City of Bellingham and Whatcom County

Energy Resource Scarcity/Peak Oil Task Force Report

November 2009

Contents

1. EXECUTIVE SUMMARY

In May 2008 both the Bellingham City Council and the Whatcom County Council passed separate resolutions establishing the Energy Resource Scarcity/Peak Oil (ERSPO) Task Force to study and provide recommendations regarding the local consequences of a decline in the supply of traditional energy resources. The ERSPO Task Force process included meetings as a whole, in subcommittees, and in consultation with members of a Portland, Oregon Peak Oil Task Force working group. The Portland group's March 2007 report served as a model for much of the local ERSPO Task Force's work, with several of the applicable Portland Peak Oil Task Force findings incorporated into this report.

This report summarizes research and information relevant to Bellingham and Whatcom County and recommends actions to allow the community to better adapt to declining oil and gas supplies. The measures suggest ways to prepare for a lower carbon energy future in a manner consistent with ongoing efforts to reduce global warming, but with an urgency driven by potential for sudden change.

Peak oil describes the point of maximum production after which the ability to produce oil will begin to decline. Peak oil production in the U.S. occurred in 1970 and this country now imports 60% of the oil we use. On a global scale peak oil timing is not definitive, but there is a growing body of opinion, including that of the International Energy Agency, that it may be sooner rather than later. Natural gas, coal and nuclear fuels are also expected to peak, but those peaks will occur later than petroleum.

As the ERSPO Task Force members considered energy status and potential impacts to our community from peak oil, discussions revolved around the intertwined, inseparable issues of impending energy scarcity and higher energy prices. As the supply of oil dwindles, market forces of supply and demand will determine price. Oil will become more expensive and over time less available at any price.

The progression of these impacts is difficult to predict, particularly in light of the 2009 economic recession and other global forces. High oil prices in 2008 gave us a glimpse of a world with higher energy prices. The subsequent steep drop in prices, the current worldwide economic downturn (with reduced oil demand), and a return of some excess capacity, have eased the public perception that there is an "oil crisis." However, prices could increase rapidly when worldwide demand strengthens. Economic downturns reduce capital investment in new oil supplies, making the supply of oil for a recovering world economy even more challenging. The possibility of sudden supply disruption due to global political instability is another global force that adds to the importance of preparing for declining oil supplies.

1.1 Sense of Urgency

Our current economic, social and political institutions expect that reliable, abundant energy supplies will be readily available to meet continued demand. Whatcom County residents and businesses depend on oil and natural gas for their economic welfare and many of their most critical activities, including transportation, food supply, water delivery, health care and electricity. It is too rarely acknowledged that global oil and natural gas reserves are finite and that sufficient substitutes are unlikely to be widely available in the near future.

Most reports and studies on peak oil and energy resource scarcity convey a strong sense of urgency in planning for a future with dramatically reduced petroleum supplies. The International Energy Agency (IEA) was founded during the oil crisis of the early 1970s and acts as energy policy advisor to the industrial world. The IEA has traditionally been very confident about world energy supply, but in the last few years has been expressing a growing concern regarding supply.

For the *World Energy Outlook 2008* report,[1] the IEA engaged for the first time in an extensive field-by-field analysis of the world's largest oil fields. The Executive Summary of the report opened with a strongly worded admonition, "The world's energy system is at a crossroads." The report continues: "Current global trends in energy supply and consumption are patently unsustainable — environmentally, economically, socially. But that can — and must — be altered; there's still time to change the road we're on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. What is needed is nothing short of an energy revolution."[2]

Thus the IEA concluded that even with timely investment, we appear headed for an oil supply crunch. The Executive Summary of the *World Energy Outlook 2008* report ends with the following words: "It is within the power of all governments, of producing and consuming countries alike, acting alone or together, to steer the world towards a cleaner, cleverer and more competitive energy system. Time is running out and the time to act is now."[3] The current recession is resulting in plummeting investment, not the surge in production that would be needed to keep up with rebounding, post-recession demand.

A 2008 report by a United Kingdom (UK) industry task force evaluated views on when peak oil may occur and then evaluated views on how the impacts might be addressed both from a demand perspective (i.e. How are we to get by with less oil?) and from a supply perspective (i.e. What are the options to replace oil?). The UK task force concluded that "Neither the government, nor the public, nor many companies, seem to be aware of the danger the UK economy faces from imminent peak oil."[4]

Similarly, some of the Portland Peak Oil Task Force members noted that during its 2006-2007 efforts, the Portland business community was less engaged in the peak oil question than other constituencies. Therefore, it is worth noting the UK industry approach and its "call to action" for the UK government.

1.2 Findings

The ERSPO Task Force is in alignment with the high level of urgency expressed in the various studies and reports we reviewed, including the Hirsch report,[5] the Portland Peak Oil Task Force report,[6] the Oil Independent Oakland Action Plan,[7] the San Francisco Peak Oil Preparedness Task Force Report,[8] the Spokane Sustainability Action Plan,[9] and the UK Industry Task Force on Peak Oil and Energy Security.[10] The era of relatively plentiful and inexpensive oil will soon be over, and the sooner the community acknowledges and addresses this reality, the more secure our future will be.

This report is organized around the six areas recognized by the City/County ERSPO resolutions: Energy & Water, Land Use & Transportation, Food & Agriculture, Public & Social Services, Economic Transition, and Community Education & Preparation:

Energy & Water – Baseline data indicate county energy usage of about 50% electricity, 25% natural gas and 25% petroleum. Approximately 70% of Whatcom County's electricity is generated by hydroelectric (renewable) resources, which is favorable in terms of cost, carbon emissions, and long-term conservation of non-renewable resources. Should energy supplies in general become constrained, hydropower available to Whatcom County may diminish.

Gasoline and petroleum-based diesel fuel are the most vulnerable to peak oil and also the most difficult to replace in the near term. The decline in oil availability will lead to increasing prices that will have a direct impact (see Land Use & Transportation).

Whatcom County's major sources of water are the Nooksack River and Lake Whatcom. The principal peak oil consideration with water is with transport and treatment. In general, the ERSPO Task Force agrees with the Portland Peak Oil Task Force's conclusion, "Water, sewer and solid waste services are not expected to be affected significantly." However, provisions should be in place to ensure that the necessary fuel is supplied to water, sewer and waste treatment facilities in energy shortage situations.

Land Use & Transportation - Transportation fuels derived from petroleum power over 90% of road, air, rail and water transportation in the U.S. The decrease in oil availability will lead to increasing fuel prices directly impacting nearly all levels of most industries. A disruption or temporary shortage of fuel supplies may result in shortages at the retail level. No liquid fuel, non-hydrocarbon alternatives exist that can meet more than a small fraction of our current demand for oil-based transportation fuel in the near term. A ten- to twenty-year lead time is required to transition away from energy dependence on petroleum.

As fuel prices rise at a local level, so will the transportation costs of daily life. Transportation is a component of most commerce activities, e.g. commuting, delivery of food and other goods, school buses, as well as many others. Land use and transportation planning must address a future with scarcer and more expensive transportation fuels.

Food & Agriculture – While Whatcom County holds a strong position in global trade and boasts a large number of small farm operations, energy price is a concern and is one of many factors leading to high production costs and the unacceptable trend in the loss of county farmland. Farmers need production and marketing strategies to increase resiliency, thereby reducing vulnerability to peak oil effects of high prices for fuel and agricultural chemicals and higher costs for transport of farm inputs and outputs.

Cost and quality of food are driving concerns for most consumers in Bellingham and Whatcom County. Studies show that as much as 3.5% of food costs may be attributable to energy expenses and 4% may be attributable to transportation costs. Demand for locally-grown food will increase due to a variety of factors. Thus, prime agricultural land needs to be protected for production on all scales.

Public & Social Services - Increasing energy and fuel prices will most seriously affect those living on the economic margin. People with a significant portion of their expenditures dedicated to energy will be hardest hit and feel the impacts first.

Unemployment is likely to rise to the extent that higher energy costs affect employers. These combined factors will put greater pressure on public and social service agencies.

Economic Transition - While it is hard to predict detailed economic and social hardships associated with higher oil prices, it is certain that there will be changes in what products are shipped around the globe – with more attention given to finding efficiencies at all stages of production and delivery. Following the peak in world oil production, we can expect the economy as a whole to experience significant disruption and volatility. Business owners must increasingly consider how more expensive and scarcer energy will affect their businesses, both from the upstream supply side and from the downstream consumer demand perspective.

Going beyond considering what percentage energy plays in their operating costs, we encourage businesses to consider the following questions:

1. How will peak oil affect production costs?
2. How will demand for the product or service be affected?
3. How will upstream suppliers of raw materials or semi-processed goods be affected?
4. What reasonable substitutes or alternatives are available to mitigate higher production costs, shifts in consumer demand and disruptions in raw material supply?
5. What opportunities might there be to develop "green" businesses locally?

Community Education & Preparation - The public is generally more aware of global warming/climate change than it is of the issues and impacts surrounding energy resource scarcity. Whatcom County is progressive in comparison to other parts of the country in addressing climate change. Actions to address climate change and to prepare for energy resource scarcity/peak oil can be complementary (although this is not always the case- for example, a response to oil depletion may be greater usage of coal or oil from tar sands, both poor options in terms of climate change). In general, the ERSPO Task Force's findings and recommendations provide an opportunity to augment existing local efforts in climate change, sustainability and "greening" our city and county.

One approach used in other cities and towns to educate and develop ERSPO strategies is a "Transition Initiative." It involves engaging the community in local/neighborhood planning for a future with scarcer and more expensive oil. Recently a local *Transition Whatcom* initiative was started, which could provide a starting point for broader community participation (see Appendix 6).

1.3 Climate Change

Both the City of Bellingham and Whatcom County developed Climate Action Plans in 2007. The Action Plans identified measures that are being deployed now and those planned for the future by government and by the wider community to reduce CO_2 emissions. The majority of actions taken to reduce CO_2 in response to changing climate conditions are also actions that will increase the community's resilience to changes that will occur due to increased costs and decreased availability of petroleum and other carbon based energy. Wherever possible, the ERSPO Task Force recommends coordination and/or consolidation of government and community actions to address global warming, energy scarcity and peak oil.

1.4 Recommendations

The primary ERSPO Task Force recommendations are grouped into four categories, with additional recommendations listed in the six report sub-sections.

Understand the current energy use situation

- Utilize energy data collection systems used to measure fossil fuel emissions for climate response to validate current energy usage and measure future changes.

Plan for a future with less fuel and energy resources

- Assess and integrate emergency plans for sudden and severe shortages (fuels, energy, food, etc.) into Whatcom Unified Emergency Management planning.
- Begin including the impacts of more expensive and less available fossil fuels into all government and business planning processes.

Take actions to begin addressing a reduced energy future

- Foster land use patterns and transportation systems that will make it easier for people to shift trips from autos and trucks to other types of transport.
- Encourage community efficiency and conservation programs, and ensure that efficiency gains are accompanied by actual reduced resource and energy use.
- Preserve farmland and expand local food production (including community gardens), processing and distribution.
- Seek partnerships with businesses, universities and other government agencies to evaluate and address the economic impacts of energy resource scarcity.
- Strengthen the community safety net to protect vulnerable and marginalized populations.

Get the community involved in the process

- Widely publicize the Energy Resource Scarcity/Peak Oil message throughout the community via meetings and through the City and County websites.
- Encourage and support "Transition Whatcom" as a community-based, community-led initiative to address a reduced energy future.

The majority of these recommendations support or complement activities already taking place as part of Bellingham's or Whatcom County's Climate Action Plans.

2. WHY PEAK OIL MATTERS

A growing body of energy industry experts believes that the world has already reached, or will soon arrive at the peak of global oil production[1]. Once this peak is attained, an inevitable decline in easily available supply will follow. Liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social and political costs will be unprecedented.[2]

The U.S. Department of Energy published in 2005 a report entitled *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*, written by Robert Hirsch, Roger Bezdek, and Robert Wendling. Commonly known as "the Hirsch Report", after its lead author, this publication warns that "The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem." The report maintains that viable mitigation options exist on both the supply and demand ends, but that *to have substantial impact, mitigation options must be initiated more than a decade in advance of peaking*. Our ability to

replace current liquid fuels with alternatives will depend on rate of decline and our commitment to finding replacements. The Hirsch report highlights that developing and implementing alternatives may take decades to have a positive effect and that addressing the demand side of the equation is equally as important as addressing the supply side. (Refer to Appendix 2 for a more detailed explanation of Peak Oil.)

Since oil production in the United States has peaked and is now in decline, our nation has a continued and growing dependence on foreign oil imported from many politically unstable regions. We can no longer assume that energy prices will remain stable or will increase gradually. Rather, we are facing a future of heightened uncertainty in our energy supply as well as volatility in energy prices. Reducing our local dependence on fossil fuels is both a way to prepare for declining future oil availability and a way to prudently invest in our economic future. The benefits of transitioning away from fossil fuel-based energy consumption to a greater reliance on more renewable energy resources may result in the creation of local green collar jobs and substantial economic benefits. Voluntary reduction of total energy consumption ahead of the peak should result in increased community resilience and have considerable environmental benefits.

A decline in affordable energy will have significant impacts for transportation, food production and delivery, business and home energy use, land use planning, municipal water and wastewater treatment and social services. This report examines the energy vulnerabilities of various sectors of the community and considers appropriate changes in order to ensure that economic, social and environmental infrastructures are resilient in the face of uncertainties brought about by shifting energy markets.

Support for renewable energy reduces the need for electricity generated from non-renewable sources like fossil fuels by creating a market for clean, healthy energy supplies. Both the City of Bellingham and Whatcom County buy green power in the form of Renewable Energy Credits (RECs) to offset municipal electricity use. Western Washington University, local businesses and several thousand residents in the City of Bellingham and Whatcom County also participate in purchasing RECs, resulting in the federal Environmental Protection Agency recognizing the Bellingham community as one of the top green power communities in the country. The purchase of green power is just one important action among many contained in the City's and the County's Climate Action Plans. ERSPO Task Force's recommendations should be considered alongside these plans as part of a multi-pronged strategy to protect and preserve the longstanding ecological and economic prosperity of the City of Bellingham and Whatcom County.

2.1 Energy Resource Scarcity/Peak Oil

The genesis of the Peak Oil concept was geophysicist M. King Hubbert's 1956 paper, which correctly forecast that the peak production of oil in the United States would be in 1970-1971. From a global perspective, peak oil is the expectation that our ability to produce oil will peak and then decline as the recoverable oil reserves worldwide can no longer supply enough oil to meet demand. Figure 1 illustrates the U.S. oil peak as well as other countries that have already peaked in oil production.

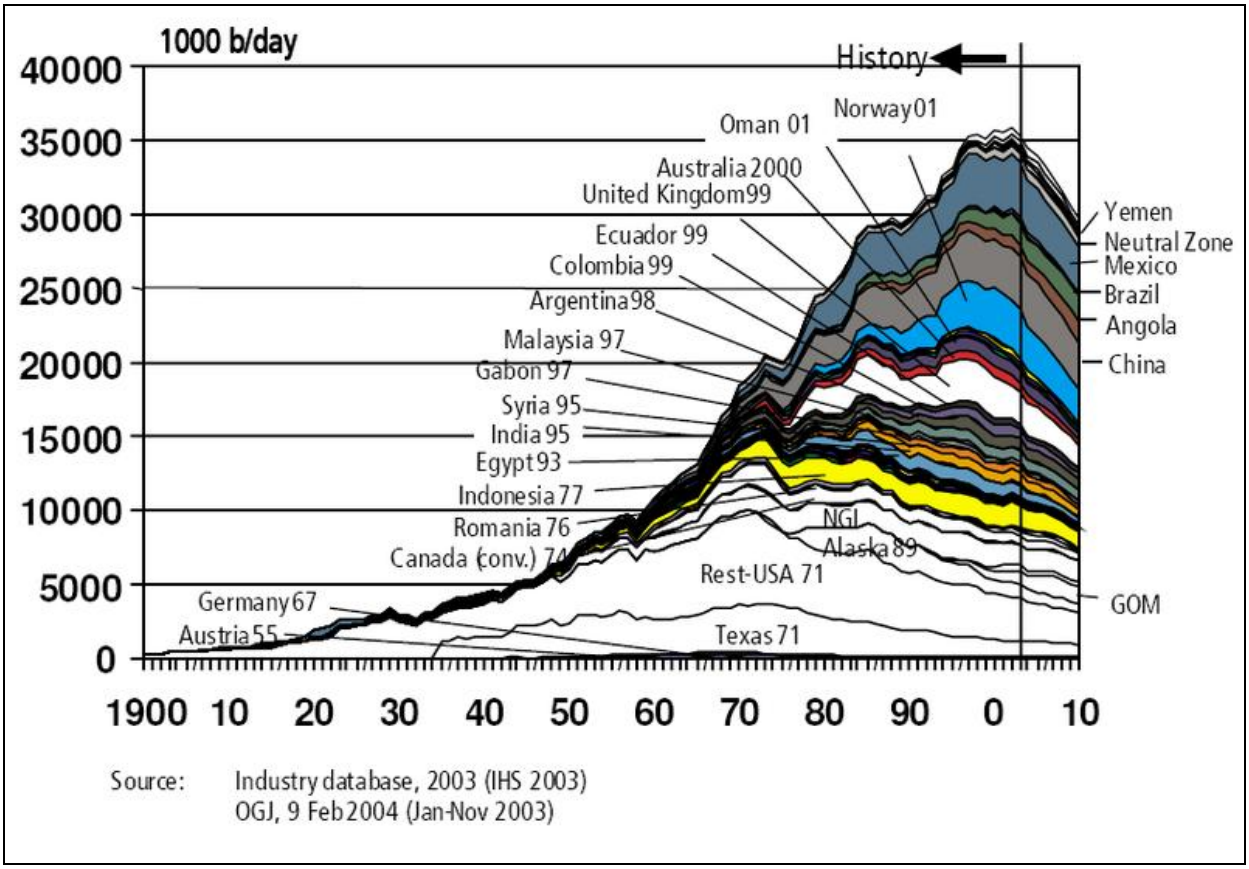

Figure 1 – Countries where oil production has already peaked

Figure 2 illustrates the growth in world crude oil production over the past 25 years. Production has flattened since 2005 and has dropped off in 2009 with reduced demand caused by the worldwide economic downturn.

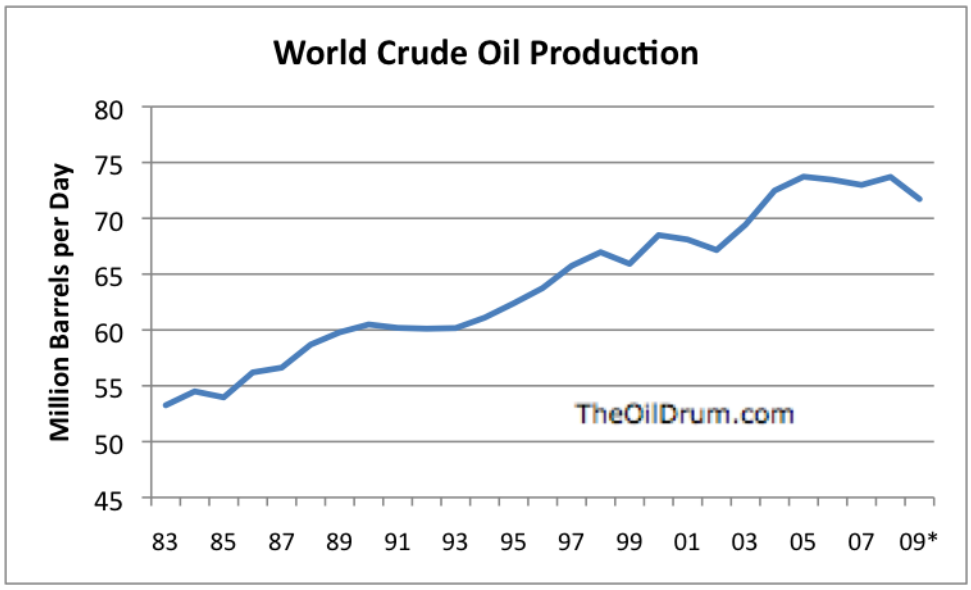

Figure 2 – World Crude Oil Production 1983-2009
(Source: http://www.theoildrum.com)

Some experts feel that this plateau indicates that the peak has already occurred, while others predict the peak will be reached in the near future. Predictions are fraught with uncertainties

because of poor data, political and institutional self-interest, limited and classified information about global oil reserves, and other complicating factors. So while it is difficult to predict *exactly* when this peak will be reached, an emerging consensus is that the peak will occur within the next decade.[3] We won't know if we have peaked until worldwide demand picks up requiring higher production levels.

Natural gas resources are also finite, but peak production is not expected to be as imminent as with oil. Most knowledgeable forecasts predict the natural gas peak to occur around the year 2030. Figure 3 shows several forecasts that support this timing. However, recent developments in producing natural gas from shale deposits in the U.S. have increased the total estimated U.S. natural gas reserves. This, combined with reduced world-wide demand for natural gas, may somewhat delay a natural gas peak.

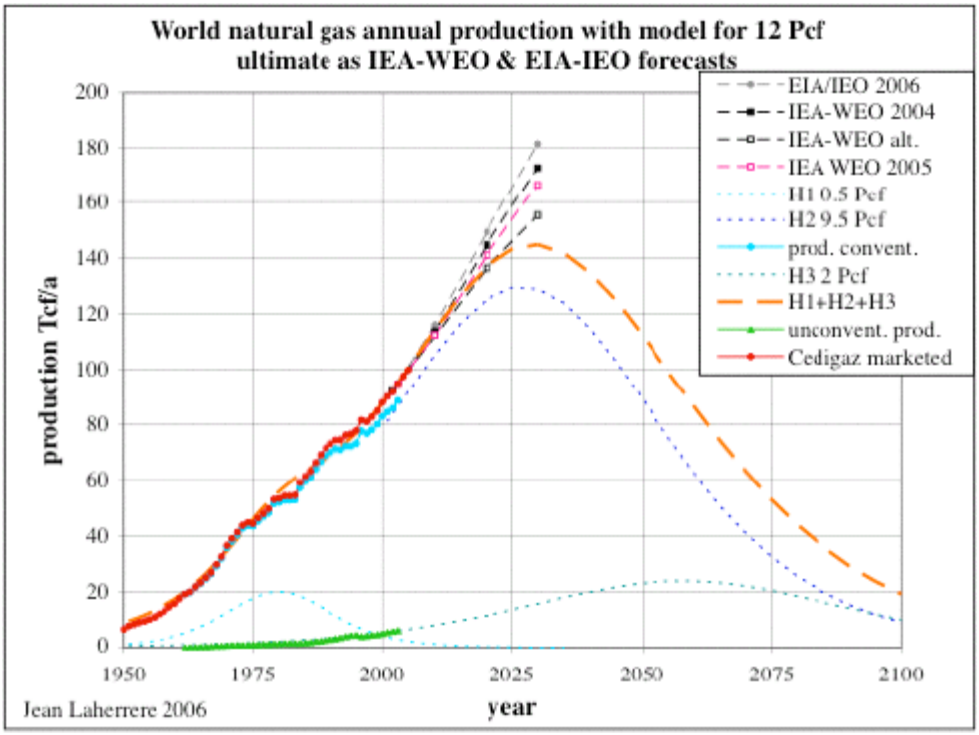

Figure 3 – A forecast of world natural gas production
(Source: Jean Laherre, 2006)
Nomenclature – Pcf (Peta cubic feet), IEA-WEO (International Energy Agency – World Energy Outlook), EIA-IEO (Energy Information Administration – International Energy Outlook)

The prospect of declining oil reserves raises an important issue for citizens and governments because as the supply peaks and can no longer keep up with demand, prices rise. Sharp price increases were acutely felt during the spring and summer of 2008 until prices dropped as a result of the world-wide economic slowdown. This price spike provided us with a glimpse of the difficulties that may be experienced throughout all sectors of society when cheap fuel is no longer readily available. It also demonstrated the importance of resilience in terms of adapting to rising fuel prices and switching to alternate modes of transportation. Whether price increases are being driven by demand, natural disasters, geo-political events, or a peak oil scenario, it is crucial to the security of our communities that we be prepared for a near future in which cheap oil is no longer a reality.

World oil production "peaking" does not mean all the oil is "running out." Peaking is a reservoir's *maximum oil production rate,* which typically occurs after roughly half of the

recoverable oil in a reservoir has been produced. According to the 2005 Hirsch report: "Peaking will result in dramatically higher oil prices, which will cause protracted economic hardship in the United States and the world. However, the problems are not insoluble. Timely, aggressive mitigation initiatives addressing both the supply and the demand sides of the issue will be required." Therefore, mitigation is desirable and possible, but will require a minimum of a decade of intense, expensive effort, because the scale of liquid fuels mitigation is inherently extremely large. Intervention by governments will be required. A proactive approach to preparing for diminished energy supplies will position Whatcom County to better adjust to this inevitable situation with minimal disruption to our economy and social structure.

A rather simple explanation for the impending peak is illustrated by Figure 4. The discovery rate of oil and gas reserves has declined significantly since the middle of the last century. The oil "tank" is being drained faster that it is being refilled. It is worth noting that, while "the oil industry has been on a hot streak in 2009 thanks to a series of major discoveries"[4] that added an estimated 10 billion barrels of new oil reserves, the added reserves would supply the current worldwide oil demand only for about 4 months.[5] Also, as energy economist Jeff Rubin has pointed out, "what the oil companies don't hold glamorous conferences to announce is that every year the world oil industry loses almost 4 million barrels per day in production through depletion."[6]

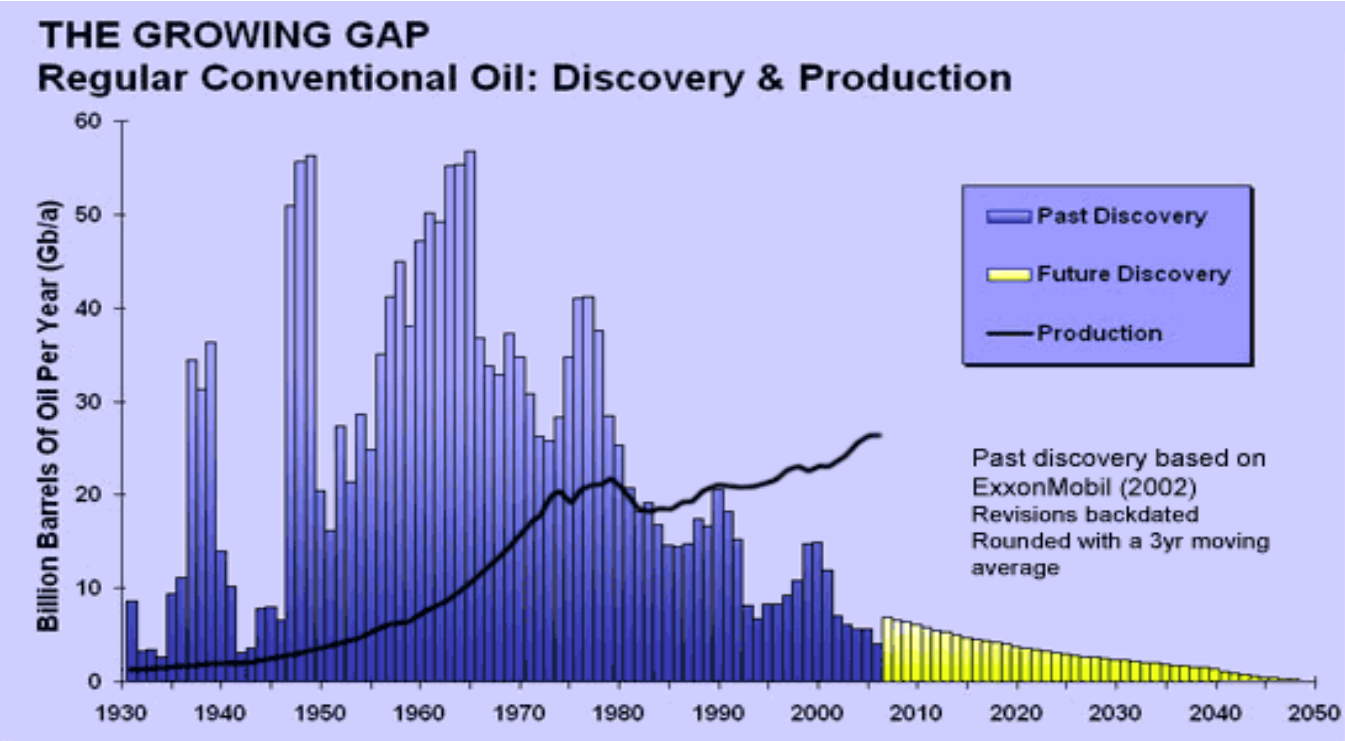

Figure 4- Decline in oil discoveries
(Source: Colin Campbell, Association for the Study of Peak Oil and Gas (ASPO))

2.2 Supply, Demand, and Price Volatility

During the last few years, oil prices have fluctuated dramatically (see Figure 5). From mid-2006, the price of oil increased from $58/barrel to a peak of $147/barrel in July 2008 (about the time the ERSPO Task Force convened). Prices then plummeted to the mid-$40s/barrel by the end of 2008. Oil prices have gradually increased in 2009, reaching the $72/barrel level during the third quarter of 2009 and hitting $81/barrel in October 2009.

Both the financial markets and the energy markets have experienced dramatic changes during 2008-2009. The sub-prime mortgage crisis and subsequent financial fallout in the world market have significantly contributed to the current recession and world economic slowdown. Although the reasons for the run up in fuel prices experienced in the summer of 2008 are not easily explainable, events suggest that high fuel prices were due to the interaction of world supply and demand, with added influence by speculative trading.

Figure 5 – Benchmark Oil Price 1985-2009
(Source: U.S. Department of Energy, Energy Information Administration)

The current world economic recession has the potential to affect the demand for oil and the timing of the oil peak in several ways. Reduced economic activity will reduce the demand for energy and oil, particularly in China, the fastest growing economy and fastest growing consumer of oil. Reduced demand may delay peak oil, if it has not yet occurred. Additionally, the current lower oil price and tighter credit markets will tend to cause oil companies to defer development of new oil fields, which would have added to the current production capacity. If so, world supply would be less able to keep up with rebounding oil demand when world economies come out of recession, again causing a rise in prices.

3. ENERGY & WATER

To establish an energy use baseline, the Task Force gathered 2005-2006 data provided by Whatcom County and supplemented with additional information. While not all energy users are represented in the data, the baseline is generally typical of the community's overall energy usage:

Whatcom County Energy Use 2005-2006		
By Sector	**Billion BTU**	**%**
Residential		
Electricity	**2650**	**42.9**
Natural Gas	**2700**	**43.7**
Propane	**830**	**13.4**
Subtotal	**6180**	**100.0**
Commercial		
Electricity	**2290**	**58.9**
Natural Gas	**1390**	**35.7**
Propane	**200**	**5.1**
Stationary diesel	**10**	**0.3**
Subtotal	**3890**	**100.0**
Industrial		
Electricity	**12890**	**72.3**
Natural Gas	**4870**	**27.3**
Propane	**60**	**0.3**
Subtotal	**17820**	**100.0**
Transportation		
Diesel	**1810**	**17.1**
Gasoline	**8780**	**82.9**
Subtotal	**10590**	**100.0**
TOTAL	**38480**	
By Type	**Billion Btu**	%
Electricity	**17830**	**46.4**
Natural Gas	**8960**	**23.3**
Propane	**1090**	**2.8**
Diesel	**1820**	**4.7**
Gasoline	**8780**	**22.8**
TOTAL	**38480**	**100.0**

Figure 6 – Whatcom County Energy Usage
(Source – Whatcom County CO_2 Emissions Survey, 2005)

Baseline data indicates roughly 50% of total energy usage is electricity. Twenty-five percent of that total electricity usage is by Alcoa's Intalco Works. Intalco's usage volume should be less in the future as its new supply arrangement with Bonneville Power Administration[1] is for half of the full plant capacity. Besides electricity, the remainder of the Whatcom energy use is from hydrocarbon-based fuels, approximately 25% natural gas and 25% petroleum (propane, gasoline, diesel).

About 70% of Whatcom County's electricity is generated by hydroelectric power facilities, which, relative to hydrocarbon based alternatives, is favorable in terms of cost, pollution and long-term conservation of non-renewable resources. Should energy supplies in general become constrained, available hydropower will be distributed more fully with other communities, causing Whatcom County's portion of the hydropower supply to diminish.

City and County government energy usage is a small portion of the County's total energy usage. City of Bellingham government usage totaled approximately 137 billion British thermal units (Btu) per year in 2006 (or 0.4% of County total). Whatcom County government usage totals 106 billion Btu/year (or 0.3% of the County total). The Whatcom data do not break out the agricultural usage. Based on the agricultural acreage in Whatcom County, the energy usage is estimated at 770 billion Btu/year (or 2% of the County total).

On a per capita basis Whatcom County's annual usage of approximately 208 million Btus is about 37% less than the state and national averages of 328 and 339 million Btus per capita respectively. The lower energy usage locally is primarily the result of western Washington's more moderate climate compared to eastern Washington (less heating in winter and less air conditioning in summer). Compared to a 65 million Btus per capita energy use globally, the United States has one of the world's highest per capita energy usages at 339 million Btus per capita. Most of the developed European countries use only about half as much energy per capita. See Appendix 3 for more on energy usage.

3.1 Local Energy Supply

3.1.1 Electricity

Puget Sound Energy (PSE) supplies most of Whatcom's electricity. The remainder comes from Bonneville Power Administration (BPA), primarily for Intalco and ConocoPhillips. The sources for PSE and BPA electricity supplies are shown in Figure 7.

3.1.2 Petroleum Fuels

Although Washington has no indigenous crude oil production, the state is a principal refining center serving Pacific Northwest markets. Transportation fuels are produced by the oil refineries in the local region, including two (ConocoPhillips and BP) in Whatcom County. The refinery processing capacity at ConocoPhillips/BP is about 320,000 barrels per day (one barrel = 42 gallons).

The local refineries receive crude oil supply primarily by tanker from Alaska. Alaskan North Slope crude is about 40-45% of the crude supply, with the remainder from other sources. With Alaskan oil production in decline, Whatcom's refineries are becoming increasingly dependent on crude oil imports from Canada and other oil exporting countries. Crude oil from Canada is about 15% of the total crude supplied to Whatcom's refineries.

The Trans Mountain Pipeline from Alberta (which includes tar/oil sands production) supplies about one-fifth of the state's oil refinery requirements. Products from Whatcom refineries are distributed throughout the Northwest and to California.

Transportation fuel sales in Whatcom County are about 4500 barrels per day (b/d) of gasoline and 1500 b/d of diesel. It is estimated that 20% of the transportation fuel sold in the county is for vehicles passing through the county. The refineries located in Whatcom and Skagit Counties are the only ones north of the San Francisco Bay Area and supply much of the northwest U.S. While the refineries are located in Whatcom County, the distribution of gasoline is by pipeline via Seattle where fuel additives and any required ethanol is blended in. Diesel is often sold to distributors and delivered separately.

3.1.3 Natural Gas and Propane

Whatcom County's natural gas energy is supplied by Cascade Natural Gas. The supply relies heavily on gas produced in Canada and transported by pipeline to the U.S. The Sumas

Center, in Canada near the border between Washington and British Columbia, is the principal natural gas trading and transportation hub for the northwest U.S. The Northwest Pipeline Corporation system supplies markets in western Washington.

The residential sector leads Washington's natural gas consumption, followed closely by the industrial and electric power generating sectors. Roughly one-third of Washington households use natural gas as their primary source for home heating. Establishment of a liquefied natural gas receiving terminal at Cherry Point was evaluated by several developers during 2003-2005 but none of the projects proceeded. Propane is used mainly for home heating where housing is not connected to the natural gas distribution system. Propane is produced either as a by-product of natural gas production (from natural gas liquids) or as a refinery by-product. Whatcom propane is refinery-sourced and supplied by several distributors.

Figure 7 illustrates Whatcom County's overall energy mix. The natural gas total includes gas used in generating electricity.

Whatcom County Energy Mix	%	
Electricity (Non oil & gas)	**42.0**	
Coal		**8.5**
Hydroelectric		**30.7**
Nuclear		**2.6**
Other		**0.2**
Natural Gas	**27.7**	
Oil	**30.3**	
Propane		**2.8**
Gasoline		**22.8**
Diesel		**4.7**
Total	**100.0**	

Figure 7 – Whatcom County energy mix
(Source: Puget Sound Energy)

As stated previously, Whatcom County currently has a significant proportion of its energy (electricity) supplied by renewable sources, primarily hydropower. Figure 7 shows that for electricity supply in Whatcom County, oil is not a factor.[2] However, some communities in Washington State are more dependent upon oil for power generation. Therefore, when oil becomes scarcer, some redistribution of hydropower may take place, thereby reducing Whatcom's share.

3.2 Energy Supply Vulnerabilities

3.2.1 Transportation Fuels

Gasoline and diesel fuel represent about one quarter of Whatcom's energy usage. Gasoline and diesel fuels are the most vulnerable to peak oil and also the most difficult to replace in the near term. Most all vehicle transport is powered by hydrocarbon fuels derived from oil. A gradual decline in oil availability and/or increasing prices will directly impact all suppliers and consumers. A temporary disruption or shortage of fuel supplies may result in shortages at the retail level. As no liquid fuel alternatives exist that can meet more than a fraction of current demand, a ten to twenty year lead time is required to transition away from energy dependence on petroleum.

The price impact of peak oil will likely be more immediate than the local supply impact. Small supply/demand imbalances in the world oil markets can cause significant price swings. This was evident in the run up and then rapid decline in world oil prices during 2008 (see Figure 5). Increased transportation fuel prices will proportionally impact those people and businesses for which the cost of transportation is significant. As discussed in Appendix 2, imports will decline as world oil production declines, with U.S. oil availability approaching domestic production levels, representing a reduction of over 50% of the country's current usage.

3.2.2 Natural Gas

Natural gas supplies a little over one fourth of Whatcom's energy requirements, with about 60% for commercial and industrial uses, 25% for residential heating/cooking and the remainder for electrical generation. As noted above, natural gas is not expected to peak as soon as oil, but is forecast to peak around 2030.

3.2.3 Electricity

The electricity supply in Washington State and Whatcom County should be relatively less susceptible in the short term to price increases and scarcity in relation to peak oil and peak natural gas. Our electricity supply is already two-thirds derived from renewable sources, primarily hydroelectric power. However, as noted previously, Whatcom's share of available hydropower might be reduced in the future. Among the other sources of electricity in addition to hydropower and natural gas; coal will eventually peak in decades to come, but is more likely to be constrained by global warming considerations before then. The small nuclear component in our area will depend on the longevity of the existing nuclear facility and the country's appetite for more nuclear power.

3.2.4 Water

Whatcom County's major sources of water are the Nooksack River and Lake Whatcom. The principal peak oil consideration with water is with transport and treatment. In general, the ERSPO Task Force agrees with the Portland Peak Oil Task Force's conclusion, "Water, sewer and solid waste services are not expected to be affected significantly." However, provisions should be in place to ensure that the necessary fuel is supplied to water, sewer and waste treatment facilities in energy shortage situations.

Water supplies in Whatcom County, in general, are locally available. One advantage Whatcom County has is that we are not dependent on large, construction-intensive storage projects for our current water supplies. Currently Whatcom County is served by surface water from Lake Whatcom and the Nooksack River and from local groundwater from wells and springs.

The surface water users in order of consumption are:

- Public Utility District #1 for the Cherry Point Heavy Industrial area and Ferndale
- City of Bellingham for its utility service area
- City of Lynden for its utility service area
- Lake Whatcom Water and Sewer District for its service area
- Miscellaneous small users throughout the county

All other supplies are groundwater based and depend on local wells. In some cases this groundwater does require treatment with chemicals.

3.3 Energy Supply Mitigation

The primary cause of global warming and climate change is the increasing amount of CO_2 generated through the burning of fossil fuels, which include petroleum and natural gas. Thus, global efforts to reduce the production of CO_2 involve reducing the amounts of fossil fuels burned. The reduction of petroleum and natural gas usage, either by design or by necessity, will reduce CO_2 emissions. It should be noted that some responses to oil shortages would have severe and negative impacts on climate change. From a global warming perspective, replacing petroleum fuels with dirtier and more carbon- intensive fuels derived from fossil resources such as oil sands, coal and oil shale is counterproductive. Therefore, it is necessary to keep both issues in mind when developing solutions to one.

Mitigation should be considered for two scenarios – petroleum supply disruptions and growing shortages on the one hand, and sharp price increases on the other (although it is likely these scenarios will be experienced simultaneously). Mitigations for transportation fuels are covered in Section 4 - Land Use & Transportation.

3.3.1 Emergency Preparedness

One may think of preparation for peak oil as preparation for a "long emergency." The City of Bellingham already has an Emergency Operations Plan and the City and County are consolidating emergency planning and management. The activities operate in conjunction with the Washington State Comprehensive Emergency Management Plan.

Declining oil supplies will require significant reductions in oil and gas usage. Appendix 4 illustrates some energy reduction scenarios and the amount of fuel use reduction required.

3.3.2 Transportation Fuels

Petroleum supply disruptions can happen at any time and are commonly the result of a natural disaster or accident, such as an earthquake damaging pipelines and refinery tanker jetties. Potential terrorist threats and other geopolitical risks should also be acknowledged. Such circumstances should be already addressed in the city and county disaster preparedness plans. Provisions should be in place to allocate fuel to essential municipal services (fire, police, 911). Rationing may be necessary depending on the severity and duration of the disruption. Growing shortages/price increases resulting from peak oil can only be addressed by using less petroleum fuel.

3.3.3 Propane

Propane is used primarily for home heating in Whatcom County. Local propane is a refinery byproduct and thus subject to peaking along with oil. Alternatives to propane for home heating are primarily electricity and renewables (wood, etc). If Whatcom County's available hydro-electricity is reduced due to the needs of other communities, electricity will be scarcer and thus more expensive. This may lead to a greater number of residents using wood to heat homes. While wood is considered "carbon neutral", any addition to CO_2 emissions should be avoided when possible. Additionally, local air quality would be compromised.

3.3.4 Natural Gas

Natural gas is the main commercial, industrial and residential fuel in Whatcom County. Natural gas production is expected to peak around the year 2030. About 19% of PSE's electricity is generated by natural gas but not entirely within Whatcom County. Mitigation for reduced natural gas availability is similar to that for propane. In heating service, electrical heating is the

most obvious replacement, though not without expense for retrofitting. To replace all of the natural gas usage in Whatcom County would require an additional 300 megawatts of electrical generating capacity.

3.3.5 Electricity

When considered in the context of greenhouse gas emissions, Whatcom County's electrical supply is significantly "greener" than the national average, as hydropower provides a large proportion of local electricity supply. But to replace natural gas and petroleum fuels to any significant degree will require a substantial increase in energy generating capacity. Additional coal based supplies could be more immediately available, but increased use of coal-sourced energy would exacerbate global warming effects. Should electrical supply become more restricted, wood may be used more for home heating, a practice that would increase air quality concerns.

3.3.6 Water

Almost all water users depend on some sort of pumping to move water around. Most primary pumping systems are powered by electricity; therefore, virtually all water supplies are affected by increasing costs for energy to operate those pumping systems. If hydro-powered electricity supplies are sufficient, water supplies are not directly impacted by potential disruptions in liquid fossil fuel supplies. However, since many water systems' back-up power relies on fossil fuel powered on-site generators, we should have plans for fuel scarcity.

The biggest issue, especially for groundwater based supplies, is the potential increasing cost of energy for pumping. In the case of surface water users, treatment of the raw surface water requires chemicals. These are generally industrially produced chemicals that are shipped into the area by truck. The cost and availability of these chemicals could be affected by the impacts of peak oil.

Additionally, maintenance and repair of utility systems is very dependent on the availability of liquid fossil fuels for transportation and heavy equipment. Although labor is probably the greatest cost in these situations, the ready availability of fuel is critical to accomplishing repairs when needed.

3.4 Recommendations

3.4.1 Immediate priority – Energy supply

- Establish energy data collection system to measure changes from current baseline.
    - Track energy usage and costs.
    - Make this information available to the public on a website.
- Prepare a fuel prioritization plan for emergencies and disruptions, which may serve as a template for longer-term shortage situations, i.e. rationing.
    - Offer specific provisions for water and sewer.
    - Remain consistent with state emergency planning.
    - Determine whether city/county agencies should be required to have emergency fuel reserves. (Depends on the nature of the need and level of use.)
    - Use the structures already in place in the city's energy management system for immediate disasters and add items necessary to address a "long emergency."
    - Have strategies in place for rapid reduction in fuel use.
    - Develop fuel allocation systems.

3.4.2 Intermediate priority – Energy supply

- Encourage and consider mandating efficiency and conservation programs, and ensure that efficiency gains are accompanied by actual reduced resource and energy use.
- Encourage energy use audits (Use of Resource Conservation Managers and Transition Initiative audits).
- Encourage increasing percentage of renewables in Whatcom County fuel supply mix.
- Encourage onsite dairy biogas production in Whatcom County.

3.4.3 Long-term priority – Energy supply

- Reduce total oil and natural gas consumption.
    - Consider establishing an overall reduction goal. If established;
    - Develop specific reduction targets necessary for achieving overall reduction goal.
    - Require City departments to set reduction targets for their operations.
    - Initiate a data gathering and analysis system to assess progress toward meeting goals.
    - Develop mechanisms to keep community decision-makers informed of trends in energy markets, including the global fuel supply situation and local impacts such as how residents are being affected by higher fuel prices.

3.4.4 Water system related

- The City of Bellingham and Whatcom County should study the extent of the potential risk of water supply interruption relative to the impacts of peak oil (i.e. increased energy costs and/or fuel scarcity). Emergency services for the City and County need to understand what rationing will look like in the fuels shortage scenario and where public water supply fits into that equation.
- Hold an emergency planning workshop for all public water systems to review the results of potential peak oil impacts to water supply and encourage all systems to have emergency plans in place. The intent is to utilize the existing emergency management framework to plan for the long emergency that peak oil will create.
- All public water systems should be encouraged to look at the availability and cost of current chemicals and to explore what alternatives exist if reduced availability and increased cost necessitate changes.
- All water systems should be encouraged to have emergency conservation plans in place to deal with power outages and fuel shortages. Conservation can also go a long way to control pumping costs, although rates would have to go up to offset reduced revenue for most utilities.

4. LAND USE & TRANSPORTATION

When the price of gas approached $5 per gallon in the summer of 2008, commuters, freight companies and the tourism industry all acutely felt the impact. People started carpooling and using public transit, downsizing large vehicles in favor of economy cars and taking fewer road trips during summer vacation. A peak oil scenario is anticipated to produce a similar impact, albeit more long-term, on both commercial and personal transportation.

Automobile use will ultimately decline while people seek alternative modes of transportations for their needs. Automobile users will shift to walking, biking and transit. Freight transportation will become more costly, likely leading to mode shifts from air and truck to rail and ship. Demand will increase for telecommuting and compressed workweeks. Mode shift is most likely

to occur in discretionary, non-work trips and parking demand will decrease. Individuals and families living in neighborhoods without affordable local travel options will spend an increasing portion of their disposable incomes on travel. People and businesses will ultimately relocate to be closer to each other and to transportation options.

As populations shift to city centers in Whatcom County, higher density and mixed-use developments will increase. As more residents of moderate and higher incomes opt to live closer to work and retail centers, real estate prices will reflect those changes. The cost of housing will rise in more "accessible" neighborhoods and low-income households may be forced to the edges of communities where transit service is less available. Funding will be reduced for transportation improvements (i.e. for public transit, pedestrian and bicycle path improvements, as well as for road capacity for cars) due to reduced travel by gas-powered vehicles, and potentially also due to general decline in the tax bases. Transit operation funding will be reduced for the same reasons.

Demand will rise for housing and retail services near transit stops, along with increased demand for retail, professional and civic services within walking and biking distance of more households. The need for increased density and accessibility will increase demand for new housing types, such as accessory dwellings, co-housing and live-work space. Food prices will likely increase, and food availability and selection from conventional grocery stores may decrease.

4.1 Transportation Fuel Alternatives

As noted previously, transportation fuels from petroleum are most difficult to replace. While there are large reserves of non-petroleum fossil fuels in North America that are being or could be converted to liquid transportation fuels, many of them have drawbacks.

4.1.1 Natural Gas/Liquid Petroleum Gas (LPG)

Many taxi, bus and truck fleets run on compressed natural gas (CNG) or LPG. Natural gas has a longer lead time before peaking but most LPG is produced from petroleum. Of any fossil fuel, natural gas produces the least CO_2 when burned.

4.1.2 Tar Sands

There are several large tar sands operations in Alberta, Canada that produce a total of over 1.1 million barrels per day (b/d) of synthetic crude oil. Some of this syncrude is processed at refineries located in Whatcom County as part of the crude oil supply mix (about 10%) that comes by pipeline from Alberta. However, production of syncrude is significantly more energy intensive than crude oil production, with the accompanying negative aspects of increased CO_2 emissions and environmental damage through strip mining operations. In the current low oil price environment, many tar sands expansion projects have been deferred for economic reasons. Canada's tar sands reserves, when considered as oil reserves, are second only to Saudi Arabia's reserves, but environmental concerns should limit their use.

4.1.3 Liquids from Coal

Transportation fuels can be produced from coal through various processes. In South Africa the corporation Sasol produces about 150,000 barrels per day of synthetic crude oil from coal on a commercial basis. However, as with tar sands, the process is energy- and capital-intensive and generates additional CO_2.

4.1.4 Oil Shale

Huge oil shale reserves exist in Utah, Colorado and Wyoming that can be converted to transportation fuels. However, shale oil has not been produced on a large-scale commercial basis. Similar to coal and tar sands, shale oil production is environmentally problematic and capital- and energy-intensive.

4.1.5 Ethanol

Currently the most commercially feasible, renewable alternative to petroleum-based fuels is ethanol. The production of ethanol from corn has resulted in increased corn prices, leading to the current debate about the balance of corn for food versus fuel. Ethanol produced from non-food crops and wastes probably makes the most sense, but has not yet been developed on a commercial basis. Some ethanol is currently mandated to be blended into gasoline sold in Washington State. Additional concerns are that the global demand for ethanol has resulted in an increased rate of destruction of rain forests and other critical "carbon sinks", as well as caused displacement of indigenous peoples in these areas.

4.1.6 Biogas

Biogas from dairy farm waste in Whatcom County has the potential to supply a significant portion of the local transportation fuel needs. Based on studies and a demonstration project by the Vehicle Research Center at Western Washington University, biogas from anaerobic digestion of animal wastes could in theory generate the equivalent of about 80% of the current diesel fuel requirements for Whatcom County. The biogas from the digester is purified until it is over 95% methane and then burned in a vehicle modified to burn compressed natural gas. This is demonstrated technology that has been widely used. This option assumes that dairy farming remains commercially viable and that biogas production on a variety of scales is possible.

4.1.7 Biodiesel

Biodiesel, generally refined from used cooking oil, is currently viable but not in the huge quantities needed to replace gasoline and diesel. Biodiesel is also commercially produced from oil crops but has the same issues as ethanol in that the oil crops often compete with food crops and result in destruction of critical rainforests.

4.1.8 Electric Power

Ultimately electricity may be the best replacement for liquid transportation fuels. Hybrids (gasoline + electric motor/batteries) are widely available and can increase gas mileage up to 50%. The next step is plug-in hybrids, which rely primarily on electric propulsion. Plug-in hybrids are expected to be available in the next two to three years. However, recent reports indicate that plug-in hybrids in service are not as fuel efficient as promised (50 vs. 100mpg).[1] Another factor to consider is the amount of non-renewable energy resources used and the climate-changing gases emitted throughout the manufacturing process for any type of vehicle.

The summary of transportation fuel alternatives indicates that most options have significant cost, energy efficiency and environmental concerns, and we would have limited influence in their development. Thus the recommendations focus on local initiatives.

4.2 Recommendations

Recommended local actions reflect a triple bottom line approach of addressing economic, ecological and social criteria. Actions to reduce reliance on single occupancy vehicle trips and

petroleum-based travel in general will enhance progress toward economic self-reliance, healthier communities and climate protection goals set forth in the County and City Climate Action Plans. In terms of citizen health, residents of compact, pedestrian-friendly places suffer fewer chronic ailments than those of sprawling communities. Further, residents of walkable communities are less likely to be overweight and therefore less likely to burden the health care system. Residents of compact communities spend 20 minutes per day less in a car than those in low-density suburbs.[2]

Reduced demand for roads due to fewer single occupancy vehicle trips will reduce the capital and maintenance cost of services associated with asphalt (higher asphalt costs resulting from higher oil prices). Because gas and diesel burning motor vehicles are the largest source of air pollution, air quality improvements would be expected in association with reduced vehicle exhaust.

4.2.1 General Recommendations

- Foster a land use pattern and transportation system that will make it easier for people to shift to walking, biking and transit when oil prices and transport fuel shortages stimulate changes in travel behavior.
- Prioritize investments in improvements to the county's network of pedestrian and bicycle facilities, especially in areas of low accessibility.
- Begin thinking of long-range planning in consideration of more expensive and less available fossil fuels, i.e., a several-decade transition to a truly sustainable local culture that is released from the benefits/costs of fossil fuel energy.

4.2.2 Specific Recommendations

Whatcom County and the City of Bellingham should:

- Rate each neighborhood throughout the county on its degree of "accessibility." Accessibility ratings would reflect the degree to which retail, professional and civic services (such as grocery stores, schools, doctors' offices, libraries, transit stops, day-care centers, cafes and restaurants, dry cleaners, hardware stores, parks, banks, etc.,) are located within convenient walking and bicycle distance from the neighborhoods. This information could be useful to new home buyers and renters.
- Map those portions of neighborhoods throughout the county that do NOT lie within a half-mile of a grocery store of neighborhood size (5,000 to 20,000 square feet) or larger.
- Based on neighborhood accessibility information, take action to improve pedestrian and bicycle facilities and to provide more flexible, multi-use zoning to incorporate neighborhood-scale retail, professional and civic services. Zoning should allow additional dwelling units to create a market for such services.
- Find ways to accommodate employment centers (i.e. manufacturing, office, light industrial, service, etc.) adjacent to residential areas.
- Designate Whatcom Transit Authority (WTA) Corridor stretches for revitalization, supported by frequent transit service.
- Support "location-efficient mortgage" programs in neighborhoods with a high degree of accessibility.
- Encourage WTA to refine its modeling capabilities to enable it to evaluate the effects of combustion engine fuel price increases on land use patterns and travel behaviors.
- Minimize expansion of urban growth boundaries (UGBs).
- Provide permanent protection to farms and prime farmland close to UGBs.

- Place parking meters in well-developed retail districts throughout the towns and cities in the county. Earmark a significant portion of parking revenues for pedestrian/bicycle improvements within district.
- Enhance "individual marketing" in those neighborhoods with low neighborhood accessibility to determine which measures would be most likely to reduce the number and length of single occupancy vehicle (SOV) trips in the neighborhood.
- Charge car-sharing companies and private groups a nominal on-street parking fee or no fee at all.
- Continue to expand the bike lane system, putting bike lanes on the most traveled routes for commuters, including large streets like Meridian.
- Set an ambitious but achievable goal for the people of Whatcom County to reduce the number of gallons of gasoline consumed in a week by the average county resident.
- Protect intermodal freight facilities to facilitate shift in transport modes in response to fuel price increases.
- Consider lobbying Amtrak for more stops between Bellingham and Vancouver, B.C.

5. FOOD & AGRICULTURE

Peak oil and volatile energy prices have many potential impacts to both Whatcom County's agriculture industry and to the entire food system. Relative to agriculture[1] in general (including food that humans eat, feed for animals, and processing and production methods), dependence on fossil fuels creates vulnerability to higher prices for tractor fuel, agricultural chemicals and the transport of farm inputs and outputs.[2]

High oil prices have increased demand for biofuels, resulting in pressure to convert farmland from food and feed production to fuel production.[3] An additional impact on agriculture from fossil fuel dependence is the degradation or net loss of basic natural resources.[4] This is principally seen in topsoil loss and impairment of water supplies in certain areas of the country due to unsustainable production methods fueled by inexpensive energy.

5.1 Energy and Agriculture

Each step in the food production chain requires energy (solid, liquid, or gas form) and produces various levels of carbon emissions.[5] In an energy-intensive industry like agriculture, a sustained rise in energy prices may have serious consequences by reducing profitability and by driving resources away from the sector.[6] A rise in energy prices also affects decisions regarding crop and activity mix, cultivation practices (relatively inexpensive tillage practices replacing expensive pesticides, yet possibly exacerbating soil loss), as well as irrigation and post-harvest practices.[7] Writing energy policy with food security in mind is in the nation's best interest.

In the three decades following WWII, energy use in U.S. agriculture is estimated to have increased four-fold,[8] depending heavily on fossil fuels either directly (fuel or electricity to power machinery and equipment and also for heating and cooling of buildings, animals and other products) or indirectly (fertilizers and other chemicals). Though U.S. agriculture energy use has quadrupled since 1945, crop yields have increased only three-fold.[9] The disparity is due partly to the decline in domestic real prices for oil due to competition from lower priced imports and other factors[10] making inputs less expensive. With low prices for both crude and refined petroleum, U.S. agriculture increased use of petroleum-based fertilizers and other chemicals, diesel-fueled tractors, and the transport of crops over long distances.

As chemical fertilizer and pesticide use became more prevalent, energy efficiency most often decreased (relative to output). Simultaneously, labor productivity increased, in part due to reduction in per acre farm labor. Yet agriculture's vulnerability to petroleum-based energy supply and pricing became apparent with the oil shortage resulting from the 1973 oil embargo.[11] The impacts of this energy crisis, along with other long-range trends, affected virtually all scales of operations. Agricultural energy use peaked in 1978 at 2.4 quadrillion Btus.[12]

Since the late 1970s and its associated energy price shocks, the direct use of energy by agriculture has declined by 26%. During the same time period, the energy used to produce fertilizers and pesticides has declined by 31%, averaging overall to about 28%. These decreases in energy use are due in part to switching from gasoline-powered to more fuel-efficient diesel-powered engines and adopting conservation tillage practices for field crops.[13]

In 2002 the U.S. agricultural sector's energy use represented about 1% of total U.S. direct energy consumption.[14] Therefore, it is unlikely that adjustments in agriculture will have a large effect on supply and demand for the country as a whole. However, within the agricultural sector, the amount of expenditures varies tremendously depending on commodity, production practice, and geographic place.

The agricultural sector remains particularly vulnerable to natural gas supply/price volatility. Natural gas is the major feedstock of nitrogen fertilizers and represents as much as 90% of the cost of production of anhydrous ammonia—a key component of most nitrogen fertilizers. Natural gas is also a major component in the production of phosphate (15% to 30% of the cost of production) and potash (15%) fertilizers. The total direct and indirect consumption of natural gas amounts to over 26% of total energy consumption in the agricultural sector.[15]

Of most relevance to Whatcom County is energy vulnerability in fruit and dairy production. In 2002, "fruit and tree nut" energy costs of $1.7 billion represented 17% of total production expenses, whereas energy use comprised less than 10% of total production costs in greenhouse, nursery, and floriculture production.[16] The dairy industry relies on electricity for operating milking systems, cooling milk, and supplying hot water for sanitation. Additionally, pasture management, feeding operations, and marketing activities consume energy directly and indirectly.

5.2 Energy and the Food System

Calculating energy used in the initial process of bringing crop from seed to harvest accounts for only a part of the total energy used in the food system. To assess fossil fuel use within the entire food system, one must consider processes extending from seed production to preparation of a meal. Much of the energy bill accrues during the trip from the farm[17] gate to our plate, with items in a typical U.S. meal traveling 1500 miles.[18] The total energy food bill includes the costs of electricity, natural gas and other fuels used in food processing (drying, milling cutting, sorting, baling), packaging, warehousing, refrigeration and food preparation, as well as the greenhouse gas (GHG) emissions associated with those tasks.[19]

Many notable authors and academics have brought attention to the high levels of fossil fuel use in the U.S. food system. Steven L. Hopp notes, "Americans put almost as much fossil fuel into our refrigerators as our cars….400 gallons of oil a year per citizen."[20] The authors of *Food, Land, Population and the U.S. Economy*[21] assert that once food processing, packaging, distribution, and energy used for shopping and home preparation of food (sometimes

appearing as “residential energy use” in certain statistics) are factored in, the percentage of total U.S. energy consumption represented by the food system is 17%.[22] This figure is well above the 1% figure attributed in 2002 to agriculture’s share of the U.S. energy bill.

In the broader picture of energy use and food production, the American diet in the past 50 years has shifted to processed foods and is dominated by corn and soy—discussed most notably by journalist-academics such as Michael Pollan.[23] When compared to a world average on a per capita basis, the highly-processed diet of an average U.S. resident represents a higher than average volume of food and number of calories.[24] For the average American, “fast food” accounts for 34% of total food consumption or about one-fourth of our meals eaten outside the home,[25] which adds to the energy food bill.[26]

The direct effect of high energy prices on the food bill is unclear. Farmers receive 19 cents for every one dollar of consumer expenditures on food, while 81 cents of the consumer food dollar is attributable to food processors, transporters, wholesalers, and retailers.[27] These marketers of food have greater ability than farmers of passing on higher energy costs (electricity, natural gas, and other fuels) through the production-marketing system to consumers.[28]

Indirectly, agriculture and food prices are affected by currency exchange rates and level of support for government-subsidized agricultural programs.[29] Increased fuel costs are often linked to decreased economic growth or even recession conditions, which in turn affect currency exchange rates and level of support for government-subsidized agricultural programs. Recession conditions are likely to reduce demand for higher-cost products of small- and medium-sized farms, which are often low income to begin with, and likely suffer greater negative impacts from recessions.[30]

5.3 Focus on Whatcom County

As Figure 8 shows, U.S. agricultural trade is close to 70 billion dollars per year in exports and contributes significantly to our country’s balance of payments. Whatcom County farmers figure prominently in this, especially in dairy and berry production for global markets. Lynden’s Darigold plant is one of the top ten producers of powdered milk in the United States (processing about 105 million gallons of fluid milk into powder annually).[31] Currently more than 65% of the U.S. processed red raspberry production is grown in Whatcom County.[32] The county ranks 78th out of 3,075 farm counties in the U.S., placing it in the top three percent.[33]

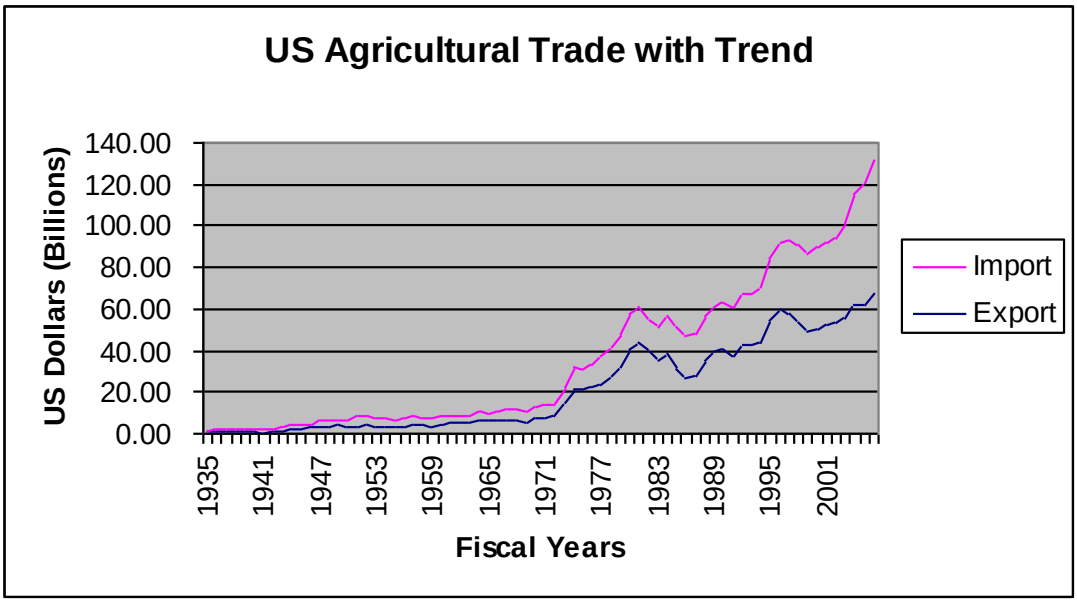

Figure 8 – U.S. Agricultural Trade
(Source: Economic Research Service, Foreign Agricultural Service)

According to the *National Agricultural Statistics Service*, Whatcom County farms numbered 1,485 in 2002 and 1,483 in 2007; land area in farms was 148,027 acres in 2002 and 102,584 acres in 2007.[34] While the number of farms was about the same, the decrease in farm acreage was approximately a one-third reduction.[35] Smaller-scale producers may have markets external to the county or state, although most produce for local markets. Volatile energy prices are also a concern for small-scale producers, but they may have the flexibility to adapt production and marketing strategies that reduce such vulnerability (see recommendations).

Within the food system continuum, producers and consumers have different interests and goals related to peak oil effects. Producers are at one end of the spectrum particularly concerned with high energy prices and consumers are at the other end of the spectrum concerned with finding the least-priced food. Somewhere in the middle are the "c*onsumer-producers*"[36] who, when making food choices, factor in health, societal, and/or environmental considerations of food production. Many consumer-producers would likely consume foods produced in fresh, local, organic, sustainable and seasonal (FLOSS) food systems,[37] considerations which go beyond merely price concerns.

5.3.1 Exploration of Local Opinions

In order to stimulate discussion and capture opinions from Whatcom County agriculture related individuals[38] about current and future energy use, farm practices and ideas for reducing the energy food bill, ERSPO Task Force's Food & Agriculture subcommittee developed a questionnaire in fall 2008. Respondents expressed opinions as individuals and not as representatives of any group. The thirty-five respondents included farmers and employees of agricultural support industries such as marketers, education professionals, bankers, farm suppliers, agricultural chemical interests, and "other technical assistance" providers. While the exercise tried to focus on farm operation impacts due to peak oil and high energy prices, the survey questions did not include price change considerations of other goods, nor how changes in relative prices of farm products produced might affect overall net returns and land values.

In general, most survey participants agreed that food would cost more in a peak oil scenario of less available/higher-cost fuel due to the associated increased costs of growing, transporting, processing, and distributing food. Foods that are highly dependent on fertilizer inputs, are transported over long distances, require time-sensitive refrigerated transport, or are highly processed (i.e. fresh fruits, vegetables, and dairy products) will experience the most significant cost increases.

Much disagreement existed amongst the questionnaire respondents as to whether "local" was cheaper or less resource dependent than buying from national food channels. There was also little agreement on peak oil's precise effects on Whatcom County agriculture. Opinions varied as to whether relative costs associated with the production, processing, and shipping of different kinds of food crops would cause some crops to be favored over others or if high food costs would motivate local citizens to want to start growing some of their own food.

Respondents were enthusiastic regarding the potential for renewable, sustainable energy production on farms (wind, solar, biogas). Most participants asked for technical and financial assistance, as well as regulatory changes in order to develop on-site renewable energy sources.[39] Respondents also identified the need for an educational effort to identify and communicate the true costs of various foods. Participants were enthusiastic about the ERSPO initiative to anticipate increasing energy costs and develop solutions for positive outcomes.

Though the opinion survey effort cannot claim to accurately and entirely represent Whatcom County's agriculture community, it does indicate interest within the farmer/farm-support community to work together to increase energy efficiency on farms and to support agriculture in general. Almost all participants supported the following ideas for local government to provide education and support activities. Local governments should:

1. Educate: Take action to help all citizens understand potential impacts of high energy costs and collaborate with WSU Extension and local schools to educate citizens about food growing, processing, preserving, cooking, and composting.
2. Provide financial incentives: Develop financial incentives to encourage farmers, processors, grocery stores, etc., to form plans to deal with the impacts of high energy costs.
3. Preserve Farmland: Preserve existing farmland and productive soils for agriculture use. Cities should open up public and private land for food growing (e.g. financial incentives to lease land) for community gardens.
4. Expand marketing opportunities for farmers: Examine and adjust regulations to help local farmers sell directly to consumers through additional farmers' markets, farm stands, Community Supported Agricultural (CSA) share programs, and public markets.
5. Strengthen current hunger relief and emergency agencies and systems: Prepare for increased food demand from a higher percentage of community members in need. Recommendations include developing a short or mid-term emergency food supply plan and establishing a major food warehousing effort in preparation for a crisis (i.e. earthquake).
6. Increase local food processing: Prioritize food processing as an economic cluster, including incentives to encourage development of processing facilities.
7. Increase composting: Plan for local utilization of organic household and municipal wastes to improve tilth of individual and community gardens and eliminate green waste in landfills.

5.3.2 Energy Inputs in Local Agriculture

One of the largest parts of the current national energy bill has to do with food-related household behavior and practices, with more energy being used to refrigerate, prepare, and procure food than is used to produce it.[40] Transportation (i.e. driving a 2-ton car to pick up a 30 pound bag of groceries) also takes its energy toll. Relative to the rest of the country, parts of Whatcom County's agriculture energy inputs are low,[41] with some options available to reduce costs:

- Water pumping needs are relatively low.
- Most feed inputs are hauled on truck, but transport via rail could reduce costs.
- Dairy manure is relatively high in nutrients and, to a certain extent, could substitute for petroleum-based energy intensive fertilizers.

The majority of electricity in Whatcom County is generated by hydro-power, which in terms of cost and greenhouse gas emissions, is advantageous. Locally a large portion of agricultural electricity use is for cooling and for processing (for example, fluid milk processing at the Darigold Plant in Lynden), which would create vulnerability if hydro-powered electricity were to become limited or more expensive due to increased demand.

Because higher and unstable energy prices can affect direct and indirect energy inputs and make agriculture unprofitable,[42] agriculture has to find ways to become more energy independent. Volatile prices of energy used in agriculture, particularly for drying and cooling, irrigation, and for costly fertilizers and pesticides, will continue. Farmers need technical assistance (see Appendix 5) to become more resilient.[43] Local city and county planning/zoning policies must protect agricultural uses to support resiliency and long-term economic viability of farms.

5.3.3 Support for Local Farms

Whatcom County boasts a high percentage of locally-owned businesses, including farms that practice direct-marketing, restaurants that locally source the food they cook and process, and chefs who cater and provide cooking classes with a local flair. However, most of the food consumed in Whatcom County is produced outside the region and food produced in this region is consumed elsewhere. Overall, local farms are not feeding Whatcom County, but are contributing to a more favorable balance of payments on a national scale (primarily with dairy powder and berry exports).

Whatcom County consumers procure food at wholesale and retail outlets of many kinds, including farmers' markets and shares in Community Supported Agriculture (CSA) and/or grow their own food in backyard or community gardens. When food prices increase, people are likely to purchase less meat and dairy and turn to less expensive value-added products (processed foods). Despite this typical trend, the Bellingham Farmers Market has seen growth in annual sales (see Figure 9), perhaps reflecting support of FLOSS (Fresh, Local, Organic, Sustainable, and Seasonal) food systems. Sourcing local foods contributes to resiliency of systems, communities and individual businesses and increases the capacity to flexibly respond to changes in external conditions such as high energy prices.[44]

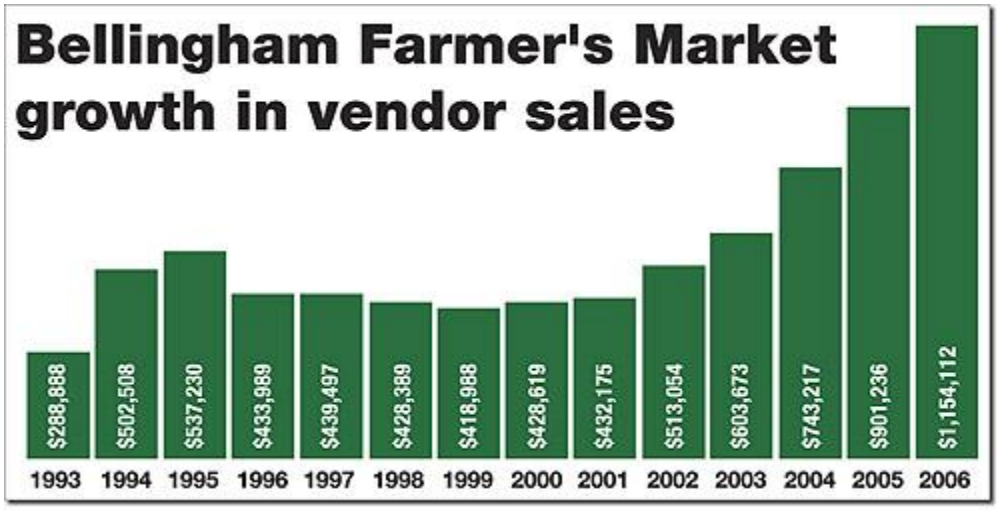

Figure 9 – Bellingham Farmers Market growth in vendor sales, 1993-2006
(Source: Bellingham Business Journal 2008)[45]

Local agriculture is dominated by small- to medium-sized farms, a model which is supported by the community. Unrestrained development and the resulting loss and fragmentation of arable land will devastate a viable agriculture industry in Whatcom County and threaten possibilities for an inclusive food security agenda.[46] Local farm advocacy groups such as Whatcom Farm Friends promote farmland preservation and market-based programs. Whatcom County's Purchase of Development Rights program[47] is an example of farmland preservation accomplished through market-based processes that match willing sellers with willing buyers. A Transfer of Development Rights program[48] may also accomplish farmland preservation goals. These and other market-based programs contribute to keeping farmland in working farms by protecting the current value of land, limiting increases in production costs, easing reduction of farm debt, and facilitating transition to the next generation of farmers.

Governmental (e.g., Washington State University Extension, Whatcom Conservation District) and non-profit organizations (e.g., Sustainable Connections and the Community Food Co-op, Growing Washington), as well as newer initiatives such as Sustainable Bellingham, Transition Whatcom, Western Washington University's Resilient Farm Project, and NW Farms & Food, serve as strong advocates for county farms and farming. Appendix 5 lists local and regional advocacy and farm support organizations. These groups and others support farming through provision of information and technical assistance including farm business management skills development; technical support for water, waste, field, and livestock management, or opportunities for direct marketing and buying.

The underlying premise of most of the notable education and marketing programs active in Whatcom County is that "local" is essential for achieving one if not all of the FLOSS (Fresh, Local, Organic, Sustainable, and Seasonal) components. Such groups give support and ideas to enhance industry flexibility and increase farm resilience. Many active local individuals also have ideas for increasing resiliency of the local farm industry. Ideas from local Whatcom County farmer, Walter Haugen, include increasing the number of local farmers markets, encouraging co-opetition,[49] increasing participation in community supported agriculture (CSA) share programs,[50] informal work shares,[51] mini-sharecropping,[52] buying clubs,[53] personal farmers,[54] and provision of insurance for small farmers.[55]

On a national level, initiatives[56] exist in some form in most western Washington counties with the purpose of connecting farmers with consumers or consumer-producers. National programs

and entities include Farm to School, Farm to College, USDA Community Food Projects grant application assistance, Food Policy Councils, Community Food Assessment, and vehicles such as resource lists and conferences. [57]

A "Future of Food" panel hosted at WWU in January 2008[58] affirmed that it is possible for Whatcom County to be self-sufficient in terms of food production, including "foods grown here, not just produced, prepared, or packaged here."[59] Yet fundamental questions remain about the importance and meaning of local and whether or not it is a way to mitigate vulnerability of Whatcom County citizens to peak oil.[60] Many of this section's recommendations relate to making a Farm-Food connection, which reduces "food miles" and supports county farms and businesses. Education activities include everything from "food-miles labeling" to facilitated discussion groups on the topic, to different ways of community networking and outreach.[61] Imagine what might be possible in our own county.

5.4 Recommendations

1. Do not allow a net loss in farm land acreage. Protect and maintain current agricultural land base of approximately 102,584 acres through policies, programs, and a tax to buy development rights.
2. Develop programs to help new farmers, including immigrants, similar to those of Bellingham's Sustainable Connections and other organizations for aspiring farmers to make land agriculturally productive.
3. Address farm labor issues.
4. Resolve regulatory impediments. For example, with USDA-certified mobile slaughterhouses (See www.lopezclt.org/sard/mpu.html; www.igfcmeats.com/2.html; www.sanjuanislander.com/groups/lopez-trust/award.shtml; smallfarms.wsu.edu/animals/onFarmSlaughtering.html; www.fsis.usda.gov/OA/foodsafetymobile/2004report.htm).
5. Support direct marketing opportunities.
6. Support the Farm-Food connection through programs such as Farm-school, Farm-hospitals, and/or Farm-prisons, which involve some work-share opportunities (a number of groups are working on such connections in the Bellingham area).
7. Support innovative CSA (Community Supported Agriculture) share programs such as Growing Washington's Just Food program. (See Appendix 6)
8. Support informal work shares. (See Appendix 6).
9. Support initiatives originating at the national level, but that also exist in some form in virtually every county in western Washington to connect farmers with consumers, including: Farm to School, Farm to College, USDA Community Food Projects grant application assistance, Food Policy Councils, Community Food Assessment, as well as vehicles such as resource lists and conferences.
10. Support Whatcom Farm Friends, and other important governmental (e.g., Washington State University Extension, Whatcom Conservation District) and non-profit organizations (e.g. Sustainable Connections, Community Food Co-op, Growing Washington), as well as newer initiatives such as Sustainable Bellingham, Transition Whatcom, Western Washington University/Huxley College's Resilient Farm Project, and NW Farms & Food, which serve as strong advocates for county farms and farming.

6. PUBLIC & SOCIAL SERVICES

Vulnerable and marginalized populations would be the first and hardest hit by higher energy prices resulting from peak oil. A subsequent increase in the size of the marginalized (economic high-risk) population is likely to follow.

During the spring and summer of 2008, Whatcom County residents experienced significant challenges to their household budgets due to a greater share of their income going to pay for fuel and energy. This economic situation resulted in a greater demand locally for public and social services. Concurrently, decreasing Washington State and Whatcom County tax revenues in fall 2008 made it more difficult for many public and social service agencies to provide a consistent level of services. These social service providers dependent on tax revenues for program support saw their funding drop and/or faced staff reductions as a result of the concurrent recessionary conditions. While the cuts were not directly due to rising energy prices, they remind us that our social safety net is vulnerable to shocks and may be particularly vulnerable to situations such as higher energy prices.

Historically, most periods of high energy prices correlate with recessionary conditions. Theoretically, higher energy prices should not automatically result in recessions or higher unemployment, but rapid and dramatic increases in energy prices can be recessionary.[1] As such, it is easy to imagine a double impact of higher energy prices on public and social service agencies.

Strategies to mitigate social disruption and negative reactions to financial stresses should include concrete actions that provide a sense of control and direction. This may be as simple as starting a community vegetable garden or encouraging neighborhood tool- and equipment-"libraries." Opportunities must be provided for citizens to be active in developing solutions, including participation in mitigation activities, beyond verbal feedback and direction to government. Should significant unemployment occur, providing a series of volunteer projects that utilize professional and technical skills could serve a double purpose. It could mean completing community-prioritized projects that may have otherwise been shelved due to lack of tax dollars, and could offer opportunities for meaningful work and action for those who have found themselves temporarily unemployed.

6.1 Energy and Demand for Social Services

Rising energy bills, along with increased costs of other goods that reflect higher energy prices, *if* combined with static or reduced incomes, will place a higher burden on public and social services:

Health Care: More individuals will be unable to afford health insurance, leading to reduced access to preventive and early-stage medical services. As people lose health care coverage or cannot afford medications, demand for health care services will increasingly shift to emergency rooms and walk-in clinics. A higher number of health problems will go unaddressed. Chronic stress can trigger and exacerbate a number of health conditions, including but not limited to, depression, diabetes, heart disease, anxiety disorders, ulcers and possibly cancers. As a result, even as costs increase, demand for health care may rise.

To reduce current and future energy consumption, St. Joseph's Hospital employs an energy manager who is working to implement changes. Still, most health care providers do not see energy conservation and energy security planning as important issues. The firms contacted by

ERSPO's Public & Social Services subcommittee said energy is secondary beyond their concerns about reimbursements, medical legal issues and health care policy in general.

Social Services: The ability to provide social services may decline due to reduced tax revenue associated with energy resource scarcity and the resulting impact on the economy. As parents deal with higher energy and related costs, the impact on the family is likely to result in an increase in behavioral problems among children and youth.[2] Those from families who are already dealing with poverty and related issues, such as addiction, are likely to experience even more serious disruptions.

Public and Government Subsidized Housing: As heating, maintenance and monthly housing costs consume a larger share of household budgets, more people will be pushed toward lower-quality housing choices or government subsidized housing programs. As tax revenues shrink, funds allocated to public housing and to other housing supported by government subsidies will decline.

Public School System: With less household money available to pay private school fees, the demand for public school services may increase. Simultaneously, the costs of maintaining, heating and lighting public school facilities will rise along with increased energy prices.

Law Enforcement: First responders, especially police, will at times become primary service providers as stresses lead to added mental health problems, increased drug and alcohol abuse and addiction, and higher rates of family and domestic violence. Financial stress does not cause domestic violence, but can worsen existing problems. Law enforcement services may experience increased demand, and the legal system is likely to see higher case loads.

Government Services: Economic disruptions affecting access to services and residents' ability to allocate their own resources to meet their personal needs have primary and secondary effects on service delivery. In a situation of increased energy prices, rising demand for public and social services could seriously impact the system's ability to respond to the rapid increase in volume of applications.

Increased unemployment through the fall-winter 2008-2009 placed great pressure on the state unemployment system to respond quickly to the demands of new claimants. Simultaneously, the number of applications for food assistance and Temporary Assistance to Needy Families (TANF) increased significantly, resulting in increased caseloads without sufficient infrastructure to process all the applicants. The agencies needed time to recruit and train new staff. Funds were available and caseloads could have increased more rapidly if the infrastructure existed to process all the applications as needed.

Some government-supported social service agencies have contingency plans and access to additional funding to address changes in demand. For example, food assistance programs or TANF have access to federal dollars to increase capacity as the eligible population increases, although the amount of federal funds available would eventually shrink relative to lower tax revenues. Government-supported agencies are better equipped than non-governmental, non-profit organizations to deal with shocks, but problems can still arise.

Drug and Alcohol Treatment Services: Another primary effect of higher prices and increased unemployment is the likely increase in addiction and crime. Drug and alcohol abuse are likely to increase, along with higher rates of domestic violence and other crimes that typically correlate with financial stress. As a result, law enforcement agencies and services will be in

greater demand. The need to respond to, arrest, provide legal services to, and incarcerate more individuals would severely strain the current systems. It may be necessary to resort to measures such as decriminalizing some nonviolent offenses in order to meet the increased demand for law enforcement, court services and jail facilities. Programs such as Drug and Treatment Courts, which keep a significant percentage of nonviolent offenders out of the legal and prison systems, are critical to getting the most out of dwindling financial resources.

Other Services: A secondary effect will be seen at animal shelters, subsidized child-care providers or public nonprofit service providers. As people make financial choices about what they can and cannot afford, it may mean giving up family pets to the animal shelter. Enrolling children in subsidized child care programs like the YMCA's early learning programs or Boys and Girls Club may result. Both of these organizations saw increased enrollments beyond their capacities in 2008. As we are seeing in 2009, recessionary conditions are hard on nonprofits. Some fail, while others scale back service dramatically, often while demand is rising. Higher energy prices would ripple throughout the economy, and when financial resources are constrained, donations from individuals as well as businesses will be reduced. For non-critical services this may be an inconvenience, but a reduction in vital services such as medical research or support for the disabled may have serious implications.

6.2 Recommendations

1. Redesign the safety net and protect vulnerable and economically marginalized populations:
    a. Support state and national efforts and explore city options to emphasize preventative health care.
    b. Facilitate discussion among health care providers to expand health care and health care access.
    c. Support prioritization models similar to the expanded Oregon Health Plan.
    d. Work with Puget Sound Energy and local organizations such as the Opportunity Council to support financial assistance and energy-efficiency measures and systems so that marginalized populations can maintain utility service.
    e. Police, legal systems and other services should prepare for an increase in drug and alcohol abuse as well as higher rates of domestic violence.
    f. Support treatment and diversion programs that result in fewer individuals burdening the legal system and jails.
    g. Strengthen current hunger relief systems (see Food & Agriculture).
    h. Plan for possible subsidization of school breakfast and lunch programs.
    i. Review rules such as program eligibility requirements to see whether that should be adjusted as a broader segment of the population is in need.
    j. Develop strategies for coping with widespread unemployment.
    k. Encourage residents to participate individually and collaboratively in actions that provide a sense of control and preparedness, such as community and neighborhood gardens, neighborhood mapping, emergency preparedness and strengthening of neighborhood associations.
2. Prepare emergency plans for sudden and severe shortages.
    a. Develop a comprehensive food plan to ensure that food supplies are adequate in a short-term and mid-term emergency. (See "Issues in Emergency Food Distribution for Whatcom County, WA" available at http://www.wwu.edu/resilience/Publications/EM_Food_Whatcom-IGCR_08.pdf).
    b. Establish a major food warehousing system capable of meeting food needs beyond the 72-hour recommended supplies for home emergency preparedness.

c. At a neighborhood level, provide training and planning for emergency situations.

7. ECONOMIC TRANSITION

It has often been said that oil is the lifeblood of the industrialized world. We have become dependent on oil as an essential input, with an assumption of stability in supplies and pricing. Given that alternatives are still marginal, oil is a non-replaceable input in the short-term.[1]

The price of a barrel of oil more than doubled in price from 2007 to an all-time peak (even when adjusted for inflation) of nearly $150 in July 2008. The 2008 recession brought prices back down to lows in the $30-$40 per barrel range, but in the four months prior to June 2009, prices per barrel again doubled to over $70.[2] In October 2009 the price hit $81/barrel.

Daniel Lerch has characterized the problem of energy resource scarcity as a problem of energy uncertainty, as we enter a period where we may see even more frequent and larger fluctuations in oil prices and supply.[3] With such uncertainty in the price of a material most important to the global economy, local businesses will be challenged to set meaningful budgets, make long-range plans and meet the needs of employees and customers.

While opinions differ as to the exact date of global peak oil and as to what the time path of production will be after the peak, there is near consensus that oil will become relatively more expensive in the future. Environmental concerns, political instability and difficulties accessing new oil fields (e.g., deep ocean fields) all put upward pressure on the price of oil. Domestic price pressures also arise from the aging infrastructure we have for refining and distributing oil products in the United States. Current infrastructure can supply current demand, but is limited in its ability to supply much in the way of increased demand. The evidence strongly suggests that the price of oil will rise in the near future and will be volatile.

7.1 Oil Prices and the Current Economic Climate

Some have argued that 2008's dramatic rise in oil prices was a bubble due primarily to speculation,[4] and that the subsequent decline in price proved that there is no reason to be concerned about oil supply.[5] Paul Krugman, however, pointed out that world oil production had to be either consumed or stored. Since he could find no evidence that oil was building up in inventories, this indicated that a speculative bubble was not to be blamed for the high prices.[6] According to some prominent economists specializing in energy issues, triple digit oil prices were a primary element of the process that produced the current recession. Large movement in prices, followed by demand destruction, is exactly what one would expect in an environment of energy resource scarcity.[7]

Economists James Hamilton and Jeff Rubin both believe that the challenges brought on by triple digit oil prices may soon return. Hamilton: "Even if we see significant short-run gains in global oil production capabilities, if demand from China and elsewhere returns to its previous rate of growth, it will not be too long before the same calculus that produced the oil price spike of 2007-08 will be back to haunt us again."[8] Rubin: "Once the dust settles from the various crises rocking financial markets, we are looking at the same basic demand-supply imbalance that we were looking at before the recession began."[9]

To further complicate the matter, low oil prices and the recession have led to investment plans being shelved and many oil project cancellations. When the economy recovers and demand begins to increase once again, the supply problem may be that much worse than it would be

otherwise. New investment is required to compensate for the depletion of existing fields, and the International Energy Agency has warned that the lack of spare oil capacity is a near term concern.[10]

7.2 Impacts of Energy Resource Scarcity and Peak Oil

When trying to anticipate the impacts of peak oil on the regional economy, we first focus on the influence of higher fuel prices. Higher prices imply the following general impacts:

- Faster rates of inflation – including higher food costs.
- Increased costs of commuting, and reduced driving.
- Higher costs of public services such as road repair/resurfacing.
- Higher costs of and possible curtailment or interruptions in public services such as school bus services.
- Reductions in disposable income (assuming the price of oil rises faster than income).
- Goods with high weight to value ratios will not be shipped as far, but additional emphasis on comparative advantage and economies of scale will allow other items to be shipped long distances.

At issue, then, is what elected officials and planning agencies can do to mitigate the impacts of higher oil prices. The sharp increase in oil prices witnessed in 2007 and 2008 gives some indication of the impacts we might expect in the future. As oil prices were reaching new highs, some economists began talking about the possible reversal of globalization, noting that soaring transport costs indicated a fundamental realignment of trade patterns.[11]

The relative price of a product (how much one item costs compared to another) is one of the primary factors in most economic transactions. This point is relevant in discussions about higher oil prices because you cannot reach conclusions about behavior changes focusing only on the price of oil. It is not possible to say what will happen when you know only that the price of one thing has increased. You also have to know what happens to the price of other, related goods.

Energy resource scarcity/peak oil will result in higher prices for oil, and higher oil prices will affect the price of many other goods. In fact, higher oil prices will affect the price of almost everything. But the effects will be uneven and difficult to predict. The price of some items will increase sharply because the cost of oil represents a large share of the price of the product. The price of other items will not increase very much because the cost of oil is a small proportion of the final price of the good.

It is often difficult to know when the cost of oil represents a large share of the final price of a good and/or whether substitutes are available to mitigate the impacts the increased price of oil has on the price of a particular good. For example, it is incorrect to assume that it will not make sense to ship goods long distances when the price of oil increases. The cost of shipping is but one cost. Economies of scale and infrastructure differences could be such that some goods get shipped longer distances with higher oil prices, assuming businesses and companies that offer economies of scale are still able to function. It depends very much on the type of goods being sold.

Goods with a high value-to-weight ratio tend to have relatively low transport costs, but goods with a low value-to-weight ratio typically carry significant transport costs. When shipping diamonds from South Africa to the United States, shipping costs won't matter, because transport cost as a percentage of the selling price of a diamond is nominal. (And, assuming, of

course, there is a market for diamonds in an economically-challenged world). However, for many manufactured goods it will not make economic sense to continue shipping so many goods at such a great distance. A high percentage of what China exports to the U.S. will fall into this freight-sensitive category – two common items being furniture and steel.[12]

Manufacturers of products that are energy-intensive to produce will likely be among the first businesses to experience the adverse impacts of higher energy prices, as well as businesses that use those products as essential inputs.

Proximity to transportation hubs may become a more important factor in the location of production facilities, and proximity to customers and employees will need to be more closely considered by all businesses. Whether higher oil prices will make households and businesses move to city centers in greater numbers cannot be stated with any degree of certainty. Nearness to services and places of employment may be attractive in the short run, however, in extreme cases, the long run accessibility of food supplies and water may lead to migration out of urban areas, not to mention issues of security in such a situation.

Businesses that depend heavily on discretionary consumer spending are at risk, especially those goods and services for which there are readily available substitutes. There may also be disproportionately less demand for consumer products that require oil or natural gas to operate.

While overall effects of peak oil and rising energy prices are difficult to predict in detail, every economic sector is likely to produce both winners and losers. We know that the higher oil prices will be inflationary and will cause hardships. We know that there will be changes in what is shipped around the globe, with more attention given to finding efficiencies at all stages of production and delivery. Still, we don't know enough about relative prices, the role oil plays in the final price of many goods, when substitutes are possible, and other factors to describe in detail what will happen as oil prices increase.

Consideration should be given not only to higher prices, but also to disruptions in available supply. Following the peak in world oil production we can expect the economy as a whole to experience significant disruption and volatility. Policy makers should be aware that the challenges faced by businesses may be unpredictable, are potentially dramatic for some industries, and that the risk of business failure is increased. Business should begin thinking about the way more expensive and scarcer energy will affect their businesses in the future. Going beyond considering what percentage energy plays in their operating costs, we encourage businesses to consider the following questions:

1) How will high energy costs affect production costs?
2) How will consumer demand for the product or service be affected?
3) How will suppliers of raw materials or semi-processed goods be affected?
4) What reasonable substitutes or alternatives are available to mitigate higher production costs, shifts in consumer demand, and raw material supply disruptions?
5) What opportunities might there be to develop sustainable businesses locally in an energy constrained future?

For an economic baseline of 2009 conditions in Whatcom County, please see Appendix 7: 2009 Whatcom County Snapshot.

7.3 The Rebound Effect

Before making recommendations, it is important to consider what has become known as 'the rebound effect.' "Put simply, the 'rebound' effect is the extent of the energy saving produced by an efficiency investment that is taken back by consumers in the form of higher consumption, either in the form of more hours of use or a higher quality of energy service."[13]

As new technologies (or government mandates) come online to improve energy efficiencies, the price per unit of energy tends to decline (i.e. the price for gasoline may stay the same, but if you are able to get more miles per gallon in your vehicle, the price per unit of energy has declined). Standard economic theory tells us that when price declines, demand increases. As demand increases, more energy is consumed. To some extent, the rebound effect offsets the beneficial effects of the new technology or government mandate. The effect is sometimes referred to as 'Jevons paradox.' W. Stanley Jevons, a 19th century British economist, observed that greater energy efficiency will in the short-run produce energy savings, but in the long-run may result in higher energy use.

Even as energy efficiency has increased in the U.S. during the past 30 years, so has net energy consumption per capita.[14] And the average vehicle in the U.S. today consumes as much gasoline as it did 30 years ago, when engines were 30% less efficient.[15] Jeff Rubin sums it up: "More cars, bigger cars, driven more. That's what all the improvements in fuel technology have got us. The result is that we are as gasoline dependent today as we were in the midst of the past two oil shocks."[16]

None of this is to say we should not pursue increased energy efficiencies. Rather, we need to ensure that increased efficiencies are accompanied by *significant decreases in energy resource consumption*. The rebound effect can be mitigated with varying levels of intervention (e.g. significant reduction to market supply, carbon taxes, license fees, or increasing leisure time instead of increasing production/consumption) to maintain an overall benefit of efficiency improvements.[17]

7.4 Recommendations

1. City and County governments should adopt recommendations of ERSPO's Land Use & Transportation subcommittee to foster alternative transportation and land use. Two of the biggest challenges to business competitiveness are commuting and moving freight. For example, City and County governments should support mixed-use zones that include provision for some small decentralized manufacturing facilities.
2. Engage business, government and community leaders to initiate planning and policy change. Directly involve civic and business leaders in issue briefings, including infrastructure providers, business leaders, freight and logistics industry, building industry, food industry, health care providers, public agencies, major non-profit organizations, utilities and public utility commission, and faith communities. Educate key city employees. Provide regional and national leadership by collaborating with leaders in other jurisdictions.
3. Identify and promote sustainable business opportunities for an energy constrained future. These might include sustainable building design services; renewable energy and conservation services and products; sustainable industrial design; repair/re-use/extending lifetime of various products, including remodeling and insulating of existing buildings. Expand workforce training to support sustainable industries and increase job opportunities for workers displaced from conventional industries.

4. Conduct a comprehensive survey of existing city business assistance programs. Provide case studies, personal impact calculators and business evaluations as tools to help businesses assess impacts on their business sector.
5. Facilitate development of local business networks or barter systems that build community and broaden economic opportunity.
6. Catalog/inventory what we import from out-of-state and abroad, what products and services we will need, and what resources we have available locally. Establish programs (or plans) to produce those products or substitutes locally when to do so makes economic sense.

8. COMMUNITY EDUCATION & PREPARATION

ERSPO Task Force members have found that peak oil and climate change impacts are inevitably intertwined and must be addressed together in order to increase the likelihood of developing successful responses. Solutions for one problem may exacerbate or be made less viable by the other. For example, in response to energy scarcity, an increase in coal burning is likely, which is a serious problem in terms of greenhouse gas emissions and climate change. Or, in response to climate change, proposals may be made to develop more nuclear power facilities, which, beyond the obvious problems of nuclear waste disposal, would require enormous amounts of energy, huge financial investment and many years to build.

Although the timing, duration and depth of our slide along an energy descent curve is difficult to predict, our understanding of peak oil makes the pathway inevitable, while global warming makes our responsiveness imperative. Whatcom County will experience numerous challenges due to the growing scarcity caused by increased demand for and reduced availability of global energy supply unless we, as a community, *significantly* reduce our energy demand, dramatically increase efficiencies and develop local renewable energy sources, optimally in that order. This issue of how to address energy usage reduction is one with social, political and economic ramifications. It must be approached in a systemic manner to make progress and to prepare for an energy future that is likely to be quite different from the one we have imagined without the reality of peak oil.

A proactive approach to addressing pending energy scarcity is important. We need to find a way to involve the whole community in the process of restructuring to build the resilience that will be required to weather the economic and social shocks that will arise from shrinking energy supplies and increasing impacts due to climate change.

The challenge is how to approach the prospect of energy scarcity in a way that engages as much of the community as possible in a positive manner. It will be important to support opportunities for learning skills that may be of more value in a situation of high energy prices. These may be skills that provide a measure of control and stability for an individual or family, such as learning how to grow and preserve food to ease strain on the food budget or how to repair things. Important opportunities will also include building skills to support a changing business mix, for example, repairing bicycles, insulating buildings and installing solar panels.

Currently, some individuals and businesses are preparing for and making changes based on information they have obtained and beliefs they hold about these issues. Their self-interest has guided them to make their own individual choices to reduce personal dependence on carbon-based fuels or to manage their business in as “green” or cost-efficient a manner, related to energy, as their resources permit. Collectively, these individual efforts are already making important differences for the energy future of Whatcom County. However, for the

majority of residents, it will be challenging to accept the need for significantly reducing energy use and making lifestyle changes that are perceived as difficult.

8.1 The Need for Community Engagement

By themselves, education and information dissemination have been found largely *not* to be effective in encouraging action. A strategy composed exclusively of research and education is likely to lead to longer inaction and apathy, except among those who are already "on board." Social Marketing (not to be confused with social *network* marketing) has informed us that the greatest motivators are the need to belong and the urge to do whatever actions one perceives others, particularly peers, to be doing. Therefore, an effective strategy should include engaging large portions of the public in action, finding ways to involve previously disinterested demographic groups, and making sure these changes and actions are publicized well in order to get the attention of those who are NOT involved and provide motivation for them to participate.

The ERSPO Task Force would like to see, with Councils' support, comprehensive community engagement and coordinated actions that prepare Whatcom County's citizens and businesses to be more resilient regarding future energy and climate volatility. We would like to promote a community education plan to inform our residents about the peak oil issue and engage them in dialogue to determine the best course of action to mitigate the impacts on individuals, their families, businesses and neighborhoods. Our aim is to move from individual actions to collective action with efficiencies and benefits obtained through economies of scale.

The objective is to collectively curtail energy use and carbon emissions wherever possible, and to continue to expand upon progress made. "Reduce, reuse, and recycle" are fairly universally-accepted concepts and Whatcom County and the City of Bellingham are both leaders in this area. This region can also become a national leader in community resilience and energy descent planning through conserving, converting and curtailing energy use wherever, whenever, and however possible.

The City of Bellingham performed surveys in 2004, 2006 and 2008 to help identify residents' satisfaction level and priorities for city services. P*rotecting the environment* and *protecting the livability of neighborhoods* were top priorities for citizens. Through the processes of education, communication, recommendations, and policy implementation and action, councils can meet the desires of citizens to protect the environment and preserve the livability of this region.

If residents and business owners are cognizant of their use of energy and their carbon footprint, we can hope that they will act in their own and in their community's interest to prepare for and minimize the effects of energy scarcity and climate change. The level of participation and enthusiasm for reducing energy usage will be directly related to knowledge and understanding of the issues and how much each person believes his or her actions can make a difference, as well as how much they perceive that others are also engaged. It is critical to energy resource behavior change that there is a demonstrated level of commitment and action that one can see in the community and among peers. Therefore, it is important that the city and county act as leaders in supporting and making these changes themselves.

The role of the Councils and the ERSPO Task Force and their successors is to develop and support a community awareness and engagement program that informs citizens and businesses about energy resource scarcity and peak oil. Ideally this process would provide both opportunity and mechanisms to collect input from residents and businesses regarding

policy and to implement changes that will address the critical areas of transportation, food, water, land use and social service provision.

This feedback should be used to guide policies and the development of programs and practices that prepare for energy volatility, scarcity and increased cost. Additionally, it will be important to create measures of success and reports to the public about what improvements the city, county, individuals and businesses have made. See Section 3 ("Energy and Water") for Whatcom County's Energy Baseline, Appendix 3 ("Energy Use Comparisons") for information on how our energy use compares with other regions, Appendix 4 ("Energy Use Reduction Scenarios") for ideas on possible reduction scenarios, and Appendix 7 ("2009 Whatcom County Snapshot") for the 2009 economic baseline for Whatcom County.

ERSPO's Community Education & Preparation subcommittee acknowledges that numerous organizations and community efforts already exist that are working towards being able to meet our basic needs locally as much as possible. Many provide education about sustainability and many tools are at our disposal to use and build upon. Neighborhood advisory committees, RE Sources, Sustainable Connections, Sustainable Bellingham, Smart Trips program data, The Center for Local Self-Reliance, and WSU Extension are just a few.

A new community organization, Transition Whatcom (transitionwhatcom.ning.com), based on the Transition Initiatives model, shows great promise in rebuilding community resilience with a special focus on preparing our community for a low-energy future. The Transition Initiatives process does not prescribe the actions each area should take. Instead, it provides a well-developed format for engaging the diverse members of a community and harnessing the creativity and imagination of the residents to envision and create their own set of solutions. See Appendix 6 for more detail on Transition Initiatives. For a full explanation of the Transition process, see *The Transition Handbook*.[1]

8.2 Recommendations

Education *of* and input *from* citizens of the communities represented by the City of Bellingham and Whatcom County councils are critical to achieving success in increasing community resilience.

1. The ERSPO Task Force recommends a well-publicized community event promoted by city and county government at which the Task Force publicly presents its findings and recommendations. Perhaps this event would include a keynote speech from a known authority on energy scarcity. Out of this introduction further events could result such as a PowerPoint presentation offered by ERSPO Task Force members to neighborhood associations, non-governmental organizations, churches; or whoever seeks a presentation of the Task Force's findings and recommendations.
2. Three to six months after the public unveiling, the Councils might provide their own report defining their proposed goals and actions. Again, this could be a well-publicized community event promoted by city and county government.
3. Task Force members request that the Mayor, County Executive and other government leaders study this report and incorporate appropriate sections into whatever presentations and/or negotiations they take on in the future. For example, conversations with the WTA, agricultural/food industry groups, transportation planners, etc., should include the lessons learned through this exercise. ERSPO Task Force's ultimate hope is to empower leadership to build community resilience by proactively engaging with, and working towards solutions for, the probable impacts of energy

scarcity. Community members and government leaders should also be aware of what other cities are doing.

4. Inform citizens about peak oil and foster community and community-based solutions:
    a. Research public understanding of Bellingham's energy future.
    b. Leverage existing programs to communicate with the public about Bellingham's energy future.
    c. Design and implement a highly visible information campaign that would integrate peak oil issues into a broader context of energy and sustainability.
    d. Work with community-based organizations to provide information about options and resources to help citizens prepare.
    e. Design competitions or incentives for neighborhoods or businesses to meet reduction targets.
    f. Work with schools to educate students about peak oil and related issues.
    g. Integrate peak oil into the Bellingham Waterfront Development project and other strategic planning projects.
    h. Plan for public schools to be used as distribution points for public services and community support.
    i. Facilitate development of local business networks or barter systems that build community and broaden economic opportunity.
    j. Encourage all educational institutions around the county to begin teaching skills likely to be of value in a post-carbon era.
    k. Contract with Western Washington University and/or Whatcom Community College to perform a study to determine the approximate post-carbon, sustainable population of Whatcom County, assuming that significant portions of the food and other essential goods for all citizens are produced within the County. Identify in the study in-County resources not currently available but required for that self-sufficient lifestyle. The word "sustainable" implies use of resources and land in a way that does not degrade the ability of future occupants to live here productively for hundreds of years. Ensure that this study undergoes peer review and, subsequently, public dissemination.

9. ERSPO REPORT SUMMARY

The Energy Resource Scarcity/Peak Oil Task Force started work in August 2008 at a time when oil was over $100/barrel, gasoline was $4/gallon and the worldwide financial meltdown was imminent. From an energy perspective, prices were at or near record highs. During the following year, world financial markets crashed and economic recession became widespread. Concurrently, the price of oil dropped to the $30-$40/barrel range before returning to the $70-$80/barrel range. By late 2009, with pressing financial concerns related to recession and high unemployment, and with gasoline prices back down in the $2-3 range, the specter of high energy prices and supply shortages has faded from the priority lists of most citizens and governments.

Yet the basic peak oil problem has not gone away; it has only been deferred somewhat due to reduced worldwide energy demand. As economies recover and demand picks up, a supply crunch will come. The recommendations in this report remain valid. It is incumbent upon local government and citizens to consider the effects and responses to the impacts of more expensive and scarcer energy supplies, even if the timing is not readily predictable. We are seeing the economic result around the country, as well as in Bellingham and Whatcom County, of planning and budgeting that did not anticipate the dramatic reductions in revenues that we are now experiencing.

This document is a draft report. It touches the surface of where local emphasis might be placed. The Whatcom County Council and Bellingham City Council should determine what and if further work is warranted.

Transition Whatcom's goal is to coordinate a county-wide, citizen-led Energy Descent Action Plan (EDAP). In recognition of this, the Councils could support the EDAP process and look forward to that plan as a more detailed product that builds on this draft report.

RESOLUTION NO. 2008-16

RESOLUTION TO ESTABLISH A PEAK OIL TASK FORCE TO STUDY AND MAKE RECOMMENDATIONS REGARDING THE CONSEQUENCES OF DIMINISHING ENERGY RESOURCES ON WHATCOM COUNTY AND THE CITY OF BELLINGHAM.

WHEREAS, proactive planning is critical so that our communities are resilient and prepared in the face of the environmental, economic, and social challenges of diminishing energy supplies; and

WHEREAS, currently U.S. economic, social and political institutions are dependent on abundant energy supplies; and

WHEREAS, Whatcom County and its citizens and businesses depend on oil and natural gas for their economic welfare and their most critical activities, including transportation, food supply, water delivery, health care and electricity; and

WHEREAS, global reserves of oil and natural gas are finite and sufficient substitutes are unlikely to be available in the immediate future; and

WHEREAS, a growing body of energy industry experts believe that the world has already arrived at, or will soon arrive at, the peak of global oil production, which will be followed by an inevitable decline in available supply; and

WHEREAS, U.S. oil and natural gas production have peaked and are now in decline, ensuring our nation's continued and growing dependence on oil and natural gas imported from politically unstable regions; and

WHEREAS, global demand for oil and natural gas continues to increase, and the decline in global oil production threatens to increase resource competition, geopolitical instability, and lead to greater economic disruptions; and

WHEREAS, we can no longer assume that energy prices will continue with modest cost increases that can be easily planned for, but rather we are facing a future of increasing uncertainty in our energy supply and volatility in energy prices; and

WHEREAS, Whatcom County governments, residents and businesses will benefit from greater attention to this topic, as they are not currently aware of the full implications of an impending decline in energy supplies, such as impacts on transportation, food production and delivery, business and home energy use, land use planning, municipal water and wastewater treatment, social services, and additional demands on first responders; and

WHEREAS, many of the options to lessening dependence on fossil fuels could result in local green collar jobs and substantial economic benefits; and

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WHEREAS, the City of Bellingham and Whatcom County have each adopted Climate Action Plans. the success of which depends upon reducing carbon dioxide emissions from burning fossil fuels; and

WHEREAS, many other communities are developing plans that analyze the impacts of Peak Oil on their communities and recommend appropriate responses.

NOW THEREFORE, BE IT RESOLVED THAT THE CITY COUNCIL OF THE CITY OF BELLINGHAM: acknowledges the enormous challenges of confronting energy vulnerability; and

BE IT FURTHER RESOLVED THAT: a task force will be established to study and make recommendations regarding the consequences of diminishing energy resources. This task force should examine the energy vulnerabilities of our current infrastructure and consider appropriate changes in order to ensure that economic, social, and environmental infrastructures are resilient in the face of uncertainties brought about by shifting energy markets. The task force will include up to 18 members selected by the Mayor of Bellingham and the Whatcom County Executive, representing a broad range of government, community and business interests. The task force members guiding each sub-committee will include those with expertise and knowledge of the category to be examined. Sub-committees shall be established to include the categories of:

1) Land Use and Transportation;
2) Food and Agriculture;
3) Public and Social Services (including public education, health, social services, utilities and public safety);
4) Economic Transition;
5) Energy and Water;
6) Community Education and Preparation (to reduce dependence on fossil fuels).

BE IT FURTHER RESOLVED THAT: the task force's charge is:

1) To utilize current and credible data and information on the issues of peak oil and natural gas production and the related economic and societal consequences;

2) To seek community and business input on the impacts of declining oil supplies, rising energy prices and proposed adaptations;

3) To develop recommendations to the city and county councils in this calendar year on strategies the city and county governments can take to mitigate the impacts of declining energy supplies in areas including, but not limited to: transportation, business and home energy use, agriculture and food security, health care and social services, land use planning, water and wastewater treatment, and local energy development. These recommendations and proposed outcomes will include suggestions as to appropriate implementing bodies (governmental and non-governmental), and possible funding sources for outcome success.

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These recommendations will be integrated into the long term strategic planning efforts of both the City of Bellingham and Whatcom County; and

4) To propose methods of educating residents and businesses about this issue in order to reduce dependence on fossil fuels.

PASSED by the Council this 19th day of May, 2008.

Council President PRO TEM

APPROVED by me this 19th day of May, 2008.

Mayor

ATTEST

Finance Director

APPROVED AS TO FORM:

Office of the City Attorney

City of Bellingham
City Attorney
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05-05-03 Peak Oil Task Force.doc (3)

SPONSORED BY: CONSENT
PROPOSED BY: WEIMER
INTRODUCTION DATE: MAY 20, 2008

RESOLUTION NO. 2008-042

ESTABLISHING AN ENERGY RESOURCE SCARCITY TASK FORCE TO STUDY AND MAKE RECOMMENDATIONS REGARDING THE CONSEQUENCES OF POTENTIAL CHANGES TO THE SUPPLY OF ENERGY RESOURCES ON WHATCOM COUNTY AND THE CITY OF BELLINGHAM

WHEREAS, proactive planning is critical so that our communities are resilient and prepared in the face of the environmental, economic, and social challenges of diminishing energy supplies; and

WHEREAS, currently U.S. economic, social and political institutions are dependent on abundant energy supplies; and

WHEREAS, Whatcom County and its citizens and businesses depend on oil and natural gas for their economic welfare and their most critical activities, including transportation, food supply, water delivery, health care and electricity; and

WHEREAS, global reserves of oil and natural gas are finite; and

WHEREAS, a debate exists about the development of economically viable substitutes in the future; and

WHEREAS, some energy industry experts believe that the world has already arrived at, or will soon arrive at, the peak of global oil production, which will be followed by an inevitable decline in available supply; and

WHEREAS, U.S. oil and natural gas production appear to have peaked and are now in decline, ensuring our nation's continued and growing dependence on oil and natural gas imported from politically unstable regions; and

WHEREAS, global demand for oil and natural gas continues to increase, and the decline in global oil production threatens to increase resource competition, geopolitical instability, and lead to greater economic disruptions; and

WHEREAS, we can no longer assume that energy prices will continue with modest cost increases that can be easily planned for, but rather we are facing a future of increasing uncertainty in our energy supply and volatility in energy prices; and

WHEREAS, Whatcom County governments, residents and businesses will benefit from greater attention to this topic, as they are not currently aware of the full implications of an impending decline in energy supplies, such as impacts on transportation, food production and delivery, business and home energy use, land use planning, municipal water and wastewater treatment, social services, and additional demands on first responders; and

WHEREAS, many of. the options to lessening dependence on fossil fuels could result in local green collar jobs and substantial economic benefits; and

WHEREAS, the City of Bellingham and Whatcom County have each adopted Climate Action Plans, the success of which depends upon reducing carbon dioxide emissions from burning fossil fuels; and

WHEREAS, many other communities are developing plans that analyze the impacts of Peak Oil on their communities and recommend appropriate responses.

NOW, THEREFORE, BE IT RESOLVED, that the Whatcom County Council acknowledges the enormous challenges and potential opportunities of confronting energy vulnerability; and

BE IT FURTHER RESOLVED that a task force will be established to study and make recommendations regarding the consequences of changes to the availability of energy resources. This task force should examine the energy vulnerabilities of our current infrastructure and consider appropriate changes in order to ensure that economic, social, and environmental infrastructures are resilient in the face of uncertainties brought about by shifting energy markets. The task force will include up to 18 members selected by the Mayor of Bellingham and the Whatcom County Executive, representing a broad range of government, community and business interests. The task force members guiding each sub-committee will include those with expertise and knowledge of the category to be examined. Sub-committees shall be established to include the categories of:

1) Land Use and Transportation;
2) Food and Agriculture;
3) Public and Social Services (including public education, health, social services, utilities and public safety);
4) Economic Transition (including retail, manufacturing, service, tourism);
5) Energy and Water;
6) Community Education and Preparation.

BE IT FURTHER RESOLVED that the task force's charge is:

1) To utilize current and credible data and information on the issues of peak oil and natural gas production and the related economic and societal consequences;

2) To seek community and business input on the impacts of changes to energy resource availability, rising energy prices and proposed adaptations;

3) To develop recommendations to the city and county councils in this calendar year on strategies the city and county governments can take to mitigate the impacts of declining energy supplies in areas including, but not limited to: transportation, business and home energy use, agriculture and food security, health care and social services, land use planning, water and wastewater treatment, and local energy development. These recommendations and proposed outcomes will include suggestions as to appropriate implementing bodies (governmental and non-governmental), market based and regulatory programs/incentives as well as possible funding sources for outcome success.

4) To propose methods of educating residents and businesses about this issue in order to optimize the use of and therefore reduce our dependence on fossil fuels, electricity and other energy sources subject to resource scarcity.

APPROVED this 20th day of May 2008

ATTEST:

Dana Brown-Davis, Clerk of the Council

WHATCOM COUNTY COUNCIL
WHATCOM COUNTY, WASHINGTON

Carl Weimer, Council Chair

APPROVED AS TO FORM:

Civil Deputy Prosecutor

Appendix 2: Peak Oil — An Overview

This document was prepared by John Rawlins, ERSPO Task Force member. It is based heavily on a similar appendix in the Portland Peak Oil Task Force Final Report written by John Kaufmann of the Oregon Department of Energy and provided to Portland Task Force members as part of the initial Portland Peak Oil Task Force Briefing Book. This March 2009 update includes ideas and events that have occurred since Kaufmann wrote his original draft in 2006. See also "Whatcom County/Bellingham Solutions from a Peak Oil Task Force," as an overview of peak oil and the need for a local task force, prepared by the committee that drafted the task force Resolutions passed by both Councils. The report includes a list of references and recommended books: http://www.cob.org/documents/mayor/boards-commissions/energy/peak-oil-briefing.pdf.

PEAK OIL − AN OVERVIEW

Much has been written about the concept of "peak oil" in recent years. Peak oil as applied to the world means that the total world production rate (measured in Millions of Barrels per day, or Mbbl/d) increases to a maximum (a peak in the production rate versus time curve) at some point in time, then declines. The time at peak corresponds physically with having used about half the Earth's original endowment of oil. Once the peak occurs, the global oil production rate can no longer be increased (unless phenomenally huge new fields come online). The oil production rate will level out (or plateau) and then begin a long-term decline. Production will no longer be able to meet growing demand as it has in the past. Furthermore, because Gross Domestic Product (GDP) correlates with energy use, the world GDP can no longer grow. Thus, peak oil represents one of several limits to growth, unless humans develop affordable, expandable, and scalable alternatives in a timely manner.

Dr. M. K. Hubbert, the lead oil geologist for Shell Oil, developed the peak oil concept based on observed U.S. oil production five decades ago in the 1950s. In 1956 Hubbert correctly predicted that U.S. (lower 48 states) production would peak around 1970. Even the subsequent discovery and rapid development of Alaskan north slope oil production did not increase total U.S. production above the peak achieved in 1970. Alaskan north slope production itself peaked in 1988. It is worth noting here that, as of 2009, about two-thirds of Washington State's west coast oil comes from Alaska (now in decline); the balance comes from other countries.

Peak oil typically encompasses the idea of peak natural gas as well. Since much natural gas (conventional gas) is "associated gas" that accompanies oil production, its production curve is similar to oil's. World natural gas is anticipated to peak perhaps about a decade later than oil. The United States was expected to experience the effects of declining natural gas production sooner than that. North American gas production has increased somewhat in the past few years, in part through the development of unconventional gas from "tight" shale rock formations in the U.S. Shale gas is more costly to produce than conventional natural gas.

We estimate that comparable quantities of natural gas in Whatcom County come from two sources: U.S. unconventional gas from the Rockies and elsewhere (slightly increasing), and conventional Canadian gas (in decline). It is more expensive, and far less common, to import natural gas than oil. Natural gas has to be liquefied for transport and storage and then re-gasified for distribution. The status of several proposals for establishing re-gasification terminals on the U.S. west coast is unknown at this time.

Oil accounts for about 40 percent of the energy we use, and natural gas accounts for another 25 percent. Oil provides virtually all our transportation energy. Natural gas heats about half our building space and generates about 7 percent of Washington's electricity. In addition, oil and natural gas are used for numerous industrial processes, including use as a feedstock for thousands of products such as asphalt, fertilizers, pesticides, plastics, chemicals, paints, medical products, vinyl, and shoes and apparel. Because of the degree of our reliance on oil (and gas), peaking of oil/gas could well result in peaking of nearly everything – food, building materials, clothing, synthetic rubber, plastics, and potentially even human population.

Declining oil and natural gas production rates could have a major impact on the U.S. and world economies. All the major recessions of the past 35 years were preceded by sharp increases in the price of oil. The energy crises of the 1970s provide a preview of the impact of peak oil. U.S. oil production peaked in 1970 and started a decline, which continues to this day. We turned to imports to make up the shortfall. OPEC used this growing dependency for political purposes, cutting production 6-7% in 1973 and tripling prices. As a result:

- GNP growth fell from 4% in 1960-73 to 1.8% in 1973-82;
- Productivity growth dropped from 2.5% in 1966 to less than 1% in 1979;
- Unemployment rose from 4.8% in 1972 to 8.3% by 1975;
- Inflation was 8.8% for the decade; and,
- Take home pay dropped 6% from 1973 to 1979.

High prices stimulated energy conservation and development of more expensive, harder-to-get supplies from places like Alaska and the North Sea, and eventually OPEC was forced to reduce prices. However, this time there is no major new resource areas to develop, with the possible exception of arctic regions as (ironically) global climate change leads to melting of the arctic ice cap. The impacts of near-term peaking could be deeper and will last longer (decades) than they did after U.S. oil production peaked.

Opinions differ as to when production will peak. Some experts believe the peak is imminent or has already happened. Many believe it will occur in the next 10 to 15 years. The most optimistic opinions place the peak around 2030 to 2040. The primary difference revolves around estimates of Earth's ultimately recoverable reserves and the effect of prices in stimulating advanced recovery and development of unconventional resources. Generally speaking, the lower estimates tend to come from petroleum geologists (many retired) and physicists, the higher estimates from economists.

A review of the data leads us to conclude the peak likely will occur sooner rather than later. Among our observations are the following:

1. Trends of both discoveries and production point to a global resource base of about 2.2 trillion barrels of oil originally in place. The world has already used more than one trillion barrels, and is currently using more than 30 billion barrels per year (or about 85 million barrels per day – all liquids).
2. Optimistic estimates that the earth once held 3 trillion barrels of recoverable conventional oil would require a reversal of historic discovery trends and a doubling of estimates of remaining reserves.
3. In the long run, cumulative production cannot exceed total discoveries. Experience in many oil-producing nations indicates that production lags discovery by 25 to 40 years.

For example, in the U.S., the discovery rate peaked in the early 1930s, and the production rate peaked in 1971. The world discovery rate of oil peaked in the mid-1960s, and has declined ever since.

4. The discovery rate fell below the production rate in the mid-1980s and has continued to fall. The world currently finds one barrel for every four or more that it uses.
5. Higher oil prices and increased drilling have not resulted in increased discovery rates. New discoveries have tended to be fewer, smaller, deeper, more remote, and more costly. The largest, most easy-to-find deposits are likely to already have been found. For example, a much-heralded recent discovery in the Gulf of Mexico (Jack field) is located in a hurricane-prone area under 7,000 feet of water and another 20,000 feet below the ground, and contains 1 to 6 months worth of oil at current rates of consumption − the costs of producing this would be even higher than present deep-water fields, and it would not noticeably delay the peak.
6. About two-thirds of oil-producing nations have already peaked and are in decline, including the U.S., Mexico, and the North Sea (U.K. and Norway). At least two of the world's five largest fields ever found − Burgan in Kuwait and Cantarell in Mexico − have peaked and begun to decline, and there is concern that Saudi Arabia is having difficulties maintaining production from the world's largest field, Ghawar. Russia, currently the largest producer of oil in the world, recently announced that 2008 will likely be the year of its peak production rate.
7. Knowledge of where oil may or may not be located is more extensive than ever. Geologists have identified what kind of geological formations are likely to produce and hold oil, and the earth's geology has been extensively mapped. In addition, millions of wells have been drilled looking for oil and other resources. The likelihood of finding new fields comparable to those in Middle East, Texas, Russia, Mexico, or the North Sea, is very low.
8. Estimates of existing reserves are unreliable, especially for some of the OPEC countries. Reserve estimates of OPEC member nations jumped 60 percent in the late 1980s. This was likely due to a link between proved reserves and production quotas, rather than new (unannounced) discoveries. In the past few years, Shell Oil and Kuwait downgraded their estimates of proved reserves by 20 and 50 percent, respectively.
9. Nations that depend heavily on oil imports are especially at risk of massive dislocations as exporting nations approach and pass their oil production peaks. For example, consider U.S. imports from Mexico. The Cantarell field in Mexico, which was responsible for about half of total Mexican production, is now in such steep decline that Mexico is likely to have no oil at all to export by about 2015. The U.S., which imports about two-thirds of its oil, has depended on Mexico in recent years for about 12% of U.S. oil. At the time of this writing (2009), Mexican oil exported to the U.S. is in decline.

   The rate of decline of Mexico's total exports is greater than the rate of decline of its oil production rate because of increasing internal oil use (ironically, funded in large part by a growing economy based on oil exports). The only estimate to date for the future of total world oil exports indicates that world exports could decline to zero as early as 2030. However, we note that unknown economic turbulence due to peak oil and other causes could have a dramatic impact on that estimate in either direction.

Several other forces could create conditions similar to peak oil effects that would require reductions in U.S. oil consumption:

1. Geopolitical events affect production of fossil fuels. Most of the remaining oil and natural gas deposits are located in nations that are either unstable or hostile to the U.S., and both voluntary production cuts and war-related disruptions can limit productive capacity or output.
2. The production and use of all fossil fuels may have to decline rapidly to reduce carbon emissions in response to global warming concerns.
3. A decline in the value of the dollar relative to other currencies could reduce our purchasing power and force the U.S. to reduce its share of oil use to levels commensurate with its share of the world population. The U.S. currently has about 5 percent of the world's population, but uses about 25 percent of the world's oil production.
4. The worldwide economic decline of 2008-2009 is resulting in cancellation of a significant portion of new oil field development, with the possible result that 2008 could well be the year of world peak oil production rate. Prior to 2008, annual new oil production (capacity additions) was barely able to keep up with decline of the pre-existing production base – with the result that world oil production had been nearly constant since 2005. If the present trends of worsening economic conditions and wealth destruction continue to limit funds available for new oil field development, declining world oil production may be unavoidable from now on.

Many believe higher prices will stimulate either new discoveries or the development of alternatives. For example, Cambridge Energy Research Associates (CERA), a major economic consulting firm, released a report in November 2006 claiming that world oil production will not peak before 2030. This is based on the highest estimate of developable resources to date, and has come under criticism from many. In particular, CERA projects that the market will stimulate more production from advanced recovery techniques, Canadian tar sands, and U.S. oil shale than others forecast. Our review of the literature suggests these resources will cost more and be developed far more slowly than CERA assumes. As of this writing, the 2008-2009 global recession has led to such a large decline in world oil prices that Canadian tar sand development has slowed significantly**.**

Below is an assessment of some of the major supply alternatives. While alternatives will be used in some measure, they are highly unlikely ever to fully replace oil and natural gas. All have a lower energy return on energy invested (EROEI) than oil or natural gas − that is, they take more energy to produce and yield a smaller net energy gain. For example, most of the alternatives yield 2 to 5 units of energy for every unit needed to produce them. This compares to oil and gas, which historically have had net energy ratios of 20:1 and greater. As a result, the alternatives are less productive and more expensive.

In addition, most of the alternatives produce electricity rather than liquid transportation fuels, and many have significant environmental problems and/or have their own supply constraints, particularly if production is increased to offset declining oil and gas resources. All would take decades to replace a significant amount of declining oil and natural gas reserves. Once decline has set in, the rate of decline would likely be in the range of 4% to 10% per year.

1. *Coal* - Conventional wisdom used to be that U.S. coal reserves would provide centuries worth of production at current use rates. Coal can be used to generate electricity, and it can also be converted into gaseous or liquid fuels. However, there are major caveats to this conventional wisdom:

a. Increased use of coal would aggravate global warming unless the CO_2 is sequestered. Sequestration is currently not a proven technology, and its use would require about one-quarter of the energy in the coal to accomplish.
b. Use of coal to replace oil and natural gas would eventually require quadrupling coal production rates, which is not feasible.
c. Recent estimates of world-wide coal reserves and production capacity suggest that global coal production will peak around 2020-2030, with a U.S. peak in that same time-frame. At best, peak production in the U.S. might be about 20% higher than it is currently. Presently, the energy produced from coal in the U.S. is in decline, even as more tonnage is being produced. The cause of the energy decline is that high quality coal (high energy content) is nearly exhausted and the trend toward production of lower quality coal has reduced overall energy recovery.
d. If peaking of oil supply is in the 2005-2015 timeframe, and coal and natural gas peak in the 2020-2030 period, then the world (including the U.S.) is indeed facing peak total energy around 2010-2020, and there will be no significant conventional fossil fuel-based replacements for oil-based liquid fuels.

2. *Nuclear power* produces only electricity, which means it is not well suited to replace oil as a transportation fuel. Even if nuclear power could meet all U.S. energy needs, the 10-fold increase in nuclear power plant capacity would require massive infrastructure costs. With that many plants in operation, known reserves of uranium would be depleted in about 20 years. Breeder reactors could extend the life of uranium reserves, but safe, affordable breeder reactors are not currently available. Breeders would also require spent fuel chemical processing and recycle facilities that do not exist in this country. Nuclear power also poses the problems of nuclear waste disposal and nuclear weapons proliferation. Washington State has had strong opposition to nuclear power, and currently has only one power reactor operating on the Hanford reservation in Eastern Washington.

3. *Tar sands* in Canada and Venezuela are abundant. However, the tar, or bitumen, is not in liquid form, but rather more like sand-impregnated asphalt. The bitumen requires "upgrading" before the product can even go to refineries. This makes tar sands extraction land and water intensive, energy intensive, polluting, and high in carbon emissions. In addition, it has an EROEI of about 3 to 1, meaning it takes about one-third of the energy in the tar sands to produce it.

4. *Oil shale* has many of the same environmental problems as tar sands. The "oil" is actually a low-energy-density organic compound and, like bitumen, requires chemical processing (or upgrading) prior to introduction into refineries. In addition, oil has never been produced commercially from shale. Shale oil has an estimated EROEI of about 1.5-to-1, meaning two-thirds of the energy it yields must be used to produce it. This would increase the amount of CO_2 emitted. Capturing the CO_2 would further reduce net energy.

5. *Enhanced oil recovery* involves advanced methods to extract more oil from a field, such as in-fill drilling, horizontal drilling, hydraulic fracturing, and injection of solvents like CO_2, nitrogen or steam to make the oil move more easily. Because of costs, enhanced recovery is unlikely to affect an oil field's peak since it is not typically applied until after production has peaked. Recent studies also suggest these methods simply allow the oil to be extracted a little faster, with the total amount of oil produced from a field remaining about the same. Oil producers have been using these "enhanced" recovery techniques for several decades.

6. *Biofuels (biodiesel and ethanol)* are highly touted to replace oil for transportation. In concept, biofuels are carbon neutral; meaning the CO_2 the fuels emit is balanced by the CO_2 the crops incorporate as they grow. In practice, using crops to produce fuel results in bringing new land into cultivation, and that releases enough CO_2 into the atmosphere that the CO_2 payback time is on the order of one century. Biofuels would compete with other uses of the land, such as food, forest, erosion control, and habitat. In addition, most ethanol in the U.S. is now made from corn, which is oil- and natural gas-intensive to grow and, as a result, has a low energy return. Best-case analysis estimates the EROEI at about 1.67-to-1. There are hopes that ethanol will be able to be made from cellulosic plants such as switchgrass, which are less energy intensive and can be grown on marginal lands. However, this is still in the research stage. Biodiesel has a better EROEI (3-to-1 or slightly greater) than ethanol, but will probably require dedicated crops and cropland, thereby limiting the amount that can be produced. While biofuels hold some promise, they are unlikely to replace more than a small share of the petroleum-based liquid fuels currently used.
7. *Hydrogen* is often touted by many as the clean, renewable fuel of the future. However, hydrogen is an energy carrier, not an energy source – much like a battery. Hydrogen is not found in its most useful state − H_2 − but must be separated from other atoms to which it is attached, such as carbon or oxygen – and that requires energy. Most hydrogen today is produced from natural gas. This is not sustainable when natural gas is in decline. In the long run, if hydrogen is to be used as a transportation fuel, it will have to be electrolyzed from water using renewable power. But because of thermodynamic losses in producing and transporting the hydrogen, it may be more efficient to use the renewable power directly. In addition, because of its volume and because it leaks so easily, hydrogen is difficult to store and distribute. The current storage and distribution infrastructures for natural gas and gasoline would have to be replaced, at huge costs, to accommodate hydrogen.
8. *Clathrates* are ice crystals containing methane (i.e., natural gas) found at the bottom of oceans. The potential resource is immense. However, methane is a more potent greenhouse gas than CO_2, and release of even part of this methane could trigger runaway global warming. At this time it is not technically feasible to capture the methane for commercial use without a large portion escaping.
9. *Renewables (wind, solar, biomass, wave power)* will need to be developed to the fullest extent possible, and fortunately Washington is well-endowed with them. However, aside from biofuels, most renewables produce electricity or thermal power (heat). Their applications rarely include transportation. While abundant, it is not clear how much of our total energy needs renewables will be able to meet. The immediate need for renewables is to meet electric load growth, then to begin displacing coal and natural gas in electrical generation to reduce CO_2 emissions. In addition, fossil fuels are required to build renewable power plants. We need to begin building the infrastructure now while cheap oil and natural gas are still available. They will be more expensive and difficult to build once oil and natural gas supplies are declining.

In addition to utilizing alternative supplies, it will be necessary to reduce how much energy we use. While we cannot conserve our way to zero, in the future we will need to use less energy than we use today. With the peak of world oil production approaching, we need major improvements in energy efficiency − we need to improve the efficiency of our cars, our homes and buildings, our lights and appliances, and our industrial processes. In addition to technology improvements, we will need to restructure various institutions and systems. For

example, we should reinvigorate our rail system, develop mass transit, and change land use patterns to reduce the need to travel. We will also need to change behaviors. We should ride-share, walk and bicycle more often, and vacation closer to home.

Regardless of when the peak occurs, the implications are potentially profound. It would be prudent to have acted decades ago. Robert Hirsch, co-author of the highly regarded SAIC report completed for the U.S. government entitled *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*, concludes that peak oil is going to happen, although the timing is uncertain, and that it could cost the U.S. economy dearly. The report further concludes that to have substantial impact, mitigation options must be initiated more than a decade in advance of peaking and will cost in the range of $1 trillion. The costs of acting too late will exceed the costs of acting too early.

The adaptation will require a massive effort. It took decades to develop coal, oil, and natural gas into significant energy sources. It will take decades to transition to a new way of doing things, and will require large amounts of capital and energy. If we wait until the peak occurs, we will be trying to build the new infrastructure and re-localize at the same time that energy supplies are declining, prices are rising, and we're struggling to maintain other services. Energy efficiency and renewable energy technologies will provide a strong base for jobs in the post-peak oil-and-gas economy, and can serve as a vital economic development tool for Washington.

Appendix 3: Energy Use Comparisons

Per Capita Energy Usage

The United States and Canada have the highest energy usage per capita by a considerable margin. Figure 10 compares energy usage per capita with national gross domestic product (GDP). Developed European countries and Japan use only half the energy per capita as the U.S. Part of the difference can be attributed to the greater urbanization and use of public transport in these countries, although Australia, with a much lower population density than the U.S. only uses about two thirds as much energy per capita. The conclusion is that a high standard of living (if measured by per capita GDP) with less (or more effective) energy usage is possible at half the current U.S. level. The estimated Whatcom County energy usage is shown for reference.

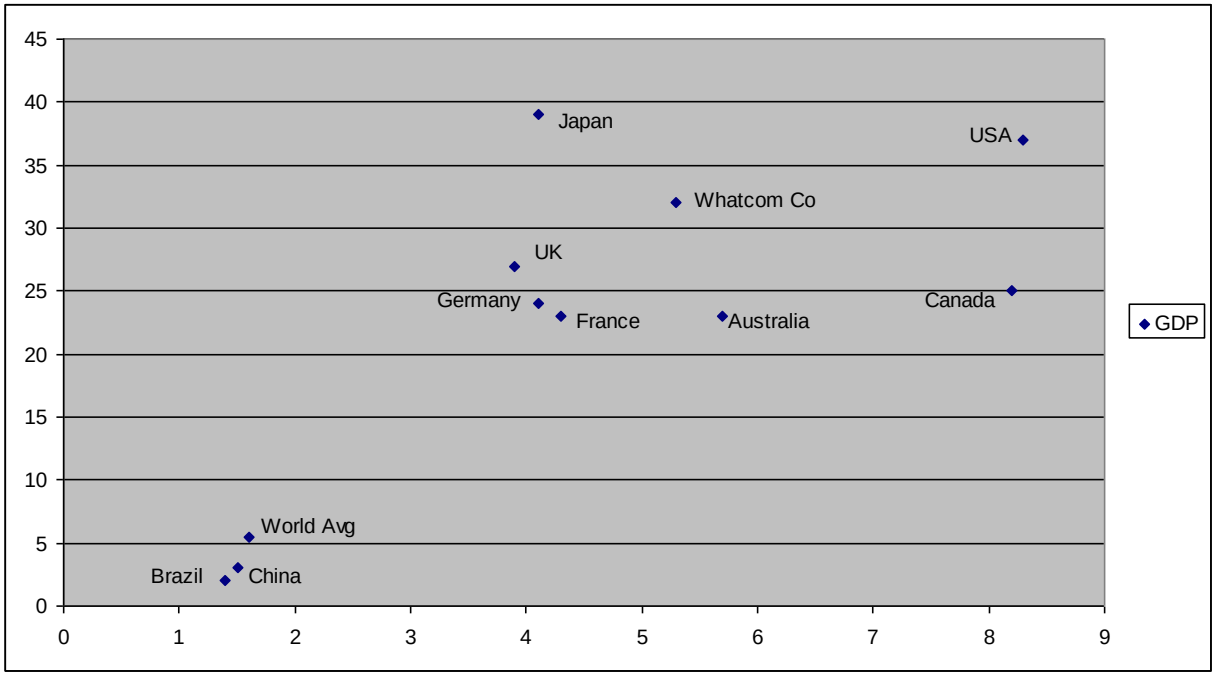


Figure 10 - Per capita energy use versus per capita GDP (units are in tons oil equivalent per capita vs. $1000 GDP)
(Source: Original graph was produced by Frank van Mierlo from data in the 2006 *Key World Energy Statistics* from the International Energy Agency)

Per capita energy usage also varies among the states in the U.S. but within a more narrow range (See Figure 11). With the exception of Alaska, most states' energy usage in the U.S. is similar to the national average of 339 million Btu per capita. Washington ranks 30th with 328 MBtu per capita.

Whatcom County's estimated energy usage is about two-thirds of the Washington State average and similar to California and Vermont. We expect Whatcom's milder climate (milder summers and winters) contributes to the lower usage.

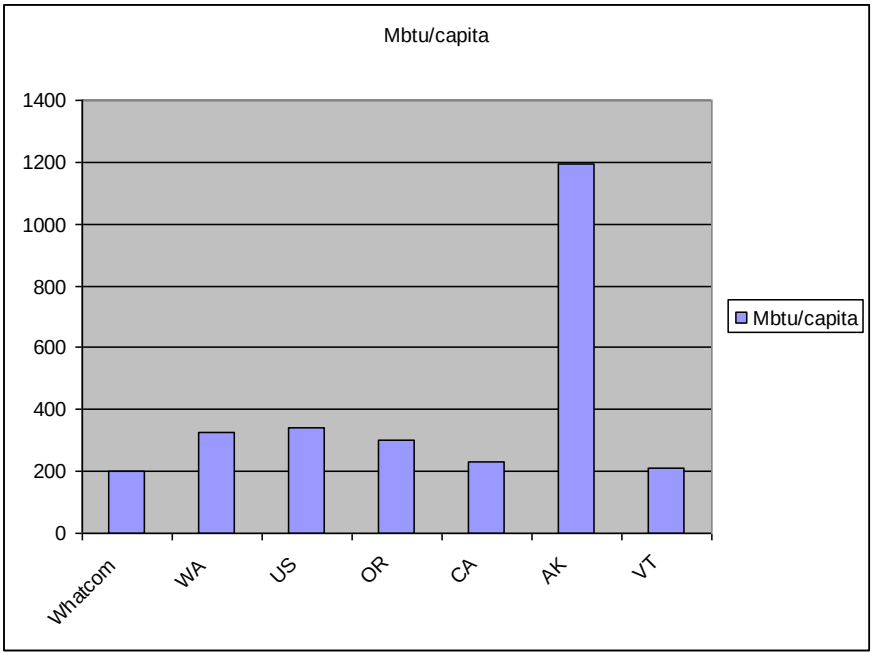


Figure 11 - Per capita energy usage, selected U.S. states, million Btus per capita (Mbtu/capita)
(Source: U.S. Department of Energy, Energy Information Administration)

Energy for Electricity Generation

Washington has a relative abundance of hydroelectric power compared with most other states and is therefore less reliant on fossil fuels for producing its electrical power. In Whatcom County the primary sources of electrical power are Puget Sound Energy (PSE) and the Bonneville Power Administration (BPA). PSE supplies most residential, commercial and industrial users while BPA supplies major industrial users.

Figure 12 compares Whatcom County's PSE electricity supply sources with the U.S. average and Figure 13 includes the BPA supply to Intalco and ConocoPhillips which is primarily from hydropower.

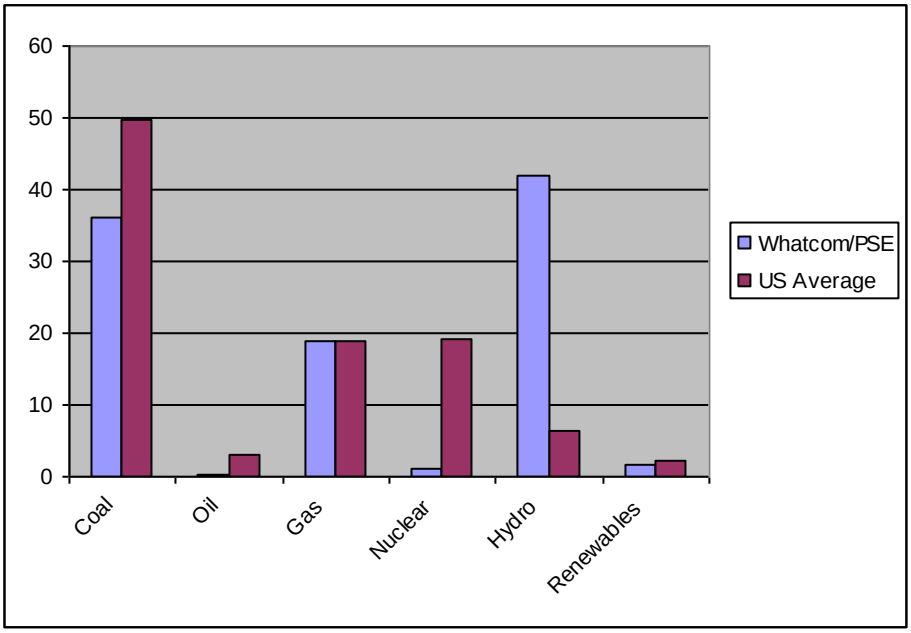


Figure 12 - Sources of Whatcom County/PSE electricity supplies
(Source: Puget Sound Energy website; U.S. Department of Energy, Energy Information Administration)

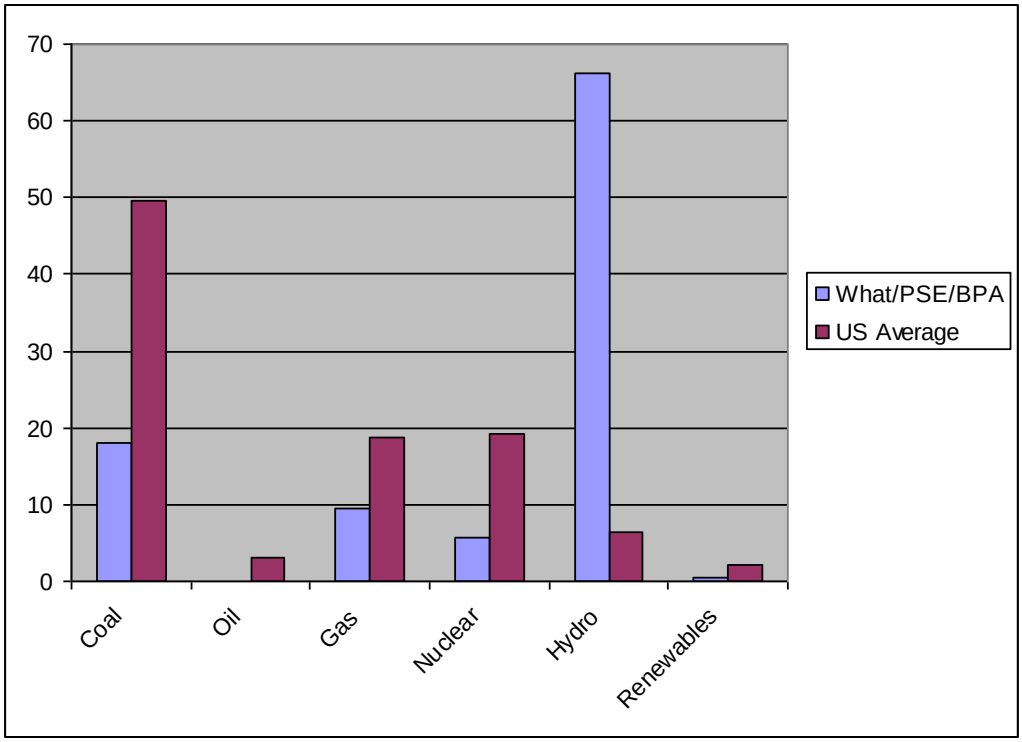


Figure 13 - Sources of Whatcom County/PSE/BPA electricity supplies
(Source: Puget Sound Energy and Bonneville Power Administration websites;
U.S. Department of Energy, Energy Information Administration)

These charts indicate that we are much less dependent on fossil fuels for our electricity and have a higher percentage of hydro/renewables. However, the amount of hydro capacity is unlikely to increase so replacement of electricity generated from oil and gas will have to come from other sources.

Appendix 4: Energy Use Reduction Scenarios

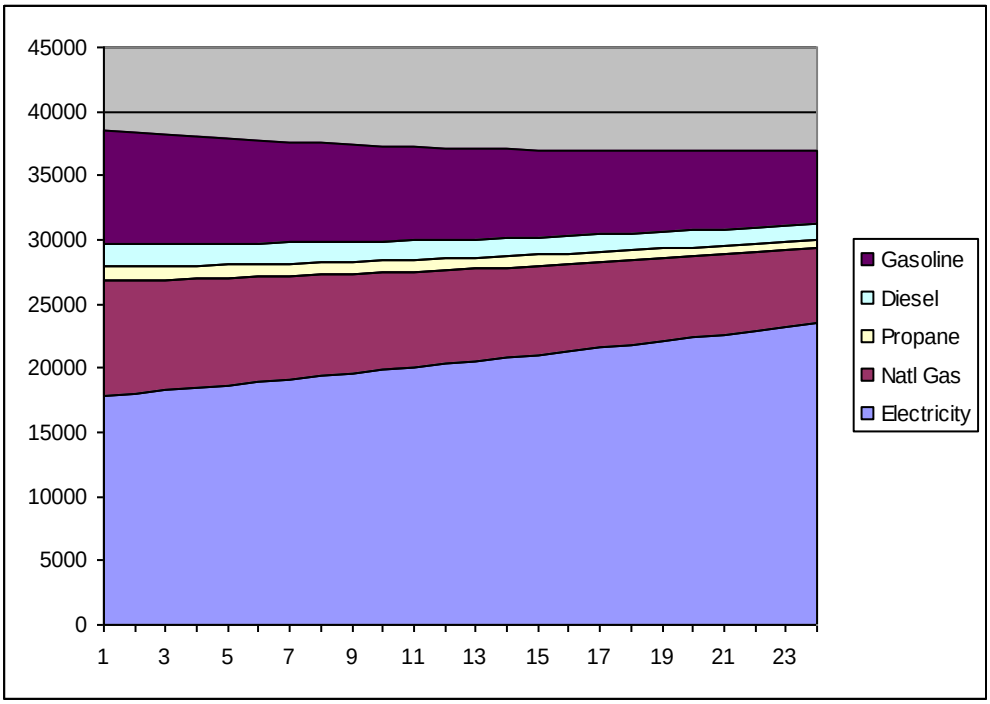
A key recommendation of the Portland report is to "Reduce total oil and natural gas consumption by 50% over the next 25 years." We have not specified such a target for Whatcom County. However, it is instructive to look at the impact of various energy reduction scenarios on the Whatcom energy baseline.

Whatcom County is currently evaluating "Whatcom 2031", preparing for the next planning period as required by the Washington State Growth Management Act. We have used this time frame for our energy reduction impact scenarios.

Built into the Whatcom 2031 assumptions is a growth in the county population from 191,000 in 2008 to 251,490 by 2031, a growth rate of 1.2% per year. (Note that the growth rate between 1990 and 2008 was 2.2%/year.) If the current per capita energy usage remained constant, the energy usage, assuming a 1.2% population growth rate, would grow from about 38.4 trillion Btus currently (using 2005-6 data) to about 50 trillion BTUs in 2031.

Scenario 1

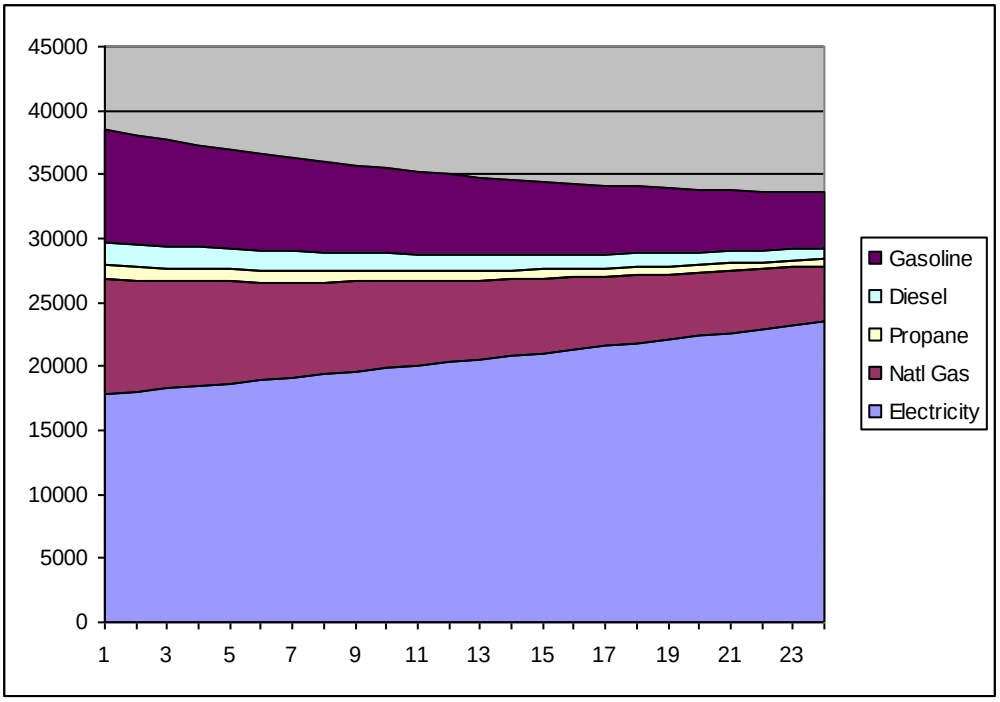
This assumes that electricity use increases with population (1.2 % /year) and all hydrocarbon fuel use is reduced by a net 1.8 %/year. The oil and gas fuel usage is reduced by about 34% by 2031. However, the total energy usage is only reduced slightly (down 4%) because the electricity use increases with population



Scenario 1

Scenario 2

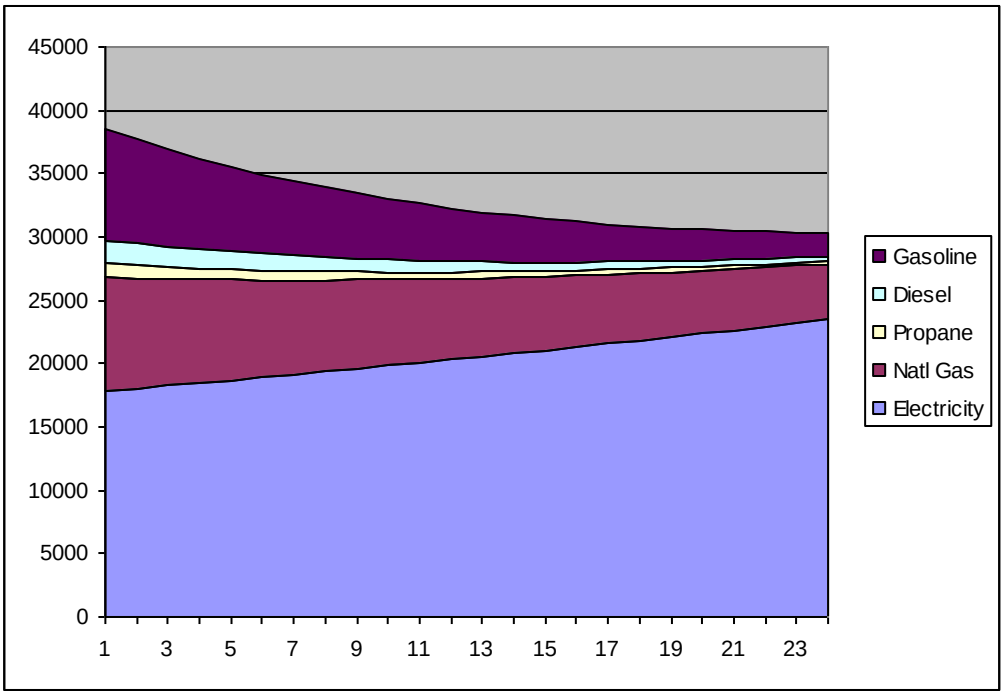
Oil and gas use must be reduced by a net 3%/year to achieve a 50% reduction by 2031, a target similar to the Portland Report. Again note that the overall energy usage is reduced by a more modest amount of 15% because of continued electricity use by a growing population.



Scenario 2

Scenario 3

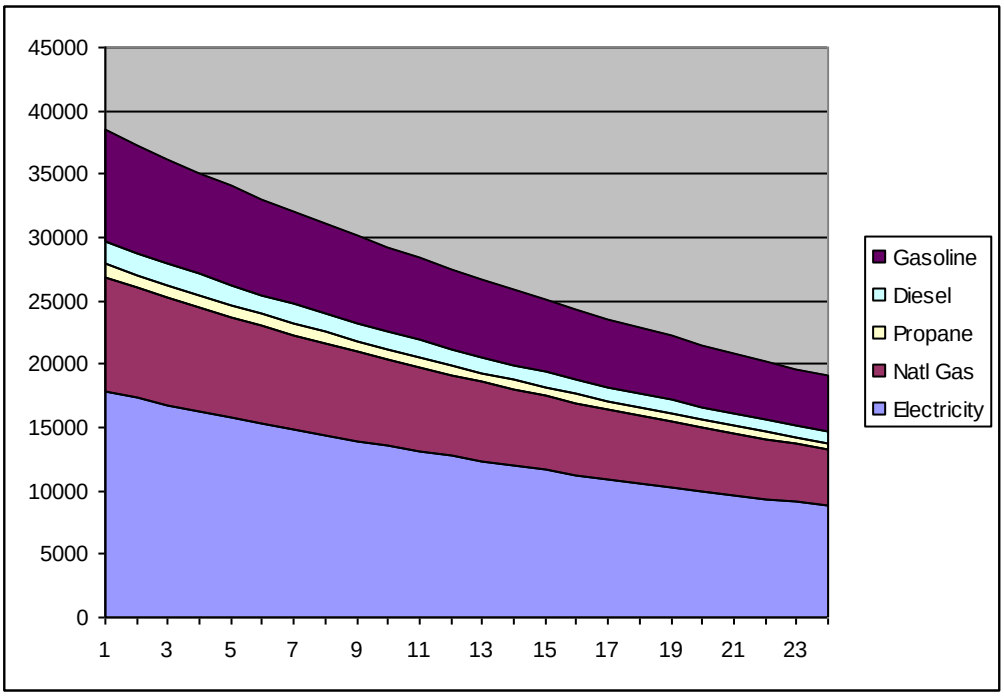
After world peak production is reached, some scenarios for the decline in oil supply capacity envision the U.S only having access to supply for 20% of the current needs by 2031. This would be the result of continuing decline in U.S. domestic oil production and less oil available for export from OPEC and other oil exporting countries. In that scenario local oil (propane/diesel/gasoline) consumption would have to be reduced by about 6.6%/year to live within 20% of the current oil baseline. This scenario also assumes the same 3% annual reduction in natural gas usage as in Scenario 2.



Scenario 3

Scenario 4

As noted in Appendix 3 European total energy usage per capita is only about half of the U.S. average. Whatcom County usage is about two-thirds of the U.S. average. So Whatcom would need to reduce per capita energy consumption by one third to match European energy efficiency. This would require a reduction of 3% per year in all energy uses to reduce per capita energy use by 50% by 2031.



Scenario 4

Appendix 5: Area Advocacy and Farm Support Organizations

Whatcom County

- Ag Plastics Recycling, www.re-sources.org
- Anti-Hunger Coalition Resilient Farm Project; The Resilience Institute, http://igcr.blogspot.com/2008/11/everyday-farming-is-food-security.html, Resilient Farms Project
- Bellingham Alternatives to Hunger (Food Bank), www.bellinghamfoodbank.org
- Bellingham Farmers Market in three locations, www.bellinghamfarmers.org
- Community Food Co-op's Farm Fund, www.communityfood.coop
- Community-to-Community Development's Food Justice Alliance Program www.foodjustice.org
- Community Supported Agriculture (CSA) Participating Farms:
    - Cedarville Farm (Bellingham, 592-5594)
    - Double Rainbow Farms (Bellingham, 303-1391)
    - Holistic Homestead (Everson, 303-3711)
    - Nooksack Valley Farmers - Harmony Farms (Everson, 201-1491)
    - Red Tail Farms (Van Zandt, 592-8027)
    - Rosa Verde Farm (Bellingham, 383-0893 or 319-7378)
    - K&M Red River Farm (Lummi Island, 758-2919)
- Farmers Growing Trees for Salmon, www.whatcomcd.org
- Ferndale Farmers Market, Ferndale farmersmarket.org
- Food not Lawns (See Sustainable Bellingham)
- Food to Bank On, http://www.sconnect.org/foodfarming/Food%20To%20Bank%20On/
- Fourth Corner Slow Food, www.fourthcornerslowfood.com
- Growing Washington, www.growingwashington.org
- Haynie Grange
- Kulshan Community Land Trust, www.kclt.org
- Laurel Grange
- Lummi Island Community Land Trust
- Mary Ellen Carter, www.cookingwithmaryellen.com and Ciao Thyme, www.ciaothyme.com
- Nooksack Salmon Enhancement Association, www.n-sea.org
- Nooksack Valley Center for Sustainable Agriculture
- Opportunity Council, Whatcom www.oppco.org/
- Small Potatoes Gleaning Project, www.gleaningproject.org
- Students for Sustainable Food
- Sustainable Bellingham (and Food not Lawns), www.sustainablebellingham.org
- Sustainable Connections Food & Farming Program, www.sustainableconnections.org
- Tom Malterre, Whole Life Nutrition, info@wholelifenutrition.net
- Transition Whatcom, http://transitionwhatcom.ning.com/
- Uprising Organics http://www.uprisingorganics.com/
- Washington State University Whatcom County Extension, www.whatcom.wsu.edu
- Whatcom 4-H Youth Development, whatcom.wsu.edu/4-h_youth.html
- Whatcom Anti-Hunger Coalition, bfbed@openaccess.org
- Whatcom Conservation District, www.whatcomcd.org
- Whatcom Land Trust, www.whatcomlandtrust.org
- Whatcom County Noxious Weed Control Board, http://www.co.whatcom.wa.us/publicworks/weeds/index.jsp
- Whatcom County Farm Friends, www.wcfarmfriends.com
- Whatcom Farm Inc., http://www.sustainableconnections.org/foodfarming/folder.2008-01-09.3020842594/
- Whatcom Salmon Recovery, http://whatcomsalmon.whatcomcounty.org/
- Whatcom Weston A. Price Foundation, www.westonprice.org/
- Nooksack Salmon Enhancement Association, www.n-sea.org

Regional

- Cascade Harvest Coalition, www.cascadeharvest.org
- Meals that Heal, MealsThatHeal@wavecable.com

- North Cascades Institute, http://www.ncascades.org/
- Northwest Agriculture Business Center, www.AgBizCenter.org
- WSU Northwest Research & Extension Center

Washington State

- American Farmland Trust, www.farmland.org
- Farm Services Agency, www.fsa.usda.gov
- Future Farmers of America, www.ffa.org
- Local Food Action Initiative
- Natural Resources Conservation Service, http://www.wa.nrcs.usda.gov/
- Office of Farmland Preservation, http://ofp.scc.wa.gov/
- Puget Sound Food Project, www.cascadeharvest.org/programs/puget-sound-food-project
- Risk Management Association Programs, www.rmahq.org
- Tilth Producers of Washington, www.tilthproducers.org
- Washington Agriculture and Forestry Education Foundation, http://www.agforestry.org/
- Washington Red Raspberry Commission, http://www.red-raspberry.org/
- Washington State Department of Agriculture Small Farm and Direct Marketing Program (Fred Berman), agr.wa.gov
- Washington State Department of Agriculture Disaster Preparedness, agr.wa.gov/FoodSecurity/
- Washington State Farm Bureau, www.wsfb.com
- Washington State University Extension, ext.wsu.edu
- Washington Sustainable Food and Farming Network, www.wsffn.org

Food Banks

- Bellingham
- Blaine
- Christ the King
- Everson Nooksack Valley
- Ferndale
- Foothills
- Hope House
- Lord's Table
- Lummi
- Lynden
- Nooksack Tribal
- Salvation Army
- Southside
- St. Josephs Outreach
- Hot Meals (Whatcom County Free Food Hotline: 788-7328)
- Bellingham Community Meal
- C.A.S.T. Coffee & Sandwiches
- Church on the Street
- Ferndale Community Meal Program
- Food Not Bombs
- Lighthouse Mission
- Loaves & Fishes Hot Meal
- Maple Alley Inn
- Nooksack Food Bank
- Saturday Sun Rise
- Salt on the Street
- Soups on
- Source for list above: http://www.gleaningproject.org/Documents/food_brochure-April_2008.pdf
- Food Stamps
- Opportunity Council: 734-5121 ext. 233
- Homeless/Hunger Programs
- Whatcom Anti-Hunger Coalition

Appendix 6: Transition Initiatives

The question remains: *How can our community respond to the challenges and opportunities of Peak Oil and Climate Change?* (For more information see http://www.transitionus.org/). Motivated individuals with a shared concern in the community begin by forming an initiating group and then adopting the Transition Model (http://transitiontowns.org/TransitionNetwork/TransitionPrimer), intending to engage a significant number of community members in kicking off a Transition Initiative. A Transition Initiative is a community working together to look Peak Oil and Climate Change squarely in the eye and address this BIG question:

> "For all those aspects of life that this community needs in order to sustain itself and thrive, how do we significantly increase resilience (to mitigate the effects of Peak Oil) and drastically reduce carbon emissions (to mitigate the effects of Climate Change)?"

After going through a comprehensive and creative process of:

- Raising awareness about peak oil and climate change issues and the need to undertake a community-led process to rebuild resilience and reduce carbon emissions.
- Connecting with existing groups in the community.
- Building bridges to local government.
- Connecting with other transition initiatives.
- Forming groups to look at all the key areas of life (food, energy, transport, health, heart & soul, economics & livelihoods, etc).
- Kicking off projects aimed at building people's understanding of resilience and carbon issues and community engagement.
- Launching a community defined, community implemented "Energy Descent Action Plan" over a 15 to 20 year timescale.

This process results in a coordinated range of projects across broad areas of life. The projects strive to rebuild the resilience we have lost as a result of cheap oil and to reduce drastically the community's carbon emissions. The community also recognizes two crucial points:

- We used immense amounts of creativity, ingenuity and adaptability on the way up the energy upslope. There is no reason for us not to do the same on the down slope.
- If we collectively plan and act early enough, there is every likelihood that we can create a way of living that's significantly more connected, more vibrant and more in touch with our environment than the oil-addicted treadmill that we find ourselves on today.

Transition Initiatives is a social experiment on a massive scale, not a process defined by people who have all the answers. No one knows if the process will work. On the other hand, everything that you read on the Transition Towns website is the result of real work in the real world and hearty community engagement. There is not an ivory tower in sight, no professors in musty oak-paneled studies churning out erudite papers, no slavish adherence to a model carved in stone.

At the time of this writing, ERSPO members David MacLeod, Kate Clark, Tom Anderson, and Rick Dubrow, along with several other proactive community members, have formalized the creation of a local *Transition Whatcom* initiative. *Transition Whatcom* has recently been recognized by the global *Transition Network* as the 17th official 'Transition Initiative' in the U.S. Therefore, a possible future direction is for this ERSPO report to encourage and support citizen participation in *Transition Whatcom's* creation of an *Energy Descent Action Plan (EDAP)* for Whatcom County. Our hope is that both councils will study *Transition Initiatives* and, more particularly, *Transition Whatcom*, and support these efforts however they see fit.

Appendix 7: 2009 Whatcom County Snapshot

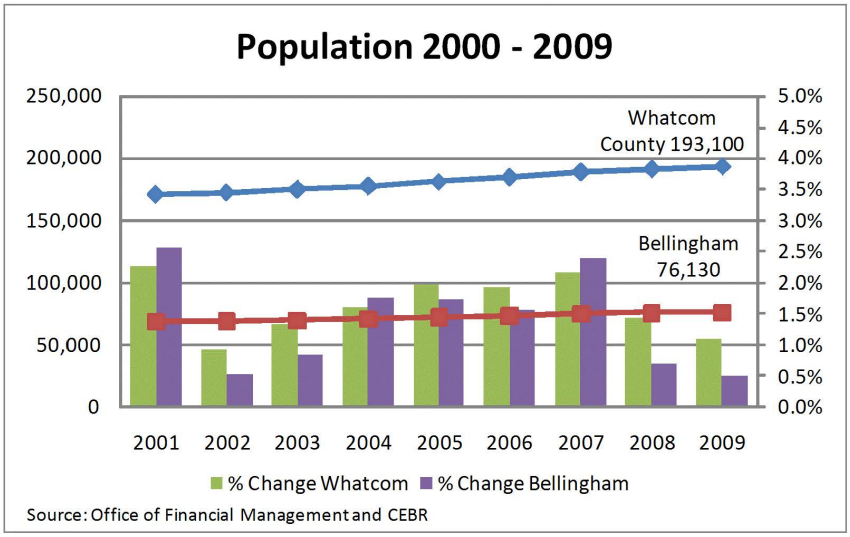
2009

2009 Whatcom County Snapshot

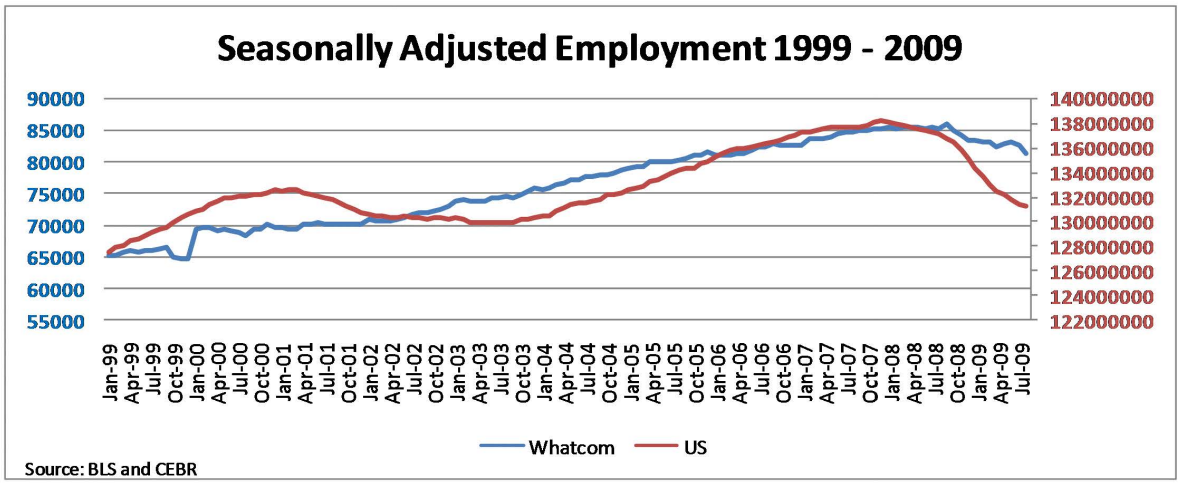
BY: WWU CENTER FOR ECONOMIC AND BUSINESS RESEARCH

Population in Bellingham and Whatcom County has been steadily increasing with people moving into and throughout Whatcom County. The majority of Whatcom's population is White (88.7%), followed by Hispanic (6.5%) and American Indian (2.9%). Of the different age groups in Whatcom, the biggest increase since 2000 is the 45-64 year old age group (3.6%). There has also been a decrease in the 25-44 year old age group (-3.3%), which implies a slight aging of the population.

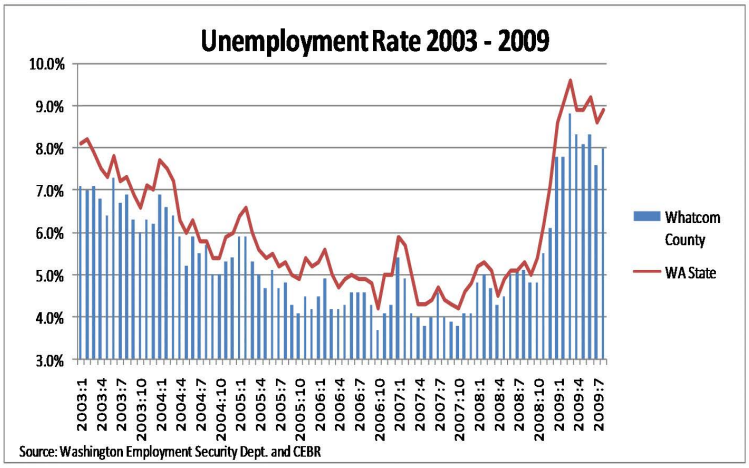
Other counties within Washington State and other states in the U.S. have had higher population growth rates in recent years and show the same aging of the population.



We often hear that the local economy lags behind the U.S. by 6-12 months. And while some indicators such as home prices do show such a lag, other indicators do not. Historical employment data shows little correlation between the local and national economies. For information on prior years, contact CEBR.



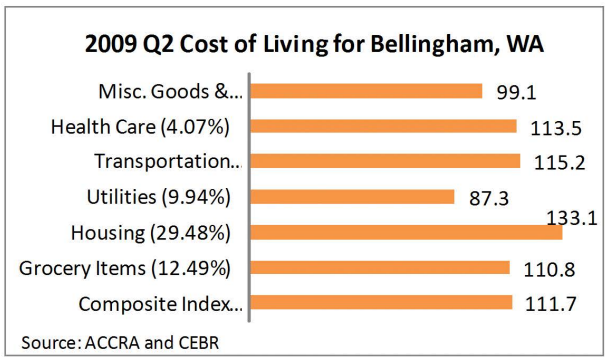
2009 Whatcom County Snapshot

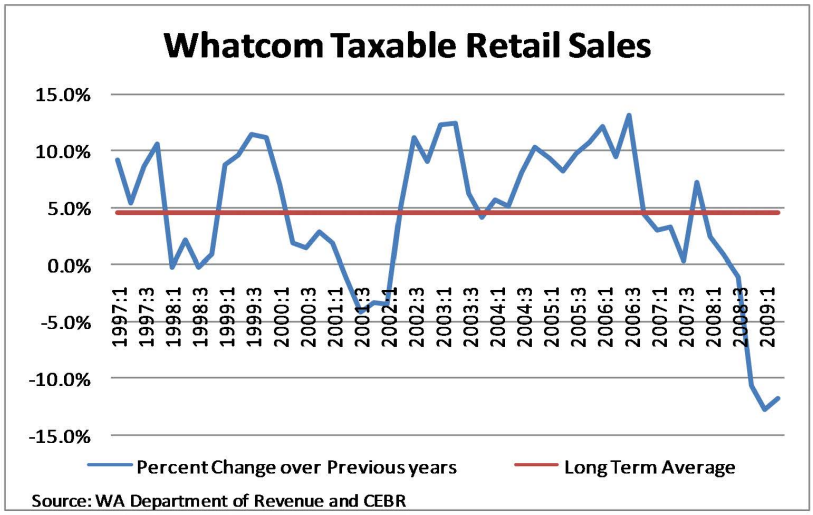


Visit us at www.cbe.wwu.edu/cebr

Unemployment in Whatcom County has been below both the state and U.S. level since 2000. With the recent increase, unemployment is now the highest it has been since the early 1980s. We expect unemployment could increase into 2010 and will recover very slowly.

The ACCRA Cost of Living Index shows the cost of specific items in a city relative to the same items in other cities. The index is constructed so that the U.S. average is 100. The overall cost of living index for Bellingham was 111.7 in the second quarter of 2009—suggesting that the cost of living in Bellingham is roughly 12 percent above the U.S. average. The cost of living is slightly higher in Seattle, WA and Portland, OR but wages are also higher in those larger, urban areas.

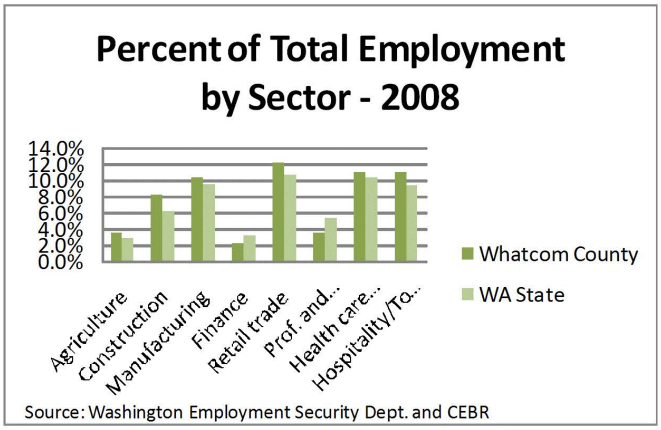




Taxable retail sales have declined sharply with the recession. The drop in tax revenues is a very important issue for city, county and state agencies.

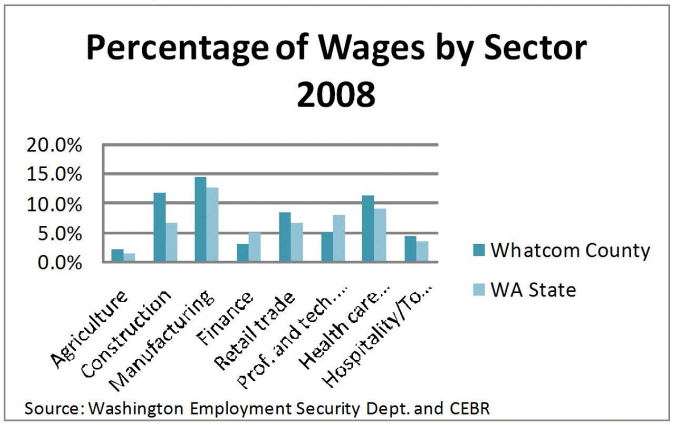
We tend to imagine a wave of Canadian shoppers traveling south when the Canadian dollar is strong (relative to the U.S. dollar). In fact, border crossings have varied little in recent years, despite periods when the Canadian dollar has been strong. Border data are available on the CEBR website.

2009 Whatcom County Snapshot



Sectors with the most employment are retail trade, healthcare and social assistance, and manufacturing. According to Washington Employment Security Department, the fastest growing occupations are veterinary technologists and technicians, personal financial advisors and computer hardware engineers. The top five largest employers in Whatcom County in 2008 were St. Joseph Hospital/Madrona Medical Group, Western Washington University, Bellingham School District, Whatcom County, and the City of Bellingham.

Generally wages in Whatcom County are lower than the state average. The highest wages in Whatcom County are in the petroleum and coal manufacturing sector. According to Washington Employment Security Department, the highest wages by occupation include physicians and surgeons, family and general practitioners, real estate brokers, chief executives and dentists.



	Whatcom	WA State	US
Population (2008)	196,529	6,549,224	304,059,724
Growth (%) since 2000	17.80%	11.11%	8.04%
Households (2008)	78,093	2,698,930	126,237,884
Labor Force (2008)	94,866	3,312,856	151,062,383
Unemployment Rate (2009:8)	8.00%	9.20%	9.60%
Per Capita Personal Income (2008)	$24,570	$28,290	$26,178
Median Household Income (2008)	$46,766	$53,940	$50,007
Individual Poverty Rate (2007)	14.50%	11.80%	13.30%
H.S. Diploma or More (2008)	89.40%	88.90%	84.00%
B.A. Degree or More (2008)	34.80%	30.00%	27.00%
Crime - Violent (2007) Per 1,000	2.2	3.3	4.5
Crime - Property (2007) Per 1,000	19.5	37.6	32.1

Source: Census, Washington Prospector, City-Data, BLS, FBI, CEBR

NW Washington's Source for Business Knowledge

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Fax: 360-650-7688
E-mail: hart.hodges@wwu.edu

Appendix 8: Energy Resource Scarcity/Peak Oil Task Force Members

Tom Anderson is a consulting engineer and former Public Utility District manager.

Gigi Berardi is a professor at Western Washington University, Huxley College of the Environment and works with Huxley's Resilient Farm Project/The Resilience Institute.

Kate Clark has worked in the local economic development sector, including workforce development for the energy industry. While involved with the ERSPO Task Force, she and several other community members formed the Transition Whatcom Initiating Group.

Rick Dubrow is a general contractor and president of A-1 Builders, Inc. and Adaptations, the company's design division. He serves on the Board of RE Sources and on the Initiating Group of Transition Whatcom. Additionally, Rick was a co-founder of Sustainable Connections and Futurewise Whatcom.

Brian Humphrey is WorkSource Administrator for Skagit and Island counties.

David MacLeod has served on the Core Vision Team for Sustainable Bellingham and during the ERSPO Task Force process became an initiating member of Transition Whatcom. He is employed in Whatcom County's manufacturing sector.

Jim McCabe is a retired oil and gas industry executive and a Guest Lecturer at Western Washington University College of Business and Economics.

John Rawlins is a retired nuclear physicist and Whatcom Community College professor.

Evan Stark is an electrical engineer employed in private industry.

Appendix 9: End Notes

1. Executive Summary

[1] International Energy Agency; *World Energy Outlook 2008*; (Executive Summary can be viewed at http://www.iea.org/Textbase/npsum/WEO2008SUM.pdf).
[2] Ibid.
[3] Ibid.
[4] UK Industry Task Force on Peak Oil & Energy Scarcity, *The Oil Crunch: Securing the UK's energy future,* October 2008.
[5] Robert Hirsch; R. Bezdek; R. Wendling; *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*; report prepared for U.S. Department of Energy, March 2005; http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf.
[6] City of Portland Peak Oil Task Force; *Descending the Oil Peak: Navigating the Transition from Oil and Natural Gas*; March 2007; http://www.portlandonline.com/shared/cfm/image.cfm?id=145732.
[7] Oil Independent Oakland by 2020 Task Force; *Oil Independent Oakland Action Plan*; February 2008; www.oaklandnet.com/oil/pdfs/OIO-ActionPlan-020608.pdf.
[8] Peak Oil Preparedness Task Force; *San Francisco Peak Oil Preparedness Task Force Report*; March 2009; www.sfenvironment.org/downloads/library/peakoil_final_report.pdf.
[9] City of Spokane Mayor's Task Force on Sustainability; *Sustainability Action Plan: Addressing Climate Mitigation, Climate Adaptation and Energy Security*; March 2009; www.greenspokane.org/Sustainability_Action_PlanB.pdf.
[10] UK Industry Task Force on Peak Oil & Energy Scarcity. op.cit.

2. Why Peak Oil Matters

[1] Robert Hirsch; R. Bezdek; R. Wendling; *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*; report prepared for U.S. Department of Energy, March 2005; http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf.
[2] Ibid.
[3] Ibid.
[4] Jad Mouawad; "Oil Industry Sets a Brisk Pace of New Discoveries", *New York Times*, September 23, 2009.
[5] Responses to Mouawad's article include "Peak Oil Not a Problem According to NY Times; Scientific American – Our Response on the Financial Aspects" by Gail Tverberg, *The Oil Drum* (http://www.theoildrum.com/node/5811); and "Is the Global Oil Tank Half-Full, Is it Half-Empty… or Are We Running on Fumes?" by Richard Heinberg (http://www.energybulletin,net/node/50231).
[6] Jeff Rubin; Why Your World is About to Get a Whole Lot Smaller. Random House, 2009, p 11.

3. Energy & Water

[1] Bonneville Power Administration. http://www.bpa.gov/corporate/about_BPA/facts/FactDocs/BPA_Facts_2008.pdf.
[2] Puget Sound Energy. http://www.pse.com/energyEnvironment/energysupply/Pages/Default.aspx.

4. Land Use & Transportation

[1] Danny Westneat; "Reality Check On Plug-In Cars", *Seattle Times*, February 22, 2009.
[2] Cascade Scorecard, Sightline Institute, 2006.

5. Food & Agriculture

[1] As defined by Whatcom Farm Friends, agriculture is the science, art and business of cultivating soil, producing crops, and raising livestock. Farming is the growing and harvesting of food, fibers, forests, and flowers - providing almost everything we eat, wear, and use. Agriculture is the world's oldest, largest, and most essential industry. As an urban society, 90% of America's population has little contact with the systems that determine our general food welfare and standard of food quality. Agriculture is our nation's largest industry, yet only 2 million Americans are actually farmers. Over

20 million people work in agriculture related jobs. Growers produce the raw products and other people turn them into the things we use and eat every day.

[2] Richard Heinberg. "What will we eat when the oil runs out," *The Lady Eve Balfour Memorial Lecture* (Central Hall, Westminster, London), 2007.

[3] See William Schulz. "The costs of biofuels," *Chemical & Engineering News* 85 (51) (2007), 12-16. Also see Heinberg, 2007 and Biomass Research and Development Initiative (BR&DI), *Increasing Feedstock Production for Biofuels; Economic Drivers, Environmental Implications and the Role of Research*, Available at: National Agricultural Library, 2007.

[4] Heinberg, R. op. cit.

[5] Gustavo Best. " 'Energizing' the food production chain for the attainment of food security." *SDdimesions* (July 1996); http://www.fao.org; Sustainable Development Department, Food and Agriculture Organization of the United Nations.

[6] Carl E. Behrens and Carol Glover. *U.S. Energy: Overview and Selected Facts and Numbers*, Congressional Research Service Report R40187; February 3, 2009; http://assets.opencrs.com/rpts/R40187_20090203.pdf

[7] Brent D. Yacobucci. *Alternative Transportation Fuels and Vehicles: Energy, Environment, and Development Issues,* Congressional Research Service Report RL30758, 2000; See also USDA, Economic Research Service, *Agricultural Resources and Environmental Indicators, Agricultural Handbook No. 705*, 1994, 106; and John Miranowski, "Energy consumption in U.S. agriculture," USDA Conference on Agriculture, June 24, 2004 at www.farmfoundation.org/projects/03-35EnergyConference

[8] David Pimentel and Mario Giampietro*. Food, Land, Population and the U.S. Economy,* Executive Summary; Nov 21 1994; www.dieoff.com/page40.htm. Also see Doris Newton and Jet Yee, *Agricultural Resources and Environmental Indicators: Agricultural Productivity*. United States Department of Agriculture Economic Research Service. AH 722. November.

[9] Ibid, p40.

[10] H.O. & J.G. Youde, "Some impacts of the changing energy situation on U.S. agriculture," *American Journal of Agricultural Economics* 56(5), (1974), 878-887 and K. Hanson, S. Robinson, & G. Schluter, "Sectoral effects of a world oil price shock: Economy-wide linkages to the agricultural sector," *Journal of Agricultural and Resource Economics*, 18(1) (1974), 96-116.

[11] Marc Labonte, *The Effects of Oil Shocks on the Economy: A Review of the Empirical Evidence*, Congressional Research Service Report for Congress, RL31608. Available at http://www.ers.usda.gov/publications/arei/ah722/arei5_1/AREI5-1productivity.pdf.

[12] John Miranowski, G. P. Robertson, J. C. Broome, E. A. Chornesky, J. R. Frankenberger, P. Johnson, M. Lipson, E. D. Owens, D. Pimmentel, L. A. Thrupp. "Rethinking the Vision for Environmental Research in US Agriculture", *Bioscience*, Vol. 54, 1, pp. 61-65, January, 2004.

[13] Lester R. Brown of the Earth Policy Institute attributes reduction in tillage to a decrease in direct fuel use. He notes that the combined use of gasoline and diesel fuels in farming decreased from a historic high of 7.7 billion gallons in 1973 to 4.2 billion gallons in 2005 – a 45% decrease. See Lester R. Brown, "The oil intensity of food," 2009 at www.the oildrum.com/node/5533.

[14] Randy Schnepf. *Energy Use in Agriculture: Background & Issues*, Congressional Research Service Report RL32677, Nov 2004.

[15] Ibid, p5.

[16] Ibid, p21.

[17] A farm is defined as any place where $1,000 or more of agricultural products were produced and sold, or normally would have been sold. The $1,000 threshold can be met by any combination of sales and government payments. Abnormal farms are institutional, experimental, and research farms.

[18] This oft-quoted figure can be traced to work by University of Essex's Jules Pretty, especially in his work with colleagues published in *Food Policy* – See JN Pretty, AS Ball, T Lang, and JIL Morrison, "Farm costs and food miles: An assessment of the full cost of the UK weekly food basket", *Food Policy* 30(1) 2005, 1-20. See also www.essex.ac.uk/bs/staff/pretty or www.julespretty.com. Pretty has published widely on topics of energy efficiency in agriculture and efficiency ratios. Interestingly, Cornell University's David Pimentel, writing in and about the United States, has been derided for his

topical work, whereas Jules Pretty has been knighted (he has been awarded an OBE). See also Jay Tomczak, *Implications of Fossil-Fuel Dependence for the Food System*, (Michigan State University, 2005), popularized also in works by economist Jeff Rubin and journalists Alisa Smith & J.B. MacKinnon—see *Plenty: Eating Locally on the 100-Mile Diet*, (NY: Harmony Books, 2007) at 100milediet.org/. See also U.S. Department of Energy, *U.S. Agriculture: Potential Vulnerabilities*, Research Report prepared by the Stanford Research Institute, Menlo Park, CA, 1969). Estimates also showed fresh produce in the U.S. traveling an estimated 1500 miles (J. Barton, *Transportation and Fuel Requirements in the Food and Fiber System*. Agricultural Economic Report No. 444. Economic, Statistics, and Cooperative Service, USDA. In: Heller and Keoleian, 2000), primarily because 90% of all fresh vegetables consumed in the U.S. are grown in specific areas, such as the San Joaquin Valley of California (1994 study in *The Practical Farmer*, appearing in Heller and Keoleian, 2000). Today, the National Sustainable Agriculture Information Service reports that fresh produce travels between 1300-2000 miles, with an average of 1500 miles, before being consumed (National Sustainable Agriculture Information Service, *Reducing Food Miles*, 2009; available at http://www.attra.org/farm_energy/food_miles.html). Processed food in the U.S. travels an average of 1300 miles (National Sustainable Agriculture Information Service, *Food Miles Background and Marketing*, 2008; available at http://www.attra.org/attra-pub/PDF/foodmiles.pdf).

[19] See the work of Martin C. Heller, Martin C. and Gregory A. Keoleian at the Johns Hopkins Bloomberg School of Public Health. Note that nearer is sometimes not necessarily better – there are trade-offs to consider, e.g, manufacturing efficiency, energy mix, other waste production and processing with various economies of scale of central production. See also Randy Schnepf. *Energy Use in Agriculture: Background & Issues*, Congressional Research Service Report RL32677, Nov 2004.

[20] Barbara Kingsolver, Steven L. Hopp, and Camille Kingsolver, *Animal, Vegetable, Miracle: A Year of Food Life* (NY: HarperCollins, 2007), 5. Also see Richard Manning, "The oil we eat," *Harper's Magazine* (February 2004) at www.harpers.org/TheOilWeEat.html.

[21] David Pimentel and Mario Giampietro. See Carrying Capacity Network, November 2, 1994 at www.dieoff.com/page40.htm

[22] David Pimentel and Mario Giampietro, *Section III-Ecological Constraints to Food Production in the United States, 1994.*

[23] Such availability of corn and soy has translated into increasingly more manufactured food products based on these products (with corn supplying the carbohydrates, soy the protein, and both supplying the fat. See Michael Pollan, *The Omnivore's Dilemma* (New York, Penguin Press, 2006), p 91. Pollan explains the implications of this — corn contributes about 554 calories a day to America's per person food supply and soy contributes another 257. See Michael Pollan, *In Defense of Food* (New York: Penguin Press, 2008), p 123. For a presentation of the distribution of corn molecules that come originally from corn in a typical McDonald's meal as measured by a mass spectrometer—with soda recording a 100% distribution, milkshakes 78%, and cheeseburgers 52% see *New Solutions No. 13: Food, Feed and Fuel*, 2007 at http://www.communitysolution.org/nsreports.html. Dietary choices are influenced by the low cost and ready availability of corn- and soy- containing manufactured foods. With consumers making up to 200 food-related decisions daily—See Brain Wansink, *Mindless Eating*: *Why We Eat More Than We Think* (NY: Bantam Books, 2006)—overeating of high-calorie processed foods is commonplace and has health and national health budget implications. Also see any of Harriet Friedmann's work on industrial agriculture out of the University of Toronto, such as "Modernity and the hamburger: cattle and wheat in ecological and culinary change" at www.yale.edu/agrarianstudies/papers/hamburger.pdf and "What on earth is the modern world-system? Food-getting and territory in the modern era and beyond," *Journal of World-Systems Research* Vol. VI (Summer/Fall 2000). Note: Much of this applies to Whatcom County agricultural consumers rather than producers.

[24] Pimentel and Giampietro, 1994, Executive Summary.

[25] Lynn Brantley et al. *Food Consumption and Access*, Capital Area Food Bank (June 1, 2002), www.clagettfarm.org/purchasing,html.

[26] See *New Solutions #13: Food, Feed and Fuel*, 2007 and *New Solutions #14: Food Health and Survival*, 2007 at http://www.communitysolution.org/nsreports.html

[27] Schnepf, R. op.cit, p31.
[28] Ibid, p31.
[29] E. Phimister, D. Roberts, and A. Gilbert, "The dynamics of farm incomes: Panel data analysis using the farm accounts survey", Journal of Agricultural Economics 55(2) (2004), 197-220.
[30] Department of Natural Resources an Parks, Snoqualimie flood-farm task force report (Seattle, WA).
[31] Pers. comm. Cheryl DeHaan, 7/6/09; also see Whatcom Farm Friends website http://www.wcfarmfriends.com/go/site/1579/ and http://www.agcensus.usda.gov/Publications/2007/.
[32] pers. comm, Henry Bierlink, 7/06/09. Also see Allison Roberts, "Agriculture—A hidden Whatcom County treasure," *Whatcom Counts',* February 22, 2007 at www.whatcomcounts.org. Note also that Whatcom County's biggest horticultural crops, raspberries, for example, are harvested for one month per year and then rely on cold storage (freezing) for at least the next 11 months (although some crop is carried over past one year) before being thawed, processed, and repacked. This post-harvest cost is one of the largest energy inputs for these crops (pers. communication, Craig McConnell).
[33] www.agcensus.usda.gov/Publications/2002.
[34] The acreage designated as ''land in farms" consists primarily of agricultural land used for crops, pasture, or grazing. It also includes woodland and wasteland, provided it was part of the farm operator's total operation. Land in farms includes acres in the Conservation Reserve Program and Wetlands Reserve Programs.
[35] www.agcensus.usda.gov/Publications/2007.
[36] See Carlo Petrini, *Slow Food Nation*, (Bra Italy: Slow Food Editore, 2005); also see *The Snail*, Spring 2009.
[37] FLOSS is an idea developed by Henning Sehmsdorf of Lopez Island, WA. See Henning Sehmsdorf, "Living the holistic highlife: self-sufficiency on a small family farm (part-one)", *Biodynamics* (Summer 2005) at csanr.wsu.edu/demofarms/HolisticHighLife.pdf.
[38] Questionnaire was made available to members of the Whatcom Farm Friends distribution list and Whatcom Farmers listserve.
[39] See Best, 1996 for a good discussion of bioenergy (using waste products not first-generation crops, rural mechanization, and various forms of solar energy (direct and indirect)). See white papers of the WSDA, eg, agr.wa.gov/bioenergy, as well as new bulletins on related topics by *Business Week* at www.businessweek.com/print/bwdaily/dnflash/mar2005 and The National Energy Foundation at www.nef.org.uk/greenenergy and the National Research Education Laboratory at www.nrel.gov. See also Grace Lilly and Noelani Penney, "Agricultural waste management in Whatcom County," *WSU Extension County Food Assessment*, 2008 for a good discussion of current and projected uses of county wastes from dairy, berry, and nut operations. Excerpts from their report are available through Gigi Berardi at http://www.wwu.edu/resilience/Research/FarmResilience/FarmResilience.shtml.
[40] See Lester R. Brown (Earth Policy Institute)'s guest post, "The Oil Intensity of Food," www.the oildrum.com/node/5533
[41] Pers. Comm., WSU Extension professor, Craig McConnell.
[42] Schenpf, CRS Report, 2004.
[43] See *Defining Resilience: A Review of Resilience Literature and its Applications to Small Farms Agriculture* by Rebekah Green of the Resilience Institute (formerly, Institute for Global and Community Resilience) in conjunction with its Small- and Medium-Sized Farms USDA Resilience Grant. The white paper is in draft form and is due to be released in fall 2009.
[44] Daneil Alesch and James Holly. *Surviving extreme events: A guide to help small businesses and not-for-profit organizations prepare for and recover from extreme events,* (Fairfax, VA: Public Entity Risk Institute, 2004).
[45] Heidi Schiller, "After 15 years, the market's all grown up," *Bellingham Business Journal* (2008). Also see Kevin Dolan, Amy Strohm, and Michelle Toshack, "Direct farm marketing in Whatcom County," *WSU Extension County Food Assessment Project*, June, 2008. Excerpts from their report are available through Gigi Berardi at http://www.wwu.edu/resilience/Research/FarmResilience/FarmResilience.shtml.

[46] See Ericka Pizzillo, "Zoning rules erode farm protections," *The Bellingham Herald*, April 23, 2000 as a special report "Breaking up the farm" and "Farm smells, sounds grow crop of complaints from newcomers," *The Bellingham Herald*, April 24, 2000 and additional related articles in the "Breaking up the farm" series.

[47] A purchase of development rights (PDR) involves the sale of the right to develop a piece of land for residential, commercial, or industrial purposes, while leaving all the remaining rights (i.e. the right to possess, use, modify, lease, sell the land, etc.). PDR is a voluntary program, where a land trust or some other agency usually linked to local government, offers to buy the development rights of a parcel from the landowner. The landowner is free to refuse the offer or to negotiate a higher price. Upon finalization of the agreement, the purchaser retires the development rights and a permanent deed is placed on the property, restricting the type of activities that may take place on the land in perpetuity. This achieves a legally binding guarantee to ensure that the parcel will remain forever as agricultural or open (green) space. The deed restriction may also be referred to as a conservation easement, or, since most PDR programs are designed to preserve agricultural use, an agricultural conservation easement. As a result, PDR programs are occasionally called PACE programs (purchase of agricultural conservation easements).

[48] Transfer of development rights (TDR) program is the exchange of zoning privileges from areas with low population needs, such as farmland, to areas of high population needs, such as downtown areas. These transfers allow for the preservation of open spaces and historic landmarks, while giving urban areas a chance to expand and satisfy growth needs.

[49] Co-opetition involves competition among farmers through increased marketing and distribution venues, but also cooperation among farmers in purchasing seed orders, work, advice, etc.

[50] CSA programs provide small farmers with working capital that is paid back through harvested produce. Growing Washington is a nonprofit that administers the Just Food program, which funnels outside money toward purchase of CSA shares and distributes the CSA shares to poor people.

[51] Informal work shares involve people who contract with a farmer to work each week and are then paid in food by the farmer. No money changes hand.

[52]A county homeowner marks off an acre on his/her property and invites a farmer to grow food on it. Land rent is paid with a CSA subscription, currently worth about $450 for 20 weekly boxes.

[53] Most food co-ops start as buying clubs, with the advantage of no overhead for storefront, employee wages, etc. Buying clubs provide an alternative to farmers markets for farmers who can't afford time away from the farm.

[54] Personal farmer programs exist in Portland and San Francisco, as well as internationally. Information and support ranges from developing farm business management skills, technical support for water management or small yard livestock rearing, or opportunities for direct marketing and buying.

[55] The requirement for high insurance levels prevents many small farmers from being able to sell to supermarket chains or to participate in the farm-to-school cafeteria chain.

[56] See Community Food Security Commission; www.foodsecurity.org/.

[57] See Gail Feenstra, "What's on your plate? Farm-to-school programs promote health," *Community Food Security News* 2009, 8-9. and Sarah C. Murray, "A survey of farm-to college programs: History, characteristics and student involvement," *Community Food Security News* (2006), 12-13. Also see Kelli Sanger and Leslie Zenz, *Farm-to-cafeteria connections* (Olympia: WSDA, January 2004). See also *Marketing Programs* (Olympia: WSDA, 2005).

[58] See The Resilience Institute, "The future of food". *Bounceback*, 2008 at igcr.blogspot.com/2008/02/future-of-food.html. Groups in Seattle are trying the experiment, too. See AP, "Seattle group commits to local-foods diet: Experiment supports farmers, cuts fossil-fuel use," *The Bellingham Herald*, 2007.

[59] Angela MacLeod, Sustainable Bellingham, for EAT LOCAL WEEK recorded her efforts to eat a 100% local diet (confined to Whatcom, Skagit, and San Juan Island counties) including local fruits and vegetables, beef, chicken and eggs, locally caught wild fish and canned tuna, and local oils and dairy products. http://sustainablebellingham.org/wiki/wikka.php?wakka=ALocalDiet.

[60] See Andrew Martin, "If it's fresh and local, Is it always greener?" *New York Times*, December 9, 2007 at http://www.nytimes.com/2007/12/09/business/yourmoney/09feed.html?_r=1&oref=slogin. Martin notes, "If mass producers of strawberries ship their product to Chicago by truck, the fuel cost of

transporting each carton of strawberries is relatively small, since it is tucked into the back along with thousands of others. But if a farmer sells his strawberries at local farmers' markets in California, he ferries a much smaller amount by pickup truck to each individual market. Which one is better for the environment? Mr. Tomich said a strawberry distributor did the math on the back of an envelope and concluded that the Chicago-bound berries used less energy for transport. Maybe. Regardless, the story raises valid questions." For a contrary view, see Walter Haugen, "Some Common Errors" at http://www.localharvest.org/blog/15945/?page=1.

[61]See Jason Bradford, *Can My County Feed Itself?*, Energy Farm blog from Mendocino County, that looks at different classes of food security threats (including diet, land requirements, and available land space) at http://archive.energyfarms.net/search/node/can+my+county+feed+itselfB. For what's possible see Sustainable Bellingham, *Wiki: Food Articles* at www.sustainablebellingham.org/wiki/wikka.php?wakka=FoodArticles.

6. Public & Social Services

[1] Using fall 2008 as a case study for what to expect with peak oil or higher energy prices is problematic. The increase in unemployment and business closures seen in 2008 is almost certainly due to the credit crisis and recession – not specifically energy prices or the availability of energy. High energy prices preceded the recession and some people argue a causal relationship exists. But that argument does not consider the critical role of a housing/mortgage bubble, financial speculation in commodities (especially oil), and other factors. It is also important to remember that energy prices were falling rapidly before unemployment accelerated. Oil was below $50 per barrel for much of 2009 and gasoline hovered around $2.00 per gallon locally. For reference, that value is slightly higher than it was a decade ago, after adjusting for inflation.

[2] Article: "A Structural Model of the Effects of Poverty on the Externalizing and Internalizing Behaviors of 4- to 5-year-old Children," Mary Keegan Eamon, MSW, *Social Work Research,* Vol. 24, No. 3.

7. Economic Transition

[1] Robert Hirsch; R. Bezdek; R. Wendling; *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*; report prepared for U.S. Department of Energy, March 2005; http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf.

[2] Energy Information Administration: WTI Spot Price History http://tonto.eia.doe.gov/dnav/pet/hist/rwtcd.htm.

[3] Daniel Lerch. Post Carbon Cities: Planning for Energy and Climate Uncertainty. Sebastopol, CA: Post Carbon Press, 2007.

[4] David Cho. *Washington Post*: "A Few Speculators Dominate Vast Market for Oil Trading" (August 21, 2008) http://www.washingtonpost.com/wp-dyn/content/article/2008/08/20/AR2008082003898.html?hpid=topnews

[5] Jack Walker. *Seeking Alpha*: "Was 'Peak Oil' a Multi-Billion Dollar Hoax?" (Oct. 20, 2008) http://seekingalpha.com/article/100670-was-peak-oil-a-multi-billion-dollar-hoax.

[6] Paul Krugman. *New York Times*: "More on Oil Speculation" (May 13, 2008) http://krugman.blogs.nytimes.com/2008/05/13/more-on-oil-and-speculation/

[7] James D. Hamilton. "Causes and Consequences of the Oil Shock of 2007-2008" (April 27, 2009) http://dss.ucsd.edu/~jhamilto/Hamilton_oil_shock_08.pdf.

[8] James D. Hamilton. Testimony prepared for the Joint Economic Committee of the U.S. Congress: "Oil Prices and the Economic Downturn" (May 20, 2009) http://www.econbrowser.com/archives/2009/05/Hamilton_JEC_2009_05_20.html.

[9] Jeff Rubin. *Why Your World Is About To Get A Whole Lot Smaller: Oil and the End of Globalization*. New York: Random House, 2009. p 20.

[10]Reuters. "IEA Says Oil Capacity Crunch Looms at End of 2013" (Feb. 27, 2009) http://uk.reuters.com/article/idUKLR48018520090227.

[11]Jeff Rubin and Benjamin Tal. *CIBC World Markets*: "Will Soaring Transportation Costs Reverse Globalization?" (May 27, 2008) http://research.cibcwm.com/economic_public/download/smay08.pdf.

[12] Jeff Rubin, op. cit. (2009).

[13] Horace Herring (Lead Author); Cutler J. Cleveland (Topic Editor). 2008. "Rebound effect." In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth August 30, 2006; Last revised November 18, 2008]. <http://www.eoearth.org/article/Rebound_effect>.

[14] Mithra Moezzi. "The Predicament of Efficiency," *Proceedings of the 1998 ACEEE Summer Study on Energy Efficiency in Buildings* (August 1998). pp. 4.273-4.282.

[15] Jeff Rubin, op. cit. (2009).

[16] Ibid.

[17] For a more nuanced explanation of the rebound effect than we have room for here, see *also The Rebound Effect Report: An Assessment of the Evidence for Economy-Wide Energy Savings from Improved Energy Efficiency*, UK Energy Research Centre, 2009. http://www.ukerc.ac.uk/support/tiki-index.php?page=ReboundEffect.

8. Community Education & Preparation

[1] Rob Hopkins. *The Transition Handbook: From Oil Dependency to Local Resilience*. Green Books Ltd., 2008 (distributed in the U.S. by Chelsea Green).