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Patrick D. Murphy*

ピークオイル期のポストカーボン経済に向けた沖縄の備え

パトリック D. マーフィー

世界的な石油生産のピーク到来という観点から、沖縄は昨今の経済発展の方向性について再考する必要がある。エネルギーの価格高騰が沖縄の経済に打撃を与えることが予想される中、沖縄は安価な交通手段に支えられる観光産業とは異なる、新たな経済的手段を模索しなくてはならないだろう。液体燃料や石炭などの固形燃料の運搬コストが高騰しているため、電気エネルギーの生産は、化石燃料への依存から脱却する必要がある。また、海水の淡水化も影響を受けるため、観光産業に十分な量の水の供給能力にも問題が生じる可能性がある。ピークオイルと気候変動の衝撃は互いに不可分な合併要素として経済組織に衝撃を与えることなど、沖縄は、エネルギー生産と生活基盤の危機という観点からも、気候変動の危険性について指摘する必要がある。いずれの場合においても、持続可能性が最も重要な指針となることは言うまでもない。

Okinawa's current orientation for economic development is doomed. It is doomed because it relies on two key economic flows that are likely to dry up in the coming decades: U.S. military presence and tourism. Both of these drivers will slow if not screech to a halt entirely as the plateau of global peak oil production gives way to the long descent to a low energy consumption future. As the costs of fueling aircraft and maintaining bases dependent on air transport in far flung places become an intolerable budgetary burden, U.S. military leaders will have to reassess oversea bases and draw down their military presence in such locations as Okinawa, Diego Garcia, and other island sites.

The departure of U.S. forces from Okinawa will fulfill the desires of the vast majority of Okinawans who have voted in favor of an end to the U.S. military presence. While the situation remains quite fluid, there exists a standing plan to transfer nearly half of the U.S. Marines on the island to Guam by 2014. Early in 2010, Defense Minister Toshimi Kitazawa opposed the Social Democratic Party's proposal for the complete transfer of

* Professor, University of Central Florida　フロリダ中央大学教授

Marines (Onojo, 2010). But in any case, larger factors will come to bear on American decisions regarding their presence on Okinawan soil. One of the great benefits of their departure is that the closing of the bases will open up a significant amount of land that can be used for agriculture, permaculture, and water storage. The economic impact of the decline or elimination of the U.S. military presence is less clear. While base revenues as a percentage of Okinawa's gross domestic product have remained relatively flat since 1990, they do represent a sizable amount of income particularly in terms of land rent. At the same time, the central Japanese government has significantly increased its transfer of finances for public works and other functions and the degree to which this economic input might decline in connection with the dismantling of the bases remains impossible to gauge. Nevertheless, the U.S. military will depart, if not as a result of political decisions and popular dissent, then as a result of cost cutting measures as the price of fuel rapidly rises and the U.S. government confronts the necessity of austerity deficit reduction budgets, which will eventually include defense spending.

The same factors that will fundamentally alter Okinawan land use patterns in terms of a transition from military bases to agricultural and inhabitation uses for those spaces will also cause a significant curtailment of tourism. Tourism has been the most rapidly developing portion of the non-governmental sector of the prefectural economy, accounting for 20% of "Okinawa's total external receipts" as of 2004; of that amount 40% is spent on imported goods and services (Kakazu, 2011). As Akino Zayasu noted in October of 2010, "In fiscal 2009, 5.69 million people visited Okinawa prefecture. Though the number of domestic visitors is declining, visits by tourists from overseas have increased for two years in a row, reaching 240,000 annually." She continues: "'Due to declining birthrates, domestic tourism continues to languish. Attracting visitors from East Asia, particularly China, will be the key to Okinawa's development going forward,' notes the Okinawan prefectural government's tourism-related commerce and industry department." That figure of nearly 6 million visitors represents four times the total population of Okinawa. Yet, the prefectural government has, according to Kakazu, set a goal of 10 million visitors by 2017.

Although Okinawa opened a new terminal for cruise ships in 2009 in Naha, most tourists arrive by air. Rising fuel costs will become an increasing deterrent for all but the most affluent of global vacationers regardless of how they arrive. While some might see cruise ships as an alternative to aircraft in the future, they actually use far more fuel per passenger mile than the most fuel efficient commercial airliners. Thus, a conversion from aircraft to cruise ships will not reduce the costs of tourist transportation to Okinawa, while the costs of shipping cargo will rise thereby increasing the prices of the significant amount of imports that support tourism.

The rising cost of energy will negatively affect Okinawa's economy not only in terms of transportation but also in terms of electricity and with it potable water. Two crucial liquids are key to the Okinawan tourism industry: fuel and water. But, to a certain extent, there is really only one crucial liquid: fuel. Okinawa has embarked on the highly energy

intensive strategy of providing a sufficient and stable supply of water for tourism by means of desalination. Desalination depends on significant amounts of energy that will become increasingly expensive. One study indicates that electricity accounts for nearly 50% of the cost of the current desalination plant: "electricity is the most dominant factor of cost" (Yamazato). The Okinawa Seawater Desalination Center was completed in 1997 at a cost of 34.7 billion yen and the national government covered 85% of that cost. Its construction reflected a recognition of the frequency of drought in Okinawa and the doubling of water consumption from 200,000 cubic meters per day in 1972 to 420,000 cubic meters in 2002 (Yamazato). With the rapid increase in tourism in recent years and a recurrence of drought conditions, Toru Yamazato indicates that desalination production increased by fifty percent from 2002 to 2005.

The electricity used to desalinate water comes from the Okinawa Electric Power Company (OEPC), which relies on coal and oil to fire the boilers that feed the desalination center. Thus the cost of fresh water will rise with the cost of oil or the cost of shipping coal. In part to address concerns about global warming, OEPC is building the Yoshinoura thermal power plant, which is scheduled to come online in 2011. That plant will rely on LNG for fuel provided by the Osaka Gas Company and beginning in 2014 the LNG supplied will be shipped from Australia, approximately 5,000 miles away (Topham and Tsukimori, 2010). LNG prices will probably not remain at their current record low prices as international demand rapidly intensifies in the coming decades. But even if those prices remain stable, the fuel needed to power the ships to bring LNG to Yoshinoura, much less the cost of importing oil for OEPC's older plants, would increase the price tag of the island's electricity generating fuels.

As for other sources of energy, little has so far been done in the Ryukyus. There is a test operation underway on Miyako island and various research projects have been announced, but so far little alternative energy has actually been produced ("Japanese testing," 2010). It is highly unlikely that Okinawans will consent to the building of a nuclear power plant for energy and it is questionable that even if they did so the fuel would be available for powering up once the plant was finally ready for startup given the global competition for fuel for new reactors already under construction. Solar and tidal power is a long-term source for electrical energy on the island, but both would likely remain insufficient to run desalination projects, given the more basic electricity needs of residents. They do, however, represent the most promising options for energy self-sufficiency in the future.

Therefore, looking at the near future costs of energy and the inability to rely on desalination as the route for supporting tourist water demands, Okinawans need to begin planning for a fundamental transition of their economy away from external energy and financial inputs and toward sustainability and autonomy. Okinawa has accomplished such economic autonomy and relative self sufficiency in its long history and will need to do so again before the end of this century, although with a significantly larger population than in the past.

In order to understand the plateau on which Okinawan planning now stands and the changed world on the other side of it that requires fundamental rethinking of Okinawa's future, people need to become conversant with certain key global phenomena and strategic arguments. First is the matter of peak oil production and the coming decline of total carbon-based energy production. Second is the matter of climate change. Third is the matter of social organization and sustainability.

Numerous geologists, scientists, and policy analysts around the world have been presenting evidence about imminent peak oil production and the rate of global energy production for several decades.[1)] Most recently the IEA, International Energy Agency, in *World Outlook 2010*, has stated unequivocally that conventional crude oil production peaked in 2006. In the report's executive summary the authors write, "Crude oil output reaches an undulating plateau of around 68–69 mb/d by 2020, but never regains its all-time peak of 70 mb/d reached in 2006, while production of natural gas liquids (NGLs) and unconventional oil grows strongly." By "unconventional oil" they primarily mean synthetic oil produced from Canadian tar sands, Venezuelan extra heavy oil, and coal liquefaction, all of which are more expensive to refine than conventional crude. Likewise, new sources of conventional crude oil will either be smaller, less accessible, or both, increasing costs of production. The age of cheap oil has ended. The report also indicates that peak conventional oil will cause a rapid rise in natural gas demand. Due to the difficulty of transporting natural gas, there will be a significant increase in the production and demand for LNG, with a likely rapid escalation in prices as demand threatens to outstrip supply. Thus Okinawa's ability to attract tourists and to supply their lavish utilizations of desalinated water and electricity will be negatively impacted by this new energy reality.

Climate change is another global phenomenon directly affecting Okinawa, although its impacts will likely be felt more gradually and with less certainty than those resulting from peak oil. Many books have been written on the basis science of climate change and so there is no need to review the fundamentals here.[2)] Two aspects of it, however, that threaten Okinawa do deserve attention: rising sea levels and shifting rainfall patterns. After nearly two thousand years of relative stability, sea level worldwide has been rising gradually for the past two centuries and appears on the verge of a dangerous acceleration. Most recently, scientists have reported disturbing trends in Greenland that have led many scientists to conclude "that sea level is likely to rise perhaps three feet by 2100—an increase that, should it come to pass, would pose a threat to coastal regions the world over" (Gillis, 2010).

What would an approximately one-meter rise in sea level do to Okinawa? A quick scan of the island's best beaches indicates that many of them would be lost entirely while others would be seriously compromised with beach width severely reduced. Additionally, such sea level rise would subject the remaining beaches to erosion from storm surge, while Naha's low-lying airport might be at risk from flooding. The end of the century might seem a long way off, but it is important to consider that even the minimal one-third meter rise in seal level predicted for this century based on the twentieth-century rise in sea

level will be reducing the shoreline year by year. In Florida with a similar rise in sea level and the impact of storm surges from stronger hurricanes, many seaside communities have lost their beaches to erosion while the costs of artificial sand replenishment become increasingly unaffordable. Also related to Okinawa's natural attractions, climate change not only affects its beaches but also threatens its coral reefs, which draw tourists to the island.

Climate change is not only contributing to sea level rise around the world but also altering rainfall patterns, affecting typhoon strength, and altering the monsoon season. There does not seem to be any information—at least available in English—that provides some insight to whether or not these changing patterns of precipitation will affect the availability of naturally occurring freshwater on Okinawa. It is, however, an issue that needs to be taken quite seriously and studied in order to determine whether or not desalination would need to be intensified or if more storage facilities, such as reservoirs, need to be built on the island to capture rain when it does fall. After all, as Kakazu observes, "the water supply is precariously dependent on rainwater." This situation has come about because of the increasing reliance on dams and reservoirs to retain water for consumption. While sites for future dams are extremely limited at the present time, the departure of U.S. military forces while posing an economic hardship may also open up spaces for just such additional water retention capacity, assuming that the rains continue to fall with sufficient frequency and in sufficient volume to fill the reservoirs.

Social and economic organization reliant on external inputs within the context of a perpetual growth model theory of economics threatens the stability and sustainability of Okinawan life. While no one outside of Okinawa has the right or the ability to recommend a particular path forward, there are some general concepts that would likely prove useful as the need to move the economy away from a reliance on tourism and foreign military revenues becomes more widely accepted. There are several interrelated concepts worth reviewing: sustainability, post-carbon energy, and permaculture.

The term "sustainability" is bandied about with great frequency and a wide range of meanings today.[3)] Here, it needs to be thought of as the fundamental ability of the prefecture to provide the basic necessities to its people on a long-term basis relying on the resources at hand. Full sustainability, therefore, is not possible. Nevertheless, as a goal it provides an ideal against which efforts at reducing external reliance can be measured. It also provides an orientation for the utilization of internal resources, such as fuel, topsoil, and water, on the one hand, and sources of energy, such as tidal, solar, and wind, on the other hand. The most valuable research about sustainability is that which does not begin with sustainable possibilities, but rather with how to get from the current levels of unsustainability to cultural and economic practices that conform to a lower energy consumption future. For instance, *The Transition Handbook* assumes that there is going to be a significant and relatively rapid decline in energy production for transportation. Author Rob Hopkins remarks, "Climate change says we *should* change, whereas peak oil says we *will be forced to* change." His book outlines how communities can begin to prepare not only

for an "age of limits," a rather shopworn phrase that never did really catch on with people, but for an age of limited transportation. The global market of agricultural production and shipment is entirely dependent on fossil fuels. Billions of people will be affected by a drastic reduction in global agricultural trade. As already discussed, a reduction in air travel will seriously impact the Okinawan economy, but rising fuel prices will have relatively little effect on domestic life in Okinawa as the island transitions away from automobiles to public transportation, not only the monorail but numerous other vehicles that deliver far more passenger miles per gallon than even the most fuel-efficient combustion-engine driven car. There will occur a resurgence in vernacular architecture designed to eliminate the need for air conditioning and increase reliance on natural lighting. And, there will necessarily be a shift in occupations, away from service industries catering to the tourists and the military toward life support services and light manufacturing.

Post-carbon forms of energy will become crucial.[4] Initially, Okinawa can increase its reliance on natural gas, possibly exploiting offshore resources within prefectural limits. Eventually, however, unless local sources are found or a feasible system for extracting ocean bed methane hydrates is developed, the shift will be toward solar, wind, and tidal sources. Technological breakthroughs are occurring quite rapidly in the research and development of these sustainable energies, which take society beyond the idea of renewables, since none of these three is actually diminished by utilization. The development of such alternative energies may be especially important given the likelihood of political conflicts over offshore natural gas deposits between Taiwan and the Ryukyus.

David Holmgren in *Future Scenarios* focuses not so much on community resiliency in the face of a rapid decline of fossil fuel energy inputs, as Hopkins does, but rather he addresses the concept of "permaculture," a different approach to growing food locally and organically.[5] Okinawa has a long tradition of highly productive local agriculture that can provide the backbone of a strategic reduction of food imports. Permaculture offers a supplement to that focusing on the use of perennial plants in addition to annuals and on the intercultivation of multiple crops. While there is no doubt that imported food will be available for a very long time to Okinawa, the cost of such food may become increasingly prohibitive until significant alternatives to fossil fuels are developed. The release by the vacating military of some 20% of Okinawa island will open up land on which an intensive agriculture can be expanded.

This argument began with the use of the word "doomed," but it was applied narrowly to the prospects of the economy as it is currently constructed. It is appropriate to end with the use of the word "promise." The transition from fossil-fuel based economics will be a long and hard way for much of the world and the paths that various peoples, countries, and locales take will determine the degree of difficulty, hardships, and adjustments that people will experience on their way into a future quite different from the present day. Okinawa has the freedom and opportunity within the resource necessities that present themselves to pursue a path that will circle back to many of the values and practices that have long defined a vibrant, resilient, ancient island culture capable of not simply endur-

ing the turmoil ahead but weathering it well.

Notes

1) On peak oil theory, see the following books and websites: Michael Ruppert, *Confronting Collapse: The Crisis of Energy and Money in a Post Peak Oil World* (White River Junction, VT: Chelsea Green, 2009); Kenneth S. Duffeyes, *Hubbert's Peak: The Impending World Oil Shortage* (Princeton: Princeton University Press, 2008); Matthew R. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy* (New York: Wiley, 2006); Jeff Rubin, *Why Your World Is About to Get a Whole Lot Smaller: Oil and the End of Globalization* (New York: Random House, 2009); http://www.peak-oil-news.info/global/theory/; and http://aspo-usa.com/. Numerous additional books and websites exist and these are just a sample of those in English.
2) On the science of climate change, see the following sample of books and websites in English: Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis* (New York: IPCC, 2007); Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge: Cambridge University Press, 2007); David Archer and Stefan Rahmstorf, *The Climate Crisis: An Introductory Guide to Climate Change* (Cambridge: Cambridge University Press, 2010); Stephen Peake and Joe Smith, *Climate change: From Science to sustainability* (New York: Oxford University Press, 2009); http://www.epa.gov/climatechange/; http://www.newscientist.com/topic/climate-change; http://www.nature.org/initiatives/climatechange/; http://www.exploratorium.edu/climate/; and http://www.ipcc.ch/.
3) On sustainability, see the following: Erik Assadourian and The World Watch Institute, *State of the World 2010: Transforming Cultures: From Consumerism to Sustainability* (New York: Norton, 2010); Simon Dresner, *The Principles of Sustainability*, 2nd ed. (London: Earthscan Publications, 2008); Andres R. Edwards, *The Sustainability Revolution: Portrait of a Paradigm Shift* (Philadelphia: New Society, 2005); Andres R. Edwards, *Thriving Beyond Sustainability: Pathways to a Resilient Society* (Philadelphia: New Society, 2010); John Ehrenfeld, *Sustainability by Design: A Subversive Strategy for Transforming Our Consumer Culture* (Cambridge: Yale University Press, 2009); http://www.sustainability.com/; and http://www.sustainabilityinstitute.org/.
4) On renewable energy, see the following: Travis Bradford, *Solar Revolution: The Economic Transformation of the Global Energy Industry* (Cambridge: The MIT Press, 2008); Roger H. Charlier and Charles W. Finkl, *Ocean Energy: Tide and Tidal Power* (New York: Springer 2009); Joao Cruz, *Ocean Wave Energy: Current Status and Future Prespectives* (New York: Springer, 2010); Jack Hardisty, *The Analysis of Tidal Stream Power* (New York: Wiley, 2009); Richard Heinberg, *Powerdown: Options and Actions for a Post-Carbon World* (Philadelphia: New Society, 2004); Richard Heinberg and Daniel Lerch, eds., *The Post Carbon Reader: Managing the 21st Century's Sustainability Crises* (Berkeley: University of California Press, 2010); Daniel Lerch, *Post Carbon Cities: Planning for Energy and Climate Uncertainty* (Santa Rosa: Post Carbon Press, 2008); and http://www.postcarbon.org/.
5) On permaculture, see the following in English: Graham Bell, *The Permaculture Way: Practical Steps to Create a Self-Sustaining World* (White River Junction, VT: Chelsea Green, 2008); David Holmgren, *Permaculture: Principles and Pathways Beyond Sustainability* (Hepburn, AU: Holmgren Design Services, 2002); Ross Mars, *The Basics of Permaculture Design* (East Meon, UK: Permanent Publications, 2005); Bill Mollison, *Introduction to Permaculture* (sisters Creek, AU: Tagari, 1997); Bill Mollison and Reny Mia Slay, *Permaculture: A Designers' Manual* (Sisters Creek, AU: Tagari, 1997); Rosemary Morrow, *Earth User's Guide to Permaculture* (East Meon, UK: Permanent Publications, 2010); http://www.permaculture.org/; http://www.permacultureactivist.net/; http://www.permaculture.net/; http://www.permacultureph.org/about.html. See also the first site here that links to sites in Japanese, such as the last two, and other Asian languages: http://www.permacultureplanet.com/directory_asia.html; http://pcnhiroshima.no.land.to/; http://www.pccj.net/; and http://www.pcnq.net/.

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