Virtual Co-Laboratory for Policy Analysis in the Greater L.A. Region

A. Scope and rationale of the MRPI: The purpose of the proposed virtual (online) co-laboratory is to revolutionize and transform the use of computable economic models in public policy analysis for metropolitan areas. The scientific merit of the co-laboratory is that the recent advances in the field of *urban, public* and *environmental economics* (UPE-Economics) and the related discipline of environmental engineering, will be synthesized with expertise from the disciplines of *urban planning* (Planning) and *geographic information systems* (GIS) in order to pioneer a first-ever, state-of-the-art virtual laboratory, on which academics and practitioners can collaborate on the analysis and formulation of policy.

The MRPI will advance outstanding research by organizing the collaboration of UC experts from three UC campuses, and thus achieving synergies among UC experts that have not been made possible before in the UC system or elsewhere. This will catapult the UC system into a position of leadership in the application of UPE-economics to real policy analysis issues.

An equally important aim of this MRPI is to improve policy analysis in practice, by making accessible to practitioners (Metropolitan Planning Organizations) in Southern California's Greater L.A. region, the advances and tools of analysis developed in academia, and to do so in a way that will engage the MPO analysts in ongoing collaboration with the experts in the UC system.

B. Contributing disciplines and collaborating campuses: UPE-Economics, broadly defined, is represented by the Director/PI, Alex Anas (Professor of Economics at UC-Riverside and the Director of the Center for Sustainable Suburban Development), Richard Arnott (Economics) and David Swanson (Sociology) who will contribute demographic forecasting. In addition, Matt Barth, Professor in CE-CERT (Civil Engineering - Center for Environmental Research and Technology) and Director of Transportation Systems Research at UC-Riverside, and his collaborators will participate in the MRPI contributing their expertise in environmental and transportation engineering.

A team of urban planners, civil engineers and public policy economists led by Robert Cervero at UC-Berkeley, Professor of City and Regional Planning, will contribute specific technical, planning and public policy expertise. Professor Cervero will contribute his expertise on transit-oriented development and transportation and land use planning. He will coordinate the efforts of a team that includes Professor Elizabeth Deakin, of City and Regional Planning who is an expert on transportation, land-use, and environmental policy, the institutional and legal aspects of urban transportation, and currently spearheading a study on transit oriented development opportunities for California's high-speed rail system; assistant professor Joan Walker from civil engineering who is an expert on behavioral modeling, urban infrastructure and service demands, and urban systems analysis; Professor Harrison Fraker, from the Department of Architecture, will contribute his expertise on sustainable building designs, green urbanism and zero-waste community designs; Associate Professor Karen Chapple, of City and Regional Planning, will be the expert on affordable housing; community development tied to sustainable land-use and transportation planning; infrastructure and economic development; Professor Stephen Raphael, School of Public Policy is expert on the spatial mismatch impacts on unemployment; and on social equity issues.

Michael Goodchild, Professor of Geography and Director of the NSF funded National Center for Geographic Information and Analysis at UC-Santa Barbara will lead the co-laboratory's GIS and the

critical human-computer online interface development efforts. Professors of Geography Rick Church, Martin Raubal and Stuart Sweeney will participate in the development of the virtual co-laboratory.

It is planned that UC-Riverside will employ two full time post-doctoral researchers and two graduate research assistants with suitable training from engineering or economics, while each collaborating campus will employ one full time post-doctoral fellow and one full time research assistant.

The collaborating campuses complement well the strengths of UC-Riverside which now has a complete selection of nationally and internationally known experts spanning various disciplines who can model the interactions of urban economy, demographics, transportation, land use and environmental quality, to the best-practice scientific standards. UC-Berkeley's outstanding experts in planning, public policy and green development will provide the strength in planning and public policy which is presently lacking at UCR, while UC-Santa Barbara's outstanding expertise in geographic visualization and spatial computing will provide the strength in GIS and the online interface development for the co-laboratory.

C. Bridging the gap between science and practice: UPE-economists focus on theoretical models, or on econometric analysis of data. Computable models of metropolitan areas as complex systems have been advanced in universities by only a handful of economists such as Lowry, 1964; Ingram, Kain and Ginn, 1972; Mills, 1972; De Leeuw and Struyk, 1975; Arnott and MacKinnon, 1977a,b; Kim, 1979; Anas, 1982; Berechman and Small, 1988; Moore, 1986; Anas and Arnott, 1991, 1993, 1997; Mansur, Quigley, Raphael and Smolensky, 2002; Anas and Liu, 2007. Despite these advances in universities, a gap has existed between the economic science and the adoption or practice of this science by the MPOs. MPO analysts are technically skilled but not used to thinking computationally about complexity as economists now are (Judd, 1998). Consequently, modeling in MPOs has lagged the science. Such modeling practice satisfies Federal guidelines, but has limited impact on policy.

This gap between urban planning and UPE-economics has attracted models such as DRAM/EMPAL, MEPLAN, TRANUS, UrbanSim, PECOS and others, all developed by non-economists. These for-profit models purchased by MPOs are developed by consultants are inconsistent with economic science, and are imperfectly documented partially verifiable black-boxes. Some such models have even been challenged in court for conceptual inconsistencies in addressing the basic complexity of transportation and land use interactions (see Garrett and Wachs, 1996). These models have been useful, however, since they have provided focal points for debate and improved the state-of-the-art in the use of modeling in MPOs.

The virtual co-laboratory to be developed by the MRPI aims to break the *modus operandi* connecting the fields of UPE-economics, urban planning and GIS. The Southern California Association of Governments (SCAG) and other L.A. agencies and stakeholders, will partner with us around the RELU-TRAN model to jointly and interactively discover, design and evaluate policy solutions to vexing urban problems.

D. Involvement of the MPOs: SCAG is the MPO serving the Los Angeles, Orange, Riverside, San Bernardino, Ventura, and Imperial counties in the Southern California mega-region. SCAG monitors trends in the region, and models subsystems (e.g. transportation, or transportation and land use) on the computer, insuring that projects are compliant with Federal and state regulations and guidelines. SCAG is the largest MPO in the U. S., covering a sprawling geography of 38,000 square miles and 18 million residents. SCAG coordinates the federally mandated Regional Transportation Plan, produces

demographic reports for the region, and acts as the clearinghouse for regional projects by the local governments. SCAG manages the compliance of projects with federal and state guidelines for environmental quality and economic efficiency, as required, for example, by the Clean Air Act (CAA) and the Intermodal Surface Transportation Efficiency Act (ISTEA). For almost two years, SCAG has been interacting informally with us, providing data, and learning about the economic characteristics of the RELU-TRAN model (developed by the Project Director, Alex Anas), which is the model we will be applying in the proposed MRPI. Once the MRPI is established, we will formalize our relationship with SCAG without any cost encumbrance on SCAG or a commercial benefit to us. Through such a formal collaboration, the best-practice science developed at the UC system will be applied in the real world with the participation of the practitioners, and in a way that illuminates critical policy issues for California.

E. Importance of the MRPI to California: Over the next 20-30 years, the Greater Los Angeles area will grow by millions of people. Whether this growth can be sustained without severely compromising quality of life depends on how well policy issues are addressed with quality economic analysis supporting practical policy formulation. Providing specific and useful answers to policy questions requires complex analysis, since environment, energy, land use, housing, transport infrastructure are not isolated economic subsystems but interact with feedbacks. Modeling the interactions is necessary to understand how specific policies and plans work. For example, when a policy bearing on the transport system is studied by a transport model in isolation, it may show certain effects on the environment and negative net benefits, but when all the subsystems such as land use, environment, housing, regional economy are considered together, then more accurate and complete pictures of the impacts of policies and their net benefits will emerge.

The Greater Los Angeles Region will serve as the test bed for the development and calibration of the computable RELU-TRAN model in the first two years of the MRPI, complete with the GIS and human-computer online interface. Beginning with year three, the working model will be placed in the virtual co-laboratory setting in which it will start providing an analysis and evaluation of alternative policies for the sustainable development of the Greater L.A. region on a continuing basis in collaboration with SCAG and in a way that is open to public scrutiny by others.

F. The RELU-TRAN model: The Regional Economy, Land Use and Transportation (RELU-TRAN) model was developed by Alex Anas (Director/PI) under an NSF award (SES 9816816) and extended and applied to the Chicago region under a U.S. Environmental Protection Agency award to Anas (2004-STAR-B1, RD-83184101-0). RELU-TRAN is a dynamic, spatially detailed computable general equilibrium model of the regional economy that takes into account the interconnections and feedbacks between real estate and labor markets, housing, land use, transportation, energy use and the environment. The model's equations have been published in full detail in a refereed journal (Anas and Liu (2007)). The model is unique in terms of its adherence to economic science. It is consistently *price and market based* recognizing the important processes of the real world. Firms maximize profits, households maximize utility, prices clear markets, and asset values equal the present value of net rents. Government is modeled consistently as setting taxes/subsidies, investing in public goods, setting zoning or aggregate development constraints and redistributing net revenues from taxes/subsidies. RELU-TRAN examines positive effects and normative aspects of scenarios, plans, policies, taxes, regulations. The positive effects include those on transportation, land use, energy, and the environment. The normative aspects include aggregate costs

and benefits as well as distributional effects, namely who gains and who loses. RELU employs an efficient algorithm to solve iteratively for the interactions among industries, the labor and housing markets, the location of residences and jobs and the (re)development of (buildings) land. TRAN models work and non-work trips, choices of travel mode and route of travel on road networks.

G. Specific policy questions for the Virtual Co-laboratory: Examples of policy questions that can be answered by the RELU-TRAN model are:

a) Environmental quality. (i) Should zoning or taxes on development be used to protect environmentally sensitive areas from excessive real estate development? **(ii)** How much would tolls on traffic congestion versus taxes on fuel reduce greenhouse gases (global warming)? **(iii)** How quickly will development strain the region's limited water resources?

b) Energy use. (i) How much do various taxes, incentives or regulations cut energy use in personal and freight transport, in the operation of buildings, in production and in the warehousing of goods? **(ii)** How quickly and how much can a region raise its share of electricity from renewable sources such as solar and wind?

c) Land use. (i) How does urban sprawl affect the dispersion of jobs and residences and the costs of human interaction such as excess commuting and congestion? **(ii)** How will proposed increases in densities along major boulevards impact congestion and quality of life? **(iii)** How would exurban development containment and environmental constraints affect densities in urbanized areas, limiting urban sprawl?

d) Housing. (i) What is the long term affordability of housing in the region, especially for lower income and minority groups, given demographic change, population growth and immigration? **(ii)** How do growth control policies in local jurisdictions affect housing affordability?

e) Transportation. (i) What are the costs and benefits of additional highway capacity? **(ii)** How should public revenues from congestion tolls and fuel taxes be used to produce maximum benefit? **(iii)** How would the region adjust to high gas prices, or to hybrids/electric vehicles? **(iv)** Have low densities locked in auto dependence making transit permanently uneconomical? **(v)** What are the best ways to pursue transit oriented development.

H. How the co-laboratory would operate: The academic researchers make a baseline run of RELU-TRAN for the next 20-30 years divided into at least 5-year periods. The underlying data sources, calibrated parameters, and outputs of this run and the results are displayed on the co-laboratory's server using accessible economic exposition. Population, demand for exports, the growth of the national economy and some other factors are forecasts that are input into the model. The model then computes, in a manner consistent with economic theory, a number of outputs by subarea, both GIS-mapped and tabulated on the server at different levels of aggregation. These include the distribution of jobs and residences among the region's zones and counties, the growth or decline in the region's industries, changes in land use, housing and commercial building stock by type and subarea, changes in traffic congestion, transit use, vehicle-miles traveled, gasoline and electricity consumption, CO_2 emissions, etc.

Urban planners at SCAG and academia, and other agencies in the region react to the baseline run by changing the inputs (raising and lowering growth rates etc), or by inputting proposed projects (e.g. planned highways), or policy options (e.g. highway tolls, local vs. regional growth controls etc). The co-laboratory allows planners to independently input most changes, while some changes may require the project's academic team to assist. The results are explained by the planners and the academic researchers in a structured way, cataloguing what was learned, how the model improved knowledge, and which new questions emerged.

Regional governance in the region is complex. SCAG's letterhead hints: "*The Regional Council is comprised of 83 elected officials representing 187 cities, 6 counties, 5 County Transportation Commissions, Imperial Valley Association of Governments and a Tribal Government representative...*" Cities like Los Angeles and Riverside that control local land use, and regional bodies e.g. the Air Quality Management District, will participate in the virtual co-laboratory, reflecting the complexity of the region. They can test the effects of policies e.g. across-the-board zoning or taxes on car or truck emissions. The co-laboratory will remain above the region's complex politics, (1) by a scientific dedication to improving the use of economics in policy; (2) by the data, calibration and outputs remaining in the public domain and open to scrutiny; (3) by the findings not being binding on policy decisions; (4) by disavowing commercial ties among participating institutions and the researchers; (5) by inviting economics, urban planning and real estate experts from universities to be independent overseers of the co-laboratory; and (6) by future support coming only from non-profits committed to public policy

I. Long term goals for the co-laboratory: As explained above, in the short run, the co-laboratory will synergize experts in the UC system that work in the related disciplines of UPE-economics, GIS and planning and public policy. In doing so, the MRPI will have created a first-ever research environment that will be unique and will catapult the UC-system into a position of leadership. It was also explained that this will be done in a way that engages MPO practitioners in partaking in computationally supported policy analysis.

The co-laboratory will be launched at the end of the second year and will achieve a complete and working form in the beginning of the third year. The last three years will be devoted to demonstrating the co-laboratory's usefulness and success, and to documenting its impact on policy analysis practice. After the five year period, expanding the co-laboratory to the entire State of California will be possible.

During the five years, the co-laboratory will apply for additional sources of funding from Federal and State agencies and private foundations. It is expected that such applications will be successful and thus will augment the depth and scope of policy analysis that will be performed on the co-laboratory. Thus the initial five year funding requested from the UC system should be viewed as an investment in a research practice that will engage the practitioners and that will grow and bear fruit over an extended period.