Access to Reliable Energy is Not Just Important, it is Necessary to Prosper

By Randy Simmons & Ken Sim

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INTRODUCTION

We are Randy Simmons and Ken Sim. Randy is a university professor of political economy and Ken provides environmental professionals across the world with rugged handheld units that improve their ability to measure and monitor environmental conditions. We have both worked on environmental policy issues for several years. This collection of essays details our ideas about how non-professionals might start to think systematically about energy issues.
Olivia hummed a tune as she made her way along the path in the early morning light. She had a busy day ahead and music helped pass the time and made her tasks seem easier. When she got to the well, there were already others in line. She had slept in a little and was now paying the price. If you’re not one of the first to get there in the morning, your water is muddy and off-color from being stirred up by the people in front of you. But the baby had been screaming in the night and she did not get the rest she usually did. After 20 minutes, she collected her reddish-brown water and returned to her village a half mile away on the dirt trail. Several villages shared the well and they were fortunate to have one so close. She knew many who walked for miles to use the well.

She made two other trips to the well that morning. It takes a lot of water to have sufficient for drinking, food preparation, meal clean-up, and washing clothes. She sent the children out to collect firewood after her first trip, so by the time she had made her third trip to the well, there was enough wood to get a fire going to make breakfast. Most of the calories her family would consume was from corn grown in a nearby village. Like many in rural Malawi, she would grind the corn by hand with a large mortar and pestle to make a dense bread. Rarely, they would have protein in the form of a recently killed animal - but not often. Most meat spoiled by the time it reached them. Like her neighbors, her house was made from mud. But while most of her neighbors had thatched roofs, her late husband had scavenged some thin, tin siding from the city and it usually kept them dry. Olivia was coming up on 26 years old and providing for her 5 kids kept her busy. Her youngest had developed a perpetual cough, probably aggravated by cooking over an open fire indoors. She hoped he would get better soon, but if not, she would take him on the two day trip to the village that had a doctor. She’d already lost one child to sickness and did not want to lose another. In the meantime, she had laundry to do. Not a lot; they didn’t have many clothes. But it would take a while doing it by hand with some of the water she collected earlier.

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Stephanie hummed a tune as she made her way along the path in the early morning light. She had a busy day ahead and music helped pass the time and made her tasks seem easier. Early morning walks were a great way to start the day, and she needed a big head start “getting her steps in”. If she did not get her goal of 25,000 steps, there would be no “party on her wrist” from her new FitBit fitness tracker. Even worse, she worried in the back of her mind that she would be that much closer to obesity without her wrist party. Her walk got her heart rate up for 20 minutes and she headed home to get ready for the day. Her fair-trade, shade-grown coffee was almost ready in the machine when she got there, and, after a quick, hot shower, she took a minute to enjoy the sunrise and savor a cup. She heard a toilet flush upstairs and knew that the kids would be getting ready for school soon. Going into the kitchen, she put some eggs in one pan and sausage in another. They were ready in five minutes and she had it waiting on the plate for the kids when they came downstairs. Stephanie grabbed some orange juice and almond milk for the table from her new Samsung fridge, while checking the family calendar that now displayed on the refrigerator door.

After some help and encouragement, all three kids and her husband converged at the table. Her oldest daughter skipped the eggs, finished Stephanie’s coffee, grabbed a protein shake she could drink in the car, and then she was gone. Her youngest ignored the food and poured himself a bowl of cereal, spilling as much as he got in the bowl. Her other child picked at the eggs while her husband grabbed a couple of sausages as he went to the garage to pack up the Suburban for school drop-off. After everyone was out the door, Stephanie threw away the rest of the eggs, put the remaining sausages in the refrigerator, and put the dishes in the dishwasher. She quickly started a load of laundry in her walk-in closet, started another load in the mudroom downstairs, and sat down at her computer. She worked from home as an accountant for some local businesses, balancing books and keeping track of expenditures.

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The question of whether Olivia or Stephanie lives a “better” life is another discussion. Clearly, however, Stephanie has a richer life - richer in that she has more money and security. While money may not buy happiness, money, or at least a minimum amount of money, is *highly correlated* with happiness and satisfaction. Some happiness studies,¹ which we believe are relatively poor measures, show that people in rich countries are somewhat happier than those in poor countries. Stephanie’s wealth allows her to make choices not available to Olivia — where to live, what to eat, and what to wear.

The differences between the lives of those in lower income and higher income countries are often stark and disturbing. How then, did rich countries get rich? That is a question addressed in great depth by others who point to good political and economic institutions, as well as norms and values.² One thing that wealth has allowed and encouraged is the use of natural resources for energy, which was necessary for economic expansion.

A story from rural America demonstrates something about the differences in Olivia’s and Stephanie’s lives. Electricity came later to rural America than to urban areas. One of the means of providing access to electricity in rural areas was the Rural Electrification Co-op. Access to electricity transformed life in rural America. The Tennessee Valley Authority (TVA) was the first rural electrification cooperatives. A story about a land buyer for the Tennessee Valley Authority (TVA) how rural Americans felt about getting electricity:

> Traveling a country road at dusk in the early 1940s, the land buyer came across a farmer sitting on a little knoll overlooking his newly electrified farm. As the farmer gazed down at his house, barn, and smokehouse ablaze with light, he had a special look of wonder on his face.

> About a week later the TVA man attended the church to which this farmer belonged. During the service the farmer got up to give witness: *Brothers and sisters, I want to tell you this. The greatest thing on earth is to have*

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²See Deidre McClosky’s three volumes on Bourgeois Values, Dignity, and Equality for examples of how some academic economists think about the foundations of Western wealth and progress.
the love of God in your heart, and the next greatest thing is to have electricity in your house (italics in original). ³

Most of the people who lived through the rural transformation that happened because of electricity are now gone. The rest of us have no memory of life without electricity. No memory of hauling water because there were no electric pumps, washing clothes by hand, or not having light to read by in the evening. There are, however, nearly a billion people in the world who know what that life is like because they do not have electricity. Approximately 2.7 billion do not have access to clean cooking facilities. ⁴

One of the most popular Disney movies today is “Frozen,” based on Hans Christian Andersen’s tale “The Snow Queen.” In one of the opening scenes, a team of Nordic men travel to a remote, frozen lake, cut large ice blocks from the lake, load the heavy blocks on sleds, and travel back to the village below. The ice will then be insulated and stored until needed during the warmer months. It will cool drinks, preserve food, and provide refreshing treats in the summer. Although the group sing-alongs are completely optional, this is basically how food was preserved for thousands of years (though not really all that well compared to what we are used to).

In the 1800s, entrepreneurs, industrialists, and engineers began developing and experimenting with mechanical refrigeration. In other words, using a machine and a chemical process to artificially cool water into ice or cool air to a lower temperature. Beer brewers in the Northeastern United States and meat packers in the Midwest were the first to discover the big benefits of mechanical refrigeration. Initially only available on a commercial scale, beer could be brewed and animals could be slaughtered not just during winter, but any time without fear of getting people sick or producing an inferior product due to warm weather. By the turn of the 20th century, those products were shipped in refrigerated, or reefer, semi trucks, and railroad cars. Citrus fruit from Florida was shipped north, Washington apples were shipped south, fish was available in land-locked states. Food became safer and foodborne illness a rare exception. People were living better, healthier lives.

Today, more than half the square footage in grocery stores in the United States is refrigerated. The food for sale there allows us to spend less time cooking and more time in other activities. Many people in poor countries spend the majority of their time getting and preparing food by hunting, gathering, hauling water, starting fires, etc. Many, especially in tropical regions, have no way to store food without bacterial contamination for long periods of time. As a result, they must gather, cook, and prepare food every single day — just like people in now rich countries did in the 1800s. People in richer countries, with their basic needs met in part by refrigeration, have time to use for other tasks, like maintaining an additional source of income or enjoying leisure.

While Ken and his three brothers were growing up in the 1990s, his parents would go to the Air Force base’s discount food commissary once every 3 weeks, stocking up on all kinds of foods and packing it into the eight-foot-long chest freezer in their basement. They would buy as many as 10 gallons of milk at a time, keeping the newest milk at the back of the fridge where it was colder so that it would last longer. Opening a gallon of milk with a freshness date that occurred after another jug was a capital offense in his house. His friends would come over and stare into their fridge, wondering how all of this food could possibly be eaten. For his parents, collecting, gathering, and storing food took just more than 3 hours every three weeks. Compare that to the nearly all-day everyday task that it is for many in developing countries and we can begin to understand the importance and impact that refrigeration has on modern society. We have become richer, healthier, and have more free time because refrigeration saves us so much time, money, and effort.

For entertainment’s sake, we have listed below a few scenarios in which you can expect to be extremely grateful for refrigeration, or its close cousin, air conditioning:
A) Giving birth to a baby on the third floor of a hospital in Mobile, Alabama in July.
B) Eating steak in Atlanta from a steer that was butchered months before in Omaha.
C) Taking a cancer medication that was refrigerated during development and transport to keep it stable and preserve its life-saving capability.
E) Typing on a computer that was manufactured with parts that can only be made in sub-zero temperatures.

That’s great, but what does this have to do with electricity? Refrigeration requires compression to work effectively. Compression is a lot of work and is usually accomplished with electric motors. Without electricity, refrigeration cannot happen at the scale it currently does. So if you have no electricity, it becomes difficult to reap the benefits of refrigeration. This is well illustrated by Todd Moss of the Center for Global Development who developed a graph (Figure 1)\(^5\) showing that his new single-family refrigerator alone uses nine times more electricity in one year than all the electricity used annually than the average Ethiopian and three times more than the average Nigerian.

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This suggests a couple of things: 1) Economic development requires a lot of electricity; 2) Africans use very little electricity. In fact, according to Moss,

“Nearly seven out of every ten Africans still have no access to modern electricity. This affects their health and education and it especially limits economic opportunities. Survey data consistently point to cost and reliability of electricity as among the very top constraints to business growth.”

A LOT OF ELECTRICITY

So, how would we get “a lot of electricity” to people, be they in the third world or the first world? First of all, you have to be able to produce a lot of electricity. Contemporary media and energy policy worldwide would have us believe that electricity production in the 21st century is as easy as setting up some windmills or dropping in a couple of solar panels. These electricity sources, however, are inherently intermittent. That is, they work sometimes — when it’s not cloudy or when the wind is blowing. “Sometimes Energy” is problematic because there is no way to effectively store it. Giant batteries just don’t exist, so electricity has to be produced at roughly the same time it is needed. Wind and solar are good ways to add drops in the electricity bucket, but they don’t produce solid base-load, reliable electricity. You can’t flip on a switch and use wind energy if the wind isn’t blowing.

Isn’t intermittent electricity better than nothing? Yes, it is, but reliable electricity is the backbone of economic development, what will get electricity to the billion people who have none, and help the 2.7 billion without access to clean cooking facilities. As World Bank Vice President Rachel Kyle explained:

Access to energy is absolutely fundamental in the struggle against poverty, It is energy that lights the lamp that lets you do your homework, that keeps the heat on in a hospital, that lights the small businesses where

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In addition to the intermittent sources, countries in energy poverty need other, superior, electricity production methods and sources. Would you want to start a business where you can manufacture things only if the sun is shining bright enough? Would you want a family member hospitalized and on a respirator that only works if the wind is blowing? Would you plant an expensive cash crop if you knew you could operate your irrigation pumps only if the right set of environmental conditions were met at exactly the right time?

To get a lot of electricity, people need sources that are reliable, stable, safe, and powerful. For decades, the United States has used hydro-electric dams, coal-fired generators, and nuclear reactors as reliable baseload power. More recently, natural gas turbines have replaced some of the coal and nuclear sources because natural gas has become cheap, reliable, clean, and plentiful. The beauty of these sources is that it’s fairly easy to have them “ramped up” to meet demand. That is, when the sun goes down and more people are using lights, you can simply put more coal on the fire, so to speak. Gas and coal are easy to transport in pipelines, trucks, and boats. Nuclear happens to be much safer than most people imagine and has powered cities, submarines, ships, and more for decades without incident. Aside from the fewer than 50 people killed because of the accident at Chernobyl, there have been no deaths from the more than 600 nuclear plants built around the world since 1954. Nuclear fuel, coal, and gas are plentiful, with huge reserves available domestically and worldwide. Also important is the fact that pipelines, shipping routes/methods, railroads, and nuclear waste facilities are already in place and abundant. When comparing infrastructure, it’s important to note that large-scale wind and solar are both produced optimally in areas of low population, creating the need to install costly and redundant transmission lines to get the electricity from where it is produced to where it is used. Although coal, small, intermittent, renewable sources of energy, it is estimated that those living in energy poverty would benefit significantly from a reliable source of energy. The EU defines energy poverty as: “a distinct form of poverty associated with a range of adverse consequences for people’s health and wellbeing – with respiratory and cardiac illnesses, and mental health, exacerbated due to low temperatures and stress associated with unaffordable energy bills. In fact, energy poverty has an indirect effect on many policy areas - including health, environment and productivity.”

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gas, and nuclear are considered “dirtier” than wind and solar, it’s interesting that as their use has skyrocketed over the last century, nearly every measure of pollution has improved, not worsened.\(^\text{11}\)

If higher income countries are to maintain a lot of electricity and lower income countries need to develop a lot of electricity to catch up, it stands to reason that the focus should be on sources of electricity that provide reliable and safe power to the most people. Wind and solar tend to garner attention because they are relatively new, are considered (maybe incorrectly) to be clean, are heavily subsidized, and are considered by some to be magical, that is they provide free electricity.

**CONCLUSION**

As Olivia’s children become rich enough to afford Stephanie’s lifestyle, they will require a lot more energy, and not just electricity. Being able to cook food over an electric or gas stove, rather than an open fire will be a huge step forward in health and life options. Joining the global digital world will open new vistas. Access to transportation will open new education and occupation opportunities. Unless, of course, politics stop her children from gaining access to reliable energy sources.

The politics of energy production and consumption are the subject of future papers. For now, we note that governmental attempts to influence energy markets often benefit the politically connected, stifle innovation, and encourage wasteful lobbying. Focusing on renewable electricity sources often misses the fact that electricity consumption makes up only about 20 percent of the world’s total energy consumption. Less than one-third of global fossil fuel is used to produce electricity and almost 100 percent of transportation relies on fossil fuels. This all means that climate goals are and will continue to be met because of expanding the use of natural gas; wind and solar cannot replace fossil fuels.\(^\text{12}\)
