DR. ARMIN AZIMA

The Controllable Energy

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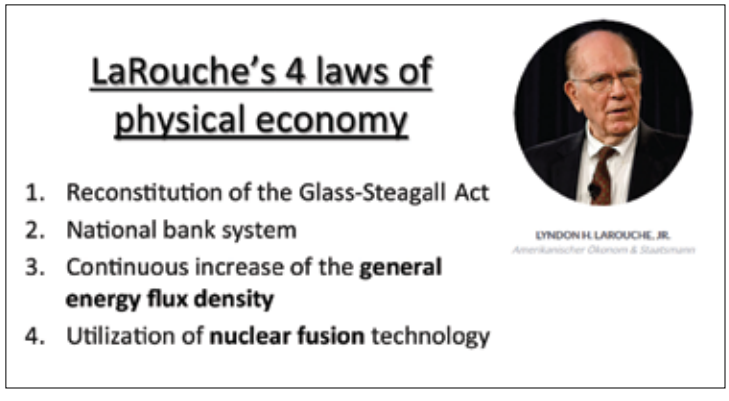
Armin Azima

Ladies and Gentleman, dear conference board, and dear Helga Zepp-LaRouche. Thank you very much for the invitation to give this talk. It is an honor for me to be here and I believe that I will convince the audience that physics in our modern world is very exciting. Promising developments are currently ongoing, about which you maybe even haven't heard so far. Thus, please allow me to inform you and simultaneously entertain you with the marvelous progress in the field of energy technology, which we can witness today in the world.

In this talk I will concentrate on the following topics: I will provide you with some interesting numbers on the progress of German energy transition and what it means practically for the German people. Then I will focus on two hot spots of nuclear science in the world, which are very promising and provide the hope of having a very nice future with cheap, clean and powerful energy sources. Especially the mastering of fusion technology will open the gate to a new, wonderful world with possibilities that are currently unthinkable. And I would like to present you some ideas of what could be done, if power were cheap. However, in the history of mankind, we all know that every technology can be used for the sake of prosperity or for destruction. And of course the stronger and more powerful the technology, starting from the invention of steel, up to the first fission of an atomic nucleus, the higher the hazard of the correlated weapon. That's why I feel it to be my responsibility to speak out loudly against the deployment and use of nuclear weapons in general here, which I will underline scientifically in the last section of my talk.

LaRouche's Four Laws

Before I discuss technology, however, I would like to mention LaRouche's Four Laws, the First of which is the reconstitution of the Glass-Steagall Act, and the



Second being the introduction of a national banking system.

LaRouche's Third Law concerns the continuous increase of the general energy flux-density of society in general. This demand includes the further development of civil infrastructure to be able to make use of powerful energy sources for increases in the productive physical economic output.

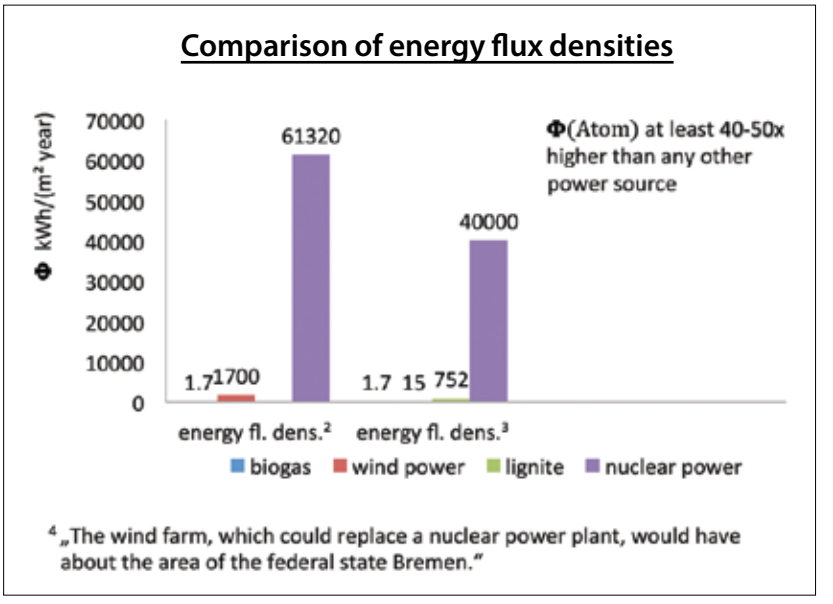
LaRouche's Fourth Law, a topic that is important for me personally, being a physicist, is the research for the development of the utilization of nuclear fusion as an energy source, which in my personal belief provides the only possibility of maintaining a high level of prosperity in a growing world, for all mankind into the future.

But let me at first start with one of the major aspects in LaRouche's Four Laws, and that is the energy flux-density.

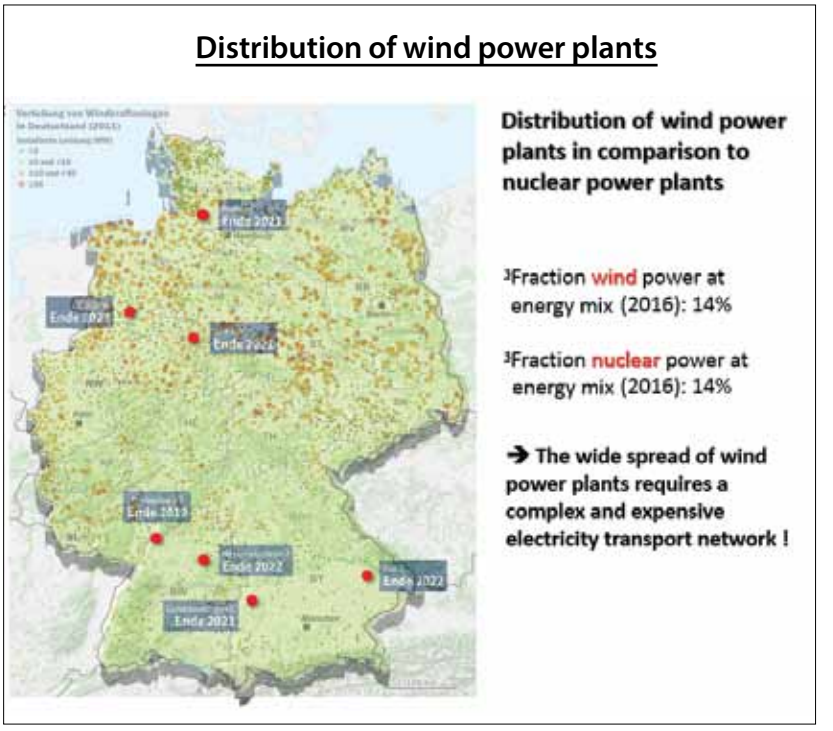
Consequences of Germany's Energy Transition

As a consequence of the well-known transition to regenerative energy sources in Germany I have created a map of all of the installed wind turbines in Germany, which are plotted as brown spots. Together, in 2016, they generate about the same amount of power as the seven red spots representing the nuclear power plants. And as you may know, those red spots will all disappear by 2022, when Germany's national exit from nuclear power generation will be fulfilled. The wide spread of power generators, which we in Germany call "decentralization of energy production," requires a complex and expensive power transport network—especially as compared to the time when the power mix was dominated by a few powerful central power plants about 20 years ago.

Energy costs have risen, and will rise still further in the future. Currently, we have fulfilled a transition to about 30% of



*The energy flux-density (**Φ**) of nuclear power vastly exceeds that of other power sources, for example, biogas, wind, and brown coal. Shown here are two sets of calculations of **Φ**. The author's calculations are the bars on the left and those of Dr. Günter Keil, on the right. (Some bars are too small to be visible.) The quotation is from the news program* Tagesschau.

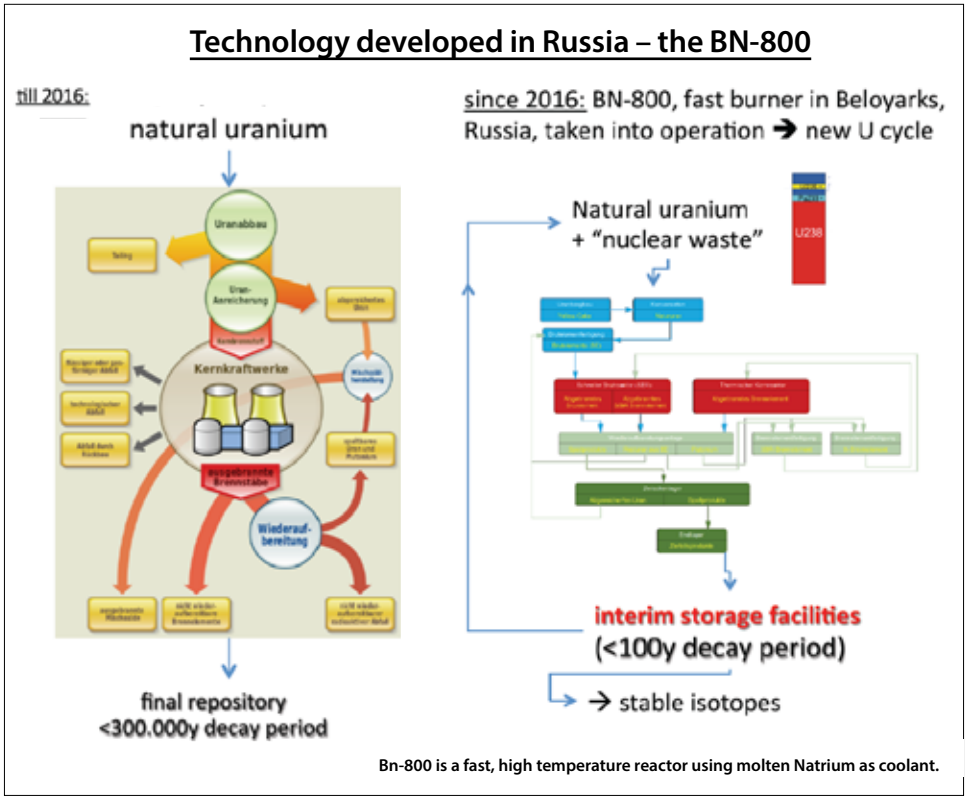


Federal Ministry for Nuclear Safety

Germany is covered with wind farms (brown spots), all of which, in 2016, produced as much power as the seven nuclear power plants (red spots). But the red spots are to disappear by 2022, when Germany is to completely exit from nuclear power. The key, upper left, shows installed capacity of wind farms in megawatts by size and color of the spots, as of 2011.

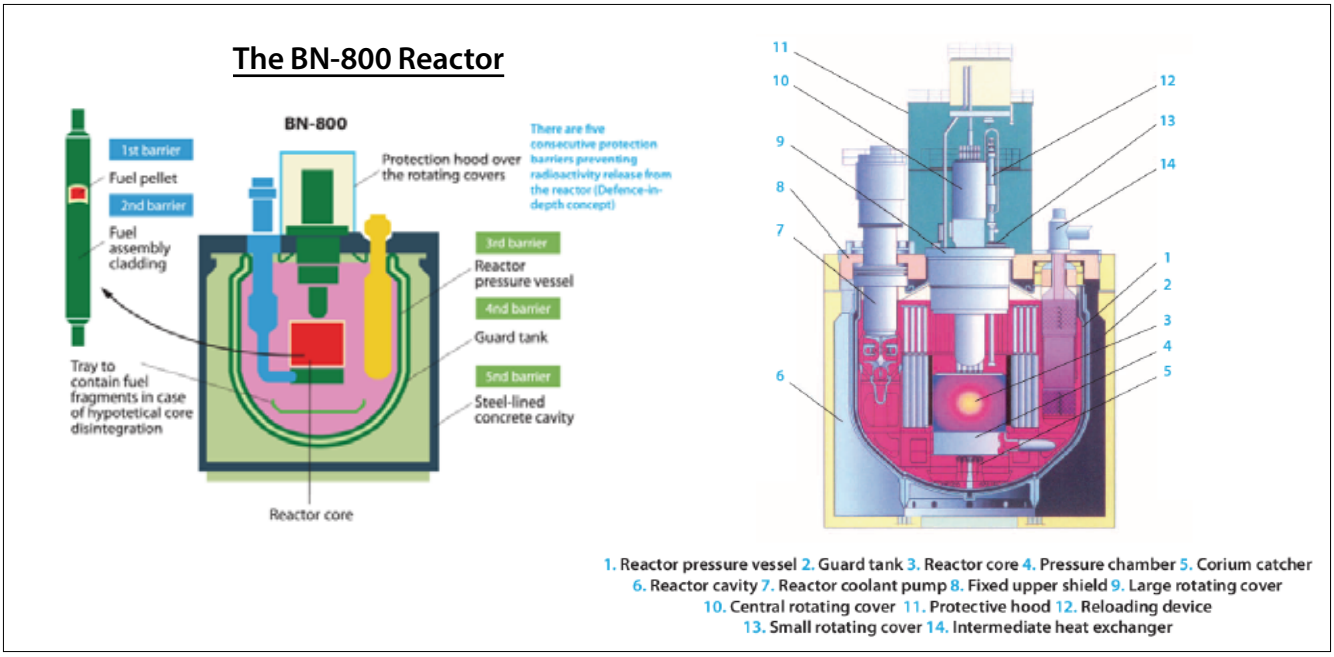
regenerative energy sources in our energy mix and the electricity price has increased by more than 50%, inflation-adjusted. And the goal is to reach 80% in the year 2050! The federal government however, claims that electricity prices will decrease again after 2025, to which I would add the word "maybe." We will see.

I have calculated the final power bill for Germany and compared it to France, which has more than 50% of nuclear generated power in its electricity mix. Sure, Germany is a wealthy country and many people can afford the higher energy prices, not all, but many. Even for a comparably large and comparably densely populated developing country, a power bill of 150 billion euro per year would be definitely too high. Hence, the French energy mix might be better suited to their needs, to say it in diplomatic words.



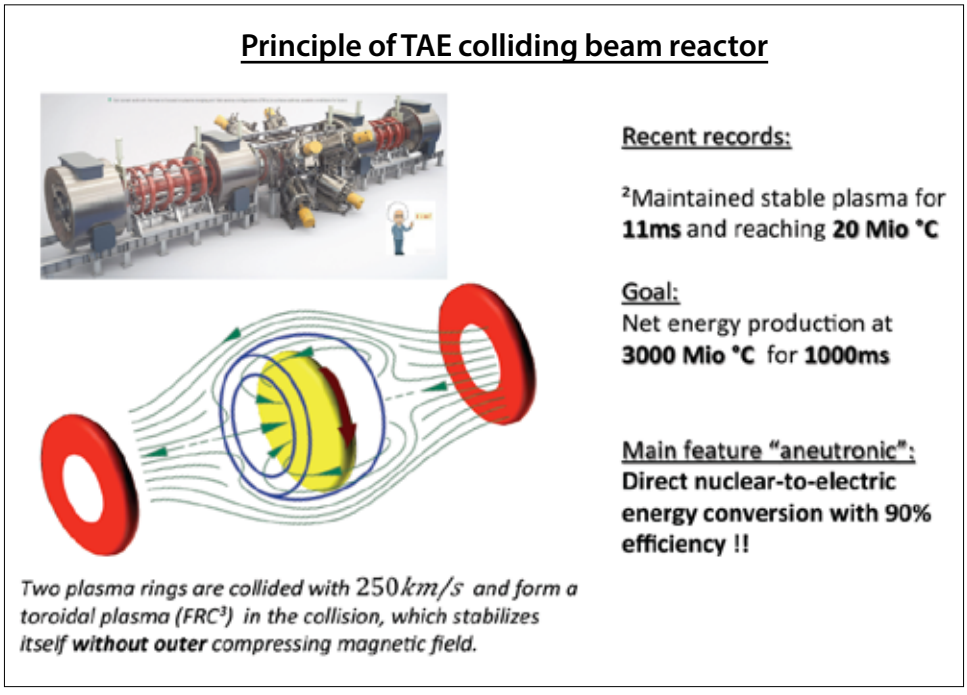
Nuclear Power as Such

Let's now concentrate on nuclear power in detail. As we have learned, the energy flux-density of nuclear fission power is currently the highest technologically



available of all power sources today.

Despite that fact, the German federal government has decided to fully exit nuclear power technology in Germany by the year 2022. The question is, "Why?" From a rational standpoint there can only be the following three criticisms, three reasons: the problem of nuclear waste disposal, reactor safety, and the prevention of proliferation of nuclear weapons. Due to limited time I will concentrate on the first point.



First some fast basics. Our general nuclear reactors are light-water reactors, which work with thermal, hence "slow" neutrons. The chain reaction is then greatly improved, since the slow neutrons interact with the fuel much more efficiently. However, this has a price: the neutrons lose the ability to crack isotopes of even mass number, which significantly decreases the amount of possible fuel materials for these reactors.

Natural uranium consists mainly of the isotope U-238, with an even mass number, which cannot be fissioned by the thermal, slow neutrons. Hence U-238 is artificially enriched by the isotope U-235. After three years of operation, most of the U-235 is burned up, while the amount of U-238 is almost the same as at the beginning. But new materials have been created in the process, such as plutonium and other minor actinides, which we refer to as "nuclear waste."

Natural uranium becomes enriched, and then burned. The waste is separated and finally disposed of, and part of the fuel rod is recycled and reused in this process. The problem: The final repository must safely contain the waste.

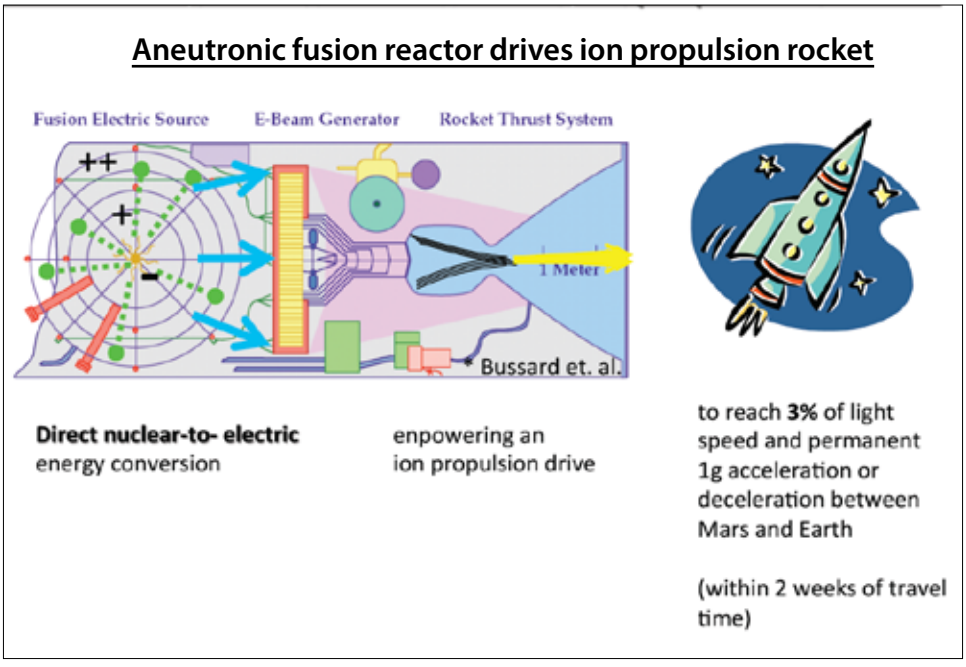
The Russian 'Fast Burner,' BN-800

Russia has chosen another way. Since 2016, a new reactor type, called BN-800 has been brought on line. This reactor is called a "fast burner," not to be confused with a "fast breeder." The BN-800 is not a breeder reactor, it's a burner. It uses "fast" neutrons, and thus their neutrons can, with similar efficiency, fission *all* the heavy isotopes including those with even mass number! And that's the trick; this reactor is now capable of reusing its "waste" as new fuel in a long cycle, over and over again. The much smaller fraction of nuclear "waste" compared to conventional reactors, has an additional advantage, in that it decays way faster. After only 100 years, this "waste" can be taken out of storage. Thus, with this technology, a *final* disposal repository is no longer needed!

To make it perfectly clear, the BN-800 can burn "nuclear waste" as if it were conventional nuclear fuel. No final depository is needed for the end-products of this reactor. And this reactor is in operation *now* at this very moment!

The BN-800 has de-defined the word "nuclear waste," because what is the waste now? Actually, it is exactly as Lyndon LaRouche predicted about ten years ago, when he said, "There exists no nuclear waste, only we currently do not have the technology to make use of the end products."

So, I delete this bullet point from the list of criticisms of nuclear power. Problem solved! Let's quickly move to another topic. I would like to show you some recent news concerning fusion research.



Aneutronic Fusion

I would like to introduce to you a company called Tri-Alpha Energy from California. The mission of this company is to master a special form of nuclear fusion, which is vastly unknown, that is the p-B-11 reaction [the fusion of a proton with a boron-11 nucleus]. The special feature here is the aneutronic character of the end products. Classical fusion devices, such as the ITER tokamak project, are built to use D-T (deuterium-tritium) fuel, which mainly burns to neutrons as end product. But those little fellows are hard to make use of as they are electrically neutral and permeate matter easily, and thus cannot be easily transferred to electricity.

Two rings of plasma collide in the center. At the collision point, the two rings merge and form a donut shaped plasma sphere, which can stabilize and contain itself. The longest this machine has been able to keep the plasma stable, is more than 10 milliseconds. Recently they have also shown that they can reach high temperatures of up to 20 million degrees Celsius, which are milestones for this project.

Of course there is still a long way to go to reach finally 3 billion degrees Celsius for one second. But because the end products are positively charged, the direct conversion of the fusion energy to electricity works with 90% efficiency—no steam production, no turbine, is needed, which greatly reduces the size, and makes possible a 100 megawatt reactor of the size of a truck!

We can dream about future machines, as for example, what the U.S. physicist Robert Bussard has proposed. The direct nuclear-to-electricity conversion would allow us to empower an ion propulsion engine to continuously accelerate (or decelerate) a rocket at a rate equivalent to ± 1g up to a few percentage points shy of the speed of light speed. This would reduce the travel time between Earth and Mars to less than about two weeks! All the inner planets would become reachable. Yes, of course, at the moment it sounds like a dream, but scientists are really working on these kinds of engines.

What If . . .

And this brings me directly to more visions, of what would be possible with such a fusion reactor. What if power were extremely cheap and what if energy were available in abundance? We could think of desalination of seawater on a large scale or artificial petroleum synthesis, or, one of my favorite ideas, which is a revolutionary waste recycling system, which not only burns waste to CO_2 and ashes, but uses even more power to transform the ashes into a plasma state. Of course, this is a very energy-consuming process, using the arc-plasma technology. But in the plasma state we would be able to crack down any component, any material, in to its molecules or even atoms, which plasma could then be further re-sorted and extracted element-wise out of the "waste"—an almost perfect ~ 100% recycling. We finally arrive at an end of hunger and thirst for all of us!

Last but not least, please let me remind you again about LaRouche's last two Laws. Keeping in mind what I presented before, I think these demands are neither abstract nor unrealistic. Instead, reaching these goals would make our world better in all aspects, and that is why we should keep on working to realize them.

Thank you for your attention.