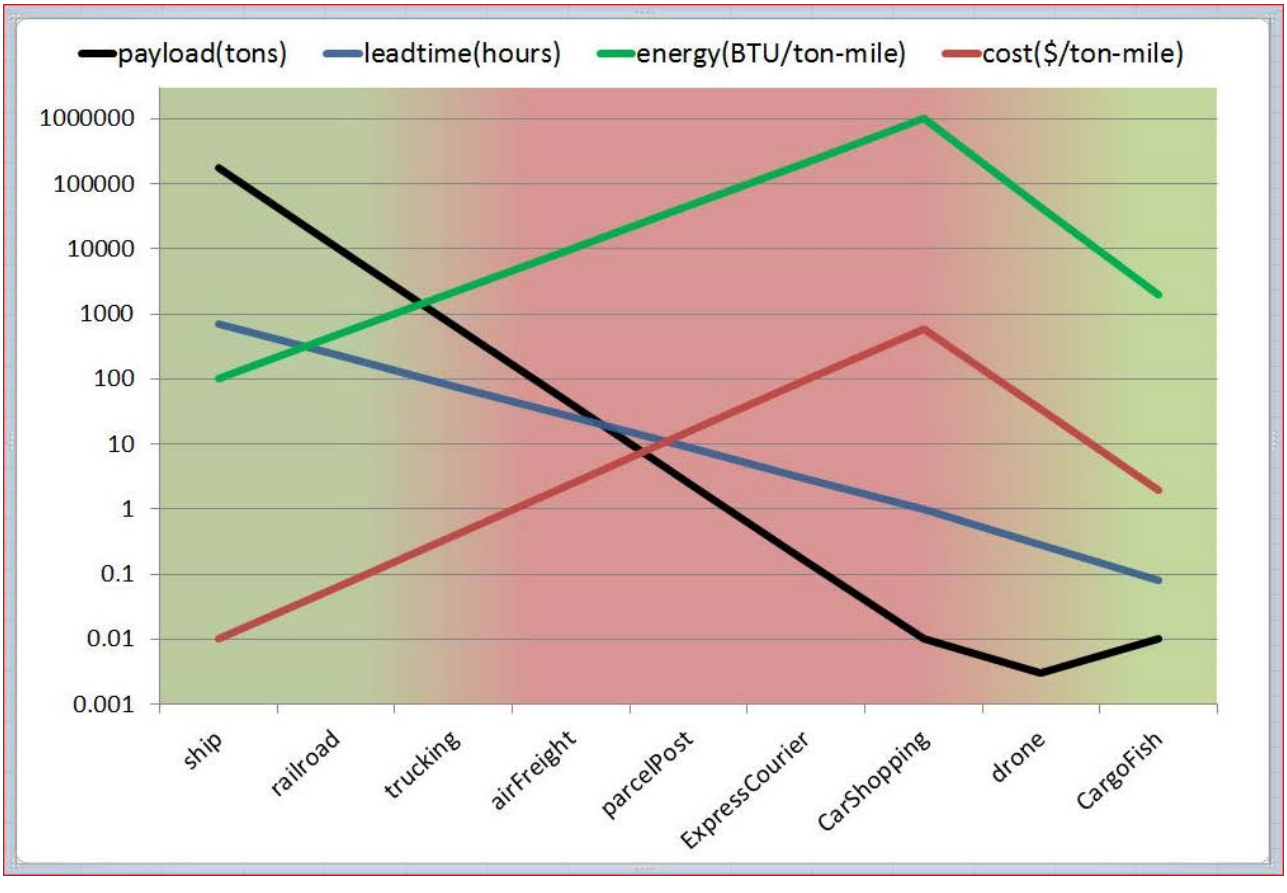
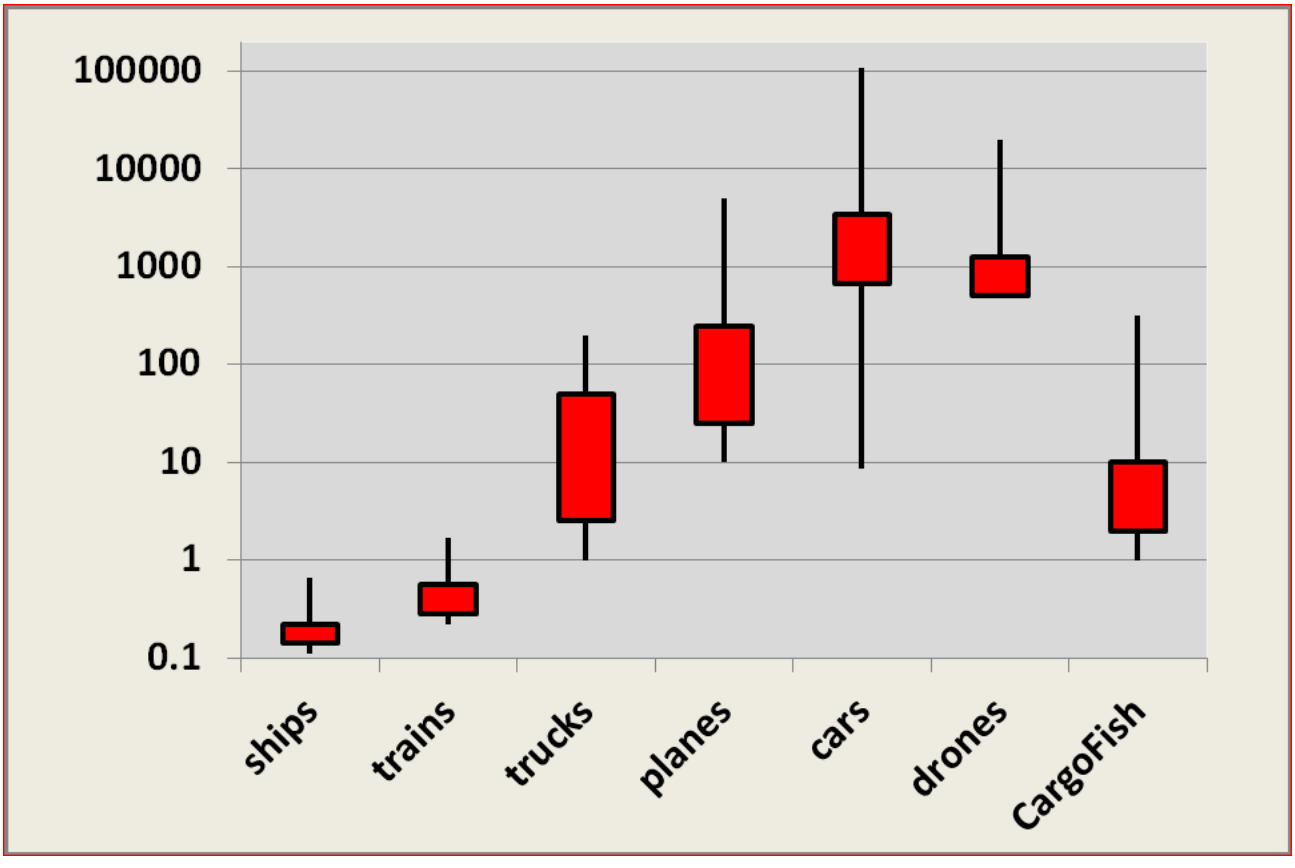
My name is Robert DeDomenico, and I am a lifelong New Jersey resident except for my six years in the US Navy. I have had a long career in nuclear power, as well as personal pursuits and studies in a variety of other areas, most notably transportation. In particular, for the last eight and a half years I have been developing a novel last mile parcel transportation technology. I have carefully scrutinized the nature and scope of the "last mile" problem and all approaches for solving it, and have developed a solution easily capable of efficiently and economically handling fast moving consumer goods (FMCS) distribution, mail pickup and delivery, and household solid waste collection. The advantages it offers in comparison with any other method in use or proposed are numerous and substantial, and its inclusion in the New Jersey Energy Master Plan, at least as an area of interest.

The following graphic compares just a few freight modes in four different characteristics. Notice the vertical axis is logarithmic, so each is a factor of ten difference from the adjacent increment.



The background is shaded green behind those modes that have the lowest specific energy intensity, and red behind those modes that have the highest specific energy intensity. The only significant mode not display is pipeline, which carries fifteen percent of all US freight ton-miles, a figure which neglects water and sewer because they are not typically thought of as freight carriers.

Here now is a box and whisker treatment of just the specific energy intensity, again with a logarithmic vertical axis, this time in units of thousands of BTU's per ton-mile, (kBTU/ton-mile).



Specific energy intensities for typical payload sizes are in the red box areas. The tip of the top whisker is the lightest load, and of the bottom whisker the heaviest. For the cars, drones, and CargoFish modes, the set of payload weights considered were something along the lines of two ounces, one pound, five pounds, and ten pounds. (No lower whisker for the drone mode because Amazon's drone net payload is advertised as only five pounds.) In my verbal comments I provides some typical power to weight ratios of freight modes, which correlate well with these energy intensities. The overriding principle of transportation energy efficiency is achieved by moving only what matters. CargoFish is "right-sized", rail based (though not traditional rail,) and electric. Its expense of installation will prove even less than some other utilities, though I admit it cannot be proven without it being tried.

Here I have answered the talking points for the transportation focused public hearing:

1. What are the intermediate timeframes and pathways to new or enhanced clean transportation systems? What clean and reliable transportation goals should be set for 2030 and 2050? The goals should not be married to any single approach, but adaptive to emerging technologies. The underlying goals are to reduce energy consumption, especially petroleum dependent consumption, with minimal detrimental side effects. One goal should be to help foster promising pilot technologies. A better goal is to successfully implement any new significantly beneficial technological approach capable of rising to unsubsidized widespread adoption.

2. What is the most significant obstacle that the state will face in implementing a clean transportation plan by 2050? Distraction from the best approach is the greatest obstacle. The available resources with which to implement policy are finite, and no approach to transportation can be subsidized fully without neglecting some other. Corporations promoting approaches all stand to gain for themselves with what they propose, and so are more interested that their approach prevails than the best, and will always couch this as a firm belief that theirs is the best. What are some solutions to these challenges? The only available solution to this challenge is in due diligence and conscientious execution in evaluating and selecting a promising basket of those approaches most worthy of state support, being careful not to fully neglect any one on basis other than true lack of merit.

3. What is the role of clean transportation in freight movement? Freight movement, in particular last mile parcel and automobile shopping, is the best place to launch a novel clean transportation technology that can deliver results far beyond what most believe is even possible. Ponder this if you will… freight is the purposeful movement of anything other than people. With this broad and inclusive definition, fast moving consumer goods including bottled water are freight, as is municipal water. Notably, tap water typically costs a small fraction of a cent per gallon, whereas bottled water is very often more than ten dollars. This price difference is not because of packaging per se, but mode of last mile distribution. It accurately reflects the ratio of energy expended in its transport. Tap water is "packaged" in plumbing, where it requires application of only modest differential pressure to flow far and easy to whatever destination calls for its delivery by opening a valve. Bottled water is handled, trucked, hand trucked, shelved, consumer picked, and driven. Aside from those things delivered by utility systems, the necessities of everyday household life suffer the same expensive and circuitous path as bottled water when distributed via warehouses, trucks, roads, and most of all cars. When we drive out and back to the grocery or convenience store to resupply anything not delivered otherwise, and pick up, as an example, an 8 pound gallon of milk using a thirty-four mpg car, the specific energy intensity for that payload is over 1.6 million BTU per ton-mile. For last mile, immediate dispatch, small payload movements, far better is achievable using a utility system approach. How much better? North American rail freight does the arterial long haul for only 285 BTU per ton-mile, which is more than 5600 times as efficiently. US long haul trucking, at 2500 BTU per ton-mile, is almost 650 times as efficient. There is one specific technological approach already far along in proof of concept development that can reduce last mile distribution energy intensity by more than 99 percent, and do so economically, too. How much does this matter? For household driving, one mile out of every eight is shopping by car, and total US vehicle miles travelled are astronomical. (Literally… we drive more than eight billion miles per day, about three trillion miles a year, in other words… half a light-year!) What should the State do to promote low-carbon freight/goods movement? At a minimum, New Jersey should request information from in state businesses developing highly efficient last mile distribution technologies. Based on the merit of submissions received, the state could then consider further actions such as grant funding for a proof of concept demonstration pilot, especially if the most promising applicant is a startup not otherwise well funded. In such a case, without state support the best approach might never even be put to the test. With enabling state funding, any pilot implementation capable of delivering on these metrics will result in a rapidly cascading flow of private funding, not only without further need of any state subsidy, but also growing the state economy and tax base, and firmly establishing our leadership position in the field.

4. How can clean transportation solutions impact goods movement and economic growth? In case the characteristics of the approach that make it clean are also economically advantageous, then the solution can evolve into natural growth without need of further subsidy. A utility system approach for last mile distribution of fast moving consumer goods can revolutionize ecommerce and drive economic growth, much as railroads did almost two centuries ago.

State Policy

5. What are the regulatory or statutory barriers to the expansion of low- and zero-emission vehicles? The lowest emission vehicles do not operate on ordinary roads, but on specialized tracks requiring their own rights of way. NJAC 16-25 covers utility accommodation for things that are essentially just that: wires, cables, fibers, pipes, etc.

6. What are the clean fuel transportation approaches the State should consider to achieve its zero emission vehicle (ZEV) goals of 330,000 ZEVs on the road by 2025? New Jersey should consider what the underlying goal is, that of reducing dependence on petroleum fuel. This can be more economically and effectively achieved by technologies other than just battery powered versions of otherwise ordinary automobiles. Broaden the definition of road, and have one hundred zero emission vehicles for less than only one ZEV road vehicle costs! Why do the vehicles that reduce petroleum consumption have to drive on the same already congested roads?

7. What actions can the state take with its own fleet to demonstrate clean transportation leadership? New Jersey State Government, just like any large corporate body, has frequent need to move small payloads,

especially around the various clusters of state buildings. The state can pilot the new technology, taking full and first advantage of its merits. How would these actions affect service reliability? These actions would drastically improve service and reliability.

8. What strategic incentives should be considered for encouraging the adoption of zero emission vehicles, plug in hybrids, and other low emission and clean fuel transportation? Incentives should be structured so as to take into account results per dollar, as opposed to the Federal incentives based on battery size.

9. What best practices can the state adopt from other states and local governments that have advanced clean transportation goals? The state of New York has an Energy Research Development Authority that routinely awards grants for exploration and/or development of promising new technologies.

10. What actions can the state take to help promote clean and reliable transportation at the state's ports?

11. What role should utilities play in clean transportation? The next great revolution in clean transportation will effectively be a utility system… a new one. And it will be completely powered by an old one, electricity.

Technological Advancements

12. What existing and emerging technologies need to be incorporated into future transportation planning? CargoFish is an emerging technology "de facto" teleportation via utility system (similar to, but not pneumatic tubes), being developed in Mannington, Salem County, and needs to be incorporated into transportation planning in this state and across the country.

13. How can the State best encourage research and development of new technologies? New Jersey could cast a wider net for new approaches and their proprietors, than just where traditional expectations are. It is not always the universities and young people that bring fresh perspectives to the fore and useful new innovations into common use. It can be extremely difficult without any acknowledgement or support.

14. How could new technology impact infrastructure investment? New technology could spur new infrastructure, and by symbiotic with restoration of many miles of existing but aging infrastructure in need of refurbishment. Several cities in the US and around the world, including NYC, have sections of the city where utilities are co-located in underground "utilidors". This type of installation may have higher initial cost, but typically lower ongoing operation and maintenance cost. It is not inconceivable, that in some utility refurbishment operations it will prove advantageous to back fit a utilidor, or at least simultaneously refurbish several utilities at once in a shared trench and street opening.

Infrastructure Investment

15. What infrastructure investments, policies, and procedures are needed to support the future of clean transportation in the state? What infrastructure needs will the state have in the promotion of clean and alternative fuel vehicles? The state will need an entirely new "capillary" infrastructure, one that is thus "right-sized" to the majority of "freight" movements, which are small.

16. What clean transportation funding mechanisms should the state explore? The state could explore broadly defined and merit based competitive solicitations, that do not exclude on the basis of existing financial backing or lack thereof. What type of financial planning and programming should be considered?

17. What incentives can New Jersey explore to encourage the transition to clean transportation? New Jersey can explore providing a competition based award, without any barriers to entry other than the merit of the endeavor.

Reliability and Security

18. What is the effect of increasing alternative fuel vehicle adoption on energy generation and the utility distribution system? What role should utilities play?

19. How can clean transportation systems assist in assuring enhanced energy security, reliability, and resiliency? The right clean transportation technology can be highly secure and reliable, and almost entirely impervious to the effects of weather. It may be that it serves only a slice of total transportation needs, but no transportation system does any more than that.

20. What strategies can NJ TRANSIT develop (infrastructure, facilities, vehicles, labor, workforce, training, etc.) to implement clean transportation (buses, paratransit and rail) by 2030 and 2050 while maintaining reliability? NJ TRANSIT leverages telecommunication systems to augment operations and maintenance, and could make good use of a "de facto" teleportation system for small articles, such as repair parts, at least some of which are small.

Economic Growth and Workforce Development

21. What new industries will be needed to meet clean transportation goals? The new industry of a new utility and all the accoutrements supporting it. What new jobs and training will be needed to meet the demands of these industries? There will be need of more entry level construction skills, which is a great advantage. There will also be need of "mechatronics" technicians, as the workings of a fully automated last mile distribution system will involve both controls the elements they control.

22. What is the impact of changes in transportation on the mobility of the workforce? The impact of a distribution utility will be a reduction in need of travel, including extra trips to and from remote work locations for want of needed parts. Workforce mobility will be effectively enhanced. Imagine an appliance repair technician arriving to troubleshoot and repair an over/under washer dryer. No matter how large the service van, he cannot bring along every one of the wide variety of repair parts. He determines the problem and needed part, orders it for instant dispatch from his company material warehouse for arrival within thirty minutes, then uses the short wait time to disassemble, cleans and prepare for installation. The part arrives at the customer's connection on this distribution network and is installed by the technician, completing a job in only one trip that without this new utility would have taken two.

23. How does the state encourage innovation startups in this sector? The state needs to ensure that merit is not neglected for want of matching resources. If a great startup cannot put up fifty thousand in cash, should it be denied any significant support regardless how advantageous its pursuit could be for the citizens of the state and country?

24. What are possible public-private partnerships in transportation innovation and what do they look like? They are very similar to the existing telecommunications and utilities. Some are private, some public, and all share rights of way under NJAC 16-25. This type of new partnership will deliver new value, literally as well as figuratively, to our society.

Environmental Justice

25. What strategies could be implemented to allow for disproportionately impacted communities to have access to clean transportation options? An approach promoting things more affordable and potentially ubiquitous, even if it begins in affluent areas, will have much faster propagation into affluent areas. And such things as distribution utilities are capable of direct service to persons unable to drive for any reason, making the crowd enjoying the benefits of one a much more diverse group regardless where it is installed. As rural electrification was mandated by regulators, any successful new utility distribution system could have rates scheduled so as to finance its own expansion into areas that may not have otherwise been served as quickly.

26. What efforts are most successful towards making clean energy measures and zero emission vehicles affordable and accessible to all? The effort of implementing an emission free last mile distribution utility system. Accessibility to other utilities is near universal, and will eventually be so with such an approach as well.

27. How can the state play a role in ensuring that disproportionately impacted communities receive opportunities and benefits connected to the clean energy economy and expansion of low and zero emission vehicles? To begin with, because the sole advocate of the most beneficial approach happens to be an in state start up still striving for access to any appreciable capital, the state can find a way to give this startup a chance to succeed. There is historical precedent in none other than the Erie Canal, which was built entirely under New York State support without any Federal funding. Then governor of New York, DeWitt Clinton, had detractors proclaiming the project "Clinton's Folly", until it became an absolute success and was in profit by the time of its completion.

I have already offered several other pertinent observations in person at three of the seven public meetings, among them some information on my own dedication to developing this concept. Nonetheless, let me just list a few specifics of the effort:

Presentations given:
Rowan University, Glassboro, NJ, 2013
NYSERDA, Albany, NY, 2013
2014 First International Physical Internet Conference, Quebec City, Canada
NYIT Transportation Technology Symposium, NY, NY
USDOT Exploratory Advanced Research Program, Novel Surface Transportation Modes, Turner-Fairbanks Research Center, MacLean, VA, 2015
Royal Geographic Society 2015 Annual Conference, Exeter, England
2015 International Urban Freight Conference, Long Beach, CA
Transportation Camp, Washington, DC
USDOT, Office of Freight Operations and Management, Washington, DC
YPT Philadelphia, 2016 Transport Roundup, Philadelphia PA

Some competitions entered:
2013 MIT Climate Colab
2013 Philips Innovation Fellows, on IndieGoGo.com
2014 MIT Climate Colab
2017 MIT Climate Colab
Fresh Ideas for Military Transportation
Buckminster Fuller Challenge
Shark Tank audition, Boston, MA
Shark Tank audition, Salisbury, MD
Six Minute Pitch Competition
George Mason University, Outside the Box Competition
Verizon (Ventures?)
2017 Ocean Exchange Orcelle Competition
2018 Ocean Exchange Orcelle Competition
Nokia 2018 Innovation Challenge

Grants applied for
NYSERDA PON 2584, 2891, and 3345
DOE FOA 1919

RFI's answered:
Texas A&M Transportation Institute "Campus Transportation Technology Initiative" RFI
Philadelphia, PA, "Using Technology to Make a Smart City"

Some notable material studied:
"Report on the Subject of Public Roads and Canals", Secretary of Treasury Albert S Gallatin, 1808
"Pneumatic Despatch", Professor C. A. Carus-Wilson, Journal of the Society of Arts, March 2, 1900
"Enchanted Rendezvous – John C Houbolt and the Genesis of the Lunar Orbit Rendezvous Concept", circa 1995, James R Hanson
"Shop 'Till We Drop: A Historical and Policy Analysis of Retail Goods Movement in the US", 2013, Laura Schewel and Lee J Schipper
"The Baggage System at Denver: Prospects and Lessons", Dr. Richard de Neufville
"Competition Within the United States Parcel Delivery Market", Alan Robinson

A few of the people I have spoken to:
Alain Kornhauser, Princeton transportation researcher

Anne Goodchild, freight researcher
Barbara Ivanov, freight researcher
Genevieve Gulliano, freight researcher
Sergio Barbarino, Proctor and Gamble Research and Development
Dario Biggi, Italian Postal System
Suzanne Zammit, Rutgers Camden Colab
Serpil Guran, Rutgers Eco-Ignite
Jerry Creighton, NJIT
Dr. Benoit Montrieul, founder of the "Physical Internet" movement
Joseph Tario, New York State Energy Development Authority Project Manager (retired)
And many, many others.

Numerous other materials were studied, competitions entered, leads pursued, conferences attended, abstracts accepted with invitation to present, and others rejected. Many direct observations and experiments conducted, and prototypes of increasing capability assembled. Extensive study of conveyor belts, pipelines, ships, barges, trucks, railroads, canals, bridges, tunnels, engines, flight, rocketry, plumbing, drones, sidewalk bots, electric and autonomous cars, courier services and parcel shipping, and US personal travel and shopping habits, including their history and economics.

I would like to specifically quote these relevant excerpts from "Enchanted Rendezvous – John C Houbolt and the Genesis of the Lunar Orbit Rendezvous Concept". First, from the foreword:

"One of the most critical technical decisions made during the conduct of Project Apollo was the method of flying to the Moon, landing on the surface, and returning to Earth. Within NASA during this debate several modes emerged. The one eventually chosen was lunar-orbit rendezvous (LOR), a proposal to send the entire lunar spacecraft up in one launch. It would head to the Moon, enter into orbit, and dispatch a small lander to the lunar surface. It was the simplest of the various methods, both in terms of development and operational costs, but it was risky. Since rendezvous would take place in lunar, instead of Earth, orbit there was no room for error or the crew could not get home. Moreover, some of the trickiest course corrections and maneuvers had to be done after the spacecraft had been committed to a circumlunar flight. Between the time of NASA's conceptualization of the lunar landing program and the decision in favor of LOR in 1962, a debate raged between advocates of the various methods. John C. Houbolt, an engineer at the Langley Research Center in Hampton, Virginia, was one of the most vocal of those supporting LOR and his campaign in 1961 and 1962 helped to shape in a fundamental way the deliberations. The monograph that is printed here is an important contribution to the study of NASA history in general, and the process of accomplishing a largescale technological program (in this case Apollo) in particular. In many ways, the lunar mode decision was an example of heterogeneous engineering, a process that recognizes that technological issues are also simultaneously organizational, economic, social, and political. Various interests often clash in the decision-making process as difficult calculations have to be made and decisions taken. What perhaps should be suggested is that a complex web or system of ties between various people, institutions, and interests brought forward the lunar-orbit rendezvous mode of going to the Moon in the 1960s."

Last, from the conclusion:

"Whether NASA's choice of the LOR concept would have been made in the summer of 1962 or at any other later time without the research information, commitment, and crusading zeal of Houbolt remains a matter for historical conjecture. His basic contribution, however, and that of his associates who in their more quiet ways also developed and advocated LOR, seems now to be beyond debate. They were the first in NASA to recognize the fundamental advantages of the LOR concept, and for a critical period in the early 1960s, they also were the only ones inside the agency to foster it and fight for it. The story of the genesis of the LOR concept thus testifies to the essential importance of the single individual contribution even within the context of a large organization based on teamwork. It also underscores the occasionally vital role played by

the unpopular and minority opinion. Sometimes one person alone or a small group of persons may have the best answer to a problem. And those who believe passionately in their ideas must not quit, even in the face of the strongest opposition or pressures for conformity."

I feel that it is an appropriate coincidence that the Energy Master Plan is being revisited now, as we are approaching this December the fiftieth anniversary of the first manned circumlunar navigation, and next July of that historic lunar landing. Let us not be afraid to explore making history again.

Thank you for the opportunity to participate.

Sincerely,
Robert DeDomenico
CargoFish
Mannington NJ