Small Modular Reactors will Benefit Developing Economies

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Today, with 8 billion humans on this planet, only the few wealthy countries are extracting natural resources to bolster their economies and provide prosperous lives for their citizens.

Earth has existed for more than 4 billion years without present-day humans. In the past, dinosaurs and cavemen never used its plentiful natural resources.

The discrepancy in the allocation of earth's natural resources between developed and developing economies, emphasizes a critical point affecting the future of the human species.

When we consider the needs of developing economies, we have no choice but to consider that access to electricity is a crucial cornerstone to alleviating poverty, promoting economic growth and improving living standards. It is an essential social and economic indicator. The link between electricity and GDP per capita is one of the strongest correlations in the social sciences. Why are we not utilizing a seemingly endless clean supply of electricity to shine some light on the hundreds of millions of people living in the dark?

Small Modular Reactors (SMR's) hold the potential to revolutionize the clean electricity landscape by providing scalable and flexible solutions across both the developed and

the developing world. Generation IV SMRs do not need to be near any large waterbody at all, a critical factor in many water scarce countries. They also incorporate a number of technological advances to meet the criteria of sustainability, nuclear safety, economic competitiveness and resistance to nuclear proliferation.

Small modular reactor development globally, is in part due to many South African engineers and scientists having been absorbed into private industry in South Africa and all over the world, including the USA. SMR's have the potential to bring significant benefits to developing economies due to:

- Lower initial capital investment as SMRs require a lower upfront capital investment due to their compact size and modular design.
- Reduced construction time as SMRs can be deployed relatively quickly, with deployment timelines as short as three years.
- Siting flexibility as SMRs can be installed in a variety of locations, including remote areas with less developed infrastructure.
- Scalability as SMRs can be scaled up or down to meet energy demands. This flexibility allows developing economies to adjust their energy production as their needs change.
- Job creation and economic impact as the construction and operation of SMRs can create jobs and stimulate economic activity.
- Enhanced safety as SMRs have simpler designs and use passive cooling systems, making them inherently safer to operate than traditional reactors.

The generally accepted definition of access to electricity includes the provision of electricity, safe cooking facilities, and a minimum level of consumption. The International Energy Agency (IEA) takes a more holistic approach to its definition, requiring households to meet a

minimum specified level of electricity, which gradually increases over time and is based on whether the household is in a rural or urban environment. The set minimum threshold is currently at 250 kWh per year for rural households and 500 kW per year for urban households according to the IEA.

According to the US Energy Information Administration (EIA), the average annual electricity used by a US residential customer in 2022, was 10,791 kWh. This equates to an average of roughly 900 kWh per month, 43 times the minimum rural threshold accepted by the IEA. We can thus understandably surmise that economic growth in developing economies inevitably requires growth in demand for electricity. Those economies that continue to grow, along with their long-term electricity sovereignty, must therefore develop their nuclear energy capability as a matter of fact rather than of opinion. Referring particularly to South Africa, which is an economy based on developing its mining, industrial and agricultural growth. It must focus its substantial base load electricity and energy growth on domestic nuclear power growth.

As a species, *WE CANNOT* accurately predict all future economic, technical and energy developments, which may radically change the upcoming economy and other progress of humans. However, we *CAN* focus on certain existing issues which need to be highlighted as the very reality that cannot be ignored. The proverbial elephant in the room is that there are consequences of those wealthier developed countries avoiding methods to deliver electricity to those in developing countries.

The electricity from wind and solar renewables is weak, intermittent and unreliable. This makes them only suitable for certain situational applications, but the reality is that economic demand to achieve steady growth is for continuous, uninterruptable, dispatchable power. Delivery of electricity to humans makes them suitable to grow industries that provide products and services to the 8 billion on this planet.

Using current nuclear technology methods, the used energy rods are taken out and replaced after approximately five to ten years. However, only 3% of the energy available contained in nuclear fuel is used at this stage and ***97% of the energy*** originally contained in this stored material is still available and can be used. In other words, there is still a further 10 times the energy used still available from the Slightly Used Nuclear Fuel (SUNF) with revised usage methods. It can then be extrapolated that nuclear power will be available to humans for a further 50,000 years or more from these SUNF sources. How are we not as a species, embracing this gift from galactic solar events the universe has bestowed upon us?

Next-generation reactor designs like Small Modular Reactors (SMRs) and advanced fast reactors offer greater efficiency, improved safety features, and a notable reduction of spent fuel.

Two of the co-authors of this article are from South Africa, and they believe their country is well positioned to stand on its rich history of nuclear transparency and compliance as a gateway into Africa, as well as the Middle East and SE Asia. With increased safety, oversight and non-proliferation measures, isn't it time that the developing world share in the power needed to build resilient economies of their own?

The costings from South African based nuclear companies developing SMR's, are estimating ~$0.12/kWh by the third plant with no need for back up capacity, cost of capital and disposal costed in. It has an energy availability factor of 95%, all of the time. So, we can accurately predict production. As the modular production supply chain grows and incorporating recycled material, the cost is predicted to reduce to ~$0.01/kWh within the next generation.

Now is as good a time, as we are going to get to take the critical leap as a species to nuclear power. As a species, we

can make use of the infinite power that we have access to because of collapsing stars, and hundreds of millions of nova and supernova galactic events across space and time. The infinite light in our universe has sent us the densest form of solar power it could ever muster when we use atoms for peace. Nuclear generated electricity and a rapid roll-out of Small Modular Reactors is the fastest way to cast a lasting beacon of light in forgotten developing worlds living in the dark.

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