amounts, but they are estimates supplied by the agencies that wish to see these systems built. I am not aware of any transit system in the United States that ever ended up carrying as many people as were forecast for it. Thus, I believe that my use of these patronage estimates is, if anything, a bias in the direction of showing DPM effectiveness. An additional factor is that all of the DPM energy calculations were based on operating energy alone. Because our experience with other transit systems shows that we can expect an additional 30-40 percent energy consumption to heat, air condition, and light stations, this again is a bias in the direction of showing DPM effectiveness. I believe these net energy calculations are quite fair to the DPM systems.

This does not mean that DPM systems should not be built, however. Energy saving is only one of the reasons for building them. Certainly the trip creation implied by all of these new downtown circulation trips represents a net social benefit, and makes the city a much more attractive place for those who work or live there. In the case of DPMs in particular, the primary goal is the revitalization of the downtown area. If a DPM can actually accomplish such rejuvenation, and if the dollar subsidy required to construct and operate it is seen as acceptable by the voters, then surely it is a good idea to construct them despite their slightly adverse impact on energy consumption.

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Energy Intensity of Various Transportation Modes

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This paper is an overview of the existing literature related to the energy intensity of various transportation modes, including intracity (automobiles, buses, automated guideway transit systems, vans, and heavy and light rail transit) and intercity (airplanes, automobiles, buses, trucks, rail, waterways, and pipelines) modes for passenger and freight movement. Energy intensity has been correlated with operating conditions such as speed, load factor, and type of commodities being moved. Statistical and engineering approaches have been used to estimate energy intensity. Energy intensity values vary considerably according to operating conditions, types of hardware, trip characteristics, load factors, and types of commodities being shipped. Suggested energy intensity values for several transportation modes are discussed.

The United States currently uses petroleum at the rate of 2.8 to 3.5 million m^3/d, of which more than one-third is imported. Likewise, the transportation sector, which represents nearly one-fifth of the gross national product, has increased its use of petroleum and is almost entirely dependent on it. Because very few countries are oil exporters, the United States is particularly vulnerable to another oil embargo. This situation prompted the establishment of a department of energy and led the executive and legislative branches of the national government to express serious concern about the overall energy situation. Also, the Energy Conservation and Policy Act of 1975 aimed at reducing petroleum dependence and improving the efficiency of the existing transportation system.

If we are to reduce the use of petroleum, we must know how much petroleum each mode uses to move passengers and freight and how we can reduce petroleum use while maintaining reasonable passenger and freight mobility. The latter needs to be thoroughly investigated in terms of the impact of alternative fuels on the various modes. How to improve the output of passenger- and kilogram-kilometers to decrease petroleum used for general energy demands should also be studied. This can be accomplished by improving the technical and the operational efficiency of the transportation system. Improving efficiency involves such strategies as converting to diesel fuel, reducing vehicle weight, and improving aerodynamic and rolling characteristics of the various modes. Improving operational strategies means improving load factor, mode shift, and empty haul.

This paper discusses transportation output (i.e., kilogram- or passenger-kilometers) and energy input. The yardstick known as energy intensity (EI) helps us to compare various modes quantitatively from the point of view of energy use. Transportation energy efficiency can be defined as output divided by input, or 1/EI.

One way to define transportation output is by means of passenger-kilometers for passenger operation and kilogram-kilometers for freight operation. Airlines and trucking associations have raised serious questions about this definition because it does not take into account quality-of-service parameters such as travel time, convenience, and reliability. For example, a kilogram of coal shipped by barge at 10 km/h cannot be compared with a kilogram of flowers moved from Los Angeles to New York in a controlled environment. Although important, issues such as this one cannot be addressed within the scope of this paper.

EI represents kilojoules expended by a particular mode in moving people or freight or both. On a macrolevel, the energy used may be the total amount of energy used in a year for moving a certain number of passenger-kilometers by airplane. On the other hand, the energy expended at a microlevel may be the amount of fuel used to fly a certain type of airplane between certain cities at a certain altitude and speed. It is important to note that the energy in this definition refers only to operational energy. Other energy uses such as for maintenance and construction (or indirect energy) are also important but cannot be treated adequately at present. The transportation output could be stated as the number of passengers times distance, or as passenger-kilometers (kilogram-kilometers for the freight application). Both micro and macro approaches are valid and will be discussed here.

EI OF URBAN TRANSIT SYSTEMS

This section discusses reasonable EI estimates for automobiles, buses, rail, and automated guideway transit (AGT) systems.

Automobiles

Recently there has been a substantial decrease in the EI values of new automobiles. This trend is expected to continue in the future. The EI values of automobiles used in urban areas is low because of low occupancy. The best estimate is 33 343 kJ/passenger-km, based on an average occupancy of 1.7 persons/automobile (1).

There is a considerable difference in the EI values of urban versus intercity driving. Many accelerations and decelerations, added to idling, contribute to the fuel inefficiency of the urban automobile. Also, the load factor is higher for an intercity trip.

Reports published by the U.S. Department of Energy (DOE) and the Environmental Protection Agency (EPA) provide excellent automobile fuel-consumption data (2). However, existing data on traffic characteristics (load factor, trip length, number of trips) are not very reliable. From the viewpoint of energy conservation, reducing vehicle weight is the best strategy to reduce fuel consumption, but this may have undesirable impacts on safety standards.

The EPA highway cycle is roughly 48 percent more energy efficient (provides 48 percent more kilometers for the same liters of gasoline) than the urban cycle; whereas the combined cycle (highway and urban) is roughly 20 percent less energy efficient.

Table 1. Energy intensity of selected urban rail transit systems.

Transit System	Energy Consumption (kJ/car-km) 1970	1973
Rapid Transit		
New York	42 422	42 422
Chicago	35 669	42 619
Montreal	37 898	38 751
Cleveland	55 733	-
Rapid Transit-Light Rail		
Philadelphia	-	68 191
Trolley Car		
Chicago	29 702	-
Dayton	29 702	-
Philadelphia	-	44 586
Light Rail		
Newark	-	35 669
Pittsburgh	-	59 405
New Orleans	-	31 800
Ohio	-	32 981

Commercial and School Buses

The best estimates of EI values in kilojoules per vehicle-kilometer versus kilojoules per seat-kilometer for urban buses appear below:

Vehicle Type	Kilojoules per Vehicle-Kilometer	Kilojoules per Seat-Kilometer
Diesel bus	20 320	410
Medium-size bus	18 350	606
Minibus	11 146	460
Van	8 720	786
School bus	10 753	213

Variations in energy intensity for urban buses can be attributed to several factors: load factor (EI is inversely proportional to load factor); trip configuration (length of trip, number of accelerations and decelerations, idling time); humidity, temperature, and road surface conditions; vehicle configuration; and type of propulsion system (diesel buses are more efficient than gasoline-powered buses).

The actual EI value for urban buses is 1975 kJ/passenger-km, which is high because of the low average load factor, 15.7 passengers/bus. The actual EI value for school buses is 500 kJ/passenger-km based on a load factor of 22.4 passengers/bus.

Rail Transit Systems

Tables 1 and 2 show the EI values (kilojoules per car-kilometer and kilojoules per passenger-kilometer) for three types of urban rail systems. The necessary data have been derived from transit operating reports for 1970 and 1973 (3). The study on rail transit systems noted that the EI of rail systems depends on load factor, trip length, type of rolling stock, station spacing, capacity (number of seats per rail car and number of cars), and other factors. Almost all rail transit systems have high EI because of low average load factors. It is important to note that these systems use nonpetroleum sources of power. Data on load factors, however, are not very reliable. Regenerative braking can have a significant impact on reducing the EI of urban rail transit systems.

A list of suggested EI values for rail systems, which may vary depending on the particular environment, is presented below:

System	Kilojoules per Seat-Kilometer	Kilojoules per Passenger-Kilometer
Rapid transit	787	2557
Light rail	918	3062
Trolley coach	655	2183

AGT Systems

For most AGT systems, only projected data are available. These data, received from the manufacturers and other published sources, may be optimistic. Figure 1 shows the sensitivity of speed to the EI figures.

In regard to EI values for AGT systems, preliminary study shows that these systems are more efficient from the energy viewpoint; however, they vary greatly with

Table 2. Energy intensity of urban rail transit systems.

System	No. of Seats	Kilojoules per Car-Kilometer	Load Factor (kJ/passenger-km) 100 Percent	50 Percent	25 Percent
Rapid transit	55	27 800	767	1540	3080
Light rail	40	37 166	918	1836	3672
Trolley car	50	32 971	655	1311	2622

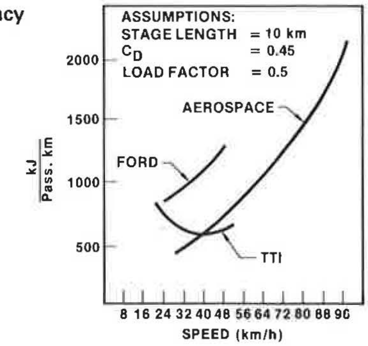


Figure 1. Energy efficiency versus speed.

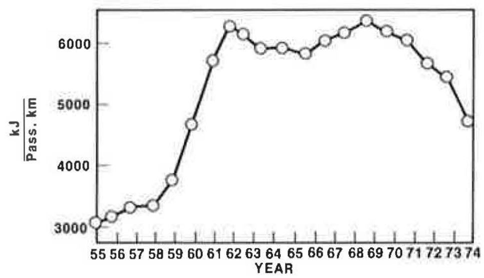


Figure 2. Energy intensity for passenger and cargo airplanes.

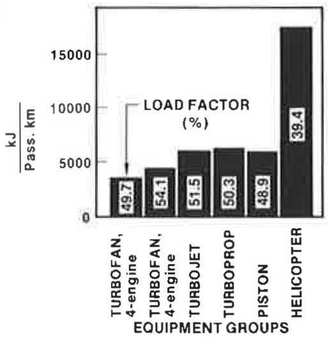


Figure 3. Energy intensity for intercity airplanes (equipment groups).

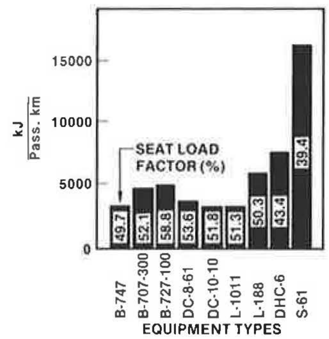


Figure 4. Energy intensity for intercity airplanes (equipment types).

the design. For an AGT vehicle comparable in size to a subcompact automobile, the EI is 1594 kJ/passenger-km, compared with 2465 kJ/passenger-km for the automobile. AGT systems have the potential to conserve energy and to use alternate power sources. The ride quality, average speed, privacy, and reliability of the AGT system are all comparable to the automobile.

EI OF INTERCITY PASSENGER MODES

This section examines EI values for airplane, automobile, bus, and rail modes.

Intercity Passenger Airplanes

Figure 2 shows the historical variation in EI values (4) from 1955 through 1974 for intercity passenger airplanes. Figure 3 shows the EI values for various equipment groups such as turbofan four-engine wide bodied and turbofan three-engine regular bodied. Figure 4 shows the impact of various equipment types such as the Boeing 747 and 727-200 on EI values (5).

Based on a literature survey and available data, a reasonable estimate of EI value appears to be 4260 kJ/passenger-km (at current load factor). This is only an estimate; for a particular situation, the actual EI number may vary by 30 percent more or less. The table below, based on 1974 and 1975 airline statistics, provides EI estimates at current load factors:

Equipment Type	EI (kJ/passenger-km)
Turbofan	
Four-engine, wide bodied	3362
Three-engine, wide bodied	3753
Three-engine, regular bodied	5900
Turbojet, four-engine	6000
Turboprop, four-engine	6720

These numbers should be updated each year after the latest Civil Aeronautics Board reports are made available.

Because passenger airplanes carry most of the nation's air cargo, a better method of fuel allocation should be applied when calculating the EI value for intercity passenger aircraft. Considerable potential exists for improving the energy efficiency of intercity airplanes. Factors such as improved load factor, reduced speed, improved ascent and descent procedures, and improved technology (turbofan) can have a substantial impact on reducing the overall EI of intercity air operation.

Intercity Automobile

EI for intercity automobile travel depends primarily on vehicle weight and the amount of urban versus rural driving. The results for the highway cycle, given in Table 3, are converted into EI values calculated at 50 and 100 percent load factors (5).

Given the model year and the type of trip (urban versus highway), a reasonable estimate of the EI values can be made from reports published by DOE, EPA, and Consumer Reports. The DOE and EPA testing method makes use of the chassis dynamometer, while Consumer Reports' results come from actual road tests.

Although transportation professionals strongly disagree about load factor, it is usually higher for intercity trips. The best suggested number, based on the literature survey, is 2.4 passengers/automobile. The national personal transportation study (6) shows a higher load factor, which is unsatisfactory because of the sample size for trips greater than 160 km. A Boeing report (7), based on the Northeast Corridor and Kansas, states that a figure of 2.4 passengers/automobile is more appropriate. Using this occupancy rate, the EI value for an intercity trip is 1737 kJ/passenger-km. The automobile can be competitive with other modes if occupancy rates are increased.

The fuel economy of the intercity automobile is expected to continue improving at a reasonable pace at least until 1995, after which time there must be a technology breakthrough to realize further gains in fuel economy. Present load factor conditions indicate that an automobile now consumes nearly double the energy consumed by a bus. The airplane, however, consumes

Table 3. Energy intensity for intercity automobiles (highway cycle only).

Car Type	Engine Size (cm^3)	No. of Cylinders	Transmission	Curb Weight[a] (kg)	Kilojoules per Vehicle-km	EI (kJ/passenger-km) 50 Percent Load Factor	100 Percent Load Factor
Toyoto Corolla	71	4	Manual	877	1537	817	456
Volkswagen Rabbit	97	4	Manual	810	1753	937	529
Datsun B 210	85	4	Automatic	860	2282	1217	683
Pontiac Sunbird	231	6	Manual	1194	2600	1363	746
Ford Mustang II	302	8	Manual	1200	3590	1886	1029
Plymouth Volare	225	6	Manual	1581	2600	1100	600
Buick Skylark	231	6	Manual	1492	2900	1230	673
Ford Granada	302	8	Manual	1535	3140	1330	726
Ford Thunderbird	351	8	Automatic	1910	3769		850
Dodge Aspen S. E.	360	8	Automatic	1590	4434	1874	1021
Oldsmobile Cutlass	231	6	Manual	1651	2900	1037	571
Chevrolet Malibu	250	6	Automatic	1673	3015	1078	593
Dodge Monaco	225	6	Automatic	1707	3426	1226	676
Lincoln-Mercury	351	8	Automatic	1946	3769	1338	716
Chrysler Cordoba	318	8	Automatic	1894	4187	1489	763
Buick Le Sabre	231	6	Automatic	1764	3015	938	523
AM Matador	258	6	Automatic	1868	3589	1112	617
Plymouth Gran Fury	318	8	Automatic	1989	4188	1292	713
Dodge Royal Monaco	440	8	Automatic	1998	4819	1367	754
Lincoln Continental	460	8	Automatic	2289	5120	1440	786

[a]May differ somewhat depending on the source and assumption.

more than double the energy consumed by the automobile.

EI values for the intercity automobile vary greatly according to load factor (dependent on length of the trip, type of vehicle, and trip purpose); type of vehicle (subcompact, compact, standard, luxury); percentage of urban driving (total urban distance divided by the trip length and multiplied by 100)—the higher the percentage of urban driving, the higher the average EI value; trip length; average speed and speed distribution; temperature; humidity; and road conditions.

Intercity Bus

The table below shows the EI values of intercity bus systems for 1973 through 1976 [Row 1 represents gross intercity operations; rows 2 and 3 are obtained (5) after eliminating charter and local services.]:

Type of Operation	EI (kJ/passenger-km) 1973	1974	1975	1976
Regular route intercity kilometers only	790	738	782	775
Intercity route after eliminating charter service	703	657	687	731
Intercity route after eliminating charter and local services	682	639	672	720

Reasonable EI estimates can be made using current load factors. The suggested number is approximately 721 kJ/passenger-km, estimated at 45 percent load factor. The data on which these numbers are based appear to be reliable because of the requirements imposed by the Interstate Commerce Commission.

Intercity bus is the most efficient mode of intercity passenger transportation under the current operating conditions. Under full load conditions, the suggested EI value is about 328 kJ/seat-km.

Intercity Passenger Rail

EI values for intercity passenger rail operations vary greatly. The differences in EI values stem from such factors as type of rolling stock (specific fuel consumption varies according to the type of the propulsion plant—gas turbine, diesel, diesel electric, electric); train configurations or consists (long-distance trains usually have an extra load of sleeper cars, baggage cars, lounge cars, mail car); type of track (quality of track dictates the allowable speed and number of slow orders; curves and grades also affect performance); trip characteristics (load factor, stage length, and dwell time all affect energy efficiency); and method used to estimate EI values. The data base for statistical and engineering approaches may not be consistent.

For metroliners or electric-hauled Amfleet consists, EI is 721 kJ/seat-km. This figure is based on the input to the generating station (nuclear, coal, oil fired). An approximate EI value under a certain load factor can be obtained with this equation: kilojoules/passenger-kilometer = (kilojoules/seat-kilometer) (1/load factor). A realistic EI estimate is around 490 kJ/seat-km for diesel electric trains (short- to medium-haul) and 656 kJ/seat-km for cross-county trains. The national average EI value for an intercity rail passenger operation is 2294 kJ/passenger-km under actual operating conditions. However, the EI value for an intercity rail passenger operation on a particular route cannot be easily estimated without knowing the type of train consist (number of parlor cars, snack cars, coach cars and density of seating, and baggage cars), type of power plant, and length of trip.

Once such information is known, the EI values can be estimated. Generally, these values will be on the low side because they do not account for circuity and other losses such as those resulting from switching. However, more work is needed to develop reasonably accurate EI values in actual working environments.

EI OF INTERCITY FREIGHT TRANSPORTATION MODES

Intercity Air Freight

Figure 5 shows the historical variation in EI values (4) for all cargo planes. Figure 6 shows the variation in EI (5) as a function of the equipment group. Figure 7 shows the impact of the type of equipment on EI values (5). Figure 8 shows the impact of stage length of EI values. Only the incremental fuel (i.e., extra fuel used to carry the cargo) is allocated to the cargo, so EI values are small. Passenger aircraft carry most of the country's air cargo, so using incremental fuel allocation does make sense.

The operational data base (traffic and fuel use data) for air cargo operations is reliable compared with that for competing modes. A reasonable EI estimate for all intercity cargo aircraft is 18 000 J/kg·km, which varies with the type of equipment. The table below, based on limited search, suggests EI values for various types of intercity cargo planes:

Equipment Type	EI (J/kg·km)	Load Factor (%)
Turbofan, four-engine, regular bodied	16 000	58
Turbofan, three-engine, regular bodied	22 000	65
Turbofan, four-engine, wide bodied	12 000	62

The EI values for passenger-cargo aircraft are lower than on cargo-only airplanes and depend on the method

Figure 5. Operating energy intensity for all-cargo airplanes.

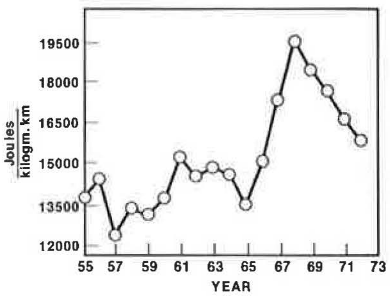


Figure 6. Energy intensity for all-cargo airplanes.

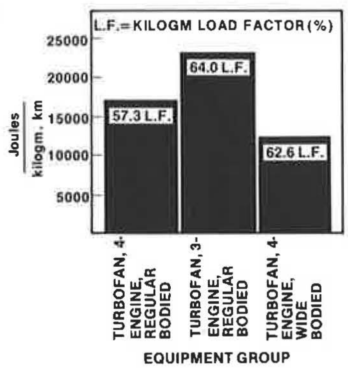


Figure 7. All-cargo intercity aircraft energy intensity.

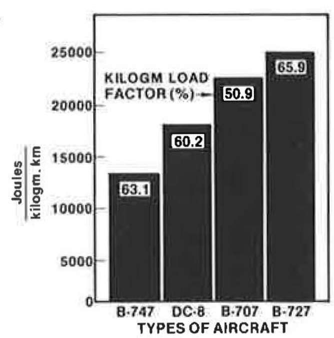
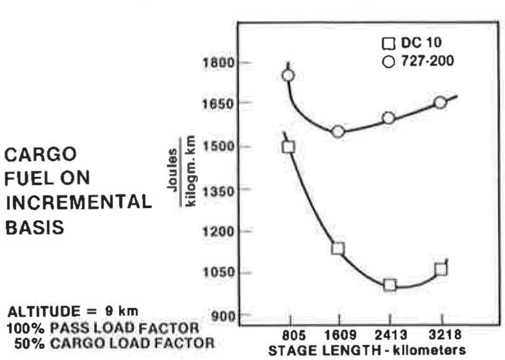


Figure 8. Energy intensity of intercity planes.



used. No gross EI number can be ascribed at the present time; each case should be analyzed individually by using the incremental fuel method.

Intercity Truck

Figure 9 shows the EI value as a function of cruising speed (5) varying from 16 to 113 km/h. Two different load factors are considered for evaluation purposes.

The following conclusions about EI values for intercity trucks may be drawn from a review of the literature and completed analyses. The EI values for intercity trucks depend on type of truck (single unit, tractor-semitrailer, tractor-trailer combination, van truck), type of commodity carried and density, average ratio of load to vehicle capacity, trip characteristics (length of trip, average number of stops), operational characteristics (speed at cruising, number of accelerations and decelerations), and length of empty haulback. Therefore, no precise EI number can be ascribed to intercity truck operations, but we can provide a gross number based upon past energy use and traffic (kilogram-kilometer) statistics.

Judging from past statistics and operational data, we can best estimate EI for intercity combination trucks at around 1806 J/kg·km. Better input operational data are needed to refine this number, because available operational and traffic data are inadequate. The fuel and technical performance data provided by manufacturers and other published sources make the engineering analysis approach highly attractive. Efforts should be made to attain a good traffic base that can be used as input to engineering analyses.

Intercity Freight Trains

Figure 10 shows the impact of cruising speed on EI values (5) for intercity freight trains for four different types of commodities. By using statistics on traffic and fuel data, a gross EI number of around 540 J/kg·km could be ascribed to intercity rail freight operations. This EI does not take into consideration the inefficiency from high circuity factors inherent in the present railroad infrastructure. For example, the disaggregate EI values will differ considerably from the gross numbers according to type of commodities shipped (low density versus high density, commodities needing special equipment such as refrigerator cars), type of freight cars utilized (type of car affects ratio of cargo weight versus gross weight, which in turn affects efficiency), trip and track characteristics (length of trip, quality of travel), operational characteristics (fuel consumption for idling and yard switching), empty haulback, and type of power.

Pipelines

The following table shows the EI values for crude oil at two flow rates in a pipe whose inside diameter is 31.75 cm:

Flow Rate of Crude Oil (m^3/h)	EI (J/kg·km)
284	0.145
330	0.188

The table below shows the EI values for refined products (inside pipe diameter of 15.4 cm and flow rate of 50.31 m^3/h) and crude products (inside pipe diameter of 31.1 cm and flow rate of 512 m^3/h):

	EI (J/kg·km)	
Product	Refined	Crude
Gasoline	93	0.229
Jet fuel	109	0.246

Product	EI (J/kg·km) Refined	Crude
Kerosene	106	0.251
No. 1 fuel oil	119	0.268
No. 2 fuel oil	131	0.287
Diesel fuel	133	0.280
Propane	85	0.192

[These values are very sensitive to flow rates, and the average EI is 111 J/kg·km. The results were obtained from data supplied by the Continental Oil Company.]

The EI values for oil pipelines are extremely sensitive to parameters such as flow rate, pipe diameter, pipe roughness, type of pump (electric, centrifugal, reciprocating piston), and type of product moved through the pipeline. No single EI should be ascribed, but an EI value of 253 for crude and of 181 for crude products seems to be a reasonable estimate at present. Future study will be warranted when better data become available.

There is little published material relating to EI values for gas pipelines, and no useful information was obtained by communicating with several gas pipeline companies. Documentation about methodology, traffic volume, and operational and design characteristics of pipelines is lacking. The best possible EI number obtained from available data sources is approximately 1445 J/kg·km.

Figure 9. Energy intensity of trucks in cruising.

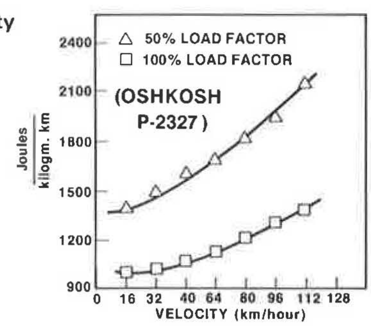


Figure 10. Intercity rail freight energy intensity.

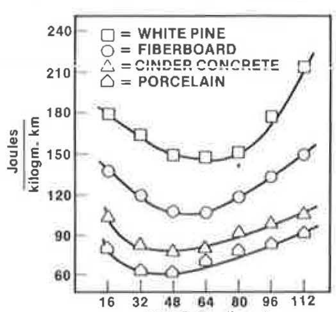
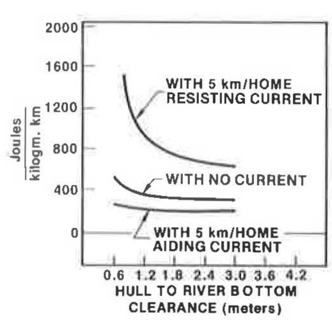


Figure 11. Energy intensity for a standard four-barge flotilla.



EI values for gas pipelines depend on several factors such as temperature, length of the pipeline, inlet pipeline pressure, pipeline diameter, and type of pump (electric or reciprocating).

More research is needed in this area to understand the design and traffic characteristics of gas pipelines.

Waterways

The table below shows the historical variation of EI values (4) for the operation of deep-water and inland waterways, and Figure 11 shows the variation in EI value for a standard four-barge flotilla (4,5):

Year	Deep-Waterway EI (J/kg·km)	Inland Waterway EI (J/kg·km)
1964	403	279
1965	331	279
1966	299	289
1967	360	282
1968	436	282
1969	483	280
1970	504	258
1972	457	328
1973	485	353
1974	416	274

The deep-water EI data are expressed as residual oil energy content divided by kilogram-kilometers of coastal and coastwise traffic; inland waterway EI is the distillate content divided by kilogram-kilometers of this traffic. Data related to traffic (average length of haul and average load) and fuel consumption are scarce for all types of waterways (lake, river, and coastal), so reliable conclusions are difficult to make at this time.

EI of barge flotillas on inland waterways is extremely sensitive to parameters such as channel width, flotilla load, geometry, speed, and horsepower. No meaningful average values can be ascribed to a flotilla operation. Rather, individual cases should be evaluated based on flotilla and waterway characteristics.

The major deterrent to the EI of inland waterway operations is the high level of circuity, which in certain cases may raise the EI value higher than the competing rail system for the same origin and destination points. Gross estimates of EI values for deep-water and inland waterways are 433 and 361 J/kg·km respectively. These EI values do not take into consideration the impact of circuity and may be off by as much as 50 percent; they are, however, the best numbers available.

SUMMARY

This paper is not the final answer to questions of energy intensity of transportation modes. It does, though, provide better insight than has been previously available. The major weakness of the study is the scarcity of quality data. These data needs relate to the following:

1. Traffic—trip length, load factor, number of trips, volume of traffic (person-kilometers, kilogram-kilometers, car-kilometers), and types of commodities moved;
2. Mode characteristics—type of vehicle, number of seats, and capacity of the system (number of people who can be moved per hour versus the weight that can be hauled per hour); and
3. Engineering parameters—aerodynamic characteristics, rolling characteristics, transmission efficiency, and thermal efficiency.

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**Dr. Mittal was employed by Union College, Schenectady, New York, when this research was done.*

One Approach to Local Transportation Planning for National Energy Contingencies

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Because of the uncertainties associated with the nation's petroleum supply and the possible effects of federally imposed fuel contingency measures on transportation, the steering committee of the Metropolitan Planning Organization in the north central Texas region directed the development of a plan to minimize the impact of federal fuel contingencies on transportation in the Dallas-Fort Worth metropolitan area. This paper summarizes the planning effort that resulted. The major objective of the plan was to minimize the impact of fuel allocation and rationing on local mobility, especially work trips, and thereby to reduce the adverse effects of a near-term energy shortage on the local economy. Through an examination of these federal regulations, the impact of the 1973-1974 Arab oil embargo, and projections of future petroleum supply and demand characteristics, alternate fuel shortage scenarios were developed and transportation-related problems identified. Potential solutions of these problems were analyzed as to their effectiveness and applicability. A set of recommendations for actions by local governments, public transit systems, and the private sector was developed from the results of these analyses.

Past experience has shown that the imposition of federal contingency policies regarding energy use can have a profound impact on local transportation systems. Federally imposed fuel austerity measures during World War II and the more recent federal fuel allocation program of the 1973-1974 Arab oil embargo produced significant modifications in public travel habits. The more recent of these experiences demonstrated that local problems resulting from these contingencies will vary in each area and will require resolution at the local level.

With these concerns in mind, the steering committee of the Metropolitan Planning Organization (MPO) of the Dallas-Fort Worth area requested the North Central Texas Council of Governments' (NCTCOG) Transportation Department to develop short-range plans that would minimize the effects of national energy contingencies on local ground transportation systems. This paper highlights portions of the resulting short-range plan, A Metropolitan Transportation Plan for National Energy Contingencies (1).

STUDY DESCRIPTION

The initial assumption of the energy contingency study was that the threat of a future oil interruption is a distinct possibility. If and when such an emergency were to occur, it was further assumed that the federal government would impose fuel allocations, rationing programs, or both, that would affect the local transportation system. These federal actions would spread the oil shortages equally across the nation, and the Dallas-Fort Worth area would experience fuel reductions similar to those in other urban areas.

It was decided at the outset that, since the federal regulations provided the mechanism for the necessary fuel reductions, local energy conservation should not be the intended goal of the study. It became apparent, however, that energy conservation would indeed be a by-product of many of the recommended actions.

Because the purpose of the study was to assure the continued economic vitality of the Dallas-Fort Worth area, a major concern was the maintenance of local mobility, especially of work trips. Therefore, a major objective was to ensure some means of transportation by which every worker in the area could reach his or her place of employment. Since most work trips (about 90 percent) are made by automobile, the study paid special attention to the expected problems of these automobile users. The development and use of alternate transportation modes (e.g., transit, carpools, and taxis) in areas where they are not now available also became a major study objective.

At the same time, the study team wanted to ensure that the existing transit and paratransit systems would be utilized to their maximum and that these systems would be allowed to continue operations as efficiently as possible. Resolving the anticipated problems of fuel shortages, passenger overloading, and unmet transit and paratransit demands were major concerns. Planning