



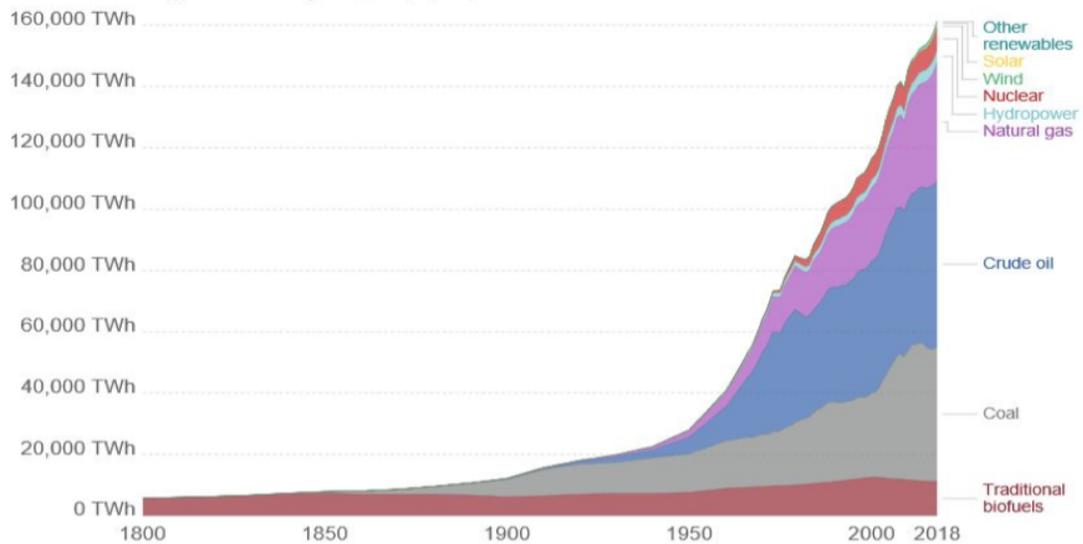
## Green Goderich Green Energy Speakers Recap March 10, 2020

*Green Goderich believes that education based on solid scientific research and opinion is critical to our path going forward. The following is a recap of the three speakers from our March 10, 2020 event, who presented based on scientific research and personal opinion. The following is not necessarily the opinion of the members of Green Goderich.*

### Bob Budd: 100% Renewable Energy or 100% Sustainable Energy

#### Global primary energy consumption

Global primary energy consumption, measured in terawatt-hours (TWh) per year. Here 'other renewables' are renewable technologies not including solar, wind, hydropower and traditional biofuels.

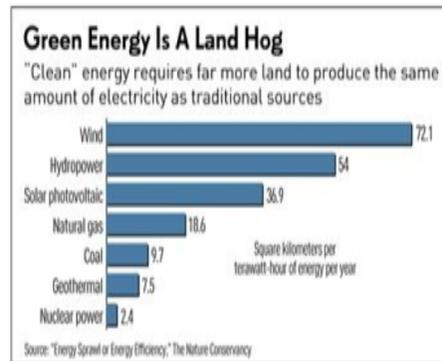


Source: Vaclav Smil (2017) and BP Statistical Review of World Energy

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- In 1988, Dr. James Hansen, a climate change scientist and activist, spoke to the Congressional Committee about greenhouse gases, he stated: “There is an urgency of moving beyond fossil fuels to carbon free energy sources” even back then
- From James Hansen’s book, *The Storms of my Grandchildren* (page 204): “The scientific method requires we keep an open mind and change our conclusions when new evidence indicates that we should. The new evidence affecting the nuclear debate is climate change, specifically the urgency of moving beyond fossil fuels to carbon free sources.”
- We have three major challenges: Climate change, resource depletion, and loss of biodiversity

- Sustainable energy must:
  - a) Decarbonize and scale rapidly
  - b) Meet the need of 9 billion humans
  - c) Not drive further biodiversity loss
- The amount of low carbon energy required to replace existing fossil fuels and provide new energy for the developing world makes the 100% renewable concept implausible
  - o Solar panels, wind turbines, and batteries all rely on intensive resources and energy commitments
  - o Green energy in general is very land intensive which creates bio-diversity challenges



- A study done in 2016 stated that the earliest path to emission reduction in Ontario is making nuclear the mainstay of our electricity system
- But the ambition of 100% renewables future is not a practical option, as 64% of the energy generated would be wasted
  - o This is due to the mismatch between the renewable energy generation and the actual electricity demand at any given time
- In comparison, nuclear power benefits include: Low emissions and minimal usage of raw material and land
- To replace fossil fuels the key is to deeply decarbonize electricity supply, then use that to transform fossil fuel heavy transportation, heating, and industry
  - o This is a task of massive scale and so far the only way we have been able to deeply decarbonize grids is by using hydro or nuclear or a combination
- Countries relying on wind and solar have clearly had less success
- You can compare various countries here: <https://www.electricitymap.org/>
- Ontario is a world leader in how to produce very low emissions electricity when you do not have large river systems to dam, we should be proud of that
  - o Nuclear energy has been the corner stone
  - o For residents of Ontario wanting to reduce their carbon footprint, using our clean electricity to replace home heating and electrifying transportation is a good strategy
  - o You can follow Ontario's daily generation mix and emissions numbers at <http://gridwatch.ca/>

## Dr. Grant Dawson: Nuclear Power – the Actual Risks

- Nuclear power is created by reactions of uranium that produce energy and heat
- In Ontario, nuclear power is currently responsible for 61% of Ontario's electricity production (<http://www.ieso.ca/corporate-ieso/media/year-end-data>)

### *Criticisms of Nuclear Power:*

- a) Safety and risk of radiation
- b) Waste disposal concerns
- c) Too expensive
- d) Slow to build
- e) Nuclear proliferation concerns

### *Safety:*

- Solar deaths: Roof top accidents
- Hydro: Dam breaks
- Wind: Work accidents  
(<https://www.visualcapitalist.com/worlds-safest-source-energy/>)

## Energy Sources Risk Comparison <sup>[14]</sup>

Energy Source	Deaths per 1,000 TWh	% of Global Primary Energy Supply (2015)
Coal	100,000	28.1%
Oil	36,000	31.7%
Natural Gas	4,000	21.6%
Hydro	1,400	2.5%
Solar	440*	<1%
Wind	150	<1%
Nuclear	90	4.9%

### *Waste:*

- Only 400,000 tons of nuclear waste has been produced since 1940 worldwide whereas 35,000,000,000 tons of CO<sub>2</sub> are produced yearly  
(<https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/radioactive-waste-management.aspx>)
- Nuclear waste must be stored in a proper geological space, the key is selecting a good location that will not be dug up in the future by accident

### *Expense:*

- Wind and solar last 20-40 years, whereas reactors last 40-60 years
- Big upfront construction costs for nuclear power but it is cheap to run
  - o Very similar to renewables in that regard

**Build:**

- Smaller reactors can be built more quickly now, are less expensive, and are easier to cool down

**Proliferation:**

- Best solution is political, nuclear proliferation treaties are fairly effective ([https://en.wikipedia.org/wiki/Treaty\\_on\\_the\\_Non-Proliferation\\_of\\_Nuclear\\_Weapons](https://en.wikipedia.org/wiki/Treaty_on_the_Non-Proliferation_of_Nuclear_Weapons))
- Potential to build floating nuclear plants that are operated by modern countries, which supply power to less developed nations without the risk of proliferation (<https://whatisnuclear.com/blog/2020-01-26-offshore-power-systems.html>)
- No serious issues among modern countries, as most already have reactors but do not want nuclear weapons

## **Dr. Michael Dawson: Avoiding a 21<sup>st</sup> Century Tragedy of the Commons**

- Tragedy of the Commons, according to Wikipedia, is “a situation in a shared resource system, where individual users, act independently according to their own self interest, behave contrary to the common good of all users by depleting or spoiling the shared resource through collective action”
- To sustain a shared resource there are two choices: Privatize or regulate
- The global community must regulate climate change for any change to occur
- To eliminate fossil fuel by 2050 we need to:
  - a) Decarbonize electricity grids
  - b) Provide clean electricity to power transportation, industry, and heating
  - c) Provide clean electricity to the one billion people on the planet who currently lack a basic electricity supply and to the 2-3 billion new arrivals on the planet
- **Eco-Traditionalist Pathway:** Reduce/reuse/recycle, use less energy, change behaviours to reduce our CO<sub>2</sub> footprint, all power from renewable sources, and phase out nuclear power
  - o But for each of these environmentally minded individuals there are 15 who are not inclined to do these changes
  - o After 50 years shipping, jet travel, oil consumption, and global CO<sub>2</sub> emissions has greatly and steadily increased
  - o In our global tragedy of the unregulated commons, rational self-interest will trump decisions of conscience for both countries and individuals, we cannot count on enough countries and individuals to change their behaviours
  - o It is a fantasy to imagine that Ontario can achieve sustainable low carbon energy by the traditional pathway
- **Eco-Modernist Pathway:** Decarbonizing the electrical grid, modern cities thriving on plentiful power, energy from renewable and nuclear sources
  - o With the eco-modernist pathway, in 2040 there would be no fossil fuels, geothermal for home heating/cooling, renewables/batteries for transportation, and the base power would be from nuclear and hydro
  - o The low risk of a nuclear power mishap outweighs an almost certain CO<sub>2</sub> catastrophe
- Democracy is a tragedy of the commons, we choose a leader based on our own self-interest

- To get around this tragedy we must hold our leaders accountable
  - We need rules we can live by with good conscience
  - The commons must be regulated, we need global approval
  - Vote to include nuclear power in our energy plan
- For a global low CO<sub>2</sub> future we need the following:
1. An eco modern approach
  2. Fossil fuels must be more expensive
  3. Electricity must be cheap
  4. Oversight of nuclear programs