All of us, at some point, hope to enjoy retirement. Yet we also face uncertainty about the future. Maybe we can adapt to a changing retirement income, even if it is for the worse. But it would certainly help if we could plan.

It might seem strange to think that the field of physics could have anything useful to say about retirement planning. I believe it can provide useful insights particularly if we expand our time horizon from the next few years to the coming decades.

Myself, I am a physicist with a specialization in the atmospheric sciences. I became interested in the problems of economics and finance by way of studying another long-run concern: climate change. Around the time of the 2006 documentary “An Inconvenient Truth,” atmospheric scientists were occasionally asked to speak publicly about the science of global warming and to offer social prescriptions for finding solutions. I rather admired how the documentary provided some challenging physics for a general audience. Yet, with most of my scientific colleagues, I felt some discomfort about saying how and whether we should control carbon dioxide emissions. Pronouncements on policy weren’t our expertise.

Still, many economists were suggesting policy-based remedies, like decreasing carbon dioxide emissions by increasing energy efficiency. Their complex social models offered the appeal of climate solutions without great economic pain.

I thought it might be worthwhile to try to think of the relationship between climate and society in a different way, by considering all the wonders of civilization as part of the physical world. As with the motions of the sun, oceans or a blade of grass, our daily activities, even our thoughts, are slaves to inviolable physical laws.

Chief among these laws is the Second Law of Thermodynamics which says that nothing can happen without a dissipation of energy in some higher “potential” form. Dissipation sustains circulations in the system while allowing it to do work. Burning high potential fuel allows pistons in a car engine to circulate and turn its wheels. We consume food with calories to radiate heat while we think and move.

What does the Second Law imply for civilization? And what does it mean for retirement? I believe that my research has shown that fiscal measures of our global economic wealth have a fixed link to our capacity to dissipate energy. Our total global power production capacity is what ultimately sustains all the world’s economic circulations and wealth. The two are so inseparable that both have risen in lock-
step over the past few decades. Each has more than doubled since 1970. The link between wealth and power has been an average 7.1 +/- 0.1 watts per one thousand inflation-adjusted (year 2005) U.S. dollars.

This result is important because it offers the following very simple prescription: Global wealth, once adjusted for inflation, cannot increase without a commensurate rise in global power production capacity.

I would like to note a common confusion here. The constant correspondence between wealth and power that I claim is not the same as the varying correspondence between GDP and power. Wealth is not current GDP. Rather wealth is accumulated over time. It is therefore a summation of prior inflation-adjusted production. Also, wealth is not some inert stock like the “physical capital” of standard economic treatments. Rather, it is a representation of our capacity to interact with each other through our social, transportation and communications networks.

The wealth of our existing networks grew from the prior efforts of us and our ancestors. Maintaining this existing network capacity requires that we ceaselessly dissipate potential energy in the form of fossil fuels, nuclear and renewables. Growing the networks will require faster energy consumption. And, put to an extreme, if current power production were ever switched off, like a houseplant without sun, civilization would wither and die.

In a paper that appeared in the Summer 2012 Retirement Management Journal™ (Vol. 2, No. 2), I described this relationship more fully. The conclusions made the point that our global wealth and power production capacity are currently growing at a rate of about 2.2% per year, adjusting for inflation. Moreover, even with the Great Recession, this global rate of return has been fairly stable over the past couple of decades, inching upwards only very slowly.

Stable growth can help us plan. Inertia allows us to expect the coming decade to be characterized by similar returns: 2.2% may be nothing spectacular, but at least it offers some realism to the best and worst of what we may come to expect.

We should keep in mind, however, that the 2.2% figure is a constraint on the globe as a whole. If we see developing countries boom at a faster rate, then we should anticipate that wealthier countries will come off worse. Also, physical considerations tell us the primary factor that determines how fast we can consume energy is the availability of primary energy reserves. We will remain reliant on burning fossil fuels for quite some time. So, if reserves of these fuels are suddenly discovered much faster than we consume them, then our energy consumption capacity – and our wealth – should be expected to grow faster than normal. Otherwise growth will be constrained.

Booming discoveries of oil accompanied accelerating rates of return in the two decades following World War II. Today, available statistics suggest that the United States is doing well, but that global energy discoveries are only barely keeping up with rapidly growing consumption. Nations are increasingly competing for their share of a relatively modest global rate of return.

I have no qualification to offer investment advice. In any case, the future is essentially unknowable. But I would like to suggest that financial planning for the coming decade should consider the following: Our capacity to discover and produce energy matters in a very profound way. Energy reserves are like our collective retirement account, with their own rate of return. If discoveries ever flag relative to consumption, then rates of energy consumption must eventually adjust downward, and the expectation should be that wealth will follow. The tide that lifts all boats may also be the one that lowers them.