1993 food relief to Somalia—two months' worth of rations for 4 million people. Already 15,000 tons have been delivered by Sudan to the World Food Program.

Great projects for agriculture

The case of Sudan, and a short survey of the four main economic regions of the continent, all point to the necessity of great projects for agriculture development throughout the continent. Providing reliable water, high-energy inputs per hectare, and transportation, in the unique physical conditions of Africa, will yield spectacular results. Here are the specific projects:

River systems development. The Jonglei Canal should be resumed and completed as early as possible. The interbasin development of Lake Chad and the Zaire River system (Ubangi water diversion) must proceed (see map, page 73). The development of the Niger, Zambezi, and other river systems must proceed.

Oasis projects. Nuclear-powered seawater and brackish water desalination facilities must be located at strategic points on arid coastlines—the Mediterranean, Red Sea, Gulf of Aden, Indian Ocean—to create the basis for "agro-nuplexes," where large communities can live and work with the abundant power and water for agriculture, food and farm chemical processing, and industry. This is critical for Egypt, where over 97% of the currently available water—the Nile River flow—is utilized. Much of the desert between Cairo and and the Suez Canal can be readily transformed into arable cropland, with only the supply of adequate water and power.

Advanced technologies. Modern irrigation techniques—trickle, drip, hydroponics, and aeroponics—growing plants under environmentally controlled conditions, are essential for certain arid parts of Africa, such as Egypt and Somalia. Irrigation allows standard yield increases of at least four times; and hydroponics can allow up to 100 times more yield per surface area. Except in Sudan, in southern Africa, and a few other regions, many of the soil types on the continent are leached and poor. Advanced soil-less agriculture can circumvent this limitation. Successful tests have been done in South Africa for hydroponic fodder factories to maintain sheep and dairy herds.

Food irradiation. This method of preserving food, especially animal protein, could begin to bring diets up to needed nutrition levels, even before the continent is fully electrified. In hot or tropical areas, over half of many crops is lost to pests and decay; this can be stopped by irradiating the food for storage.

Fishing fleets and port facilities. Rich fish potential exists off the coasts of much of Africa—for example, the Gulf of Aden; but only the fishing off the coast of South Africa and west Africa has been utilized. Fleets of large fishing vessels, and port facilities for handling and preserving the catch, need to be developed as part of the great projects that can transform the resource continent.

Railroads needed for industrialization

The following material is excerpted from a chapter appearing in The Industrialization of Africa, *a book issued in 1980 by the Fusion Energy Foundation Wiesbaden, Germany, and New York, U.S.A. The book detailed a program for constructing a system of 164 new nuclear-powered African agricultural and industrial centers, or "nuplexes," which by the year 2000 could be serving as the drivers for bringing the entire African continent up to U.S. or western European economic standards.*

Unfortunately, the policy was not adopted, and in the 13 years since the book's publication, the condition of Africa's infrastructure has grown far worse than it was in 1980. Indeed, in April 1987, the Fusion Energy Foundation was forced to shut its doors in the United States because of a lawless bankruptcy action brought by political forces bitterly opposed to the policy of industrializing Africa and the rest of the Third World.

In terms of its structure, the present African railway system has hardly gone beyond that inherited from the colonial era, as a brief glance at **Figure 1** indicates.

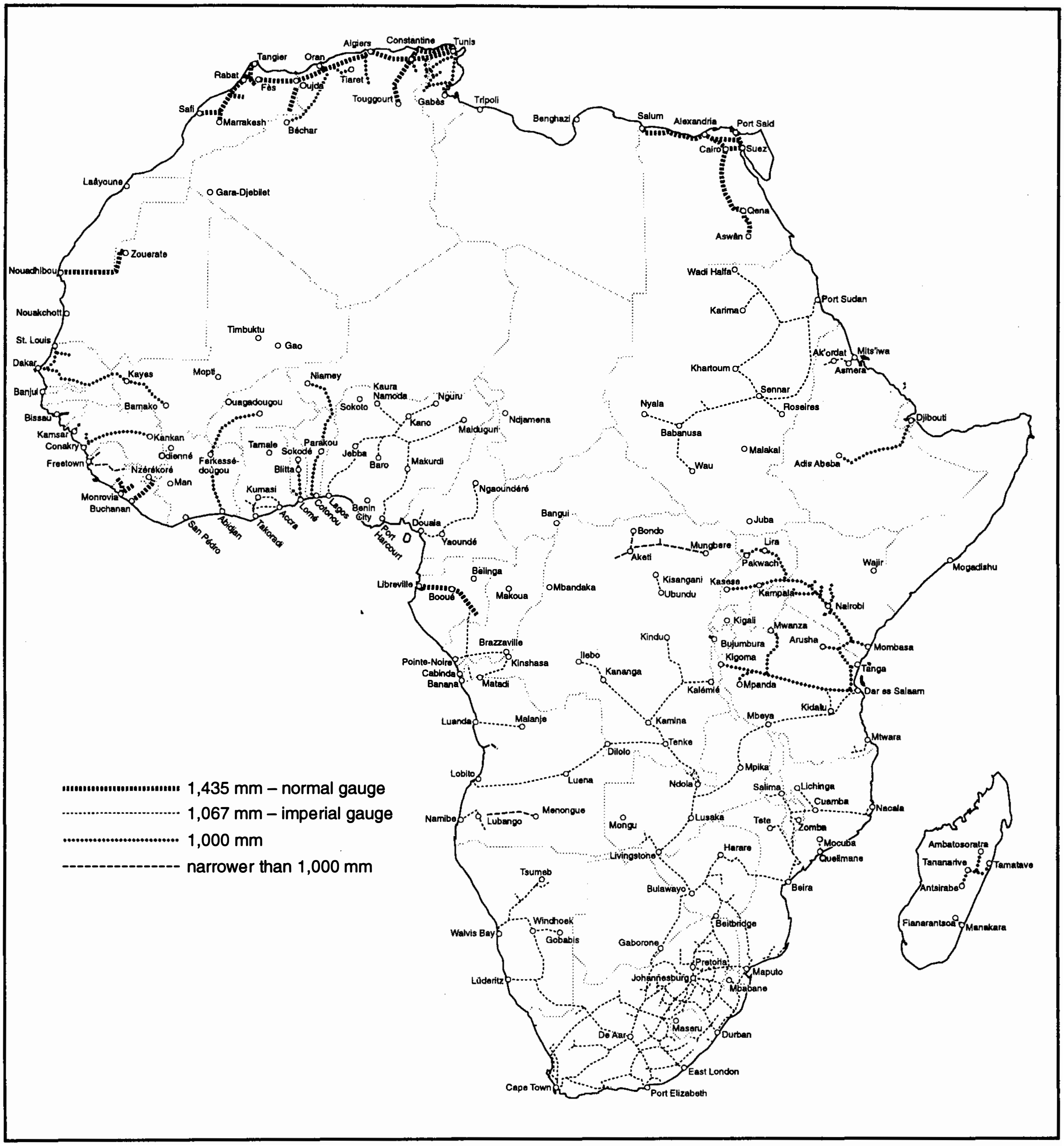
1. No interconnected railway network exists. As a rule, the individual lines run from the coast inland, according to the economic conceptions of the former colonial masters, who looked upon their colonies as mere suppliers of raw materials. This situation is particularly grotesque in West and East Africa, while South Africa, and, to some extent, North Africa, have an actual network.

2. The present railway system is over-aged; about 90% of the lines were built during the colonial period.

3. Track widths differ, depending upon who the colonial masters were. **Table 1** summarizes the relative distribution proportions of these various systems. Such variations in track width (gauge) naturally make construction of a unified African railway network extremely difficult. Additionally, 85% of the entire network consists of narrow-width track, which may have been adequate, at the lowest possible investment-costs, for raw materials transportation, but which are completely inadequate for a developing industrial economy.

4. Another severe problem confronting today's African railways is the result of hidden "recolonialization" by institutions such as the International Monetary Fund (IMF) and World Bank. Lack of investments, due to restrictive financ-

FIGURE 1
The state of African railways in 1990



Sources: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980; *The Times Atlas of the World,* New York: Times Books, 1990.

TABLE 1

Size of Africa's railway system in 1980

Gauge	Track width (mm)	Length in use (km)
Imperial	1,067	52,000
Normal	1,435	13,000
Meter	1,000	15,000
Other	<1,000	1,000
Total		**81,000**

Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

TABLE 2

Railways of selected countries

Country	Network length (km)	Network density	
		km/ 1,000 km²	km/1 million inhabitants
Africa (without South Africa)	59,000	2.7	150
Zaire	5,200	2.5	200
Nigeria	3,500	3.8	45
West Germany	31,600	127.0	510
U.S.S.R. (without Siberia)	134,000	11.0	520
France	37,000	67.0	710
Czechoslovakia	13,200	100.0	890
United States	320,000	35.0	1,400

Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

TABLE 3

Main proposed international railway lines for Africa

Line	Route	Length (km)
Trans-Sahara	Fès-Béchar-Niamey	2,700
Atlantic Line	Makurdi-Douala-Kinshasa-Luanda-Windhoek	4,000
Trans-West Africa	St. Louis-Kankan-Parakou-Ngaounderé-Bangui	4,400
West African Coastline	Dakar-Freetown-Abidjan-Lagos-Douala	3,800
Trans-Central Africa	Yaoundé-Bangui-Pakwach	2,400
Trans-East Africa	Adis Abeba-Nairobi-Quelimane	3,600
Pacific Line	Mombasa-Dar es Salaam-Beira-Maputo	3,000

Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

ing and debt-service policies, has led to accelerating disintegration of infrastructure in large parts of Africa, especially disintegration of the railways. With the exception of Southern and Northern Africa, and some countries in tropical Africa, the railways have deteriorated to such an extent that hardly any regular transportation can be maintained.

5. The last problem is a simple one: Underdeveloped Africa has too few railways, as the comparison with industrial nations shows (**Table 2**). The present average track-density of 700 km per 1 million inhabitants in Europe compares with 150 km per 1 million inhabitants in Africa. This comparison becomes even less favorable when one considers that lines in the industrial countries consist of two or more tracks, while, as a rule, in Africa they are only single-track. The resulting contrast between 1,400 km per 1 million inhabitants in Europe to 150 km in Africa illustrates the actual size of the gap which has to be closed.

The first problem to be solved is that of *different gauges.* The railway network will remain only piece-work unless an obligatory standard gauge is agreed upon. The majority of African countries tend to favor the narrow "Imperial Gauge" as the standard, first of all because 60% of the existing track is of this width (construction of narrow gauges is cheaper than the broader ones). This may appear reasonable on the basis of short-term considerations, but over the long term—especially with respect to an industrialized Africa—it is a very bad decision. We propose the normal gauge of 1,435 mm as the standard for all of Africa, for the following reasons:

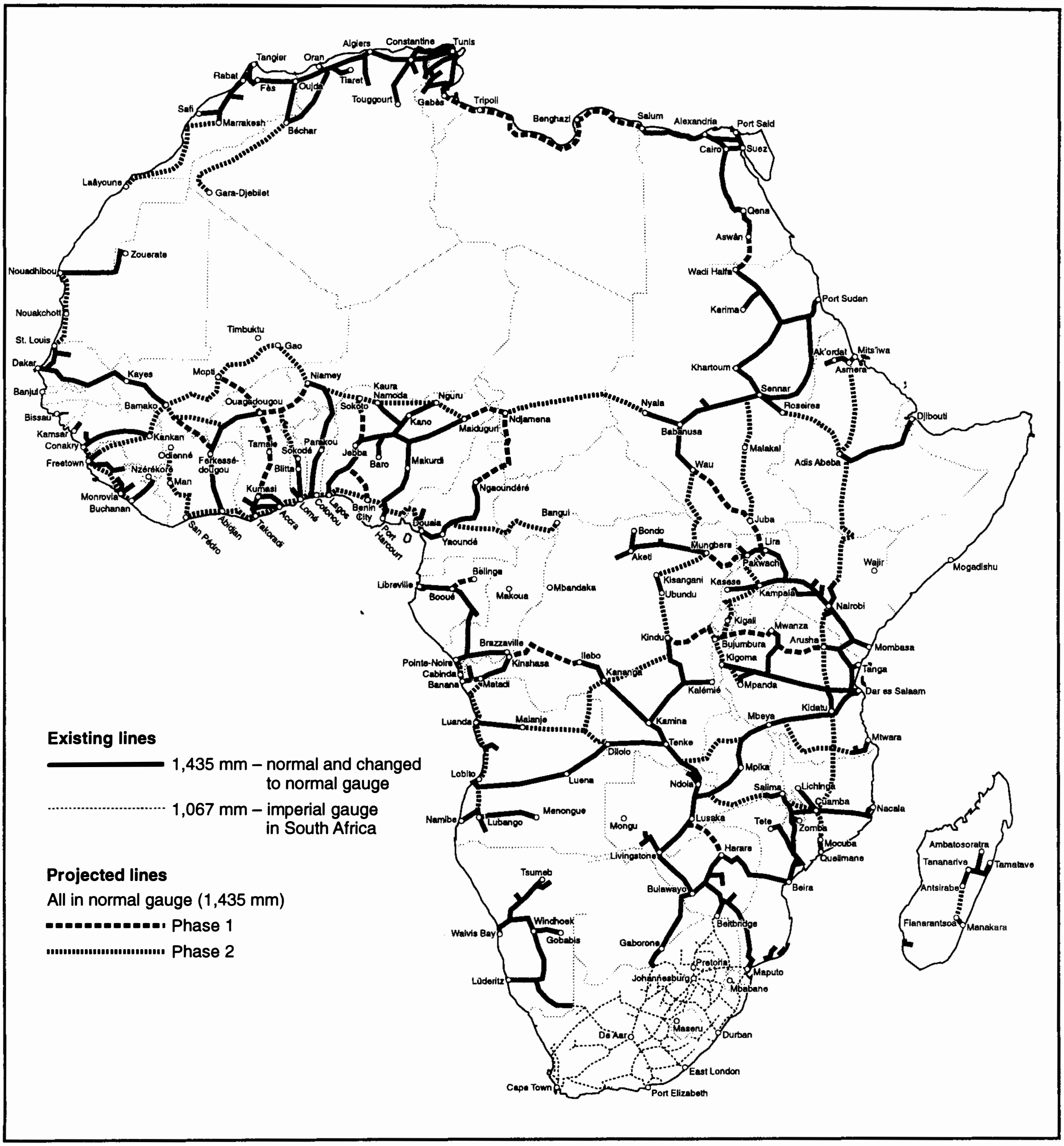
1. Construction costs for the narrow-width track can be 33-66% cheaper than the normal gauge, but the higher investment costs for the normal gauge will pay off better in the future; the normal width permits higher velocities, higher axle-loads, and therefore higher transport utilization than the narrow gauge. This may not be an important consideration at the present volume of African transport, but the railways of developed Africa will have capacities several times greater than this present volume.

2. Africa's railway system should be seen in connection with neighboring regions (Europe and the Middle East), where the railways are nearly all normal-gauge. With increasing development, direct railway connections between Africa, Europe, and Asia will be constructed. A standard gauge will be an important prerequisite.

3. Africa's future railway network will be over 500,000 km in length. Compared to that, the present track, amounting to 45,000 km (without South Africa), which has to be converted to the normal gauge, is downright meager, even disregarding the basic repairs needed on most of the track

FIGURE 2

Projected railway network, phase 1 and 2 (main lines)



Sources: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980; *The Times Atlas of the World,* New York: Times Books, 1990.

stretches.

African governments like that of Gabon, which is constructing the new Trans-Gabon Railway with normal-width track, or the government of Nigeria, which plans to totally convert the country's narrow gauge to normal, are exemplary for their foresight.

Assuming a population of 462 million living in nuplexes at the end of the 20-year period, and taking European transport-density standards of 700 km railway network per 1 million inhabitants as a comparative base (see Table 1), we calculate an African network length of 320,000 km for the year 2000. Taking into account two-lane track for the main lines of the network, and more than that in the nuplexes, we get 650,000 km of track length. This network density, 11 km per 1,000 km^2 or 400 km per 1 million inhabitants, is still considerably less than the prevailing density in industrial nations. Nevertheless, presuming industrial centralization as foreseen for the nuplex concept, it will be both adequate and attainable: An estimated transport-volume of 6.5-7 billion tons per year corresponds to a utilization of about 5 million ton-kilometers per kilometer of track, and can, given a certain degree of efficiency, be multiplied.

Railway construction will have two points of emphasis:

1. Creating a dense network of the nuplex-centers, where the railway will carry the largest proportion of the transport tonnage. Construction of a total of 250,000-300,000 track-kilometers will be necessary in these centers alone. A network just as dense, if not quite as compact, will be necessary in densely populated regions such as West Africa and in the North African coastal region.

2. Construction of an interconnected continental rail network: Regions far from the coasts and landlocked countries will obtain effective connections to the ports, and thus to the world markets; international lines will connect individual national networks to each other, and will thus form the *backbone of the economic and political unity of Africa*. **Table 3** shows the main new international lines to be constructed; these will equip Africa with continuous north-south and east-west connections, and will thus connect the continent with Europe and Asia. A *Gibraltar tunnel* will allow rail transport from western Europe to Cape Town, and connections with the Arab region will exist via Egypt to the East European and Asian regions [see *EIR*, July 26, 1991, p. 36].

In the following, we will sketch the phases of construction of the African railway system. This is confined to a period of 20 years, the period in which the nuplexes will be built. The major construction will begin in the third phase in the 10th year. About 50% of the planned construction will occur in the fourth phase. The reason for this is the development process of the industrial nuplexes: Their export capabilities will become significant only after the 15th year, resulting in steadily increasing railway transportation; additionally, after the 15th year, the construction of the nuplexes will have proceeded far enough to enable a significant share of the materials required for railway construction to be drawn from the nuplexes' own production.

Four-phased construction approach

Construction activity in the *first phase* will emphasize two points:

1. Conversion of available narrow-gauge track to the normal gauge. An initial exception will be South Africa, because the track here is in good condition. Since all track concerned is single-lane, conversion will mean new construction parallel to the old line, a process which will permit continued use of the old track and, in many countries, will make repairs of the old track superfluous.

2. Construction of new lines, especially to the landlocked countries and those regions at longer distances from the harbors, which will be sites for agricultural nuplexes. The projects included can be seen in **Figure 2.**

First-phase construction will amount to 56,000 km.

In the *second phase*, parts of the network will be laid in two lanes. This applies, firstly, to densely populated regions with certain development advantages, such as Nigeria and North Africa. The double-lane track will be extended to connect important harbors with extensive inland regions:

West Africa: Senegal-Mali (Dakar-Kayes); Ivory Coast (Abidjan-Ferkessédougou); Cameroon (Douala-Yaoundé).

Central Africa: Zaire (Banana-Kinshasa).

East Africa: Sudan (Port Sudan-Khartoum); Kenya-Uganda (Mombasa-Kampala); Ethiopia (Djibouti-Adis Abeba); Tanzania (Dar es Salaam-Mbeya); Mozambique-Zambia (Beira-Lusaka); Mozambique-Zimbabwe (Maputo-Harare).

Newly constructed stretches will have the function of:

1. Developing further access to areas of agro-nuplexes and connecting them with surrounding regions. This includes the following projects:

West Africa: Mali (Bamako-Mopti-Gao); Mali-Niger (Gao-Niamey); Togo-Upper Volta (Blitta-Niamey); Ivory Coast (San Pédro-Odienné); Cameroon-Central African Republic (Yaoundé-Bangui); "Transsahelian" (Bamako-Nyala).

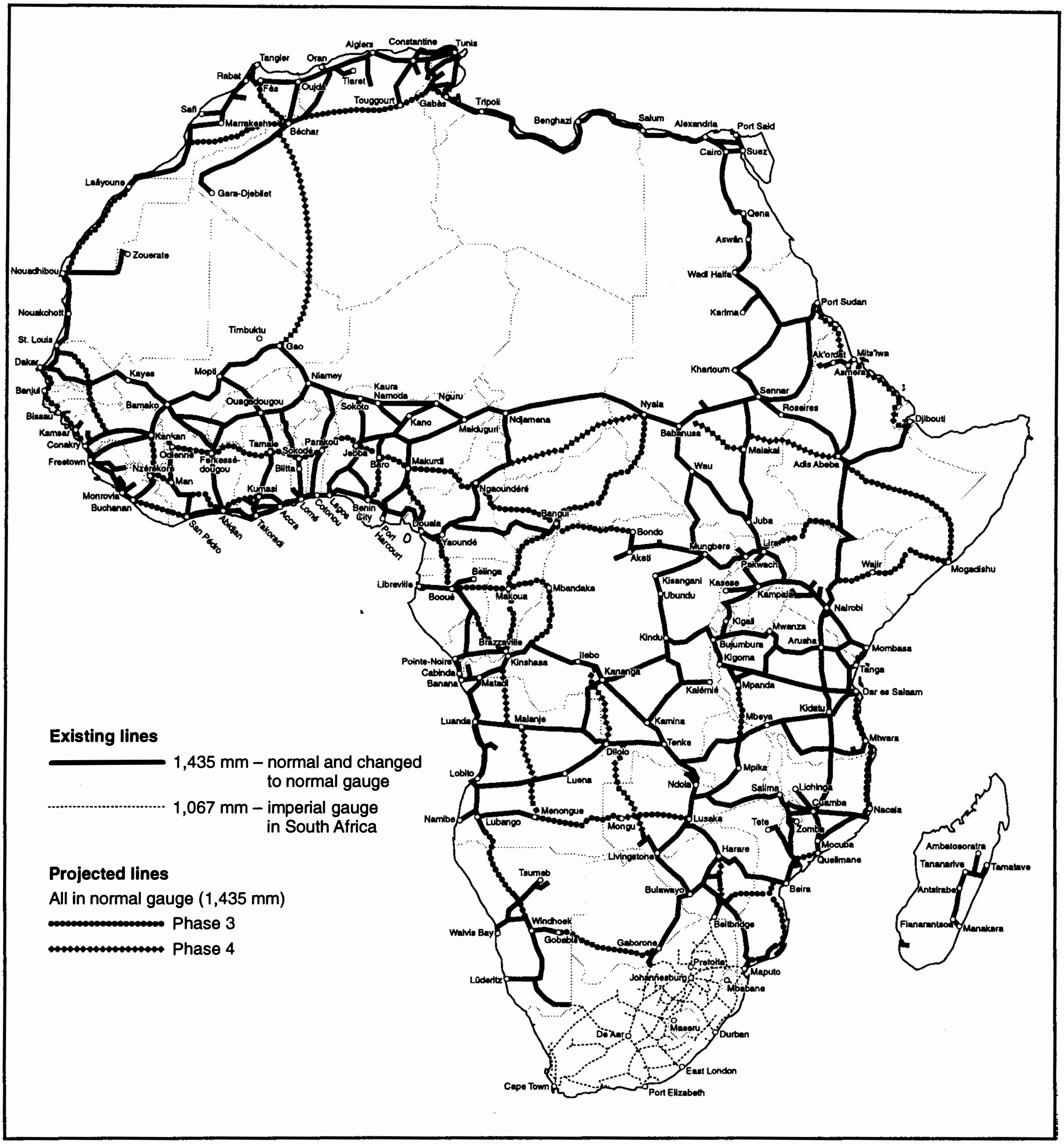
Central Africa: Sudan-Zaire (Wau-Kindu); Angola-Zaire (Malanje-Kananga); Angola (Malanje-Dilolo).

East Africa: Sudan (Sennar-Juba); Uganda-Rwanda-Tanzania (Lira-Kigali-Mpanda); Sudan-Ethiopia (Roseires-Adis Abeba); Ethiopia (Asmera-Adis Abeba); "Trans-East African" (Nairobi-Quelimane).

2. Some lines will open additional ports for inland regions, such as the Freetown (Liberia), Kankan (Guinea) line to Bamako (Mali) in West Africa, and, in East Africa, the connection of Tenke (Zaire) and the port of Mtwara in Tanzania, to be developed. Zambia-Malawi will be connected to Nacala with the Cuamba-Salima-Ndola line.

3. The remaining large projects of this period will aim

FIGURE 3
Projected railway network, phase 3 and 4 (main lines)



Sources: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980; *The Times Atlas of the World,* New York: Times Books, 1990.

TABLE 4
The African railway building program

Year	Initial capacities: Network length (km)	Initial capacities: Track length (km)	Construction in 5-year period (km)	Costs (billions $)	Steel (millions $)	Wood (million m³)	Concrete (million tons)	Construction labor force
0	13,000							
5	69,000	69,000	56,000	56	6.7	10.1	50.1	840,000
10	112,000	130,000	61,000	61	7.3	11.0	55.5	910,000
15	185,000	300,000	170,000	170	20.4	30.6	154.7	3,360,000
20	320,000	650,000	350,000	350	42.0	63.0	318.7	6,300,000
Totals			637,000	637	76.4	114.7	579.0	

Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

TABLE 5
Projected rolling stock and staff for African railway system

Year	Length of track laid (km)	Locomotives	Coaches	Wagons	Costs (billions $)	Steel (million tons)	Staff
5	56,000	4,800	17,000	250,000	21.2	7.3	280,000
10	61,000	5,200	18,000	270,000	23.1	7.9	300,000
15	170,000	14,500	51,000	770,000	64.3	22.1	850,000
20	350,000	29,500	104,000	1,580,000	132.3	44.7	1,600,000
Totals	637,000	54,000	190,000	2,870,000	240.9	82.0	3,030,000

Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

at providing industrial nuplexes with trans-regional railway connections. This means the partial construction of the *West Africa Coast Line,* the construction of the *Atlantic Line* from Matadi to Lubango, construction of the already projected railway from Marrakesh to Laâyoune, and the connection Nouadhibou-St. Louis.

Construction volume in the second phase will amount to a total of 61,000 km.

In the *third phase,* construction activity will be massively expanded. This will be due to the increase in exports from agro-nuplexes, and also exports from the industrial nuplexes, which will increase rapidly from the 15th year, so that a connected, even if somewhat loosely meshed African railway network must exist. During this phase, materials needed for railway construction will increasingly be derived from internal production, reducing import dependency; concrete, reinforced concrete, and, partially, the rails themselves will be produced in Africa.

The first aspect to be emphasized will be construction of about 50% of the international network, consisting of two-lane track; additional construction of international lines will result in a track network approximately as indicated in **Figure 3.**

The main emphasis in construction activity, however, will be in the nuplexes. In the 15th year, the agro-nuplexes should have about 700 track-kilometers at their disposal, including the accessible main lines. Production facilities in the industrial nuplexes will be provided with a dense network of track connections and links to the main lines, and construction sites for satellite cities will be connected by rail. This signifies construction of about 1,000 track-kilometers for each industrial nuplex. The total volume of construction is then as follows:

Double-track construction:	45,000 track-kilometers
New track construction:	25,000 track-kilometers
Rails in the nuplexes:	100,000 track-kilometers
Total:	170,000 track-kilometers

The railway construction program in the *fourth phase* will create a rail network for the developed regions which measures up to European standards, i.e., construction of 350,000 track-kilometers to achieve a total network of

TABLE 6

Rolling stock density in Europe and Africa in 1980

(number of units per kilometer of track)

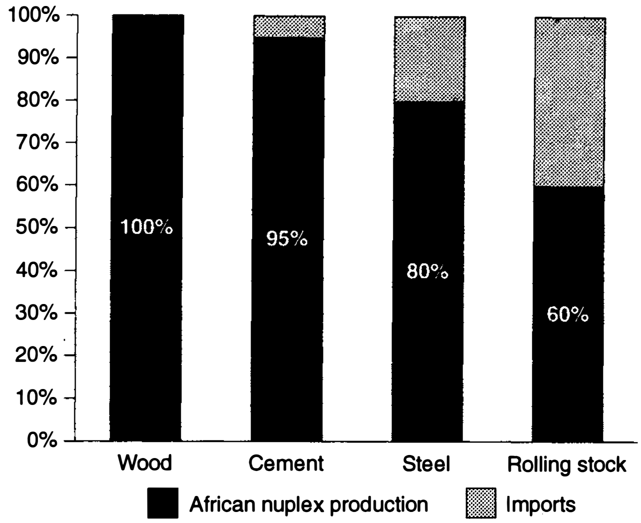
Type	Europe	Africa
Locomotives	0.085	0.078
Wagons	4.5	0.9
Coaches	0.3	0.1
Staff	5.0	4.3

Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

FIGURE 4

Most material requirements for railroads could be provided by African nuplexes

(percent of total requirements)



Source: Fusion Energy Foundation, *The Industrialization of Africa,* Wiesbaden: Campaigner Publications, 1980.

320,000 km and a track length of about 650,000 km. This phase cannot be sketched here in much detail, because construction will concentrate primarily upon increasing the density of the national systems and developing a rail network in the nuplex areas. The trans-regional network will also be expanded. Figure 3 illustrates the entirety.

The end of the fourth phase by no means signifies the end of railway construction in Africa. The network of 320,000 km is calculated only for the nuplex regions and their population; the development of the population lying outside of the nuplexes and the expansion of available and construction of new industrial and agricultural nuplexes in the following years will be accompanied by a doubling of railway network capacities.

Costs of the program

In the following, we will provide a first approximation of construction costs, and material and labor force requirements in two tables. The calculations are based upon the following parameters:

1. A construction cost of $1 million per 1 km of track is assumed (in 1978 prices). This value is far below the European average, but higher than the present costs of African railway construction of $0.5-1.0 million. This higher assumed average is appropriate because increasing economic development will also bring increasing labor costs. These construction cost figures are for total costs; they include the first wagon parks, buildings, temporary infrastructure, etc.

2. Material calculations are based on the following values:

120 tons steel per km of track, 60 kg rails;

180 m^3 wood per km using wooden sleepers (1,600 sleepers/km track);

400 m^3 (910 tons) concrete per km track for bridges, tunnels, etc.

The value for concrete requirements should only be taken as a rough parameter, because it can vary greatly according to local conditions.

3. Labor power requirements are taken as 70 man-years/km. This includes all activities involved in construction of a stretch of track, temporary infrastructure, auxiliary construction, etc. Seventy man-years is calculated on the basis of capital-intensive methods, whereas labor-intensive methods, such as those used by the Chinese in building the *Tanzam,* would result in a calculation of 200 man-years. The skills-structure is as follows: 5% highly skilled, 35% skilled, 65% basic-trained and auxiliary manpower. The values in **Table 4** always give the labor force requirement of the last year of the respective five-year period. **Table 5** shows required rolling stock, corresponding costs, steel and personnel requirements. The parameters for calculation are taken from European railway statistics. For comparison, **Table 6** provides present average values for Africa.

If we consider this construction program in connection with the development of the industrial nuplexes, it turns out that the largest part of materials required can be covered by domestic production. Cement for concrete will be available in the very first years, and deliveries of steel for rails and vehicles can be expected from the tenth year onwards; production of transport and personnel vehicles, and later even locomotives, can begin in the third phase.

Figure 4 illustrates the extent to which materials requirements can be met by domestic production.