Some additional thoughts about renewables in Canada

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SOME ADDITIONAL THOUGHTS

ABOUT RENEWABLES IN

CANADA

Abstract

Significant non renewable energy reserves could lead to lower investment in renewable technologies and further help growth of GHG emissions. Current state of renewable technology allows implementation at competitive market rate (wind) whose development could bring further industrial prosperity, environmental benefits, international recognition, reduce future energy uncertainties, keep natural resources to future generation leaving positive bequest value Canada large GNP brings, besides well being , obligation of clean technology developments taking leading role in promotion of sustainable development, helping developing and low income countries to import technologies, develop its renewable possibilities and keep strong commitments and respect in international agreements.

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1.Introduction

With the dawn of the new century a question of environmentally related subjects are raised worldwide. Higher concentration of gases that caused global worming are passively observed by many[1], with only limited number of higher income countries to develop, implement and further improve renewable technologies. Although price of installation and operation of the most renewable are much higher than standard non renewable fuels and they become competitive in a case of high oil price(120$/barrel), it is still a far away dream for the most of the world. Poverty leaves poor out of modern technology, but oblige the high income ones to more vigorously pursue their own and rest of the world interests. These group of income and technology owners are trying each to solve the issue of energy security on its own way what makes a bund of different cases: high income countries enriched with classical energy resources declined to suffer of Dutch disease unwilling to more vigorously peruse renewable possibility; high income ones with no classical energy sources but with significant steps in development of renewable, or those who cope with energy crises developing new transit routes and differentiate energy sources and trying to improve industry environment standards following JI/CD. Faced with more severe weather responses to our activities all our efforts seems to be too slow This paper tries to encourage further questions and ways of investment strategies in the one of the richest and at the same time blessed with natural resources country: Canada.

Canada with its 33 mil. inhabitants, 35thous.$/capita income, 680 million of oil reserves, 1614 billion gas reserves is significant energy and economic partner in the world.
Being endowed with natural resources this north world area is among biggest oil produces in the world (9th), contribute significantly by its products (8th), gas, hydro(6th) and has considerable nuclear energy centers situated in Ontario. Further to that country exports oil, electricity's to USA, Japan, have oligopolistic oil refining market, strong network of pipeline and gas transporting systems, government regulated market for energy, products and is proud to have transparency in financial, management and environmental matters.

Although having excellent legal and regulatory system with goal of 65 $MtCO_2$ reduction by 2010, for which it committed 3.7 billion to implement on climate –change related activities, Canada has experienced 20% rise of CO_2 from 1990 to 2001, had some serious heat waves in Southern States, accompanies with drought on the prairies, ice storms in eastern parts, forest fires which are all signs to wakening call and consequences of vulnerability even in the highly regulated country.

[1] *The World Health Organisation-2,4 million people die each year due to air pollution. The most common problems are cardio pulmonary-breathing caused from fine particle air pollution; pneumonia, aggravated asthma, bronchitis, emphysema, lung and heart disease, respiratory allergy...*

Table1: Oil/gas reserves and CO_2 emissions

	Oil reserves	**Natural gas reserves**	**GHG**
	Mill.	Billion	mil.Co2
British Columbia	25,5	252,1	53,9
Alberta	278,4	1.182,7	191,8
Sakachevan	182,0	77,6	47,5
Manitoba	3,8	-	12,1
Ontario	1,9	11,6	163,3
North. Terit	10,4	14,0	3
Other	178,3	76,5	112,4
Total	**680,3**	**1.614,5**	**584,00**

Source:www.wikipedia.org

From the *Table 2* Canada's energy strengths are more clearly shown where estimated energy production surpasses estimated demand. Further estimation of long term policies goes toward export with shy prediction of renewable growth. To invest in renewable now or wait to be exhausted is question that policy need to consider, having in mind high environmental degradation, long term investment and installation needs, potent ion human and ecological crises if faced with energy shortages and possibility to invest, export and profit from new industries related to renewable technology export.

Table2: Canada in 2010-some predictions

2010	**Production Mote**	**Demand estimate Mtoe**	**Total import**	**Total export**	**Electricity generation**	**Growth rates**
Coal	39.9	4.7	8.7	20.3	14.1	-0.6
Oil	217.3	86.8	54.2	174.4	0.5	0.3
Gas	197.0	63.4	1.0	88.0	15.7	4.9
Comb Renewable wastes	17.0	15.6			2	5.2
Nuclear	23.4				12.7	2.2
Hydro	33.4				54.6	1.2
Geo,solar, Wind,other	0.5				0.2	
Elctricity Heat		60	3.4	5.4		
Total	528.3	221.5	67.3	288.1	100	

Source:IEA Energy Policies of IEA Countries,2004

2.Pre feasibility facts

In order to prevent further environmental degradation some research, policy mechanism need to be thoroughly explained to population in order to accept new ideas, invest more in renewable, consider alternatives in transport, implement energy efficiency measures in housing/industry living and be aware that each day that is postponed in research and investment in energy saving and investment could leads to not so timely far away loss of human health, lives, loss of natural properties/prosperities and bring lost profit/ opportunity.

The first step to consider is Government regulation. Mechanisms that are known today (Kyoto, CO_2 trading, feed- in tariffs, grants) are not producing enough strength to cope with energy problems worldwide while GHG emissions compete with industrial competition between Asia/Others and produce minimal or no fines.

In order to achieve goals we do not need to burn all bridges but to incorporate knowledge of existing laws, mechanisms and transmit it into real life.

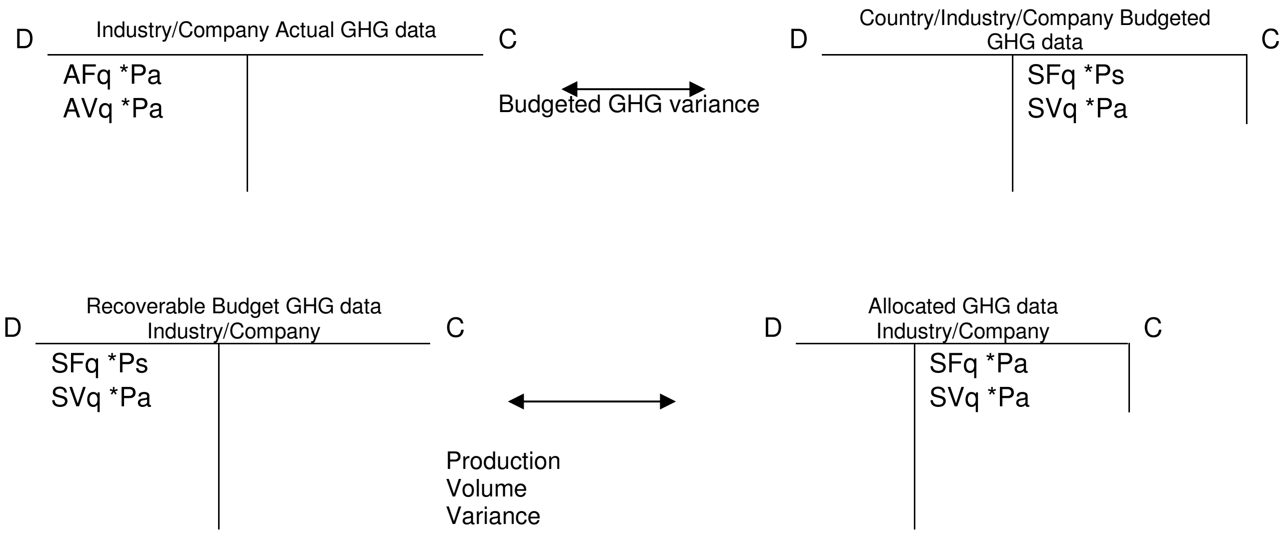
Lets start with recognizing the harmful effect of CO_2 which is by all means cost and establish relationship between Government and the biggest polluters: companies. It is known fact that in times of crises (which now is) company turns to cost reduction. This means turn to cost accountancy.
There is level of GHG reduction determined by Kyoto that Government need to further impose to companies:

1. Allowed CO2

Where:
SFq= standard fixed GHG quantity
SVq=standard variable GHG quantity
Pa=Price GHG (CO_2 market price actual)
Ps=Price GHG (CO_2 average standard price last year average for example)

On the world level firm commitments toward GHG reduction are made, each year counts ,each country matters, industry and each polluter /company is obliged to measure, publicize in its accounting reports how it progress. It is of primary importance full commitment to this goal in a way not to allow CO_2 trade with emissions that could mislead us further with possibility to create GHG heavens(like tax oasis in finance) Poor countries now sell their permits to rich and level of CO_2 is legally globally increased. Instead to allow some mid term time for each company to install clear technology is the right way to go. This expensive installation could be supported by grants (tax payers), low interest on loans, tax allowances etc.

2. Each Company commit itself to GHG reduction by measuring and publishing data



On the company level accounting procedure allows to recognize the biggest polluters inside(production), to measure price of CO_2 in statements and in the mid term trade with GHG certificate inside country, world until cleaner technologies are implemented in its business structure.

Parallel to these activity long, mid and short term energy strategy should have clear goals of incorporating renewable and pursue energy efficiency measures again on all levels: world, country, industry and each household not abandoning economic facts: maximizing revenue and minimizing costs.

$\max R = a_1 + b_1 * R_{\text{non renewable}} + c_1 R_{\text{renewable}} + e_1$
$\min C = a_2 + b_2 * C_{\text{non renewable}} + c_2 C_{\text{nonrenewable}} + e_2$

$R_{\text{renewable}} = a_1 + R_{\text{CO2mitigation}} + R_{\text{social}} + R_{\text{price,economical}} + R_{\text{fin.infrast.efficiency}} + R_{\text{demand seasons}} + R_{\text{export}} + e_1$
$R_{\text{non renewable}} = a_2 + R_{\text{price}} + R_{\text{export}} + R_{\text{quantity}} + R_{\text{demand seasons}} + R_{\text{price,economical}} + e_2$

$C_{\text{renawable}} = a_1 + C_{\text{investment}} + C_{\text{operation}} + C_{\text{financial}} + e_1$
$C_{\text{non renawable}} = a_2 + C_{\text{initial capacity}} + C_{\text{operating}} + C_{\text{financial}} + C_{\text{envirn.CO2}} + C_{\text{social}} + C_{\text{agricultur.loss}} + e_2$

where

Total supply =Total demand

$$a1\sum\left(\frac{Rren-Crenew}{1+r}\right)^{n}+a2\sum\left(\frac{Rnonren-Cnonrenew}{1+r}\right)n+$$

$+(\text{Investment}+\text{Import-Export})_{ren+non.renew} = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + e_1$

where:

X_1=GDP/capita
X2=Dummy seasons
X_3=Total population
X_4= Export possibilities
X_5= Business cycle dummy
X_6=Environmentally cap
X_7=Industry development

If all factors are recognized in regression variable we should have a price per energy ($kWh) demanded and supplied. Equilibrium price is reached when S=D

Q_d=a- bP
Q_s=c+dP
P^e= a-c/b-d
$P_t = P^{e+} (d/b)^t (p_t - p_o)$

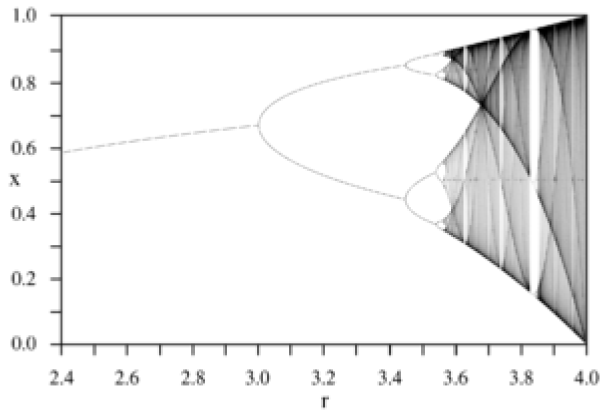
$$\int_{-\infty}^{\Pi} Y\frac{q-\pi}{\pi*(1-\pi)}f(q)dq=\int_{\Pi}^{\infty} Y\frac{\pi-q}{\pi*(1-\pi)}f(q)dq$$

By considering economic terms and conditions thorough possibilities of country, regional map of renewable potentials should be made. That means that implementing solar in a country such as Canada would be locally and globally treated as wasted resources. Instead investment of Canada government banks in solar rich areas (Africa) in order to trade with agricultural products minerals would be highly recommended.

After country potentials are examined (Canada: wind, wave, tidal, geo) speed of development investment and installation should be calculated. It is a widely known fact that optimality to use/exhaust cheaper supply source before moving on to a more costly one makes sense when costs are discounted. This was challenged by two researches at the University of Montreal Gaudet Gerard and Lasserre Pierre (2008) who incorporated uncertainty into calculation. They concluded that conservation of the cheaper source will depend on the expected future change in cost of the risky source. Even if the cheaper source happens to be risky they argue that you may want to conserve it for future use if the expected change in costs is negative.

By further incorporating knowledge of uncertainty of prices, quantities, production peak of non renewable , with environmental and human degradation, time and investment constraint we need to admit that speed of acting /non acting is important variable of future utilities and growth.

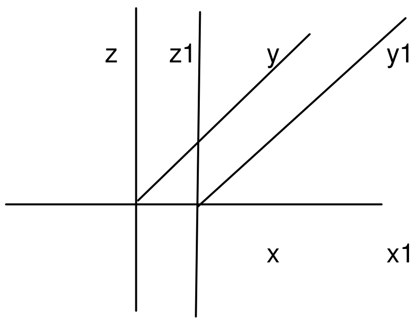
Investment in energy sector is slow process, money and time demanding. In a way it follows bifurcation diagram where investing now in non renewable made us further away from clean environmental aim.



$X_{n+1} = r * Xn * (1-Xn) + e$

This high uncertainty of future production peak and leisure of non investing implies future more demanding and harder tasks to achieve and less results overall.

Second what should bear in mind is that velocity of moving toward new balance of renewable/non renewable mix should be governed, financed, monitored and protected in order to avoid potential break down (whether financial, political, or environmental).
Lorentz transformation analogy could help us to understand this task.



If

X=price
Y=quantity
Z=(environmental, economical, energy, social balance)

Then moving along investing in new balance in time period(1-0) goes as follows:

$$balance_1 = \gamma (t - \frac{velocity * balance_0}{c^2})$$

$price_1 = price_0$

$quantity_1 = quantity_0$

This new balance would provide the bigger energy quantities, bigger prices (inflation, time) but produce new balance of sustainable development along existing technologies.

If on the other hand some new breakthroughs are made and old technologies replaced we should consider Lorentz attractor as new beginning of the new technology development (history:steam engine, radio technologies, wheel).

In that case if X= quantity Y= new technology; Z= price:

$dx/dt = \sigma (y-x)$ dquantity/dt= σ (new tecnology-quantity)

$dy/dt=x(q-z)-y$ dnewtecnology/dt=quantity*(b-price)-new tecnology

$dz/dt=xy-bz$ dprice/dt=quantity*new technology-b*price

2.2.Financial , social and uncertainty facts to be considered

$$=-I\int_t^{\infty}(R-C)*e^{-rn} = -I\int_t^{\infty}(pq - Coper - \int_t^{\infty}(C_{environment}*e^{-r} - \int_t^{\infty}(C_{social}*e^{-r} - \int_t^{\infty}(C_{operating}*e^{-r}$$

$X_{n+1}= r*X_n*(1-X_n)+e$

$e2 = a1+\sigma\,e1+\alpha\quad e1+\beta\ e1+\delta\,e1+e0$

Uncertainty is related to standard deviation of its self and need to be minimized, could produce some uncertainty effects that could be stochastic and have a short term effect on investment and environmental measures taken, or could have permanently shift whole industry/country/ on higher or lower level .

In that way α could mean errors and uncertainties related to financial sector β could be some negative social response on renewable investments δ government fail to impose measures that levels CO2,lack of grants, price un competitiveness and similar

$$ROI= -I_{\text{initial cost}}+\frac{C_{ren}-C_{nonren}}{(1+r)^n}*infl1+\frac{C_{financial}}{(1+r)^n}infl2+\frac{C_{opportunity\cos t}}{(1+r)^n}infl3+e$$

infl1= CPI (Transport, Communication, Household supplies, Food consumption) 60%
infl2=CPI (Household Utilities, Drinks, Tobacco) 30%
infl3=CPI (Recreation, Education, Health) 10%

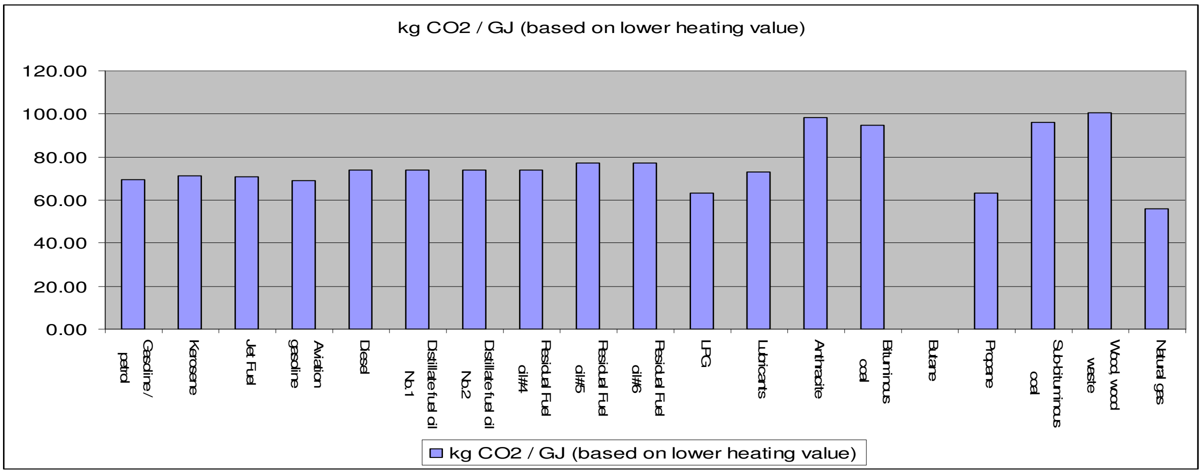
3. Sectors, growth, and social implications

Greatest polluters and energy consumers are to be found among transport, industry (cement), electricity generation, due to coal, oil, and gas combustion. Potentials to reduce could be implemented in transport, industry, institutions, households in a way to achieve greater efficiency, use renewable for power, cooling, heating needs.

3.1.Transport

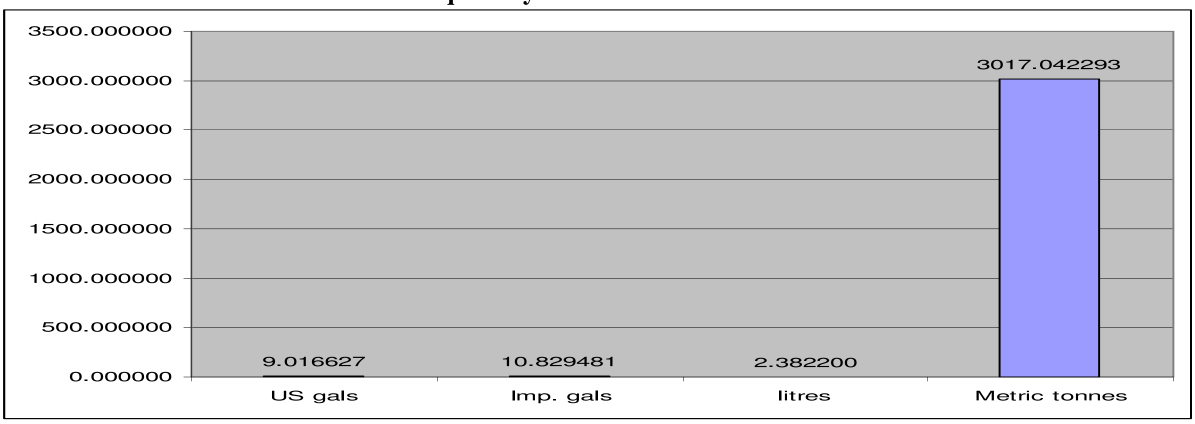
The biggest CO_2 polluters could be found among wood, sub bituminous coal and anthracite over 80 kg CO_2/GJ, and the least one something less than 60kg CO_2/GJ is gas. The other non renewable sources such as gasoline, kerosene, LNG impacts environment in the way to pollute between the 60-80kg CO_2/GJ.

Picture1: kg CO_2/GJ



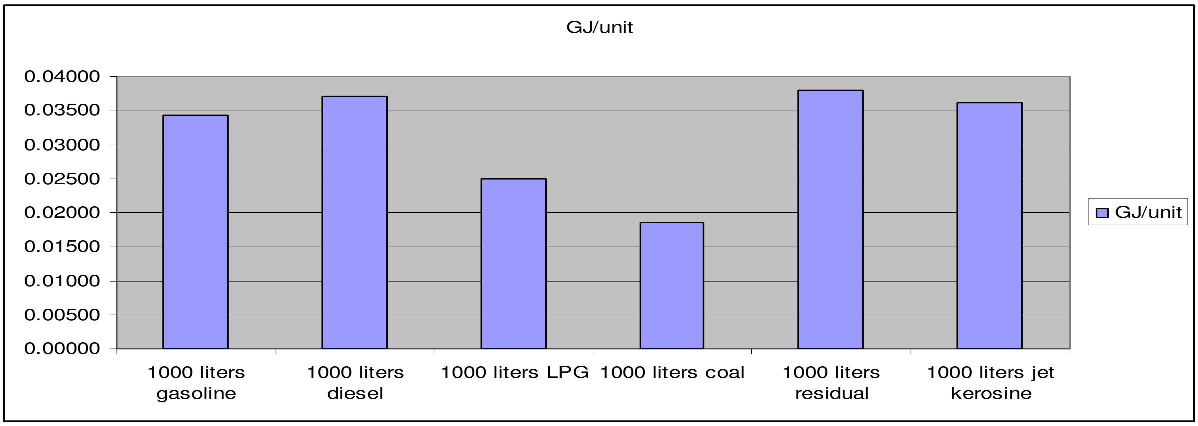
It is clear that 1000 metric tones produce much more CO_2 (3017 metric ton), than US gallon (9,01 metric ton CO_2) or liters (2,36 metric ton CO_2). (*Picture2).*

Picture2: Emission based on fuel 1000 quantity=metric tonnsCO2



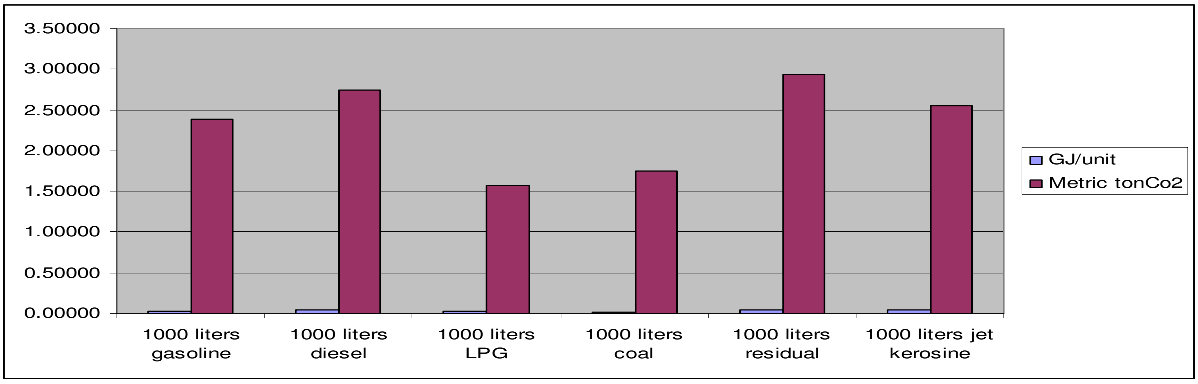
It is also worth noting that the same quantity of fuels does not produce the same energy quality : so 1000 liters of diesel is 0,035GJ, while 1000l LPG is 0,025 GJ of energy.

Picture3: GJ/unit

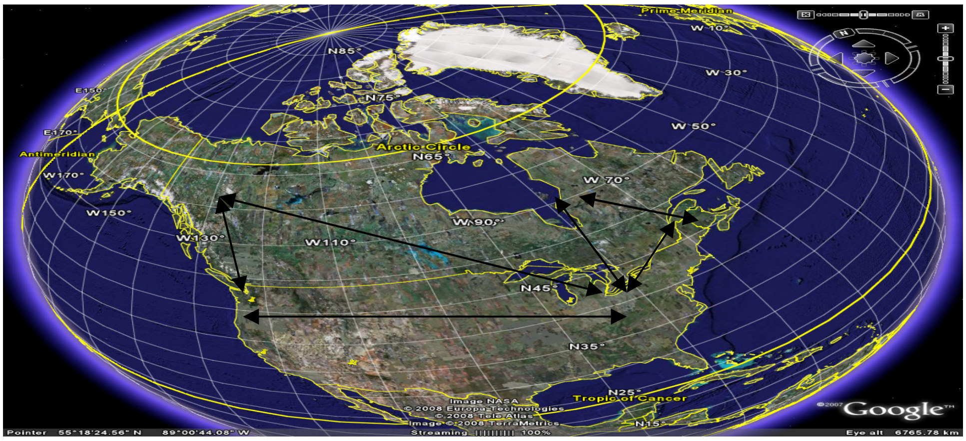


The hugest negative impact on environment is caused by residuals where 1000 liters means 3 metric tons of CO_2, while diesel with 1000liters impacts environment with 2.7metric tons of CO_2.

Picture4: metric tons CO_2 per 1000 liters used

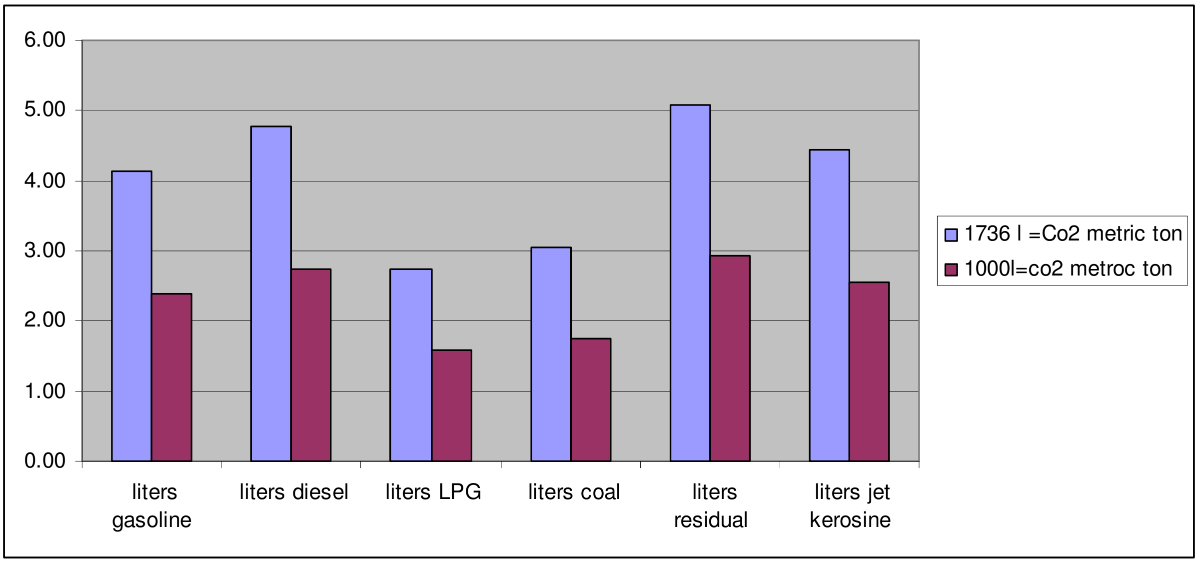


Picture4:Travel Across Canada=14 470km



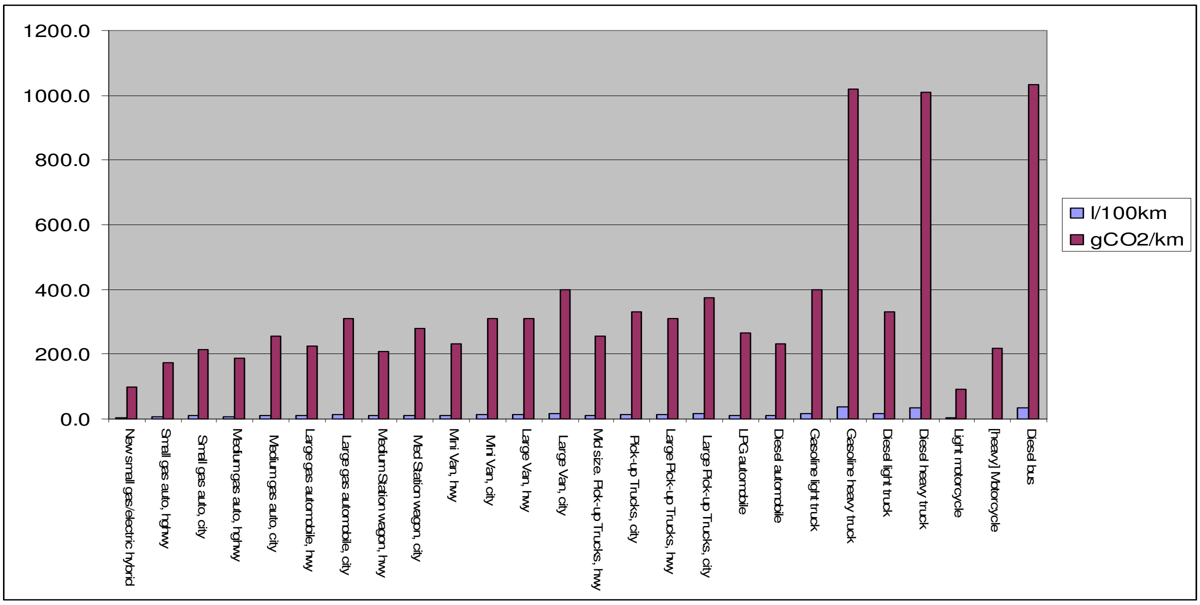
If some traveler would like to sightseeing Canada as described by black arrows on picture 4, he would pass some 14.470 km and spend around 1.736 liters of gasoline. This travel would have different impacts on environment if he uses different kind of fuel. Worst impact clearly is obtained by using residuals (5metric tons CO_2) and diesel (4,8metric tons of CO_2). Kerosene and gasoline would harm nature by producing between 4-5 metric tons CO_2, while LPG and coal impacts at least.

Picture5: metric tons CO_2 if 1000 liters used and 1736 liters used



This journey of ours would be most harmful if we travel by gasoline heavy trucks, diesel heavy truck and diesel bus, and the best solution would be if we choose transportation such as electric hybrid or light motorcycle.[2]

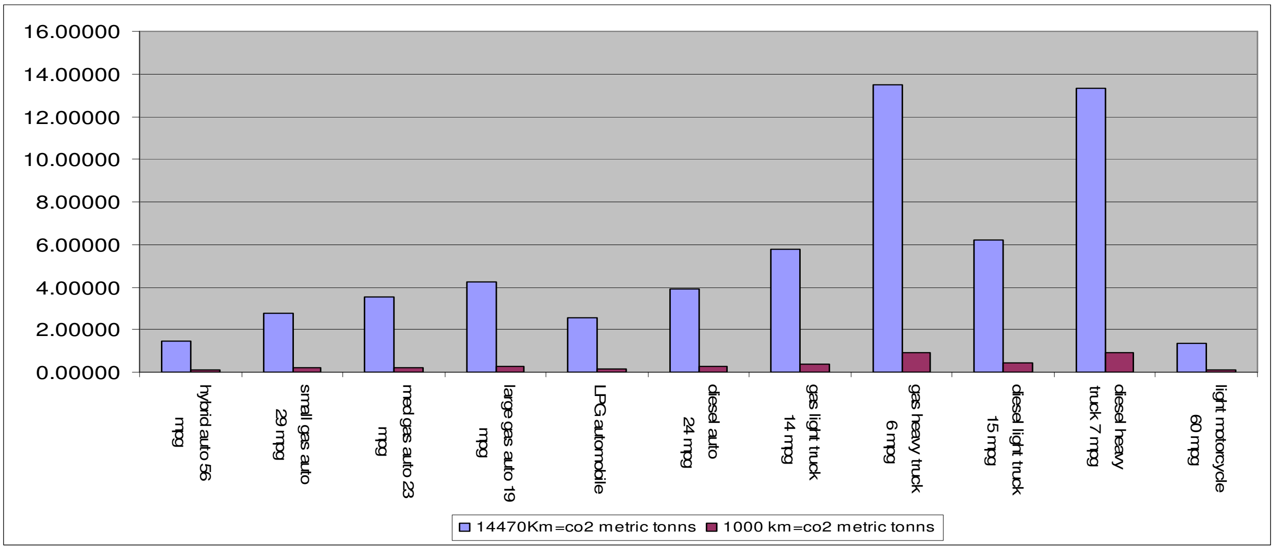
Picture6: l/100km and gmCO_2 emission /km



[2] Canada has 22 mil.drivers each driving an average 16 000 km per year

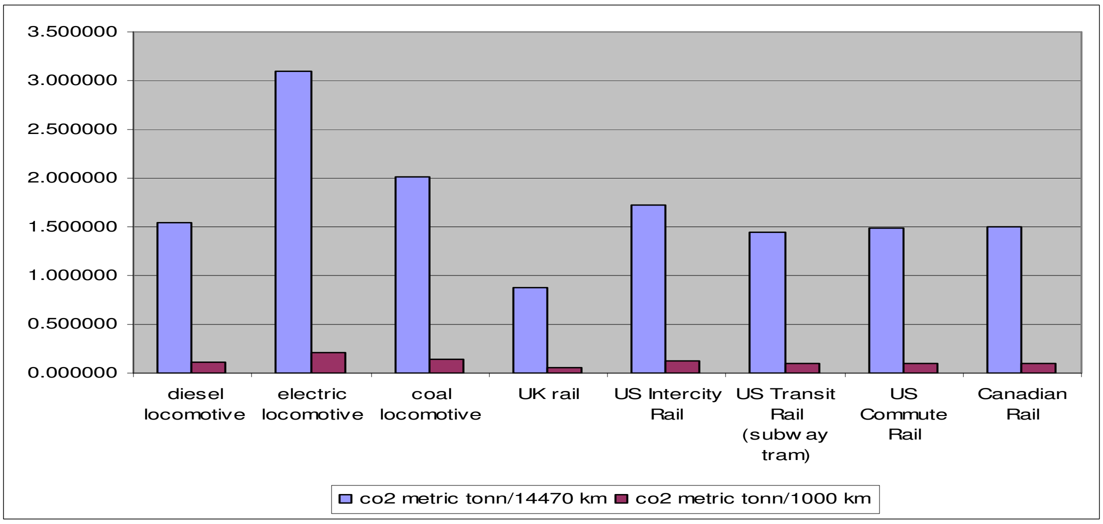
Crouse travel across country with gas heavy truck would produce 13 metric tons of CO_2, while same kilometers could be reached with much smaller pollution of 1,8metric tons if passed with light motorcycle.

Picture7: Road - Total emission metric ton / 1000vehicle km/



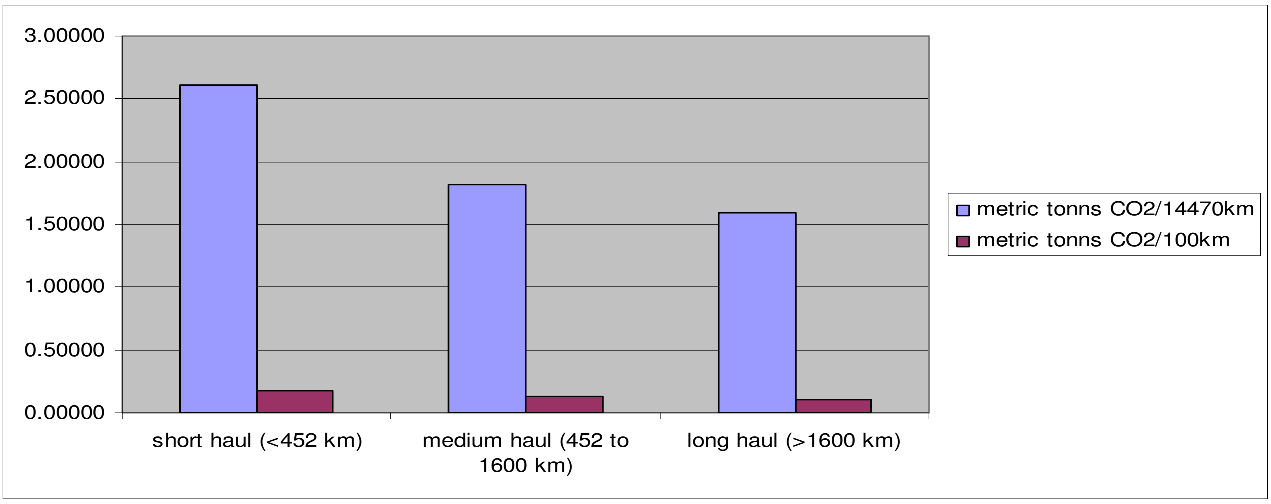
If we choose to travel, instead of car, by rail much better results on environment would be met. The strongest impact would be obtained by electric locomotive with around 3 metric tons of CO_2, while the most beneficiary would be UK rail with only 0,9 metric ton on the whole journey across land.

Picture8: Rail -Total emission metric ton / 1000vehicle km/



Air crafts emits more CO_2 as the journey prolongs with differences whether is it a word about long, short or medium haul.

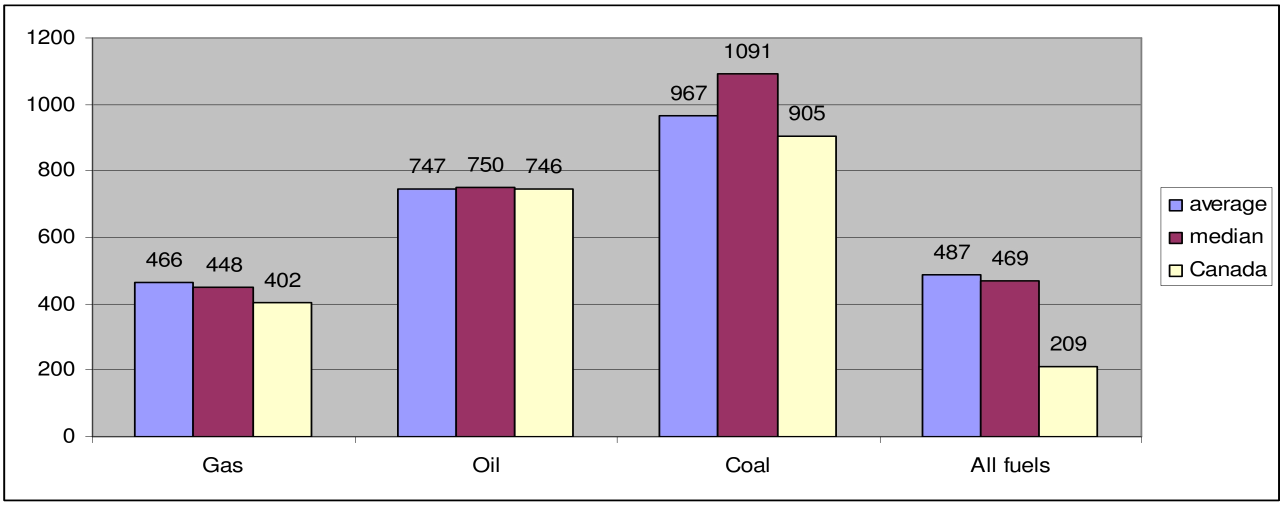
Picture9: Aircraft -Total emission metric ton



3.2.Industry

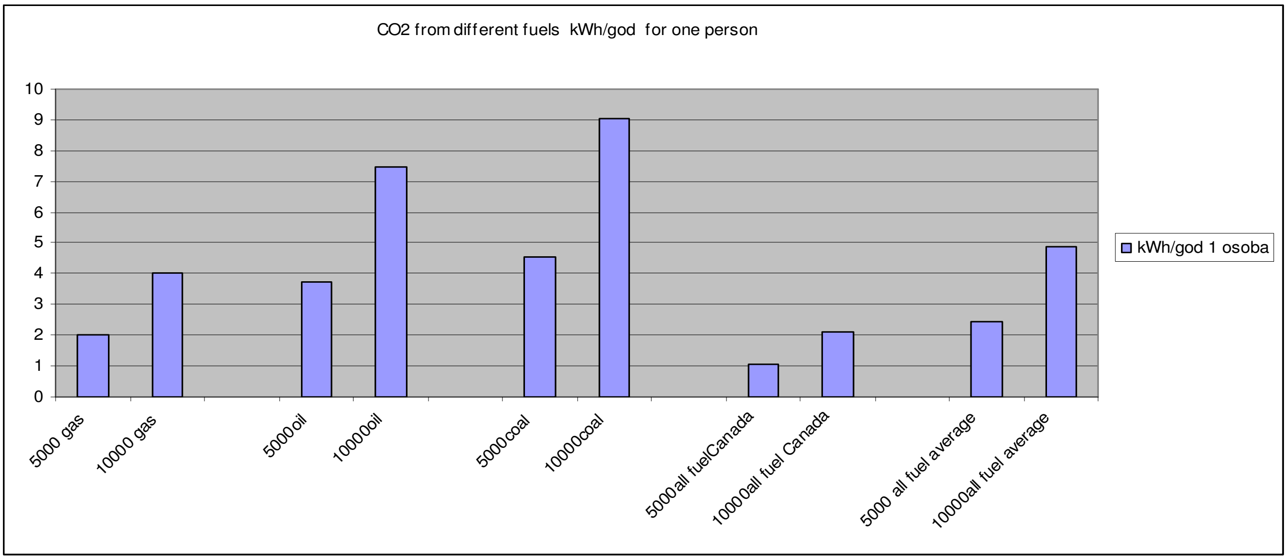
The second most significant source of pollution is industry. Although Canada's impact on environment is a little bit less than world average it follows trend having coals as the main source of pollution (905g CO_2 /kWh), oil (746 gCO_2 /kWh) and gas (402 gCO_2/kWh).

Picture10: gCO2 emissions/kWh average world, median, Canada in 2004



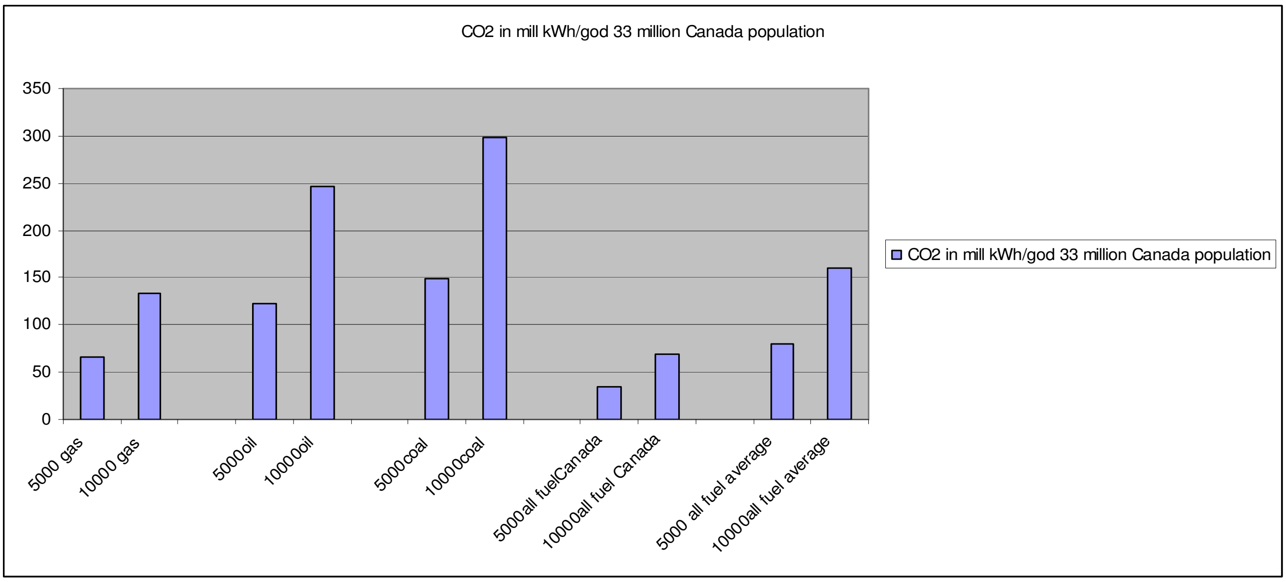
Picture 11 shows CO_2 that resulted from average electricity consumption in the world compared with consumption in Canada for different fuels. One person in Canada (10 000 kWh yearly electricity consumption) causes $9gCO_2$ emission if uses coal supply, while average is $4{,}5gCO_2$. For oil 7,5g of CO_2 is produced if electricity comes from oil.

Picture11: gCO2 emissions/kWh average world, median, Canada in 2004



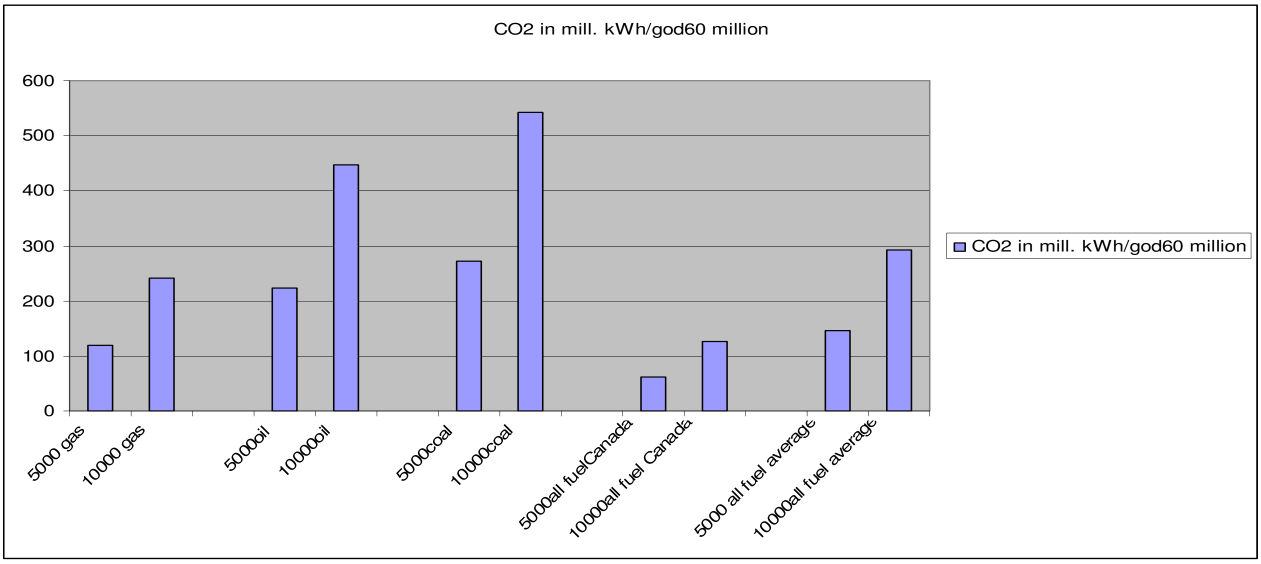
This reasoning multiplies in negative environmental impact if all population are considered and energy is supplied by coal solely than 300mil. gCO_2 is produced. Significant difference between energy consumption on average world level and Canadian standard is significant. The second important fact to note is that electricity produced from gas impacts three times less environmental damage than coal and two and half than oil.

Picture12: gCO2 emissions/kWh average world, median, Canada in 2004



The picture deteriorates significantly if we double Canada's population where difference between gas and coal in CO_2 emissions differs for $300gCO_2$ yearly.

Picture13: gCO2 emissions/kWh average world, median, Canada in 2004



This basic facts brings us to reasoning in what way we should measure GHG impacts, create energy strategy for country in the most beneficial economical and least harmful way.

Δ GHG $(e_{base}-e_{prop})E_{prop}(1-\lambda_{prop})\,(1-e_{cr})$

where

e_{base}	*is the base case GHG emission factor*
E_{prop}	*proposed case annual electricity produced*
λ_{prop}	*fraction of electricity lost in transmission and distribution*
e_{cr}	*GHG emission reduction credit transaction fee*

Further to that in order to calculate total emission global warming potentials[3] for CO_2, N_2O and CH_4 are calculated together with –n- fuel conversion efficiency and -λ -fraction of electricity lost in transmission and distribution.

$e_{base} = (e_{co2}GWP_{co2} + e_{Ch4}GWP_{ch4} + e_{n2o}*GWP_{n2o}) * 1/n*1/1-\lambda$

having in mind that GWP where for example 1 tonne of nitrous oxide cause 310 time more global warming than a tonne of carbon dioxide.

Greenhouse gas		***GWP***
CO_2	=	*1*
CH	=	*21*
N_2O	=	*310*

[3] *The global warming potential GWP describes the potency of a GHG in comparison to carbon dioxide which is assigned a GWP of 1.*

God way to start is to recognize who uses energy and try to develop energy efficiency saving model.

$X_{efficiency}=a_1+a_2*X_{residential}+a_3*X_{commercial}+a_4*X_{institutional}+a_5X_{industrial}+a_6X+e_n$

Improvements in efficacy need to be monitored, published, observed, put in timely frame, allocated clearly, regulated, fined if not met in mid term period due to low management capability etc and stretches in following direction:

Yx=a1+a2Heating System(Heating electricity, Fuel saving, Simple payback, Seasonal efficiency)+a3*Cooling System(same)+a4Building envelope(walls, window, Solar shading, Doors, Roof , Floor below grade, Floor below grade)+a5Natural air infiltration+a6*Ventilation+a7*Lights+a8*Electrical equipment+a9*Hot water+a10*Pumps+a11*Fans+a12*Motors +a13*Process electricity+a14*Process steam+a15*Steam losses+a16*Heat recovery+a17* Compressed air a18*Refrigeration +e1

*$X_{institutional}$ =a1+ a2*Heating system +a3*Cooling system +a4*Building envelope +a5*Ventilation +a6*Lights +a7*Electrical equipment +a8*Hot water +a9*Motors +a10*Process electricity +a11*Process Heat +a12*Process Stem +a13*Stem losses +a14*Compressed air +a15*Refrigeration + Other+e1*

*$X_{industry}$ = b1+b2*Heating system +b3*Cooling system +b4*Building envelope +b5*Ventilation +b6*Lights +b7*Electrical equipment +b8*Hot water +b9*Motors +b10*Process electricity +b11*Process Heat +b12*Process Stem +b13*Stem losses +b14*Compressed air +b15*Refrigeration + b16*Heat recovery +b17*Other+e2*

After potential of savings are observed and plan of energy usage reduction made in each segment: industrial, housing, institutional, long term fuel income need to be carefully managed and best mix that incorporates renewable implemented.

$X_{fuel\ mix}=c1+c2*X_{coal}+X_{oil}+X_{gas}+X_{wind}+X_{biomass}+X_{geo}+X_{tidal}+X_{wave}+X_{solar}+e$

having in mind

$\Delta GHG==a1+a3(X_{fuel\ mix2}-X_{fuelmix1})+e1$
Power=Central grid +Isolated grid +Off grid+ e
$min\ (P_{base\ case}-P_{renewable})+(CO_{2\ base\ case}-CO_{2\ renaw.\ mix})$
$max\ (E_{efficacy\ proposed}-E_{efficacy\ based})+(Revenues_{proposed}-R_{based})$

Incorporating renewable need to follow carefully maximisation of potential natural possibilities and resources where following is observed at least for a year after decision is made:

***Wind** = a1+a1*Wind Speed annual +a2*Wind resource assessment (wind speed, air temperature, atmospheric pressure)+a3*Wind turbine (power capacity, per turbine, manufacturer, model, number of turbines, power capacity, hub high , rotor diameter per turbine, swept area per turbine, energy curve data, shape factor)+a4*summary(capacity factor, electricity delivered to land, electricity exported to grid)+e1*

***Photovoltaic**=b1+b2*Climate (number of sunny days, declination, sun reflection, extraterrestrial radiation, clearness index,)+b2Grid system (On /off grid)+b3*Photovoltaic system (batteries, inverters, controllers, structure)+b4*PV modules (single crystalline silicon, polycrystalline silicone, ribbon silicon, cadmium telluride, copper indium diselenide, amorphous silicon)+b5*Utilization+b6*Power production+e2*

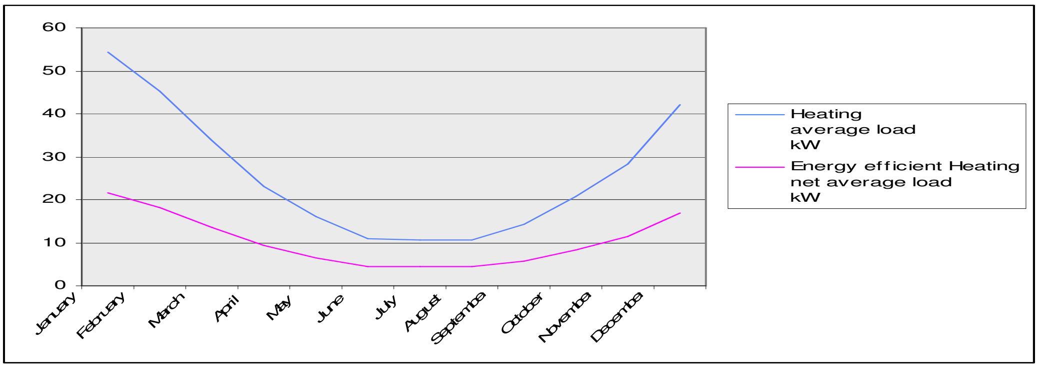
Biomass Heating*=c1+c2*Waste heat recovery+c3*Biomass combustion system+c4*Peak load heating system+c5*Back up heating system+c6*Biomass fuel (wood chips, agricultural residues, municipal waste)+ c7*Biomass storage+c8*Biomass transfer+c9*Combustion shamber+e3*

Examples and possibilities of implementation re presented as follows:

3.3 Heating

In the first example base case considers a building/space of 1000 m^2, heated with coal (35$/t),with 58 W/m^2 where heating load for building will produce 230MWh. At the total peak heating load 58 kW and requires 1078$ total. If end use energy efficiency measures are levelled at 60%, net peak heating load is 23kW, and net heating is 92MWh.(*Picture14*)

Picture14: Energy efficiency measures-heating

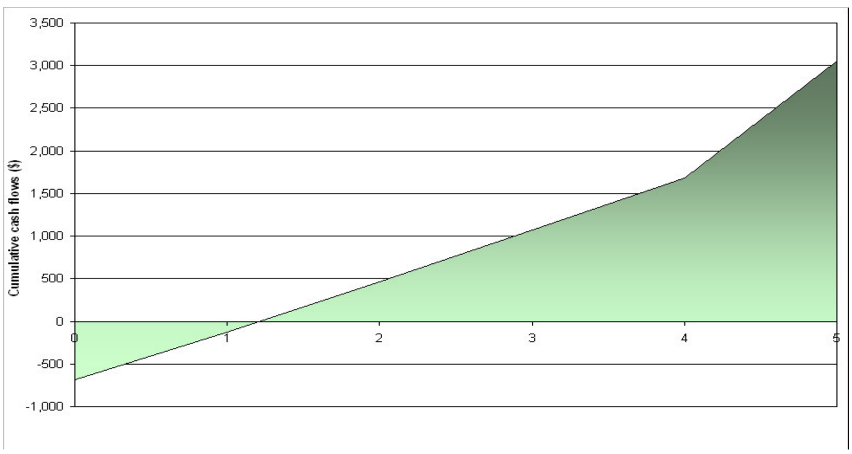


Our aim is to replace coal system and transfer to biomass fuels. This new system is based on yard waste with capacity of 15 kW and total heating delivered will produce 83 MWh. In that case we could expect reduction of cost of heating from 1078 to 743$.

In addition to reduced financial expenditures GHG emissions are significantly reduced where net change in GHG emissions is 96.

	MWh	*tCO2/MWh*	*tCO2*
Coal	*288*	*0,338*	*97*
Biomass yard waste	*177*	*0,006*	*1*

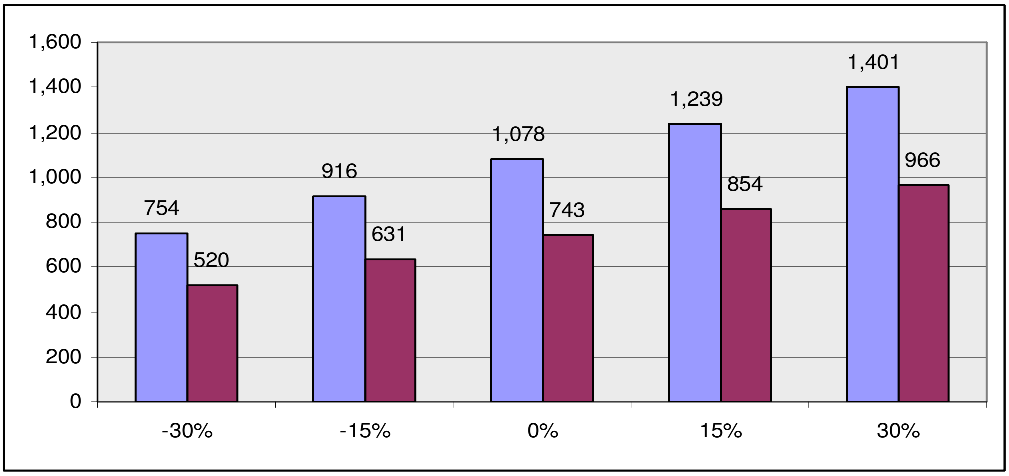
Picture15: Cumulative cash flow graphs from energy efficiency, input change



Project is feasible in economical sense while it produces 6,8% IRR, have large and positive NPV 2203$, and can expect equity payback for 1,2 years.

By introducing sensitivity analysis in our calculation and expect initial cost to change at 30% following yearly heating expenditure could appear as possible. (*Picture16*)

Picture16: Sensitivity analysis coal/biomass prices change



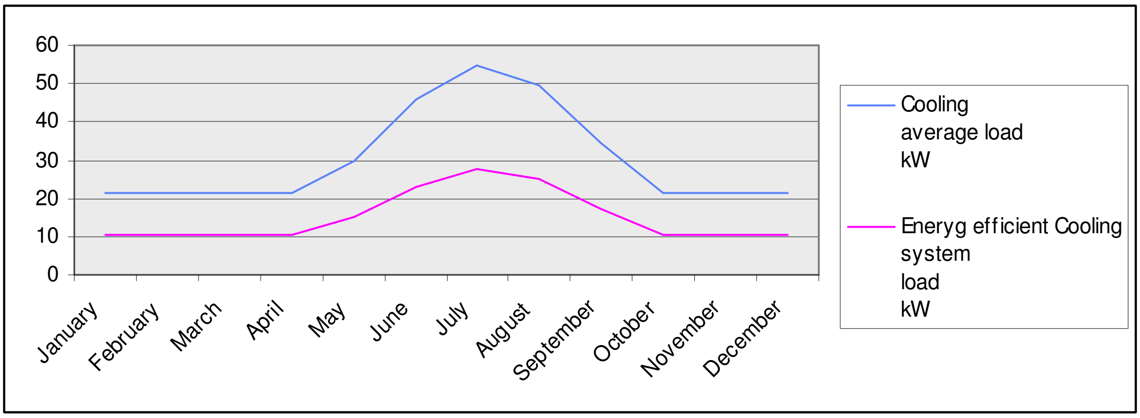
3.4.Cooling

Making another attempt to show haw can small investment bring changes in efficiency and quality of air cooling system is taken as an example.

Lets consider again a space of 1000 m^2 cooled with coal as the base fuel. It needs 58W/m^2 cooling load for total space, with 270 MWh of total cooling hours. For peak load of 58kW we would need 29t of coal and paid for that 866$.

By implementing end use energy efficiency measures net peak cooling load is 29 kW and net cooling is 135MWh.

Picture17: Energy efficiency measures-cooling



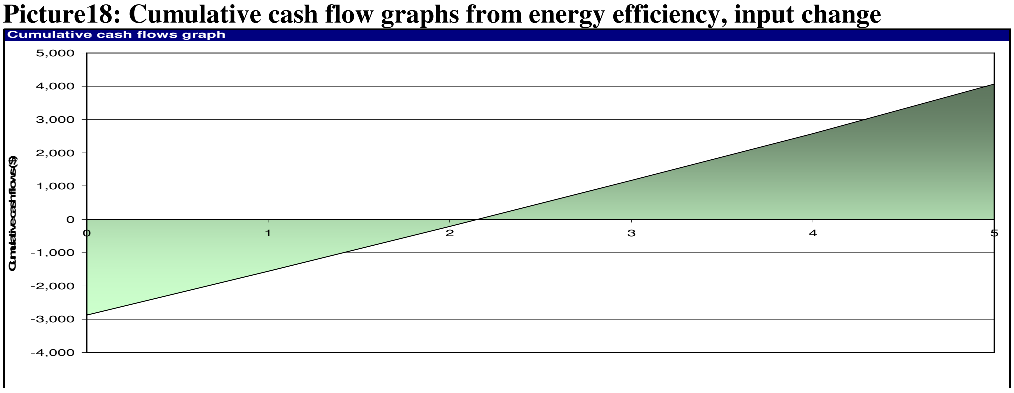
Energy efficiency measures are not all we want to accomplish. That why coal is considered to be replaced by biomass. In that case we would need 12t of biomass capacity if 30kW would be reached and energy delivered 135MWh.
For our financials situation cost would significantly decrease from 866$ to $246.

Positive climate effects are observed and presented as follows:

	CO_2 emissions Kg/GJ	*CH_4*	*N_2O*	*Consum. MWh*	*GHG tCO_2/MWh*	*GHG tCO_2*
Coal	*92,7*	*0,0145*	*0,029*	*270*	*0,338*	*91*
Biomass		*0,00299*	*0,0037*	*68*	*0,006*	*0*

Where net GHG reduction of 90 $tCO_2$is equal as putting 18,5 cars and trucks out of use.

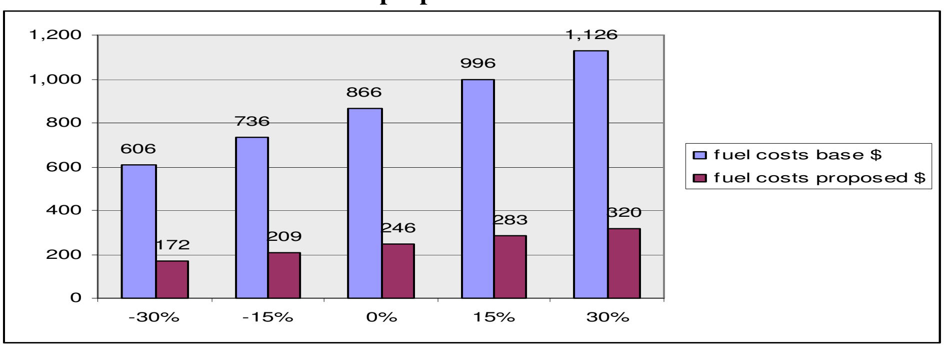
Picture18: Cumulative cash flow graphs from energy efficiency, input change



NPV is positive and large again 2640 $, equity payback 2,2 years and we could hope that huge return on equity of 30% will appear .

Sensitivity analysis of 30% change in initial investment means bracket for 606-1126$ for base case, and 172-326$ for proposed case.

Picture19: Fuel costs on base and proposed case



3.5. Power

There are huge potentials of savings and energy input replacements. Basics again incorporates best resources for renewable, lowest transportation costs, lowest transmission losses, highest energy efficiency etc. For local/state investors economic calculation need to be supported by Government terms of security and environment.

NPV= -Investment in wind+ $\sum \frac{Rwind - Cwind}{(1+r)^n} + \sum \frac{RCO2reduced}{(1+r)^n} + \sum \frac{Rnorenewablesreserves}{(1+r)^n}$

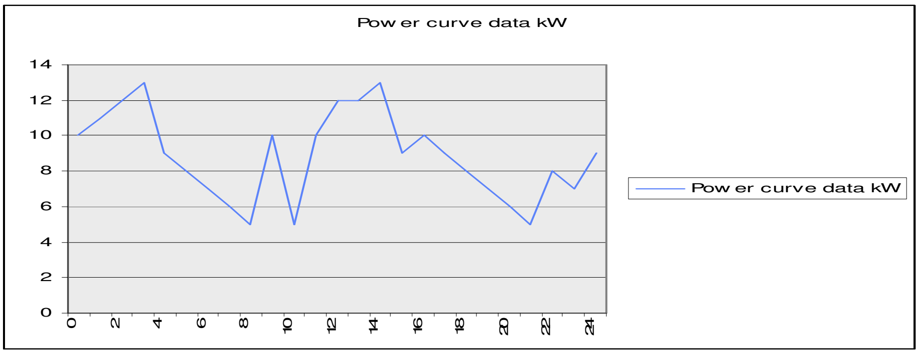
$+ \sum \frac{Cnorenewablesproduction}{(1+r)^n} + \sum \frac{Securityincreased, unsertaint\ reduced}{(1+r)^n}$ -

$\sum \frac{Csitesbeauty\ degraded, birds}{(1+r)^n}$ +e1

Lets consider wind system of 600kW turbine (hub highs 24m, diameter 15m,swept area 177 m2,Sharpe factor2) which produces 75MWh gross.

Intermediate load power system is fuelled by gas than 600kW gas turbine produces 5 256MWh electricity.

Picture20:Power curve based on wind speed



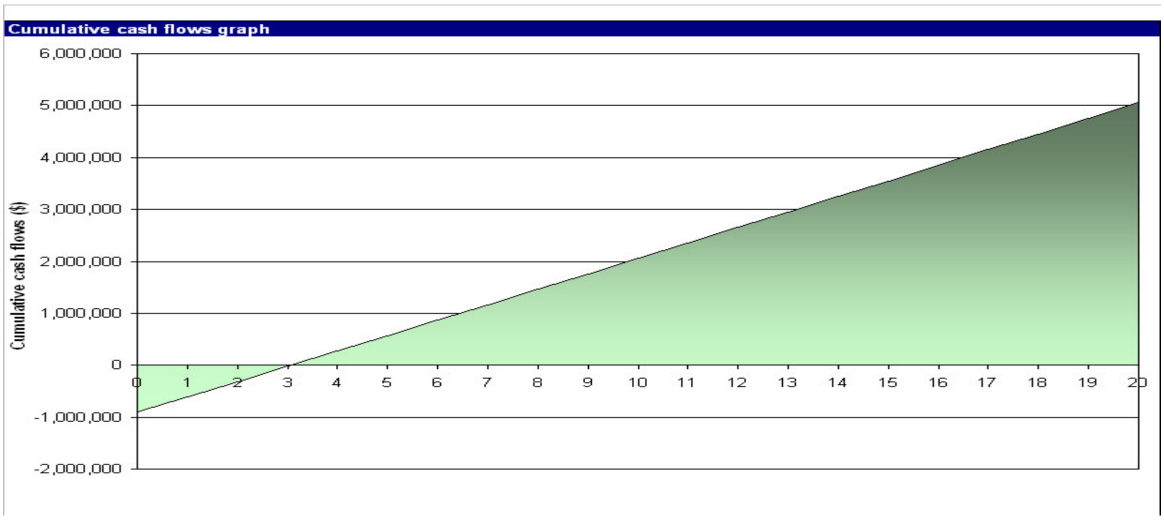
By comparing CO_2 emissions of wind and gas turbine electricity production following is obtained:

	MWh	*tCO2/MWh*	*tCO2*
Gas	*5311*	*0,211*	*1121*
Wind	*56*	*0*	*0*

Difference of 1.121 in net annual GHG reduction equals as 228 cars not used and amounts if price of carbon is 15-20$/t between 16-22 thousand $ yearly .

Important fact is that this project is financially liable with pre tax IRR of 30%, payback period of 4 years, energy production 204/MWh, and NPV large and positive 996 thousand $. (*Picture 21*)

Picture21: Cash flow



This few examples show how indeed clean environment and efficacy is possible and financially viable on the small scale basis. But as in case of every good policy large support in energy strategy and clear vision from Government is needed to reach all levels of society.

Table 3 shows current Canada's population of 33 mil people who consume around 10000kWh energy per capita per year. On the world level this consumption is much lower 5 000kWh per year per capita . If we equally (that would not be the case in the real world) divide sources of energy on consumption and incorporate efficiency of its usage it is easily calculated that capacity needed in Canada is between 45-90 billion kW.

Table3:Population33mil high and low demand for renawabel and non renawable energies

population	33,000,000.00	33,000,000.00			33,000,000.00	33,000,000.00
	current lower demand	*current higher demand*			*current lower demand*	*current higher demand*
kwh yearly/capita	5000kWh	10000kWh	Effic+daysx24h		Kw installation	kW installation
geo	33,000,000,000.00	66,000,000,000.00	0.6*360*24	5,184.00	6,365,740.74	12,731,481.48
wave,tidal	33,000,000,000.00	66,000,000,000.00	0.2*360*25	1,728.00	19,097,222.22	38,194,444.44
wind	33,000,000,000.00	66,000,000,000.00	0.35*360*26	3,024.00	10,912,698.41	21,825,396.83
biomass	33,000,000,000.00	66,000,000,000.00	0.87*360*27	6,912.00	4,774,305.56	9,548,611.11
nonrenewable	33,000,000,000.00	66,000,000,000.00	0.9*360*28	7,776.00	4,243,827.16	8,487,654.32
Total kwh	**165,000,000,000.00**	**330,000,000,000.00**			**45,393,794.09**	**90,787,588.18**

In money terms if total value of indistrial capacity would be between 64.976 -129. 952 billion $.

Table4: Investment costs

		Invest. $/per kW	$ invest, 33mil popul 5 000kwh	$ invest, 33mil popul 10 000kwh
geo	1/5	1600	10,185,185,185.19	20,370,370,370.37
wave,tidal	1/5	1800	34,375,000,000.00	68,750,000,000.00
wind		1200	13,095,238,095.24	26,190,476,190.48
biomass	1/5	1000	4,774,305,555.56	9,548,611,111.11
nonrenewable	1/5	600	2,546,296,296.30	5,092,592,592.59
Total elec.supply	1		**64,976,025,132.28**	**129,952,050,264.55**

Although this larger amounts of total installation needed that are the highest for wind/wave sources of energy these rises significantly is population of country is going to double in the next century or two. (2 human generations).

Table5:Population 33mil. high and low demand for renawabel and non renawable energies

population	60,000,000.00	60,000,000.00			60,000,000.00	60,000,000.00
	current lower demand	*current higher demand*			*current lower demand*	*current higher demand*
kwh yearly/capita	5000kWh	10000kWh			kW	kW
geo	60,000,000,000.00	120,000,000,000.00	0.6*360*24	5,184.00	11,574,074.07	23,148,148.15
wave,tidal	60,000,000,000.00	120,000,000,000.00	0.2*360*25	1,728.00	34,722,222.22	69,444,444.44
wind	60,000,000,000.00	120,000,000,000.00	0.35*360*26	3,024.00	19,841,269.84	39,682,539.68
biomass	60,000,000,000.00	120,000,000,000.00	0.87*360*27	6,912.00	8,680,555.56	17,361,111.11
nonrenewable	60,000,000,000.00	120,000,000,000.00	0.9*360*28	7,776.00	7,716,049.38	15,432,098.77
Total kwh	**300,000,000,000.00**	**600,000,000,000.00**			**82,534,171.08**	**165,068,342.15**

In that situation investment costs rises from 118.138 bil-236.276 bill $.

Table6: Investment costs

		Invest. $/per kW	$ invest, 60mil popul 5 000kwh	$ invest, 60mil popul 10 000kwh
geo		1600	18,518,518,518.52	37,037,037,037.04
wave,tidal		1800	62,500,000,000.00	125,000,000,000.00
wind		1200	23,809,523,809.52	47,619,047,619.05
biomass		1000	8,680,555,555.56	17,361,111,111.11
nonrenewable		600	4,629,629,629.63	9,259,259,259.26
Total elc supply			**118,138,227,513.23**	**236,276,455,026.46**

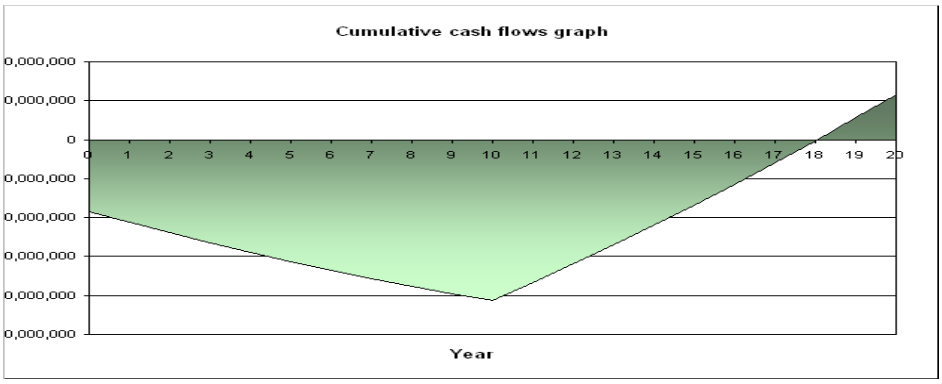
Putting all facts on the large scale has not for its purpose to scare us, but to consider more carefully opportunities of right investments and predict possible status quo in our calculation on future generations. Although more expensive renewable energy installations are financially viable if longer period of time is considered 20-25 years, with no negative impact on environment.

If 33 000thousand MWh is produced by wave 7.023.768 t of CO_2 emissions are not exhausted in air what corresponds to 1,4million cars and trucks not used. If the similar amount of energy is produced by wind 1,3million tCO_2 is not in the air what also means 1,3miilion cars not used.

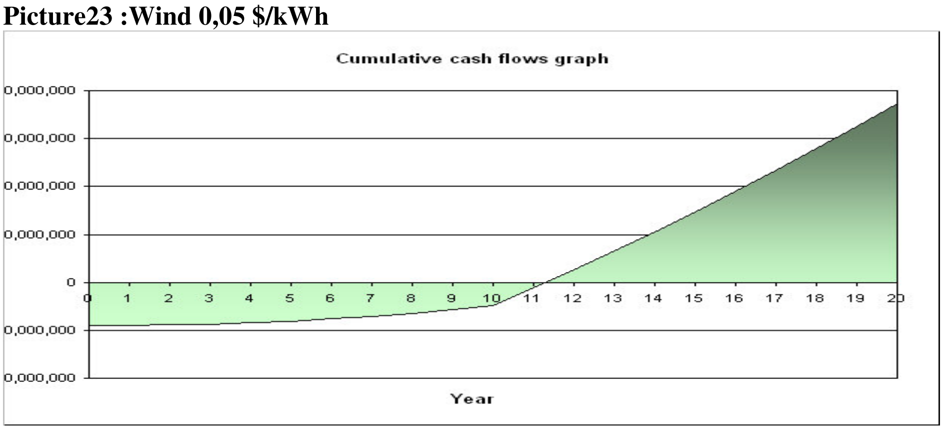
	MWh	*tCO2/MWh (0,211)*	*cars not used*	*IRR assets*	*Symple payback*	
All fuels	*33,00 thou.*					
Wave	*33,288*	*reduced 7.023.768*	*1.427.932*	*2%*	*0,05$/kwh*	*19years*
Wind	*32,412*	*reduced 6.838.932.*	*1.390.355*	*3%*	*0,05$/kWh*	*11years*

Pictures 22 and 23 show that renewable energy installation is not just beneficial to environment, but is economically viable on long term.

Picture22:Wave 0,05 $/kWh



Picture23 :Wind 0,05 $/kWh



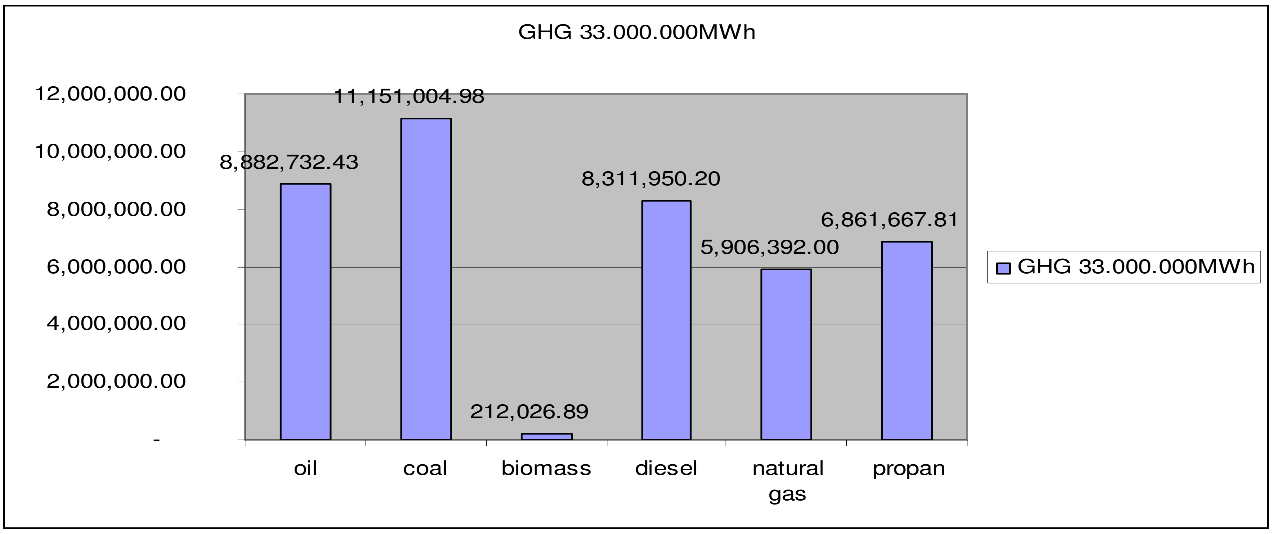
If we magnify this reasoning with electricity production from gas/oil and calculate tCO_2 emissions large difference in environmental quality is observed. To produce same amount of electricity we need .3.300 billion of oil that exhaust 9,996 million CO_2 in the air. Although gas input produce a half of oil emissions it is still present large amount of money 4,mill $ terms or impacts on health.

	Quantity	*tCO2*
Oil	*3.300.000.000 l*	*9.996.268*
Gas	*33.000.000.000 kWh*	*5.906.392*

Table7: CO_2 emission

fuel	quantity	measure	CO2 emisision factor kg/GJ	CH4 emisision factor kg/GJ	N2O emisision factor kg/GJ	MWh	tCO2/ MWh	GHG
oil	3,300,000,000.00	l	74.1	0.0019	0.0019	37,136,866.00	0.269	9,996,268.00
coal	3,700,000.00	t	92.7	0.014	0.0029	34,617,461.00	0.338	11,697,560.00
biomass	5,900,000.00	t		0.0299	0.0037	32,383,369.00	0.006	208,065.00
diesel	3,100,000,000.00	l	69.3	0.0019	0.0019	33,048,503.00	0.252	8,324,167.00
natural gas	33,000,000.00	MWH	49.4	0.0036	0.0009	33,000,000.00	0.179	5,906,392.00
propan	4,500,000,000.00	l	57.5	0.0009	0.0009	33,223,750.00	0.208	6,908,192.00

Picture24 :GHG emission from 33 000 000MWh



4. New Projects and ideas derived from renewable

By pursuing green idea a ways of implementation and further developments are endless. Let's consider few sectors where some new ideas could be explored.

4.1Transport

Currently large blame on transport industry is connected with CO_2 .Two major ways of transport are divided into: the one that is commuted in towns and between them. While the first group includes problems such as traveling to work bypassing small distances, large congestions and accumulation of CO_2 on small area, longer distances are burdened with diesel truck transport that emits also more negative particles into air.
Although numerous Government attempts have being known in order to decrease single man travel and congestions by improving public transportation systems (tubes, buses, trams, inner city trains; fee on traveling in town with car-London, green certificates on car registration and license prolongation,) or by encouraging long kilometers transport to be made by railway instead of trucks ,there are still lots of congestion, GHG and inefficient use of energy and resources(non renewable, time, health, security etc) . Unfortunately more and more cars are on the street (we can expect more while China have 1 car on 120 people; other low income country would like to improve transport standard) ,and still huge truck transport world wide.

It is of high importance for large metropolitan areas to develop its transport system in order to be more energy efficient, to induce more population not to use cars(stop one man-one vehicle-marketing program) , and that this transport would be partly made possible due to renewable energy. Small electric cars in towns, fast trains supported by electro magnetic fields, small in the air tubes that zig zags across city would provide cleaner, with more trees and no congestions sites areas.

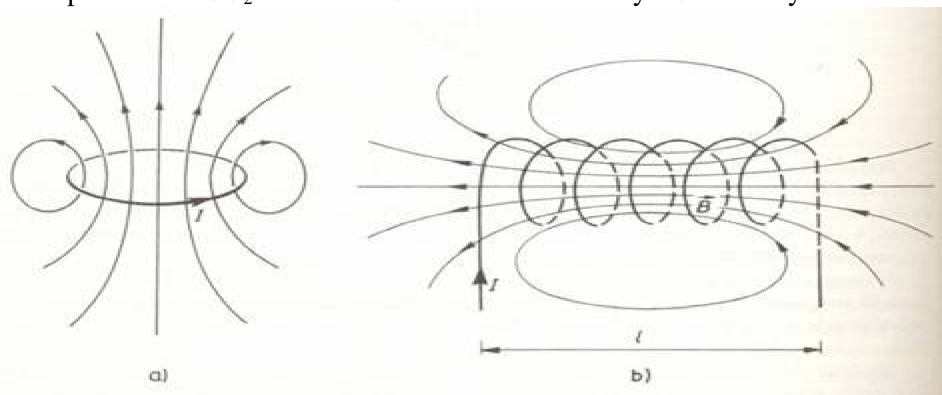
Long kilometers truck should be replaced by train transportation fueled with renewable suitable along the route (Ontario wind, Manitoba, Winnipeg- bio fuels, rests from production).

Transport could fuel and encourage other activities connected with common transportation such as one wagon to be reserved for tourist purposes, educational, restaurants, moves-in that way general knowledge would be raised along the every day or inter country travel. Some old Indianans stories that employee's first nation giving them opportunity to work and present different culture could exist with computer presentation and simulation of entertainment educational field alone Trans Canada route. Yes indeed people in train could reach some conclusion abut future education, industry development or decide which movie should get what award rising social competences.

Clean fuel could indeed be beneficiary to society making them again together involved – in that way abandoning the old culture one man in one car, and spending to much hours in front of TV at home.

There are vast unexplored field in the area of magnetic transportation. If this is managed one day a population could fast travel between continents using negative and positive magnetic poles. Area around the north magnetic pole could be big All Earth and even Inter Galactic start. This starting point should be open to all people around globe and additional source of revenues (restaurants, tourism, entertainment around pole with Aurora Borealis, industry by producing magnetic airplanes) obtained.

Transport=a+a1*CO_2reduction+a3*turisam+a4security+a5*industry related+a6*every day commuters+e1

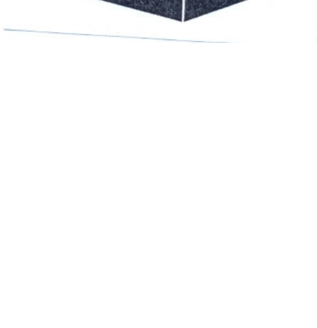


In the time we are waiting for cheap anti gravity vehicles we have in our hands knowledge about magnetic and electric forces that could also be beneficiary when considering environmentally clean transport.

$$B=\frac{\upsilon}{4\Pi}\frac{m}{r^3}\sqrt{1+3\sin^2\lambda}$$

$$P=\frac{W^n}{12\Pi e c^3}\left|P\right\|^2$$

$$F=q*E_{electric}+qv*B_{magnet}$$



4.2.Housing

Huge potentials of savings in energy can be incorporated in housing area. Currently, the most popular/usual are saving bulbs, lower heating temperature, less cooling days , buying renewable electricity, application of off grid wind, photovoltaic installation on the roof etc.

Besides these measures additional means of encouraging clean energy input should be encouraged by giving families tax brackets and other incentives (free GHG emission/energy efficiency appliances, energy software) , using public transport and implementation of energy efficiency measures.

Future in this field lies in daily improvements, savings and incorporating more renewable in everyday activities.

New buildings should and could be build in cooler not so settled areas made in way as block of houses or apartments connected (more energy saved) , building where each apartment have a small garden inside, (healthy food) and common inside greenhouses for vegetable (CO_2 from energy used for gardening). Whole cities can be build in north near geo thermal energy sources with schools , industries and agricultural apartments fueled by earth energy.

4.3.Industry

Currently large source of pollution but also an potential to bring change partly lays on industry. More vigorously investing in energy efficiency and production by using clean energy is task ahead. Incorporating in its accounting procedure energy coefficient with aims of reduction, making visible these facts on quarterly results and being rewarded or punished of not doing so on the stock market/Government fines is further part of the process.

Closer relation between industry and government(tax credits, grants, support of industry to government vision of clean environment), education(close cooperation between schools and industry, produce small computers that are possible for each student reducing paper and wood destruction, , and energy sectors (green certificates, credits, common financing of renewable etc) in order to reach goals in GHG reduction.

4.4.Finance

Financial sector is important link between current production and further development aims. Healthy credits directed in housing, industry developments that firmly incorporates energy efficiency clean environment together with other market or profit elements need to be part of calculation. Although 2008 brought some really bad news from these sector make some people wonder: Could we not invest in renewable technologies and future stability and energy security instead of burdened future tax budget with huge bail out money?

However, decisions are made and future budget is burdened with some bad investment banking policies. And banking system functions further. Hopefully , with much wiser advisory staff.

It is important to note that solid, transparent, financing is further one important milestone to reach aim of GHG reduction and that derivatives based on GHG, CO_2, weather, energy resources are not part of bad policy. Just…. they need to be managed with social, moral, economical and financial common sense.

Variables that need not to be neglected when loan, derivatives, crediting is concerned are as follows:

Loans

Amount of housing loan=a1+a2*income (current /potential)+a3(applicant age, health family conditions)+a4(guaranties) +a5(quality –market)+a6*(energy efficiency +environment)+e1

Amount of industry loan=a1+a2*(FCF)+a3(NPV)+a4(environmental- clean energy)+a6(benefit to society)+e1

Credit card

-If buy in shop green products get a bigger amount of credit on shop card

-If buy green electricity get loans with lower interest rate

-If pay public transport with card instead of driving a car get tax deduction

etc

Derivatives

GHG certificate=debt=credit in a year order to avoid emission increase

Coal, oil, gas futures=$P\ e^{nt-q} + P_{CO2} - P_{security}$

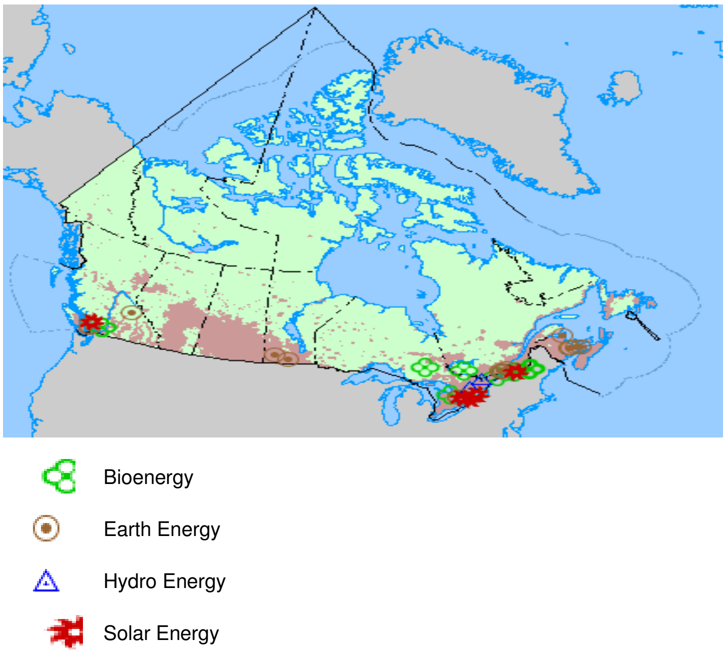
Wind, geo, wave futures= $P\ e^{nt-q}\ {}^{-}P_{CO2} + P_{security}$

4.5.Government

Carefully managed, viewed, directed and controlled economic and energy policy is part of the daily Government duties. Strong commitment to international agreements in order to reduce harmful GHG gases should be one of the clear aims of Canada's policy. This signs of good will, obligation and common Earth goals should be further communicated on the local and State levels in forms of firm legislation. This is to be incorporated further into energy, accounting, environmental and economic laws subject to monitoring and further regulation.

It needs to be clear that renewable in Canada are not going to develop fast due to significant oil/gas reserves unless strongly subsidized and incentivized by Government. This means that Government should order/make Global world and Canada's natural resource renewable development possibilities in order to avoid uneconomical decisions (such as installing on small or large scale photovoltaic) and decrease natural resources on the worldwide scale.

Two parallel activities need to be managed. The first one is everlasting measurement, monitoring ,reporting energy and gas activities connected with industry ,housing, transport, institutional activities and meet energy reduction goals by working constantly on managing energy efficiency..



The second activity should be directed toward supporting investment activities directed into renewable technology installments. Clearly communicated government incentives, grants and tax reduction need to be transferred to each entrepreneur, company ,individual willing to commit itself to GHG reduction goal and made possible more secure future energy source.

The base for calculation could follow these steps:

$$\Delta \text{GDP} = a1 + a2 \sum_t^n \frac{GDPn - GDPt}{(1+n)^t} + a2 \sum_t^n \frac{Tax.reven. - Incentives, Grants, Subsidies}{(1+n)^t} +$$

$$a2\ (Pop.n - Pop.t) + a3 \sum_t^n \Delta Energy\ \sec ur. + a4 \sum_t^n \Delta GHGreduction + a5$$

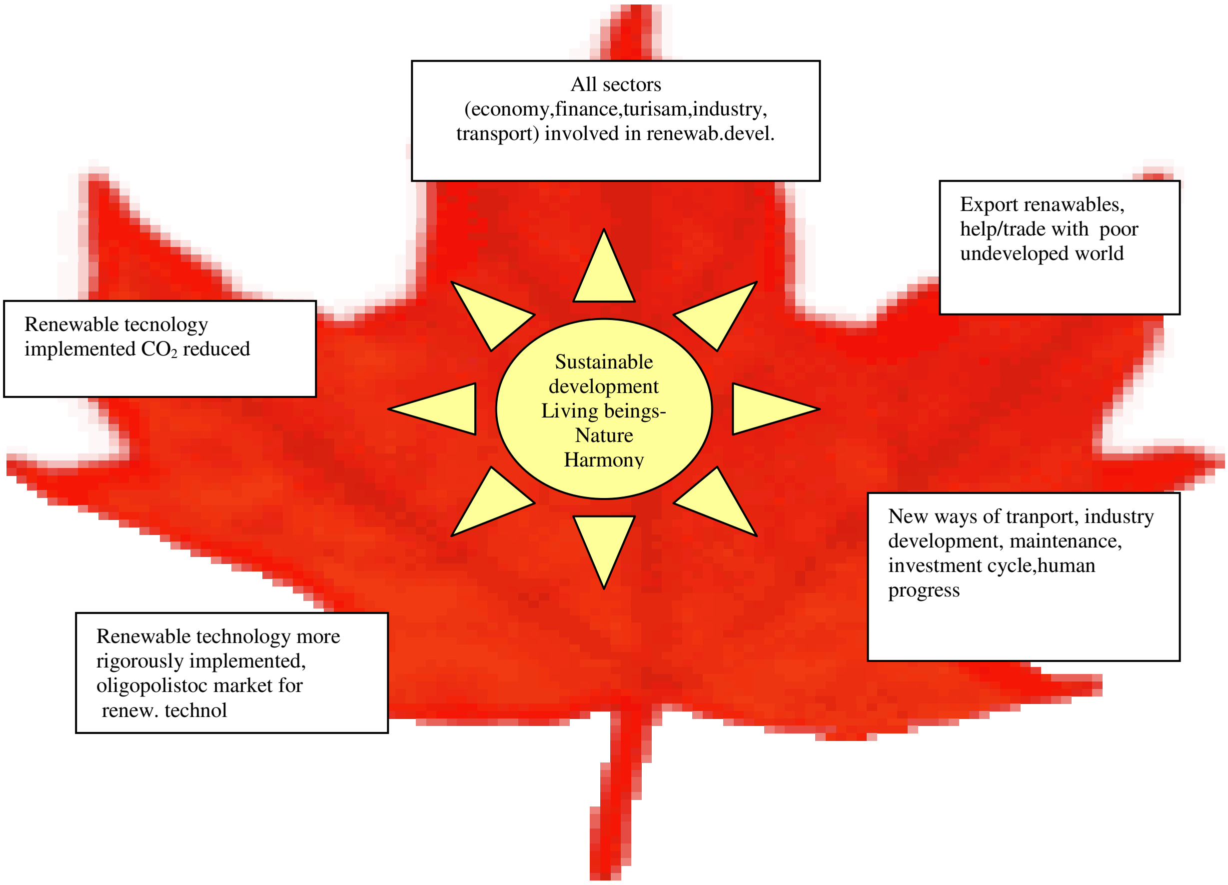
$$\sum_t^n \Delta Kyoto + Internat.commitm. + e1$$

5.Conclusion

Large oil and gas reserves supported by highly developed industry are features that made a good base for future high income Canada's GDP growth rates. This paper tries to tackle problems related to slow progress of implementing renewable technologies. It is established that lack of large internationally recognized corporate that produce wind/solar/geo technologies that originates in Canada implies lower level of international competitiveness in the field, smaller prospects of future supply to low income countries that are in position to implement concentrated solar, photovoltaic, wind, large vulnerability to increased negative environmental impacts and higher CO_2 emissions raised locally and at the world scale.

It is concluded that although knowledge, money and time are working for Canada' economy and renewable industry development this process is still to slow (compared with Danmark), not enough recognized in future energy strategies, lacks clear vision of new technologies and transport/housing possibilities, what brings uncertainties in current industrial process making it still very strongly connected to classical oil/gas processes.

Government should establish real possibilities for development renewable inside country, support entrepreneurs in field, increase grants, incentive amounts that support green electricity and energy efficiency. Only together non renewable and renewable sources of energy could bring Canada to higher level of development in a way that helping itself and other increase globally level of human and environment well beings.


All sectors
(economy,finance,turisam,industry,
transport) involved in renewab.devel.
Export renawables,
help/trade with poor
undeveloped world
Renewable tecnology
implemented CO_2 reduced
Sustainable
development
Living beings-
Nature
Harmony
New ways of tranport, industry
development, maintenance,
investment cycle,human
progress
Renewable technology more
rigorously implemented,
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-Government of Canada response to the IEA standard review of energy policy

-Information on greenhouse gas sources and sinks Canada’s gas inventory

-IEA(2008)-Key World Energy Statistics

-World resource institute-A guide to Designing GHG Accounting and Reporting Programs