

GASOLINE RATIONING ... Are You Kidding? 2/12/09

**Energy ... the common factor in peak oil, growth,
financial collapse, and automobile travel.**

ABSTRACT:

As an immediate antidote to the complex, intertwined, global, economic-energy crisis, it is proposed that the United States government quickly move to legislate the reduction of gasoline consumption by rationing. This is a far better alternative than relying on wild market speculation or increased taxation.

At first this concept seems counter-productive, but further examination shows we need a bold about-face in our thinking and habits instead of attempting continued business-as-usual as we enter the second (declining) half of the short oil age.

Every gallon of gas consumed for purposes other than absolute necessity and national security represents precious finite energy wasted instead of being available for the food chain, essential transport, and other critical components necessary for our future survival.

An analysis of the balance of energy flow into and out of any dynamic system shows simply why a controlled reduction of gasoline usage offers the best possibility for a quick and relatively easy reduction of energy consumption. This bold action will help mitigate the inevitable post-oil age collapse of industrialized civilization.

As disconnected as they may seem, closer examination will show why the leveling and imminent decline of finite fossil energy (beginning with peak oil), a debt-based financial economy, and gasoline consumption are closely interactive.

If the proposal that follows seems preposterous, unnecessary, or unworkable, at least read the summary review and conclusions. Retain and compare this paper for future reference after the failure of all other proposals to continue a high-energy future as energy resources decline.

AN ENERGY ANALYSIS:

By late 2008, it is clear that the world is slipping into an unprecedented economic crisis precipitated by terminal growth. The basic underlying cause is that an absolute prerequisite (along with inert raw materials) for growth of anything (a bird's nest, a living body, a building, or a civilization) is a readily available source of surplus energy. Since 2004, the world-wide production and consumption of finite fossil fuels led by conventional oil, which peaked in 2005, began to level off and is facing a terminal decline.

The modern economic concept of a debt-based financial system predicated on expected future growth cannot continue. The limits of pre-stored energy have changed the rules.

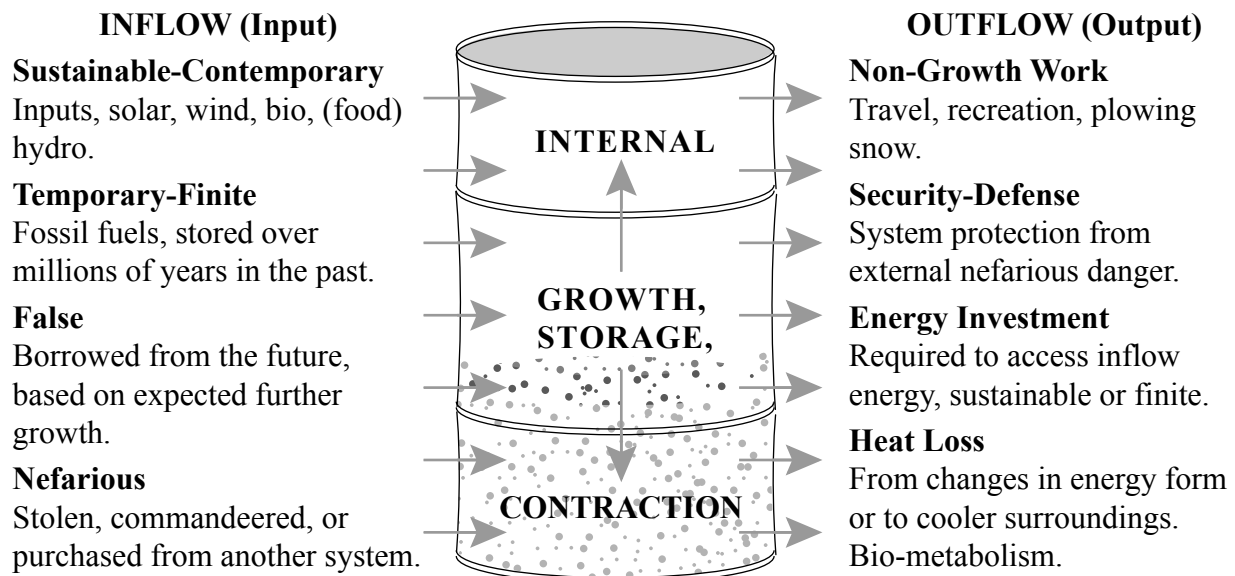
The following model of energy flow shows our basic human predicament. Energy is that elusive multi-faceted “something” required for any combination of work, heat, and growth. It can be stored for future use and is frequently confused with currency, wealth, and power, which is only a measure of how fast it is being used. Without energy in any of its many forms, nothing happens except system contraction and cooling.

Engineers simplify this complex principal by analyzing and quantifying the energy balance over a period of time within a closed dynamic system. Since energy cannot be created or destroyed, the difference between all the energy inputs minus all the energy outputs must be accounted for as internal growth, storage, or contraction (decay) and can be summarized in an energy-flow model. In minus out equals growth or decay.

The basic concept is no different than water flowing into and out of a leaky pail or electrical current flowing into and out of a storage battery. Another personal analogy is energy (from food) flowing into our bodies while energy in the form of work and heat to maintain our metabolism and temperature flows out. An excess of inflow over outflow appears as growth (even obesity). What could be simpler?

Yet, misunderstanding the balance of energy is the basis for so many seemingly dissimilar problems like running out of gas, excess weight as fat storage, or the collapse of civilizations. Understandably, much confusion arises because energy can hide in many different forms and is always trying to dissipate to a lower-energy form. For instance, the pail can leak, the water can evaporate or we might starve for lack of food.

ENERGY-FLOW BALANCE FOR A CLOSED SYSTEM



SPECIFICS: (left-side inflow)

The most important factor in the above model is the overwhelming contribution (over 85%) from the TEMPORARY-FINITE input of fossil energy. Nuclear is also a smaller finite energy factor (about 6%) because fissionable uranium, which peaked in production about 1980 during the cold war, is also non-renewable. Since all left-side TEMPORARY-FINITE inputs must eventually and inexorably decline by their very definition as finite, internal system growth will cease and begin to concurrently decline unless energy outputs on the right side also proportionally decrease, or other left-side inputs increase enough to make up the shortfall of TEMPORARY-FINITE energy and keep the entire system from contracting.

We waste valuable time trying to find new energy sources, arguing about how much is left, or how the climate is changing while, by about 2020, all finite fuels (oil, natural gas, coal, and fissionable uranium) will have peaked and started down the second half of the brief industrial age. The first half led to un-precedented energy-fueled growth. The second half will lead to energy-starved system contraction, unless we instead constrict the right-side output of our energy-balance system.

The most confusing input, which led to our current economic crisis, is the FALSE borrowing of wealth from the future based on the perception of continued growth of the complete system. Wealth, as measured by paper currency or metal coins, is not energy. It can't do work or keep us warm. It is only a temporary quantitative value assigned to real things, goods, or services and subject to change at any time. Continued growth infers an increase of wealth equal to the original principle plus interest. This can not happen without a steady surplus (over output on the right side) of either honest TEMPORARY-FINITE energy inputs from the past or CONTEMPORARY SUSTAINABLE inputs from the present.

The borrowing of wealth based on expected, continued, future growth is the backbone of our entire financial system. But remember the basic premise: a system cannot grow without ever-increasing energy. It may take time for this connection between energy and wealth to make sense, but think about it, you can't keep a pail from emptying today with hope of rain next week.

The leveling or peaking, beginning in 2004 at about seventy-five million barrels per day of conventional crude oil production and resultant sharp price increase, led to the incipient collapse, first of the growth-based housing and then of the entire, intertwined, debt-based, highly-leveraged, world-financial complex. Everyone started to spend far more on energy and all related goods and services.

In the last quarter of 2008, all liquid fuels including non-conventional oil from tar sands, deep-off-shore, polar, natural gas liquids, and bio-fuels also peaked at about eighty-five million barrels per day and began to decline. This is because the collapse in economic activity, demand, and lower price rendered these non-conventional sources unprofitable. We have clearly passed "peak oil".

It may seem audacious for an energy engineer to attempt to simplify and explain macro-economics, but economists, politicians, bankers, financial advisers, pundits, and so on don't seem to understand the basic role of energy. Further infusions of paper wealth, bail outs, and stimulus packages based on hope of growth revival in the future cannot work because future energy growth, dependent primarily on oil, is no longer possible.

In our present predicament, CONTEMPORARY-SUSTAINABLE inputs account for less than ten-percent of our total energy consumption. Because of the dilute, sporadic nature of incoming, annual solar energy in its common forms of direct solar, wind, bio-energy, or hydro power, the sum (from the sun) can NEVER remotely approach the quantitative level of conveniently stored fossil fuels, which represent millions of years of prehistoric solar energy. Other non-fossil inputs like tidal, wave, or geothermal are tiny, site-specific and poor in energy return. They cannot amount to more than diversions to our main focus, the imminent decline of TEMPORARY-FINITE fuel inputs.

The last energy input on the left side of our energy balance is NEFARIOUS. For smaller internal subsystems like nations or societies, this is a most important factor. "We want what you have". Whenever a closed group of bio-species exceeds or diminishes its carrying capacity (in its most basic form, food) or expands population, the over-powering urge to survive (the "Selfish Gene") leads to territorial conflict. Sometimes this external input is hidden as a seemingly benevolent interaction. But the energy balance is the same. Energy is transferred from one sub-system to another. This is simply a non-sustainable contraction of one system to support growth in another. All externally-sourced TEMPORARY-FINITE fossil fuels could be included in this category, like oil from Canada and Mexico, but instead are lumped together as one specific input because of their dominant, unique contribution compared to the other inputs.

The NEFARIOUS category also holds true for non-energy resources, but these are just inert raw materials which cannot be accessed (mined), transported, or processed into useful goods and growth without ... energy. Open the history book to any page, and this last category underlies and explains much of the glory and tragedy of our past. The slave trade would be an example. As surplus fossil energy winds down, unfortunately we are beginning to regress to past human nature, which is to do anything to keep left-side inputs maximized in order to continue a high level of right-side outputs and at the same time avoid system contraction and ultimate collapse.

For a complete closed system, like our planet, subsystem NEFARIOUS inputs are not possible. We can't raid the moon for energy except for a little tidal gravity. We can access a small amount of internal geothermal energy, but it is site specific and can't contribute more than a tiny fraction of our needs. Our best sustainable energy input source always has been and still is the sun.

SPECIFICS: (right-side outflow)

To keep our closed system from contracting as TEMPORARY-FINITE left-side inputs begin to decline in the post-fossil fuel age, our only option is to reduce right-side output losses just as with the water pail or storage battery. We must try to plug the leaks.

HEAT LOSS from a warmer body to colder surroundings is one of the fundamental laws of physics. On a world macro-basis, there is nothing to reduce this energy output because the sun and the world are always in energy equilibrium. The effect of increased natural or industrial greenhouse gases only serves to raise the world temperature a few degrees to a new equilibrium level. The resultant global warming does not reduce the overall quantity of energy output back into cold outer space.

However, the desired temperature of small sub-systems like living bodies or houses can be maintained with far less input energy by reducing right-side HEAT LOSS through better clothes or insulation. This is the basis for efficiency savings and makes sense as long as decreased energy improvements are not offset by continued overall system growth such as an increase in population. This common phenomenon was identified by W.S.Jevons at the beginning of the fossil-fueled industrial age in the 19th century, and bears his name, “Jevon’s Paradox”.

HEAT LOSS is a significant category from a human basis because it accounts for the energy output as we, individually and collectively, dissipate the heat from metabolizing food. Higher food consumption from increased population results in proportionally more right-side energy lost as heat and/or non-growth work, forever.

SECURITY-DEFENSE energy output can be most important in a subsystem energy balance. It is the opposite of NEFARIOUS inputs. How much precious energy is expended by an individual, a village, or a nation to defend the integrity of a specific energy-based system? Military energy requirements can be massive. In systems where energy inputs are copious, like ours has been in the fossil-fuel age, this is not a problem. But in any other time, the energy cost to resist NEFARIOUS encroachments from other systems can be ruinous by itself.

In future low-energy times, SECURITY-DEFENSE losses will begin to be very important. For instance, a single animal can exhaust itself by fighting for survival or to protect territory and food sources. The end result is the same, system-decay leading to death. A nation like the Roman Empire can fail from inadequate internal energy left for securing NEFARIOUS inputs after losses for SECURITY and DEFENSE. Should the last internal energy go to feeding people or defending them?

A third and often overlooked energy loss is the ENERGY INVESTMENT required to acquire the inflow energy. This ratio is named by the acronym EROEI (Energy Returned On Energy Invested). Sometimes this term is shortened to EROI and is usually analyzed for a specific energy source as the quantity acquired divided by the quantity expended. When the ratio is greater than unity the acquisition is considered positive and the effort makes sense. The harvesting of fossil energy originally put this ratio over 100:1 but is steadily declining as we deplete the easiest sources of prehistoric finite energy.

An example of a very positive EROEI is wood. Otherwise our ancestors would not have survived. In the fossil fuel age, it takes only a tiny bit of energy to acquire the petro-fuel required to in turn harvest a huge multiple of bio-energy. However, this loop is clearly unsustainable if more wood is harvested in one year (about one cord or 3000 pounds, wet, per acre) than grows through photosynthesis of incoming solar energy in the same period. In addition, the soils, water, and minerals as ashes from the burned wood, need to be replaced. Over-harvesting beyond sustainability has historically led to the overshoot of population and collapse of civilizations like Easter Island.

There are many examples of marginal EROEI's, which do not significantly help system growth and avoid contraction and decay. The confusion creeps in when other subsystem inputs or losses are mixed in with those used directly in an analysis.

For instance, there is much argument concerning the EROEI of corn ethanol for fuel. Should all the inputs to grow the corn like irrigation energy, fertilizer, fossil energy to manufacture farm equipment, and many more be included in the inputs? Should the heat from burning rather than returning to the same land the co-products (stalks, leaves, and ashes) be considered output? Depending on the methodology used, EROEI for corn to fuel-ethanol ranges from less than one up to 1.5.

In addition, it is clear from our energy-balance model that the output energy for ethanol as fuel is lost as NON-GROWTH work rather than assimilated as INTERNAL GROWTH. Using 30% of our corn for fuel instead of food for growth and survival does not make sense from any quantitative or ethical view. Yet, here we are. Drive up to the gas pump and fill with 10% ethanol, a tragic testimonial to our intelligence.

On a personal level, the external right-side ENERGY INVESTMENT to acquire energy is different from NON-GROWTH WORK. Instead of going for a ride on the bike or a hike, we could expend the same food energy growing more food or cutting firewood. Much hidden energy loss is from energy consumers who do not work directly to facilitate energy inputs (including food, like a farmer) but still contribute to right-side energy losses. This has always been true of children, the aged, or infirm, but it is equally true for anyone not directly involved in the energy chain. For instance, a productive adult who is suddenly out of work represents a continuing energy-system drain because he/she still has to eat.

This argument could be carried further to question the energy-input contribution of (in no particular order) the energy required for financial services, marketing, insurance, recreation, entertainment, transportation (with no fuel), management, building construction (except to save energy), space exploration, and so on. It may sound heretic to question traditional careers, but without copious surplus energy, any activity not directly related to fuel, food, or warmth will be greatly challenged. All of the above occupations grew far out of proportion to farming and keeping warm only because of the fossil energy age. Even essential needs like medical care and communications are already under pressure.

THE CAR IS THE CULPRIT:

This leaves us with NON-GROWTH WORK as the only category of output energy we can significantly reduce to keep pace with declining input without reduced population or an immediate reduction in life style. This brings us to the main thesis: gasoline rationing.

The mechanical definition of energy is the ability of some thing to do work, where work is simply a force acting over a distance. Distance is the most important term here because it implies movement or travel. If we use our personal stored energy (from food) for the work required to crawl, walk, bike, or run from point A to point B, at least we have an obvious result, we're in a different place, B. Our energy (to do the work) consumption is apparent regardless if we really needed to get to B to survive. If we use another quantity of precious energy to get back to A or go in circles, we literally have wasted energy going nowhere. This is the same energy which could have been used to grow food, for defense, to build something, or forestall contraction and decay. Indiscriminate travel is a very suspect use of energy. Only the travel to acquire food or fuel is essential for system survival.

Only in the profligate fossil-fuel energy age do we have the luxury of the masses riding in a 4000-pound chariot, traveling seventy-miles an hour, with extra heat and entertainment. Up to the last months of 2008, American drivers had been burning gasoline at the rate of four-hundred million gallons ... per day! This amounts to one-eighth of world oil consumption and an outflow of American wealth for foreign oil of over a billion dollars per day as long as oil prices hovered about one-hundred dollars per barrel.

We use more energy to travel a few miles to the supermarket than is in the food we bring home to feed a family of four for a week. In our overall energy balance, the EROEI in this case is clearly less than one which contributes to system decay.

In the last few years, oil and gasoline prices climbed to record highs as production of all related petro-products began to level off. Our future-growth-dependent economic system ground to a screeching halt. Debt- based growth and expansion based on a continued energy surplus could no longer continue. Other forms of energy could not substitute for the peaking production and consumption of oil.

As long as market forces control the price of gasoline and prices are high because of production shortfalls all over the world, the wealthy can still out-bid the poor. But high gasoline consumption also affects the price of other related energy-intensive needs like food, diesel, jet fuel, and heating fuel. Finally, now with the cessation of growth and the economic collapse, there is a temporary surplus of oil and gasoline for the first time since the eighties when plentiful world oil replaced waning U.S. supplies. The result is an unprecedented price collapse exacerbated by the speculative machinations of the commodity markets, in turn leading to turmoil and further curtailment of world oil production.

Truly, we have started down the second half of the oil age. This is a classic chicken and egg question. Which came first and was the cause: the housing bust leading to debt-based financial collapse or the peaking of world oil? Since new housing and debt-based growth, like all real system internal growth, cannot occur without energy. It would appear that waning energy and sharply higher prices were the basic problem. Do we have to wait a few years to prove this in hindsight?

There are many other possibilities to reduce discretionary energy consumption (NON-GROWTH-WORK) commensurate with the leveling and imminent decline of TEMPORARY-FINITE fuels, but none are as obvious or excessive as the American love-affair with the automobile. Even gasoline at under two dollars per gallon is too expensive if the economy has ceased to grow leaving out-of-work consumers with no cash for gas and cars that use way too much.

We are now experiencing a snowball effect and learning just how much of our economy depends directly on the automobile. New car production (also debt financed on the premise of continued growth) has suddenly stalled. The travel and tourist industry are suffering. Indirectly, highway taxes and suburban home demand are in serious jeopardy.

SPECIFICS: (internal growth, storage, or contraction)

What actually is internal growth or contraction of an energy system like a national society made up of millions of people? In times of new, temporary, gross surplus of left-side energy inputs, the right-side outputs are relatively small. The system has an inherent natural impetus to grow. This is manifested as skyscrapers, super highways, millions of cars, and most importantly ... population growth.

A surplus of energy, which vastly increases food supply without the usual proportionate manual labor requirement, especially encourages and facilitates growth. More food equals more mouths to feed. This is a basic natural effect, which only works until a new higher limit of carrying capacity is reached to balance the temporary surplus of INPUT energy. At this point, growth can no longer continue. The new population level is restrained by a ceiling dictated by the balance of input and output energy in all its forms.

A mathematician, Thomas Robert Malthus, proposed this concept in his 1798 publication, "An Essay On The Principle Of Population". He used the term "misery" for the result when the natural tendency of a population to expand clashes with the maxed-out carrying capacity for a particular society. This is true of all the animal kingdom. Humans are no exception. The tenuous conflict between food and other essentials ruled for all of human history until the short fossil-energy age temporarily proved Malthus wrong. Now we're in serious trouble because we're not only bumping against a much higher resource ceiling, but the temporary resource bonanza of finite energy is beginning to decline. The ceiling is coming down with no hope of further growth. We're running out of gas.

WHY RATION?

If we continue to let market and speculative forces establish the price as world oil (energy) production declines, we will continue to see price spikes. Maybe not as quickly or as high because there are far fewer consumers who can bid the price back up. No one knows how and when this will play out, but it is certain that there will be less gasoline as oil production, the predominate part of finite input energy, inexorably declines. The tragedy of this inevitable scenario is that the love of the automobile trip, especially by those left who can afford gasoline even at a higher price, will deny increasingly valuable energy for more essential needs. Already this is happening with ethanol and bio-diesel.

Increased taxation of transportation fuel, as practiced for years in other industrialized countries, is a step in the right direction but not much better than when only market forces balance price, supply, and demand. The wealthy can still outbid the poor. On the positive side, at least increased taxes encourage smaller cars and reduced travel by all, the price is somewhat stabilized, and some of the fuel cost flows to the national treasury.

THE BACKGROUND (in numbers and simple physics):

Presently, in very rounded numbers, two-hundred million licensed U.S. drivers consume each day four-hundred million gallons of gasoline (ten million 42-gallon barrels). This gives every driver an average of two gallons or at twenty-five miles per gallon, fifty miles of travel ... each day! This quantity represents one-eighth of world oil production just for American gasoline. Does this level of gross energy consumption justify the premature demise of our energy-intensive civilization?

If all drivers were restrained equally in gasoline use, there are a number of ways overall consumption could decline **WITHOUT ANY** initial reduction in distance traveled. For instance, let's focus on the simple physics involved for transportation, starting with the basic principal which everybody should understand:

$$W = F \times D$$

Work (W) output is equal to the fuel (energy) used in the engine, minus heat losses, to provide the force (F) required to move the car, times the distance (D) traveled.

We can easily reduce the left-side fuel required to provide the necessary work (W) without reducing distance (D) by decreasing only the force (F) on the right side. This could initially leave the distance traveled (D) unchanged.

For driving on the level, (F) consists of only two significant drag forces that require work (as fuel-energy) to overcome: rolling (R) and air turbulence (T). (T) might also be called wind resistance or air drag. (T) and (R) represent energy lost as heat, forever, from pushing air molecules aside as the car passes through the air or flexing the tire over an uneven surface.

In algebraic terms:

$$F = R + T$$

If we take a minute to further investigate these two terms, it will clear up much confusion, bogus information, and save a lot of fuel.

Rolling drag (R) is simply a numerical measured coefficient for a type of wheel (on a specific surface) times the weight on the wheel. For a hard rubber tire on pavement it is about 0.015 times the weight on the wheel. If the tire pressure is increased, this coefficient is less. If vehicle weight is less, rolling resistance (R) is also reduced. This is why bike tires are pumped up hard, and bikes work easiest on hard pavement. Lighter vehicles use less fuel. That's all there is to it. Not much we can do here except use a lighter vehicle or pump up the tires for a few percent reduction in fuel consumption.

Air drag (T for turbulence) is a little more complicated but needs to be clearly understood regardless of how we move into a low-energy future and especially with electric cars which have very little energy onboard. Here is where we can make significant reductions of work (fuel) required and are presently terribly wasteful.

There are three important factors multiplied together to make up the air drag (T). At very high altitudes thinner air also reduces air turbulence, but we will ignore that factor for our analysis. The total equation for air drag is:

$$T = A \times S \times V(\text{squared})$$

The frontal area of a vehicle is (A). Simply put, a vehicle with twice the frontal area will have twice the air drag. This is why airplanes are packaged like a cigar and travel in thinner air, and bicyclists crouch down to go fast. Yet, we insist on driving cars as big as barn doors because fuel has been so plentiful and inexpensive for the last 100 years. Smaller cars would immediately save a lot of work (fuel).

The second term (S) is a measured factor, which defines the shape of the vehicle and the way air (wind) flows around it. Intuitively we know that a streamlined egg shape will move through the air with less turbulence than a rectangular brick, yet we still waste gas driving cars shaped like one. A modern streamlined car has a shape factor (known as the coefficient of aerodynamic drag) of about 0.3 and there is not much more we can do about this factor except drive well-shaped cars. In addition, both frontal area and shape factor are not significant below speeds of about 30 mph when the total air turbulence (T) is small and less than rolling drag (R). We don't worry about shape and frontal area while pushing a baby carriage.

This brings us to our third factor, speed or velocity (V). This is the most important of all three terms because it is squared. If we go twice as fast (churning and heating air) it becomes four times as restrictive. (Two squared equals two times two equals four.) Do we really need to drive fast to get somewhere a little sooner? Only rationing will encourage slower driving because speed will use up the coupons quicker over a shorter distance.

The three terms (A, S, V), multiplied together, constitute the best possibility for considerable immediate fuel savings without an initial reduction in distance traveled and change in current way of life. Remember, this is fuel (energy) that is and will be far more critical for our complete energy system such as food, heating oil, social services, commercial transport, national defense, petroleum-based products, and all the other ubiquitous uses of petroleum as a food or feedstock. Converting coal and natural gas to automotive fuel, converting to diesel passenger cars, or plugging in hybrids only avoids the issue by substituting other TEMPORARY-FINITE energy inputs and moves us farther down ... the wrong road.

Rationing would dictate changes in driving habits equitably between rich and poor. No other concept gives us such a significant energy impact reduction for our future survival, yet it needs to be legislated so all share the effort. We need to get started while we still have considerable energy left but less every year.

In the not-too-distant future, when reduced speed and smaller cars are not enough, we will obviously have to drive less, plus shorter distances as restricted by increased rationing. This writer remembers World War II when our family had coupons for three gallons per week. That was a clear, temporary, national emergency at a time when the U.S. produced most of the world's oil and fueled the war. The collapse of our short oil age and termination of one-hundred and fifty years of steady growth appears even more perilous.

IMPLEMENTATION:

The devil is in the details, but in the electronic age rationing should be possible. No matter how inconvenient and unpopular, it is our only hope to quickly and significantly reduce energy output commensurate with the leveling and downward slide of petro-fuel availability. We have no choice. We waste too much gasoline now for fast frivolous travel in huge vehicles. The first pass should be easy. Our kids will wonder why we burned up our finite energy endowment and didn't save some for their survival.

The present consumption of about two gallons per day per licensed driver should be halved to one gallon per day very quickly. Perhaps one and one-half gallons per day would be an easier first step. This would still provide about fifty miles per day in an efficient car driven appropriately.

Each licensed driver who owns a registered vehicle would receive, monthly, from the state motor vehicle department a book of coupons (in the form of a swipe card) called Tradable Fuel Allocations (TFA's) or something similar. There would be one coupon per gallon or multiples. These must be presented at the gas station along with the payment for gas before pumping.

Each gas station would have a small electronic machine to record usage and ascertain the unused gallons available prior to pumping. Like a phone card, the same machine could count the total coupons used and reconcile the number with the gallons pumped for each day. The TFA's could be in multiples and the swipe card used similar to a debit transaction

Unused TFA's or swipe cards are negotiable and may be sold for cash at any agreed-upon street price like a long-distance phone card. There will be an immediate web-based or local market place to facilitate this need.

Obvious exceptions to rationing would be all governmental, municipal, emergency, security, and essential needs. In short, gasoline rationing would only effect private consumption. Gasoline required for farming and the food chain and all other commercial gasoline purchases would also be exempt and would be handled on a case to case basis to preclude abuse. This way the only commerce that would be reduced is where discretionary personal travel is involved. City folks who don't need much gasoline could sell coupons to those who need to drive long distances. This inequity will cause great consternation but reflects the true energy cost and threat to our future survival from profligate gasoline consumption.

The recreational market segment is in jeopardy as gasoline becomes expensive and the economy collapses. Unfortunately, this already happened leading to the price collapse in late 2008 and can only spike back up when declining production intersects a new, lower-level resurgence in demand. Is it ethical and wise to accelerate the demise of modern civilization as we use our children's survival fuel so we can play today? With gasoline rationing, everyone, rich or poor, will have an equal choice to use their fuel allotment for essential needs or consciously save it for pleasure.

SUMMARY-REVIEW:

1. Profligate gasoline consumption is the largest, quickest, and easiest candidate for controlled downsizing of energy consumption in order to mitigate and delay the inevitable post-fossil-fuel crash.

2. Rationing is the best equitable way to reduce consumption ahead of the imminent decline in world oil production. Rationing would keep price low and stable as well as minimizing wild market-price swings. Now, uncontrolled demand, production costs, alternative liquid fuels (some competing with food), speculation, world tension, and steadily declining oil fields all interact. We are totally unprepared and out of control as we enter a new era of diminishing energy from fossil fuels. As the most intelligent species we should recognize the facts and plan accordingly.

3. Since American drivers use about one-eighth of world petroleum just for gasoline, a positive action to downsize will send a huge message to the rest of the industrialized world, which is directly sharing with us the integrated energy-economic crisis.

4. Rationing would provide the time and price stability for exploration and development of alternative fuels, if any. The wild price swings we have now discourage long-range planning.

5. The street monetary value of Tradable Fuel Allotments (TFA's) would have the added advantage of putting instant cash in the hands of poor or frugal drivers. This would redistribute real wealth from those who can afford and choose to consume more to those who do not.

6. The equitable sharing and downsizing of gasoline consumption benefits all future energy consumers, rich or poor. Rationing is the only way for peaceful co-existence when diminishing essential resources are available for constant or steadily increasing demand. This is true for all survival scenarios.

7. Considering the dire circumstances facing us as we enter the second half of the oil age, it is highly probable that some form of rationing will soon have to expand to other critical uses like aviation fuel, commercial diesel, and industrial transportation fuel. If we ration gasoline now, that time can be postponed.

8. The controlled reduction of discretionary gasoline consumption will also leave more future petroleum feed-stocks available at a more stable price for heating oil, plastics, lubricants, agriculture, wood harvesting, strategic material mining, and a thousand other things that are oil-dependent, ubiquitous, and now taken for granted.

CONCLUSIONS:

A thesis is offered based on the following logic path:

1. Real energy is required for GROWTH ... of anything.
2. Our debt-based financial system of principal plus future interest is an example of GROWTH dependency which can only work when there is a continued surplus and commensurate increase in availability of real energy.
3. Over ninety percent of our real energy is derived from FINITE sources led by oil (about forty percent), which has recently peaked in availability due to the natural constraints of our finite planet plus increased costs and difficulty of extraction.
4. Suggested alternatives are minuscule, site specific, delusional, or limited by annual incoming solar energy. The finite fossil fuels also represent solar energy but with the concentration of hundreds of millions of years in the making in three convenient forms. These are the laws of physics and math. No amount of wishful thinking or research grants can change them.
5. In order to keep our energy-intensive society from quickly contracting and then collapsing from reduced real-energy input, we have only one option, to reduce real-energy losses.
6. A most wasteful energy loss (one-eighth of world oil) is the American use of gasoline for fast travel in large cars.

7. We could make a giant first step in oil reduction and mitigation of the imminent real energy decline by rationing the availability of gasoline equally between the wealthy and poor. One gallon per day per licensed driver would halve our U.S. consumption with very little decrease in miles traveled if we drove smaller cars slower.

8. Electronic tradable gasoline coupons could be saved or openly traded on the open market. This would immediately transfer wealth from those who can afford to prematurely use tomorrow's energy today, to those who choose to conserve and soften the impact of the imminent post-oil age.

Please give these thoughts a chance. Let them sink in. Test them against other proposals and pass them along to others, especially to those in a decision-making capacity. Our best hope is rapid, exponential, diffusion of ideas and information now possible in the electronic age.

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