Nuclear Energy Option

Media advisory, IEP-IRP consultation workshops

UNIVERSITY OF JOHANNESBURG

- Fairly costing renewables
- Energy Density → scalability
- Nuclear is not unsafe

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Fairly costing renewables

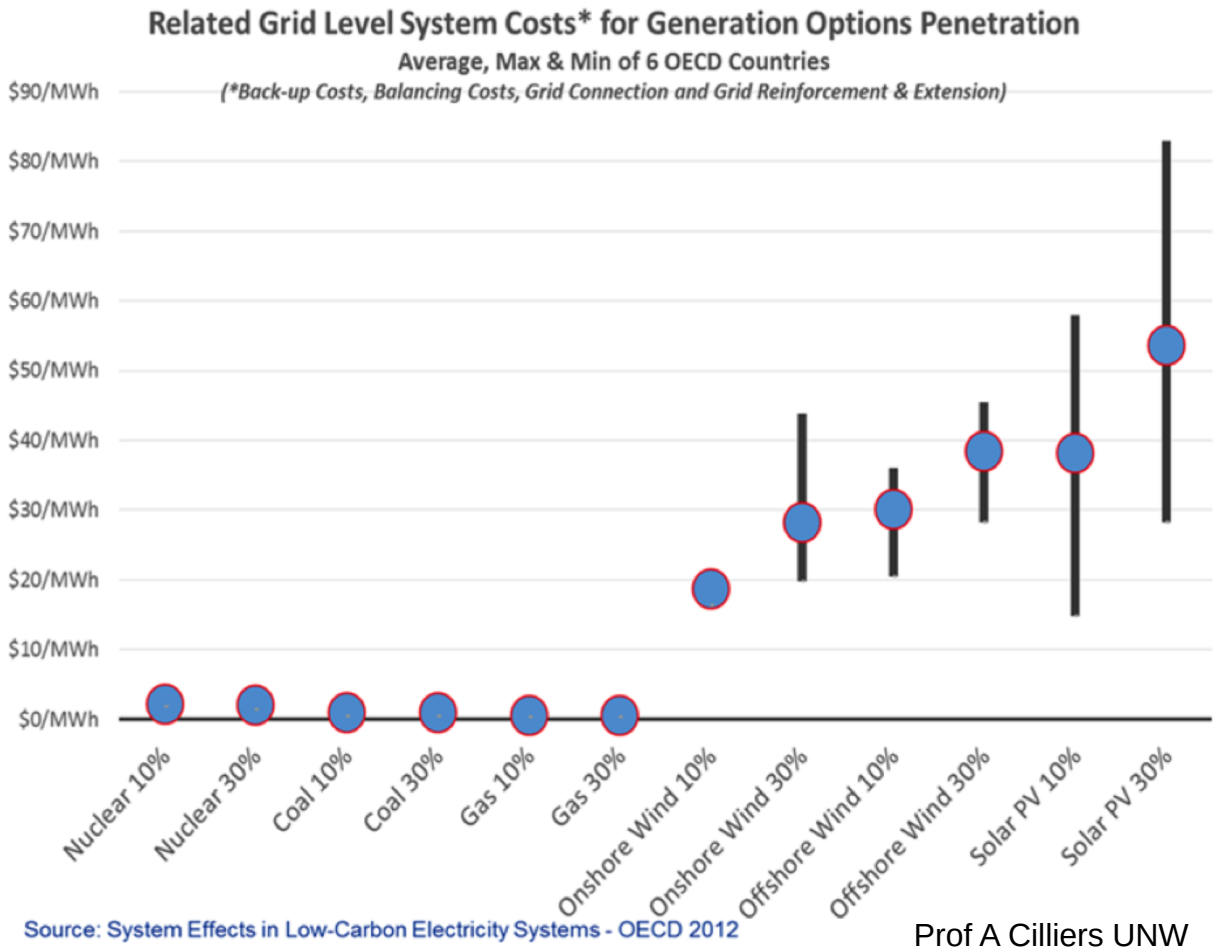
- Renewables are prejudicial to the current grid above a certain level (~ 20%)
  - There is **no sensible storage** of energy production at many GW rates
  - Therefore power must be produced to **follow the demand**.
  - **Renewables are variable** in an unpredictable way, and this is prejudicial to the concept of a stable grid with dispatchable power.
  - One needs a a **lot of backup**, not just enough for more regular periodic fluctuations, but also for the larger chaotic fluctuations.
  - There is also the problem of rapid, regional, smaller fluctuations. This needs to be smoothed.
  - The costing of renewables are neglecting the cost of variability on the grid and the cost of backup.
  - Several countries found out the hard way that above 20% renewables makes power more expensive.
  - SA must not make the same mistake.

Fairly costing renewables

- To have the renewables dominating the grid :
  - There would need to be the concept of a **copper plate grid** which is **smart** with a lot of **backup**.
  - It would need many sensors —> deep learning —> artificial intelligence —> fast switching decisions —> infrastructure to implement this in utilities and in variable tolerant loads at the consumer end.
  - **This is still a matter of research**.
  - There is no commercial product yet that can do this.
  - Therefore, too high a loading of renewables damages the grid, the existing baseload and puts up the cost of power.

- **Case of Germany, Australia** etc ....
  - Ultimately the Utility passes on this cost of renewables to the consumer.
  - Power becomes more expensive.

Fairly costing renewables



Prof A Cilliers UNW

Fairly costing renewables

- **Conclusion**
  - Renewables must explicitly by charged for their variability and requirement of back-up

Power density → scalability

- Consider the relative density / diffuseness of the power source
  - Fossil fuels have about 1/100,000,000 the power density of nuclear
  - Renewables can have a power density defined, in terms of plant size for power production as well.
  - For example, the size of a turbine field with the volume of air moving through it.
  - The size of a PV or CSP installation.
  - Then Renewables and carbon based fuels are all milions of times more diffuse than nuclear.
  - They require either more fuel or more plant.
- Load factors → Overcapacity
  - Renewables have load factors of 15% - 25%. This has consequences !
- Take advantage of the enormous energy availability and compactness of nuclear fuel.

Power density → scalability

- Do we want 10% more power or 10 x more power ? (I think 10 x)
  - What can we do with more power ?
    - Easy to **transport** a more dense fuel and the locate power stations where they are needed.
    - **Desalination**.
    - Production of **synthetic fuels** for transport.
    - One can **actually sequester CO_2** from the atmosphere and have a carbon neutral technology.
      - Driving a car is then like planting a tree.
    - One **can terraform** the planet by adjusting the CO_2 year on year.

- Basically, there is a limit to the scalability of renewables … they are just too “diffuse” in their power density.
- There are many possibilities that open up when there is more power available.

Nuclear is not unsafe
The “Three Nuclear Nightmares”

- **Proliferation** is easy to monitor
  - Tell-tale signs

    Modification of plant.

    Change in isotopic content of fuel rods, other in-core indicators.

    Leakage of minute but detectable finger-print species into the environment.
- **Waste** as a resource
  - It is rather trivial in volume compared to medical and industrial waste.
  - A plant has its lifetime of waste (60 years) typically stored unprocessed on site.
  - With processing, volume reduction.
  - Storage technologies exist – accessible storage.
  - A solid waste is preferable.
  - It is ultimately a resource, new technologies will allow it to be mined for energy and for rare materials, and to be quieted.
- **Accidents**, the risk can be made sufficiently low

Backup

Energy comparison - again

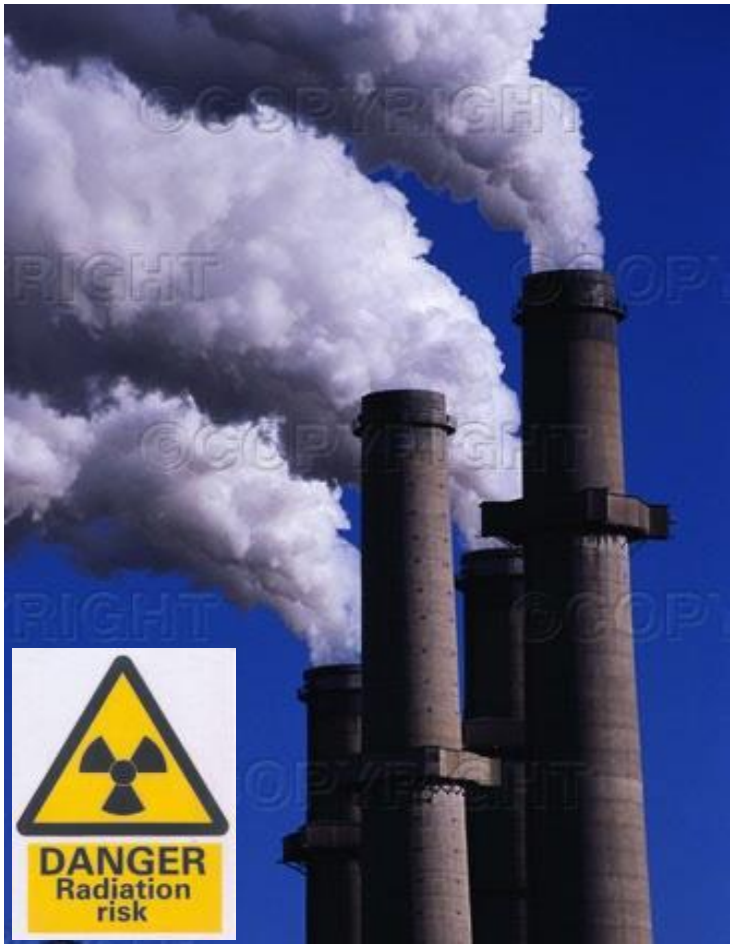
(10g of 10% enriched uranium)

5.76 tons of coal

1.5 to 2.5 tons of ash

21 tons of CO^2

Radiation also from Coal Fired Power Stations



- **Coal has ~ 1 ppm U and ~3 ppm Th.**
- **Uranium released into the atmosphere from coal fired power stations, 25 000 tons / year.**

- **1GW power station**
  - **100** times more activity release.

Oak Ridge Nat Lab Review Vol. 26, No. 3&4, 1993

- Nuclear Energy is a 100 year stop-gap
- It is proven safe in a catastrophe and is being further improved
- After 100 years a new technology will emerge