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This month's Museletter contains two pieces. The first is a rather long essay containing an autobiographical sketch of the path that led me to write full-time about the transition to a post-carbon world, titled "Life After Growth." The second piece, "Goldilocks and the Three Fuels," was recently published by Reuters.

Life After Growth

What if the economy doesn't recover?

In 2008 the U.S. economy tripped down a steep, rocky slope. Employment levels plummeted; so did purchases of autos and other consumer goods. Property values crashed; foreclosure and bankruptcy rates bled. For states, counties, cities, and towns; for manufacturers, retailers, and middle- and low-income families, the consequences were—and continue to be—catastrophic. Other nations were soon caught up in the undertow.

In late 2009 and early 2010, the economy showed some signs of renewed vigor. Understandably, everyone wants it to get "back to normal." But here's a disturbing thought: What if that is not possible? What if the goalposts have been moved, the rules rewritten, the game changed? What if the decades-long era of economic growth based on ever-increasing rates of resource extraction, manufacturing, and consumption is over, finished, and done? What if the economic conditions that all of us grew up expecting to continue practically forever were merely a blip on history's timeline?

It's an uncomfortable idea, but one that cannot be ignored: The "normal" late-20th century economy of seemingly endless growth actually emerged from an aberrant set of conditions that cannot be perpetuated.

That "normal" is gone. One way or another, a "new normal" will emerge to replace it. Can we build a different, more sustainable economy to replace the one now in tatters?

Let's be clear: I believe we are in for some very hard times. The transitional period on our way toward a post-growth, equilibrium economy will prove to be the most challenging time any of us has ever lived through. Nevertheless, I am convinced that we can survive this collective journey, and that if we make sound choices as families and communities, life can actually be better for us in the decades

ahead than it was during the heady days of seemingly endless economic expansion.

In this essay, I would like to share my conclusions on this subject and the process by which I arrived at them. It's a bit of a long story, so please bear with me. First, the conclusions.

Four Propositions

The following summary statements are fundamental both to grasping our current situation and managing our way toward a desirable future:

1. **We have reached the end of economic growth as we have known it.** The "growth" we are talking about consists of the expansion of the overall size of the economy (with more people being served and more money changing hands) and of the quantities of energy and material goods flowing through it. The economic crisis that began in 2008 was both foreseeable and inevitable, and that it marks a *permanent, fundamental* break from past decades—a period in which economists adopted the unrealistic view that perpetual economic growth is necessary and also possible to achieve. As we will see, there are fundamental constraints to ongoing economic expansion, and the world is beginning to encounter those constraints. *This is not to say the U.S. or the world will never see another quarter or year of growth relative to the previous year.* Rather, the point is that when the bumps are averaged out, the general trend-line of the economy (measured in terms of production and consumption of real goods) will be level or downward rather than upward from now on.
2. **The basic factors that will inevitably shape whatever replaces the growth economy are knowable.** To survive and thrive for long, societies have to operate within the planet's budget of sustainably extractable resources. This means that even if we don't know exactly what a desirable post-growth economy and lifestyle will look like, we know enough to begin working toward them.
3. **It is possible for economies to persist for centuries or millennia with no or minimal growth.** That is how most economies operated until recent times. If billions of people through countless generations lived without economic growth, we can do so as well—now and far into the future. The end of growth does not mean the end of the world.
4. Life in a non-growing economy can be fulfilling, interesting, and secure. The absence of growth does not imply a lack of change or improvement. Within a non-growing or equilibrium economy there can still be a continuous development of practical skills, artistic expression, and technology. In fact, some historians and social scientists argue that life in an equilibrium economy can be superior to life in a fast-growing economy: while growth creates opportunities for some, it also typically intensifies competition—there are big winners and big losers, and (as in most boom towns) the quality of relations within the community can suffer as a result. Within a non-growing economy it is possible to maximize benefits and reduce factors leading to

decay, but doing so will require pursuing appropriate goals: instead of *more*, we must strive for *better*; rather than promoting increased economic activity for its own sake, we must emphasize whatever increases quality of life without stoking consumption. One way to do this is to reinvent and redefine growth itself.

The transition to a no-growth economy (or one in which growth is defined in a fundamentally different way) is inevitable, but it will go much better if we plan for it rather than simply watching in dismay as institutions we have come to rely upon fail, and then try to improvise a survival strategy in their absence.

In effect, we have to create a desirable "new normal" that fits the constraints imposed by depleting natural resources. *Maintaining the "old normal" is not an option*; if we do not find new goals for ourselves and plan our transition from a growth-based economy to a healthy equilibrium economy, we will by default create a much less desirable "new normal" whose emergence we are already beginning to see in the forms of persistent high unemployment, a widening gap between rich and poor, and ever more frequent and worsening financial and environmental crises—all of which translate to profound distress for individuals, families, and communities.

'Limits to Growth' The journey that led to my formulating these propositions began in 1972, when a book called *Limits to Growth* was making headlines. This relatively compact volume, which went on to become the best-selling environmental book of all time, provoked the first Great Wake-up Call of my adult life, changing the course of everything I have thought and done ever since.

Let me explain why *Limits to Growth* impacted me so deeply.

That book, which reported on the first attempts to use computers to model the likely interactions between trends in resources, consumption, and population, was also the first major scientific study to question the assumption that economic growth can and will continue more or less uninterrupted into the foreseeable future.

The idea was heretical at the time—and still is: during the past few decades, growth has become virtually the sole index of national economic well-being. When the economy grows, jobs appear, investments yield high returns, and everyone is happy. When the economy stops growing, financial bloodletting ensues. And so predictably a book saying that growth *cannot* and *will not* continue beyond a certain point proved profoundly upsetting in some quarters, and soon *Limits to Growth* was prominently "debunked" by public relations efforts organized by pro-growth business interests. In reality, this "debunking" merely amounted to taking a few numbers in the book completely out of context, citing them as "predictions" (which they explicitly were not), and then claiming that these predictions had failed. The ruse was quickly exposed, but rebuttals often don't gain nearly as much publicity as accusations, and so today millions of people mistakenly believe that the book was long ago discredited. In fact, the original *Limits to Growth* scenarios have held up quite well*.

In principle, the argument for eventual limits to growth is a slam-dunk. If any quantity grows steadily by a certain fixed percentage per year, this implies that it will double in size every so-many years; the higher the percentage growth rate, the quicker the doubling. A rough method of figuring doubling times is known as the rule of 70: dividing the percentage growth rate into 70 gives the approximate time required for the initial quantity to double. If a quantity is growing at 1 percent per year, it will double in 70 years; at 2 percent per year growth, it will double in 35 years; at 5 percent growth, it will double in only 14 years, and so on. If you want to be more precise, you can use the Y^x button on your calculator, but the rule of 70 works fine for most purposes.

Here's a real-world example: Over the past two centuries, human population has grown at rates ranging from less than one percent to more than two percent per year. In 1800, world population stood at about one billion; by 1930 it had doubled to two billion. Only 30 years later (in 1960) it had doubled again to four billion; currently we are on track to achieve a third doubling, to eight billion humans, around 2025. No one seriously expects human population to continue growing for centuries into the future. But imagine if it did—at just 1.3 percent per year (its growth rate in the year 2000). By the year 2780 there would be 148 trillion humans on Earth—one person for each square meter of land on the planet's surface.

It won't happen, of course.

In nature, growth always slams up against non-negotiable constraints sooner or later. If a species finds that its food source has expanded, its numbers will increase to take advantage of those surplus calories—but then its food source will become depleted as more mouths consume it, and its predators will likewise become more numerous (more tasty meals for them!). Population "blooms" (that is, periods of rapid growth) are always followed by crashes and die-offs. Always.

Here's another real-world example. In recent years China's economy has been growing at eight percent or more per year; that means it is more than doubling in size every ten years. Indeed, China consumes more than twice as much coal as it did a decade ago—the same with iron ore and oil. The nation now has four times as many highways as it did, and almost five times as many cars. How long can this go on? How many more doublings can occur before China has used up its key resources—or has simply decided that enough is enough and has stopped growing?

It makes sense that economies should follow rules analogous to those that govern biological systems. Plants and animals tend to grow quickly when they are young, but then they reach a more or less stable mature size. In organisms, growth rates are largely controlled by genes. In economies, growth seems tied to factors such as the availability of resources—chiefly energy resources ("food" for the industrial system). During the 20th century, cheap and abundant fossil fuels enabled rapid economic expansion; at some point, therefore, fossil fuel depletion could put a brake on growth. It is also possible that industrial wastes could accumulate to the point that the biological systems that underpin economic activity (such as forests, crops, and human bodies) begin to fail.

But economists generally don't see things this way. That's probably because most current economic theories were formulated during an anomalous historical period of sustained growth. Economists are merely generalizing from their experience: they can point to decades of steady growth in the recent past, and so they simply project that experience into the future. Moreover, they have ways to explain why modern market economies are immune to the kinds of limits that constrain natural systems; the two main ones concern *substitution* and *efficiency*.

If a useful resource becomes scarce, its price will rise, and this creates an incentive for users of the resource to find a substitute. For example, if oil gets expensive enough, energy companies might start making liquid fuels from coal. Or they might develop other energy sources undreamed of today. Economists theorize that this process of substitution can go on forever. It's part of the magic of the free market.

Increasing efficiency means doing more with less. In the U.S., the number of inflation-adjusted dollars generated in the economy for every unit of energy consumed has increased steadily over recent decades (the [amount of energy, in British Thermal Units, required to produce a dollar of GDP](#) has been dropping steadily, from close to 20,000 BTU per dollar in 1949 to 8,500 BTU in 2008). That's one kind of economic efficiency. Another has to do with locating the cheapest sources of materials, and the places where workers will be most productive and work for the lowest wages. As we increase efficiency, we use less—of either resources or money—to do more. That enables more growth.

Finding substitutes for depleting resources and upping efficiency are undeniably effective adaptive strategies of market economies. Nevertheless, the question remains open as to how long these strategies can continue to work in the real world—which is governed less by economic theories than by the laws of physics. In the real world, some things don't have substitutes, or the substitutes are too expensive, or don't work as well, or can't be produced fast enough. And efficiency follows a law of diminishing returns: the first gains in efficiency are usually cheap, but every further incremental gain tends to cost more, until further gains become prohibitively expensive.

Unlike economists, most physical scientists recognize that growth within any functioning, bounded system has to stop sometime.

But this discussion has very real implications, because the economy is not just an abstract concept; it is what determines whether we live in luxury or poverty; whether we eat or starve. If economic growth ends, everyone will be impacted, and it will take society years to adapt to this new condition. Therefore it is important to be able to forecast whether that moment is close or distant in time.

Hence the *Limits to Growth* study. The authors fed in data for world population growth, consumption trends, and the abundance of various important resources, ran their computer program, and concluded that the end of growth would probably arrive between 2010 and 2050. Industrial output and food production would then

fall, leading to a decline in population. (By the way, the Limits to Growth scenario study has been re-run repeatedly in the years since the original publication, using more sophisticated software and updated input data. The results were similar. See *Limits to Growth: The 30-Year Update*.)

My Personal Story of Waking Up to Limits

That's why *Limits to Growth* meant so much to me when I encountered it at age 21. I realized that the world in which I had been born, raised, and educated was headed toward what is politely known as a "historical discontinuity," but more colloquially termed "collapse," "a cliff," or "a brick wall." Millions of young people today are having the same experience as they learn about climate change. Welcome to the club.

At the time, I had been trying to make my way as a young musician. My father had been a chemistry and physics teacher, but I had gravitated toward the arts: after being trained as a classical violinist, I had taught myself also to play electric guitar.

As I absorbed the implications of *Limits to Growth*, I realized that there were more important things than band rehearsals and gigs to attend to, so I mostly left the music business (though I continue to be an avid amateur violinist) and began looking for ways to help shift society toward a more sustainable path. I became a freelance writer-editor and started pursuing projects I thought might lead me toward a better understanding of global trends and of how our species might avert an overwhelming economic and environmental disaster.

It was clear that society would need to undertake fundamental changes. But what were those changes, exactly? I thought the best way to find out would be to form an intentional community as a kind of social laboratory in which to explore alternatives in energy, food production, and lifestyles. I ended up spending most of the next 20 years living in three communities—one in Toronto that I helped establish, and others in Colorado and southern California that had already been going for some time before I joined. Intentional communities (sometimes also known as communes, with many now thriving under the banner of "eco-villages") are a fascinating social phenomenon, and hundreds still flourish worldwide.

By the early 1990s, I was eager to reconnect with mainstream society and bring what I had learned to a wider audience. My wife, Janet Barocco, and I had met in an intentional community in southern California; together we moved to a suburban home in Santa Rosa. By the latter years of the decade I was teaching in a college program on sustainability that I had helped initiate and design, while also continuing to make my way as a freelance environmental writer.

It was at this point, in 1998, that I heard a second Great Wake-up Call.

Peak Oil

It came in the form of [an article in *Scientific American*](#) by veteran petroleum geologists Colin Campbell and Jean Laherrère (both of

whom had overseen exploration and production in major oil companies), explaining why world oil extraction would reach a maximum around 2010 and begin its permanent decline thereafter. I quickly realized that Peak Oil would likely be the first non-negotiable global limit to growth. The hazy forecast that industrial society would hit a wall sometime in the 21st century was suddenly focused to a painful specificity. Growth had acquired a hard expiration date.

Of course, oil does not pose our only societal limit, or even the most important one in the bigger scheme of things: climate, water, and topsoil are clearly more crucial in the long run. But the peaking of world oil production could potentially bring modern industrial civilization to its knees, while also undercutting coordinated efforts to deal with all sorts of other problems.

Up to this point I had little interest in the subject of oil, or energy generally. However, as I re-read the *Scientific American* article, I realized the pivotal role petroleum plays in the modern world—in transportation, agriculture, and the chemicals and materials industries. I began spending hours each day studying energy history and oil production statistics. I soon realized that the Industrial Revolution was really the Fossil Fuel Revolution, and that our modern food system is based on cheap fossil energy. Further, the entire phenomenon of continuous economic growth—including the development of the financial institutions that facilitate growth, such as fractional reserve banking and the marketing of derivatives—is ultimately based on ever-increasing supplies of cheap energy. Growth requires more manufacturing, more trade, and more transport, and those all in turn require more energy. This means that if energy supplies can't expand and energy therefore becomes significantly more expensive, economic growth will falter and the financial system built on expectations of perpetual growth will fail, possibly in a rather spectacular way.

As early as 1998, Campbell, Laherrère, and others were discussing a Peak Oil impact scenario that went like this. Sometime around the year 2010, they theorized, stagnant or falling oil supplies would lead to soaring and more volatile petroleum prices, which would precipitate a global economic crash. This rapid economic contraction would in turn lead to sharply curtailed energy demand, so oil prices would then fall; but as soon as the economy regained strength, demand for oil would recover, prices would again soar, and the economy would relapse. This cycle would continue, with each recovery phase being shorter and weaker, and each crash deeper and harder, until the economy was in ruins. Meanwhile, volatile oil prices would frustrate investments in energy alternatives: one year, oil would be so expensive that almost any other energy source would look cheap by comparison; the next year, the price of oil would have fallen so far that energy users would be flocking back to it, with investments in other energy sources looking foolish. Investment capital would be in short supply in any case because the banks would be insolvent due to the crash, and governments would be broke due to declining tax revenues. Meanwhile, international competition for dwindling oil supplies might lead to wars between petroleum importing nations, between importers and exporters, and between rival factions within exporting nations.

Naturally, I also examined the arguments *against* the likelihood of a near-term peak in global oil production. What if Campbell and Laherrère were simply wrong? There are those who claim that new technologies for crude oil extraction will increase the amount of oil that can be obtained from each well drilled, and that there are nearly endless reserves of alternative hydrocarbon resources (principally tar sands and oil shale) whose development will seamlessly replace conventional oil, thus delaying the inevitable peak for decades. There are also those who say that Peak Oil won't be much of a problem even if it happens soon, because the market will find substitutes as quickly as needed—whether electric cars, hydrogen, or liquid fuel made from coal. I found all of these arguments weak: the new oil extraction technologies won't come into wide use for several years, and will be applicable mostly to newly developed fields (of which there are fewer and fewer each year as exploration efforts continue to show mostly disappointing results), not to the old super-giant oilfields that produce the great bulk of oil that we use today. Tar sands and oil shale will be slow to extract; indeed, in the case of oil shale, we may never derive liquid fuels in any substantial quantity due to the enormous costs of processing this very low-grade material. And substitutes like electric cars, liquids from coal, and hydrogen will take a very long time to develop and will in most cases be much more costly than the equivalent elements of our current system of petroleum fuels and internal combustion engines.

I continued to study the world energy situation for the next few years. And, with every passing year, events appeared to be supporting the Peak Oil thesis and undercutting the views of the oil optimists. Oil prices were trending upward—and for entirely foreseeable reasons: discoveries of new oilfields were continuing to peter out, with most new fields being much more difficult and expensive to develop than ones found in previous years. More oil-producing countries were seeing their extraction rates peaking and beginning to decline despite efforts to maintain production growth using high-tech, expensive secondary and tertiary extraction methods like the injection of water, nitrogen, or CO₂ to force more oil out of the ground. Production decline rates in the world's old, super-giant oilfields, which are responsible for the lion's share of the global petroleum supply, were accelerating. Production of liquid fuels from tar sands was expanding only slowly, while the development of oil shale remained a hollow promise for the distant future.

I corresponded with and met the authors of the *Scientific American* article, and interviewed other petroleum geologists and engineers. One expert after another offered further reasons for concluding that the thesis of "The End of Cheap Oil" was correct, that there were no ready substitutes for crude oil, and that the consequences of a near-term global oil production peak would be profound.

Given the almost complete absence of mainstream media coverage of the subject, I spent several months assessing whether I should step into the breach and write a book on Peak Oil. The fact that I had no background in the oil industry or in any relevant academic field weighed against doing so. Yet the need was clearly overwhelming, so I decided to try. I spent 2001 and 2002 writing *The Party's Over: Oil, War and the Fate of Industrial Societies*, which was published the following year and went on to sell over 50,000 copies with

translations in six languages. I began receiving lecture invitations, and, over the next few years, gave over 300 talks to a wide variety of audiences in a dozen countries. More books followed: *PowerDown: Options and Actions for a Post Carbon World* (2004); *The Oil Depletion Protocol: A Plan to Avert Oil Wars, Terrorism and Economic Collapse* (2006); *Peak Everything: Waking Up to the Century of Declines* (2007); and *Blackout: Coal, Climate and the Last Energy Crisis* (2009).

I was determined to sound a warning not just to the general public, but especially to politicians and appointed government officials. Members of a burgeoning informal global network of Peak Oil activists arranged for me speak to hundreds of national, state, and local politicians and appointed officials in the U.S., to about a hundred members of the European Parliament, and to national Parliamentarians in the U.K., Australia, and New Zealand.

From Scary Theory to Scarier Reality

Then in 2008, the Peak Oil scenario became all too real. Global oil production had been stagnant since 2005 and petroleum prices had been soaring upward. In July, 2008, the per-barrel price shot up nearly to \$150—half again higher (in inflation-adjusted terms) than the price spikes of the 1970s that had triggered the worst recession since World War II. By summer 2008, the auto industry, the trucking industry, international shipping, agriculture, and the airlines were all reeling.

But what happened next riveted the world's attention to such a degree that the oil price spike was all but forgotten: in September 2008, the global financial system nearly collapsed. The reasons for this sudden, gripping crisis apparently had to do with housing bubbles, lack of proper regulation of the banking industry, and the over-use of bizarre financial products that almost nobody understood. However, there are reasons for concluding that the oil price spike was a much more important contributor to this economic meltdown than is generally discussed (see www.energybulletin.net/node/49798).

In the aftermath of that global financial near-death experience, both the Peak Oil impact scenario proposed a decade earlier and the *Limits to Growth* standard-run scenario of 1972 seemed to be confirmed with uncanny and frightening accuracy. Global trade was falling. The world's largest auto companies were on life support. The U.S. airline industry had shrunk by almost a third. Food riots were erupting in poor nations around the world. Lingering wars in Iraq (the nation with the world's second-largest crude oil reserves) and Afghanistan (the site of disputed oil and gas pipeline projects) continued to bleed the coffers of the world's foremost oil-importing nation.

Meanwhile, the debate about what to do to rein in global climate change exemplified the political inertia that had kept the world on track for calamity since the early '70s. It had by now become obvious to nearly every person of modest education and intellect that the world has two urgent, incontrovertible reasons to rapidly end its reliance on fossil fuels: the twin threats of climate catastrophe and

impending constraints to fuel supplies (with most of the remaining oil reserves located in just a few countries). Yet at the Copenhagen climate conference in December, 2009, the priorities of the most fuel-dependent nations were clear: carbon emissions should be cut, and fossil fuel dependency reduced, *but only if doing so does not threaten economic growth*.

The cruel irony, obvious to my Peak Oil-aware colleagues but apparently not to the delegates at Copenhagen, was that *the decades-long era of rapid economic growth based on increased fossil-fueled production and consumption is over anyway*. The world's last chance to collectively, cooperatively negotiate a turn away from the precipice was being squandered for the sake of a goal that was no longer achievable.

I could take no satisfaction from these confirmations of the *Limits to Growth* and Peak Oil scenarios; being able to say "I told you so" hardly made up for the shock of knowing that our last opportunities to change direction had been missed and that the train of industrial civilization was now not merely still chugging toward a broken bridge, but was actually starting to plummet into the gorge below. We had succeeded somewhat in helping increase public awareness of an issue: due to the efforts of thousands of scientists, writers, and activists, "peak oil" had become a recognizable term in public discourse. But we had failed to budge government policy in more than very minor ways (I had, for example, assisted the City Council-appointed Peak Oil Task Force of Oakland, California, which produced a sensible report on which, so far, little action has been taken).

The world has entered a new era. The project of awakening and warning policy makers and the general public was worthy of the investment of all the effort we could muster. In fact, it would have been negligent of the *Limits to Growth* authors, Colin Campbell, Jean Laherrère, and thousands of climate and environmental scientists and activists (myself included) not to give it our best shot. But it is now too late to avert a collapse of the existing system. The collapse has begun.

It is time for a different strategy.

By saying this, I am not suggesting that we should all simply give up and accept an inevitable, awful fate. Even though the collapse of the world's financial and industrial systems has started, effort now at minimizing further dire consequences is essential. Collapse does not mean extinction. A new way of life will almost certainly emerge from the wreckage of the fossil-fueled growth era. It is up to those of us who have some understanding of what is happening, and why, to help design that new way of life so that it will be sustainable, equitable, and fulfilling for all concerned. We all need practical strategies and tools to weather the collapse and to build the foundation of whatever is to come after.

Journey to a New Economy

The propositions described above, and my personal journey, are the starting points for a search that can be summarized in a single question: *What are the guideposts toward a livable, inviting post-*

growth society?

This search has in many instances entailed a literal, geographic journey. During the past few years, as I traveled the lecture circuit, I met thousands of people who had already concluded on their own that the global stage was being set for an economic crash of epic proportions. They had passed through the psychological stages of grief—denial, anger, bargaining, depression, and acceptance. They were thinking creatively, building new lives, and experimenting with a wide range of strategies for meeting basic human needs while using much less of just about everything.

Some of these folks, like me, had been thinking along these lines for a long time—since the 1970s. Many were much younger, though, had learned about Peak Oil or climate change just within the past few years, and had recently decided to devote their lives to building a post-hydrocarbon world. Some were clearly members of what was known in the 1970s as the "counterculture." Others were mainstream citizens—investment bankers, real estate sellers, high school teachers, small business owners, corporate middle managers—who had chanced upon information that awakened them forcibly from their routines. Many of these folks lived in large cities, but others in small towns or on farms; some were rich, some poor (a few by choice); some were devout, others agnostic or atheist; some were working alone on survivalist projects, while others were building community organizations; some saw the transition as a business opportunity while others were working through non-profit organizations. Here are just three examples that stand out.

In 2005, while on a lecture tour in Ireland, I met a young college teacher named Rob Hopkins who believed that life could be better without fossil fuels. He had led his students in developing an "Energy Descent Action Plan" for their town, and believed he had the seed for something larger and more significant. He soon moved back to his native England to earn his Ph.D., and designed his thesis project around helping the village of Totnes begin a cooperative, phased process of transitioning away from its dependence on fossil fuels. This project in turn led to the start of a series of Transition Initiatives in villages, towns, and neighborhoods throughout the U.K. In 2007, a version of Rob's written Ph.D. thesis was published as a book (*The Transition Handbook*) that quickly began inspiring others to take up this strategy. Today there are hundreds of Transition Initiatives at various stages of development in a dozen countries (including over 50 in the U.S.).

While in Montana for a speaking engagement at the University of Montana in Helena in spring 2009, some local Peak Oil activists drove me to the town of Ronan and introduced me to Billie Lee, who had helped start Mission Mountain Food Enterprise Center. The Center is housed in a fairly small, non-descript building and features medium-scale food processing equipment that local small food producers can rent at reasonable rates. This enables small farmers to produce value-added products (everything from canned soups to herbal tea bags) that are profitable and are price-competitive with those made by industrial food companies located hundreds or thousands of miles from Ronan. Local food has become an obsession for the sustainability-minded during the past few years, and local food

systems will be a necessary pillar of post-growth economies. Yet aspiring small-scale farmers often have a hard time getting started because they cannot afford the equipment to enable them to produce profitable value-added products. Here in the tiny hamlet of Ronan was an ingenious solution to the problem, and one that deserves to be replicated in every agricultural county in the nation.

On a trip to New England in 2007, I met Lynn Benander, a community energy activist and entrepreneur who had started a project called Co-op Power to bring renewable energy to low-income and multi-ethnic communities throughout the Northeast. Typically, renewable energy projects cost more to get going than conventional coal or gas power projects, and so they tend to be found in wealthier communities and regions. Conversely, the most polluting energy projects tend to be sited in or near poor neighborhoods or regions. Co-op Power aims to change that imbalance of power—in a way that *any* community can copy. A typical project: You help four people put up a solar hot water system and everyone comes to help you put up yours; you save 40 to 50 percent off your total system price, get to know your neighbors, and learn how your system works. Co-op Power had also pioneered a cooperative financing method that cuts through the usual roadblocks to renewable energy projects in poorer neighborhoods by leveraging member equity.

Individually, these initiatives and projects may seem to be on too small a scale to make much of a difference. But multiplied by thousands, with examples in nearly every community, they represent a quiet yet powerful movement.

Few of these efforts have gained national media attention. Most media commentators who address economic issues are focused on the prospects—positive or negative—of the existing growth-based economy. These projects don't seem all that important within that framework of thinking. But in the new context of the no-growth economy, they may mean the difference between ruinous poverty and happy sufficiency.

The trends are already in evidence: as the financial crisis worsens, more people are planting gardens, and seed companies are working hard to keep up with the demand. More young people are taking up farming now than in any recent decade. In 2008, more bicycles were sold in the U.S. than automobiles (not good news for the struggling car companies, but great news for the climate). And since the crisis started, Americans have been spending much less on non-essentials—repairing and re-using rather than replacing and adding.

Many economists assume these trends are short-term and that Americans will return to consumerism as economic crisis shifts into recovery. But if there is no "recovery" in the usual sense, then these trends will only grow.

This is what the early adopters are assuming. They believe that the nation and the world have turned a corner. They understand something the media either ignore or deny. They're betting on a future of local food systems, not global agribusiness; of community credit co-ops rather than too-big-to-fail Wall Street megabanks; of small-scale renewable energy projects, not a world-spanning system

of fossil-fuel extraction, trade, and consumption. A future in which we do for ourselves, share, and cooperate.

They're embarking on a life after growth.

* * *

The realization that growth is at an end raises many questions. Will the financial impact be inflationary or deflationary? Will some nations fare better than others, leading to protectionist trade wars? Will the "down-sizing" of social and economic complexity lead also to a substantial die-off of the human species? How quickly will all of this happen?

There simply are no hard and fast answers to such questions. The financial, energy, food, transport, and political systems on which we rely are complex, so it is almost impossible to reliably model their response to a shock such as a resource limits-imposed end to economic growth. The only reasonable response, it seems to me, is to act as if survival is possible, and to build resilience throughout society as quickly as can be, acting locally wherever there are individuals or groups with the understanding and wherewithal. We must assume that a satisfactory, sustainable way of life is achievable in the absence of fossil fuels and conventional economic growth, and go about building it. This will be the focus of my work from now on—and it is likely to be the work of the next few generations as well. Call it Transition, call it cultural survival and renewal, call it what you will, it is the only game in town for the foreseeable future.

* A recent study by Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) concluded, "[Our] [analysis shows that 30 years of historical data compares favorably](#) with key features of [the *Limits to Growth*] business-as-usual scenario...."

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Goldilocks and the Three Fuels:

A Cautionary Tale of Resource Depletion
(published by Reuters, Feb. 18, 2010)

Where are oil prices headed in 2010? Forecasts for the end of the year are all over the map, from over \$100 a barrel to under \$50. The difference hinges mostly on assumptions about whether the economy will recover or relapse. But it may be that price volatility has become an inherent feature of the oil market—and fossil fuel markets in general—for reasons that can perhaps best be explained with the help of a little history and an old children's story.

Once upon a time (about a dozen years past), oil sold for \$12 a barrel and a lot of people thought it would get even cheaper because the market was glutted. But instead the price rose: many big oilfields were aging and yielding less, and it was getting harder to find new ones—especially in places easy and cheap to drill. So the glut eroded and petroleum prices rose. Seeing a perfect opportunity (a necessary commodity with stagnating supply and growing demand), speculators drove the price up even further.

As prices lofted, oil companies and private investors also saw opportunity and started funding expensive projects to explore for oil in remote and inconvenient places, or to make synthetic liquid fuels out of lower-grade carbon materials like bitumen, coal, or kerogen.

But then in 2008, as the price of a barrel of oil reached its all-time high of \$147, the economy crashed. Airlines and trucking companies downsized, motorists stayed home, and demand for oil plummeted. So did the price, bottoming out at \$32 at the end of 2008.

But with prices so low, investments in hard-to-find oil and hard-to-make substitutes began to look tenuous, so tens of billions of dollars' worth of projects got canceled. Yet the industry had been counting on those projects to maintain a steady stream of liquid fuels a few years out, so worries about a [future supply crunch](#) began to make headlines.

By mid-2009 the oil price had settled within a Goldilocks range—not too high (so as to kill the economy and, with it, fuel demand), and not too low (so as to scare away investment in future energy projects and thus reduce supply). That [just-right price band](#) appeared to be between \$60 and \$80 a barrel.

How long prices can stay in the Goldilocks range is anybody's guess, but production declines in the world's old super-giant oilfields continue to accelerate and exploration costs continue to mount, which means that the lower boundary of that just-right range will inevitably continue to migrate upward. Meanwhile the world economy remains frail, so that even \$80 oil could strain the recovery.

When discussing the increasing perils of the current oil supply-demand-price balancing act, some commentators opine that the world supply of oil has peaked; others say it is demand that has peaked. It is a distinction without a difference.

There are similarities with U.S. natural gas. Recent shale gas projects have yielded significant quantities of fuel, and reserves of the stuff are enormous. But drilling costs and per-well decline rates are high, so producers can make a profit only if gas prices are toward the upper end of their [historic range](#).

Nearly everyone believes that U.S. coal supplies are virtually endless, but the Goldilocks syndrome is coming into play there, too. Coal prices just about doubled in the two years leading up to the economic crash of 2008, and [high-quality coals from the eastern region of the country are depleting fast](#).

We will never run out of coal, oil, or natural gas—in the absolute sense. The Industrial Revolution started in British coalfields, and there is still an enormous amount of coal in Britain; but the coal that's left there is prohibitively expensive to mine, so that nation's coal industry is virtually gone. Goldilocks grew dissatisfied with her options, got up, and left. The same has been gradually transpiring in the U.S. oil patch over the past four decades, and the same will happen wherever useful non-renewable resources are found.

Economic theory says the Market will always find a substitute for whatever resource is depleting to the point of scarcity. When it comes to fuels, the substitutes are alternatives to coal, oil, and gas—primarily, [renewables like wind and solar](#). Investing in them should be a no-brainer. But, during the Goldilocks interval, increasing price volatility for oil, gas, and coal can make all energy investments dicey. That means that, as a society, our main strategy for navigating the energy transition will almost certainly have to be conservation.

The lesson of the parable: If you're an investor, beware—oil prices are going to be increasingly hard to predict over the longer term. And if you make energy policy, don't get any more hooked on non-renewable resources than you already are. If you do, you'll eventually be spending much of your time chasing fickle Goldilocks—and in the end, she's a bear.