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Sustainable Community Energy Planning

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Sustainable Community Energy Planning

Sponsored By: AEC Daily
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Description: Provides an overview of community energy planning (CEP) and includes discussions on conventional and sustainable energy planning, developing a sustainable CEP, energy demand and supply management, and energy education, demonstration, and awareness.

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Learning Objectives

At the end of this program, participants will be able to:

- identify six sustainable planning principles and state how community energy planning relates to each
- describe the energy influences on various aspects of a CEP including land use, transportation, water treatment, waste management, and on-site planning
- compare and contrast conventional community energy planning to sustainable community energy planning
- list and describe the five steps involved in developing a sustainable CEP
- describe seven energy demand reduction techniques
- list different types of sustainable energy supplies and renewable energy options, and
- describe the impact energy performance programs have on the building industry.

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Why Study Community Energy Planning?

Sustainable Planning Principles

How community energy planning relates to sustainable planning principles:

Complete, Livable Communities - Every aspect of community life has an energy component.

Environmental Protection - Extracting some energy sources (oil, gas, coal, etc.) can inflict heavy environmental damage.

Energy and Emissions Reduction - Some energy production creates toxic emissions.

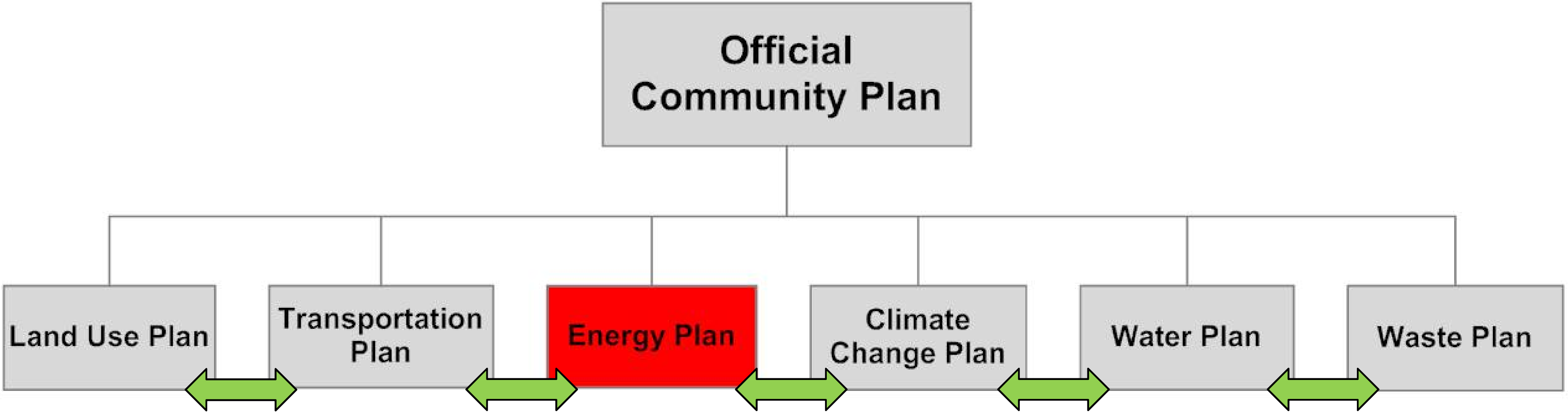
Green, Efficient Resources - Some energy sources are finite and must be used efficiently and/or replaced with renewable (green) sources.

Enhanced Economic Performance - Reducing energy costs improves community economic performance.

Sustainable Community Management and Public Education - Energy planning/management raises awareness of all connected issues.

Community Energy Planning (CEP)

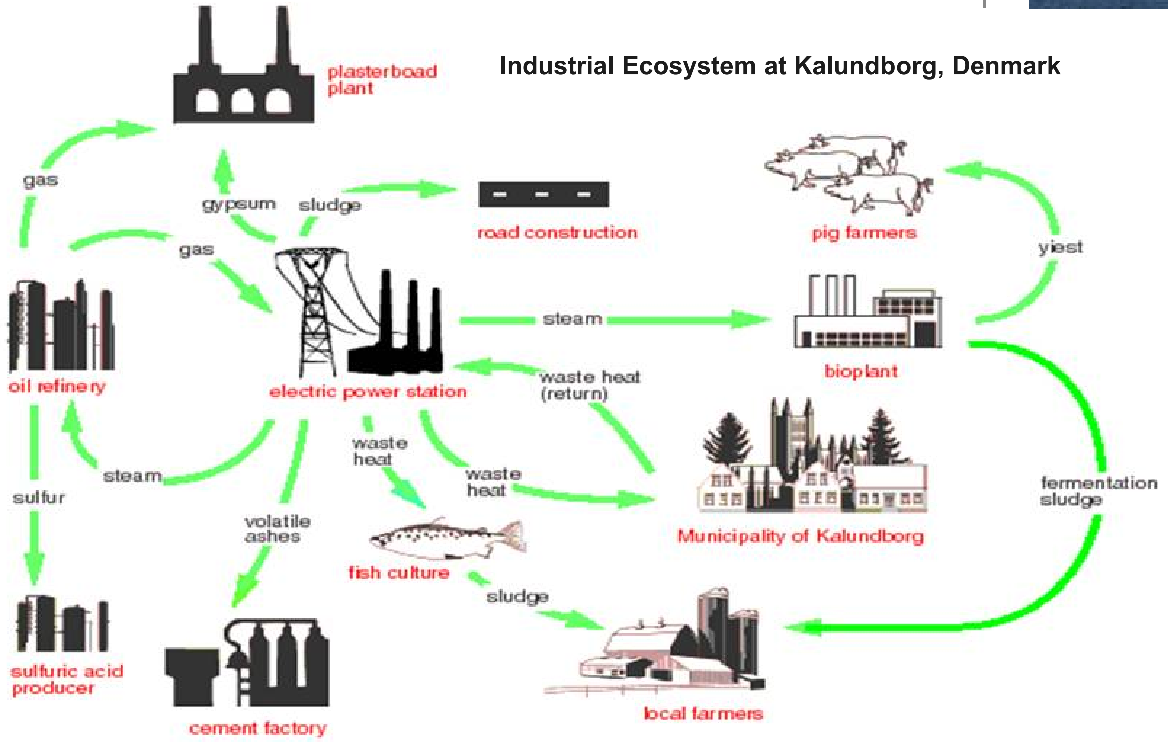
Community energy planning is an essential part of sustainable community planning.



*Note: There are numerous synergies between all of these plans and no one plan can be developed in isolation.

Energy Influences Land Uses

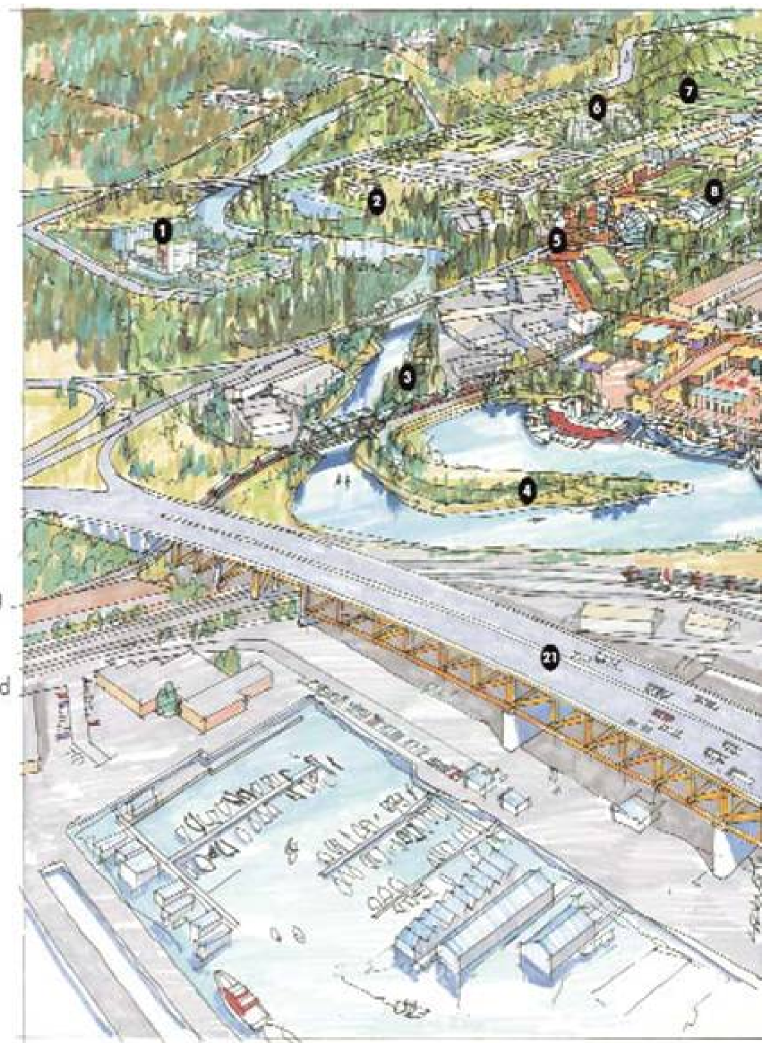
Kalundborg, Denmark (pop 20,000) has developed a network of industrial processes which use each other's waste products and which recapture surplus energy outputs from one another's processes in an integrated industrial ecosystem. The city supplies energy in a district system to all of its inhabitants from this network.



Energy Influences Land Use Planning

Maplewood, North Vancouver, BC is weaving an eco industrial network through the community and tying it into the green system. Part of the planning exercise examined current and future energy production patterns in order to identify potential suppliers. It is the intention that those potential suppliers would then become nodes and supply energy or treat waste locally, and that additional uses (residential, etc.) would be built close enough to receive it. In the event commuting is required, all industrial, residential, and commercial uses would be linked by green corridors that facilitate non-vehicular options (walking, cycling) as well as stormwater management, habitat corridors, etc.

1. Seymour Creek Retail Area
2. Maplewood Farm
3. River Walk
4. Seymour River Estuary Spit
5. Village Centre (See Inset)
6. Medium-Density Housing on DNV Land
7. Sports Fields
8. New Business Park
9. VPA Lands (Innovative Housing Research Project)
10. Artisanal Industrial Area with Continued Ship Repair
11. Greenhouses, Aquaculture & Nursery
12. Hydrogen Energy Facility
13. Park Street Marsh

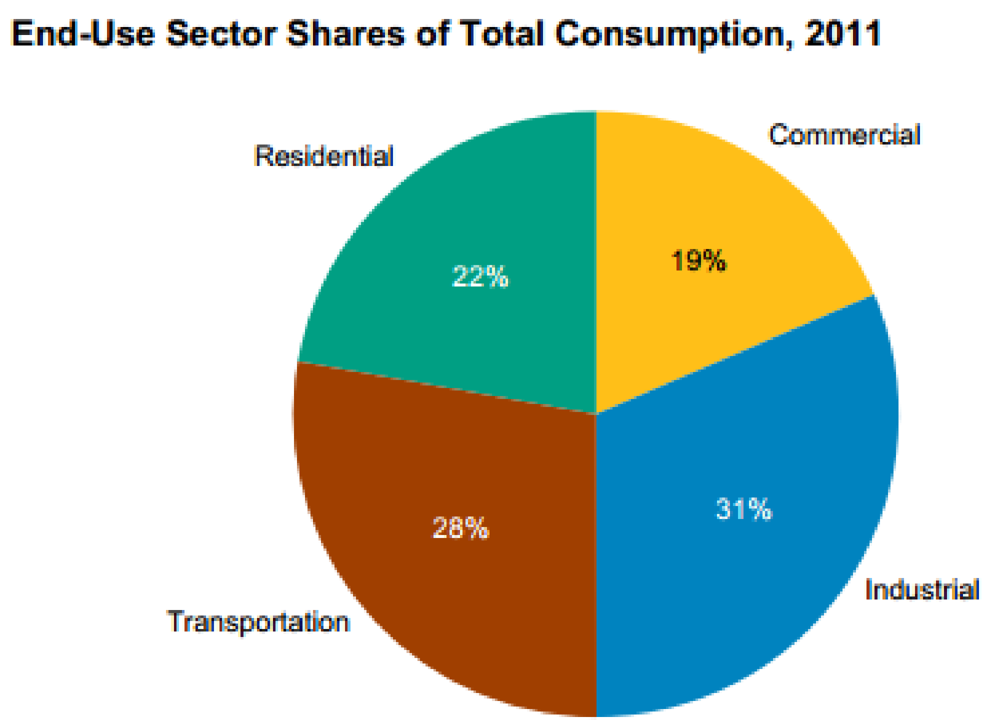


Source: http://maplewoodproject.org/upload/documents/Final_Report.pdf

Energy Influences Transportation Planning

Transportation is, in many cases, the largest energy user.

Encouraging production of goods and food locally; providing good transit, cycling and walking alternatives; placing uses closer together, etc. all contribute to reducing this figure.



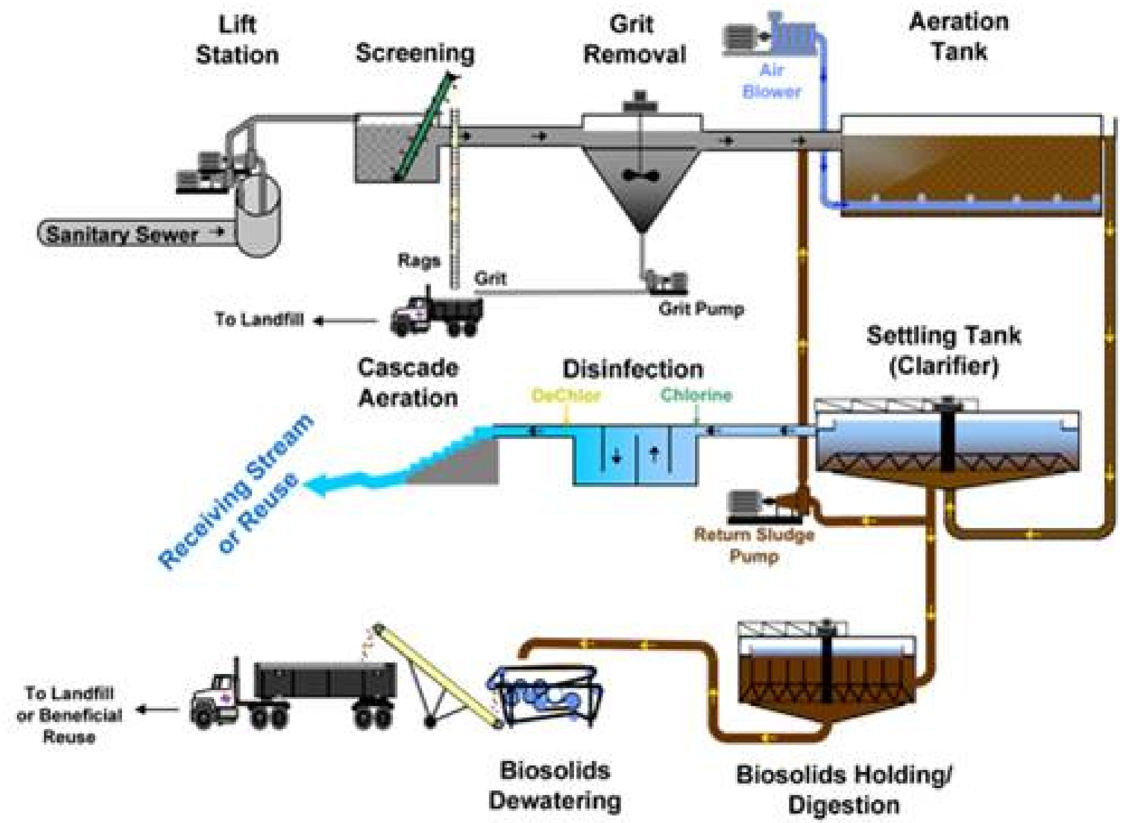
Source: U.S. Energy Information Administration, Annual Energy Review, 2011.

Energy Influences Water Treatment Planning

In the U.S., approximately 3% of the total electricity generated by the electric power industry is consumed by publicly owned water and wastewater industries.

By 2016, when additional federal and state drinking water treatment regulations will be in effect, the energy used for water treatment is expected to be at more than 100 million kWh per day*, an increase of 30% over 1996 levels.

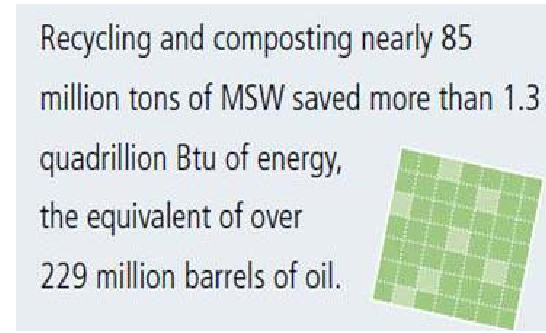
*This equals roughly 10x the production of the Hoover Dam, which produces 4.2B kWh/year on average.



Energy Influences Waste Management Planning

Municipal solid waste (MSW) requires enormous amounts of energy to transport and/or incinerate. Both recycling and composting programs can reduce this energy demand.

There are numerous waste-to-energy technologies now available. Waste-to-energy can include methane extraction from landfill for fuel, incineration/gasification of municipal waste to create heat and hot water, and use of biomass “waste” as fuel in district systems, etc.



Ouje-Bougoumou, Quebec district system, burns waste woodchips from a local sawmill.

Energy Influences Site Planning

BedZED

BedZED, England (Beddington Zero Energy Development) is the UK's largest mixed use sustainable community. It was designed to create a thriving community in which ordinary people could enjoy a high quality of life, while living within their fair share of the Earth's resources.[1]

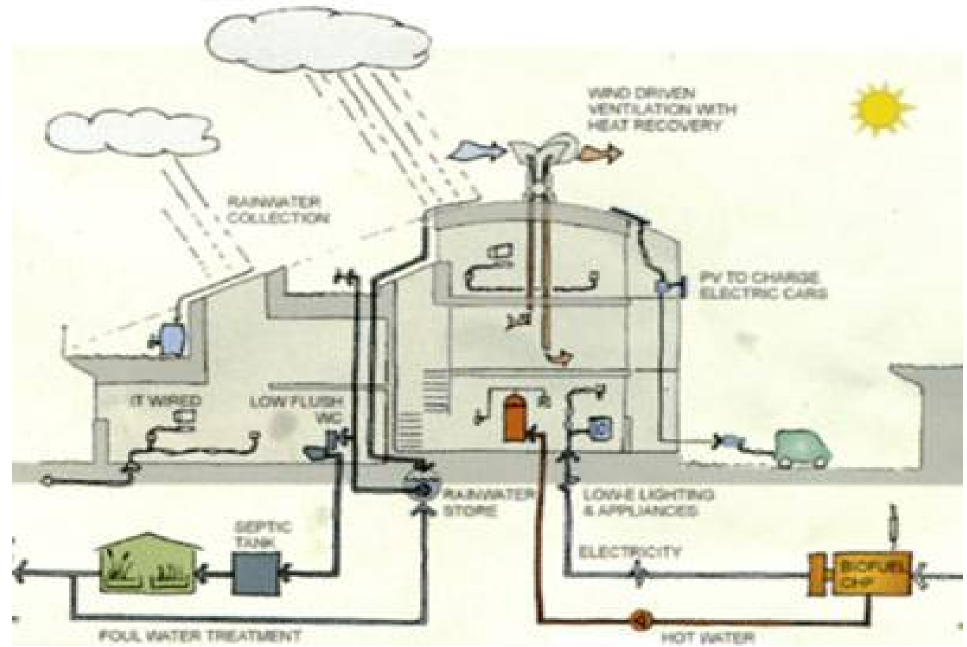
All the units in the community face south for solar energy capture. The buildings are clustered to optimize a shared energy system fuelled by municipal "waste" biomass. Office spaces in the project lessen the need to commute to work. PV (photovoltaic) cells integrated into glazing produce electricity to power shared electric vehicles.

[1]Source: *BioRegional Solutions for Sustainability*. http://www.bioregional.com/flagship-projects/one-planet-communities/bedzed-uk/ Accessed February, 2012.

Energy Influences Site Planning

BedZED

The “commute” to the office: just across the bridge



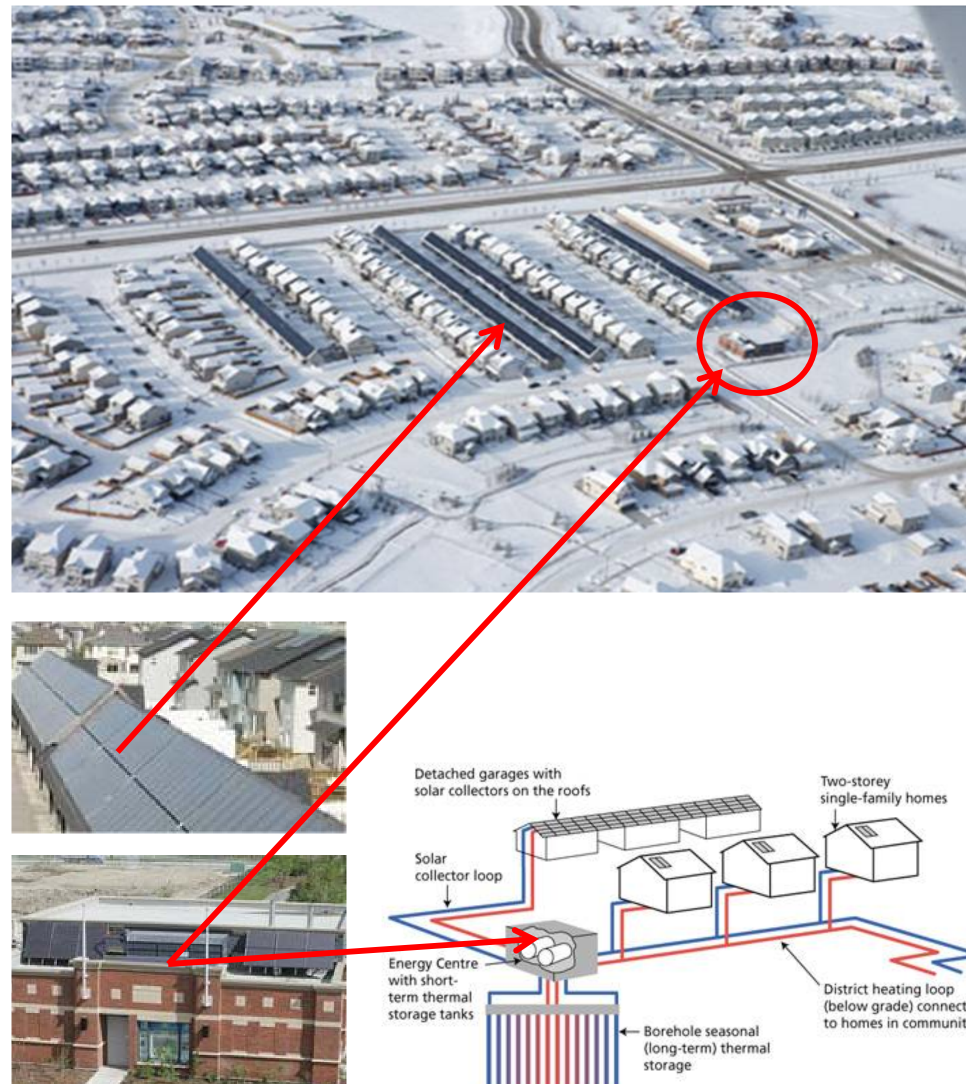
The PV windows and the vehicles they power

The integrated biological water treatment and energy systems

Energy Influences Site Planning

Drake Landing Solar Community (DLSC), Okotoks, AB is a planned neighborhood that has successfully integrated Canadian energy-efficient technologies with a renewable, unlimited energy source—the sun. DLSC is heated by a district system designed to store abundant solar energy underground during the summer months and distribute the energy to each home for space heating needs during winter months.

All of the homes and garages in the community face south. The garage rooftops collect the solar energy that is then stored underground. The community energy center then distributes heat in winter.



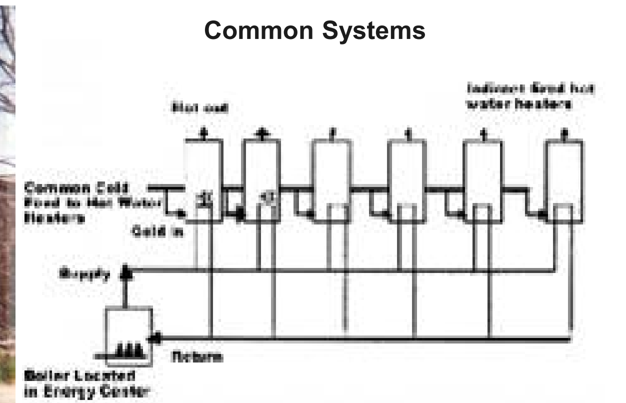
Source: *Drake Landing Solar Community*. http://www.dlsc.ca/ Accessed February, 2012.

Energy Influences Site Planning

Ithaca New York Co-housing Community (EcoVillage) (1997)

The project is an alternative model for suburban living which provides a satisfying, healthy, socially rich lifestyle, while minimizing ecological impacts.

All the homes are oriented south for solar energy. The homes are clustered to facilitate energy sharing and preserve farmland. The common building uses the adjacent pond as a heat source. There is one external boiler for each group of six or eight efficient homes which distributes heat and hot water (space heating requires less energy than hot water). The roofs are configured to receive future renewables.



Boiler water circulates and heats water stored in tank in each house

Energy Influences Site Planning

A senior and family housing high-rise in Toronto, ON was designed to house a district energy system which provides heat and power to the entire newly redeveloped affordable housing neighborhood of 5000 units, stores, and amenities.

Energy Influences Building Design/Role

A high school in Hamilton, ON was designed to supply heat and power to eleven major buildings in the city core with a cogeneration system.

As a result, Hamilton was one of the few communities able to provide shelter, food, and care for its at-risk population during the East Coast blackout of 2003.

Community Energy Planning Benefits

Community energy planning enhances energy security because it reduces needs, dependence on others, and energy disruption from climatic and political events. It also lessens vulnerability to price shocks, as local production avoids global price surges arising from shortages due to warfare and political maneuvers. Community energy planning stimulates the local economy: local production keeps money in the community. It addresses environmental concerns: waste-to-energy replaces resource extraction and reduces pollution. In addition, it enhances social well-being in that reliable, non-toxic, affordable energy sources improve mental and physical health.

Conventional Energy Planning vs. Sustainable (Integrated) Energy Planning

Conventional Community Energy Planning

Ensuring adequate supplies of energy for the future involves energy utilities, energy companies (oil, gas, and coal suppliers), and regulatory agencies forecasting future energy demand based on energy use trends, and then planning and constructing capacity to meet that demand. For electrical utilities, this involves assessing possible technologies for power generation, cost, and availability of resources (coal, oil, gas, hydroelectric capacity) to generate enough electricity to meet foreseeable future demand. Dealing only with the supply side of the equation means that where demand continues expanding, the energy sector will have to continue expanding capacity and finding more reserves of energy. This situation is ultimately not sustainable due to the finite amount of conventional energy resources available. Combustion of fossil fuels also leads to higher levels of greenhouse gases and other air pollutants.

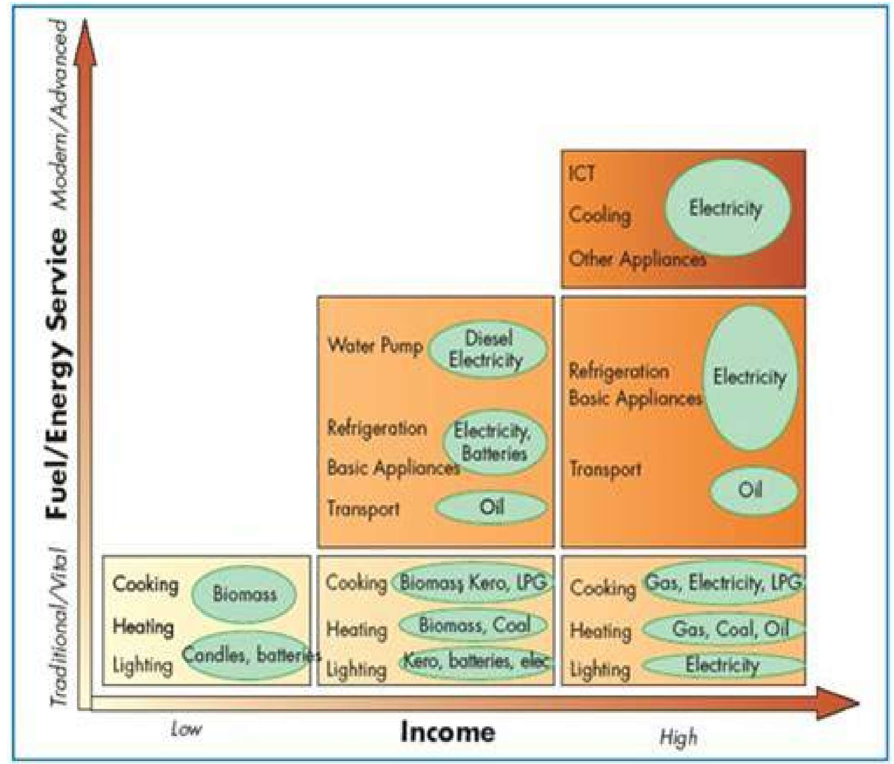
W.A.C. Bennett Dam on the Columbia River in British Columbia, Canada−part of BC Hydro's electrical supply system . © http://www.ourbc.com

Coal fired power plant located in Ulaanbaatar, Mongolia. © HD+C Ltd.

Conventional Community Energy Planning

Conventional energy planning emphasizes supply-side options to meet growing energy demand (i.e. new power plants and supply infrastructure) and creates a relatively low number of jobs for investment. Conventional forms of energy are generally purchased from outside the community, with local sources of energy often ignored.

Oftentimes, the income levels influence the type and amount of energy used in a community. Most communities are currently dominated by imported fossil fuels. Centralized energy production is favored over decentralized or distributed sources. The full cost (especially environmental) is not reflected in energy prices.



Conventional Community Energy Planning

In most communities, a large component of the energy that is used originates in the form of fossil fuels—oil, natural gas, coal bed methane, or coal. The extraction and use of fossil fuels has impacts on the natural environment, from damage to animal and plant habitat, local water and air pollution near the well head, pollutants produced during refining, to CO_2 emissions and the release of other air pollutants when the fossil fuel is burned. In most cases, the fossil fuels are imported into the community, sending money out that cannot then be used for local job creation and investment. This model is largely a one-way flow of energy using a finite resource, and is ultimately not sustainable.

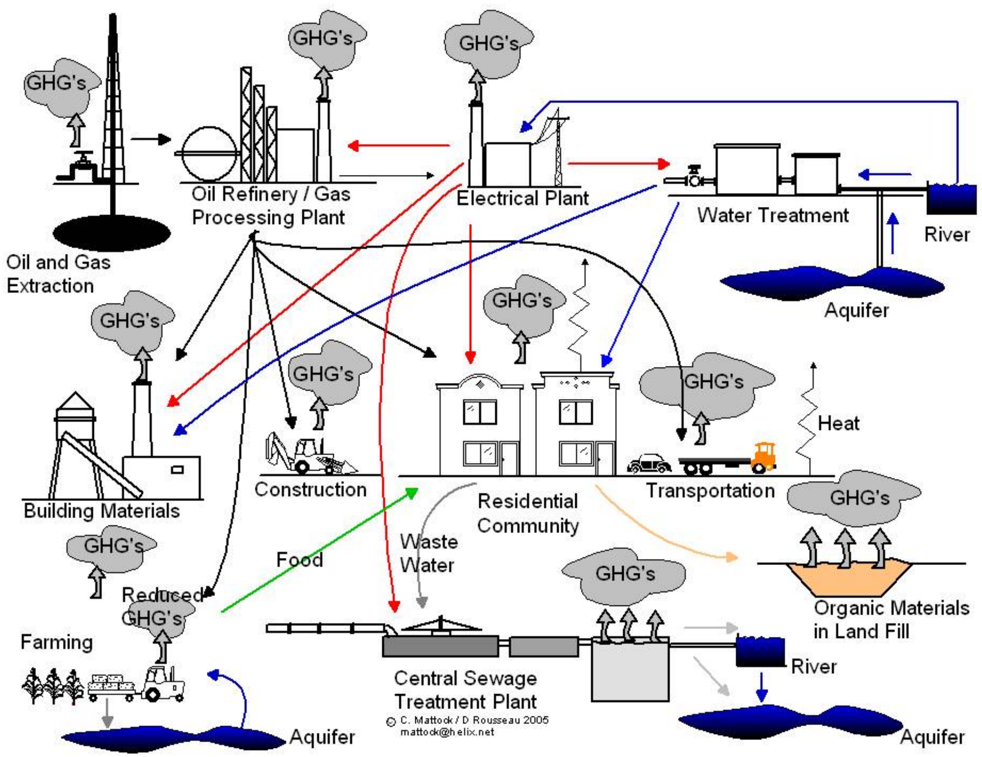


Diagram illustrates typical supply and use of energy in a conventional community. ©Habitat Design + Consulting Ltd. and Archemy Consulting Ltd. 2006.

Conventional Community Energy Planning

Continually expanding supplies of conventional energy alone is no longer a feasible strategy for most communities. This is due to the fact that conventional energy supplies, particularly fossil fuels, are rapidly depleting—resulting in rising energy costs. Fossil fuels also contribute to global climate change and other air quality problems. The environmental costs of conventional energy are impacting human health, food production, and climate.

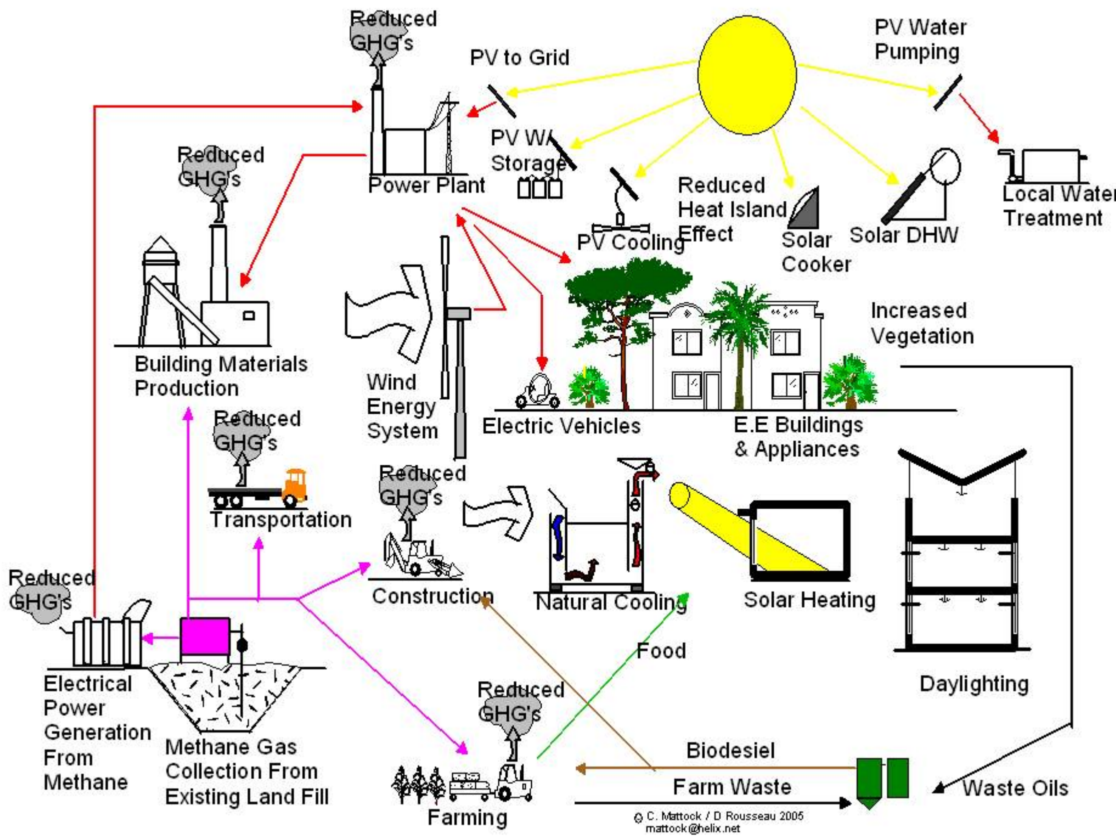
These problems can be reduced or solved by conserving energy use, using conventional energy sources more efficiently and utilizing locally available renewable energy where feasible. For a community to tackle these issues in a effective way, a holistic approach is necessary. The development of a sustainable (integrated) community energy plan (CEP) is required.

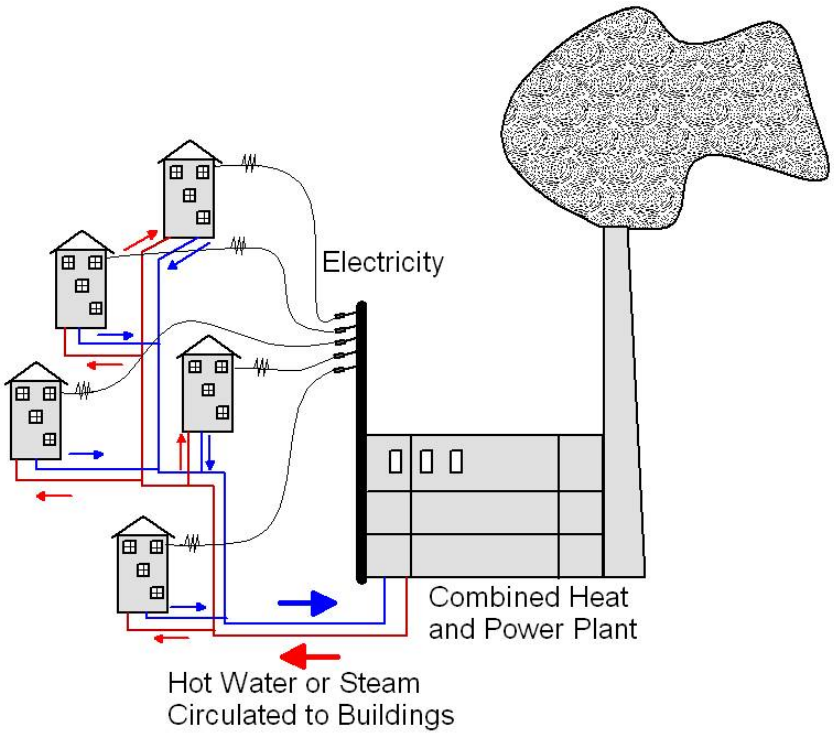
Sustainable Community Energy Planning

Energy planning is integral to all aspects of community planning and building design. Community energy planning begins by identifying energy demand reduction opportunities in community services and building operations in order to raise the viability of supplying them with smaller, local, renewable sources. It prioritizes those sources whose usage would have a further community benefit such as reducing waste or emissions, and integrates them into a delivery system which uses the most efficient techniques such as cogeneration. In order to ensure proper plan implementation and management, the energy plan also incorporates a comprehensive community education/awareness strategy.

Sustainable Community Energy Planning

In a sustainable community energy plan, all natural sources are included. All energy aspects of the community are integrated into one plan. The buildings and processes acquire a role in energy production and distribution.





Developing a Sustainable CEP

Developing a Sustainable CEP

1. Establish a vision:

Identify the organizations and individuals who need to be involved in creating and implementing a CEP such as government agencies, utilities, local industry, planners, architects, engineers, developers, contractors, manufacturers, etc.

Demonstrate to the community, industry, and institutions that energy planning needs to be a priority.

It is important to engage the public and use discussions to define a timeline (20-30 yrs).

Examine the economics, social benefits, and the risks of inaction.

Developing a Sustainable CEP

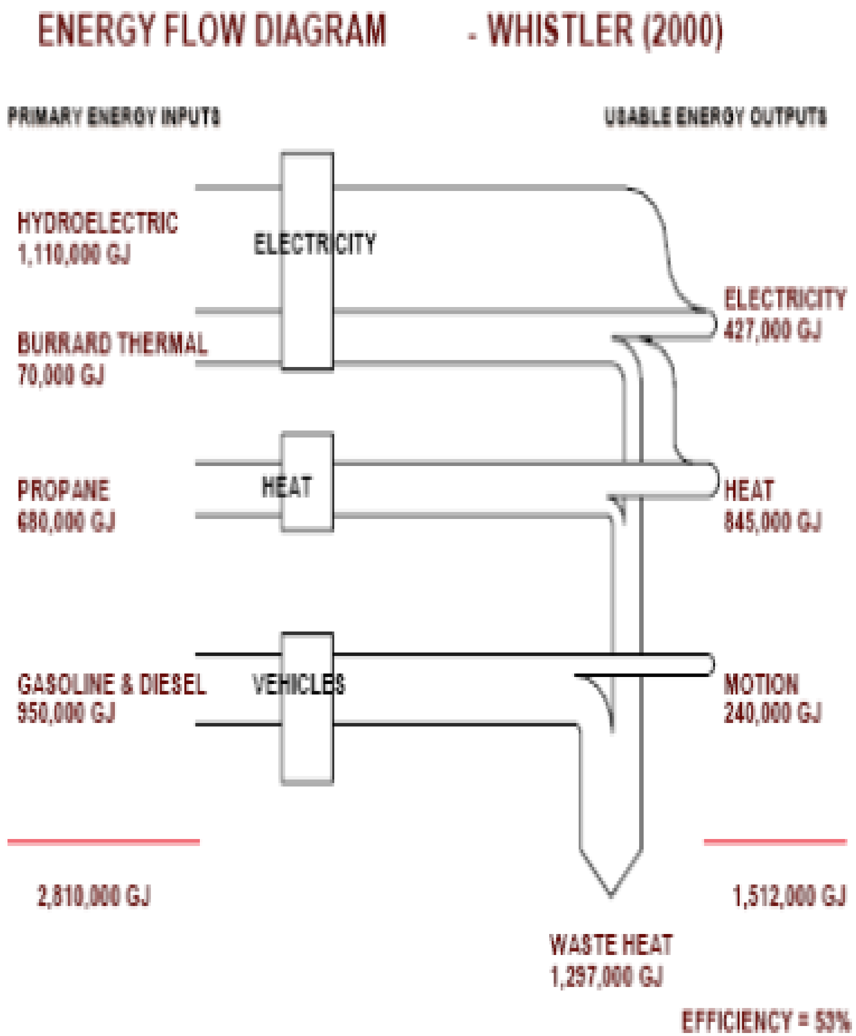
2. Develop a baseline:

Study and share an understanding of the existing situation.

Collect and analyze data about energy supply and demand by sector, fuel type, and application.

Identify local energy resources:

- energy conservation potential in building stock, municipal, commercial, and industrial operations
- renewable resources
- existing waste streams viable for clean energy sources, and
- energy being discharged into environment.



Developing a Sustainable CEP

2. Develop a baseline:

Forecast future energy needs—consider the following:

- What are the per capita energy use trends?
- Is the population increasing, decreasing, or stable?
- Will the development pattern of the community change?
- Are major industrial energy users likely to expand or contract?
- Are any new major expansions of municipal infrastructure planned?

Developing a Sustainable CEP

3. Set targets and goals:

Quantify the vision by using the baseline condition of the community to set targets and indicators based on a combination of: current technology and predicted advances; community capacity to achieve future targets; and the community's own environmental carrying capacity.

Examples of potential goals include: municipal operations reducing energy usage by X% within Y years; new energy supplies being "clean" (i.e. minimal or no pollution); and the community becoming energy self-reliant in Z years.

Developing a Sustainable CEP

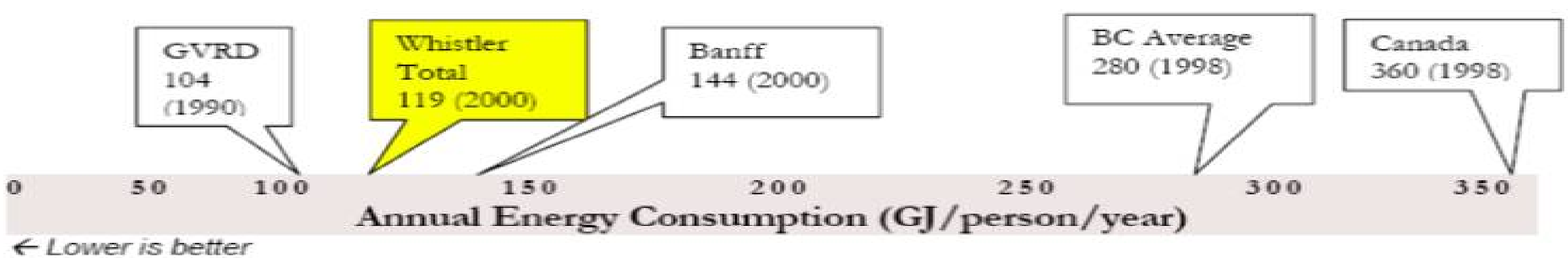
3. Set targets and goals:

Determine the base “business-as-usual” case.

Calculate the technical and economic potential for change.

Benchmark against other communities.

Consult with the community.



Benchmarking diagram for Whistler, BC against other western Canadian communities and provincial average

Developing a Sustainable CEP

4. Identify actions:

Identify the programs and projects needed to realize CEP:

- Look for “lessons learned” and best practices from other jurisdictions, especially those with similar climate, energy prices, and demographics.
- Ensure that they support CEP goals.
- Be realistic.
- Rank projects against the “triple bottom line”* and community priorities.
- Develop a schedule.
- Take into account community priorities and values.
- Resolve all conflicts of interest.

*Triple bottom line, or full cost accounting, infers the inclusion of economic, societal, and ecological criteria in the determination of the success of a particular action.

Developing a Sustainable CEP

5. Implement plan and monitor progress:

Establish indicators* and collect data.

Measure indicators on a regular basis to determine the effectiveness of programs and projects.

Modify programs and projects where necessary to achieve the desired end results.

Report to the community and celebrate successes.

*Indicators are tools which measure progress towards or away from goals, and they serve as the basis for setting targets i.e. per capita or total community energy usage.

CEP Case Study: Kamloops, BC

CEP Case Study: Kamloops, BC

CEP Scope	Comprehensive City and Community Energy Plan
Community Size	296 square kilometres (most in land reserve)
Population	92,882(2006) greater metro area
Climate	Semi Arid Steppe
Annual Average High Temperatures	January -2°C , July 28°C
Annual Average Low Temperatures	January -8°C , July 13°C
Location	South central interior of British Columbia 50°43'N 120°25'W
CEP focus areas	Land area / transportation Site and building design Infrastructure Energy supply
Benefits of CEP	Cost savings, reduced environmental loadings, liveability
Schedule	Adopted April 1997 Reviewed March 2000

CEP Case Study: Kamloops, BC

A community energy plan was developed and simultaneously integrated with a renewed official community plan (OCP). The CEP formed a chapter in the OCP.

Energy-related factors that required consideration included: cold winters and hot summers that lead to high heating and cooling energy consumption; steep topography that leads to high energy consumption for water and wastewater pumping; and a heavy reliance on the automobile for transportation due to dispersed development.

CEP Case Study: Kamloops, BC

CEP development process:

The CEP development process included: developing energy-related objectives that support overall community objectives and integrate into existing and developing OCPs; identifying strategies for achieving energy objectives and supporting broader community goals; establishing the city's baseline energy use; using computer modeling to evaluate energy implications of alternate development scenarios; developing a plan of action to meet energy objectives; and establishing monitoring and management protocols to ensure continued relevance of the plan.

CEP Case Study: Kamloops, BC

Energy-related planning goals identified in the OCP:

- Encourage infill and densification.
- Discourage urban sprawl.
- Direct new development to serviced growth areas.
- Reduce distances between residential and shopping areas.
- Promote a mix of housing types and increased density in old and new neighborhoods.
- Promote alternative forms of transportation including:
  - walkways
  - public transit
  - bicycle paths, and
  - ride sharing.

CEP Case Study: Kamloops, BC

CEP process:

A community energy stakeholder group was formed to oversee development, including representatives from energy utilities, provincial ministries, city staff, the school board, the business sector, and industry.

The process was started by reviewing the community goals stated in the OCP; then energy-related objectives to support broader community objectives were developed.

CEP Case Study: Kamloops, BC

The CEP development process used a geographic information system (GIS) modeling tool (INDEX) to: establish the baseline energy use for the city; predict energy use for a typical subdivision zoned for future development; model various future development scenarios; and provide support for workshops with stakeholders to select preferred development scenarios from an energy perspective.

CEP Case Study: Kamloops, BC

Integration of the CEP with other city programs:

The city adopted an ISO 14000 environmental management system for solid waste management including: pollution prevention; materials and energy quantification; and monitoring and tracking.

Kamloops joined the Canadian Federation of Municipalities Partners for Climate Protection (PCP).

CEP Case Study: Kamloops, BC

Benefits of integration with other city programs:

Integrating these mechanisms leverages the benefits of an existing successful organizational structure (PCP program); ensures an over-arching view of energy activities; and has the direct support and interest of city council.

It also increases efficiency and productivity—greenhouse gas emissions correlate directly with energy consumption and modeling, and monitoring of greenhouse gas emissions can be combined with energy modeling and monitoring.

CEP Case Study: Kamloops, BC

CEP features and key initiatives:

Some key initiatives included: the implementation of an energy performance points system to encourage energy-efficient development patterns; increased density guidelines to encourage sufficient residential densities to make commercial services and transit viable in designated areas; alternative fuel for use in fleet vehicles for city and other public/private vehicle fleets; energy audits for existing and future city facilities; joint water/energy retrofits for commercial and residential buildings; street orientation guidelines to ensure solar access; and district energy zoning to support development of a district energy system in the downtown core, and to identify other neighborhoods for similar treatment.

CEP Case Study: Kamloops, BC

Implementation experience:

The review showed that many of the actions in the plan had been fully implemented or comprehensively investigated by city staff. Many of the transportation recommendations were fully implemented. However, there were three high profile aspects of the plan that did not pass the comprehensive feasibility study: the proposed district heating system for a municipal complex; piping waste heat to the downtown from a local pulp mill; and the use of a district heating system in a moderate density housing subdivision. The performance point system, development standards, and coordination of energy activities were not implemented.

CEP Case Study: Kamloops, BC

Reasons for some items not being implemented:

The CEP had been developed with the input of many different stakeholders so no party felt a sense of ownership over it. There were also numerous personnel changes, and a few years later, only a few of the original participants were still involved.

There was no clear responsibility for individual action items because these items required the collaboration of many people; responsibilities were lost through personnel changes and lack of communication.

There was insufficient regard for existing successful energy saving programs and initiatives that were being developed and implemented by the City of Kamloops independently of the specific actions detailed in the CEP.

There was a change in drivers as public concerns about quality of life issues had eased and support for certain development restrictions had waned. With population growth and economic development slowing down, there was less concern about making energy planning a key focus.

For more information visit: "Kamloops Community Energy Planning." *Community Energy Association*. http://www.communityenergy.bc.ca/showcase-and-awards-introduction/kamloops-community-energy-planning Accessed February, 2012.

CEP Case Study: Kamloops, BC

Lessons learned:

Keep it personal because a community energy plan needs a sense of ownership from those who will implement it. Too much external involvement may be counterproductive.

Avoid duplication by integrating the plan with parallel programs to improve efficiency, data consistency, and relevance.

Nurture organizational links by recognizing each others' needs, skills, and resources and by continuously working together towards common goals.

Leverage the successes enjoyed by the more effective organizations and their programs by integrating activities with them.

Don't reinvent the wheel; use existing or off-the-shelf tools to save time and resources.

Don't over-rely on individual champions by ensuring that the knowledge and policies contained within CEPs are effectively institutionalized to make certain they will withstand changes to staff and local government officials.

Keep it dynamic by regularly reviewing the achievements, barriers, and opportunities of the plan, and noting social and economic changes that influence its implementation.

Energy Demand and Supply Management

Energy Demand Reduction Techniques

One of the immediate and more cost effective demand-side energy management strategies that can be taken is to persuade energy users to change their energy use behaviors. This can be done through several measures.

Develop public awareness campaigns to inform people about the cost savings and other benefits that the consumer can gain from changing their energy use behaviors.

Deliver education programs in schools linking energy savings with protecting the environment.

Provide free advice on low-cost/no-cost measures that can be taken to reduce energy use.

Pricing energy at its true cost of production (removing subsidies) will typically lead to more careful energy use by the end users.

Energy Demand Reduction Techniques

Pricing thermally generated electricity to promote uses that can be deferred to off-peak hours can reduce the need for increased generating capacity.

Real-time feedback on actual energy consumption can allow a building operator to fine-tune energy use and minimize it. The Power Cost Monitor is a device that can be attached to an existing electrical power meter and allows the homeowner or building operator to monitor their energy consumption in real time. This not only raises awareness of energy use and its costs, it also allows the homeowner/ building operator to shut down unnecessary energy uses. As with most activities geared towards improved performance, continuous measurement of performance is necessary.

Grants and loans for part or all of a package of energy efficiency measures can be used to encourage building owners to invest in energy conservation measures.

Energy Demand Reduction Techniques

Energy Audits: Provide energy audits for houses, buildings and industrial facilities to identify energy saving opportunities. Subsidize cost of audits to increase uptake.

Financial Incentives: Set energy prices to encourage energy conservation or shifting energy use to off-peak periods. Offer tax breaks or credits to encourage investment in energy efficiency measures, and provide low interest loans or grants to homeowners, building owners and industrial operations to reduce the cost of energy efficiency improvements.

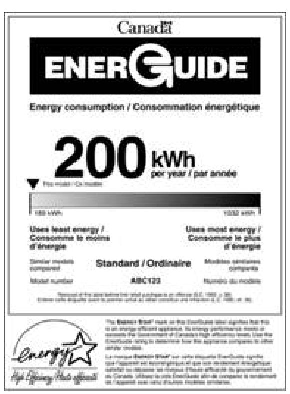
Technical Support: Provide or subsidize energy engineering consulting services for commercial building and industrial sectors.

Building Codes: Implement or strengthen energy efficiency codes for new construction and major renovation projects.

Energy Labeling: Rate and label the energy efficiency of houses, buildings, appliances and equipment.

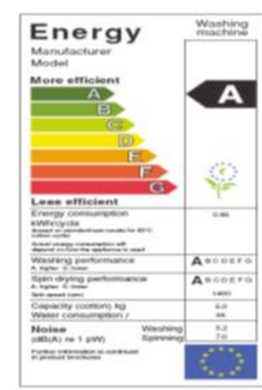
Energy Demand Reduction Techniques

Energy labeling of appliances, building equipment and building components allows buyers to choose more efficient products. Energy labeling also allows building codes, government and utility energy conservation programs, and public awareness campaigns a way of identifying the products they are requiring or requesting that consumers purchase. Over the past 20 years, energy labeling of appliances, office equipment, HVAC equipment, windows and doors, etc. has been instituted by national governments, utilities, and energy agencies in North America, Europe, and parts of Asia. These labels can be used to inform consumers and also can be used to enforce energy conservation requirements in new construction and energy retrofit programs. Some of the better known labeling programs include:



EnerGuide
Shows annual energy use and how a particular appliance compares within its group

ENERGY STAR®
North American label for most efficient appliances within a group



European
Lists annual energy use
Rates efficiency within group

Energy Demand Reduction Techniques

Utility Regulation: Mandate that energy service providers must achieve certain targets for energy efficiency. Disconnect utility profits from increased sales of energy.

Improved Generation and Distribution: Seek gains in efficiency in the generation, transmission, and local distribution of electricity. Approximately 7% of generated electricity is lost during long distance transmission; local production reduces this loss.

Using Demand Reduction To Create Supply

The Willis Tower (formerly the Sears Tower) in Chicago will be retrofit over a five-year period, as yet incomplete. A fifty-story hotel will also be built next door.

The energy demand reduction aspects of this retrofit will lower the building's electrical consumption by 80%. The new energy-efficient hotel will use just part of this energy savings, and the rest will become available through the existing grid for new or existing uses.

Source: "Willis Tower Greening Project/Hotel." *Adrian Smith and Gordon Gill Architecture*. http://smithgill.com/#/work/willis_tower Accessed February, 2012.

Sustainable Energy Supply

Prioritize energy supply options:

1. Select fuel from potential pollutants or sources requiring treatment (solid wood or agricultural waste, sludge, municipal waste/methane, tires).
2. Select fuel or energy normally discharged into the environment (flared gas, heat generated from various processes and sources, chiller plant cooling, engine cooling water).
3. Select renewable sources (solar, wind, ground source, moving water and tidal energy, biomass, prevailing winds).
4. Establish efficient use of (fossil) fuels (high efficiency engines, combined heat/energy processes).

Sustainable Energy Supply: Fuel From Potential Pollutants

Methane capture from landfill: Delta, BC

Methane is piped from a landfill to a greenhouse. The greenhouse uses the gas to run a cogenerator to raise tomatoes; it only uses heat and then sells power to the grid.

This reduces fossil fuel use (and cost) by 20%.

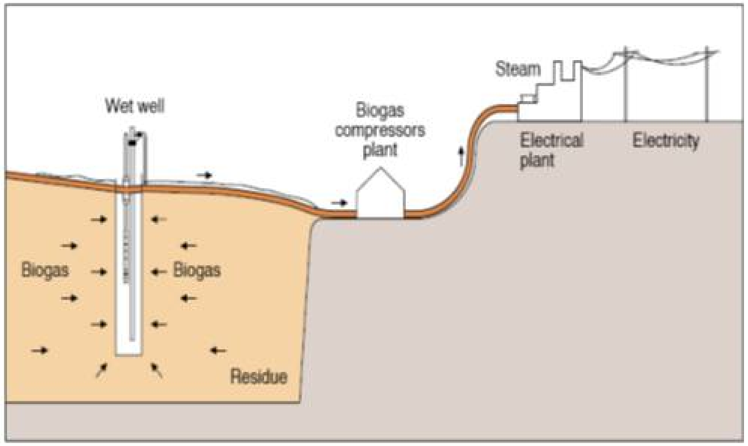
- $150K/yr (net) to Vancouver (landfill owner)
- taxes ($80-$110K/yr) to Delta (local municipality)
- electricity for 7000 homes
- 200,000 T CO_2 equivalent reduction/yr

Sustainable Energy Supply: Fuel From Potential Pollutants

Methane capture from landfill: Gazmont (cogeneration power plant), Montreal, QC

Commissioned in 1996, the 25 MW capacity Gazmont power plant destroys the landfill gas emitted by the city of Montreal's closed landfill.

Previously flared methane gas is collected from a 30-year-old landfill. The gas is cleaned, mixed with natural gas and burned to produce electricity from steam. The plant has 25 MW peak capacity, and 190,560,000 kWh annual energy generation.



Sustainable Energy Supply: Fuel From Potential Pollutants

Gazmont (cogeneration power plant), Montreal, QC

- $8.4M electricity generated annually
- $37M cost paid back in under five years
- 15 permanent jobs created
- Landfill converted to eco park
- Adjacent circus school campus integrates some of the energy with other green technologies

Source: http://www.biothermica.com/3_1_1_evaluation.html Accessed February, 2012.
Source: http://www.tohu.ca/en/CESM/pavilion.aspx Accessed February, 2012.

Sustainable Energy Supply: Fuel From Potential Pollutants

Matamoras “Green Energy” Facility, Tamaulipas, Mexico

The facility uses pyrolysis to transform waste tires into heat, electricity, residual steel, and carbon.

- Extends landfill life by removal of five million tires from waste stream.
- Municipality saves $4M in electricity annually.
- Revenue is generated from 50 tons/day of carbon black and scrap steel.
- The project qualified for North American Development Bank Financing.
- The project improved sanitation.
- There is minimal impact on air quality.

Sustainable Energy Supply: Fuel From Potential Pollutants

Direct conversion of waste-to-energy (no landfill):

Plasco Energy Group, Ottawa, ON converts post-recycling municipal solid waste into electricity through a unique energy-efficient gasification process. Waste is not incinerated and no landfill is required.

Source: http://www.plascoenergygroup.com Accessed February, 2012.

Sustainable Energy Supply: Fuel/Energy Otherwise Discharged Into Environment

Recover heat from cooling water used for power plants, chillers, or industrial applications.

Burn landfill gas (methane*) to generate heat and/or electricity.

*Methane is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide (CO_2) over a 100-year period and is emitted from a variety of natural and human-influenced sources. Human-influenced sources include landfills, natural gas and petroleum systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial process. (EPA)

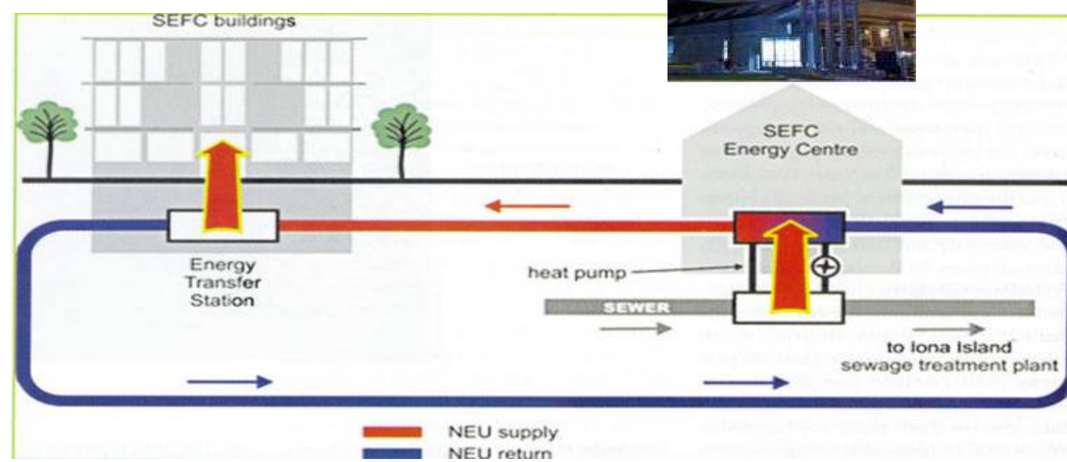
Sustainable Energy Supply: Fuel/Energy Otherwise Discharged Into Environment

The False Creek Village project in Vancouver, BC extracts heat from the municipal sewer system just before it enters the adjacent salt water bay.

This heat is used as the only heat source in the district heating system for this neighborhood of 3000 residents and 22 buildings*.

Capturing the sewer heat helps maintain the correct temperatures for spawning, etc., in the bay.

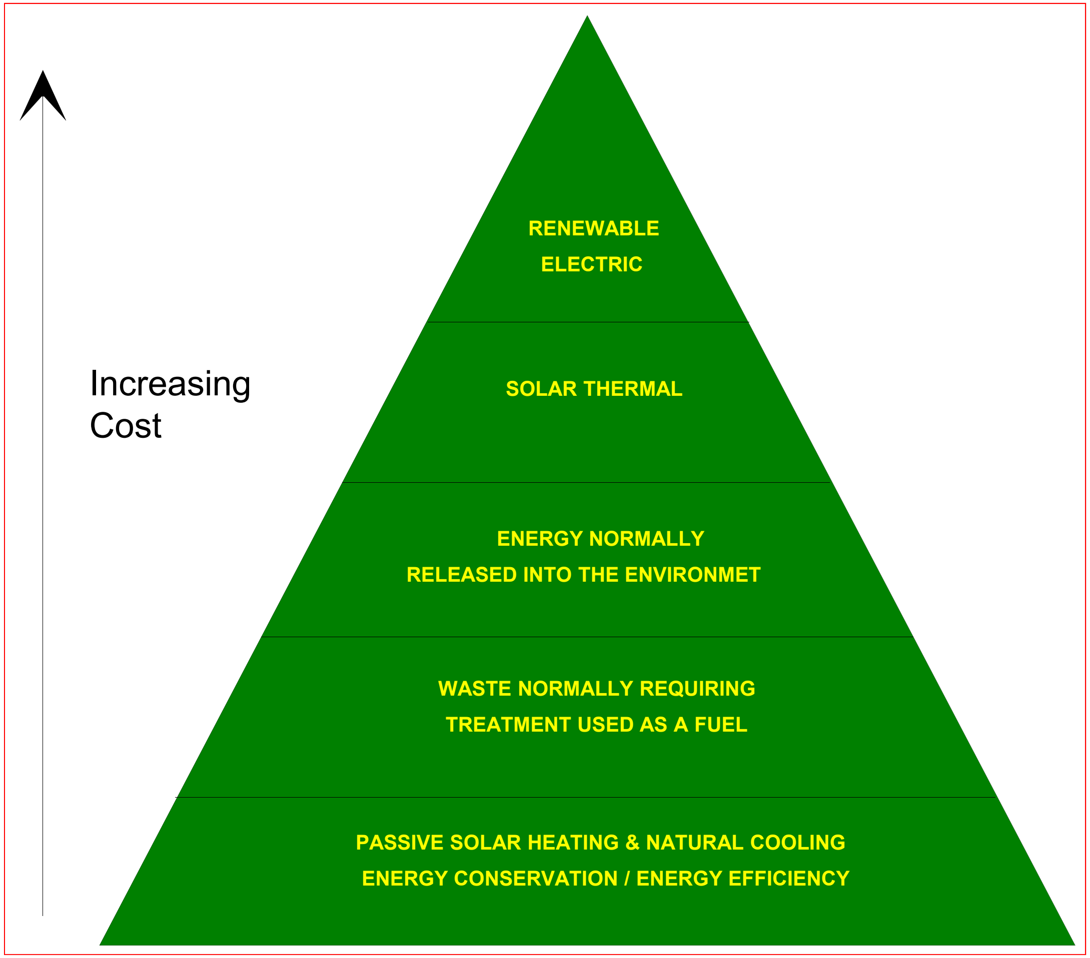
*One building is a net zero building.



Sustainable Energy Supply: Renewable Energy Options

The most cost effective and feasible means of utilizing renewable energy usually are:

- passive solar space heating
- natural air flow cooling
- biomass
- solar water heating, and
- solar preheating of ventilation air.



Renewable Energy Options: Cost Analysis

RETSCREEN
Renewable Energy Technology Screening Tool

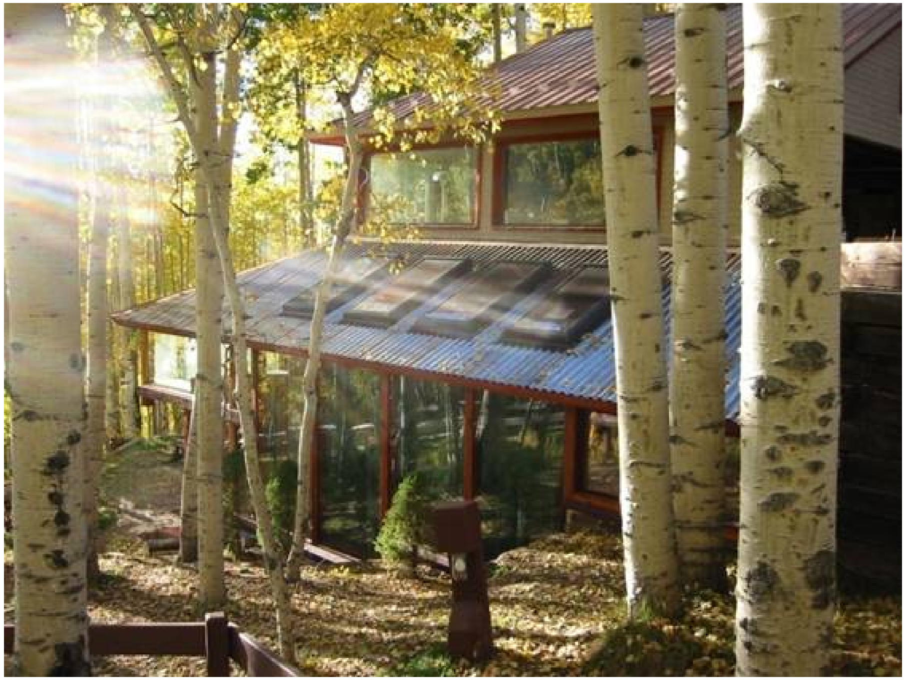
This tool provides the initial evaluation of the technical and financial viability of renewable energy technologies for a specific location.

This tool may be downloaded for free at: http://www.retscreen.net/.

Renewable Energy Options: Passive Solar

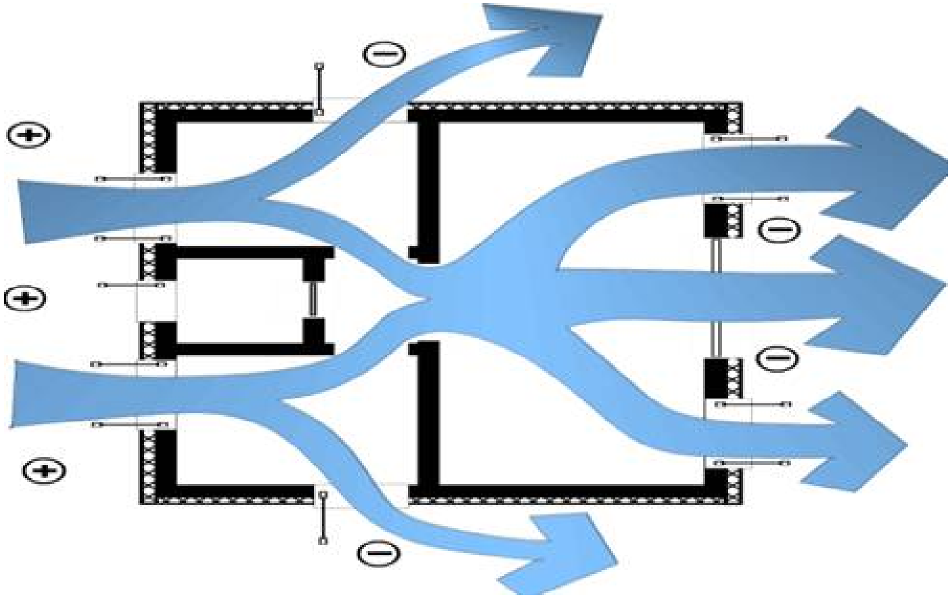
The simplest method to use solar energy is by allowing sunlight through equator-facing windows during the heating season.

Solar gain must be shaded from windows with appropriately sized overhangs to prevent summer overheating.



Renewable Energy Options: Air Flow Cooling

Providing opening windows and vents in a building oriented to prevailing summer winds and with an open floor plan can allow for wind-driven air flow cooling.



Renewable Energy Options: Active Solar Technologies

Solar Hot Water: This can provide 30% to 100% of domestic hot water requirements depending on the climate and water usage.

The installation uses commonly available skills in construction industry. And most important, the source of energy is locally-provided and free.

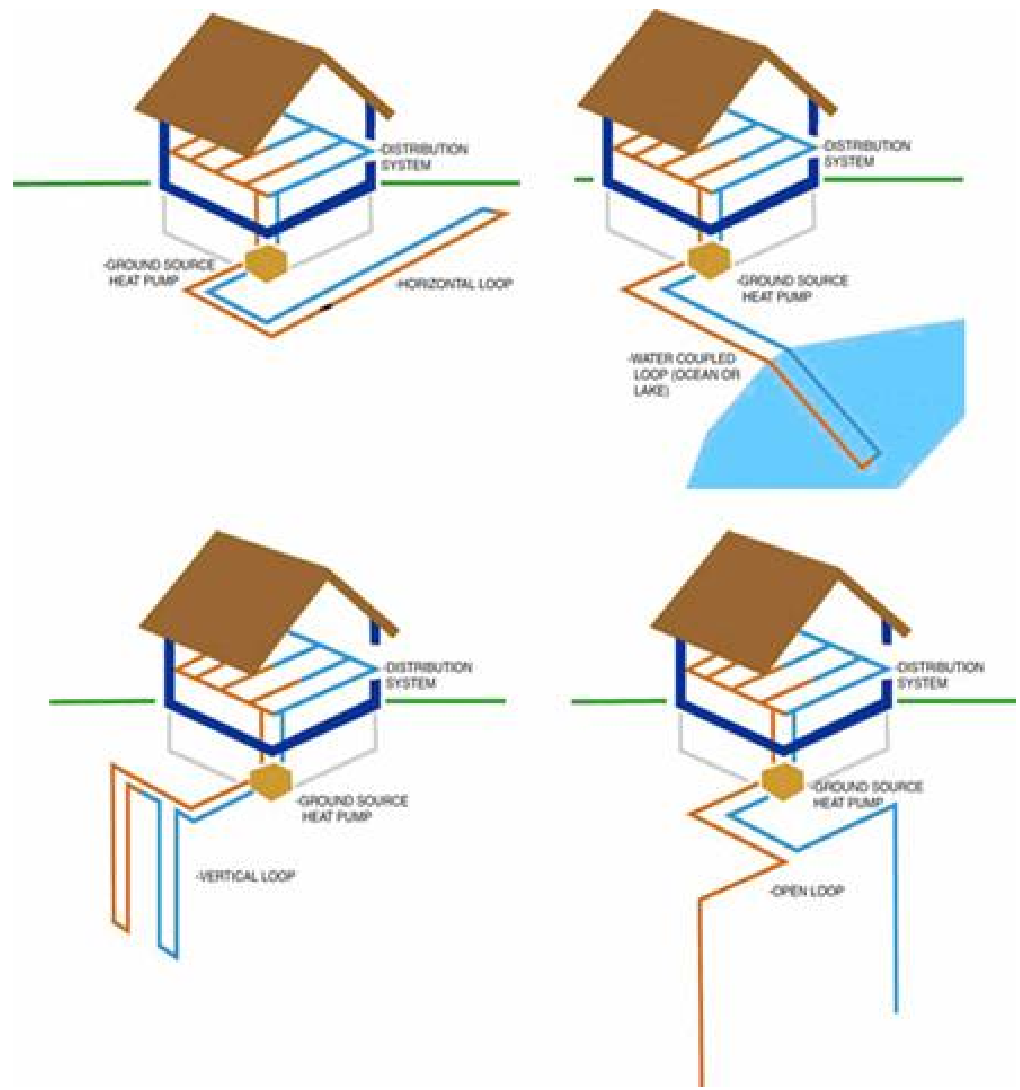
Photovoltaics: PV arrays come in many sizes and can also supply 100% of electrical needs.

PV cells can also be integrated into glazing, roofing, and building cladding.

Renewable Energy Options: Geothermal (Earth Energy)

The earth maintains a constant temperature of 10.0˚C (50.0˚F) below the frost line, and this heat can be extracted by a heat pump for building heating and commercial uses. Geothermal systems can also be used for cooling by reversing the pump.

Systems use a series of coils laid horizontally or vertical narrow tubes to extract the heat. The systems can also use well or lake water as a heat source. They can be sized for single homes, large high-rises, or entire neighborhoods.

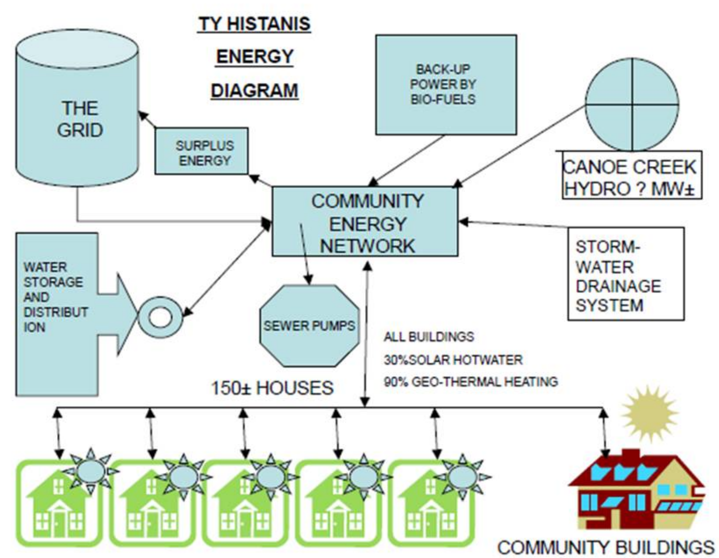


Renewable Energy Options: Geothermal (Earth Energy)

This net zero infill triplex in Montreal, QC uses three geothermal wells as part of its renewable energy system. For more information visit: http://www.cmhc-schl.gc.ca/odpub/pdf/66939.pdf or http://www.cmhc-schl.gc.ca/en/inpr/su/eqsucoin/upload/Ty-Histanis_E-July21.pdf Accessed February, 2012.

This 215-unit First Nation's housing community in BC uses geothermal sources in its district energy system.

The Ty-Histanis Village
Tla-o-qui-aht First Nation – Tofino BC

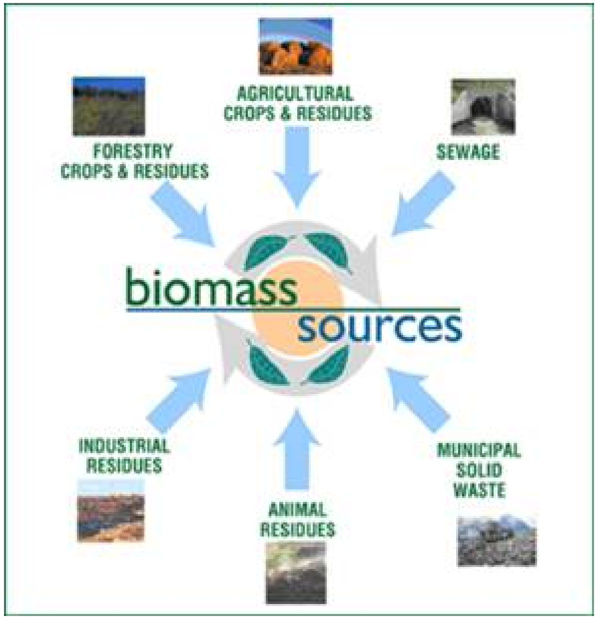


Renewable Energy Options: Biomass

Biomass is any previously living organic matter, and it comes in a number of different forms.

Sources include wood waste (dead trees, old shipping pallets, sawdust, wood chips, wood pellets) plant matter from agricultural processes, municipal waste, algae, etc.

Sometimes the material is converted to another fuel such as ethanol, and sometimes it is used directly as fuel itself.

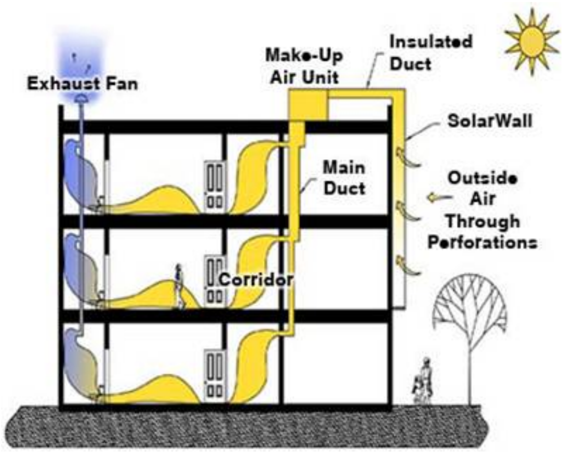


Renewable Energy Options: Ventilation Air Preheat

Perforated metal cladding mounted a few inches from equator-facing wall surfaces forms an air cavity which becomes superheated by the sun.

This heat, which rises naturally, is recovered at the top and is used to preheat ventilation air.

This system has also been used to reclad leaky masonry buildings, thus performing two tasks simultaneously.



Renewable Energy Options: Cogeneration Systems

Cogeneration uses one energy source to produce two separate forms of energy.

Cogeneration produces electricity and recovers “waste” heat to provide space heating, domestic hot water, or process hot water:

- Generating electricity from fossil fuels is inefficient (seldom more than 30% to 40%).
- Utilization of waste heat through cogeneration can create a system efficiency of up to 89%.

Cogeneration heating systems can service a single building, a neighborhood, or an entire community:

- Residential developments must be at least 30 dwellings per hectare (12 UPA) to be suitable for a district energy distribution system.

Cogeneration Retrofit System

The owner of a two-tower, 30+-year-old residential apartment complex in Toronto, ON, confronted with rising electricity and heating costs and high maintenance expenses for the existing boiler system, decided to install a cogeneration system. This system would reduce electricity costs by generating electricity on-site and applying the accompanying heat to space heating and potable hot water heating. The owner aimed to reduce electrical operating costs, and protect himself against anticipated increases in electricity prices. He also wanted a system that would provide a simple payback of less than four years, as well as equipment with a long working life and reasonable maintenance costs.

A cogeneration system would address these expectations. As stated, a cogeneration system is an electrical-mechanical system that simultaneously produces both electricity and heat. It uses the heat that is normally rejected by an electrical utility both at the plant and in the transmission system. Electrical utilities discard 70% of the fossil fuel energy they consume, compared to 10-30% for a cogeneration system. This offers significantly improved energy efficiency, compared to conventional building energy systems that use electricity supplied by a utility, generated by the combustion of fossil fuels.

Cogeneration Retrofit System

Highlights of the Cogeneration System Installation

System components:

- Heavy-duty diesel truck engines modified to run on natural gas
- Electrical generators (96.5% efficiency)
- Electrical power conditioning equipment
- Electrical power monitoring equipment
- Heat recovery equipment (combustion exhaust, engine jacket, charge air cooler)
- HVAC system interface (piping, valves, pumps, heat exchangers, controls, etc.)
- Safety system (pressure, temperature, valves, current, voltage, smoke, natural gas, etc.)
- Computer control and monitoring system

Cogeneration Retrofit System

A double-block wall enclosing the equipment room was constructed for the cogeneration system. The double wall provides an air gap to reduce noise from the equipment by about 40dB. Fresh air and exhaust venting is provided. The equipment was mounted on reinforced concrete pads.

Pipes from the cogeneration system connect to the hydronic heating system, which provides heat to the suites via a two-pipe system from the central boilers. Most of the heat for the domestic hot water is drawn from the main heating loop. The charge air coolers capture the heat of compression from the turbochargers and supply part of the heat for the domestic hot water. Combustion exhaust is filtered through heat exchangers and silencers and then piped to the outside by means of a variable speed fan. The room is maintained at negative pressure to ensure that no gas passes to other parts of the building. Fresh air comes in through an un-powered air duct; a percentage of this air is filtered and used as combustion air for the engines.

Cogeneration Retrofit System

- Each basement unit rated at 125 kWh
- Sound control required:
  - Double-walled enclosure for engines
  - Exhaust silencers
  - Air supply ducts with a minimum of two elbows
- Mechanical room under negative pressure to prevent gases from escaping
- Annual natural gas consumption 85,000 m^3
- Annual average electrical power production 277,000 kWh
- Cost of installation $400,000 CAD
- Saves approximately $108,000 ($54,000 per unit) annually; engines require rebuilding every year at the cost of $8,000
- System life expected to be 100,000 hours
- Key success factors:
  - Available excess parking space
  - Careful front-end planning of heat recovery and use of recovered heat
  - Overcoming approvals issues

View report here: http://www.cmhc-schl.gc.ca/en/inpr/bude/himu/inbu/upload/Application-of-a-Co-Generation-System-in-a-Residential-Complex.pdf
Accessed February, 2012.

Energy Education, Demonstration, and Awareness

Energy Performance Programs Awareness Impact

There are now a number of building energy performance standards, rating, and ranking programs. The LEED® programs are perhaps the most highly recognized. Others include BREEAM®, Green Globes, BuiltGreen™, NAHB's green home guidelines and a number of municipal green guidelines, etc.

Cumulatively, these programs have:

- placed non-rated buildings at a distinct marketing disadvantage
- integrated building energy performance into sustainable planning guidelines, urban design guidelines and zoning bylaws, and
- spawned a new series of standards (such as LEED® for Neighborhood Development™) which recognize that many issues must be addressed at the neighborhood or community scale.

A few other initiatives are described in the following slides.

The EQuilibrium™ Initiatives

EQuilibrium™ is a Canadian national sustainable housing demonstration initiative that brings the private and public sectors together to develop homes that combine resource- and energy-efficient technologies with renewable energy technologies in order to reduce their environmental impact.

Source: http://www.cmhc.ca/en/inpr/su/eqho/ Accessed February, 2012.

EQuilibrium™ Housing: Goals And Objectives

EQuilibrium™ Housing Initiative goals include:

- developing a clear vision and approach for low-environmental impact healthy housing across Canada
- building the capacity of Canada's home builders, developers, architects, and engineers to design and build EQuilibrium™ homes and communities across the country, and
- educating consumers on the benefits of owning an EQuilibrium™ home and achieving market acceptance of EQuilibrium™ houses and sustainable communities.

★ Please remember the **exam password VISION.** You will be required to enter it in order to proceed with the online examination.

EQuilibrium™ Housing Initiative: Description

EQuilibrium™ housing integrates a wide range of technologies, strategies, products, and techniques, including photovoltaic panels, solar hot water, and geothermal energy systems, etc.

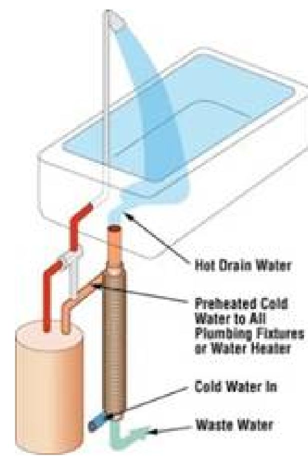
These highly energy-efficient grid connected homes aim to produce as much energy each year as they consume for heat, light, and power (i.e. net zero equivalent).

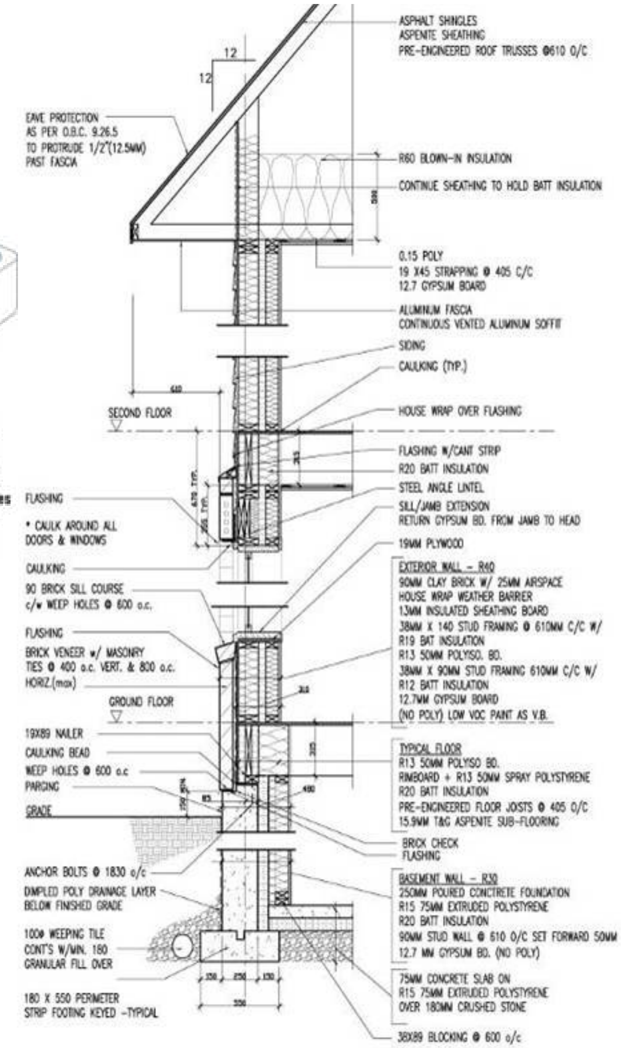
EQuilibrium™ homes combine and integrate design and building practices into an integrated “whole house” solution meeting the needs of both occupants and builders alike within the challenges of the Canadian climate.

All homes are open for tours and monitored for one year, and performance results are shared publicly.

Features of EQuilibrium™ Homes

- Very high levels of insulation
- Low levels of air leakage
- High performance triple or quad pane windows
- Renewable energy systems (i.e. photovoltaics, solar water heating, ground source heat pumps)
- Passive solar heating and cooling
- Environmentally-preferable building materials and finishes
- Mechanical ventilation with heat recovery
- Drainwater heat recovery
- Very efficient appliances and lighting
- Natural daylighting
- Water conservation and reuse
- Land and natural habitat conservation





TYPICAL WALL SECTION
1:20

EQuilibrium™ Housing Initiative

Fifteen homes in all regions of Canada have been planned, designed, and/or built to date. House forms include a variety of single family homes, a duplex, an infill triplex, a prefab home and the retrofit of a 60-year-old 1½-story home. For more information, visit: http://www.cmhc.ca/en/corp/about/cahoob/upload/Chapter_7_EN_dec16_w.pdf Accessed February, 2012.

Lessons Learned

The homes are currently a niche market with strong potential for long-term growth. The barriers to growth are not technological—the obstacles are cost, insufficient industry capacity, and lack of consumer awareness. Making large improvements in energy efficiency is much less expensive than adding renewable energy systems. Improving energy efficiency needs infers looking beyond just heating and cooling loads. Low energy homes ("near net zero") are more feasible than net zero energy homes.

EQuilibrium™ Demonstration Community Initiative

The EQuilibrium™ Communities Initiative was built on the success of the EQuilibrium™ Sustainable Housing Demonstration Initiative.

EQuilibrium™ Communities were chosen by a national competition. Funding for research design, monitoring, and promotional support has been announced for four communities to date. The program will continue to the end of 2012.

For more information visit: http://www.nrcan.gc.ca/media-room/news-release/54a/2009-06/1998 Accessed February, 2012.

EQuilibrium™ Communities Selection Criteria

Energy - A community that balances energy supply and use to minimize greenhouse gas emissions.

Land Use and Housing - A compact community with a balanced mix of activities, housing choices and commercial, institutional, recreational and industrial land uses.

Water, Wastewater and Stormwater - A community that will minimize the use and disposal of water and negative impacts on watersheds.

Transportation - A community that reduces fossil fuel use from personal vehicle travel and provides opportunities for energy-efficient and healthy alternatives.

Natural Environment - A community that protects, enhances, and restores the natural environment.

Financial Viability - A marketable community that, through its design, operation, integration and financing, is economically viable over the long term.

EQuilibrium™ Communities

Station Pointe, Edmonton, AB (est. complete in 2014):

- 220 affordable townhomes and apts.
- 1400 m^2 retail, daycare, and community uses
- Targets: 75% energy reduction, district system, on-site wastewater treatment, passive house design

For more information visit:
http://www.cmhc-schl.gc.ca/en/inpr/su/eqsucoin/upload/Station-Point_E-July21.pdf
Accessed February, 2012

Ampersand, Ottawa, ON (complete and sold out):

- 1000 townhomes and mid-rise apartments, 25,000 m^2 commercial/retail space, civic uses, and public open space
- Targeting zero energy consumption, rainwater reuse, district systems, renewable sources, and green financing

For more information visit:
http://www.cmhc-schl.gc.ca/en/inpr/su/eqsucoin/upload/Ampersand_E-Jul21.pdf
Accessed February, 2012.

EQuilibrium™ Communities

Regent Park Phase 1, Toronto, ON (occupied):

- Total project 5100 units
- Phase 1: 670 condos and 360 rental units
- 2500 m^2 retail, community spaces
- 50% energy usage reduction
- District energy system

For more information visit:
http://www.cmhc-schl.gc.ca/en/inpr/su/eqsucoin/upload/Regent-Park-E-July21.pdf
Accessed February, 2012.

Ty-Histanis, BC (partially built):

- 171 singles, 32 duplexes and 12-unit elders
- Core with multi-family buildings, school, health clinic, pharmacy, recreation center, and youth/ elders center
- District energy system using geothermal

For more information visit:
http://www.cmhc-schl.gc.ca/en/inpr/su/eqsucoin/upload/Ty-Histanis_E-July21.pdf
Accessed February, 2012.

Living Building Challenge

The Living Building Challenge is a philosophy, advocacy tool, and certification program that addresses development at all scales. It is composed of seven performance areas: Site, Water, Energy, Health, Materials, Equity, and Beauty. These are subdivided into a total of twenty imperatives, each of which focuses on a specific sphere of influence.

LBC also began at the building scale and now encompasses the neighborhood and community scales.

LIVING

Living Building Challenge defines the most advanced measure of sustainability in the built environment possible today and acts to diminish the gap between current limits and ideal solutions.

The 2030 Challenge

The 2030 Challenge has been adopted as a target by numerous organizations. (http://architecture2030.org/2030_challenge/adopters)

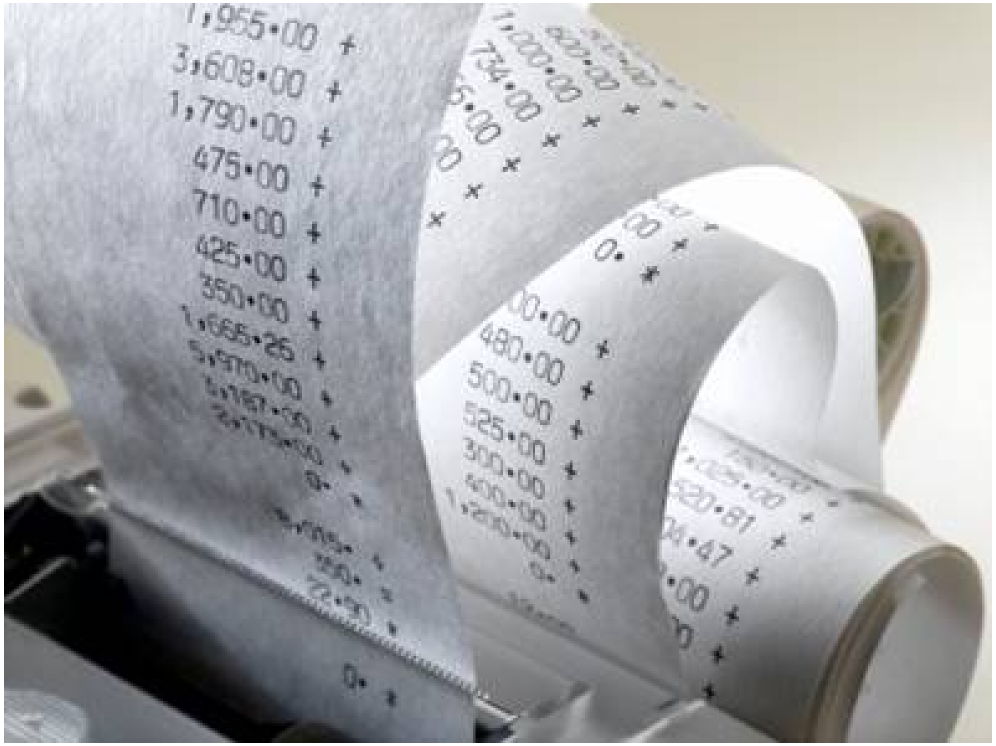
New buildings, developments and major renovations target 60% reduction below the regional or country average of fossil fuel, GHG-emitting, energy consumption performance for that building type.

At minimum, an equal amount of existing building is to be renovated annually to meet the same target.

The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:

- 70% in 2015, 80% in 2020, and 90% in 2025, and
- carbon-neutral in 2030 (using no fossil fuel GHG-emitting energy to operate).

Source: http://architecture2030.org/2030_challenge/the_2030_challenge Accessed February, 2012.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Summary

Summary

A community energy plan (CEP) is an essential part of a community plan.

A CEP addresses a comprehensive range of issues through an energy lens.

A CEP includes “finding” energy through the retrofit of existing buildings and the design and construction of new energy-efficient ones.

A CEP identifies clean renewable sources and prioritizes converting waste and contaminating materials into clean energy sources.

A CEP integrates buildings, community uses, energy sources and processes in order to capitalize on the synergies between these elements.

Building awareness of energy issues and involving all sectors in planning and operation is critical to the success of a CEP.

Conclusion

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