except for conflicts concerning military estimates of needs. Most of the discussions in this paper cover the activities and policies of WPB. After the war

changed from a two front to a single front, pressures formed to eliminate WPB and reduce Government controls. The Civilian Production Administration replaced WPB and carried out the transition task. The Civilian Production Administration was finally phased out in 1947.

## IMPACTED STAKEHOLDERS AND THEIR RESPONSES

Table B-9 shows a selected listing of stakeholders and their problems in the World War II period. The conflict between the military and the civilian needs was the most prominent of stakeholder problems. The civilian sector lost out to the military as the war approached. When the war was ending, the civilian influence grew as evidenced by the isolationist pressures on Congress and the President to slow the shift to war production. An example of military influence was the strength of the Army-Navy Munitions Board in demanding that its needs be given priorities during the heat of the war. An example of reemerging civilian influence, as the war ended, was the pressures to let price do the allocation rather than formal Government controls.

The second prominent stakeholder problem involved industry, which had to look to the superagency for its needed materials and product quotas. Industry representatives were very vocal about the delays, confusions, and contradictions of the new Government bureaucracy. Special interest groups in the industrial sector **would also push** for gains that would put them in a favorable future competitive position.

The third prominent stakeholder problem involved management and labor. Before the war, labor had just accomplished a great deal of gains through labor legislation and confrontations with management. Labor was afraid that gains would be lost under wartime emergency actions. The Presi-

dent and Congress were pressured to include both labor and management people on the wartime boards involved with materials policies.

The fourth prominent stakeholder problem involved the established executive agencies and the wartime superagency. Overlapping of functions and power caused confusions and strained relationships. As an example, both the Department of the Interior and the Federal Power Commission wanted more say in the development of hydroelectric sources.

England and the allies were also important stakeholders that placed demands on the war agency. Supplies had to be portioned out. England's huge demands had to be reduced to a balance with U.S. needs. Russia's needs had to be portioned in the light of possible collapse of that nation. South America had to have sufficient goods to remain good neighbors. The War Production people in the United States did not always see the global picture of resources and alternatives and risks. As an example, British Empire resources around the world were still available in many cases and the English had to point this out to WPB.

Internal stakeholders emerged within WPB. The field organizations differed with the central organization on how to work with industry. Often the field groups were left confused without information or authority while having to meet the industrial user face to face.

**Table B-9.—Examples of Impacted Stakeholders and Their Responses (World War II)**

Time period	Stakeholders	Nature of the problem	Stakeholder responses	Results
1939.....	Military v. civilians	Amount of military influence in production plans	Isolationist pressures	Hesitancy of President to establish War Resources Admin.
1940.....	Industry v. antitrust units	Firms reluctant to accept defense contracts involving negotiated	industry delays	Attorney General promises freedom from prosecution
1941, .....	Military v. civilians	Consumers worried about new priorities extended by Congress	Consumer complaints	Vice President had to intervene to resolve conflicts
	Industry v. Govt. production agency	Overlapping functions by new agency	Pressures by industry for less confusion	Delays, contradictions
	U.S. v. foreign	Aid to England, Russia, South America	U.S. concern over loss of vital goods	Lend-lease program and closer foreign cooperation
1942.....	Military v. civilians	Overlapping authorities	Production Agency disturbed over free hand of the military	Production agency reorganization but problem persists
	Civilian v. Production Agency	Appeals by civilians for materials	Civilian demand for democratic treatment	Appeals Board established
	Interest groups v. interest groups	Oil groups wanted rubber from oil, Agriculture wanted the synthetic rubber from alcohol	Interest groups pressure on Congress	Synthetic rubber made from alcohol
1943, .....	Joint Chiefs of Staff v. WPB	Lack of production control	Inability of War Production Board to validate military claims for materials	Paper committee set up but resolved. Dislocation in materials flow.
1944-45.....	Free enterprise v. Govt. control interests	Pressures for allocation by price v. Government determination of need	Interagency arguments over consumer quality and price problems	Trends to decontrol as war wound down. Reorganization favored less Government involvement

SOURCE: OTA, based on data supplied from Civilian Production Administration

## SUMMARY 1939945

In the World War II period, there were four basic conservation options: 1) substitution, 2) simplification and standardization, 3) curtailment, and 4) salvage. The major strategy for materials supply was not conservation, but increased production. Other materials supply strategies included stockpiling and world sourcing.

Strategic materials were those essential to defense, including aluminum for aircraft, copper for ammunition, and carbon and alloy steel for weapons. Critical materials were those less difficult to procure but essential to the Nation.

Substitution was the conservation option used first and most frequently. Many of the substitutes used under crisis conditions were unsatisfactory. Users were eager to return to the original material

or product. Three prominent substitution methods were: 1) complete materials change, 2) changes to reduce use of critical materials, and 3) downgrading the material for a given product.

Simplification and standardization was a conservation-option that came later in the war as production began to smooth out and consumer demands for better quality increased.

Curtailment was a conservation option involving direct orders. The orders included: 1) preference rating orders, 2) allocation orders, 3) conservation orders, 4) limitation orders, and 5) inventory control.

Salvage was the recycling conservation option. Recycling of steels became an important part of re-

ducing alloy element requirements later in the war.

Implementation of production and conservation policies was accomplished during World War II by a new superagency called WPB. At its peak, 6,000 to 18,000 people were directly engaged in the activity.

In addition to the production and conservation strategies, two additional strategies were applied: 1) stockpiling; and 2) world sourcing. Manganese was stockpiled successfully with a 1-year supply available throughout the war. World sourcing of minerals like chromium and tungsten ores provided sufficient needed material to make subeco-

nomics mining in the United States questionable in spite of foreign military occupations and hazardous transportation problems.

Two general observations can be made concerning materials conservation. First, availability of materials shifted in a short period of time, for example, steel was scarce and lumber abundant and then the reverse occurred within a couple of years as the war progressed. Policies had to be shifted with the mood of the people, for example, the people would accept controls of a “Rubber Czar” during the heat of the war, yet they objected to Government intervention and leaned to private sector allocation as the war was ending.