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I cover the intersection of innovation and sustainability.

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Jeremy Rifkin's Third Industrial Revolution

Economist and energy visionary Jeremy Rifkin is senior lecturer at the Wharton School's Executive [Education](#) Program at the [University of Pennsylvania](#), president of the Foundation on Economic Trends in [Washington](#), D.C., author of 19 books, and an advisor to the European Union and to heads of state around the world. In his most recent treatise, *The Third Industrial Revolution: How Lateral Power Is Transforming [Energy](#), the Economy, and World* (September 2011), Rifkin describes how the current Industrial Revolution is drawing to a close and why and how we should work to shape the next one. He spoke to us from Washington, D.C.

This article was created collaboratively with Mary Hoff, managing editor of *Momentum*—a magazine published by the [Institute on the Environment](#) at the University of Minnesota.

We had time to discuss *The Third Industrial Revolution* with Jeremy recently.

How did you come up with this idea?

My read on history is that the great economic revolutions occur when two phenomena come together. When we change energy regimes, it makes possible much more complex economic relations. When energy revolutions occur, however, they require communication revolutions that are agile enough to manage them. If you look at the 19th century, print technology became very cheap when we introduced steam power into printing. That decreased the cost and increased the speed, efficiency and availability of print material. At the same time we established public schools in Europe and America.

We created a print literate workforce with the communication skills to organize a First Industrial Revolution driven by coal and steam power.

Then we did it again in the 20th century with the convergence of communication and energy: Centralized electricity—especially the telephone and then later radio and television—became the communication vehicles to manage a more dispersed Second Industrial Revolution, organized around the oil-powered internal combustion engine, suburban construction and the creation of a mass consumer society.

Energy historians only deal with energy, and communication historians only deal with communications, but in history you can't really do one without the other. That's the framework that led me to this kind of search, and the Third Industrial Revolution really came out of that narrative on how history evolves.

So, what exactly is the Third Industrial Revolution?

First of all, it's based on a new convergence of communication and energy. The Internet has been a very powerful communication tool in the last 20 years. What's so interesting about it is the way it scales. I grew up in the 20th century on centralized electricity communication that scales vertically. The Internet, by contrast, is a distributed and collaborative communication medium and scales laterally.

We are in the early stages of a convergence of Internet communication technology with a new form of energy that is by nature distributed and has to be managed collaboratively and scales laterally. We're making a great transition to distributed renewable energy sources. And we distinguish those from the elite energies—coal, oil, gas, tar sands—that are only found in a few places and require significant military and geopolitical investments and massive finance capital, and that have to scale top down because they are so expensive. Those energies are clearly sunseting as we enter the long endgame of the Second Industrial Revolution.

Distributed energies, by contrast, are found in some frequency or proportion in every inch of the world: the sun, the wind, the geothermal heat under the ground, biomass—garbage, agricultural and forest waste—small hydro, ocean tides and waves.

The 27 member nations of the European Union have committed to establishing a five-pillar infrastructure for a Third Industrial Revolution based on this new convergence of

communication and energy. I was privileged to develop the plan that was formally endorsed by the European Parliament in 2007.

Pillar 1: The EU has mandated a goal of 20 percent renewable energy by 2020. That means a third of the electricity has to be green.

Pillar 2: How do we collect distributed renewable energy? The first thought in Europe was, let's go to Spain, Greece, and Italy—because they have all the sun. Put in concentrated solar parks and ship the green electricity via high-voltage lines to the rest of Europe. Similarly, the Irish have the wind, the Norwegians have ample hydro. Therefore, set up large wind farms and hydro dams to capture the energy. While we believe that these more concentrated uses of what are essentially distributed energies are critical to get us off carbon, they're not sufficient. Indeed, we can't run a global economy solely on centralized, concentrated wind, solar, geothermal, hydro, etc. This forced us to ask an important question: If some form of renewable energies are found in every square inch of the planet, why would we only concentrate them in a few central points? That got us to pillar 2: buildings. We have 191 million buildings in the EU. The mission now is to convert the entire building stock of Europe to partial green power plants that can collect solar energy on the roofs, wind energy off the sides of the building, geothermal energy from the ground below the building, biomass energy from the conversion of garbage in the building, etc. This will jump start construction. Converting the entire building infrastructure of the EU will generate millions of jobs and create new opportunities for thousands of small and medium-sized enterprises stretching over a 40-year period. And all the business is local.

Pillar 3: How do we store distributed renewable energy? The sun isn't always shining, and the wind sometimes blows at night when we need electricity during the day. Hydropower can be intermittent when water tables are down because of climate change—induced drought. So storage is critical when more than 15 to 20 percent of the power grid is made up of intermittent renewable energy. The EU is committed to many different storage systems: flywheels, batteries, water pumping, etc. But we're putting most of our emphasis on hydrogen as the linchpin of the storage network. When the sun hits your roof and your photovoltaic panels generate green electricity, you can take any surplus electricity you are not using and put it in water, allowing the hydrogen in the water to be siphoned out into a tank. Then, when the sun isn't shining on the roof, you can simply transform that hydrogen back to green electricity, with only a small thermodynamic loss.

Pillar 4: How do we share green electricity with each other? We take off-the-shelf IT and Internet technology and transform the power grid and electricity transmission lines into an energy Internet. So when millions of buildings are collecting distributed renewable energy, storing it in the form of hydrogen like we store media in digital form, they can then share any surplus electricity with others by selling back onto the energy Internet. Everyone becomes an entrepreneur in a collaborative energy Internet that spans whole regions and continents.

Pillar 5: How do we integrate transport into the TIR infrastructure? The idea is to plug in electric and hydrogen fuel cell vehicles to the buildings to power up our vehicles. And then wherever you travel, you can plug back in and get electricity from the grid—or sell your car’s electricity back to the grid if the price is right.

These five pillars are only components. It’s when they are connected that we create the synergies that transform them into a seamless new infrastructure for a new economic paradigm for the 21st century.

In the business community we’re seeing a real generational shift. Older men and women tend to think more in terms of organizing economic activity in a centralized, top-down fashion. Those who are 40 years old and younger gravitate toward an organizational style that is more distributed, collaborative and lateral. It’s analogous to what happened to the music companies: The old guard just didn’t understand the far-reaching significance of millions of young people file-sharing music—they didn’t get it. Then they shrunk or went out of business. And the newspapers weren’t ready for the distributed and collaborative nature of the blogosphere. Now newspapers are either going out of business or creating their own blogs.

Steve Jobs’ real legacy and that of his generation of innovators is they set up the communication part of the Third Industrial Revolution. However, the coming together of the Internet and renewable energy—the democratization of both information and power in one matrix—is what changes the whole frame of reference for everything we do in society.

You speak of “we.” How are you doing this?

I chair a group of more than 100 companies—many of whom are the main players in the renewable energy industry, the construction industry, urban planning and architecture, IT, and global logistics and transport—that comprise the Third Industrial Revolution

Global CEO Business Roundtable. We use a similar organizational model to the one used in the film industry. Everyone has their own expertise. We come together to help political jurisdictions, the local business community and civil society create a Third Industrial Revolution narrative and game plan—analogous to a script—that can help them transition their economies into the new economic era.

The Third Industrial Revolution Global CEO Business Roundtable is the outgrowth of the dramatic changes that have taken place in the recent past. We've had two events in the last three years that signal the beginning of the endgame for the Industrial Revolution based on fossil fuels. The first one was July 2008 when oil hit \$147 a barrel and the costs of all the goods and services across the global supply chain went through the roof, purchasing power plummeted, and the entire global economy ground to a halt. That was the great economic earthquake that signaled the beginning of the endgame for an Industrial Revolution based on fossil fuels. The financial collapse 60 days later was the aftershock.

We've hit peak globalization in how far we can actually globalize the economy based on elite fossil fuels. Every time we try to re-grow the economy at the same growth rate we were experiencing before July 2008, oil prices will rise and the prices of all other goods and services will climb as well because all the economic activity of our global economy depends on fossil fuels. We grow our food in petrochemical fertilizers and pesticides. Most of our construction materials and the vast majority of our pharmaceutical products are made of fossil fuels as well as our packaging materials and clothes. Our power, heat, light and transport are also reliant on fossil fuels. The price of virtually every good and service in today's global economy is dependent on the price of oil. That is why we are likely looking at four-year cycles of growth and collapse. Each time we try to restart the engine by replenishing inventories, oil prices will climb back up, all the other prices for goods and services will spike along with the price of oil, and at around \$150 a barrel, purchasing power will plunge and the economy will shut down. That's exactly what is happening now as we head to a second collapse of the global economy.

The second big event was the Copenhagen climate change summit. One hundred ninety-two countries came together to address the issue of global warming. Even though our scientists tell us we are in the early stages of a dramatic shift in the climate of the planet due to the emissions of industrial-induced carbon dioxide, methane and nitrous oxide, our world leaders couldn't cut a deal on climate change. The rise in temperature on the

planet is playing havoc with the Earth's hydrological cycle and imperiling ecosystems, threatening a mass extinction of plant and animal life in the 21st century. Yet most of the governments of the world appear unwilling to take the necessary steps to combat climate change, putting in doubt the future viability of our species on Earth.

With all of this in mind, after oil peaked at \$147 a barrel in July 2008 I put together a meeting of CEOs and senior executives from global companies and trade associations, and we said we need to create a sustainable new economic vision and a game plan to re-grow the economy based on bringing the Internet together with renewable energy. All of our companies wanted to move quickly to turn the crisis to an opportunity. But they were going at it alone—and we realized it's only if we move together that we can help create the essential infrastructure for the next Industrial Revolution. That's how we put this Third Industrial Revolution global business network together.

Endgame? A lot of big players are not going to like the message you're delivering.

The power and utility companies like to have control over the power supply and control over the transmission lines. They want to sell lots of electrons. What we're saying to power and utility companies is, your model is not working for you. Fossil fuels are getting more expensive, and you're going to be increasingly taxed because of the mounting bill for climate change—not to mention the fact that your old centralized electricity grids are inefficient and increasingly dysfunctional.

We already have hundreds of thousands of people making their own green energy, and pretty soon it's going to be tens of millions and then hundreds of millions of people generating their own energy. And the cost curve of the collection technology—solar panels, small and large wind turbines, geothermal heat pumps, small hydro, tidal and wave technology, biomass converters—is following the same cost curve dynamics as when we went from centralized mainframe computers to desktop computers and from centralized telephone communication to distributed cell phone networks. As feed-in tariffs expand to countries around the world, allowing early adopters a premium price for the green electricity they generate and sell back to the grid, the collection technologies will become ever more efficient and cheaper. Twenty years from now the technology for collecting and distributing energy is going to be virtually free, just like information.

Millions of people are going to generate their own green electricity in the 21st century while we will leave it to the power and utility companies to run the energy Internet. The power and utility companies are going to make money by doing the exact opposite of what they did in the 20th century. That is, they are going to profit by selling as few electrons as they can. We're going to use the IBM model as a case study of what needs to be done to transform the power and utility industry. When IBM's cash cow, its retail computer, began to become less profitable because of the global competition among computer manufacturers, IBM needed to rethink its mission. IBM asked a simple question: What do we do as a company that is unique and that the world needs? It's not making computers, it's managing information—so now every company in the world has a chief information officer and IBM, Cisco, HP, and other companies manage their client's information flows.

In an analogous sense, when millions of people are generating their own green electricity and sending some of it back to an energy Internet, the question facing power and utility companies is: What is the expertise they have that will allow them to stay in business? In the future, power and utility companies will set up partnerships with thousands of businesses to help manage their energy flows in their production processes, supply chains, and logistics networks. Whether any company flourishes or fails in the volatile period of transition between an aging Second Industrial Revolution and the emerging Third Industrial Revolution will depend, to a great extent, on their energy costs. The new mission for the power and utility companies is to help clients manage their energy flow so they save on their energy use, increase their productivity and improve their margins. The corporate clients in turn will share back some of their energy savings and the income generated from increased productivity with the power and utility companies. We call these “shared savings” agreements. There's far more money to be made by the power and utility company managing energy, reducing the amount of energy their clients use, and then sharing the savings.

What are the implications of the Third Industrial Revolution for developing countries?

My sense is that developing nations can move quicker into the new economic era by leapfrogging directly into the five-pillar infrastructure, because in many instances they lack any kind of infrastructure.

What we learned with cell phones surprised all of us. We didn't anticipate millions of people getting cell phones virtually overnight in sub-Saharan Africa where there wasn't even a developed electricity grid. They just jumped in and then the cell towers came. So we think the developing countries are ideally suited to transition into the new economic paradigm. They have ample green renewable energy and they can scale locally and then, like Wi-Fi, connect their micro grids across regions. And that's what's beginning to happen.

What is the governance model for this?

The First and Second Industrial Revolutions, because they were centralized, their geographical reach was limited. The Third Industrial Revolution, because it's nodal and scales laterally, likes to run uninhibited across all borders till it reaches ocean edges. The First and Second Industrial Revolutions favored national markets and national governments. The Third Industrial Revolution favors continental markets and continental political unions. Continentalization is the next stage of globalization.

Where do we go from here?

What we have to do now is to lay down The Third Industrial Revolution infrastructure. I don't think there's a Plan B—if this isn't the way to do it, by creating a new energy/communication matrix and a five-pillar infrastructure to accompany it, then what is the plan for the world? We can't stay in the Second Industrial Revolution. It doesn't work anymore.

We need to bring the best entrepreneurial talent and scientific and technological know-how together, and work with local, regional, and national governments and their respective business communities and civil society organizations to transform the infrastructure of the global economy and prepare the world for the next great economic era.

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