JUSTnews
canadian unitarians for social justice
DISCUSSION PAPER
Number 25, Spring 2013

A Plan for 100% Renewable Energy by 2050

By John Cook

We recently examined how Australia can meet 100% of its electricity needs from renewable sources by 2020. Here we will examine how that goal can be scaled up for the rest of the world.

Energy consulting firm Ecofys produced a report detailing how we can meet nearly 100% of global energy needs with renewable sources by 2050. Approximately half of the goal is met through increased energy efficiency to first reduce energy demands, and the other half is achieved by switching to renewable energy sources for electricity production (Figure 1).

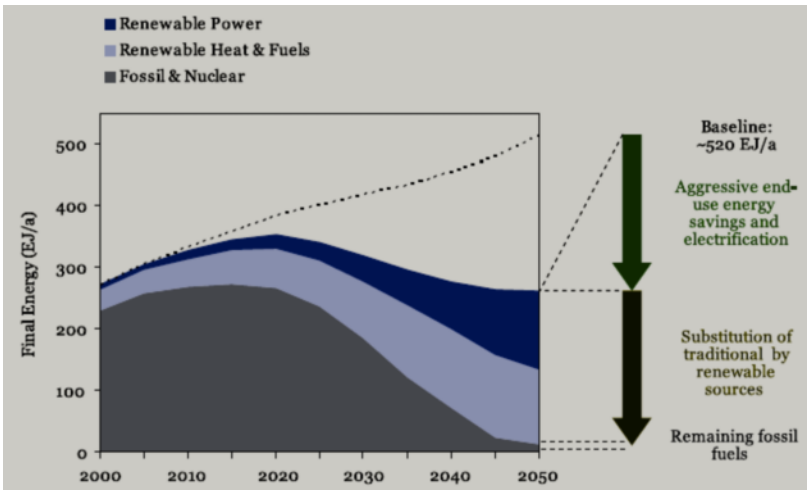


Figure 1: Ecofys projected global energy consumption between 2000 and 2050

To achieve the goal of 100% renewable energy production, Ecofys foresees that global energy demand in 2050 will be 15% lower than in 2005, despite a growing population and continued economic development in countries like India and China. In their scenario:

"Industry uses more recycled and energy-efficient materials, buildings are constructed or upgraded to need minimal energy for heating and cooling, and there is a shift to more efficient forms of transport.

"As far as possible, we use electrical energy rather than solid and liquid fuels. Wind, solar, biomass and hydropower are the main sources of electricity, with solar and geothermal sources, as well as heat pumps providing a large share of heat for buildings and industry. Because supplies of wind and solar power vary, 'smart' electricity grids have been developed to store and deliver energy more efficiently. Bio-energy (liquid bio-fuels and solid biomass) is used as a last resort where other renewable energy sources are not viable."

To achieve the necessary renewable energy production, Ecofys envisions that solar energy supplies about half of our electricity, half of our building heating, and 15% of our industrial heat and fuel by 2050. This requires an average annual solar energy growth rate much lower than we're currently achieving—an encouraging finding.

The report notes that wind could meet one-quarter of the world's electricity needs by 2050 if current growth rates continue, and sets that as its goal. Ecofys also envisions more than one-third of building heat coming from geothermal sources by 2050. If we double current geothermal electricity production growth rates, it can provide 4% of our total electricity needs by that date. Ocean power, through both waves and tides, accounts for about 1% of global electricity needs in 2050. Hydropower, which currently supplies 15% of global electricity, ultimately supplies 12% in the Ecofys scenario. As you can see in Figure 2, global renewable energy use ramps up gradually between now and 2050.

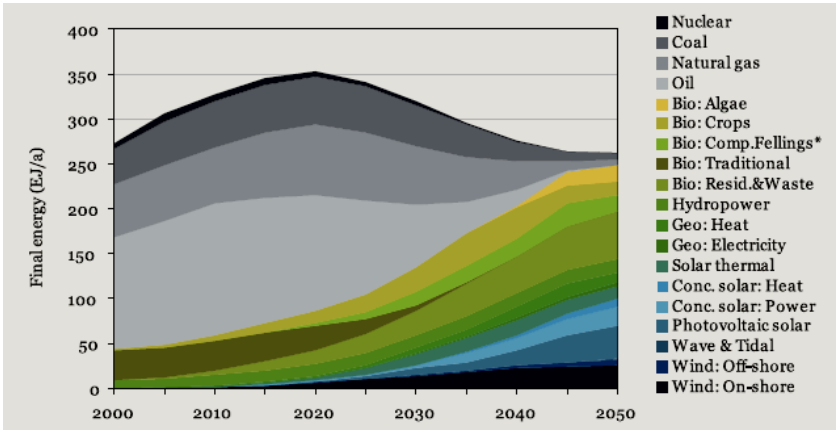


Figure 2: Energy use by source between 2000 and 2050

Burning biomass (such as plant and animal waste) will supply 60% of industrial fuels and heat, 13% of building heat, and 13% of

electricity needs. Much of the proposed biomass use comes from plant residues from agriculture and food processing, sawdust and residues from forestry and wood processing, manure, and municipal waste. All of these renewable energy technologies currently exist, and it's just a matter of implementing them on a sufficiently large scale.

Ecofys also envisions using currently existing technology and expertise to "create buildings that require almost no conventional energy for heating or cooling, through airtight construction, heat pumps and sunlight. The Ecofys scenario foresees all new buildings achieving these standards by 2030." Two to 3% of existing buildings will also need to be retrofitted per year to improve energy efficiency. Ecofys notes that Germany is already retrofitting buildings at this rate. Transportation must become more efficient, using more fuel efficient vehicles like electric cars, and increasing use of mass public transportation.

Accomplishing all of this will require a major effort, but Ecofys has a number of suggestions how we can start:

- Introduce minimum efficiency standards worldwide for all products that consume energy, including buildings
- Build energy conservation into every stage of product design
- Introduce strict energy efficiency criteria for all new buildings
- Introduce an energy tax, or perhaps a carbon emissions price
- Help developing countries pursue alternatives to inefficient biomass burning, such as improved biomass cooking stoves, solar cookers and small-scale bio-gas digesters
- Increase investment in public transportation
- Make individuals, businesses, and communities more aware of their energy consumption, and encourage increased efficiency

Undoubtedly you're wondering how much this will all cost. Ecofys finds that we will need to divert up to 3% of global gross domestic product (GDP) to investments in materials and energy efficiency, renewable energy, and necessary infrastructure. However, we also save money in terms of reduced fossil fuel use.

The report finds that we can save nearly 4 trillion Euros ($5.7 trillion) per year by 2050 based on energy efficiency savings and reduced fuel costs, as compared to business-as-usual. The up-front investments are expensive, but savings will begin to exceed those costs by 2040, and even sooner if oil prices rise faster than expected, or if we factor in the costs of climate change and the impact of burning fossil fuels on public health. The plan will reduce energy-related greenhouse-gas emissions 80% below 1990 levels by 2050, which will give us a fighting chance to avoid the 2°C global warming "danger limit."

There's a saying, "where there's a will, there's a way". In this case we have a way to fully transition from fossil fuels to renewable energy by 2050. The question is, do we have the will?

Posted on 25 March 2011 in Skeptical Science

About Skeptical Science

The goal of Skeptical Science is to explain what peer reviewed science has to say about global warming. When you peruse the many arguments of global warming skeptics, a pattern emerges. Skeptic arguments tend to focus on narrow pieces of the puzzle while neglecting the broader picture. For example, focus on Climategate emails neglects the full weight of scientific evidence for man-made global warming. Concentrating on a few growing glaciers ignores the world-wide trend of accelerating glacier shrinkage. Claims of global cooling fail to realise the planet as a whole is still accumulating heat. This website presents the broader picture by explaining the peer reviewed scientific literature.

Often, the reason for disbelieving in man-made global warming seems to be political rather than scientific. E.g.—"it's all a liberal plot to spread socialism and destroy capitalism." As one person put it, "the cheerleaders for doing nothing about global warming seem to be largely the cheerleaders for many causes of which I disapprove." However, what is causing global warming is a purely scientific question. Skeptical Science removes the politics from the debate by concentrating solely on the science.

About the author

Skeptical Science is maintained by John Cook, the Climate Communication Fellow for the Global Change Institute at the University of Queensland. He studied physics at the University of Queensland, Australia. After graduating, he majored in solar physics in his post-grad honours year. He is not a climate scientist. Consequently, the science presented on Skeptical Science is not his own, but taken directly from the peer reviewed scientific literature. To those seeking to refute the science presented, one needs to address the peer reviewed papers where the science comes from (links to the full papers are provided whenever possible).

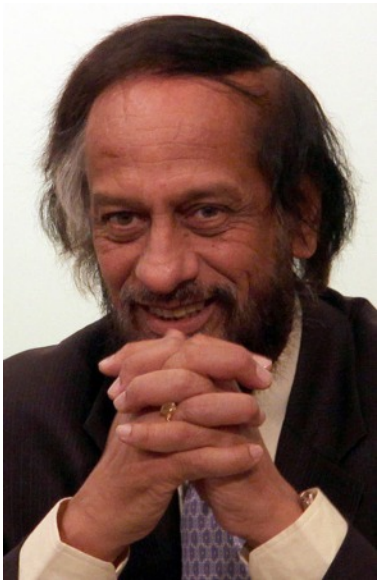
There is no funding to maintain Skeptical Science other than Paypal—it's run at personal expense. John Cook has no affiliations with any organisations or political groups. Skeptical Science is strictly a labour of love. The design was created by John's talented web designer wife.

PRESS RELEASE: Potential of Renewable Energy Outlined in Report by the Intergovernmental Panel on Climate Change

Abu Dhabi, 9 May 2011 – Close to 80% of the world's energy supply could be met by renewables by mid-century if backed by the right enabling public policies, a new report shows.

The findings, from over 120 researchers working with the Intergovernmental Panel on Climate Change (IPCC), also indicate that the rising penetration of renewable energies could lead to cumulative greenhouse gas savings equivalent to 220 to 560 Gigatonnes of carbon dioxide ($GtC0_2eq$) between 2010 and 2050.

The upper end of the scenarios assessed, representing a cut of around a third in greenhouse gas emissions from business-as-usual projections, could assist in keeping concentrations of greenhouse gases at 450 parts per million.



Rajendra Pauchari, chairperson of the IPCC in 2011

This could contribute towards a goal of holding the increase in global temperature below 2 degrees Celsius—an aim recognized in the United Nations Climate Convention's Cancun Agreements.

The findings, launched today after being approved by member countries of the IPCC in Abu Dhabi, United Arab Emirates, are contained in a summary for policymakers of the *Special Report on Renewable Energy Sources and Climate Change Mitigation* (SRREN).

The summary is a short version of a roughly thousand-page comprehensive assessment compiled by over 120 leading experts from all over the world for IPCC's Working Group III.

"With consistent climate and energy policy support, renewable energy sources can contribute substantially to human well-being by sustainably supplying energy and stabilizing the climate," said Professor Ottmar Edenhofer, Co-Chair of Working Group III at the report launch. "However, the substantial increase of renewables is technically and politically very challenging," he added.

Youba Sokona, Co-Chair of the Working Group III, said: "The potential role of renewable energy technologies in meeting the needs of the poor and in powering the sustainable growth of developing and developed economies can trigger sharply polarized views. This IPCC report has brought some much needed clarity to this debate in order to inform governments on the options and decisions that will be needed if the world is to collectively realize a low carbon, far more resource efficient and equitable development path."

Ramon Pichs, Co-Chair of the Working Group III, added: "The report shows that it is not the availability of the resource, but the public policies that will either expand or constrain renewable energy development over the coming decades. Developing countries have an important stake in this future – this is where most of the 1.4 billion people without access to electricity live, yet also where some of the best conditions exist for renewable energy deployment."

Also speaking at the launch, Rajendra Pachauri, Chairman of the IPCC, said: "The IPCC brought together the most relevant and best available information to provide the world with this scientific assessment of the potential of renewable energy sources to mitigate climate change. The Special Report can serve as a sound knowledge basis for policymakers to take on this major challenge of the 21st century."

The report will feed into the broader work of the IPCC as it prepares its Fifth Assessment Report (AR5). The AR5 Synthesis Report is scheduled for finalization in September 2014.

The SRREN, approved by government representatives from 194 nations, has reviewed the current penetration of six renewable energy technologies and their potential deployment over the coming decades.

The six renewable energy technologies reviewed are:

Bioenergy, including energy crops; forest, agricultural and livestock residues and so called second generation biofuels

Direct solar energy, including photovoltaics and concentrating solar power

Geothermal energy, based on heat extraction from the Earth‘s interior

Hydropower, including run-of-river, in-stream or dam projects with reservoirs

Ocean energy, ranging from barrages to ocean currents, and systems that harness temperature differences in the marine realm

Wind energy, including on- and offshore systems

Over 160 existing scientific scenarios on the possible penetration of renewables by 2050, alongside environmental and social implications, have been reviewed, with four scenarios analysed in-depth. These four were chosen to represent the full range. Scenarios are used to explore possible future worlds, analysing alternative pathways of socio-economic development and technological change.

The researchers have also studied the challenges linked to how renewable energy can be integrated into existing and future energy systems, including electricity grids, and likely cost benefits from these developments.

While the scenarios arrive at a range of estimates, the overall conclusions are that renewables will take an increasing slice of the energy market.

The most optimistic of the four in-depth scenarios estimates renewable energy will account for as much as 77% of the world’s energy demand by 2050, amounting to about 314 of 407 Exajoules per year. As a comparison, 314 Exajoules is over three times the annual energy supply in the United States in 2005, which is also a similar level of supply on the Continent of Europe according to various government and independent sources.

Seventy-seven percent of the world’s energy supply from renewable sources is up from just under 13% of the total primary energy supply of around 490 Exajoules in 2008. Each of the scenarios is underpinned by a range of variables such as changes in energy efficiency, population growth and per capita consumption. These lead to varying levels of total primary energy supply in 2050, with the lowest of the four scenarios seeing renewable energy accounting for a share of 15% in 2050, based on a total primary energy supply of 749 Exajoules.

While the report concludes that the proportion of renewable energy will likely increase even without enabling policies, past experience has shown that the largest increases come with concerted policy changes.

Though in some cases renewable energy technologies are already economically competitive, the production costs are currently often higher than market energy prices. However, if monetary costs of environmental impacts such as emissions of pollutants and greenhouse gases were included in energy prices, more renewable energy technologies might become economically attractive.

For most renewable technologies, costs have declined over the last decades. The authors expect significant technical advancements and further cost reductions in the future, resulting in a greater potential for climate change mitigation.

Public policies that recognize and reflect the wider economic, social and environmental benefits of renewable energies, including their potential to cut air pollution and improve public health, will be key for meeting the highest deployment of renewable energy.

Increasing the share of renewables requires additional short-term and long-term integration efforts. Studies clearly show that combining different renewable sources over larger geographical areas, will smooth variability and decrease overall uncertainty for the power system.

Advanced technologies can optimise an integrated infrastructure for renewables. Additionally, there is a need for balancing supply and demand, like advanced demand and supply forecasting and plant scheduling.

“What is unique about this assessment is that the IPCC allows us to draw on and bring together a broad spectrum of experts on each of the technologies reviewed in collaboration with scientists studying energy systems as a whole. It represents a broad, impartial and state-of-knowledge report on the present and future potential of a low carbon, more resource-efficient energy path,” says Professor Edenhofer.

Key Findings from the Summary for Policymakers

- Of around 300 Gigawatts (GW) of new electricity generating capacity added globally between 2008 and 2009, 140 GW (47%) came from renewable energy.

- Despite global financial challenges, renewable energy capacity grew in 2009—wind by over 30%, hydropower by three percent, grid-connected photo-voltaics by over 50%, geothermal by 4% and solar water/heating by over 20%. The annual production of ethanol increased to 1.6 Exajoules (76 billion litres) and bio-diesel by 0.6 Exajoules (17 billion litres) by the end of 2009. Meanwhile developing countries are responsible for more than 50% of current global renewable energy capacity.
- Most of the reviewed scenarios estimate that renewables will contribute more to a low carbon energy supply by 2050 than nuclear power or fossil fuels using carbon capture and storage (CCS).
- The technical potential of renewable energy technologies exceeds the current global energy demand by a considerable amount—globally and in respect of most regions of the world.
- Under the scenarios analysed in depth, less than 2.5% of the globally available technical potential for renewables is used—in other words over 97% is untapped, underlining that availability of renewable sources will not be a limiting factor.
- Accelerating the deployment of renewable energies will present new technological and institutional challenges, in particular integrating them into existing energy supply systems and end-use sectors.
- According to the four scenarios analysed in detail, global investments in renewable power range from US $1,360 billion to $5,100 billion in the ten years preceding 2020, and US $1,490 to $7,180 billion for the decade 2021 to 2030. For the lower values, the average yearly investments are smaller than the renewable power sector investments reported for 2009.
- A combination of targeted public policies allied to research and development investments could reduce fuel and financing costs leading to lower additional costs for renewable energy technologies.
- Public policymakers could draw on a range of existing experience to design and implement the most effective enabling policies—there is no one-size-fits-all policy for encouraging renewables.

The technical potential of renewable energy technologies exceeds the current global energy demand by a considerable amount.

Key Renewable Energy Technologies and Their Potential

Bioenergy technologies can generate electricity, heat and fuels from a range of 'feedstocks.'

Most current bioenergy systems, including liquid biofuels, reduce greenhouse gas emissions, concludes the summary for policymakers.

Others, such as advanced conversion systems, which for example convert woody wastes into liquid fuels, can deliver 80% to 90% emission reductions compared to fossil fuels.

Bioenergy, mainly for traditional cooking and heating in developing countries, currently represents over 10% of global energy supply or ca. 50 Exajoules per year.

While the share of bioenergy in the overall renewables mix is likely to decline over the coming decades, it could supply 100 to 300 Exajoules of energy by 2050, the expert review concludes.

Direct Solar Energy technologies include photovoltaics and concentrating solar power (CSP). They can produce electricity, heat and light.

Currently, direct solar contributes only a fraction of one percent to total global energy supply.

Potential deployment scenarios range from a marginal role of direct solar energy in 2050 to one of the major sources of energy supply. The actual deployment will depend on continued innovation, cost reductions and supportive public policies.

In the most ambitious climate-stabilization scenarios solar primary energy supply by 2050 reaches up to 130 Exajoules per year, much of it attributed to photovoltaic electricity generation. In some scenarios, its share in global electricity generation reaches up to a third by 2050, but in the majority of scenarios it remains below one tenth.

Geothermal Energy utilizes heat stored in the Earth's interior directly or to generate electricity, with currently about 0.7 Exajoule per year.

By 2050, geothermal deployment could meet more than 3% of global electricity demand and about 5% of the global heat demand.

Global geothermal technical potential is comparable to the global primary energy supply in 2008. However, Geothermal Energy does not reach the technical potential limit in any of the scenarios analyzed, with the deployment rate remaining below 5 percent for both the regional and global level.

Hydropower projects encompass dam projects with reservoirs, run-of-river and in-stream projects. They range from small to large scale.

The installed capacity by the end of 2008 contributed 16% of worldwide electricity supply, making hydropower the largest renewable energy source in the electricity sector.

According to long term scenarios, hydropower's share in global electricity supply may decrease to 10 to 14%. Despite absolute growth in hydropower supply and expected growth in energy demand, supplies from other sources could result in a decreasing share.

Ocean Energy technologies are diverse and use the kinetic, thermal, and chemical energy of seawater. Most are at the demonstration and pilot project phases.

Due to their nascent stages of development, they are unlikely to contribute significantly to global energy supply before 2020.

Ocean energy is currently represented in very few scenarios. As shown by the review, projected deployments could result in energy delivery of up to 7 Exajoules per year by 2050.

Wind Energy's primary relevance to climate change mitigation is to produce electricity from large wind turbines located on land or offshore.

The wind-power capacity installed by the end of 2009 met close to two percent of worldwide electricity demand.

The review shows a high expansion rate in Europe, North America and, more recently, in China and India. Deployment over greater geographic areas is likely needed to achieve the higher uses of renewables indicated by the scenarios.

Under the projection of some scenarios, global wind power share grows to more than 20% by 2050.

Notes

1. The Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN) assesses the potential contribution of renewable energy sources to climate change mitigation. Following the AR4, many governments as well as important actors in civil society and the private sector asked for more substantial information and broader coverage of all questions pertaining to the use of renewable energy.

   The 25th Plenary Session of the IPCC at Mauritius decided to hold a scoping meeting for a possible Special Report. Following the scoping meeting in Lübeck, Germany in January, 2008, IPCC Plenary in Budapest in April, 2008 decided to prepare an IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN) and agreed on its outline. The Summary for Policymakers of the SRREN was approved by the Eleventh Plenary Session of IPCC Working Group III in Abu Dhabi, United Arab Emirates, 5 - 8 May 2011 and was launched on 9 May.
2. The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to review and assess the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data. The UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC.
3. The IPCC Plenary is open to all member countries of the United Nations and WMO. Currently 194 countries are members of the IPCC. Governments participate in the review process and the Plenary Sessions, where main decisions about the IPCC work programme are taken and reports are accepted, adopted and approved. The IPCC Bureau Members, including the Chair, are elected during the Plenary Sessions.
4. The Working Group III (WGIII) 'Mitigation of Climate Change' of the IPCC assesses all relevant options for mitigating climate change through limiting or preventing greenhouse gas emissions and enhancing activities that remove them from the atmosphere. WGIII analyses the costs, benefits and risks of the different approaches to mitigation, considering also the available domestic instruments and policy measures as well as international arrangements. The WGIII is co-chaired by Ottmar Edenhofer of the *Potsdam Institute for Climate Impact Research*, Germany, Ramon Pichs of the *Centro de Investigaciones de la Economía Mundial*, Cuba, and Youba Sokona (Mali) of the *Africa Climate Policy Center* in Ethiopia.

For Further Information Please Contact:
Nick Nuttall, IPCC Plenary Spokesperson, tel: +254 733 632755 or E-mail: nick.nuttall@unep.org
Rockaya Aidara, IPCC Press Officer, tel: +41 22 730 8120 or E-mail: raidara@wmo.int

Useful links:
SRREN Summary for Policymakers
SRREN Website, www.srren.org
Intergovernmental Panel on Climate Change, www.ipcc.ch
Working Group III Mitigation of Climate Change, www.ipcc-wg3.de

CUSJ AGM—Live Streamed on the Web!

For the second time CUSJ will offer the opportunity for all our members across Canada to attend our meeting, hear our speakers, participate in the discussion, and vote for the executive. We want to honour those who don't travel because of greenhouse gases or cost, and yet want to be part of our meeting. The first hour will be chapter reports and discussion.

CUSJ Dinner Saturday, May 18th, around 6 pm at the hotel restaurant.

CUSJ Movie Night Saturday, 8 pm (Room in the hotel TBA) Climate Refugees.

CUSJ AGM Monday, May 20th:

8:30 am – Registration, Coffee and Meet and Greet.

9:00 am – Chapter Conversations: What is your strategy on climate change? In this hour we will give our chapters and social action groups time to share what they are doing.

10:00 am – AGM.

11:00 am – Keynote Speakers Hazel Corcoran & Greg O'Neil—"How Co-ops Can Change The World," followed by discussion and questions.

12:15 pm – Lunch at the hotel for those who wish to stay.

Humanity is facing a dual crisis. One crisis is in the radical increase in economic inequality around the globe. The other is the environmental degradation which we are perpetuating including climate change.

What we are AGAINST

We all know what we are against. We are against the rich getting richer and the poor getting poorer. We are against the fact that a billion people in the world live on less than $1/day, while the 1% amass ludicrous amounts of wealth. We are against over-consumption, global warming, and the extinction of endangered species.

Our leaders tell us global capitalism is the only rational economic system. In Canada and elsewhere, state involvement in the economy is being reduced in every sector including healthcare. No other models are generally considered. The problem with the corporate model of economy is that it is legally required to maximize profits. This means that there is no true accountability to people or the environment. People of goodwill, are looking for a system with more accountability to the community and the environment. The Occupy movement began an important discussion.

So, what are we FOR?

We would ask you to imagine a way for human beings to come together, to determine what we need in our local communities and to set about meeting those needs. We would do so collectively, creating a sense of community in the process. This is the description of a co-operative movement. It is significant that many different faith communities have become engaged in supporting the development of co-operatives to meet socio-economic needs.

The Rochdale Co-operative Pioneers did this, at the height of the Industrial Revolution in 1844: www.bbc.co.uk/dna/h2g2/brunel/A2764424. Would you be surprised to learn that many of their early meetings took place in a Unitarian church basement?

Come and Discuss:

1) How co-ops can address the economic and environmental issues facing us today.

2) Ways to get the message out—how to make it happen.

3) How each of us can be engaged.

We hope you will join us in person or on line!

See more at www.cusj.org

IS YOUR CONGREGATION RECEIVING JUSTnews?

Every congregation in Canada receives copies of JUSTnews, but to keep costs down we have recently reduced the numbers each congregation receives.

To be sure you get your copy of JUSTnews, become a member of CUSJ. Annual membership fees, from nominal to as much as you can give, are due May 1st. Membership information is on the last page of this Discussion Paper.

JUSTnews is published by
Canadian Unitarians for Social Justice

www.cusj.org

President
Frances Deverell

Editorial Committee
Philip Symons, Editor, Nichola Martin,
Don Vipond

Production Team
Ruth di Giovanni, Bert MacBain,
Joy Silver, Philip Symons

Submissions to or enquiries regarding JUSTnews should be addressed to:

Philip Symons, Editor JUSTnews
2125 Lansdowne Rd.
Victoria, BC, V8P 1B5

Phone 250-592-6484
philmar@islandnet.com

The views published herein do not necessarily reflect views and opinions of the Canadian Unitarian Council, Canadian Unitarians for Social Justice or all Canadian Unitarian Universalists.

STATEMENT OF PURPOSE

The CUSJ purposes are:

- to develop and maintain a vibrant network of Unitarian social action in Canada and elsewhere and to proactively represent Unitarian principles and values in matters of social justice and in particular
- to provide opportunities, including through publication of newsletters, for Unitarians and friends to apply their religious, humanistic and spiritual values to social action aimed at the relief of (1) poverty and economic injustice, (2) discrimination based on religious, racial or other grounds, (3) abuses of human rights whether of individuals or peoples, (4) abuses of democratic process, and
- to promote peace and security, environmental protection, education, and literacy in keeping with the spirit of Unitarian values

These purposes are an integral part of the Constitution of CUSJ, adopted at the CUSJ Annual Meeting in Mississauga, ON, May 19, 1999, and amended at the 2003 AGM.

I agree with the above Statement of Purpose, and wish to ☐ join or ☐ renew membership in CUSJ.

Enclosed please find my donation of $_____

Name_____

Address_____

Tel ( )_____Postal Code_____

Email_____

Add me to the CUSJ ListServ: ☐ yes ☐ no ☐ I want to know more

I wish to receive JUSTnews by: ☐ email; ☐ paper copy

Name of Congregation (if a UU member):

_____

Date:_____

Please mail to: CUSJ Membership, c/o Bob Staveley,
P.O. Box 40011, Ottawa, ON K1V 0W8

Publications mail agreement No. 40037866

Return address:
52-3190 Tahsis Ave.
Coquitlam, B.C.
V3B 6G1

Printed on recycled