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The Effects of Energy Conservation on Politics, Employment and Inflation

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THE EFFECTS OF ENERGY CONSERVATION ON POLITICS

EMPLOYMENT AND INFLATION

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Abstract

The main tenet of this paper is that up to this time there has in fact been little incentive for consumers to conserve energy. An analysis of the three main types of energy user (industry, transportation and residential) and the ways in which energy may be conserved will show that the political action and legislation necessary for conservation would fail in our democratic society. It will be illustrated that a sudden decrease in energy consumption will cause any or all of the following to occur:- government revenues will fall, unemployment increase, companies go bankrupt, and an increase in prices. The final conclusion is in fact that we will only conserve energy when by economic necessity we have to and that time has not yet arrived.

"It is a far, far better thing that I do, than I have ever done, it is a far, far better rest that I go to than I have ever known."

Sydney Carton*

PROLOGUE

On Thursday, October 7th, 1976, a chartered DC8 jetliner flew across the Atlantic Ocean from London, England, to Halifax, Nova Scotia, at a cost rumored to be $18,000. The passengers were two elderly ladies and two dogs.

1. INTRODUCTION

The time that man has existed on earth can be represented by a small cloud in the sky. A man's life can be represented by one drop of water in the cloud. It is against this background that we have to look at the role of energy conservation and the role of mankind in the future life of the earth. Decisions based within this "one" drop of water can decide the future of man, whether the cloud can continue to grow or disappear into the aeons.

No matter which way you look at it our utilisation and sources of energy will have change. Within a space of 350 years we will have exhausted the reserves of fossil fuels which took some 350 million years to make. It matters little whether or not these resources can be husbanded for another 1,000 years, and even this time span which appears huge to us is virtually insignificant in the 500,000 or so years that our species has existed on earth.

We may ask ourselves why in the space of 350 years we will have consumed most of these resources. The answer is that mankind has an inquisitive mind and he wants to find an application for that knowledge which he has acquired, to have a better life and to greed. The development of our scientific, technological and medical knowledge has enabled the human population to mushroom with exponential growth. We now have to expend large amounts of energy to maintain this population in a healthy state. We are often familiar with the fact that starvation and malnutrition is affecting an ever increasing number of people but the converse also applies that never have so many people been so well fed although this proportion of the world's population is falling.

You do not get something for nothing. The efforts to support the population at an ever increasing standard of living has led to undesirable side effects: pollution, removal of our best agricultural land for housing and for the good life. In our race to extract resources we have practiced poor conservation, e.g., "flaring" off of waste natural gas. It was once estimated that if 10% of the natural gas flared off from oil wells was used to make fertiliser, it would be sufficient to cause a "green" revolution in the underdeveloped countries. Unfortunately these countries cannot afford the fertiliser anyway but, even if they could, it would also lead to a greater population and the subsequent vicious circle of trying to grow enough food to feed an ever increasing population.

We cannot talk of energy conservation in a vacuum. Energy i

* Charles Dickens, "A Tale of Two Cities".

utilised by our system. We have to consider how this system can be designed and organised so that energy can be efficiently utilised. Energy is the "vital" force or component of the system which cannot exist without large inputs of energy. There are two sources of energy: nuclear fusion and gravitational forces and all other sources are derived from these two. The system should be designed so that it uses these two sources.

In considering energy conservation, one has to consider both the decision and the time horizon over which the decision maker is basing a decision. The basic system design and policies have to be made by governments and willingly carried out by the population. In a democracy the legislators in power base their decisions on how to get elected in the next election, not on what is necessarily good for the country and for the people. For people there are two time horizons and the first or basic decision is based on immediate needs such as eating and having a good time and a longer time horizon based on the total welfare of the family. The second time horizon is about 60 years and is limited to the welfare of grand-children as most of us do not live to see great-grand children and by and large what we do not see we do not care about.

It is in the above context that we have to look at decisions on energy conservation. A great deal of energy and conversation has been expended to explain the need for energy conservation. In fact there has been up to this time very little incentive for consumers to conserve energy. We have become conditioned by the pontifications of governments, scientists and engineers about impending energy shortages and price increases and as most of us are disinterested we quickly learn to accept price increases and we can see no evidence of shortages. The reason is that our time horizon for decision making is too small and the cost of energy is too small compared to other costs of living to raise our ire.

The design of the system is the responsibility of governments and they have to market and sell the design to the people whom they represent. The Governments have completely negated their responsibility for system design and have instead applied a "band-aid" philosophy to components of the system. This has arisen because we as a people would vote the government out of office if it tinkered too seriously with the present system. Furthermore most people fail to see any real evidence of an impending energy crisis or a need for energy conservation. If energy conservation was being tackled seriously we should ban unnecessary energy consuming devices such as private heated swimming pools. Is street lighting from 12:00 p.m. to 7:00 a.m. necessary? Should we not ban pilot lights on natural gas applicances as the State of California is proposing to do. Do we really need heavy recreational vehicles requiring heavy cars to pull them? An example of a "Band-Aid" can be found in the publication "100 ways to save energy and money in the home"(1), one of which is to buy milk in returnable bottles, which is impossible in Halifax as bottles were phased out some years ago not because the customer did not want them but because the dairy favored plastic/cardboard milk cartons.

Let us now turn and look at the design of the system. The three inter-relating components we shall look at are housing, transportation and industry. A decision that is made on any of these three will have long lasting affects, i.e., a time horizon of 50-100 years. We will show that governments do not want energy consumption to drop but only want the rate of growth to decrease or alternatively for new "cheap" energy sources to be found. It will be illustrated that a sudden decrease in energy consumption will cause any or all of the following to incur: government revenues will fall, unemployment increase, companies go bankrupt, and an increase in prices. The final conclusion will in fact be that we will only conserve energy when by economic necessity we have to and that time has not come yet.

2. ENERGY CONSERVATION IN HOUSING

There are approximately 7 million houses in Canada* and we are currently building them at the rate of 200,000-250,000 a year. The building program in the next 10 years will represent around 25% of the houses or residence units in the country. The housing component is unique in that policy on housing will affect the transportation and industrial components. Energy conservation in houses is governed by

(1) Design standards,
(2) Planning regulations,
(3) Social desires.

Planning regulations although dependent upon the local community and social desires generally encourage the building of larger residences and consumption of larger amounts of land than are really necessary.

There are three ways in which design standards can be used to foster energy conservation, viz.,

(1) Upgrading insulation standards,
(2) Changing structural design standards,
(3) Geographic or directional orientation of houses.

Although insulation standards are changing, very little attention has been paid to the other two areas.

Although the problem of changing design standards is complicated, there is a great deal of knowledge available which could be incorporated in design standards. First it is impossible to have a single design standard for the whole of North America, as in the Southern U.S.A. the major criterion will be keeping heat out, while in the Northern U.S.A. and Canada the major emphasis is on retaining heat in the building. Secondly, a typical house design, which, apart from cosmetic changes, will have an identical appearance whether it faces North, South, East or West, should be changed so that it takes advantage of the prevailing climate and the direction the house faces. Thirdly, the structural design standards can be changed at little or no extra cost so that new heating systems such as solar heating can replace existing systems economically when they become commercially feasible. The fact that little or no work is being done in these areas mean that our children and grandchildren will inherit these houses (25% of the total) for the next 50-100 years.

We have to ask ourselves what kind of a house do we really need? In this day of decreasing family size, we do not really need a house greater than 1100-1200 square feet, which will provide three bedrooms, living room, dining room, kitchen and bathroom. The house is often in fact 2200-2400 sq. ft. as most residences are perched on top of a basement of equal size. We do not need houses larger than this, but the larger houses of the policy makers provide a target for the rest of us. The first policy is to determine the maximum size of house allowable. There is no need to outlaw large houses, just make them very

*The comparable figure for the U.S.A. for activities of this kind is approximately 10 times the Canadian figure.

expensive both initially and on a continuing basis. We should encourage the rehabilitation of large houses, 2000 sq. ft. or more, into more than one residence unit. These changes could easily be achieved by either direct legislation or indirectly by fiscal policy.

Let us now turn to energy conservation in houses. The houses or residence units being considered will be a single story 1160 (29x 40) sq. ft. and a two storey 1200 (2x20x40) sq. ft. The two storey house requires about another 40 sq. ft. because of stairwells to have the same effective living area. Heated garages should be banned. The ratio of heat loss for the single storey and two storey house with R-32 insulation in the ceiling and R-14 in walls is shown in Table 1.

Table 1. Ratio of Heat Loss in Single and Two Storey Buildings (R-32 in Ceiling, R-14 in Walls)

	Single Storey	Two Storey
Basement	9.4%	9.1%
Walls	53.9%	78.1%
Ceiling	24.8%	12.8%
TOTAL	88.1%	100.0%

It would appear at first sight that the two storey house is less economical than the single storey. However if the walls are insulated to R-20 standards the situation changes. This can be achieved by using 2 by 6" frame construction instead of 2 by 4". The extra cost based on one quotation from a builders supply merchant for the single storey house is approximately $361.* and $525 for the two storey houses. These costs were based on the extra amount of wood used in the walls and an allowance of 15% for wastage and the difference in cost between the R-12 and R-20 insulation. The savings are shown in Table II. The two types of house now cost about the same to heat. It is assumed that the cost of labor to install the wood and insulation is the same as in the cheaper case. The payback period is approximately 6 years in the case of the single storey house and 5 years in the case of the two storey house. The increased cost is nothing compared to the purchase price of $40,000-$50,000.

Table II. Ratio of Heat Loss in Single and Two Storey Houses (R-32 in ceiling, R-22 in walls)

	Single Storey	Two Storey
Basement	9.4%	9.1%
Walls	24.8%	49.7%
Ceiling	34.3%	12.8%
TOTAL	68.5%	71.6%

Reference unit: Two storey house (R-20 ceiling, R-12 walls) 100%

In the above discussion each house was considered as a separate unit. If we joined two houses together each house would lose one heat loss wall. This process can be repeated many times. The resulting savings are shown in Table III for standard R-32 ceiling and R-14 walls. The adjoining walls are 29 ft. and 30 ft. respectively for one and two storey houses and a similar analysis is shown in Table IV for R-22 in walls.

By the time we reach 5 houses in a row the decrease is approximately 2% There is unfortunately a problem of acceptance of multiple or row housing by many people and a choice will have to be made between energy conservation (over 50%) and number of units in each block.

Table III. Ratio of Heat Loss in Multi-Residence Units (R-32 in ceilings, R-14 in walls)

	One Unit	2 Units	3 Units	4 Units	5 Units
		Single Storey			
Basement	9	8	7	7	6
Walls	54	43	39	37	36
Ceiling	25	25	25	25	25
TOTAL	88	76	71	69	67
		Two Storey			
Basement	9	6	5	5	5
Walls	78	55	14	43	41
Ceiling	13	13	13	13	13
TOTAL	100	74	65	61	59

Table IV. Ratio of Heat Loss in Multi-Residence Units (R-20 Insulation)

	One Unit	2 Units	3 Units	4 Units	5 Units
		Single Storey			
Basement	9	8	7	7	6
Walls	34	27	25	24	23
Ceiling	25	25	25	25	25
TOTAL	68	60	57	56	54
		Two Storey			
Basement	9	6	5	5	5
Walls	50	35	30	27	26
Ceiling	13	13	13	13	13
TOTAL	72	54	48	45	44

Why should a homeowner conserve energy? What will make him do it? A typical 1200 sq. ft. house with 2" insulation in the ceiling and virtually no insulation in the walls consumes about 1,000 gallons of oil in Halifax and about 12,000 kilowatt hours of electrical energy per year. The total cost/year for energy is about $1050 comprised of $570 for oil and $480 for electricity in Halifax. Taxes will cost about $600-$1200. Purchase costs will vary from $45,000 to $70,000 depending on location. Mortgage costs will therefore vary, around $330-550/month exclusive of taxes. Food costs anywhere from $40-$100/week. It can be seen from the above figures that the direct cost of energy is only a small fraction (7-13%) of the rest of the housing costs. In fact the more costly the purchase price of the house the less visible incentive there is to insulate.

The above heating costs can be reduced by retrofitting the house with insulation. The cost of retrofitting the house to R-32 in ceilings and R-14 in walls is $450 for the ceiling and for insulation in the walls $880. The cost of insulation in the ceiling is $450 for fibreglass (self fitted) and $750 for blown mineral wool. If we invest this money @ 10% we will earn $45 or $75 per year. The savings on the house are estimated to be $80 (1). The net savings are in fact only $35 per year with fibreglass insulation and $5 for mineral wool. For the walls the interest on investment of $880 is $88 and the savings are estimated to be $142

*All costs are in Canadian dollars based on current Halifax prices. At the time of writing $1 Canadian is equal to $0.85 U.S.A.

giving a net saving of $54. Although the Candian Federal Government encourages retrofilling by giving cash grants for materials used, a major cost component for insulating walls is the cost of labor (over 50%). It is beyond the scope of this presentation to discuss the complexity of the program except to say that its application varies in different parts of the country. If the federal government were really interested in energy conservation, it should allow the homeowner, in the same way that the manufacturer is allowed to depreciate machinery at an accelerated rate, to deduct the total payment for insulation from his income. Great care has to be taken in ensuring that a good vapor barrier exists in the walls when retrofitting, otherwise the undesirable side effects like the house collapsing will not be know for 5-10 years. Major repairs caused by lack of a vapor barrier will more than offset minor fuel savings. The only real worthwhile savings is if the houseowner can insulate the ceiling with free labor.

The government is also encouraging us to properly maintain our furnaces. The estimated savings are 10% or $20 to $57 per year. The cost of servicing at $16 per hour will soon remove our savings. We should be allowed to deduct these payments from our income tax. The most important aspect of servicing is to keep the burner in a safe condition preventing explosions or fires, rather than decreasing the amount of fuel consumed. We could also be given tax incentives to install newer and more efficient furnaces.

What is our main concern about our monthly payments? The answer is "Can we afford to make the payment?". We live for today, not tomorrow which will take care of itself. A 1% deduction in interest rates will save us $7/$1000/month. Increasing the mortgage period from 20 to 25 to 30 years will decrease the payments by $4-$6/$1000/month. (The extra cost is immaterial as the question is "Can we afford the monthly payment?".) The financial return may well be greater in devising schemes to decrease the mortgage payment rather than bothering about the cost of heating. The whole emphasis of management training is to place the effort on those areas where the savings will be greatest, which over the past year would be to invest in Japanese yen, German marks, and Swiss francs, which would provide a far greater return on investment than retrofitting one's house.

Now let us turn to a consideration of the space occupied by housing. Towns and villages were founded because they had some unique advantages over some other site. Traditionally, they were located because (1) strategic location to defend one's property, (2) a position for communication e.g., a port or ford on a river, and (3) a good place to live and had plenty of food. Subsequently, many of these towns and villages grew into cities, due in part to the small transportation distance for food. Now we find that many of our cities are consuming valuable acres of farmland. This land is in many cases defoliated for all time by asphalt and concrete and can never be reclaimed. Many municipalities do not like row housing, or cheaper housing and prefer the much more expensive single type houses and enact planning rules to ensure this. Marginal farmland will have to be increasingly used and to achieve the same results more fertilisers (requiring energy) will have to be used.

Planning rules differ from one municipality to the next. In main land Halifax, the minimum lot size for a single family dwelling is 50 ft. frontage and 5000 sq. ft. The allowance for roads in a new subdivision is from 50 to 74 ft. wide. With row housing we can accommodate 15 houses in 300 ft. compared to 6 for single family dwellings. For 2,112 houses, we would require roads totalling 10 miles for single housing and 4 miles for row housing. As somewhat more than half of all residence units constructed are single type houses we could, by constructing row housing, expect to save around 2800 miles of road, sewers, etc. and 21,000 acres of land over the next 10 years. This would cause a decrease in the road consturction industry (industrial section to be considered later) and the amount of transportation required.

In conclusion, for the housing section, it has been shown that by using row housing large amounts of energy can be saved. This is a system design for the future. Any of the other savings that can be achieved by normal maintenance will also be obtained in row housing. This type of system will also save valuable land. It is doubtful that row housing is politically acceptable to Canadians, except that condominiums and town houses are becoming popular because of the price of single type housing.

3. TRANSPORTATION

Transportation is one of the vital components of our environment. One aspect is the movement of raw materials to the production system and the final products to the people. The other aspect is the movement of people to and from work and for pleasure. This discussion is concerned with the transportation of people to and from work. We have to recognize that the most efficient means of transportation for short distances is the automobile. Efficient in this case includes intangible values such as convenience. One of the politician's favourite weapons is to build roads to get the economy moving and to curry favour with the voters. The quickest way to generate traffic is to build a freeway.

The road system can generally cope with the traffic demands placed on it, except for 2 hours in the morning and 2 hours in the evening. We are all familiar with traffic congestion at peak hours. Some people's solution is public transit, preferably rail and then buses. A rail transportation system is costly to build and is inflexible for future use. The bus system is also costly and practically every transit system runs at a deficit. If everyone travelled on a transit system to work it would have to increase in size and the deficits would mount.

We have to recognize that no matter what system is used we are faced with two alternatives:

(1) A transportation system which can easily cope with rush hour traffic and is practically empty all of the remaining time.

(2) A transportation system which can easily cope with traffic most of the time but will be heavily congested during peak times.

We have to balance these two requirements.

Let us try to look at the future in terms of need. First, primary and secondary manufacturing is becoming more automated and will require less manpower in the future. Secondly, the fastest growing segment is the tertiary or service industry, which includes governments. The service industry is labor intensive and is concentrated in the downtown areas. We are therefore concentrating and funnelling an ever increasing number of people into the downtown area and this area represents an increasingly smaller proportion of any metropolitan area. We therefore have to increase the efficiency of the total transportation system. This is the only way we will conserve energy. Tinkering with the system, such as installing flexible working hours, only enables traffic to flow more easily, delays a solution to the problem and conserves little energy.

The bus system is said to be more efficient than the car because it carries more people/mile/gallon than does a car. This is true, but short of declaring the car illegal and heaven help the government and the economy in that case, the majority of people will not use the transit system. A diesel bus does 4.1 - 5.5 m.p.g. depending upon its size but in the rush hour it travels empty one way and therefore the effective number of miles per gallon is halved. A car on the other hand contains at least one person each way, but, although four to six people can travel in a car, it contains an average of 1.14 people. Using the above facts it is therefore possible to calculate relative efficiency of buses and cars (Table V). It can be seen that large cars are similar in performance to buses and that the use of smaller cars may be more efficient. The problem is therefore to persuade more people to travel in one car in the rush hours. The above analysis also neglects the fact that the bus will travel relatively empty at the outermost points of its route even in peak hours.

Table V. Relative Efficiency of Passenger Capacity of Cars and Buses

	m.p.g.	# vehicles equivalent to 1 bus	# people/car	# equivalent people
Large	16*	7.8	6	46
Medium	21*	10.2	4-6	41-61
Bus (small)	5.5*	1/2		25-33
Bus (large)	4.1*	1/2		41-53

*These figures are based on miles/imperial gallon and discounting manufactures claims by 25%.

The only system that will persuade people to carpool is economic persuasion. Let us have a look at developing a system for Halifax. Halifax is probably unique among the major cities in Canada in that it has only 8 entry points. It is my opinion, living in the suburbs of Halifax, that most of the traffic congestion in Halifax is caused by people entering from outside. There is no metropolitan transit system and Halifax City is the only one of the three municipalities that has a decent public transit system. A metropolitan transit system is projected in the immediate future but with both local and provincial governments procrastinating it is still to be implemented.

The average daily number of vehicles entering Halifax (2) in 1975 was 97,615. If we assume that what enters will also leave, the average number of vehicles entering daily will be approximately 49,000. Further it can be estimated that approximately 17,000 (35%) of these vehicles will enter between 7:00 and 9:30 a.m. The proposed system to encourage carpooling is:-

(1) Each car entering between 7:00 and 9:30 a.m. will pay an entry fee of $4.00.

(2) For each additional passenger in the car to a maximum of three the charge will be reduced $1.00.

With only eight entry points the system could be installed easily and cost very little to run and would produce enormous revenues. (Table VI).

The only difficulty with implementing this system is a political one. Although some jurisdictions have introduced restrictions on the lines advocated, these restrictions were introduced to relieve congestion (socially desirable) and not to conserve energy and there is little likelihood of any government deigning to consider this type of system for fear of losing votes in the next election.

If this system could be proclaimed, it would have two desirable effects:

(1) A metropolitan transit system would be imple- in a short time.

(2) The revenues accruing from this system could be used to develop the transit system.

Table VI Revenues from Entry Charges to City of Halifax

# people/ car	Revenue	# cars/ day	Annual Revenue
1	$4.00	19,380	$20,155,200.
1.14		17,000	17,061,200.
2	3.00	9,690	7,558,200.
3	2.00	6,460	3,359,200.
4	1.00	4,845	1,259,700.

If the changes could have been implemented in 1976 and only cars with 4 people entered the city the revenues of $1,260,000 would pay the Halifax transit deficit of approximately $1,200,000 and the minimum fee would have to have risen to about $1.50 to cover the 1978 deficit. The system would also act as a filter for traffic entering the city and thus relieve congestion. There are also other variations of the system such as 4 toll booths for cars with 4 or more people and one toll booth for others.

It has been suggested that in order to increase the speed of buses transit only lanes on roads should be developed. However, transit only lanes are inefficient as they would tie up a lot of expensive roadway. Transit only lanes should only be considered if buses are using them every few seconds.

Let us now turn and look at the distance travelled by drivers. If we return to the Halifax situation and charging drivers entering Halifax it would appear that the average distance travelled by these drivers would be in excess of 20 miles. In a year this amounts to approximately 5,000 miles. The average driver is generally assumed to drive 10,000 miles and therefore, by car-pooling more extensively than in the past, considerable savings in gasoline would be obtained. The results are shown in Table VII.

Table VII. Savings in Gasoline Achieved by Car-pooling

People/Car	Average # miles/car	Savings in Gasoline
1	10,000	0
2	7,500	25%
3	6,666	33%
4	6,250	37.5%

These savings are permanent and are in addition to any savings that government regulations on the performance of cars will achieve. The above savings will involve a drop in federal and provincial revenues (Nova Scotia) of $425,000 and $890,000 respectively (based on average mileage of 16 mpg).

If the owner of an automobile travels an average of 5,000 miles to and from work, it follows that provincial and government gasoline tax revenues will drop 37.5% from gasoline tax. In the case of the Nova Scotia Government this would involve a loss of $13 million. These revenues, as Government expenses always increase, never decrease, will have to be replaced and this can only be done by increased taxes either on gasoline (10 cents/gallon) or something else. Unfortunately, it has been impossible to determine the average mileage a car owner drives to and from work in order to obtain better cost estimates.

The net effect of the above system is that congestion in downtown areas would be eased as the number of cars would be decreased by 75%. This means that in most cases our present road system would be able to cope for years to come with the expected traffic. Also the revenues from entry charges could be used to develop better transit systems.

Let us now turn and look at the space occupied by housing. We previously showed that 2112 standard single storey houses would require 10 miles of road and two storey row houses would require 4 miles of road. Most new houses are built on the boundaries of cities and the occupants will therefore have to travel a long way to work. Let us assume that one occupant from each house will travel to work in a car by himself and that the houses are arranged on one long road stretching from the city centre to the final house. The numbers of miles travelled/day using one person/car and 4 people/car is shown in Table VIII. The number of buses required for each peak 2 hour period assuming each bus will carry 50 people and average 10 miles/hour is also shown. If there are two 5 mile roads stretching out from the city centre the above figures will be halved. A 50 seat bus costs $36,000 and has an operating cost of approximately $1.16/mile. If it is desired to maintain a 15 minute service for this road throughout the day we would require 7, 5, and 4 buses respectively. It is by a combination of transit and cars that we can maintain a minimum investment for a good transit operation rather than operating on a boom and bust system.

Table VIII. Total Miles Travelled to and from Work Per Day

	Length of road (miles)	Miles travelled/day: One person /car	Miles travelled/day: 4 people /car	Buses: # required	Buses: mileage
Single House	10	21,120	5,280	46	1760
Duplex	6	12,672	3,172	26	1040
5 Houses	4	8,448	2,112	18	720

Now let us consider the operating performance of cars. The question as to the type of car one can afford is the same as for the house "Can I afford the payment?". We will see once again that that energy operating costs are of minor concern in the operating cost of a car. It would appear that most people sell a car either at the end of or before the last payment is due. The costs of operating a car is shown in Table IX.

The gas bills are based on average mileage 10,000 and 6,250 miles/year and a cost of $1.00/gallon. The list price for the car is minimum list price. The insurance rate (Halifax) is paid in a lump sum but is broken down to a monthly figure to bring it to a comparative basis and is based on $100 deductible, accident free driver who is over 25 years of age. The above costs do not allow for depreciation or maintenance. The cost of gasoline is no more than one fifth the cost of operating a car and carpooling brings a dramatic decrease in the cost.

The federal government encourages us to have regular tune ups on our car to save 10-15% gasoline. This would give us annual savings of $30-50 for a large car and $22-33 for a small car. These days you are lucky if the cost of one engine tune up comes to less than the annual savings. The most important aspect of the tune up is that the car will perform well and get us to where we want to go.

Table IX. Operating Costs of Car

Car	Cost	Down Payment	Monthly Payment 36 mth	Monthly Payment 48 mth	mpg	Insurance (Halifax)	Gas bill/mth. 10,000	Gas bill/mth. 6,250	Parking Monthly
Large	7000	1750	178	142	20	31.00	42	26	20-30
Medium	6000	1500	153	122	24	28.00	35	22	20-30
Small	5000	1250	127	102	30	23.00	28	18	20-30

In summary for the transportation section, it has been shown that car pooling will produce dramatic savings in gasoline consumption, decrease traffic congestion and that the revenues resulting from entry fees into the downtown area in peak hours could be used to defray deficits for transit coperations and also to expand transit systems. The most important aspect of operating a car is not the cost of gasoline, which would have to increase to approximately three times its present level to become comparable to the monthly payments required to purchase a car. The design and layout of subdivisions is also important in decreasing both the mileage driven and the consumption of gasoline. The suggested improvements will require strong government action.

4. INDUSTRIAL ACTIVITY

Conservation of energy in housing and transportation will lead to a decrease in industrial activity and further energy savings, which will be in addition to any savings that present government regulations will effect in the future. First of all, let us have a look at the effect of housing. The number of single houses started generally is over half of the residence units constructed. This means that in the next 10 years over 1,000,000 single houses will be started. If we build single houses, we will require 4700 miles of road alone for road frontage along the houses by only 1900 miles for row housing. There will also be corresponding decreases in the length of sewer pipes, power lines, telephone lines, etc. The estimated savings are a minimum of $3.0 billion and this means that a large number of manhours will be lost and consequently leading to a decrease in employment opportunities.

Carpooling will give significant reductions in annual mileage. The entry fee to downtown areas will not increase the cost of living but will decrease it because of savings affected by not driving cars. In the case of Halifax the number of entries into the city should decrease and if this falls by 75% (4 people to a car) no major road improvements in the Halifax area would be needed in the forseeable future. The three major effects would be:

(1) The loss of provincial or state revenues (In Nova Scotia this would be around $13 million).
(2) Considerable decrease in cash flow to oil companies and decreased profits.
(3) Bankruptcy for many service station operators.

These effects could only be avoided by major increases in the cost of gasoline.

People generally change their cars every 2 to 3 years.

Table X. Effect of Time Change on Demand of Cars

Average Mileage	Time Change	Demand for New Cars
10,000	2.0 years	100%
7,500	2.7 years	75%
6,667	3.0 years	67%
6,250	3.2 years	63%

Table XI. Effect of Increased Average Life on New Car Sales

Present Average Life	Average Mileage	New Avg. Life	New car Market %	Time to Reach New Level. Years
10 years	10,000	10	100%	0
	9,000	11.1	90%	11
	7,500	13.3	75%	13
	6,250	16.0	62%	16

This is based on the fact that somewhere between every 20,000 - 30,000 miles is a good time to change cars. With carpooling there would be a significant drop in the mileage and if we say that an average car is changed every 20,000 miles the time change is shown in Table X.

The car industry in Canada is approximately 1,000,000 new cars/year. When the affect of carpooling is felt, the number of new cars needed will fall. The average life of a car (8-10 years) which is a function of mileage, age and economic activity, would increase with car pooling. It is unlikely that anyone who, at present, changes his car every 20,000 miles would continue to change his car every two years but that the car would probably be changed somewhere between 12,500 and 20,000 miles. If the average life of a car is increased, new car sales will fall (Table XI). This is contrary to the long term expectations of the automobile industry.

The automobile manufacturing industry employs around 80,000. If the effect of carpooling is to decrease the demand for automobiles by around 25%, the number of persons employed would fall by approximately 20,000. This analysis does not take into account all the thousands of other people employed or affected by the automobile industry. The net effect would be to greatly increase unemployment, which would mean that taxes would have to be increased to pay unemployment and welfare benefits.

One example of the effect decreased automobile demand would have is on the steel industry. In 1977, the automobile industry in the U.S.A. consumed 21.5 million tons of steel (23% of domestic production). Although the weight of cars will continue to be reduced, the steel industry expects that the total quantity of steel sold will be about the same after allowing for increased car sales of 2% per year. If carpooling decreased the demand for cars by 25%, the demand for steel would be reduced by about 5% leading to an even greater surplus capacity in the steel industry.

Now let us consider electrical energy. We, in Nova Scotia, have been told that in order to avoid skyrocketing costs for electrical energy we will have to practice conservation. Last year the Nova Scotia Power Corperation incurred total costs of approximately $155 million and the cost of fuel was approximately $80 million. The company incurred a loss of $9 million on its operations. If everybody embarked on a program of conservation and was successful in cutting consumption by 50%, revenues would be $73 million. The cost of fuel would drop to about $40 million but the other operating costs would remain the same ($75 million) and a net loss of $35 million would result. Therefore in order to avoid a loss, the fee schedule would have to be increased by 48%. The fee schedules would have to be increased even more drastically for those utilities using more capital intensive methods of generating electricity, e.g., hydro-electric and nuclear power stations.

Two electric utility companies in Canada have recently stated that part of the increase in rates was because the increase in the amount of electricity consumed was less than expected and one of the companies employs public relations personnel who go round advising people how to conserve in the use of electricity. Two successive increases of 47% and 16% in power rates was one of the contributing factors in the fall of the Nova Scotia Government in a recent election.

The North American Society revolves around a high pressure advertising system. The two main advertising media are electronic (TV and radio) and newspapers. A newspaper is comprised of 70-75% advertising. While a manufacturer has a right to advertise his products, one can question whether or not a product is over promoted. Many grocery chains use two full pages to advertise their merchandise. One local chain in Halifax is able to get into 2/3 of a page more information than the others give in two pages. If we follow this to its conclusion and advertisers used the space they needed rather than what they think they needed, the size of the newspaper could drop by 15%. The pulp and paper industry manufactuers around 9,000,000 tons of newsprint per year and employs around 85,000 people. About 90% of this newsprint is exported. Although the pulp and paper industry is a large energy user, it is very unlikely that the Canadian Government would carry on a campaign to get other countries to cut down on the size of their newspapers as the industry employs many people and helps Canada's balance of payments.

The Canadian Government is proposing that the miles per gallon for automobiles will increase from 17.5 in 1975 to 26 in 1980 to 33 in 1985. These savings will be achieved by improved technology and by greatly decreasing the average size and weight of cars. The profit on a large car is greater than on a small car and if the automobile manufacturer is to make the same total profit the price of automobiles will have to be increased. Government revenues will also correspondingly fall. This is illustrated in Table XII. The present system uses profit margins of 20% for the retailer and manufacturer and a Federal Sales (or Excise) tax of 12%. The totals are for the sale of 100 cars. "Future 1" shows how the revenues will decrease at all three levels. "Future 2" shows the price levels when total profits are once again increased to their present levels which involves increases in the profit margins to 22.2%, 13% and 21.6% for the manufacturer, government and retailer respectively, giving a total increase of 4.2% in the final price of the car. These changes may be masked somewhat by the effects of inflation and cost of improved technology but nevertheless it is still there.

The phenomenon illustrated above for electrical energy conservation will increase the unit cost applies in all cases to producers and suppliers of energy. Oil refineries in Eastern Canada are estimated to be running 30% below capacity compared to around 10-15% in 1976 and 98% 1973. The better mileage of the 1979 model cars will also lead to a decrease in consumption of oil. The lost sales in 1976 amounted to $100 million. If follows that the unit cost ($/gallon) must increase for both oil companies and service stations. One of three paths will be followed: (1) some service stations and refineries will close, (2) the price of gas will be in-

Table XII. Effect of Product Mix Changes on Profits and Government Revenues

System	Model Type	Market Mix %	Retail Price	Retailers Profit	Wholesale Price	Federal Sales Tax	Manufacuters Selling Price	Manufacturers Profit 20%	Estimate Manufact'd Cost
Present	Large	30	6,000	1,000	5,000	536	4,464	744	3,720
	Med.	40	5,000	833	4,167	447	3,720	620	3,100
	Small	30	4,000	667	3,333	357	2,976	496	2,480
	TOTAL	100	500,000	83,330		44,670		62,000	
Future 1.	Large	5	6,000	1,000	5,000	536	4,464	744	3,720
	Med.	40	5,000	833	4,167	447	3,720	620	3,100
	Small	55	4,000	667	3,333	357	2,976	496	2,480
	TOTAL		450,000	75,005		40,195		55,800	
Future 2.	Large	5	6,248	1,110	5,138	591	4,547	827	3,720
	Med.	40	5,211	926	4,285	496	3,789	689	3,100
	Small	55	4,165	740	3,425	394	3,031	551	2,480
	TOTAL		468,755	83,290		44,330		62,000	

creased, or (3) prices will decrease to encourage consumption and maintain cash flow and eventually leading to the first alternative. The third path is already being followed, as oil companies are selling residual fuel oil at prices below that of natural gas, which is supposedly regulated at 85% of the oil price, resulting in one gas utility company not being able to accept all the gas it has contracted for but will have to pay for the contracted amount. As the utility company is allowed to maintain a certain return on investment, the price of gas will have to increase to offset the loss.

It has been shown in this section that provincial or state and federal revenues will fall. We are faced with a quandary: do we conserve now, incurring larger unit costs and higher unemployment and reap the benefit in the future or do we practice less conservation keeping the unit costs down and employment up and risk a difficult position in the future. Governments appear to have followed the latter course.

5. FUTURE SOURCES OF ENERGY

It has been previously mentioned that energy is derived from one of two sources, viz., nuclear fusion and gravitational forces. Nuclear fission power stations are currently operating but once again one is looking at a limited fuel resource. Both nuclear fusion and nuclear fission power stations involve some risk and there is the problem of the disposal of waste radio-active material. Our time frame of decision making is too small for us to accurately assess the risks and problems attached to these sources of energy. One is therefore left to the conclusion that our future supplies of ener energy should come from one of three sources, viz.,

(1) Nuclear Fusion ---------Solar Energy
(2) Wind.
(3) Gravitation ------------Tidal Power.

Wind has been used for centuries as a source of power. A combination of wind and sails was used for transportation. Windmills were used as a source of energy for pumps and grinding wheat to make flour. There is no doubt that windmills will once again be used as a source of energy and are probably best suited for more remote communities. The main problems with windmills are the design of large generators and to develop a storage system for the energy generated.

The largest source of gravitational power available is tidal power. The amount of power that can be harnessed from tides at the moment is miniscule compared to the total energy demand. Even the best source, the Bay of Fundy, may run into considerable problems with silt. Furthermore, one cannot forecast what the environmental effects of such a scheme may be.

The remaining source is solar energy. All our present fossil fuels are derived from solar energy. The problem is therefore to effectively utilise solar energy. There are many places in the world where the sun burns all day, with hardly ever a cloud in sight. These deserts would make ideal solar collectors and one has therefore to design a system to transport and store the energy in a suitable form for use when needed. Also there are many ways in which solar energy can be used, see Fig. 1, to provide energy and sustain life on earth. In essence these processes were the ones used in producing fossil fuels.

These wind and solar energy systems may well provide problems for governments. At the moment governments derive considerable revenue from fuel, but as the wind and sun are free and we can all to some extent utilise these sources, government revenues will fall and these will have to be replaced somehow. Also it is unlikely that governments, which have spent billions of dollars on nuclear systems, are going to look favourably on "free" systems and have to admit that they have wasted their investment.

6 CONCLUSIONS

It has been shown that massive energy savings can be achieved by looking at the total system but at some cost in employment and economic activity. In new housing it is estimated that energy savings of over 50% compared to the present standard house could be achieved and that a large amount of land could be preserved for agriculture but there will be problems in the acceptance of row housing. Energy conservation in transportation will be affected by housing design, but most savings (25-35%) will be incurred by carpooling, which could be brought about by charging entry fees to downtown areas and these fees could be used to develop better transit systems. Energy conservation will, as depicted here, have an adverse effect on industrial activity leading to increased prices, decreasing government revenues and more unemployment. It will therefore be necessary to encourage development of those areas of the economy which are non-intensive energy consuming to take up the slack.

It is the responsibility of governments to lead and market the proposed systems to the people they represent. The present government efforts, upon closer exam-

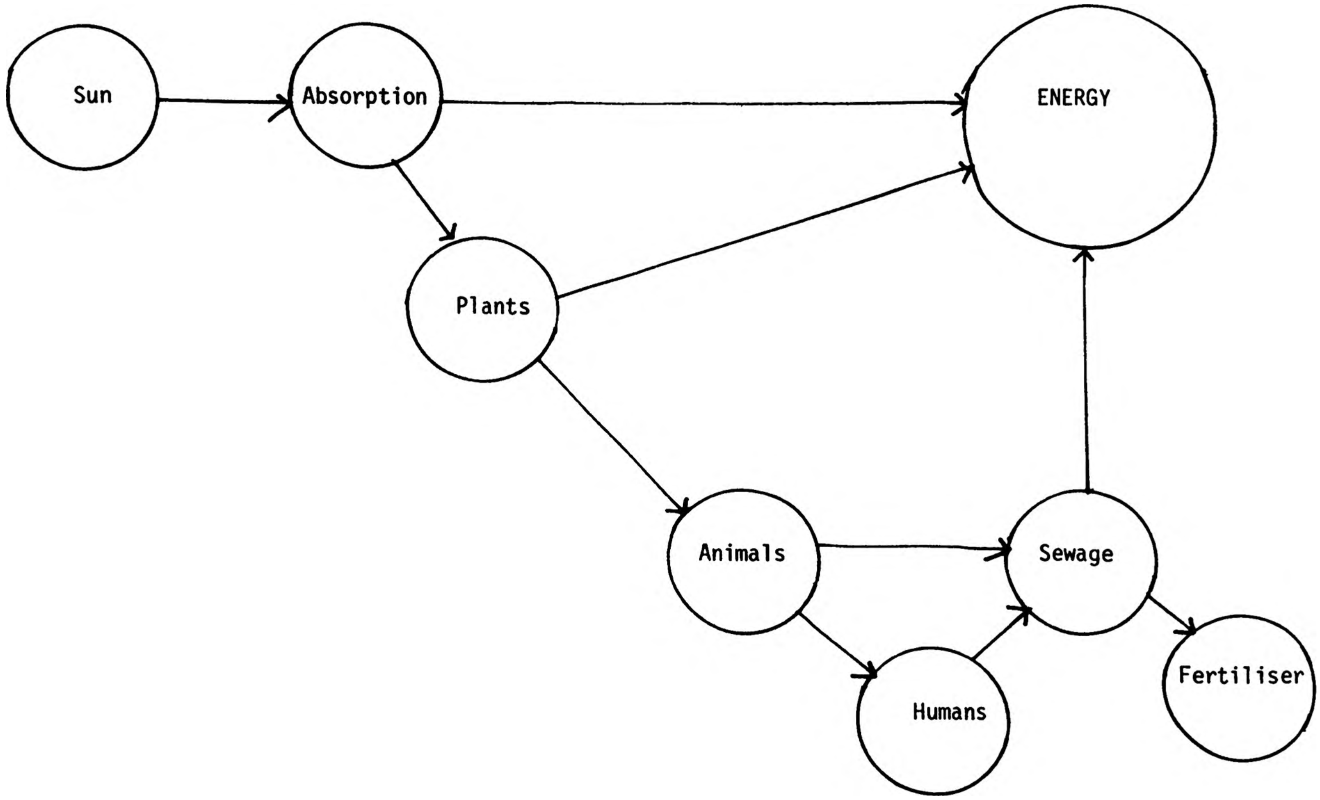

Fig. 1. The Solar Energy System

ination, amount to very little and as the cost of energy is such a small proportion of the total cost of living we are provided with very little incentive to practise conservation. To achieve the savings indicated in this paper will require strong political action both legislative and fiscal. The fiscal methods can be punitive, e.g., entry fees to downtown areas, and incentive, e.g. allowing the ordinary person income tax allowances or cash grants for practising conservations.

Finally, we should all practice energy conservation now in order for the human race to develop technology and other sources of energy before fossil fuels run out.

EPILOGUE

The reason for the DC8 jetliner charter was to transport the two pet dogs inside the passenger compartments from England to Canada. As multimillion dollar jetliners are not left idle on airport tarmac, the charter was a very favourable deal to the airline as the aircraft was going to return to Canada empty. If the airline president in the interests of energy conservation had said, "It is far, far better that I leave the aircraft in London until it is filled with passengers", it would not be long before he would be put on the corporate execution block.

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