Manchester District Calgary: Sustainable Energy Futures

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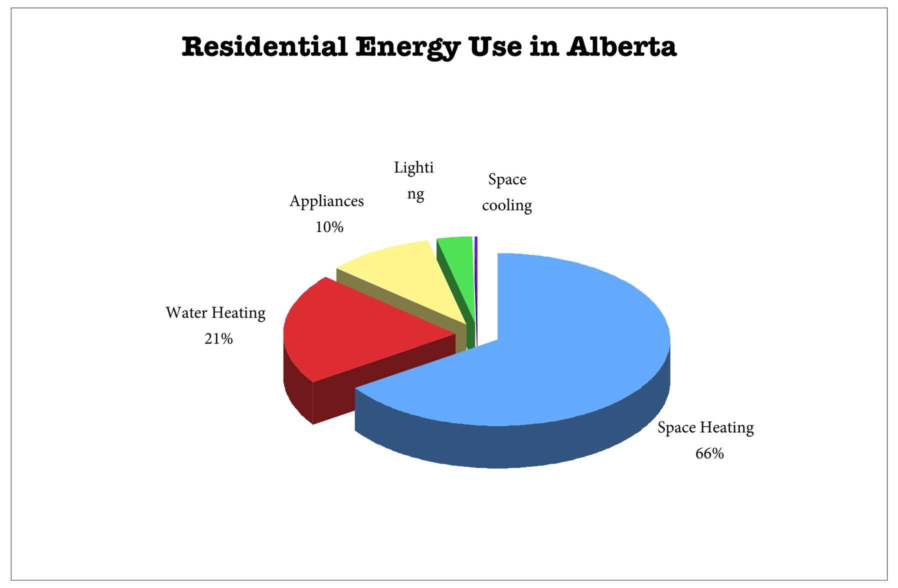
Executive Summary

The future of energy in a sustainable community is fundamentally a material question, not an energy question. Currently the principal motivator is GHG emissions associated with burning of fossil fuel sources. This is un-sustainable because it relies on a finite material resource, has impacts on environmental quality and has impacts on human health. The solution is a move towards an energy strategy that is carbon neutral and does not rely on finite material flows.

There are two fundamental strategies to achieve this. The first and most effective is energy reductions, which carry with them a permanent no impact reduction in material use associated with energy production. Pure energy reductions in the order of 60% against current levels should not be difficult. Another 40% of the adjusted energy load should be able to be realized on site with integrated, or passive strategies that do not represent a significant dedicated material effort. The second strategy os one of sourcing. There are many energy sources available for utilization and none should be ignored. However choices should provide a robust energy mix that is coordinated with the rest of the activities within the area. As a mixed use industrial district the energy solution for Manchester provides a mixture of local and remote sources, a mixture of intensities coordinated to match as closely as possible the intensity mix of the districts activities as well as a mix of developing and proven energy sources that are coordinated to work both for the district itself and within the greater city context.

There are many questions yet to be answered and projections to be tested but the proposed solution outlines a flexible and robust proposal that should outlines an ambitious but achievable set of goals that will improve the quality of life within the district and the community while setting a standard for other areas of the city to follow.

Manchester Projections					
	Adjusted Energy use (GJ/Annum)				
	Residential	Commercial	Industrial	Transport	Total
Unadjusted	4,289,423.08	3,545,592.49	9,620,208.98	7,587,072.03	25,042,296.58
Reduction	2,209,052.88	1,932,347.90	6,156,933.75	4,931,596.82	15,229,931.36
%	51.5%	54.5%	64.0%	65.0%	60.8%
Toal	2,080,370.19	1,613,244.58	3,463,275.23	2,655,475.21	9,812,365.22
On site	1,694,322.12	691,390.53	2,308,850.16	0.00	4,694,562.81
%	81%	43%	67%	0%	48%
Grid	386,048.08	921,854.05	1,154,425.08	2,655,475.21	5,117,802.41
%	19%	57%	33%	100%	52%



Alberta Residential Energy Use.

Data from: Natural Resources Canada *Comprehensive energy use Database 1990-2009*

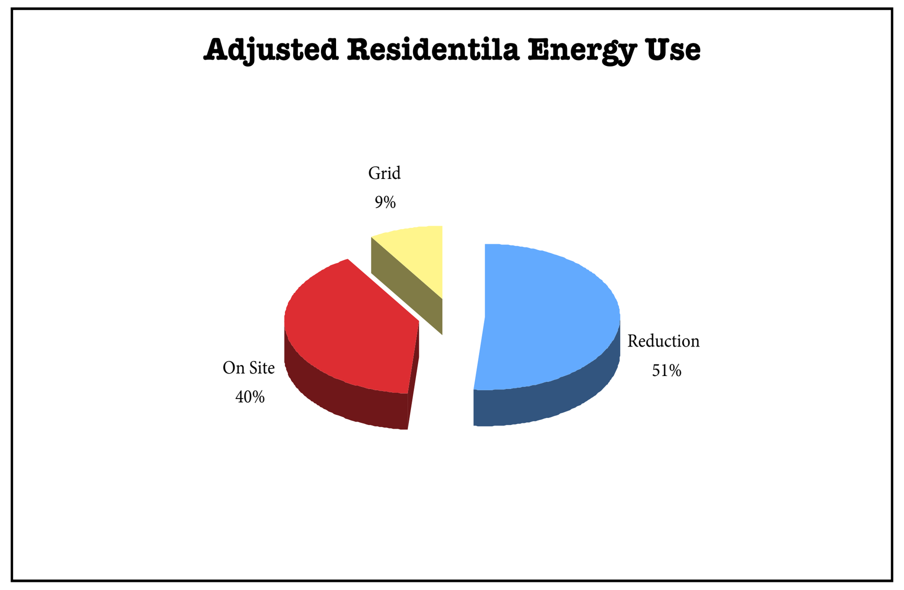
In the residential sector a target energy reduction of 90% by 2050 is reasonable.

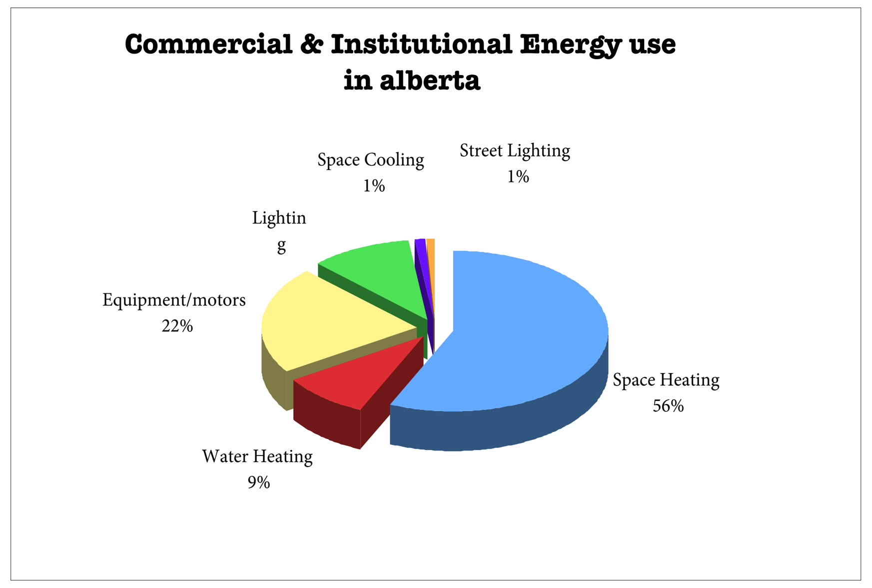
Energy Reduction.

- Doubling the thermal performance of the building envelope
- Improving the energy efficiency of appliances by just 30%
- Passive day lighting and energy efficient light.

Passive Solutions.

- Solar hot water heating is reasonable at the small to mid scale residential level
- Passive solar heating in combination with solar hot water should be adequate to cover the remaining 50% of space heating and cooling load in small and mid density residential.





Alberta Commercial/Institutional Energy Use.

Data from: Natural Resources Canada *Comprehensive energy use Database 1990-2009*

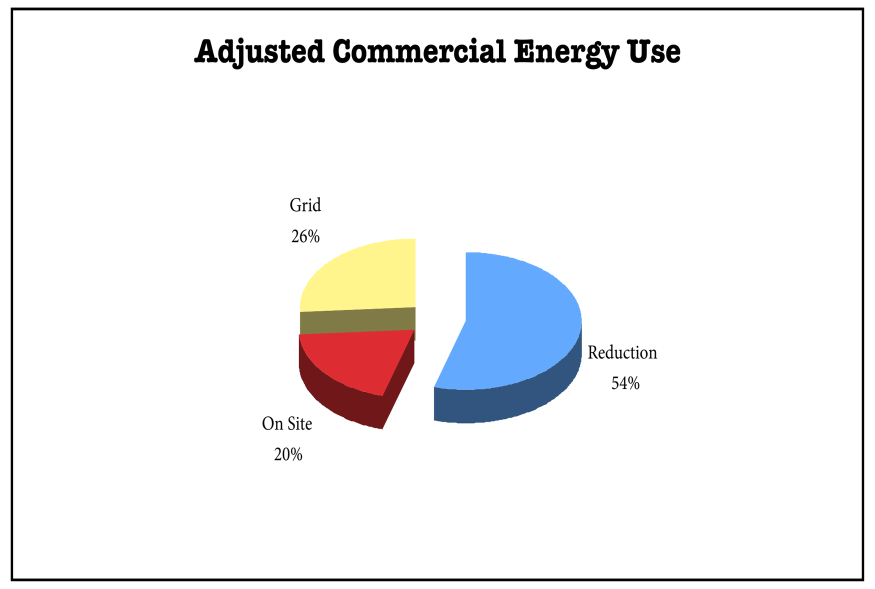
An overall target of about a 75% Reduction is reasonable when the fact that not all efforts are density dependent.

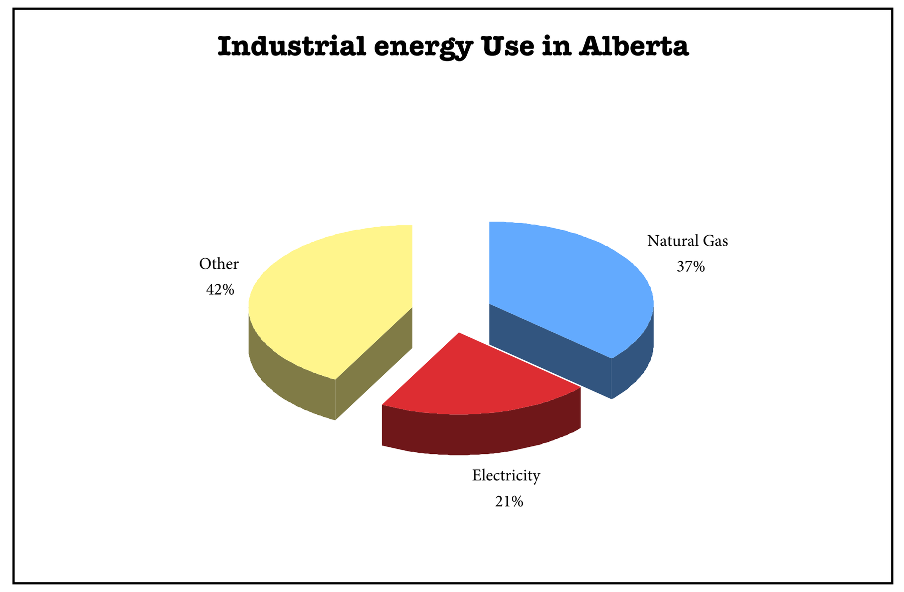
Energy Reduction

- -2x thermal envelope.
- Lighting efficiency & day lighting,

Passive Solutions

- Solar hot water
- Passive solar heating and solar hot water space heating.
- Energy recovery





Alberta Industrial Energy Use.

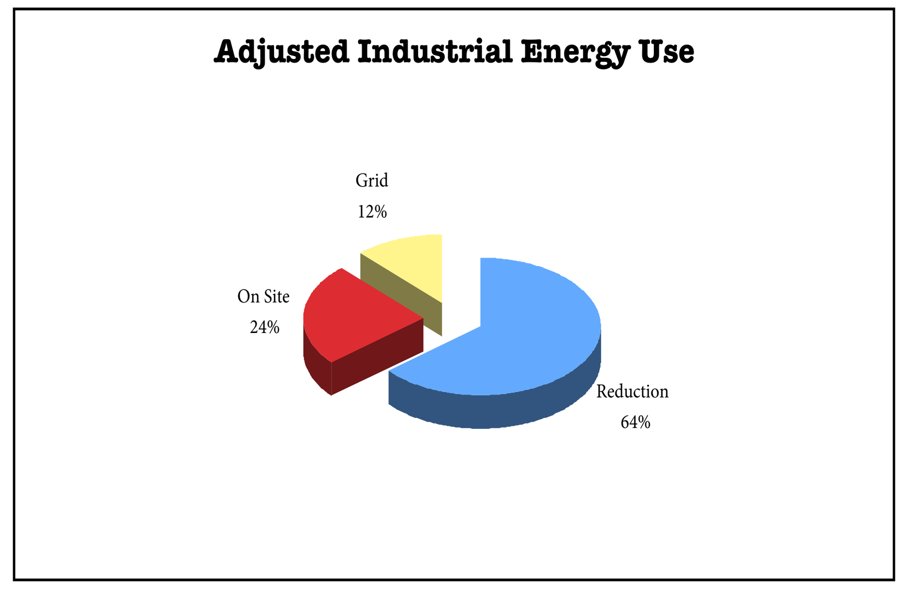
Data from: Natural Resources Canada *Comprehensive energy use Database 1990-2009*

A total of about 70% of industrial energy demand is for processes. Natural gas use for building operations accounts for 14.5% of the energy demand and electricity use in building operations the remaining 15.5%.

A target reduction in building operations consistent with the residential sector at 90% is reasonable.

The baseline established for the residential and commercial sectors set at 30% reduction in processes. If the district principle for industrial ecology is extended into the energy systems as should be the case, reductions in energy use for industrial processes could reasonably be expected to reach 50%.

This sets an energy reduction target for the sector of 60%, 50% in industrial processes and 90% in building operations.



Recommendations

A diverse energy mix is desirable tacking advantage of the benefits of multiple energy sources and providing a robust system less subject to potential interruptions in any one energy source. Energy technologies are also undergoing major transitions and the future of various technologies is not always clear. A diverse system is able to make minor adjustments in direction to take advantage of as yet unknown potentials or to mitigate unforeseen barriers or unrecognized concerns.

As per the analyses above providing energy breakdowns by sector, the relative energy needs of each sector are distinct. The resulting recommendations will thus be broken down by sector as well though they will form a complete system.

Residential

Residential energy uses are the least dense and, consequently easiest to supply. Energy efficiencies have all but eliminated infrastructure requirements for building systems. In all but high density residential the remaining power requirements could be expected to be met by on site photovoltaic panels. Lighter density areas should easily be able to compensate for the energy requirements of the denser areas and the sectors capacity on the whole can be easily managed by PV capacity. Matching light intensity uses with light intensity sources seems appropriate. Therefore the whole of the remaining electricity power requirements in the residential sector can be allocated to PV in the energy mix.

If private ownership of the panels is encouraged it distributes installation costs across a greater population making deployment of the transition easier to manage. This is economically desirable as well as it could effectively eliminates energy costs for the end user in the residential sector. While PV cannot match the rate of energy usage, buy-back tariffs and grid tie-ins make the residential sector effectively net zero and increase the robustness of the overall grid by incorporating distributed power production.

Commercial/Institutional

Commercial/institutional uses are only slightly more dense and slightly more energy intensive. The lightest uses could easily be treated in a manner similar to residential with similar advantages and similar rationals. The denser commercial uses could benefit from more intense uses energy sources and the associated cooperation strategies. Dense commercial uses will follow suit with the Industrial strategy that will follow.

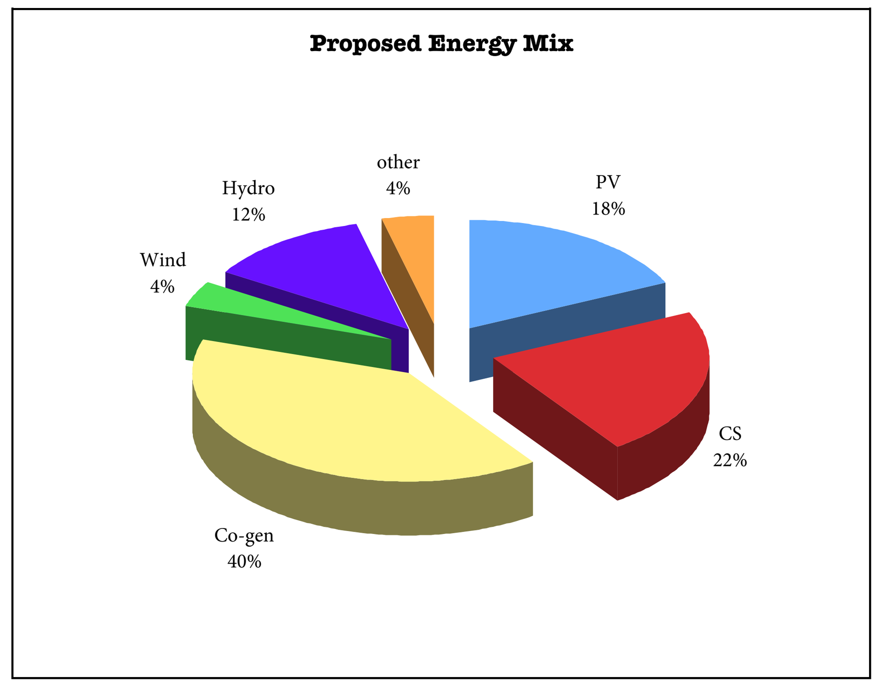
Industrial.

Industrial uses tend not to be dense but are very energy intensive. Associating more intense energy sourcing with these uses is easier to justify. The industrial sector also represents the most established sector of the district, providing an existing market This makes deploying projects with larger capital investment easier to swallow economically. The principle strategy for this sector will be one of cogeneration with a concentrating solar providing a large portion of the electricity component requirements. Processes are the largest component energy users in this sector a large portion of which are currently executed using combustion energy. Electricity need not be applied to these processes, in fact it may be a difficult transition to achieve. The heat portion of the cogeneration system would be a much more consistent match. Similarly, many industrial processes produce heat as well, and at rates which may not be able to be utilized effectively in house. This could be fed back into the cogeneration heat sink where it can be spread more effectively across the district. This goes for waste heat from the other sectors as well as from waste waster processing. It is in fact possible that concentrating solar may not even be required. In this way the energy systems for the district can contribute to the general strategy of industrial ecology. Thus far electrical production however is mostly associated with solar. As solar does not function well on its own in managing electrical base load additional electrical sources should be introduced to cover the gap.

Transportation

Transportation energy uses would most likely be electrical, although it is conceivable that they could be driven on heat as well, research into the possibility would be worth considering as it would lower the energy grade requirements for a considerable portion of the energy demand. Assuming a 100% electrical contribution however would nicely dovetail into concerns of base load. By, introducing the transportation electrical requirement into the mix from the broader city grid would provide a stable portion to the district energy mix that can compensate for the Intermittency associated with solar generation.

By way of example assume that all districts utilize principally locale sources to satisfy their energy requirements. More remote, stable power sources, such as hydro, which favours larger plants, or wind, though it is less stable, which favours concentrated farms for larger overall energy production can be used to fill the gaps for many districts. Reducing the number of remote facilities required, reducing infrastructure material, costs, and inefficiencies. Existing remote power facilities would be able to serve this purpose as the local networks are built up, allowing them to be slowly phased out as the transition to carbon neutrality progresses as well.

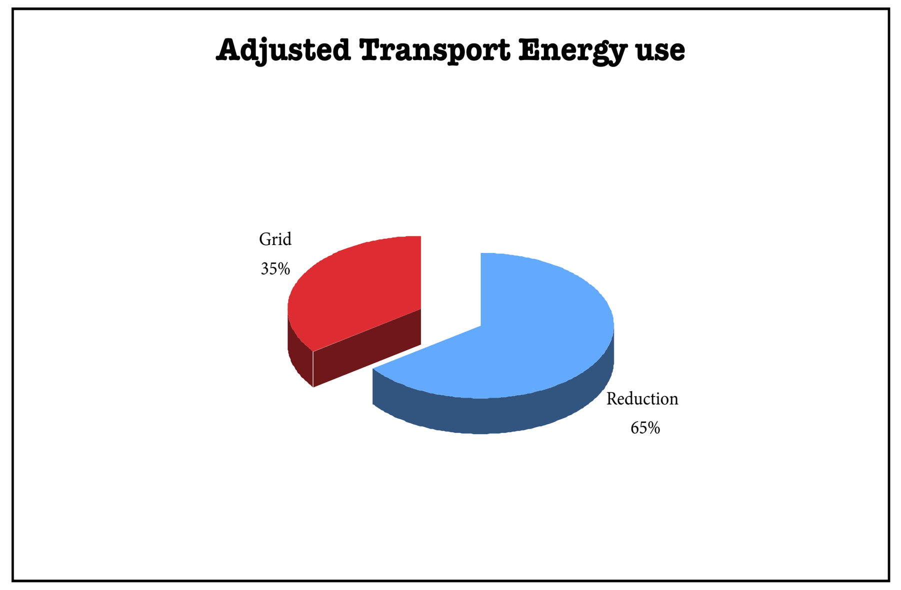


Proposed Energy Sources

Alberta Transportation Energy Use.

Transportation projections for 2050 in Manchester district call for a modal split with 5% automobile and 45% public transport as the only draws on the energy systems in the district; both of which will have transitioned completely to electric power.

Total energy use in transport would be approximately 2,469,060 GJ. This represents a reduction in transport energy use of about 65% from unadjusted projections.



Source: "Sustainabilaty" *DEXARCH, Just another Wordpress site*, April 15, 2011 <http://dexarch.wordpress.com/> (April 16, 2012)

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Source: "Samsung looking to build wind farm on north shore of Lake Erie" *The Canadian Press*, Sun. Sept. 27 2009 <http://www.cp24.com/servlet/an/local/CTVNews/20090927/090927_renewableenergy?hub=CP24Home> (April 16,2012).