Benjamin Deniston

The Economics of Planetary Defense

Benjamin Deniston of the LaRouche Policy Institute gave this presentation to the IGMASS conference on Sept. 12. The video is at http://larouchepac.com/node/23908.

I'm also with the LaRouche Policy Institute, and I'm going to be following up on what my associate Jason Ross just presented. What I'm going to focus on is that real economic growth is a transcendental, qualitative process. And what I'm going to discuss is what types of programs are needed, what types of specific programs are needed, to guarantee that type of growth. And so, what this becomes a discussion of, is economics as a physical science, the physical science of how mankind progresses and grows, increases in productivity.

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Ben Deniston: "We're trying to get the United States to take up the challenge of new science-driver programs, that will . . . completely transform man's ability to defend himself, and mankind's productivity and wealth for all society."

FIGURE

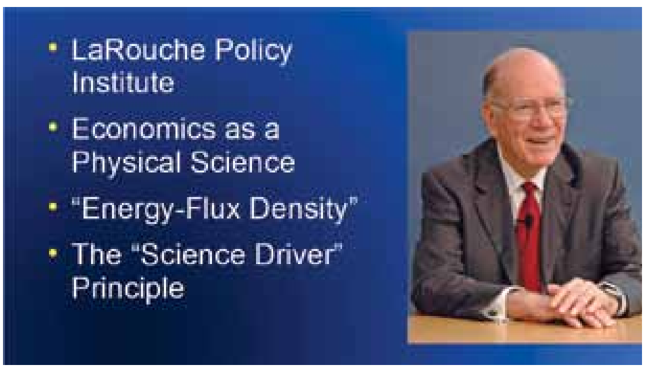
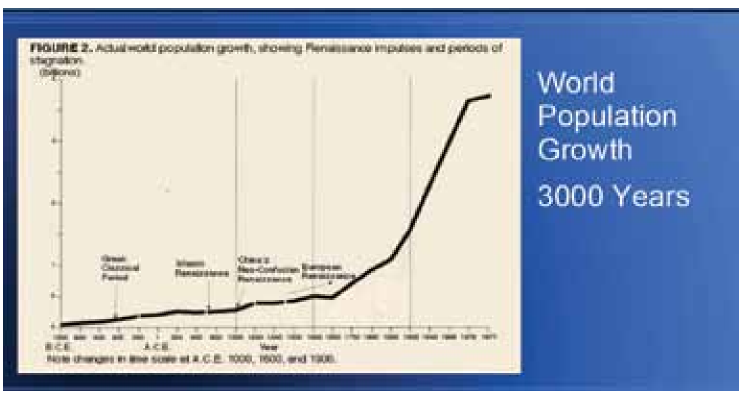


FIGURE 2



I will discuss a specific characteristic of that which LaRouche (**Figure 1**) has identified as energy-flux density, and then I will discuss what types of programs we need to ensure that we increase the energy-flux density for the benefit of mankind, for both defense and economic progress.

If you look at 3,000 years of human population levels (**Figure 2**), population is constantly increasing for the human species. So what Mr. LaRouche has studied, is how do we identify the science that gives mankind this unique capability to expand our population levels, expand our productivity per person, and how do you understand that as a science. This is important because no animal species can do this. No simple animal species can grow its population the way human economy can. So what makes mankind unique becomes a subject of scientific study.

Now, to investigate this, Mr. LaRouche has developed, again, a physical science of economics. And just to give a very brief sense, he looked at what you might call a thermodynamics of human economic processes, where you look at the ratios of productivity relative to consumption, and you look at the ratios for the whole of human society, the entire economy, and you look at the ratios of the increasing productivity per capita. And throughout human history, you've seen that it takes fewer and fewer—that each individual operative of an economy, each individual worker, becomes qualitatively more and more productive. And this is detailed in a number of LaRouche's works, for example, in his textbook on economics (**Figure 3**).

If we look again at the growth in human population levels over 3,000 years, we see that two things are the case, from the standpoint of the thermodynamics of human economics, which is that you always have a continual increase in the total energy of the human economic system; and you always have an increase, if it's successful economic growth, in the free energy of the whole economy.

Now, I'm going to highlight a key, very important metric that correlates with this process. This becomes the study of what LaRouche defined as energy-flux density, where if you look at the history of mankind's usage of different power sources, you see that mankind moves from being dependent upon wood, a wood-based system, to a system of coal, to a system of petroleum, to a system of nuclear power, both nuclear fission and nuclear fusion (**Figure 4**). And you can measure the difference in these different qualitative energy sources in the energy-density comparison of the various sources, to where you can say, to get the same amount of energy out of different fuel sources, you need dramatically different amounts. And what this reflects is that as mankind moves to utilize energy sources of higher and higher energy density, that correlates with mankind's dramatic population growth, and the in-

FIGURE 3

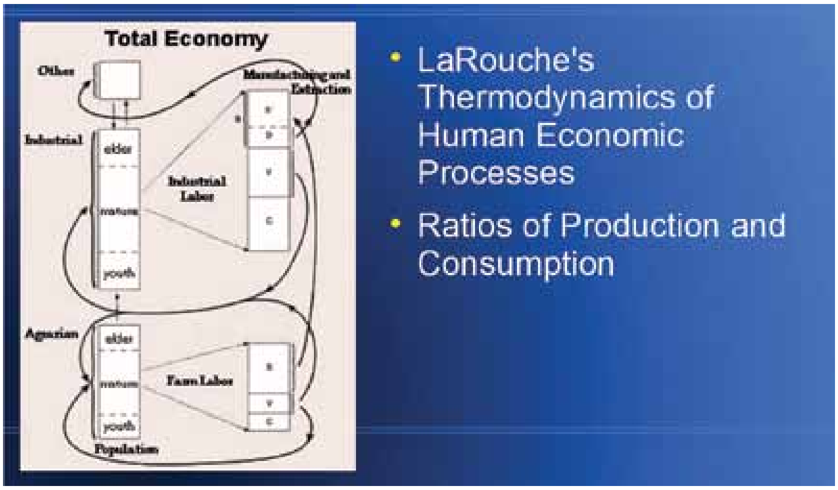


FIGURE 4

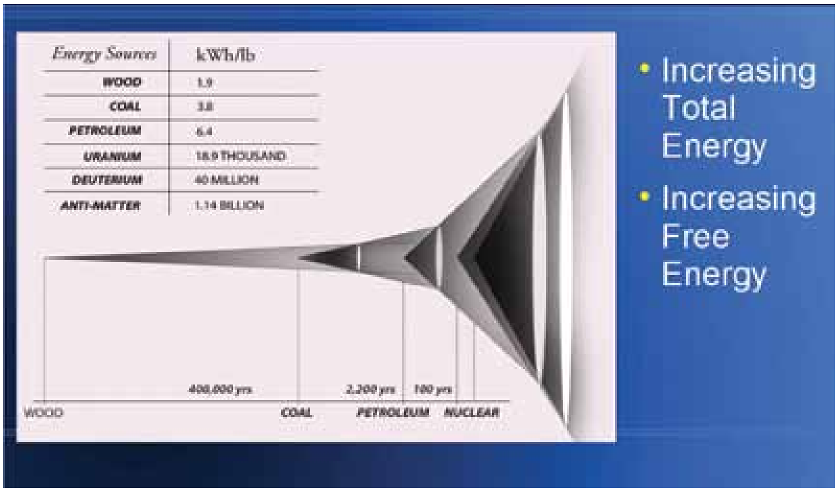


FIGURE 5

FIGURE 6

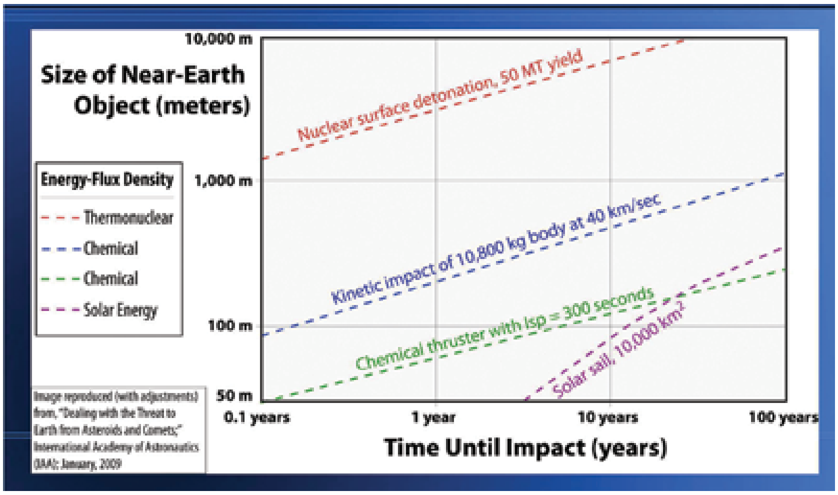


FIGURE 7

• Comparing Specific Impulse of Fuel Sources:

FUNDAMENTAL POWER SOURCE	ENERGY DENSITY (MJ/kg)	SPECIFIC IMPULSE
Chemical	1.23×10^2	450 seconds
Nuclear Fission	7.95×10^7	1,000 seconds
Nuclear Fusion	3.30×10^8	100,000 seconds
Matter-Antimatter	9.0×10^{10}	*

crease in the productive powers of every power in your society.

Now, to highlight a specific case-study in this question, we'll look at the threat of impacts on the Earth, and it's going to classified as two main areas of threats: the threats of near-Earth objects impacting the Earth; and a qualitatively different threat, the threat of long-period comets impacting the Earth (**Figure 5**). These are two examples of the types of threats that we know that mankind's going to have to deal with at some point in the future. This is not a question of "if"; it is a question of "when": "When is this going happen again?" And, "Is mankind going to be prepared to ensure that we don't have damage to the Earth and major loss of life, and potentially the extinction of human civilization? Can we take the necessary actions to ensure that that this doesn't occur?"

So, this question of energy-flux density was cited in a 2009 AIAA report on planetary defense (**Figure 6**). You can take just a simple comparison of asteroids—for example, asteroids of different diameters, going from 50 meters, to 100 meters, 1 km, 10 km, asteroids increasing in size, and then compare how early we must affect that asteroid to ensure it doesn't impact the Earth. How many months or years before an expected impact do you have to affect the asteroid?

And what we see here, is a very, very clear expression of this energy-flux density. It's one expression of a more general principle, but you can see that if we were to utilize solar sails, solar power, just become dependent on the radiant solar energy of the Solar System, that is the *least* effective method that we can use to protect the Earth from asteroids.

If we go to chemical modes, either with a chemically driven kinetic impactor to impact the asteroid with a heavy object, or attaching a thruster, a propulsion system, powered by chemical power, we have an increased efficiency in capability of defending mankind from asteroids. We can deal with larger objects, and we can deal with them in a shorter timeframe.

But by far the most efficient method is the peaceful use of thermonuclear explosives. The power density which you get with thermonuclear power gives you a much greater capability to defend mankind, and you can see, you can deal with objects that are much, much larger, and you can do it in a much shorter timeframe. So if there was an object that was 1 km in diameter, heading towards the Earth, with nuclear you can hit it only a few months before its expected impact; with chemical systems, you need to intercept it at least 100 years before, if not more, in order to have the same effect. So this is an expression of, you could say, the per-capita power that mankind has available, when we progress to different levels of energy-flux density as a mode of economic practice.

You can also see a second expression of this, if we look at the question of specific impulse (**Figure 7**). How much push do you get per unit weight of fuel, at different modes of energy-flux density? You can see that if we move from a chemical mode of propulsion to a nuclear fission mode of propulsion, and then to a

FIGURE 8

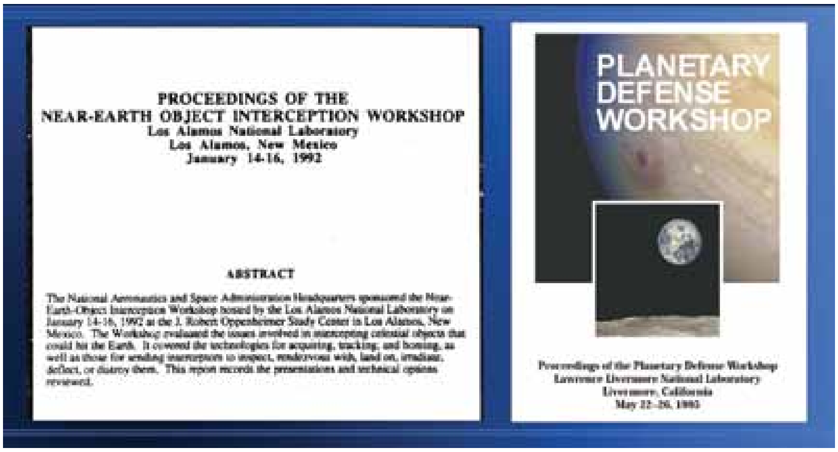


FIGURE 9

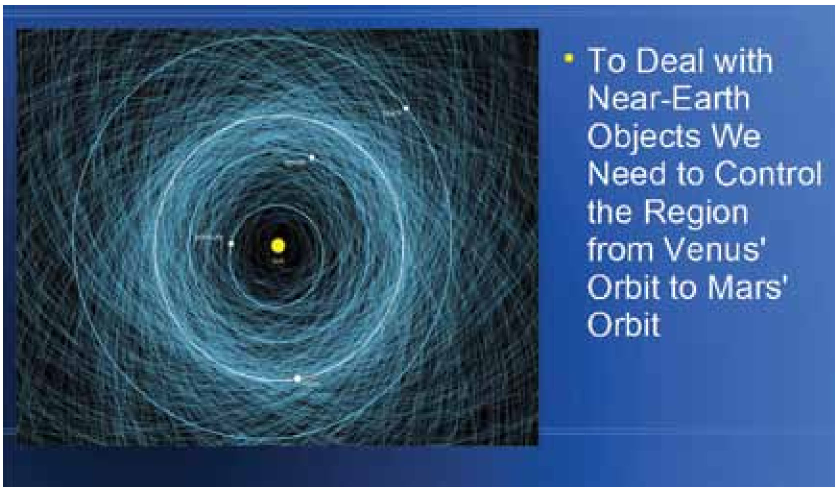
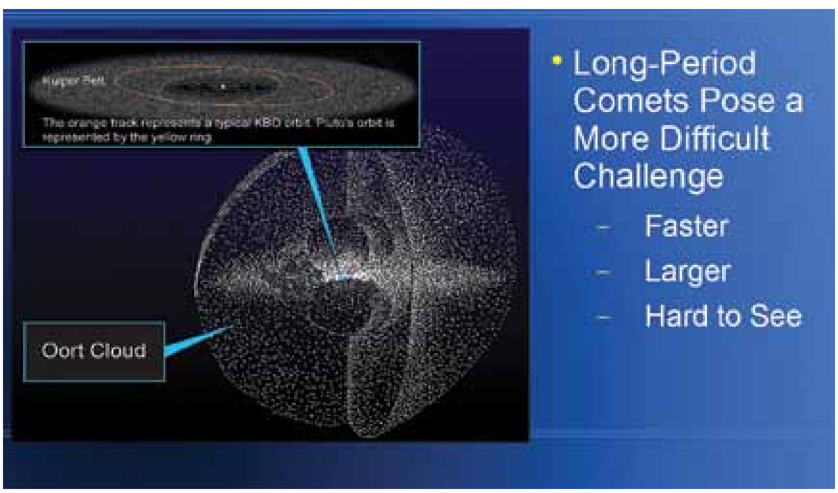


FIGURE 10



thermonuclear mode of propulsion, we have a dramatic increase in the potential power we can apply as a function of different, in this case, thruster systems or propulsion systems. And again, you can see that that is directly associated with increases in the energy density, how much energy per unit mass of the fuel.

The use of nuclear power for planetary defense, or asteroid or comet defense, is not a new subject. This was studied extensively all the way back in the early '90s, and I think it's worth highlighting the work done by the national laboratories in the United States (**Figure 8**), demonstrating the increased capability you get with nuclear systems—and this includes thermonuclear peaceful explosives. But also, as was presented yesterday, with nuclear propulsion, you're freed, you can begin to move beyond simply ballistic trajectories, and you begin to get constant acceleration. You can dramatically 1) increase the speed at which you can impact the threatening object; and 2) reduce the time it takes to get to an object if it's coming near you.

This becomes very, very important, because if the threat of asteroids and comets comes—it might not come tomorrow, but it certainly will come at some point in the future—the question is, will mankind make the advances to ensure that we can protect ourselves? For example, with the threat from near-Earth objects, we need to be able to control the region of the Solar System, stretching from, say, Venus's orbit out to Mars's orbit, and be able to intercept and move any objects that could pose a threat to us (**Figure 9**).

The challenge of long-period comets (**Figure 10**) is a second, even more difficult challenge, because they come in faster, they can generally be larger, and they become harder to see, because they come in from the outskirts of the Solar System, and you have less warning time. This is an even more difficult challenge, and mankind will have to make serious technological breakthroughs, in order to solve this challenge.

So this brings us to the example of the science driver, and this goes to what my associate Jason was discussing earlier: that if you are pushing the frontiers of science and technology, it doesn't cost you anything. If you make revolutionary breakthroughs that qualitatively transform the potential for the human species to act, you generate the rates of economic growth and progress, that pay off any initial investment many times over. But it has to be a program that pushes the frontiers of technology; it has to be a program that moves us to beyond our current limits into completely new domains of power densities and activities.

And one thing that our organization has been discussing and presenting is the question of achieving thermonuclear fusion propulsion for space travel (**Figure 11**), and engaging in international cooperation in the science driver to develop these technologies, to advance mankind's potential in space. That's one thing we are organizing for in the United States, pushing the frontier of the thermonuclear platform.

FIGURE 11

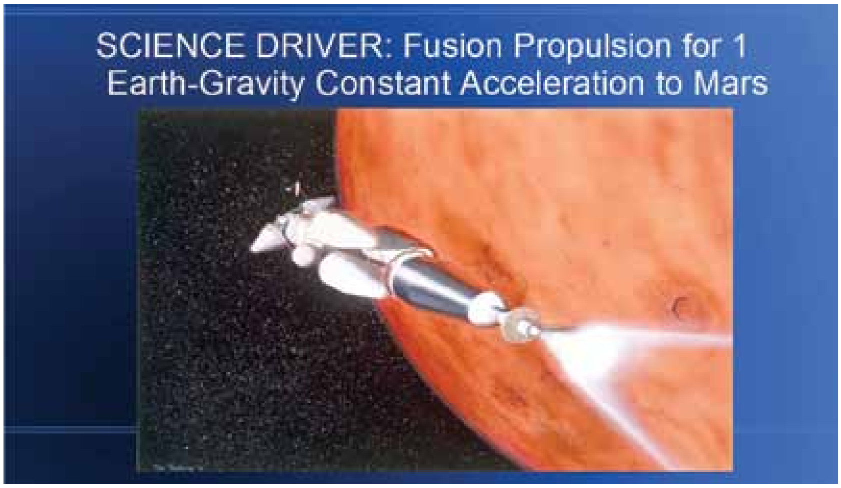


FIGURE 12

And to end, I would like to look back, on what does this actually mean for the human species? As was discussed at the beginning, no animal species can increase its population the way mankind can increase its population. This means that mankind has a capability that's not a simply biological capability; mankind has a certain unique power of mind, of creative thought, that gives mankind a unique capability to expand its power and presence in the universe.

And I think this was highlighted with the recent landing of the Curiosity rover on Mars (**Figure 12**). We're not physically there; our biologies are not there. But we're creating instrumentations that we can control with our minds, to begin to control this region of the Solar System. We're seeing the expansion of the power of the human mind, something Vladimir Vernadsky understood, with his study of the noösphere: that the way that mankind advances is by expanding the sphere of control of the human mind, to increase mankind's power in and over the universe.

So that's the objective, very briefly, for what our organization inside the United States is involved in. We're trying to get the United States to take up the challenge of new science-driver programs that will force the breakthrough in new technologies, with a heavy focus on nuclear fission, but also thermonuclear fusion, as the types of advances that will completely transform man's ability to defend himself, and mankind's productivity and wealth for all society.