

Power Lines – Myths vs. Facts



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HEALTH IMPACTS OF HIGH VOLTAGE POWER LINES

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no negative impacts on health.

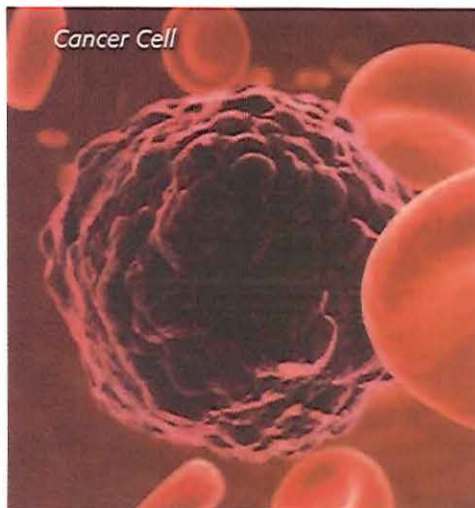
The Facts:

- The following negative health outcomes have been conclusively linked with EMF exposure in the scholarly literature: a variety of cancers, leukemia, tumor growth, skin growths, abnormal cell activity, sleep and daily rhythm disturbances, perception and memory differences and impairment, genetic defects, hormone regulation and production, gland deficiencies, mental and behavioral problems, immune system deficiencies, nervous system disorders, fetal development problems, miscarriages, birth defects, and blood and circulatory problems (Wagner 2006).
- The U.K. Stakeholder Advisory Group on Extremely Low Frequency EMFs (2007) cited links between EMFs and the following adverse effects: childhood and adult leukemia, adult brain cancer, Alzheimer's disease, Lou Gehrig's disease, breast cancer, other childhood cancers, depression, electrical sensitivity symptoms, certain types of heart disease, miscarriage and suicide.
- Many occupational, epidemiological (population health and illness), animal and cell studies reported in the peer-reviewed literature by the Colchester



School Parents' Association (1988) show major increases in the occurrences of many diseases and other health problems in children and adults exposed to EMFs. These include: leukemia, non-Hodgkins lymphoma, intestinal cancer, myeloid leukemia, brain tumors, brain cancer, immune system deficiencies, DNA uncoiling, retardation of fertilization, fetal resorption, increased infant mortality, embryo abnormality and stunting of growth.

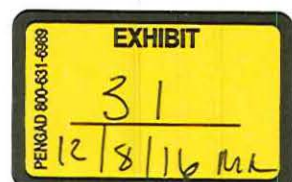
- A comprehensive review of recorded EMF effects on human health and behaviour conducted by Rubtsova (undated) included those effects recorded elsewhere in the literature as well as the following: fatigue, decrease in visual and motor reaction time, attention and memory deterioration, persistent mental disorders, headache, nausea, male sexual dysfunction, changes in cardio-respiratory functions, nervous system changes, and embryonic death.
- See other RETA Fact Sheets for more detailed facts on the impacts of overhead high voltage power line EMFs on specific diseases and other adverse health effects.



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Prepared by RETA. Updated April 30, 2009. References available at www.reta.ca.



Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES & LEUKEMIA (1979-1993 Studies)

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have not been shown to have any impacts on the occurrence of leukemia.

The Facts:

● The homes of children in Denver Colorado who developed leukemia tended to be found near electric power lines carrying high currents. A two to three-fold increase in the deaths of children living near high voltage power lines was discovered (Wertheimer and Leeper 1979). The finding was strongest for children who had spent their entire lives at the same address. Later studies to repeat this study have revealed similar results.



Leukemia victim receiving chemotherapy.

- A study of deaths in Los Angeles County found a marked increase in leukemia among electrical workers exposed to above-normal EMFs (Wright et al. 1982).
- An increased incidence of leukemia was found in New Zealand electrical workers exposed to above-normal EMFs (Pearce et al. 1989).
- An analysis of the Finnish Cancer Registry revealed a higher risk among workers exposed to EMFs for leukemia (all types combined), bone marrow cancer and central nervous system tumors (Juutilainen et al. 1990).
- Results from a large, national population-based study of the Cancer Registry of Norway supported an association between electrical workers exposed to EMFs and the risk of leukemia and brain tumors (Tynes et al. 1992).
- A higher incidence of acute myeloid leukemia (bone marrow cancer) was found in electrical workers exposed to above-normal EMFs in England (Coggon et al. 1986).
- The incidence of leukemia in children under the age of 16 who had lived within 300m of any 220kV and 400kV power line in Sweden was studied during the period 1960-1985 (Feychting and Ahlbom 1993). The risk was from 2.7 to 3.8 times the expected.



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HIGH VOLTAGE POWER LINES & LEUKEMIA (1993-1999 Studies)

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have not been shown to have any impacts on the occurrence of leukemia.

The Facts:

- On the basis of the job held the longest by Swedish men during the 10-year period before diagnosis, Floderus et al. (1993) found an association between EMFs and chronic lymphocytic leukemia (cancer of the white blood cells). The risk increased with increasing level of EMF exposure.
- Electric utility workers exposed to above-normal EMFs in Ontario, Quebec and France were studied. Workers had higher risk for non-lymph related leukemia and white blood cell leukemia, with risks varying from 2.3 to 3.2 times the expected, depending on exposure levels (Thériault et al. 1994).
- A higher risk of childhood leukemia was found among Swedish and Danish children living within 300m of transmission lines and exposed to above-normal EMF levels (Feychting et al. 1995). Risks varied from 2 to 5 times the expected, increasing with higher EMF exposure levels.



- On the basis of one of the most complete cancer data sets in Canada, Miller et al. (1996) studied the association of a variety of cancers and exposure to electric and magnetic fields for Ontario electric utility workers. In total, 260 unique job titles at 140 different work sites were sampled. The incidence of leukemia (several types) in utility workers was 4.3 to 5.5 times the expected. Within each level of magnetic field exposure, there was increasing risk with increasing exposure to electric fields.



- Michaelis et al. (1997) studied childhood leukemia in north-western Germany and found an increased risk of 3.2 times the expected for children exposed to EMFs.



- A childhood leukemia study in Los Angeles County supported the hypothesis that magnetic fields from electrical lines are causally related to childhood leukemia, with risks varying from 2.0 to 2.2 times the expected (Thomas et al. 1999).

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HIGH VOLTAGE POWER LINES, ALZHEIMER'S DISEASE AND DEMENTIA

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of Alzheimer's disease or dementia.

The Facts:

● Health data for workers exposed to above-normal EMFs in Helsinki Finland and Southern California were studied. The risk of Alzheimer's disease in these workers varied from 2.9 to 3.8 times the expected (Sobel et al. 1995). Based on a study of California workers exposed to EMFs, Sobel et al. (1996) found risks of Alzheimer's disease 3.9 times the expected for both sexes, 3.4 times the expected for women, and 4.9 times the expected for men.

● Qui et al. (2004) found that long-term occupational exposure to higher EMF levels may increase the risk of Alzheimer's disease and dementia in men. They reported a dose-response relation with risks of 2.4 times the expected for Alzheimer's disease, and 2.5 times the expected for dementia.

● Based on a systematic review of studies that explored Alzheimer's disease and occupational exposure to EMFs, Garcia et al. (2008) reported an association between the two. Pooled estimates from many studies showed consistently increased risks of Alzheimer's disease 2 times the expected.



● Huss et al. (2009) studied the relationship between magnetic exposure from living near 220-380kV power lines and the risk of mortality from neurodegenerative disease (loss of brain and spinal cord cells) among 4.7 million Swiss residents. There was a clear dose-response relation with respect to years of residence in the immediate vicinity of power lines and Alzheimer's disease. Persons living at least 5 years within 50m had a risk of 1.5 times the expected, increasing to 1.8 with at least 10 years, and to 2.0 with at least 15 years residency. The pattern was similar for senile dementia.

● Many population health and illness studies have reported that workers exposed to EMFs are at an increased risk of Alzheimer's disease, but they have not discussed how this may occur. Numerous recent studies have suggested that DNA strand breaking (Lai and Singh 1997) or significant increases in the release of certain amino acid compounds (Giudice et al. 2007) could explain the EMF-Alzheimer's disease association.



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Power Lines – Myths vs. Facts



GOVERNMENT OVERSIGHT OF POWER LINES

The Myth:

Governments and regulatory bodies will ensure that people and the environment are protected from negative impacts of overhead high voltage power lines in Alberta.

The Facts:

- Amendments passed by the Alberta Government to the *Environmental Assessment (Mandatory and Exempted Activities) Regulation* in April 2008 exempt all electrical transmission lines from the requirement for an environmental impact assessment (EIA). Previously, EIAs for lines of 500kV or greater were mandatory and those less than 130kV were exempt.
- From April 2008 and on, in most cases, it is at the discretion of the Alberta Utilities Commission (AUC 2009) to determine how much or how little environmental information even needs to be submitted by companies planning to build new high voltage power lines.
- As well, very few of the requirements under the Alberta Environmental Protection Guide for Transmission Lines (1994) need now be followed, including conservation and reclamation approvals or any public input on environmental concerns prior to construction of new lines.
- These recent changes mean that power line companies no longer need to submit detailed environmental studies to determine the impacts of their proposed power lines on the environment. These significantly reduced requirements will result in damages to the environment. For example, overhead high voltage power lines are known to kill tens of millions of birds every year in North America (U.S. Fish Wildl Serv 2002).



- The *Land Assembly Project Area Act* was passed by the Alberta Government on April 29, 2009, in spite of protests by landowners concerned about losing their land rights. It will now be much easier for the Minister of Infrastructure to designate private land for future high voltage power lines. This will effectively sterilize such land for an indefinite period of time for development, improvement or sale until the Alberta Government purchased the land or selected another route for the power line.
- The *Electric Statutes Amendment Act, 2009* was passed by the Alberta Government on November 25, 2009, in spite of strong province-wide opposition. The amendments result in the Alberta Government unilaterally determining what is "critical transmission infrastructure" and eliminates any public input into determining whether new high voltage power lines are even necessary.
- For information on the working relationship between power line companies, regulatory agencies and the Alberta Government, see Nikiforuk (2007).



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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES & CANCERS (1982-1991 Studies)

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of cancers.

The Facts:

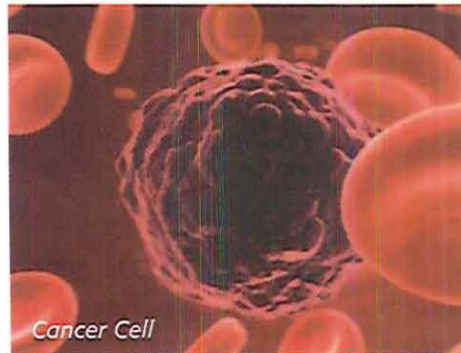
● Like childhood cancer, adult cancer was found to be associated with high-current electrical lines near the patients' residence (Wertheimer and Leeper 1982). Several patterns in the data indicated that power lines and cancer may be causally linked, including a dose-relationship.

● Canadian high voltage power line workers exposed to EMFs showed a greater than 3-fold increase in incidences of intestinal cancer (Howe and Lindsay 1983).

● Children of fathers in Texas employed in occupations with EMF exposure were at significantly increased risk of contracting neuroblastoma (cancers of the hormone and nervous systems); between 2 and almost 12 times the expected risk (Spitz and Johnson 1985).

● A higher risk for cancer of the urinary organs was reported for Swedish electrical utility workers by Törnqvist et al. (1986). Another Swedish study found that, where visible 200kV power lines were noted, cases of cancers for children 0-18 years of age were twice as likely to occur as in areas where such lines were not visible (Tomenius 1986).

● Speers et al. (1988) found that men employed in occupations associated with EMFs had a higher risk of brain cancer almost 4 times the expected. As well, there was a linear relationship between



the probability of EMF exposure and brain cancer.

● The risk of soft tissue sarcomas (connective tissue cancers) in children from Denver Colorado exposed to above-normal EMF levels was 3.3 times the expected, for lymphomas (lymph cancer) 2.2 times the expected, and for leukemia 1.9 times the expected (Savitz et al. 1988).

● Evidence has been accumulating since 1979 that power line EMFs are linked to cancer. Though the electric utility industry denounces this association, there is an international consensus among population health and illness scientists of this association (Becker 1990).

● A significantly higher risk for astrocytomas (brain cancers) of 10.3 times the expected was found among men in Los Angeles County who worked in electricity-related jobs (Mack et al. 1991). There was also a significant increase in tumor incidence with increasing length of employment in this sector.



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HIGH VOLTAGE POWER LINES & CANCERS (1991-1998 Studies)

The Myth:

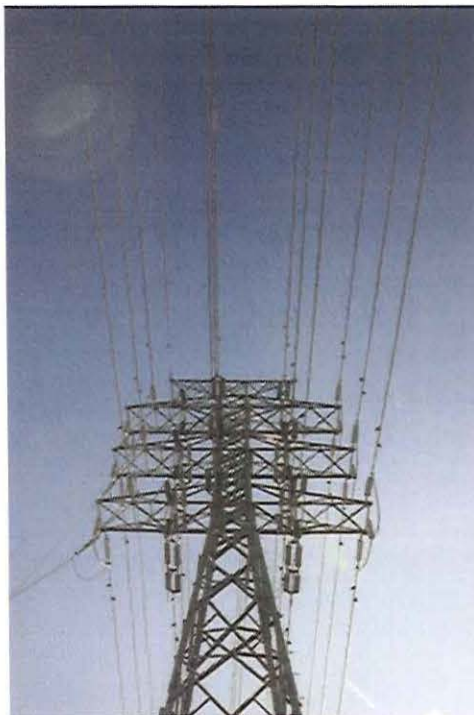
Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of cancers.

The Facts:

- A study of breast cancer in men whose occupations involved exposure to EMFs found higher risks of 1.8, 2.9 and 6.0 times the expected (Demers et al. 1991). Electric power workers, electricians and telephone linemen experienced the highest risk of 6.0 times the expected. The risk was highest among subjects who were first employed in jobs with exposure before the age of 30 years and who were initially exposed at least 30 years prior to diagnosis.
- Data from the New Zealand Cancer Registry between 1948 and 1988 revealed brain cancer risks of between 4.6 and 8.2 times the expected for individuals employed in the electrical industry (Preston-Martin et al. 1993).
- Thériault et al. (1994) found higher risk of brain cancer almost 2 times the expected for male electric utility workers in Ontario, Quebec and France.



- Increased risks of stomach and lung cancer, as well as of both malignant and benign brain tumors were found among Ontario electric utility workers exposed to EMFs (Miller et al. 1996).
- A review of 20 years of population health and illness research revealed that some studies support a possible relationship between brain cancer and EMF exposure (American Cancer Society 1996).
- In a study of Swedish men, Stenlund and Floderus (1997) revealed a link between magnetic fields, as found near transmission lines, and testicular cancer.
- The 1998 Working Group of the National Institute of Environmental Health Sciences concluded that exposure to EMFs is a possible human carcinogen.



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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES & CANCERS (1999-2004 Studies)

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of cancers.

The Facts:

- Through a re-analysis of many studies, Ebi et al. (1999) supported earlier findings for risks of childhood cancers about 2 times the expected for children exposed to EMFs. The authors also indicated that their results do not support suggestions by others that the associations between EMFs and childhood cancers are due to socio-economic status or other neighborhood factors.
- A study of breast cancer in Swedish women living within 300m of high voltage transmission lines was conducted by Forssén et al. (2000). Women below age 50 years at diagnosis had a risk of 1.5 times the expected. Women below age 50 years who had estrogen receptor-positive breast cancer had a risk of 3.2 times the expected.
- A 1997 study in Denmark of workers employed in all utility companies reported a statistically significant link between EMFs and higher risk of all



cancers combined, and of lung cancer (Electric and Magnetic Fields Research and Public Information Dissemination Program [EMFRAPID] 2002).

- A link between brain cancer and EMFs was reported in a 1995 study involving more than 138,000 utility workers at five electric utility corporations in the U.S. (EMFRAPID 2002).
- A link was reported between exposure to EMFs and brain cancer in a broad-ranging study of over 1,600 workers in Sweden in 1993 (EMFRAPID 2002).
- Laboratory studies have shown EMF impacts on skin cancer, the numbers of breast cancer tumors and cancer tumor volume (EMFRAPID 2002).
- A study of women living near a high voltage power line in Norway suggested an association between exposure to magnetic fields and breast cancer (Kliukiene et al. 2004).



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CONDUCT OF POWER LINE PROPONENTS

The Myth:

Proponents of the Heartland Transmission Line have considered public input and have dealt openly with the public.

The Facts:

- Residents provided factual information to the Alberta Electric System Operator (AESO), EPCOR and AltaLink between 2007 and 2010, much of which has been either ignored or not included on routing maps.
- Senior AESO representatives have stated that AESO is a not-for-profit company independent from electricity transmission companies. Other AESO staff have stated that AESO is funded primarily by electricity transmission and generation companies, and that many AESO staff are previous employees of electric transmission and generation companies.
- Prior to route selection AESO, EPCOR and AltaLink representatives had stated that they had not yet determined the "best" of the 4 potential routes for a power line, and that all 4 routes had been considered equally. On other occasions, company representatives indicated their preference for one route over another based on suggestions to them by the Alberta Government.



- AESO's Industrial Heartland Electricity Transmission proposal compared the 4 initial potential power line routes through a number of techniques, including a Multiple Factor Analysis and Sensitivity Analysis. Major inaccuracies within these analyses, some based on AESO's own data, have been pointed out on many occasions by residents. These inaccuracies significantly skew the results; however, AESO defends its original analyses. Similar inaccuracies exist in EPCOR's and AltaLink's January 2010 comparative analyses of the 4 initial potential routes.
- Significant differences exist between the negative impacts of overhead power lines, as reported in the scientific and popular literature, and those stated by AESO, EPCOR and AltaLink.
- Significant differences exist between the feasibility (technical and financial) of burying high voltage power lines, as reported in the literature, and that stated publicly by AESO, EPCOR and AltaLink.
- Much is written in the literature about the lobbying efforts of electricity companies in an attempt to get public and political support for their initiatives (Beder 2003a, 2003b).

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Power Lines – Myths vs. Facts



RESIDENTS' POWER LINE CONCERNS

The Myth:

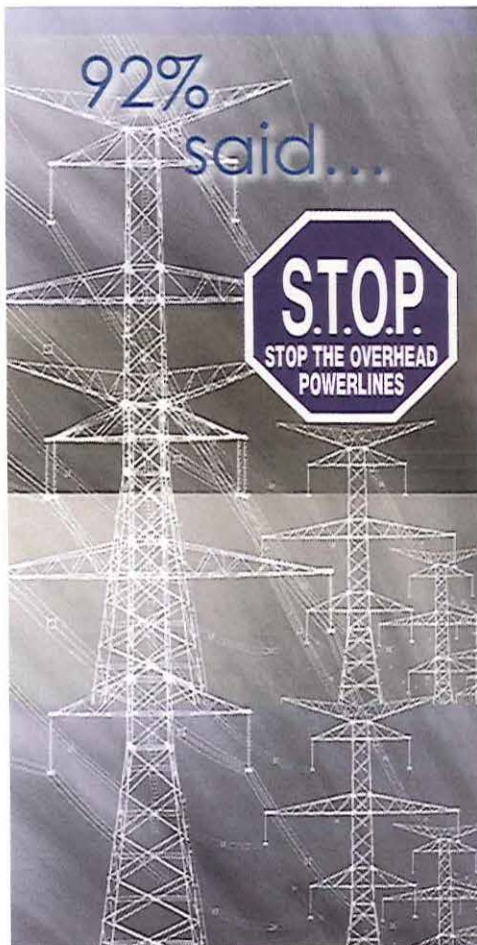
Residents are not concerned about overhead high voltage power lines in their communities.

The Facts:

- Strathcona County Council, Sherwood Park residents and the Colchester School Parents' Association teamed up in 1988 on the "Don't Hand Us That Line" campaign, opposing a proposed 240kV power line in the Sherwood Park Greenbelt. The Energy Resources Conservation Board later directed TransAlta to build the line in another corridor.
- Residents have appeared at all the Heartland Transmission Project open houses conducted by the Alberta Electric System Operator (AESO), EPCOR and Altalink from 2007 to the present. Residents have strongly expressed their

concerns about the health, safety, property value, aesthetic and environmental impacts of an overhead high voltage power line in their communities. They want the line buried.

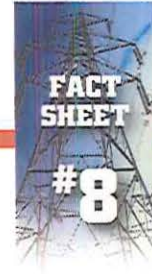
- Concerned residents incorporated the Responsible Electricity Transmission for Albertans (RETA) society in December 2008. RETA's mission is to ensure that new high voltage power lines are not constructed above ground near homes, schools, daycare centres, hospitals or environmentally sensitive areas. Lines should be buried in these cases. RETA currently has over 5,000 registered members.
- Strathcona, Sturgeon and Parkland County Councils; and Edmonton and St. Albert City Councils have passed Motions and/or written letters recommending that high voltage power lines be buried.
- Over 10,000 residents have attended public meetings organized by local community groups and RETA to express their many concerns about the possibility of overhead high voltage power lines being built in their communities.
- A March 2009 poll conducted by the Sherwood Park News indicated that 92% of respondents felt that the current local issue that bothered them the most was "potential high voltage power line construction".



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BURYING HIGH VOLTAGE POWER LINES

The Myth:

It is too expensive, and the technology is not sufficiently developed, to bury high voltage power lines.

The Facts:

● Large-scale underground high voltage power line projects constructed since 1980 involve a total of over 1,400km of cable in 17 countries (Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Portugal, South Korea, Spain, Sweden, U.K.). Individual projects varied from 0.4km to 44km in length, and from 63kV to 500kV in force (CIGRE Working Group 2007, Europacable 2009). There are hundreds of other examples from around the world of successfully buried high voltage power lines. One of these, completed in 2000, was a 500kV cable buried in Tokyo, Japan over a 39.8km distance (Yonemoto et al. 2003). The technology has been available for several decades.



- Underground cables enhance power grid security and reliability and give improved performance, compared to overhead lines.
- Underground cables are significantly more reliable. Failures in underground cables are significantly lower than in overhead lines.
- Underground cables are significantly more efficient. Transmission losses with underground cables are significantly lower than with overhead lines, which translates to a much lower carbon footprint.
- Underground cables are affordable compared to overhead lines. There is a higher initial capital cost, but this difference is cancelled out by the much higher and costly electricity losses from overhead lines over the life of the line. When this is taken into account, plus the lengthy planning delays, property devaluation, impacts on tourism and higher maintenance costs associated with overhead lines, costs of underground and overhead lines are almost equal.



- The following information is from the Askon Consulting Group (2008):
 - Underground cables are much safer than overhead lines. No electric fields are emitted from buried cables, and most importantly, the magnetic field is greatly reduced both in intensity right over the line and in distance of impact. This significantly reduces the negative health effects documented for overhead lines.
 - Underground cables provide obvious environmental benefits versus overhead lines in terms of land use, visual impact, property valuation, and tourism.

- David Quest, MLA for Strathcona, tabled a Private Member's Motion in the Alberta Legislative Assembly urging the Alberta Government to investigate the feasibility of burying high voltage transmission lines. On April 6, 2009, the Motion received unanimous support in the Assembly.

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Power Lines – Myths vs. Facts



PROPERTY VALUES AND HIGH VOLTAGE POWER LINES

The Myth:

Property values are not affected by overhead high voltage power lines.

The Facts:

- A British study in 2007 showed the value of properties at a distance of less than 100m from high voltage overhead transmission lines was 38% lower than comparable properties. The effect of devaluation has been seen up to 2.5km from such lines (Askon Consulting Group 2008).
- A study of agricultural properties in Canada in the mid-1980s found that the per acre values from more than 1,000 sales were 16-29% lower for properties with easements for high voltage transmission lines than for similar properties without easements (Askon Consulting Group 2008).
- For example, on the basis of the Strathcona County tax register, 2,300 homes within 800m of the Sherwood Park Greenbelt have a combined assessed value of more than \$1.2 billion. Based on a very conservative average property devaluation of 10-15%, the total devaluation would be \$120-\$180 million.



- It is important to note that homes lying immediately along EPCOR's and AltaLink's preferred route for the Heartland Transmission Line would experience property devaluations of up to 38% (comparable to devaluations in the above-mentioned 2007 British study).
- Property devaluation associated with a 500kV overhead power line would affect many more homes than would other overhead lines, because the much taller and wider 500kV towers would be visible for a far greater distance than in previous property devaluation studies conducted elsewhere.
- RETA's position is that homeowners and businesses must be fully compensated for these decreases in the value of their properties in the unfortunate event that an overhead power line is constructed near them.



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Power Lines – Myths vs. Facts



NATURAL ENVIRONMENT ALONG SO-CALLED "PREFERRED" ROUTE

The Myth:

There is no natural environment along EPCOR's and AltaLink's preferred route that would be impacted by overhead high voltage power lines.

The Facts:

- Significant sections of EPCOR's and AltaLink's preferred route for the Heartland Transmission Line lie within the Cooking Lake Moraine. This area contains many waterbodies and has been referred to as the Prairie Parkland "Duck Factory" because so many ducks and other waterfowl breed, nest, rear their broods here and stop over during Spring and Fall migration (Kristensen 1993a). Nowhere else in Alberta, except the Peace-Athabasca Delta and Hay-Zama Lakes area, contains such a large block of high-quality waterfowl habitat (Kemper 1976).
- Some of the waterbodies and natural spaces in this area that are important habitat for waterfowl, many other bird species and mammals, which would be directly impacted by an overhead high voltage power line, include: North Saskatchewan River, Strathcona Science Provincial Park, Bretona Pond Buck-for-Wildlife Area, Mill Creek, Fulton Creek Marshland, Fulton Pond, Fulton Creek, Sherwood Park Natural Area, Crosswhite's Pond, Bretona ConservAction Area, Baseline Slough, Sturgeon River, and many other natural ponds, sloughs and wetlands.
- Bretona Pond is a popular wetland for hundreds of birdwatchers and natural historians annually (Kristensen 1993b). Significant research has been conducted at Bretona Pond and area. Green and Koski (1984) recommended the establishment of a Buck-for-Wildlife project at this site. In 1985, the Alberta Govern-

ment and Strathcona County entered into a joint Buck-for-Wildlife project and established interpretive facilities at Bretona Pond (Kristensen 1990). The pond was identified as having "good opportunities for wildlife viewing and wetland interpretation" (Westworth and Knapik 1987) and as critical wetland habitat (Griffiths 1987). As a result, the Strath-

cona County Recreation and Parks Outdoor Master Plan (1987) listed Bretona Pond as a significant natural feature, primarily as a productive wetland for nesting, moulting, staging and migrating waterfowl. In 1989, Strathcona County and the Alberta Government further recognized the ecological significance of the Colchester area by designating the Bretona ConservAction Area just south of Bretona Pond (Kristensen 1990).

- Several hundred plant species, 3 fish species, 3 amphibian species, 181 bird species and 26 mammal species have been recorded at Bretona Pond (Kristensen 1981, 1982, 1993a, 1997, 1998, pers. comm.). A few of the more interesting bird species are: eared grebe, American white pelican, tundra swan, trumpeter swan, snow goose, ruddy duck, Barrow's goldeneye, bald eagle, peregrine falcon (species at risk), great blue heron, sandhill crane, American avocet, Wilson's phalarope, and short-eared owl (species of special concern pictured above).

See other RETA Fact Sheets for impacts on birds and other parts of the environment.



American White Pelicans

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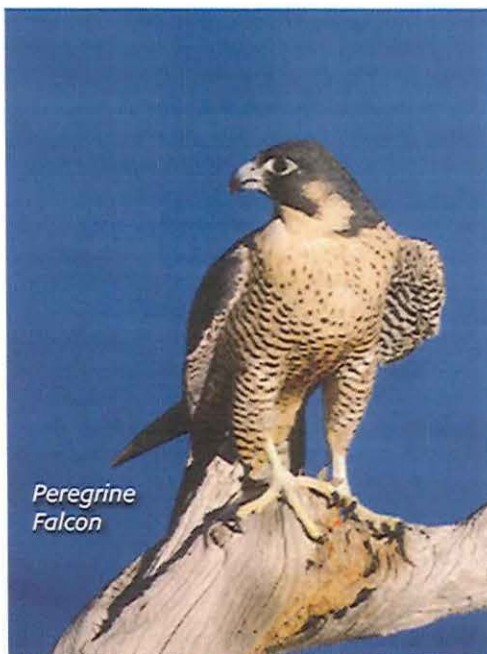
NATURAL ENVIRONMENT ALONG SO-CALLED "ALTERNATE" ROUTE

The Myth:

There is no natural environment along EPCOR's and AltaLink's alternate route that would be impacted by overhead high voltage power lines.

The Facts:

- Many environmentally sensitive areas are found along EPCOR's and AltaLink's alternate route for the Heartland Transmission Line. Particularly noteworthy sites include Lois Hole Centennial Provincial Park, Wagner Natural Area, and Manawan Lake. Other important waterbodies, wetlands, old growth forests and natural grasslands include the Sturgeon River, a Nature Conservancy of Canada quarter section, and numerous other quarter sections. Many species of birds and mammals in these areas would be negatively impacted by an overhead high voltage power line.
- Lois Hole Centennial Provincial Park (which includes Big Lake) is the largest provincial park located along the boundaries of St. Albert and Edmonton. As a result, it is a very popular and well-used area by naturalists and birdwatchers. The Alberta Government first designated the Big Lake Natural Area in 1999, and then upgraded its protected status and size in 2005, renaming it Lois Hole Centennial Provincial Park in honour of the late Lieutenant Governor of Alberta. Big Lake is globally recognized as an "Important Bird Area" and is considered one of Alberta's more important bird habitats located close to a large urban area.
- More than 235 bird species have been recorded at Big Lake, and include such noteworthy species as: common loon, double-crested cormorant, trumpeter swan, tundra swan, sprague's pipit, peregrine falcon (species at risk), short-eared owl (species of special concern), bald eagle, American white pelican, great blue heron, osprey and American avocet. Big Lake also provides nesting habitat for large colonies of Franklin's gull, and great egrets (rare in Alberta) have been recorded nesting here. Thousands of waterfowl use Big Lake annually for nesting, moulting, migration stop-over and staging.
- Wagner Natural Area, designated in 1975, contains 16 species of orchids native to Alberta as well as many other interesting plant species. Calcareous peatland habitat and marl ponds in the area are unique in Alberta. A well-developed trail system attracts hundreds of botanists and natural historians every year.



Peregrine Falcon

See other RETA Fact Sheets for impacts on birds and other parts of the environment.

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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES & BIRDS

The Myth: Overhead high voltage power lines do not have a negative impact on birds.

The Facts:

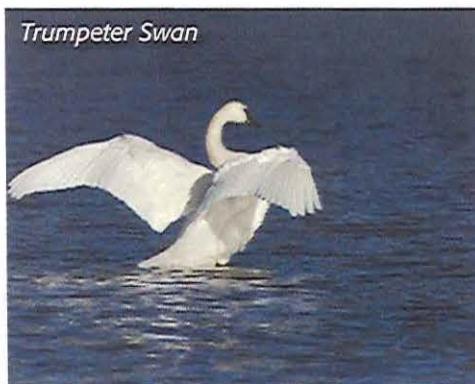
● Bird deaths resulting from collision with overhead transmission lines have been reported for over 100 years (Coues 1876, Cohen 1896, Emerson 1904). Species killed during these earlier studies included horned larks, phalaropes (shorebird), ruddy ducks and rails (waterbirds) (species also recorded along EPCOR's and AltaLink's preferred and alternate routes for the Heartland line).

- Transmission line collisions resulted in 36% mortality of fledged (able to fly) sandhill cranes in the Rocky Mountains (Drewien 1973), 44% mortality of fledged trumpeter swans in Wyoming (Lockman 1988), and 40% mortality of endangered fledged whooping cranes in the Rocky Mountains (Lewis 1993).
- Based on a wetlands study in North Dakota, waterbirds (46% documented mortality), waterfowl (26%), shorebirds (8%) and perching birds (5%) were most vulnerable to strikes with transmission lines (Faanes 1987). The author used these data to estimate 124 bird deaths per kilometer of power line per year.
- The U.S. Fish and Wildlife Service (2002) estimated up to 174 million bird deaths annually in the U.S. from collisions with overhead transmission lines, which is greater than the number of bird deaths from hunting.



Great Blue Heron

- In the Netherlands, Koops (1987) examined 4,666km of bulk transmission line, and estimated 750,000 to one million birds killed per year.
- Ainley et al. (2001) recommended burying high voltage power lines in areas where there were larger concentrations of birds to eliminate collision deaths.
- The electrical utility industry is poorly monitored for both bird collisions and electrocutions (Manville 2005). Overhead power lines electrocute tens to hundreds of thousands of birds annually in the U.S.
- Huckabee (1993) and Bevanger (1998) found that large, less maneuverable birds are more vulnerable to collisions with power lines, including herons, cranes, swans, and pelicans. Canada geese, larger duck species and grouse are also less maneuverable. Eared grebes were particularly vulnerable to power line collisions (Malcolm 1982). Bevanger (1998) found that herons, falcons, owls and perching birds were frequently electrocuted by power lines. (All of these species are also recorded along EPCOR's and AltaLink's preferred and alternate routes for the Heartland line.)



Trumpeter Swan

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Power Lines – Myths vs. Facts



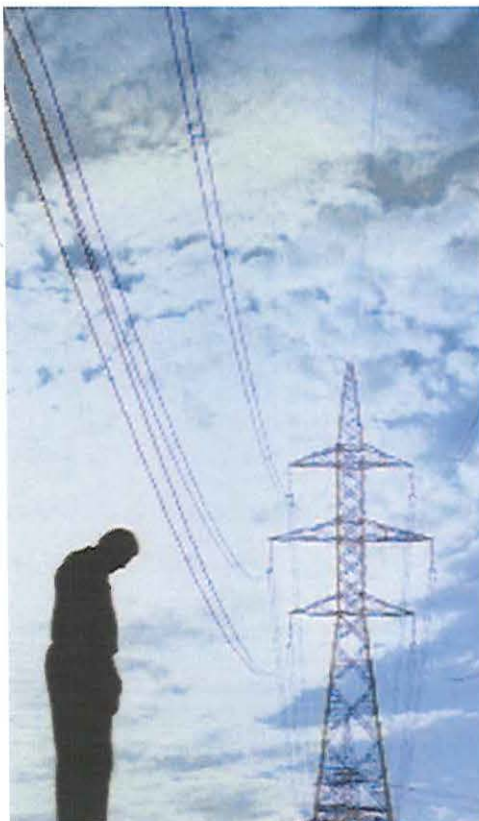
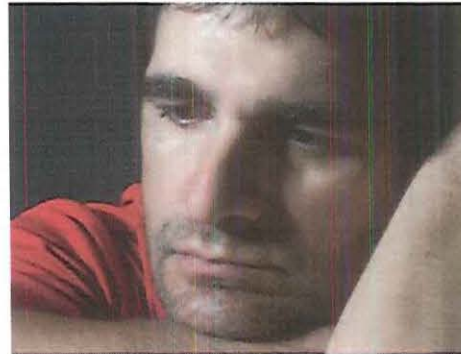
HIGH VOLTAGE POWER LINES, SUICIDE & DEPRESSION

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of suicide or depression.

The Facts:

- One of the earlier studies to find a correlation between the presence of transmission line EMFs and the increased occurrence of suicides was conducted in England by Reichmanis et al. (1979).
- Electrical utility workers in Quebec had increased risks of committing suicide up to 2.8 times the expected (Baris et al. 1996).
- Wijngaarden et al. (2000) examined mortality from suicide in relation to EMF exposure among close to 139,000 electrical utility workers. They found the risk of suicide mortality was up to 3.6 times the expected, depending on specific type of electrical utility work and worker age. Workers less than 50 years of age experienced the highest risk of suicide mortality.
- The occurrence of depression and headache in relation to living next to a high voltage power line in the U.S. was studied by Poole et al. (1993). Subjects who lived either on a property abutting the power line right-of-way or who could see the towers from their yard or house had a risk of depression 2.8 times the expected. The same subjects had a risk of non-migraine headaches 1.5 times the expected.
- Data from the Vietnam Experience Study were analysed by Savitz et al. (1994), who reported risks of depression among electrical workers 1.7 to 2.0 times the expected.
- The risk of severe depression was increased by 4.7 times the expected among Finnish subjects living within 100m of a high voltage power line (Verkasalo et al. 1997).
- In a study of Polish subjects, the difference in levels of depression and anxiety disorder between a group living next to two 400kV transmission lines and a control group was statistically significant (Zyss et al. 1997).



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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES AND BIRTH PROBLEMS

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of birth defects, miscarriage or other birth problems.

The Facts:

● Pregnant women in the San Francisco area studied by Li et al. (2002) experienced miscarriage risks that increased with an increasing level of magnetic field exposure. The risk of miscarriage among women exposed to above-normal magnetic field levels varied from 2.9 to 5.7 times the expected.

● Miscarriages among northern California women were linked to magnetic field exposure during pregnancy (Lee et al. 2002), with risks of miscarriage for exposed women up to 3.1 times the expected.



● A study of close to 1.3 million births in Norway indicated an association between several birth defects and parental exposure to 50-Hz magnetic fields (Blaasaas et al. 2002). Maternal exposure to EMFs was associated with increased risks of spina bifida (incompletely formed spinal cord at birth) and club foot. Paternal exposure to EMFs was associated with increased risks of anencephaly (children born without a forebrain) and a number of other defects.

● Blaasaas et al. (2003) studied risks of birth defects among Norwegians by residential exposure to 50-Hz magnetic fields from power lines. The greatest increase in risk was for esophageal birth defects, 2.5 times the expected.



● Birth outcomes were studied for pregnant Norwegian women in relation to distance lived from power lines (Blaasaas et al. 2004). The highest increased risks of birth defects for women living near power lines were seen for hydrocephalus (“water on the brain”), 1.7 times the expected; and for heart defects, 1.5 times the expected.

● Birth malformations among pig litters whose mothers had been exposed to 60-Hz electric fields for 18 months were 2.6 times more numerous than among litters whose mothers had not been exposed, the difference being statistically significant (Sikov et al. 1987). This increased risk of birth malformations was passed on to first generation female pigs as well.

● A laboratory study of rats was conducted to determine the effects of EMFs on development of sexual characteristics of embryos (McGivern et al. 1989). Data indicated that EMF exposure during this critical period of sexual development in male embryos resulted in several negative sexual abnormalities once animals reached adulthood.

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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES & OTHER HEALTH PROBLEMS

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no impact on the incidence of Lou Gehrig's disease, sterility, and other health problems.

The Facts:

- On the basis of epidemiological (population health and illness) findings, an association exists between Lou Gehrig's disease and occupational EMF exposure (Ahlbom et al. 2001).
- Based on a nation-wide mortality study in Denmark of over 21,000 men employed in utility companies and with above-average exposure to EMFs, Johansen and Olsen (1998) found a 2-fold increase in mortality from Lou Gehrig's disease.
- Evidence that people employed in electrical occupations have an increased risk of developing Lou Gehrig's disease is even stronger than for Alzheimer's disease or Parkinson's disease (The Advisory Group on Non-Ionising Radiation 2001). (See Fact Sheet No. 3 for information on Alzheimer's disease.)



- Effects of EMF exposure on male rat sexual organ development were studied by Khaki et al. (2008a, 2008b). In one of the studies, male rats were exposed to 50-Hz EMFs while they were embryos and for 5 weeks following birth. Prostate gland cells of animals were negatively abnormal in several ways. In the second study, when male rats were exposed to 50-Hz EMFs for 2 months following birth, cells in their seminal vesicles (glands that secrete part of the semen)



DNA double helix chromosome

- were seriously altered. The authors concluded with the suggestion that EMFs are able to interrupt the normal production of sperm and can probably cause sterility in men.
- The U.S. Food and Drug Administration indicates that interference from EMFs can affect various medical devices including cardiac pacemakers and implantable defibrillators. Overhead high voltage power lines produce EMFs strong enough to interfere with some models of pacemakers and defibrillators.
- Studies have been conducted to determine whether EMF exposure can change the genetic material of organisms. Researchers experimenting with cells have found that EMF exposure appears to inhibit the cell's ability to repair normal DNA damage (EMFRAPID 2002).
- A group of French subjects exposed to above-normal EMFs had significant decreases in sexual urges, and increases in physical fatigue, physical weakness, feeling of faintness, extreme depression, and irritability (Bonhomme-Faivre et al. 1998).

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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINES & OTHER HEALTH PROBLEMS

The Myth:

Overhead high voltage power lines and associated electromagnetic fields (EMFs) have no effects on diabetes, muscular sclerosis, disrupted sleep, and other health problems.

The Facts:

- Havas (2006) studied numerous diseases and ailments in relation to extremely low frequency EMFs. When EMF levels were significantly reduced in schools, both staff and students reported improved health and more energy. The number of students needing inhalers for asthma was reduced and student behavior associated with Attention Deficit Disorder and Attention Deficit Hyperactivity Disorder improved. Also, Type 1 diabetics required less insulin, Type 2 diabetics had lower blood sugar levels, and individuals with multiple sclerosis had fewer tremors and better balance when EMF levels were significantly reduced. In cases of tinnitus ("ringing" in the ears), symptoms disappeared when EMF levels were reduced.
- 5-60 million diabetics worldwide may be negatively affected by EMFs (Wild et al. 2004, Havas 2006). Laboratory studies document that successful functioning of insulin is reduced by EMFs (Sakurai et al. 2004, Li et al. 2005). EMF exposure causes stress at certain levels, and stress increases blood sugar levels in diabetics (Hinkle and Wolf 1950, Blank and Goodman 2004).
- 3% of the population has electromagnetic hypersensitivity (sensitivity and negative responses to very low EMF intensities) and 35% have symptoms (Philips and Philips 2006).
- Overnight exposure to 60-Hz magnetic fields (similar to power lines) disrupted brain electrical activity during night



sleep (EMFRAPID 2002). Individuals exposed to the magnetic fields experienced a pattern of poor and disrupted sleep.

- Australian and American studies have reported EMF effects on heart rate, a slowing of up to 5 beats per minute (EMFRAPID 2002). In another study, occupational exposure to EMFs resulted in impairments to the natural regulation of heart rate (Bortkiewicz et al. 1996).
- It is well known in the medical community that stress often causes, speeds up, or intensifies many diseases and other negative health effects. Landowners who face the possibility of having their private property suddenly designated as a high voltage power line corridor, and families who end up living near or within sight of high voltage power lines are under significant stress. This increased stress contributes to many diseases and other health problems. These stress-induced health impacts, together with the EMF-induced and corona effect-induced health impacts and power line safety hazards, make people who live, work or attend school near overhead high voltage power lines particularly vulnerable to accidents, illness and death.



Blood sugar test

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Power Lines – Myths vs. Facts



HIGH VOLTAGE POWER LINE SAFETY AND RELIABILITY

The Myth:

Overhead high voltage power lines and towers are safe and reliable.

The Facts:

- Overhead high voltage power lines and towers have been destroyed during tornadoes and ice storms, and deteriorate from exposure to the weather.
- For example, during the July 31, 1987 tornado in Edmonton that killed 27 people, injured nearly 300, and left at least 750 families homeless (The Edmonton Sun 1987), high voltage transmission towers and lengths of overhead lines were brought down by winds estimated up to 330km per hour. (Members of the RETA Board witnessed the downed towers and heavy power lines scattered along the tornado's path between 17 Street and 34 Street in Mill Woods, and took numerous photographs.)
- In total, the 1987 tornado caused between \$6 million and \$8 million damage to TransAlta power equipment. The storm destroyed TransAlta's Stelco substation, as well as 49 240kV double circuit steel towers, 17 138kV double circuit steel towers, and 134 138kV single circuit wooden structures (The Edmonton Sun 1987).
- 8 tornadoes, including the one in 1987, have hit Edmonton and area since 1879, killing 49 people (The Edmonton Sun 1987). Considering that an average of 8 tornadoes per year hit Alberta, it is a known fact that additional tornadoes will hit Edmonton and the rest of Alberta in the future. The danger of death, injury and significant economic loss becomes increased with every overhead high voltage power line that is constructed in Alberta.



does will hit Edmonton and the rest of Alberta in the future. The danger of death, injury and significant economic loss becomes increased with every overhead high voltage power line that is constructed in Alberta.

- Close to 1.5 million homes in Quebec and 230,000 homes in Ontario were



without electricity during the January 1998 ice storm that hit Canada and the U.S., dubbed the worst of its kind in Canadian history (Wikipedia 2009). Rain for 6 days froze onto power equipment and completely crippled parts of the Hydro-Quebec power grid for up to 33 days in the middle of winter. More than 1,000 high voltage towers collapsed in Canada alone, including the associated 735kV, 315kV, 230kV, and 120kV lines. Significant social and economic damage resulted including 46 deaths attributed to lack of electric heating, and from house fires and carbon monoxide poisoning as people built fires trying to compensate for no electric heat (CTV 2008). Hydro-Quebec's repair costs were about \$800 million plus another \$2 billion in upgrades in an attempt to prevent similar damage in the future to overhead power lines.

- 6 million people were without electricity for 9 hours in March 1989 in Quebec and area, due to a severe geomagnetic storm induced by the sun that knocked out power in Hydro-Quebec's overhead high voltage grid (Wikipedia 2009). The storm caused \$10 million in damage to Hydro-Quebec, and tens of millions of dollars to its customers.

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Power Lines – Myths vs. Facts



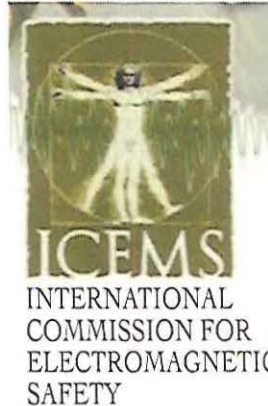
INTERNATIONAL COMMISSION FOR ELECTROMAGNETIC SAFETY

The Myth:

Without 100% proof that electromagnetic fields (EMFs) cause leukemia, other cancers, Alzheimer's disease, depression, suicide, and many other health problems, there is no need to warn or protect the public.

The Facts:

● The International Commission for Electromagnetic Safety (ICEMS), an association of renowned scientists, medical doctors and engineers involved in EMF and health research, met in Benevento, Italy in 2006. They passed the Benevento Resolution which encourages governments to adopt a framework of guidelines for public and occupational EMF exposure that reflect the Precautionary Principle.



● The Precautionary Principle states when there are indications of possible adverse effects, though they remain uncertain, the risks from doing nothing may be far greater than the risks of taking action to control these exposures. The Precautionary Principle shifts the burden of proof from those suspecting a risk to those who discount it.

● The Benevento Resolution also included the following resolutions: "More evidence has accumulated suggesting that there are adverse health effects from occupational and public exposures to electric, magnetic and electromagnetic fields, at current exposure levels. There is evidence that present sources of funding bias the analysis and interpretation of research findings towards rejection of evidence of possible public health risks. Epidemiological (population health and illness) and laboratory studies that show increased risks for cancers and other diseases from occupational exposures to EMF cannot be ignored".

● In 2008, the ICEMS passed a resolution in Venice which included the following statements: "As an outcome, we are compelled to confirm the existence of non-thermal effects of electromagnetic fields on living matter, which seem to occur at every level of investigation from molecular to epi-

demiological. The....protection standards recommended by international standards organizations, and supported by the World Health Organization, are inadequate."

● It is difficult, if not impossible, to discount statements of caution and recommendations made by the many medical doctors, scientists and engineers who are members of the ICEMS and who are experts on EMFs and their effects on human and animal health.

Evidence is mounting...



...exposures to EMF cannot be ignored.

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Power Lines – Myths vs. Facts



EUROPEAN PARLIAMENT RESOLUTION ON ELECTROMAGNETIC FIELDS

The Myth:

Without 100% proof that electromagnetic fields (EMFs) cause brain cancer, other cancers, genetic damage, miscarriages, birth defects, and many other health problems, there is no need to inform, warn or protect the public.

The Facts:

● On April 2, 2009, the European Parliament (elected institution of the European Union [EU]) passed a resolution on health concerns associated with EMFs. Following are just a few of the statements within this resolution that indicate how serious the European Parliament takes the threat of power line EMFs to human and environmental health:

- The resolution takes into account and is based on certain Articles of "the European Community (Union) Treaty, seeking to promote a high level of human health, environmental protection and workers' health and safety protection".
- "...the fact that the scientific community has reached no definite conclusions (on the degree of EMF effects) has not prevented some national or regional governments, in China, Switzerland, and Russia, as well as in at least nine EU Member States, from setting what are termed 'preventive' exposure limits."
- "...the majority of citizens do not feel that the public authorities inform them adequately on measures to protect them from EMFs."
- "Calls on the Member States to make available to the public, jointly with the operators in the sector, maps showing exposure to high-voltage power lines...Calls for that information to be displayed on an internet page so that it can easily be consulted by the public, and for it to be disseminated in the media."
- "Calls on the Council (highest political body of the EU) and Commission

(Executive Branch of the EU)...to encourage the introduction of a single standard designed to ensure that local residents are subjected to as low a degree of (EMF) exposure as possible when high-voltage grids are extended."



- One of the Articles that the European Parliament resolution is founded on is Article 174 (European Union 2006) which requires that environmental and human health protection be based on the Precautionary Principle. The foundation of this principle is that preventive action be taken to protect the environment and human health before certainty of harm from EMFs is necessarily proven. This is contrary to the approach by electricity transmission companies, industry-based organizations, and Health Canada that require 100% proof of adverse effects of low frequency EMFs before addressing public concerns and exposure standards.

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