International Mayors Forum
on
Sustainable Urban Energy Development

November 10-11, 2004

Kunming Green Lake Hotel
6 South China Cuihu Road
Kunming, Yunnan Province
P.R. China

Jointly Sponsored By:
The Ministry of Construction
The Chinese Academy of Engineering

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WEDNESDAY, NOVEMBER 10, 2004

Moderator: Wang Tiehong, Chief Engineer, PR China Ministry of Construction

8:30 am  **WELCOME SPEECHES**

Huang Wei, PR China Ministry of Construction  
Xu Rongkai, Governor, Yunnan Province  
Carol Larson, President, David & Lucile Packard Foundation  
Joseph Ryan, William & Flora Hewlett Foundation Representative

**PART ONE: KEYNOTE SPEECH**  
Moderator: Wang Tiehong, Chief Engineer, PR China Ministry of Construction

9:00 am  **CATALYZING ENVIRONMENTALLY SUSTAINABLE URBAN ENERGY DEVELOPMENT**  
Xu Kuangdi, President, Chinese Academy of Engineering

9:35 am  **PRIORITIES FOR CHINA’S URBAN DEVELOPMENT – SUSTAINABLE TRANSPORTATION AND BUILDING ENERGY EFFICIENCY**  
Huang Wei, Vice Minister, PR China Ministry of Construction

10:00 am  **BREAK**

**PART TWO: ELEMENTS OF SUSTAINABLE URBAN DEVELOPMENT**  
Moderator: Wang Tiehong, Chief Engineer, PR China Ministry of Construction

10:15 am  **Social and Environmental Sustainability in Cities**—Enrique Peñalosa, Former Mayor of Bogotá, Colombia

11:10 am  **Beijing’s Bus Rapid Transit System Development**—Sui Zhenjiang, Vice Secretary General, Beijing

11:40 am  **Shanghai’s Energy Policy Solutions to Address Urban Air Quality**—Hong Hao, Vice Secretary General, Shanghai

12:10 pm  **LUNCH**
Film Presentation: The Success of Bus Rapid Transit
—Bill Vincent, Breakthrough Technologies

PART THREE: PROMOTING SUSTAINABLE URBAN TRANSPORTATION
Moderator: Wang Tiehong, Chief Engineer, PR China Ministry of Construction

BUS RAPID TRANSIT (BRT): EXPERIENCE AND PROSPECTS IN CHINA
1:45 pm Kunming’s BRT Pilot—Zhang Zhenguo, Kunming Mayor
2:10 pm Chengdu’s BRT Development—Zhang Xueai, Vice Secretary General, Chengdu

ELEMENTS OF SUSTAINABLE URBAN TRANSPORTATION
2:35 pm Public Transport and Urban Livability—Elmar Ledergerber, Mayor, Zurich
3:00 pm Public Transport and the Environment—Maria Krautzberger, State Secretary for Urban Development, Berlin
3:25 pm Congestion Charging—Rana Roy, London
3:50 pm BREAK

4:05 pm OPEN DISCUSSION
• BRT Systems Solutions
• Congestion Pricing
• Elements of Sustainable Urban Development
• Policies to Spur BRT Systems—Experience and Lessons

5:45 pm CLOSING REMARKS
Wang Tiejhong, Chief Engineer, PR China Ministry of Construction
6:00 pm ADJOURN

6:30 pm DINNER AND TOUR OF THE KUNMING BRT SYSTEM (AFTER DINNER)
**THURSDAY, NOVEMBER 11, 2004**

Moderator: Li Renhan, Director, Bureau of Academic Activity, Chinese Academy of Engineering (Representing Shen Guofang, Vice President, Chinese Academy of Engineering)

8:30 am **WELCOME SPEECHES**

Li Renhan, Director, Bureau of Academic Activity, Chinese Academy of Engineering

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**PART FOUR: ATTACHING IMPORTANCE TO BUILDING EFFICIENCY**

Moderator: Li Renhan, Director, Bureau of Academic Activity, Chinese Academy of Engineering

**REGULATORY STRUCTURES AND MARKET INCENTIVES TO ENSURE BUILDING CODE COMPLIANCE**

8:40 am  *The Progress and Prospects of Codes and Standards*  
—Arthur Rosenfeld, California Energy Commission

  *Establishing Supervision and Implementation Procedures for Codes and Standards*  
—John Hogan, Seattle Department of Design, Construction and Land Use

**GOVERNMENT LEADERSHIP & PROMOTION OF BUILDING EFFICIENCY—INTERNATIONAL EXPERIENCE**

9:40 am  *Freiburg’s Solar PV Buildings and Region*  
—Dieter Salomon, Mayor, Freiburg, Germany

10:00 am  **BREAK**

**GOVERNMENT LEADERSHIP & PROMOTION OF BUILDING EFFICIENCY—CHINA**

10:15 am  *Building Energy Efficiency Promotion in Guangzhou*  
—Xu Ruisheng, Vice Mayor, Guangzhou

10:40 am  *Building Energy Efficiency Promotion in Beijing*  
—Zhang Xingye, Vice Director, Beijing Construction Commission

11:05 am  *Building Energy Efficiency Promotion in Tianjin*  
—Yan Dingzhong, Vice Director, Tianjin Construction Commission

11:30 am  *Building Energy Efficiency Promotion in Chongqing*  
—Qiao Mingjia, Deputy Director, Chongqing Construction Commission

11:55 pm  **OPEN DISCUSSION**

  • Reinforcing Supervision and Implementation of Building Efficiency
  • Government Policy, Regulation and Incentives for Building Efficiency

12:20 pm  **CLOSING REMARKS**

Li Xiankui, Director of Department of Foreign Affairs, PR China Ministry of Construction

12:30 pm  **LUNCH**

Film Presentation: Building Energy Efficiency in The Netherlands
## TECHNICAL SIDE MEETING I: IMPLEMENTING BUILDING ENERGY EFFICIENCY

**Moderator:** Li Xiankui, Director, Department of Foreign Affairs, PR China Ministry of Construction

### BUILDING ENERGY EFFICIENT HOMES

1:45 pm  
- **Prospect on Energy Efficiency Design Standards for Buildings**  
  —Lang Siwei, China Academy of Building Research

2:10 pm  
- **Building Energy Efficiency in Shanghai**  
  —Wang Baohai, Shanghai Building Efficiency Office

2:35 pm  
- **Canada’s Implementation and Enforcement of Codes and Sustainable Building Practices**—Kaarin Taipale, ICLEI

3:00 pm  
**BREAK**

3:15 pm  
**QUESTION & ANSWER SESSION**

5:00 pm  
**CLOSING REMARKS**  
Li Xiankui, Director, Department of Foreign Affairs, PR China Ministry of Construction

5:10 pm  
**ADJOURN**

## TECHNICAL SIDE MEETING II: DEVELOPING BUS RAPID TRANSIT AND MULTIMODAL TRANSPORTATION SOLUTIONS

**Moderator:** Li Dongxu, Director, Department of Urban Construction, PR China Ministry of Construction

### PLANNING, DESIGN, AND OPERATION OF BRT SYSTEMS

1:45 pm  
- **BRT Planning, Design and Operation**—Paulo Custodio, Logit Engenharia Consultiva

2:05 pm  
- **BRT Financing and Incentives**—Walter Hook, Institute of Transportation and Development Policy

2:25 pm  
- **BRT Experience in the U.S.**—Bill Vincent, Breakthrough Technologies  
  - **BRT System Planning**—Lloyd Wright, Institute of Transportation and Development Policy

2:45 pm  
**QUESTION & ANSWER SESSION**

3:30 pm  
**BREAK**

### APPLICATION AND DEPLOYMENT OF BRT SYSTEMS IN CHINA

3:45 pm  
- **Planning for Sustainable Cities**—Lee Schipper, EMBARQ

4:05 pm  
- **BRT Plans and Challenges in China**—Xu Kangming, BRT Expert

4:25 pm  
**QUESTION & ANSWER SESSION**

5:10 pm  
**CLOSING REMARKS**  
Li Dongxu, Director, Department of Urban Construction, PR China Ministry of Construction
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Presenter Biographies

Paulo Sergio CUSTODIO

Paulo Sergio Custodio is an Independent Consultant with more than 30 years experience in urban and regional transportation planning, transportation simulation models, integrated land use and transportation models, transportation systems and BRT planning and design. He has worked in many important companies both public and private like the Sao Paulo Metro, Sao Paulo Traffic Engineering Company – CET, Sao Paulo Research Institute – IPT, Sao Paulo City Planning Secretary – Sempla, Sao Paulo City Urbanization Company – EMURB, Sao Paulo Metropolitan Planning Company – E MPLASA and the private consultants Ductor, Planasa, CNEC, Sondotecnica, BUPEC, Planservi, TTC (Brazil), LG Mouchel and Partners (England) and Booz-Allen and Hamilton (Mexico). He has founded Logit Consultoria in 1989, one of the most known transportation planning companies in Brazil, and left the company in 1998. He has experience working in many countries like United States, England, Mexico, Venezuela, Colombia, Indonesia, India and China. Paulo Custodio has directed many projects like the development of a Land Use and Transportation Model for Sao Paulo (MUT) and the design of the BRT projects of Transmilenio (Bogota), Cartagena (Colombia), Cali (Colombia) and La Paz (Bolivia). He presently is directing a BRT project for Sao Paulo (Brazil) and advising the Institute for Transportation & Development Policy (ITDP) on projects in Jakarta (Indonesia), Hyderabad and Delhi (India), World Research Institute/Embarq in BRT projects in Mexico City and is presently working on the BRT project of the City of Queretaro (Mexico). He also is acting as expert consultant for the revision of the operations for Transmilenio in Bogota (Colombia). Paulo Custodio has a Bachelor Degree in Civil Engineering (1971) from University of Sao Paulo and a Master Of Sciences in Transportation (1974). from Northwestern University (USA).

John Hogan

John Hogan, Senior Energy Analyst with the Seattle Department of Planning and Development, has worked for over 25 years developing and implementing Energy Codes. Mr. Hogan is a member of the ASHRAE Standard 90.1 Project Committee and the Vice-Chair of the ICC International Energy Conservation Code (IECC) Committee. Mr. Hogan also is a member of the Board of Directors of the National Fenestration Rating Council. Mr. Hogan is a registered architect and mechanical engineer. Mr. Hogan has been working on Energy Standards in China since 2000.

Hong Hao

Hong Hao is the Vice Secretary-General of Shanghai Municipal Government with responsible for urban construction and management. He has held the posts of Deputy Director-General of the Shanghai Public Utility Bureau, Deputy Director of the Shanghai Construction Commission, Deputy Director of the Shanghai Foreign Capital Commission, and Director-General of the Shanghai Environment Protection Bureau. He holds a Bachelor’s degree in Economics and is a Senior Economist.

Walter Hook

Walter Hook has been the Executive Director of the Institute for Transportation and Development Policy since 1993. He received his PhD in Urban Planning from Columbia University in 1996, where he continues to serve as Adjunct Faculty. The Institute for
Transportation and Development Policy was established in 1985 in order to promote environmentally sustainable transportation policies and projects worldwide. Its founders recognized that many of the planning principles developed in the United States which locked our country into an expensive and environmentally damaging dependence on the automobile were being uncritically exported to developing countries with even more severe social and environmental consequences. ITDP has worked closely with the international financial institutions to help develop more sensible transport lending, and continues to work with municipalities in developing countries and economies in transition to make sensible transportation choices given local circumstances. More information is available about ITDP at www.itdp.org.

Maria KRAUTZBERGER

Ms. Krautzberger is the Permanent Secretary of the Berlin Senate Department for Urban Development. Previously, she held several posts where she oversaw municipal urban development and environmental issues, including Councilor for Planning, Buildings, and Housing in the city of Oberhausen, Senator for the Environment in the City of Lübeck, and Head of Office for Environmental Protection for Wuppertal Municipal Administration. She earned her Master of Science in Administration at the University of Constance, Munich.

LANG Siwei

Since the 1980’s, Lang Siwei has been engaged in R & D of energy efficiency in buildings. As the main project leader, he and his team designed energy efficiency design standards for residential buildings. He is also leading a team to develop energy efficiency design standard for public building. He is also the Vice President of China Building Energy Efficiency Association and Vice President of Chinese Association of Refrigeration. Mr. Lang graduated from Tongji University and has held various posts at the Institute of Air Conditioning, China Academy of Building Research. Currently, he is the Advising Vice Chief Engineer of the China Academy of Building Research. From 1991 to 2001, he was Director of Institute of Air Conditioning. He was a visiting scholar in Department of Mechanical Engineering, Oregon State University from 1982-1984.

Elmar LEDERGERBER

Dr. Elmar Ledergerber is currently Mayor of Zurich, Switzerland. Previous to his term as Mayor of Zurich, Dr. Ledergerber was a member of the Swiss Federal Parliament (National Council) from 1987 to 1998. In 1998, he was elected Councillor of Zürich, responsible for the construction department, which oversaw public infrastructure, housing, and city planning. He has been the Mayor of Zurich since May 2002. Dr. Ledergerber has acted as a consultant in the following fields: energy economics and policy, regional and city planning, and environment issues. He received his Ph.D in development economics.

Enrique PEÑALOSA

Enrique Peñalosa is currently a Visiting Scholar at New York University and an international consultant on urban development and management. He is writing a book on a new urban-development model for the Third World, which covers fields such as transportation, land use and housing for the poor, pollution abatement and public space. Mr. Peñalosa is an accomplished public official, who has demonstrated the success of his innovative ideas and management abilities; he completed his term as Mayor of Bogotá, Colombia on January 1,
2001. He holds a bachelor degree in Economics and History from Duke University and Masters in Management at the Institut International D’Administration Publique and a DESS in Public Administration at the University of Paris II in Paris. He is fluent in English and French.

As Mayor of the capital of Colombia, Enrique Peñalosa was the political and administrative head of a city of 6.7 million inhabitants. During his tenure (1998-2001) —The Colombian constitution does not allow immediate reelection. Mr. Peñalosa lead a profound city transformation, from an aggressive and hopeless perception the city became a city with sense of belonging and belief of a better future. Peñalosa carried out a different urban paradigm, giving “priority to children’s happiness over automobile mobility,” environmentally sustainable, but more important more egalitarian. As Mayor, some of Enrique Peñalosa’s accomplishments include:

- Led a massive effort to improve Bogotá’s marginal neighborhoods’ conditions by legalizing them, giving public services, nurseries, schools, parks, among other public works and activities with high citizen involvement.
- Created a successful Urban Land Reform institution, called Metrovivienda. This entity, working as a land bank, builds housing for the poor in a public-private partnership system with high quality urbanism.
- Created a new highly successful bus-based transit system modeled from Curiba’s BRT, based on exclusive corridors and high capacity buses, called TransMilenio, which is now the international model.
- Initiated the construction of bicycle paths in Bogotá and left more than 250 kilometers built or under construction. The number of bicycle riders increased from 0.3 percent in 1998 to 4.4 percent in 2003. Today is the longest bike path network in the developing world with more than 300 kilometers.
- Created and built the two most important urban lineal parks in the developing world, the Juan Amarillo Greenway, a 45-kilometer long park that implied formidable decontamination efforts and the recuperation of several wetlands. The Alameda El Porvenir, a 17-kilometer long pedestrian avenue through the poorest neighborhoods in Bogotá.
- Promoted a city model that progressively restricts private car use, especially during peak hours. He established a system called “Pico & Placa”, in which 40% of private cars cannot circulate during 4 peak hours every weekday; organized the first Bogotá Car Free Day and held a referendum, in which people adopted a yearly car free day; Bogotanos also voted in favor to a proposal banning car use during rush hours, from 6 AM to 9 AM and from 4:30 PM to 7:30 PM by the year 2015, however this question did not achieve the minimum percentage of votes required to be valid.

Arthur ROSENFELD

Dr. Arthur H. Rosenfeld was appointed to the California Energy Commission in 2000. Commissioner Rosenfeld is on the R&D and Energy Efficiency Committees. The latter is responsible for standards for buildings and appliances. Dr. Rosenfeld received his Ph.D. in Physics in 1954 under Nobel Laureate Enrico Fermi, then joined the Department of Physics at the University of California at Berkeley. There he joined, and eventually led, the Nobel prize-winning particle physics group of Luis Alvarez at Lawrence Berkeley National Laboratory until 1974. At that time, he changed to the new field of efficient use of energy, formed the Center for Building Science at Lawrence Berkeley National Laboratory (LBNL) and led it until 1994. From 1994-1999 Dr. Rosenfeld served as Senior Advisor to the U. S.
Dr. Rosenfeld received the Szilard Award for Physics in the Public Interest in 1986, and the Carnot Award for Energy Efficiency from the U.S. Department of Energy in 1993. He is the co-founder of the American Council for an Energy Efficiency Economy (ACEEE), the University of California’s Institute for Energy Efficiency (CIEE), and the Washington-based Center for Energy and Climate Solutions (CECS).

Dr. Rosenfeld’s website is http://www.energy.ca.gov/commission/commissioners/index.html

**Rana ROY**

Dr. Rana Roy, FCILT, is an international consulting economist who has run his own practice in Central London for the last eight years, having formerly served as a Senior Economist and Economic Adviser for the Governments of Australia and the UK, and as Chief Economist of the think-tank, ECIS, a joint initiative of the European Commission and the European Roundtable of Industrialists. He has been centrally involved in the drive for transport pricing reform in the UK and in the EU. His report for the European Conference of Transport Ministers (ECMT) on *Optimal Transport Pricing* was presented to and endorsed by the ECMT Ministers last year and has now been published by the OECD as part of the larger ECMT report, *Reforming Transport Taxes* - it is available from rana.roy@btinternet.com or stephen.perkins@oecd.org.

**Dieter SALOMON**

Dr. Dieter Salomon is Lord Mayor of Freiberg, the “solar capital city” of Germany. Dr. Salomon was elected Mayor in May 2002. He is on the Presiding Board of the German Association of Towns and Cities. From 2000 to 2002 Member of the Broadcasting Council of Südwestrundfunk (broadcasting corporation in south west Germany governed by public law). In 2000 he was elected Chairman of the Green Party in the federal state parliament of Baden-Württemberg. In 1992 he was elected into the federal state parliament of Baden-Württemberg for the Green Party. From 1990 to 2000 he was Member of the Municipal Council of the City of Freiburg for the Alliance '90/The Greens group. Dr. Salomon received his Doctorate in political science in 1991.

**Lee SCHIPPER**

Lee Schipper is co-director of EMBARQ, the Center for Sustainable Transportation and the World Resources Institute, Washington DC. He was a guest researcher at Shell International Petroleum Company, London. From 1995 until 2001 he was Senior Scientist at the International Energy Agency (IEA), Paris. He was also a Staff Senior Scientist at the Lawrence Berkeley Laboratory (LBL), University of California, Berkeley, until 2001. Dr. Schipper has authored over 100 technical papers and a number of books on energy economics, energy use and energy conservation around the world, and transportation. Schipper now has a focus on transportation, with links to fuels and transportation industries, NGOs and the World Bank. He has led a number of important activities and projects for the World Bank (http://www.iea.org/pubs/free/articles/schipper/flexing.htm; see also http:\www.back-to-work.com/clearingtheair.html). He led a recent IEA effort to understand the transport/CO₂ policies of six member countries (“Road from Kyoto,” http://www.iea.org/public/studies/kyoto.htm). In 2002, Schipper leads a new “Center for Sustainable Transportation” with initial support from the Shell Foundation. He was a member of the Swedish Board for Transportation and Communications Research for four years. He is currently a member of the US Transportation Research Board’s Committee on Sustainable
Transport. He has been a Fellow at the Industry and Energy Department of the World Bank and a visiting researcher with Group Planning, Shell International Petroleum Company, London in the mid 1980s.

Kaarin TAIPALE

Ms. Taipale is currently Senior Adviser of Strategy and Programs at the International Council for Local Environmental Initiatives (ICLEI), European Secretariat, Freiburg, Germany, and the World Secretariat, Toronto, Canada. From July 2000 to November 2003, she was the Chair of ICLEI when ICLEI facilitated the worldwide Local Authorities’ preparations for the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa. From 1993-2003, she was the Executive Director of the Helsinki Building Department, managing a staff of over 100 personnel. While at this post, she developed the new Building Ordinance of Helsinki and a Citizen’s Charter with quality control methods. She was also Chair of Helsinki’s Building Review Boards (architectural and technical boards) 1993-2000. As a Fulbright scholar, she earned a Master of Science (Historic Preservation), at Columbia University’s Graduate School of Architecture and Planning. Ms. Taipale also holds a Master of Science in Architecture from Eidgenoessische Technische Hochshule ETH-Zurich, Switzerland.

Bill VINCENT

Bill is a senior executive with over 14 years experience in executive and professional positions, including public policy, media relations, program development and management, and legal counsel. Among other things, he was appointed by President Clinton to serve at the US Department of Transportation, where he successfully oversaw the development and implementation of several transportation safety and research programs. Bill has written numerous papers and presentations regarding BRT and often testifies before government agencies and committees regarding the benefits of BRT. Recent publications and presentations include: “Hydrogen and Tort Liability: Liability Concerns Are Not a Bar to a Hydrogen Economy” (forthcoming in the Energy Law Journal, October 2004), Editor, Fuel Cells At The Crossroads: Attitudes Regarding The Investment Climate For The Us Fuel Cell Industry And A Projection Of Industry Job Creation Potential (Buckley, J. and Cable, T., (2003), Bus Rapid Transit: A Policy Primer, Breakthrough Technologies Institute (2002), The Electric Rail Dilemma: Clean Transportation from Dirty Electricity? Breakthrough Technologies Institute (2002), “The Law of Unintended Consequences: How Public Transportation Funding Laws Fail to Maximize Environmental and Other Benefits of Transit”, American Bar Association Science and Technology Newsletter (Summer 2003), and “Better, Smarter, Faster: How Bus Rapid Transit Can Enhance Mobility and Improve Air Quality At Price We Can Afford” Leadership Fairfax (2002).

WANG Bohai

Wang Baohai, is a Senior Economist and the Director of Shanghai Building Energy Efficiency Office. He has been engaged in the development, application, and management of building materials. Since the late 1990s, he has been involved in building energy efficiency research and management.
Kangming Xu

Kangming Xu is a freelance consultant who has been working on the CSEP Transportation Program’s China Bus Rapid Transit (BRT) projects as a Technical Advisor since February 2002. He provides technical assistance to decision makers and technical staff for BRT development efforts in Beijing, Shanghai, Xi’an, Chengdu, Chongqing and Kunming. He developed the first policy paper on BRT development strategies for China in early 2002. He was the founder of the only Chinese web site devoted to promote BRT development efforts in China. Kangming Xu is also a part-time professor at Chang’An University. He was the independent consultant to the World Bank and its loan borrowers for the World Bank’s Chinese Urban Transportation Loan Program. He served as the head of international consultant teams for urban transportation improvement projects in Tianjin, Shenyang, Anshan, Fushun, and Shijiazhuang. He also participated two World Bank policy studies: “Urban Transport Development Strategies for Asian Cities” and “China Logistic Development Strategy.” Kangming Xu also worked for one of the largest US consultant firms as a senior transport planner for six years. He also worked several urban expressway renovation projects for the Florida Development of Transportation. He was the city planner in Shanghai City Planning and Design Institute between 1985 and 2001. He participated the city’s master plan, public transport plan, and was the lead planner for the famous Bund Area Comprehensive Renovation Plan.

XU Ruisheng

Xu Ruisheng has been Vice Mayor of Guangzhou, Guangdong Province, since 2003. As Vice Mayor Mr. Xu in charge of urban planning, construction and administration, environmental protection, and aerial defense. From 1999 to 2003 he was Vice Mayor of Shanwei, Guangdong Province. From 1998 to 1999 Xu was Division Chief of the Urban and Rural Planning Division, Guangdong Construction Commission. Prior to his position at the Guangdong Construction Commission, he was Deputy President and Chief Engineer of the Guangdong Urban and Rural Planning Design Research Institute. Xu is a member of the 8th and 9th session of the Guangdong People's Political Consultative Conference. Xu studied architecture in South China University of Technology, and received a master of engineering. Xu is a senior engineer and the state registered first-grade architect.

YAN Dingzhong

Yan Dingzhong is Deputy Director of the Tianjin Construction Administrative Committee. Mr. Yan received his master’s degree in Engineering from Tianjin University. Upon graduation, he did design work in Hainan province. From 1999-2000, he was a visiting scholar conducting research on planning and urban economic development strategies at the University of California, Berkeley. Mr. Yan was Director of Tianjin Architectural Designing Institute (a national civil design institute) for 8 years. In 2001, Mr. Yan was transferred to the Tianjin Construction Administrative Committee as Chief Engineer, and the following year was appointed Vice Director of the committee. As a committee member, he was involved in the management of project construction quality, safety, and design. From 2003, he has been responsible for developing the Haihe area in Tianjin—a comprehensive development and construction project on the both banks of Haihe River.

ZHANG Xingye

Mr. Zhang is currently the Vice Chairman of the Beijing Construction Committee. He was technical engineer and Deputy Director in Liaoning Province at the Second Construction
Company. At the Ministry of Construction, he was Deputy Director of the Education Department, Deputy Director of the Education and Labor Department, and Head Researcher at the Education Department. He received his bachelor’s degree in Engineering and Management at the Jilin Institute of Architecture and Civil Engineering. He earned his master’s degree in Construction Economics and Management at the Harbin Institute of Architecture and Civil Engineering and his doctorate in Management Science and Engineering at the Harbin Institute of Technology.

ZHANG Zhenguo

Mr. Zhang is Mayor of Kunming. He has held the posts of Director of the Kunming Municipal Information Division, Secretary-General of the Communist Party of China (CPC) Kunming Committee, Vice Secretary of the CPC Kunming Committee, and Vice Standing Mayor of Kunming Municipal People’s Government. Mr. Zhang studied at Yunnan University, majoring in journalism, and at the Party School of Yunnan Committee and the Party School of Central Committee.
Priorities for Chinese Urban Development:  
Sustainable Transport and Building Energy Efficiency

Address by Huang Wei, Vice-Ministry of Construction, China

Deputy Vice-Chairman Mr. Xu,
Ladies and Gentlemen,

In recent years, the Chinese urbanization pace has accelerated, making urban transport and energy problems more acute. Urban development should be harmonized with the development of the economy, environment, and resources. How to attain urban sustainable development and address the problems associated with urban transport and energy consumption has become a key issue for all city governments and mayors. Today, we have 24 mayors or representatives of mayors from China, the United States, the United Kingdom, Germany, Italy as well as 120 representatives from international organizations, NGOs, and experts from municipal organizations responsible for urban transport and energy-efficiency, which have come together in Kunming to discuss issues of rapid transport and building energy-efficiency in the course of urban sustainable development. It is really of great significance to exchange experiences and explore solutions to these problems.

I. Present situation of Chinese urban transport and building energy efficiency

--- Urban transport

The urban transport system has developed the most rapidly over the last decade. Both public transport facilities and the volume of transported passengers have increased dramatically. In 2003, there were 259,000 standard public transport vehicles in Chinese cities, 120,000 kilometers of operating lines, and 381 trillion passenger trips.

The development of urban transport in China has benefited from the reform and “open door” policy. The public transport system is being coordinated with city planning and land use. The links among cities, between urban and rural areas, and between city and suburban areas are strengthened. The integration of local bus stations with long-distance bus stations has become a new public transport model for linking urban and rural transport.

--- Building energy efficiency

In the last decade, our ministry has established a building energy efficiency code, which aims to cut energy use by 50%. We formulated building efficiency policies and regulations at both the central and local levels, tried to solve technical issues, and have formed an initial technical support system. Through building efficiency pilot projects, major progress has been made in building energy efficiency. According to incomplete statistics, by 2002, China constructed 320 million square meters of energy-efficient buildings, saving 10.94 tons of coal.
and 23.26 tons of carbon dioxide.

II. Challenges faced in urban transport and building energy efficiency

First, there is a demand now for coordinated development between urban and rural areas. The strategic principle for national economic and social development is to balance urban and rural development. To build a “well-off society,” we must develop the surrounding area of a city and promote rural economic, cultural, and social development through urban development.

Secondly, there is a sharp increase in demand for transportation and energy. With urban economic and social development and the rising standard of living, the urban demand for passenger transport is increasing rapidly. We must establish a comprehensive transportation system prioritizing public transportation to meet this increasing demand. As people pursue more comfortable living and working environments, and the demand for more heating and air-conditioning continues to rise, the rate of building energy consumption will also rise each year. Building energy efficiency must be widely implemented and improved.

Thirdly, we must further limit the utilization of land, the environment, and energy resources. In the long run, insufficient urban land resources will be the main bottleneck for urban development. Due to motorization and a shortage of urban land, it is imperative to use new concepts, ideas and technologies in urban transport development and seek solutions that protect land, the environment, and resources as well as prioritize public transportation. China is a large consumer of energy. Limited fossil fuels and the environmental problems caused by the exploitation of fossil fuels seriously hamper sustainable economic and social development. We must tackle the increasing problems of building energy consumption through policies, regulations, and “scientific development.”

Fourthly, there are problems and contradictions imbedded in urban public transport and building energy efficiency.

III. The basic principle of urban public transport and building energy efficiency in China

In urban public transport and building energy efficiency, the two key components for urban sustainable development, we must adhere to the scientific approach to development and contribute to the building of a harmonious society of socialism. We hereby define the following basic principles:

1. Prioritize public transport
2. Promote energy-efficient buildings

IV. The fundamental policies for sustainable urban transport and building energy efficiency.

1. Urban transport
   (1) Through planning, build an urban transport system by prioritizing public transportation.
(2) Accelerate the construction of urban roads and public transport system.
(3) Drive the market through innovation.
(4) Improve public transport facilities and management through scientific innovation.
(5) Improve relevant regulations and standards especially with regards to service.

2. Building energy efficiency
   (1) Promote building energy efficiency through government reform.
   (2) Improve the existing building energy efficiency level by reforming the urban heating supply system.
   (3) Achieve new building energy efficiency goals by strengthening government supervision.
   (4) Speed up the legislation process for building energy efficiency.
   (5) Actively carry out international cooperation on science and technology with a focus on enhancing capacity building.

Ladies and Gentlemen,

Chinese cities are developing rapidly. The problems encountered in urban transport and building energy efficiency are probably the most complex ones in the world. The experts and relevant organizations attending the forum have made great contribution already. I hope that you continue to be actively involved in the work of urban transport and building energy efficiency in China and provide us with your valuable opinions. I deeply believe that you will make praiseworthy achievements to build a beautiful home for us.

In the process of solving problems in urban transport and building energy efficiency in China, a huge market will provide many commercial opportunities for enterprises engaged in this sector. We welcome all enterprises to get involved and again, I am deeply convinced that your returns will be guaranteed.
In many Asian nations urban populations represent less than 40 percent of total population. It is most likely that by 2050 the urban population in most Asian countries will represent more than 80 percent of total population. In Latin America the transition from a 40 to 80 percent urban population meant an increase of more than 600 percent for most of its larger cities. This will not necessarily be the case in Asia, which has for example lower population growth rates than Latin America had. But it suggests at least that many already large cities may end up with populations at least three times larger than today.

More than 50 percent of most Asian cities of 2050 have yet to be built; in several cases, more than two thirds of the cities of 2050 will be constructed over the next few decades. It is a great opportunity to create cities different than those that now exist in most advanced countries, to imagine new design and organizational schemes and to avoid the mistakes acknowledged today by urban designers of the advanced countries, as having been made by their societies. The risk is of course that blind copying will be the norm. Unfortunately nothing suggests so far that most Asian cities will be better than their counterparts in advanced western nations and many may be much worse.

A better city is a more humane one, one friendly to children, the handicapped and old people, to society most vulnerable members. A sustainable city is one in which economic development yields an ever better quality of life.

If inhabitants of New York, Paris or London were given a magic wand and told they could make their city disappear and recreate it as they wished, they would make dramatic changes. It is the opportunity that Asian cities have today: to imagine and to create a city that reflects its values and aspirations, a city with character based on its quality of life.

Contrary to stereotypes, it is not its skyline that lends character to a city. Rather it is its human spaces, its pedestrian promenades, parks, plazas, libraries, and public transport.

URBAN QUALITY OF LIFE AND ECONOMIC DEVELOPMENT

Quality of life is important as an end in itself. But it also is perhaps the most crucial element of economic competitiveness. To attract and to retain highly creative and educated people is the greatest challenge for future economic development. In an ever more integrated world, such people are able to choose where to live. Only high quality of life will be able to achieve that objective in a sustained manner.

In its formidable book The Coming of the Post-Industrial Society, Daniel Bell first described how advanced societies were entering a new stage, where the service sector would absorb most of the labor force and be the crucial element for economic growth. Initially, it was land that generated wealth and power in society. Later, with the industrial revolution, capital became the defining factor of economic development. But now in the most advanced economies knowledge has become the source of wealth and influence. Different from land or capital which could be detached from their owner, knowledge is attached to human beings that want to live happily. Cities most likely to provide that will attract them and thus economic development.
AN APPROPRIATE MODEL

It is not possible to design a transport system, unless we know what kind of a city we want. It is very different if Houston is our model, than if it is Amsterdam; or something different altogether based on a model we create. But in order to know what kind of a city we want, we have to know how we want to live, because a city is only a means to a way of life.

An appropriate model must consider other factors as well. Economic reality is one of them. Solutions relevant for economically very developed countries are not necessarily relevant for a less developed country. A subway system may be an appropriate solution for a very wealthy society, yet have an excessively high opportunity cost for a less economically developed one.

Not enough attention has been given to the construction of an urban vision for developing cities. Several reasons may explain at least partially why. First, in an era of scientific and technical predominance, of the rational and measurable, much of the fundamental criteria for urban design are subjective, ultimately ideological. Heights of buildings, widths of sidewalks, land areas to be reserved for parks, participation of pedestrian roads in the city’s network, are examples of this.

Another aspect of urban design that does not jibe with our time is the inability of market forces to solve the most important urban challenges. Adam Smith taught us that each person selfishly seeking his or her own benefit finally served society’s common good. Freedom for all to pursue their private benefit was then positive for society. However those principles are not always applicable. If all survivors from a shipwreck try to grab the closest lifeboat, they will sink it. If all citizens try to use a private car for their daily mobility, a city will become totally blocked; and the infrastructure built to try to accommodate those cars will make a city less humane.

Usually when a certain behavior is good for an individual, if all members of society do likewise it is good for society. It is the case for good eating, exercising, work or studying habits. It is not however the case with certain urban behaviors, such as private car-use at peak hours.

It is clear that Government must intervene in order to create quality cities. But urban planning is ultimately subjective, ideological. It is fascinating that in this world of reason and science, such formidable challenge is left to government.

One reason less advanced countries have not dared create different urban models is lack of self-confidence. As all technology comes from advanced nations, it is supposed that just as one learns about electronics, one learns about cities. But urban models of advanced countries are not so clearly exemplary. Less developed countries have the advantage of being able to avoid mistakes committed by more advanced nations.

Once at US $5,000 income per capita, it does not seem that further increases in income per capita bring about increases in happiness. The measure of success of a society cannot be its level of economic development but rather its happiness. We will have to seriously consider other measures of success, such as time spent by children with their grandparents.
After decades of environmental consciousness rising and many hours of wildlife television shows, children the world over have quite clear what is an ideal environment for a happy whale or a happy mountain gorilla. It is much less clear to all of us, what the ideal environment is for a happy child.

EQUALITY AND CITIES

Sustainability must mean social sustainability as well. And social sustainability means above all social justice, the underpinning of a system’s legitimacy. As it will be shown in this document, it is remarkable the coincidence between social and environmental sustainability policies.

The way we build cities and organize city life has a profound incidence on a society’s equity and social integration. Communism sought equality, but privileges for high level bureaucrats such as limousines, private clubs and beaches maintained inequalities. A city in which all citizens use public transport and all green space and waterfronts are for public use can construct significant equality.

History of the last few hundred years has been centered in the struggle for more equality. Many Asian societies have been among the most willing to make sacrifices in order to achieve social justice. After communism collapse in the Soviet Union and its waning elsewhere, many assumed that equality was no longer an issue. Income equality is incompatible with a market economy. Yet, equality is too powerful and ingrained into our visions of society to be ignored.

The equality that matters is that which matters to children. Children don’t care about luxury cars or jewels. They do care about access to sports facilities, quality schools, music lessons, parks, waterfronts. While income equality may escape us, we can strive for equality of quality of life, particularly in the case of children.

All Constitutions state in their first article that all citizens are equal before the Law; and some specify a consequence of such principle: public good must prevail over private interest. It can be a very powerful parameter for urban design and urban policy. Very different cities might result just by applying it. For example, car use may be restricted during peak hours, so that bicycles and public transport function better.

Markets do not work well in the case of land around growing cities. Supply of land accessible to urban jobs, utilities and services does not increase as a result of price increases. Land around growing cities is a monopoly. Its private ownership leads to slums. While Asian cities have a better mix of citizens of different income levels in their neighborhoods, they are not immune to the problem of slums. Private land ownership also makes it difficult to create the parks a healthy city needs.

PEDESTRIAN PUBLIC SPACE

Would it not be better if children grew up without the terror of cars? Today children in cities around the world jump in fright when told: Watch out, a car! They have good reasons to fear cars. Thousands of children the world over are killed by cars every year. Why not conceive a city where children would walk out of their houses into pedestrian streets?
For the 5,000 years cities have been known to exist all streets were pedestrian. People shared streets with horses and carriages without risk. A child could safely go on an errand several blocks away from home. Up until the beginning of the Twentieth Century this was the case, even in the world’s largest cities, such as New York, Tokyo, or Paris. Then cars appeared in growing numbers, as the century advanced. During the last 80 years we have been building cities more for motor vehicle mobility than for the happiness of children.

When cars appeared a parallel road network should have been created: One for cars and the other exclusively pedestrian. There are more than 1000 urban localities in Europe that have created pedestrian networks in the historic city centers. But growing Asian cities that will likely double or triple their area over the next few decades could do something much more radical in the part yet to be built. Magnificent networks of tree lined roads exclusively for pedestrians and cyclists could change the nature of cities and city living, making them much friendlier to people.

Pedestrian and bicycle facilities are useful for recreational and transportation purposes but they are a symbol as well, of a society that respects human dignity. In Bogotá we created a 45 km greenway, a linear park with bicycle paths, which is used for both recreation and transportation purposes. We also constructed an 18 kilometer long 15 meter wide tree-lined street, in what it was then the border of the city, exclusively for pedestrians and bicycles. It is a meeting place, a community space, but a useful transportation link as well. One branch of it leads to a mass transit station with bicycle parking. Many countries build fanciful airports in order to impress foreign visitors. For the cost of an airport a developing country city could build a formidable pedestrian road network hundreds of miles long, that lined with giant trees would not only radically improve quality of life and demonstrate respect for its citizens, but give it a unique character and impress foreign visitors even more than a sophisticated airport. It only requires different thinking, different values and priorities.

We humans are pedestrians, walking animals. Just as fish need to swim, birds to fly, zebras run, we need to walk. Humane cities need to be made for walking. We also like to see people, to be with people. It has been found that people prefer park benches where more people walk by. People like restaurants, concerts and beaches with people. People walk and are with people in public spaces. In public spaces people meet as equals, regardless of the hierarchical segmentation of society. Shopping malls can be fun places, especially if they are designed to profit from the weather and vegetation of a given city, with much spaces open to the sky and with many benches. But when malls begin to replace public spaces as a meeting place for the community, for people in a city, it is a symptom that a city is ill and perhaps society as well.

High quality public pedestrian space is not a luxury or a frivolity in developing country cities. It evidences respect for human dignity; is important for quality of life; and it constructs social justice. Because it is during leisure time that income differences are felt acutely. During work time high and low income citizens are equally satisfied or dissatisfied. But during leisure time, while higher income people have access to country houses, clubs, restaurants, vacation trips, lower income citizens and their children’s only alternative to television is public pedestrian space. The least a democracy can offer its citizens are good sidewalks. And parks and sports fields are as important to a city as hospitals and schools.

A bird can survive in a small cage, but we suppose it would be happier in a cage the size of an auditorium; and happier still flying free. In the same manner we are better in a 10 meter wide sidewalk than in 3 meter one. This is not something that can be proved mathematically,
only perceived with soul and heart. In the same way that an auditorium ceiling could be several meters lower; functionally the room may serve its purpose, but it feels differently and less well.

There is a conflict between a city for cars and a city for people. As a city becomes friendlier to motor-vehicles, it inevitably becomes less humane. Generally the slower traffic is and the wider a sidewalk is the better for the human quality of a given urban sector. And better than a wide sidewalk and slow motor-vehicle traffic is an exclusively pedestrian street.

Cars parked on sidewalks or parking bays where there should be sidewalks symbolize a lack of respect for human dignity. And in developing cities this also tends to reflect an unequal society that respects more those with power or wealth.

As mayor of Bogotá I waged a war against cars on sidewalks, where they had been tolerated without questioning for decades. We got tens of thousands of cars off sidewalks but I had to face a well financed, though happily for me unsuccessful impeachment process. As business owners argued that our position was excessive, as there was enough space on sidewalks both for parking and for passing by, we had to air an educational campaign on the subject on television. It emphasized that sidewalks are not simply for going from one place to another. They are for walking aimlessly, playing, talking, kissing and enjoying the city. It also said that sidewalks live next to streets and for that reason we usually think they are sort of the same family, but they are not. Rather, they are relatives of plazas and parks. Therefore to say that in a sidewalk there is enough space to carve out parking bays as well as for people to walk by, is equivalent to saying that the main park or plaza of a city can be turned into an open air parking lot, just as long as enough space is left between the cars for people to walk by.

What gives character to and is memorable about a city is its pedestrian space. Nobody returns from Paris talking about French highways. Childhood memories of a city usually also are from a public pedestrian space. The quantity and quality of a city’s public pedestrian space determines to a large extent how humane and civilized it is, speaking in terms of urban design.

Tourism is an increasingly important source of employment and economic growth. And tourism is a pedestrian activity. Browsing any tourism magazine it is almost impossible to find a car in any picture, except for those in ads. New York, London or Paris, each receives more than $15 billion annually from tourism because they are good places to walk and be with people. It is not New York museums that make it more attractive than for example Atlanta, or Houston. Many visitors to the Metropolitan Museum of New York would not notice the difference with those in Atlanta or Houston. Washington DC has perhaps more museums but much less tourism. Restaurants and shops can be found in any city. But New York has more people in the sidewalks, more energy.

When someone arrives to a city for the first time, he or she very likely asks the concierge at the hotel for a nice place to go to, meaning a place to walk and see people. Tourists like to walk, preferably with little cars around: they crowd pedestrian streets of the world cities, walkways about temples and historical sites, beaches and parks. Even Disney and other similar American parks, in the nation of cars, are basically pedestrian cities where people walk and are with others. If a child let go of his or her mother’s hand there is no danger from cars. Duany, Plater-Zyberk and Speck the average visitor to Disney world only spends 3
percent of his or her time at rides and shows; the rest of the time they are simply enjoying a pedestrian-only environment.

On the recently built road from Delhi to Accra there are many more pedestrians and bicyclists than cars. But the road has neither sidewalks, nor a bicycle path. Such disregard also reveals a bit about the power structure of a society. Today environmental impact studies are required for most infrastructure projects, so as to minimize or eliminate negative impacts upon plants or animals. But human impact studies should be required as well. How to make all infrastructure projects more children-friendly? A drainage canal or a road should have pedestrian spaces alongside. We can create a city for children’s happiness rather than for cars mobility. And there are incompatibilities.

Although most land on Earth became private, some unique God given parts must remain public for every child’s enjoyment. To do otherwise would be practically immoral; and public good would not prevail over private interest. It is the case with waterfronts. Waterfronts have been crucial to the charm of many cities through history, but over the last 25 years revival of many cities has centered on its waterfronts. Barcelona, Capetown, Shanghai, London, New York, Paris, Buenos Aires, Chicago, Boston, Copenhagen, are only some of the cities that have made good use of their waterfronts and have been improving them recently. Waterfronts should have public pedestrian spaces alongside, preferably isolated from road traffic by buildings or parks. Asia has potentially very beautiful waterfronts. Shanghai’s Bund is famous; Tokyo has begun to create some quality pedestrian waterfronts; Singapore has marvelous parks next to a waterfront; Bangkok’s Chao Phraya river has marvelous temples but could become much more pedestrian friendly; Hanoi’s Red river could become one of the most charming waterfronts in the world. At any rate, motor-vehicle roads should be avoided next to waterfronts. It is always tempting to place them there as there are no intersections except where there are bridges, but advanced western cities that have done so regret it today. Boston is investing billions to demolish elevated highways next to its waterfront and Paris is closing the highway next to the Seine river increasingly often, even turning it into a “beach” every summer recently.

TRANSPORT

One truth about urban transport: It does not matter what is done, traffic jams will become worse; unless a radically new model is adopted. Transport is different from other development challenges such as health or education, because it does not improve with economic development. On the contrary, traffic and transport problems tend to worsen as income per capita increases. The solution to the challenge is public transport and restrictions to private automobile use. But this requires a different city vision. It is an ideological and political issue, rather than engineering.

More than whether trains, tramways, buses, monorails are chosen, public transport success depends on density. High population density, a relatively high number of inhabitants per hectare, is the most important factor in transport policy. High density makes possible low cost, high frequency public transport. A low density suburban structure makes for long average trips and therefore costly trips. And a train or bus through a sparsely populated area cannot make frequent runs because it would go mostly empty. Higher densities are thus necessary in order to have low-cost high-frequency public transport.
High-rise buildings are not necessary for high densities. It is possible to achieve high densities with three-story or four-story high buildings. High-rise buildings dehumanize cities and tend to rapidly deteriorate with age. In most advanced cities, preferred neighborhoods are high density low-rise buildings.

Most developing country cities have relatively high population densities, not as a result of planning but simply due to low motorization rates and lack of highways. Towards 1900 the United States also had quite compact cities and people moved mainly by street car or tramway. Most Asian citizens are still dense, move by small motorcycles, bicycles or buses, generally not very well organized, but still a form of public relatively massive transport. These cities still can and should avoid sprawl.

Beyond transportation criteria, suburban low density sprawl is undesirable for other reasons. Land is used inefficiently. Suburban streets far from shops, often without sidewalks, are empty and somewhat boring. And humans need or at least like being with others, to see other people. Crowded restaurants, concerts and sidewalks are more attractive than empty ones. Suburbanites have to drive to the Mall to see people. When someone lives in a distant suburb and is invited to dine out and go to the theater, he or she is likely not to accept so as to avoid the long drive home afterwards. A spread out city thus ends up having less restaurants and theaters. A suburban environment that requires a car for going anywhere leaves many vulnerable people stranded: the handicapped, the elderly, the poor, children and the young. Such are the realms of “soccer moms” who do nothing but drive their children everywhere, as they have no other way to move about.

To talk about transport is to talk about urban structure; because transportation choices create particular urban structures. Sprawl is caused by road infrastructure investments. The existence of large roads makes it easy to drive from a place distant from the city to its center; it facilitates and stimulates the appearance of suburban housing, shopping malls, office complexes and other low density developments.

Ironically large roads do not solve congestion problems. Moreover, trying to solve traffic jams building more road infrastructure is like trying to put out a fire with gasoline. Initially the new road may alleviate congestion but simultaneously it will start to generate its own new traffic. It will stimulate new developments even farther away from the city centre. A few years after it is built, the new road will be just as clogged as the ones it replaced or complemented. But now the city will be more spread out, its population density lower, its possibilities to use mass transit lessened. Two more points should be kept in mind: To have twice the number of cars is equivalent to keeping the same number of cars but doing twice the distance. And second, there are “induced” trips. Experts have found that people drive farther if road space to do it is available. They will refrain from many trips if they are likely to find jams or for any reason spend longer time.

For the above reasons more road infrastructure brings about more traffic jams, despite apparently doing away with them. There are many other counterintuitive truths. It can be remembered that Copernicus was almost killed for saying it was the Earth that circled the sun and not the contrary, when it seemed to be the opposite. Economists have taught us that higher interest rates drive down inflation, despite our initial common sense approach that would suggest the contrary. It would take the typical developing lower income Asian city more than 100 years to have a road infrastructure like that of Houston, Atlanta or Seattle. Yet in those cities time lost in traffic jams increases every year.
Cars are wonderful but they don’t function well if we all decide to use them simultaneously at peak hours. Let us imagine that 400 wealthy individuals in a city decide to use private helicopters for their daily transport. Why would the rest of society have to forgo that natural resource that belongs to all that is silence? Why should the majority suffer great noise for the benefit of a few? Neighbors of someone who actually decided to use his personal helicopter to fly out from his garden to Manhattan sued because it was noisy. A court decided to allow the individual to use his garden as heliport. The developing world motorized minority actually generates more costs to the majority than helicopters would. Cars pollute the air; are dangerous to pedestrians; require an expensive road infrastructure that requires expensive maintenance. And the helicopter simile is yet more relevant. Despite the noise it is feasible that a few hundred use helicopters for their daily urban transport, as a minority of the population in a developing city might use cars without appreciable harm. Yet if every person were to do likewise traffic would collapse or severe damage to the city structure and quality of life would come about.

The urban transport solution is clear: Public transport; but not for those with lower incomes, but for everybody. Transport is not a technical, but a political issue. Who benefits from the policies adopted? Which is the objective of our transport policy? Is it to provide efficient mobility for all? Or rather, to minimize traffic jams for the higher income groups? While the answer is obvious, at least the democratic answer, in fact most developing country cities concentrate transportation investments on alleviating upper income drivers traffic jams.

Investments in road infrastructure aimed primarily at reducing traffic jams are highly regressive, because scarce public resources are taken away from solutions to urgent needs of the poor in order to favor the higher income minority. Moreover, lower income neighborhoods are frequently gutted in order to make space for high velocity roads that destroy neighborhoods without benefiting them as residents do not own cars. Developing countries exhibit urban highways in general and elevated ones in particular as symbols of progress: In fact they are monuments to inequality.

If car usage is not restricted, there will inevitably be traffic jams; that will bring about great pressure to invest in more and bigger road infrastructure. Severe car use restrictions are the only effective means to achieve a high population density and public transport use. People will prefer to live closer to work if transport takes longer. Unless people are not allowed to use the car, or to use it is extremely expensive or traffic conditions make it very slow, most people will continue using cars even when excellent public transport is available. Most cities have seen significant increases in the percentage of people using cars for their daily transport at the expense of public transport systems. Paris is a good example, because it has excellent public transport. Nevertheless over the last few decades and despite opening new formidable subway lines, the number of public transport users remains stable while those who drive have increased significantly every year.

Cars are comfortable. Cars have some flexibility advantages particularly for those not living in the city center; transit has restrictive schedules and does not necessarily reach all points of urban areas. For those who dislike mixing closely with strangers cars provide desired isolation. Cars are also a status symbol. In more primitive and unequal underdeveloped societies these factors weigh even more heavily. Most upper income people tend to reject the mixing closely with lower income citizens without hierarchical barriers as it happens in buses.
or trains. Only quality public transport and very severe car use restrictions will lead them to do it.

Among the means to restrict automobile use are: Tag number-based restrictions that keep cars off the road all or part of the day certain days, according to tag number endings; tolls paid to enter certain parts of the city, or to use certain roads; high fuel prices; satellite tracked road use charges, that change according to the road chosen and the time it is used; all out ban on car use during peak hours; and the simplest of all restrictions: traffic jams. If high densities and public transport use are socially accepted objectives, traffic jams should not be looked at as problems but as a useful tool. Traffic jams will lead people to live close to work, study and shop close to home and therefore cities will be denser. And traffic jams will stimulate public transport use. Traffic jams without good public transport will not achieve this purpose, but probably good public transport without traffic jams will not do it either.

BOGOTA EXPERIENCE

No two cities are equal, but Bogotá, my city, can in many ways be representative of a developing country city. It has an income per capita lower than many Asian cities and higher than many others as well. It has nearly 7 million inhabitants and most problems characteristic of large developing country cities are to be found there. Yet we have mostly recently implemented several projects aligned along a different vision of what a city should be. No great transcendental component constitutes the essence of the new Bogotá. Rather, a series of many small details often ignored in developing country cities add up to construe a different model.

Every Sunday for 7 hours, between 7 AM and 2 PM more than 120 kilometers of main arteries are closed to cars in Bogotá. It is called the “Sunday Ciclovía” (Sunday bicycle-way). More than 1.5 million people from all socioeconomic levels and all ages come out to ride bicycles, walk, and do aerobics. It is fun and it is an exercise in social integration. People have appropriated it so much that if police fails to close a given spot one Sunday, the people themselves will promptly put stones, wood or any obstacle in order to close motor-vehicles access. And any entering car would meet a very upset crowd. The tradition is also a ritual symbolizing the importance of people over cars. One night near Christmas between 6 PM and midnight the same streets are closed to motor-vehicles in order to allow people to come out in bicycles and walking to see the Christmas lights. More than 3 million people come out for this event. It is a community celebration and it gives citizens a sense of security as all are conquering the night together.

Through a tag number system, 40 percent of all cars in Bogotá are off the streets during 2 peak hours in the morning and 2 peak hours in the afternoon. Each car has this restriction twice a week. The scheme reduced trip times by about 21 minutes and lowered pollution levels. Gas consumption went down 10.3 percent. Other cities have implemented full day tag-number-based restrictions without much success. For one, a whole day restriction is so severe, that many who definitely need to use a car find ways to get special permits. And of course once a special permit is issued, many want to get one as well. And soon after half the population has one. Another problem with whole day restrictions is that many people buy an additional car making things even worse. The Bogotá restriction is less severe. Some people leave the car home, which is the socially desirable behavior. Others simply go to work earlier or later than usual and thus road space is more evenly allocated. This restriction functions well and has a higher than 90 percent popular support.
Bogotá also has a car-free day at least once a year since 1999. Differently from car-free days elsewhere, it is held on a week-day and covers the whole city and not just a few arteries or sectors. During 13 hours all citizens meet as equals in public transport, bicycles or walking. It builds community. There was much debate previous to the first Car Free Day. While Bogotá’s low motorization, only 29 percent of homes own cars and only 14 percent of the population uses the car for its daily transport, would appear to make such an exercise easy, the fact is that automobile owners concentrate most power. Nevertheless it was possible to implement it and people enjoyed the first car-free day adventure. In a referendum held afterwards, on October 2000, nearly 64 percent of voters approved establishing a car-free the first Thursday of February every year.

While cars tend to be a means of social differentiation, bicycles integrate people. How is it that those countries with the least favorable weather for bicycling as are northern European ones are those where bicycles are most used? Why almost half the population of cities like Munster, Amsterdam or Copenhagen can use the bicycle for its daily transport while developing country cities with much more favorable weather and low motorization rates practically do not use bicycles? It is because those cities have more egalitarian, more democratic and integrated societies and their urban design and behavior reflects it. But bicycles could play a very important role in the mobility and social integration of developing country cities. Not only do they tend to have temperate weather, but a majority has no other possible alternative for individual mobility.

In Bogotá we developed a large bicycle-path network and set in the planning bylaws that future roads must include bicycle-paths alongside them. Bogotá bicycle paths and all developing world bicycle paths must be physically isolated from motor-vehicle traffic because just a line painted in the street would not be enough protection against often unruly drivers. More than 300 kilometers of bicycle ways were built in 3 years. People riding to work increased from 0.3 percent to 4.4 percent of population.

Beyond its importance for transport and the environment, bicycle paths show respect for human dignity regardless of income. I would venture say that 20 percent the importance of bicycle paths lies in the protection they provide bicyclists; and 80 percent resides in that they show a citizen on a $ 20 bicycle is as important as one on a $ 60,000 luxury car. Most people riding bicycles to work are lower income citizens, for whom the savings in their monthly transport expenses are significant. A few years ago a bicyclist in the road was looked upon as a nuisance. Today, a bicyclist, usually wearing a helmet, a reflective vest and on a protected bicycle path, is also evidence of democratic urban design.

Banning car use during peak hours in a Third World city represents advantages for the majority of the population in the short term; and for everyone in the long term. It results in less travel time for the bus riding majority, due to less traffic. People have then more time with their children; and they are less bus-worn when they arrive at work and are therefore more productive. Less motor-vehicle use means less pollution. It also ends up in lower road maintenance and enhancement investments and thus less public funds for car owning upper middle classes that allow more for the poor. Social integration in public transport constructs legitimacy for democracy. And as people are forced to use some form of public transport, suburban sprawl is discouraged. Density is stimulated.
The people of Bogotá voted positively a referendum to get all cars off the streets every weekday between 6 AM and 9 AM and between 4:30 PM and 7:30 PM from January 2015 onwards. It did not achieve its goal of becoming legally mandatory because slightly less of 33 percent of total potential voters participated in the referendum; but it shows the people themselves can make radical decisions regarding the way urban life is organized. While the above sounds radical, the fact is that more than 80 percent of Manhattan’s residents, the world’s richest, don’t own cars. They simply rent them when they are to leave the city for a week-end at the beach, for example.

TRANSMILENIO

With 6.5 million inhabitants and growing and conscious of the deleterious effects growing car use could have on urban quality of life, citizens of Bogotá needed a quality transit system. Yet the city only had a chaotic fleet of 30,000 buses, practically individually owned. Most buses were old and polluting; drivers worked more than 12 hours daily; racing against other buses for passengers led to accidents, to dropping passengers, even a woman with children in the middle of the road; drivers had developed technique, so that for example in order to stop pick up a passenger they did it so that they blocked the 3 lanes of an arterial road so as to impede buses coming behind from overtaking them; and buses were very slow. It was a chaotic system, bad for the city, for passengers, drivers and even for bus owners as it was not a profitable system. And still a majority of citizens were force to take such buses for their daily transport. A version of this exists in most developing country cities.

Learning from Curitiba’s system and improving upon its technology and organization we put in place a bus-based transit system in place that transformed quality of life in our city. We called it TransMilenio. Two or four central lanes in main arteries are given exclusively to the system for buses to operate without any other traffic. Central lanes and not lanes next to sidewalks are used in order to avoid traffic often generated from driveway entrances, gas stations and minor road intersections. As passengers board the buses at stations, central lanes use also allows having one station serve both bus directions, instead of having two, one on each side of the road. Articulated 165 passenger high platform buses stop at stations and open its doors simultaneously with station doors. As passengers have already paid or have been charged through a contact-less card at the station entrance and as the station and the bus floors are at the same level, a hundred passengers can come out and a 100 more board the bus in seconds. The trunk lines buses are fully accessible to the handicapped. Passengers reach the station either by an elevated pedestrian ramp or crossing the road supported by a traffic light.

Feeder buses in regular streets with shared traffic bring passengers to the trunk lines to which they can transfer at no extra cost. One ticket permits one passenger to change from a local-stops bus that makes all stops, to an express one that only stops every 10 or 20 stations; passengers can also transfer from one line to another. Cost is the same regardless of trip length. As most lower-income citizens tend to live in the outskirts, make more use of feeder buses and make longer trips, they are subsidized by higher income ones that make shorter trips.

The first 38 kilometers of trunk line in operation TransMilenio mobilized 780,000 passengers daily. New trunk-ways recently put in operation increased the system’s extension to 54 kilometers and daily passengers to nearly 900,000. More than 15 percent of TransMilenio’s users are car owners who prefer to leave the car at home. It costs $ 0.40 to use TransMilenio
and that price covers all costs, except road infrastructure and stations. It is considered
evident though that as Government pays for private cars road infrastructure it must pay for
roads used for public transport as well. Private contractors that share in the system’s income
according to bus-kilometers provided operate the buses; other private contractors are charged
ticketing, money collection and distribution to each party. Local Government-owned
company TransMilenio manages bidding processes and controls the system operation but
receives only 5 percent of the system’s income. Efforts were made to include traditional bus
operators into the new system. In order to participate in the bidding processes to provide and
operate buses, companies must include traditional bus operators with a significant ownership
share. Also, before an articulated bus is put into service it must demonstrate that its owners
have bought and melted 7 traditional buses.

A local 25 percent tax on gasoline, of which 15 percent go to TransMilenio infrastructure,
support the system further expansion. The National Government contributes funds as well
and it is promoting and now it is funding similar systems in other Colombian cities. It is
difficult to determine exactly what the cost of TransMilenio infrastructure per kilometer is
because in every case several lanes for mixed traffic use have been re-done as well but a
rough estimate is about US $ 6 million per kilometer, including high quality public space.

An important effort was made for citizens to identify TransMilenio as a completely different,
high quality transport. Its name, the buses color, the quality public space build alongside it
with sidewalks, trees, lighting, benches, all were carefully worked factors in order to make
the system attractive to all socioeconomic levels. As it is much faster today to use
TransMilenio than private cars, many car owners are leaving their car home and using
TransMilenio. Currently 9 percent of TransMilenio users are car owners. TransMilenio is
programmed to continue expanding every year until 2015 or 2020 with some delays. By then
more than 80 percent of Bogotá’s 8.5 million citizens will live less than 500 meters away
from a TransMilenio trunk line. Bicycle parking stations will begin to be created soon near
TransMilenio stations so as to facilitate that modal interchange. Currently there are 2 more
trunk lines under way which should start operating in the first semester of 2004.

Taking all other vehicles out of a few lanes, any city’s road network can be used to put in
place bus based transit with capacities and speeds very similar to those of rail systems, at a
small fraction of the cost. While it is technically and economically viable, it is indeed a
political challenge with many conflicting interests: Traditional bus owners and car owners
that see their space reduced are the main stakeholders to be assuaged.

Avoiding, or minimizing conflicts is one reason why many developing country cities prefer
to invest in much more expensive rail systems than go to the trouble of putting bus based
transit in place. Other reasons to choose rail include: It can have a larger capacity, though
TransMilenio moves more passengers per kilometer than most rail. Even if one or two rail
lines are put in place, buses will remain the only possible means to provide public transport to
the majority of a developing country city. Rail system costs are very high. No subway in a
developing country has cost less than $100 million per kilometer, a dubious investment in
cities where many don’t have even sewage, schools or access to parks. Limiting the
alternatives to transportation, for the cost of one subway line it is possible to provide quality
bus rapid transport to a whole city. Bus based transit systems have the advantage of lower
investment and operational costs. Bus systems are more labor intensive, an advantage in
developing countries. It is easier to partially or totally build buses than train systems in
developing countries. Compared to underground systems, ground level systems, be it rail or
bus, are much more pleasant as passengers enjoy a view of the city, see the sunlight and generally feel more secure from crime. Finally bus systems are more flexible, an important asset in developing countries dynamic cities. As a city attraction center shifts, it is easier to adjust a bus system than a rail one. Bus systems can also install a parallel line nearby at a low cost and nearly duplicate capacity. Rail systems project an image of modernity. In cities sated with disastrous bus systems, citizens at first might not want buses and prefer an advanced world rail model. Unfortunately sometimes rail systems are also chosen for the worst possible reasons. Rail system salesmen are legendary for the procedures they utilize for selling their expensive wares.

Above all it must be remembered that in terms of transport, the more civilized city is not the one with highways, but the one where a child in a tricycle can move about everywhere safely.
I. BRT is the inevitable choice for Beijing’s sustainable development.

Beijing, as a mega-city, has been plagued by traffic problems. For years, Beijing has made unceasing efforts to solve this problem by continuous infrastructure investment. Funds amounting to 5.24 percent of GDP have been raised in the last decade, and roadways increased 33 percent.

However, the transportation system is still under pressure, with transportation routes only solving part of the problem. Statistics show that there are still 87 seriously congested areas, with an average speed of 12 kilometers per hour, 40 percent of passengers spend over one hour in transit, and the roadway load rate averages 0.88.

The reason for these problems is that transportation supply cannot meet demand. In 2003, Beijing residents made 21 million trips daily, an 80 percent increase compared to 1986. The vehicle population reached 2.12 million, a 200% increase compared with 10 years ago, among which 1 million are private cars.

This shows that the problem cannot be solved by only increasing transportation infrastructure. For that, we have to control and guide transportation needs, and efficiently utilize limited transportation resources.

The “Beijing Development Policy Framework” drafted by the Beijing government, puts forth a thorough, scientific, and systematic transportation strategy. Rail is an important part of the Beijing transportation plan and will be extended to over 220 kilometers in 2008.

But even with 220 kilometers of rail, only 4-4.5 million passengers will be served, 25-30 percent of total volume. Therefore, the urgent question becomes how to swiftly improve our conventional bus system to attract more passengers.

BRT bus capacity and service falls in between rail and conventional buses. Its main features are: enclosed lanes, isolated stops, level boarding, large capacity, signal priority, and an intelligent control system. BRT is only 1/5 to 1/3 the cost of rail, 1/10 the cost of subways, and 1/4 to 1/3 the construction time for subways.

With traffic needs accelerating, especially with the 2008 Olympic Games ahead, rapid construction of BRT is essential.

II. BRT Development Plans

The problem with Beijing’s current transportation system is there are too many buses and too few fast rails. The former takes 90 percent of total volume, the latter only 10 percent.
Over 200,000 buses on 700 routes results in slow, low quality service, and make buses unattractive to passengers. To alleviate this situation, the Beijing Municipal Government is developing a BRT system. The general idea is to supplement rail while bolstering bus transportation, using both old and new roads.

The concept of “supplementing rail” is based on two ideas: 1. Transition and Substitution. For planned rail lines that cannot be implemented in the near term, we will use BRT and these routes may be replaced by rail in the future (depending upon demand). 2. Expand the rail network to increase its coverage.

We can optimize bus transportation by building BRT corridors on redundant routes to reduce congestion. This could help to form an on-ground traffic network to accelerate traffic flow and improve service quality. New roads can be constructed to introduce BRT and old roads can be adapted to serve as BRT corridors.

Our goal is to build a comprehensive network composed of rails, BRT, conventional buses, in order to improve public transportation and attract more passengers.

Based on ideas mentioned above, and given consideration to Beijing priority plans and recent road construction plan, there are about 10 BRT lines initially planned totaling 200 kilometers.

**III. Implementation of the BRT demonstration corridor**

1. **Introduction**

The route goes through two administrative districts, making it a main transportation route in southern Beijing. With only conventional bus routes, passenger volume has reached 8000 passengers per hour per trip. The average speed for cars is 15 kilometers per hour at rush hour.

Originally subway line 8 was planned for the southern axis. Since this subway will not be constructed in the near term and traffic problems continue to worsen, the Beijing government decided to reconstruct the south axis road that is 80 meters wide and eight lanes. Eighteen to twenty-three meters has been reserved in the road center for subways. This is going to be a BRT demonstration route.

It starts at Qianmen and ends at Demaozhuang, is 15.8 kilometers long and passes Qianmen commercial area and four ring roads.

It connects other conventional buses with 16 stops, among them five large transportation hubs.

The BRT demonstration project is people-centered, convenient for passengers, and inexpensive.

2. **Equipment**

   (1). Road plan: Exclusive BRT corridors separate from cars at the center of road. Special passing lanes are set up at each stop.

   (2). Stops: The 16 bus stops are 5m wide, 40-60m long. Doors opens at the left side level with the platform. Protection fences are set up between waiting area and buses.
3. Buses: With Iveco technology from Italy, buses are 18 meters long, air-conditioned, have clean emissions, a capacity of 200 passengers, and a top speed of 80 kilometers per hour.

3. Intelligent BRT transport system

Intelligence is a major benefit of BRT systems based on the principle of maturity, feasibility, and practicality. It is composed of five parts:

   (1) Signal priority: gives BRT buses priority over other cars.

   (2) Passenger information service: provides passenger with useful transportation information.

   (3) Ticketing system: combined system of IC cards and ticketing personnel. Ticketing scheme proposal: standard pricing. As IC card use increases, prices may vary according to time or distance.

   (4) Bus coordination management: computerizes work plans and staff shifts.

   (5) Protection measures at stops: protective fence will go up between buses and stops, and will automatically open or close when buses come or go.

4. Operation scheme

South axis BRT routes run from 5:00am to 11:00 pm. Fifty buses will run every 4-5 minutes, or every 2-3 minutes at rush hour. Average speed is 30-35 kilometers per hour, with 6000 passengers per hour, 210,000 passengers per day in each direction.

Route plan:

   (1) Standard routes: bus stops at every stop (route No.1)

   (2) Major stops routes: bus stops at major stops and interchange stops at rush hour.

   (3) Express routes: bus stops at interchange stops only.

During the trial period, only standard routes will be used. Combined routes are dependent upon passenger needs.

5. Construction Plan

Both government and the private sector are investing in this demonstration project. Government side is mainly responsible for road, bridges, and other infrastructure construction. Private sectors are responsible for vehicle purchases, intelligence systems, and platform construction. Beijing Chang Datong Co. ltd. has been established to oversee this route.

6. Schedule of construction

The BRT demonstration routes will be finished in two phases. Phase I starts at Qianmen toward Muxiyuan, with 5 stops and is 5 kilometers long. It is expected to be completed at the end of 2004. Phase II goes from Muxiyuan to Demaozhuang, with 11 stops is 11 kilometers long and is expected to be complete at the end of 2005.

BRT is but an invention, with Beijing taking the lead. Experts from the US provided useful technical guidance that we appreciate very much. We are also developing pilot investment and construction mechanisms. We believe that after BRT’s planning, research, and
operation, its integration with the public transportation system will achieve a thorough, sustained, and coordinated development of transportation in Beijing.
Leaders, Friends and Comrades,

On behalf of the Shanghai Municipal Government, and in the name of Mayor Hang Zheng, I would like to introduce transportation construction and management in Shanghai.

With a population of 17 million, Shanghai is a mega-city. Transportation issues have always been given top development priority. In the 1990s, Shanghai launched several transportation projects including the completing the traffic network structure of “Ring Road + Radiation Road” and “Lattice Layout” inside the inner ring, rapid expressway system composed of “[]” shaped overhead and “triple crisscrossing” roadways, an integrated basic roadway traffic structure on both banks of the Huangpu River, and launched expressway and rail traffic network construction. In this period, a basic framework was laid out for future development while simultaneously addressing historical preservation issues.

In the 21st century, Shanghai proposed building a comprehensive modern infrastructure. Urban construction, especially transportation construction began shifting to “hub, functionality, and network” development. In 2002, Shanghai drafted an urban transportation white paper, and finalized the “integrated transportation” and “public transportation priority” strategy. This has created the necessary conditions for changing the construction and management of urban transportation.

I. Current Urban Transportation Conditions & Major Issues in Shanghai

In spite of the significant progress achieved in Shanghai transportation and management since the reform and opening up period, especially after the 1990s, urban transportation in Shanghai has significant traffic problems when compared to major international cities and is confronting surging social and economic development demands on its transportation system. The traffic speed in the downtown area is 25 kilometers per hour, severe traffic congestion exists during rush hour, the comprehensive roadway traffic evaluation index is in a downward trend, and the entire roadway network system is weak under fluctuations. The major causes for this are the following:

1. The road network structure.
The traffic configuration is not coordinated, the auxiliary system is imperfect, and expressway and trunk roads are not smooth. The expressway layout is badly planned and incomplete for some intersections. Road network distribution is uneven, and facilities are inadequate in some areas.

2. **Undesirable traffic environment.** Due to a series of factors including the lack of bus ways, motorized and non-motorized traffic share the same road; people and vehicles vie for the same lanes, resulting in conflicts. Traffic capacity is reduced by nearly 50% in some key roads. Collisions at intersections are still prevalent.

3. **Public transportation has not been made a priority.** Although public transportation accounts for 22.3% of total traffic volume, it has not been given proper consideration. The service level needs improvement, and the sustainable development mechanism is incomplete. Rail transit is overloaded, and connection hubs need to be constructed.

4. **Parking lots are not well organized.** Public parking spaces are lacking. There are approximately 60,000 spaces. In 2010, there will be 120,000 spaces. Yet, the utilization rate is 50% due to the lack of coordination among the various departments involved.

5. **Traffic management needs to be strengthened.** Planning, construction, and management resources should be consolidated. Basic data collection, quantitative and comprehensive analysis should be strengthened. The organization of traffic agencies should be strengthened in large-scale construction projects.

The in-depth causes for transportation problems in Shanghai are related to intensive downtown development, high population intensity, and the high concentration of administrative, commercial, cultural, and residential facilities in some areas. Yet, traffic capacity planning, control, and evaluation systems are still nonexistent.

II. **Overall thinking and development goals of urban transportation modernization in Shanghai.**

Shanghai’s economy will grow at a rate of more than 10 percent, and the population will remain at its current level or grow slightly by 2010. At the same time, the goods and passenger volume will also grow rapidly. From the perspective of traffic demand, the passenger volume (currently at 40 million trips per day) and motor vehicles (approximately 2 million) will grow significantly in the next five years. The motor vehicle traffic volume remains quite high (currently 9 million, 50% on road). From the perspective of facilities, the rail transit capacity expansion will still fall short of the rising demand growth by 2010. The downtown area road increase is unlikely to replicate the massive centralized supply model in the 1990s. As a result, there are “Three Basic Outcomes” on transportation development in Shanghai.
Outcome 1: In consideration of such factors as population, economy, land use intensity, the World Expo 2010, and the projected 2.5 million motor vehicles, the traffic demand will continue to steadily grow.

Outcome 2: Downtown rail transit will expand rapidly, and there will be an increase in road infrastructure by 2010. The infrastructure, however, will still fall short of demand.

Outcome 3: It will take a long time to optimize urban transportation. Current and future transportation work will focus on upgrading the transportation management level, and fully leveraging the role of the limited resources, while boosting construction momentum.

Based on the above outcomes, the overall thinking for modernizing urban transportation construction and management in Shanghai is:

In accordance with the strategy set in the transportation white paper, we have made transportation the permanent theme of urban development, assumed basic government responsibility over transportation management, and made solving transportation problems by 2010 a top priority. Assuming “constant demand growth, limited infrastructure, and greater management potential,” we have taken the lead in overall planning, combined short-term and long-term considerations, coordinated capacity growth and maintenance through planning, economic, legal and social means, and strengthened the links between infrastructure, policy, management, and the system as a whole. The key is to further optimize the rational deployment and coordinated development of transportation resources, primarily in the following six respects:

---Planning & Control. Roads make up the framework of a city; road construction and urban development are mutually dependent. The difficulty and cost of transportation improvement will be excessive without planning control. The basic prerequisites for solving urban transportation problems are sensible planning and design, clear-cut functions, and rigorous capacity control.

---Demand Management. The main target is motor vehicles. In order to maximize the utilization of the limited transportation infrastructure and resources in Shanghai, we will control overall traffic capacity, complement economic levers with administrative means, and move from vehicle ownership restriction measures to restricting vehicle ownership and vehicle use.

---Road Network Deployment. Rational road resource deployment helps raise road traffic efficiency. In the near term, we will focus on perfecting secondary trunk road and branch road network, and building dedicated road network for non-motor vehicles. In optimizing road network deployment, we shall accelerate infrastructure construction, implement functional sub-division, and optimize resource allocation.
---Public Transportation Priority. We should make public transportation a priority. Efforts should be made to attract bicyclists and private vehicle owners. The focus is on service level. To implement the bus priority strategy and boost the attractiveness of public transportation, we should adopt measures such as lane priority, line/network priority, updating the ticketing system, and policy support.

---Bicycles and other non-motorized vehicles. Bicycles and other non-motorized vehicles exist because of the current economic level, and their existence is justified for objective and practical reasons. No efforts should be made to force such vehicles out. In the scope of comprehensive transportation, we shall scientifically weigh the relationship of urban motorization to slow transportation. The current policy for non-motorized vehicles is to identify their role, offer a replacement transportation method, and minimize the negative impact.

---System integration. We should strengthen transportation planning, construction and overall management, specify the leading organizations and responsible departments, set up relatively centralized administrative resources due to the severe shortage of infrastructure and resources, and help better use the existing infrastructure and social resources. At the same time, we should strictly enforce the law and management.

By the year 2010, the overall objective for urban transportation development in Shanghai is to incorporate traffic demand growth factors, strive to keep downtown traffic flowing smoothly, avoid traffic congestion in large areas, preliminarily establish the public transportation priority system, set up a coordinated management system, speed up traffic management IT construction, keep supply and demand in balance, and meet the requirements of the World Expo 2010. Specific targets are:

---Road Transit: Maintain a motor vehicle speed of 25 kilometers per hour.
---Rail Transit: Maintain average travel time in downtown area to within 1 hour.
---Highway Transit: Achieve the “15, 30, 60” highway planning objective.
---Public Transportation: Account for at least 30% of total passenger flow volume in Shanghai, while rail transit accounts for at least 40% of bus transit volume.
---Static Transportation: Increase the ratio of public parking from 10% to 13%. Increase the utilization rate from 50% to 70%.
---Intelligent Transportation: Establish a downtown road traffic information acquisition and distribution system.

III. Main measures for strengthening transportation construction and management

(I) Strengthening planning guidance and control. We should improve downtown planning, strengthen control, coordinate population, industries, resources, environment and infrastructure, make the road network framework and capacity an important condition for downtown scale control, rationally organize construction projects and avoid excessive concentration of construction projects, and guarantee land availability for transportation
infrastructure construction. Adequate land should be set aside for transportation infrastructure, and the public transportation priority policy should be fully reflected at each level of planning. Underground space should be fully tapped through sensible planning. Land should be set aside for the urban administrative center. A traffic impact evaluation system should be established. Traffic impact evaluations should be taken as the basic measure for procedural and planning control of project construction in traffic sensitive areas. Implement the “one vote veto” system similar to the environmental impact assessment system.

(II) Accelerating road facility construction, and perfecting utilization management. The downtown road network distribution should be optimized. We should accelerate the construction of the downtown road upgrade project for 300 kilometer (km) of highway, 600 km of trunk roads, and 700 km of secondary trunk roads and begin intersection construction at the trunk road intersections.

With six river tunnels added, there will be 36 new lanes. In coordination with downtown road network readjustments, the river tunnel planning and layout shall be optimized.

We shall construct a distributed transit network. Ten roadways will be connected to the Jiangsu—Zhejiang Highway to provide 60 lanes.

We should focus on defining road network functions within the central ring, constructing a road network composed of dedicated express, non-motorized, and bus networks as well as walkways. We shall expand the “left turn prohibited” road system, appropriately implement left turn bans in the Inner Ring Pu Xi Yuan Wei. We should increase the number of partially or fully prohibit left turn (currently 760 intersections or 36% of all intersections have this ban). Prohibiting left turn should be extended to non-motorized vehicles as well.

We should move forward with one-way street construction. The downtown area involves 388 roads, 60% of which are located in the Inner Ring. With an emphasis on Inner Ring Pu Xi region, all the secondary trunk roads and branch roads, except for the “triple crisscrossing” roads shall be one way when conditions are suitable.

(III) Pushing forward public transportation priority development. We should accelerate the construction of the basic rail transit network, establish a passenger transportation system based on bus transit (with rail transit as the backbone complemented by bus transportation), and increase operating capacity and service level.

Strengthen the passenger public transit hub system construction. In coordination with rail transit, the Outer Ring, Central Ring, long distance transit station, and common distribution points, speed up passenger transit hub construction to facilitate passenger connection.

Establish public transit dedicated roads and priority. We should improve the non-motorized vehicle road network and construct dedicated networks. Exclusive use applies during rush
hours. Priority passage should be given to public transport at intersections where conditions are suitable.

Develop a bus rapid transit (BRT) system. Bus rapid transit network should be opened between or among downtown, new town, central town, and rail transit hubs to meet the needs of passengers in areas lacking access to rail transit and having large passenger volume.

We should deepen public transit reform, and promote sustainable development. We should coordinate investment, ticketing, corporate vitality and staff enthusiasm, establish pricing and management mechanisms and institute public transit cost reviews and a government procurement service system. The government is obligated to purchase the non-profit service provided by public transit enterprises beyond their market-driven operational capacity.

(IV) Strengthening stationary transportation construction and management. We shall push ahead with facility planning and construction, strengthen coordination, encourage private investment, and install parking lots or garage in commercial facilities. Bicycle parking facilities shall also be provided.

A regional differentiation policy should be adopted to implement “tight supply” of parking lots in the downtown busy traffic area, “moderate supply” in general areas, “supply & demand balance” between Inner Ring and Outer Ring, and “ample supply” from Outer Ring outward. Construction standards should be established and implemented.

The parking management system should be improved. Construction standards for parking lot installation and parking site/garage must be improved. We should regulate the parking demand in different areas, improve the billing policy and mechanism, and develop a parking information system.

(V) Perfecting motor vehicle control policy. The total weight control policy shall be improved. We shall impose total capacity cap on newly added motor vehicles, perfect quota auction management methods, gradually expand quota capacity, and subject buses to quota auction management. We shall deepen public transportation reform, and develop it into a scheme composed of objectives, basic modes, promotion procedures, and associated policies.

We should also intensify research on “congestion pricing,” comprehensively consider area selection, public transit restructuring, facilities, social and economic impacts, billing standard and technology, and strive for tangible results.

(VI) Vigorously pushing ahead with traffic IT construction. A series of basic projects should be constructed, including a taxi dispatch information platform, downtown road transit information collection system, urban expressway and highway “local area control, wide area guidance” management system (ATMS), and integrated traffic information sharing system. We shall use intelligent transportation technology, guide service, and fully leverage the space-time effect of limited facilities.
A traffic information acquisition and comprehensive evaluation system should also be established to mainly include routine data acquisition, updating mechanisms, local area traffic databases, and analysis/evaluation/early warning systems.

**(VII) Administering traffic rigorously through legal channels.** The traffic laws and regulations should be improved. While enforcing the traffic security law, we shall sort out the existing traffic laws, rules, and regulations according to Shanghai’s conditions. The lagging or lack of regulations should be amended or added to form a comprehensive traffic law and regulation system as soon as possible.

We should intensify law enforcement management. We should manage and prosecute in a rigorous manner, responding to and handling problems quickly. Any violation will be penalized. We shall strengthen “trouble spots,” educate and penalize passenger and non-motorized vehicle violators, raise police presence, the enforcement rate, and public satisfaction, and perfect traffic enforcement information support system.

Vehicles and drivers shall be managed in a strict manner. We should strengthen driver training management and non-Shanghai plate vehicle management as well as fully implement traffic accident third party responsibility insurance premium mechanisms.

The degree of social and public involvement should be increased. We shall improve the traffic violation reporting system, fostering a sound public opinion environment, intensifying traffic violation exposure, and mandate students to learn traffic rules and laws.

**(VIII) Perfecting the transportation system.** It is clearly stated by Shanghai CPC Committee and Municipal Government that comprehensive traffic construction and management is led by the Shanghai Development & Reform Commission and Construction Commission.

The Shanghai Development & Reform Commission is responsible for formulating the comprehensive transportation policies and white paper; Shanghai Construction Commission assumes the responsibility for implementing the transportation white paper and undertaking routine management of comprehensive transportation construction; the departments of planning, transportation, city planning, public security and patrol police etc., are responsible in their respective disciplines.

At the same time, the road facility management system should also be streamlined. We should consolidate road facility management resources, and further perfect the mechanism of communication and collaboration.

The road construction work should be intensified. We shall fully mobilize and increase the participation of each district, push ahead with the secondary trunk and branch road network construction in the downtown area.
Transportation research resources should be consolidated. We should establish a city-wide open transportation research platform and information sharing mechanism, and strengthen comprehensive transportation analysis and research to support decision-making.

We need to draw on the valuable experiences of the cities inside and outside of China for urban transportation modernization and management in Shanghai. This forum provides a unique opportunity for us. We believe, through consistent effort, the traffic situation in Shanghai will be fundamentally improved.

Thank you!
The Development of Kunming’s Bus Rapid Transit (BRT) System

Zhang Zhenguo
Mayor of Kunming

Urban transportation is a major issue for many modern cities worldwide as well as for China. As the vehicle population has increased, subsequent traffic issues have emerged in China for the first time in its history. The public has responded by urging municipal leaders to improve public transportation. Constructing an efficient modern transportation network in our city has become the primary mission of the municipal government.

By the end of the 1990s, both Kunming and Zurich signed the World Transportation Planning Agreement that laid the foundation for implementing transportation policy that made public transportation a priority. Since China’s first modern public bus corridor was opened in Kunming in 1999, Kunming has built 20 kilometers of corridors, resulting in positive responses from the public.

Today, we are offered access to the latest world BRT technology to effectively address city transportation issues. Not only is it far superior to light rail in terms of cost, it has ample passenger capacity and high efficiency. It is especially suitable for large cities in developing countries. Kunming is the very first city of China to promote the policy of ‘public transport priority’. We believe that we will do a good job in developing Kunming’s BRT network through steady efforts.

I. Kunming’s Rapid BRT System

1. Planned construction

Kunming plans to build a network of 40 kilometers that could provide public transportation service for 75 percent of its downtown area.

The bus corridor on Beijing, Renmin, and Jinbi Roads were built respectively in 1999, 2002, and 2003, with the construction cost for each kilometer being four or five million yuan, which is considerably inexpensive.

Technically, the corridors in Kunming have three strengths: (1) they are close to the motor vehicle lanes; (2) their stops are generally arranged at the intersections of trunk routes; and (3) they have spacious and comfortable platforms.

2. Implementation Results

Implementation of the corridors has resulted in: (1) the speed of buses in the downtown area increasing to 15 kilometers per hour, up from less than 10 kilometers per hour; (2) the boarding and alighting times decreased to 23 seconds, down from 56 seconds; (3) the one-way passenger capacity of buses using the corridors has increased by nearly 50 percent, reaching 8,000 riders per hour; (4) the total bus passenger capacity of the city increased to
one million riders per day in 2004, up from 500,000 riders each day in 1999; and overall bus ridership increased to 14 percent, up from 8 percent.

3. Public response

According to a public opinion poll, public support of the corridor project was only 79 percent. Yet, as of 2001, public support jumped to 96 percent. This suggests strong public support of the project.

4. Integrated assessment

The urban transport space-time resources are allocated in a more reasonable and fair manner; the public transport efficiency and service quality have been remarkably updated; the traffic volume along the corridors have been lessened, and traffic pollution has been reduced; the corridors have improved the traveling quality particularly for lower-income citizens, symbolizing a kind of respect and care toward people; and the official ‘public transport priority’ policy has been widely popularized and accepted by people of all walks of life.

II. Reviewing Kunming’s BRT System

Due to many technical and management issues, the city’s bus priority system has remained in the initial stages of a bus rapid transit system for some time. A large gap between Kunming and cities whose bus transport efficiency has been close to the level of light rail transit still exists. In addition, Kunming has been confronting tremendous transportation pressures resulting from the fast rate of motorization in recent years. Therefore, it is crucial for the city to build a real BRT system, and to improve the quality of public transportation service and the rate of bus travel to a level widely acknowledged by the public. This will certainly produce a significant impact on the city’s transportation development.

1. Unsatisfactory passenger capacity

Presently, although the one-way passenger capacity of the corridors has reached 8,000 riders per hour, there is still quite a large gap in comparison to the world’s advanced BRT levels of 20,000 to 30,000 riders per hour. It is important for Kunming to bolster its BRT’s passenger capacity.

2. Small scale and lower coverage

At present, the total length of the bus corridors is just 20 kilometers in the downtown area, which is far from sufficient. In particular, the radial routes linking the downtown area with the outlying areas lack public transport channels with large passenger capacity.

3. Bus service quality cannot satisfy the requirements of modern life.

For a long period of time, the term ‘public transport’ has meant inferior transportation. With the development of China’s economy, and the increase in the people’s living standards, citizens have a higher standard for the quality of public transport services. Therefore, it is imperative for Kunming to improve the quality of its bus services.
4. The bus system is inefficient.

The city lacks highly effective bus trunks with large passenger capacities and has a surplus of low-efficiency bus routes. Several redundant routes exist, while at the same time some areas have no bus routes. The poor integration of bus routes makes it inconvenient for passengers to change buses. Because of the one ticket-one bus system, the city’s bus network do not provide residents with a unified system.

III. Development strategy of Kunming’s BRT System

Giving priority to public transport, which is in line with the principle of sustainable development, is the one and only way for a modern big city to solve its transportation issues. By learning lessons from successful cities both at home and abroad, we will continue to give priority to city’s public transport development as part of our long-term strategy. With financial support and technical assistance of the US Energy Foundation, Kunming has completed a study on Kunming’s Rapid Public Transport System, based upon the overall summary of the experience drawn from the actual BRT practice. Kunming will soon put the “BRT Upgrade Plan” into action, which will consists of the following five measures:

1. Legislation of public transport priority policy

To fully implement the core of ‘Opinions of the Ministry of Construction on Developing City Public Transport as Priority’, the city will thus determine the city transport development strategy by implementing legislation on ‘developing city public transport as priority.’ It will also be deemed as a basic principle in guiding the city transport planning, construction, management, and operation.

The city will conduct overall research on all kinds of measures and policies, and provide sound environmental support for the priority development of public transport.

The city will strengthen public awareness for modern transportation through publicity and educational means, to enable various groups of people to understand and support the Public Transport Priority policy.

2. Fully updating BRT facilities

Effective technical and management measures will be adopted to update Kunming’s BRT capacity to a level close to light rail transit, and to increase the one-way passenger capacity in the downtown area to 12,000 or 15,000 riders per hour, and increase the passenger capacity of the radial bus routes in the city’s surrounding areas to over 20,000 riders per hour.

Upgrading the BRT facilities will modernize the city, and allow public transport to become a mainstream form of passenger transport and sufficiently compete with car transport.

3. Expanding the scale of the BRT network

While updating existing corridors, we will concentrate on the radial routes for constructing a new and better BRT system by extending the network length of BRT from the present 20 kilometers to 70 kilometers. Efforts will be made to establish a sound bus transfer system, build the BRT system into a highly effective system, and integrate the BRT system with other modes of transportation.
4. Public Transport network priority

Measures will be taken to reform the complex and low efficiency bus route network by optimizing and integrating existing bus routes. The city’s primary grade light rail train (LRT)-like bus trunk network will be built in the corridors, which will become the city’s passenger transport artery with clear signage, large passenger capacity, high speed, and high quality service.

5. Establishing modern public transport ticketing system

The city will reform its bus ticketing system. In the near future, Kunming will soon implement the bus IC card ticketing system. Over the middle and long term, the city will implement the ticket zoning system, which will cover many modes of public transport, including bus, LRT, and suburb trains.

IV. Conclusion

Both the public and the government hope that making public transit a priority in Kunming will address the transport conflicts faced by the city. Upgrading the corridors into a highly efficient modern BRT system is an ideal solution to assuage city’s public transport pressure. It is economical, highly effective, and easy to implement and expand on in a developing city like Kunming.
Seize Development Opportunities, Improve Transportation Structure and Actively Push Forward BRT in Chengdu

Sun Ping
Deputy Mayor, People’s Government of Chengdu

Ladies and gentlemen:

In recent years, with the fast development of its urban economy, car population in Chengdu has been growing at a startling speed. Total car population in the city grew to 480,000 in 2003 from 51,500 in 1990, recording an average annual growth rate of 17.3%. As urban mechanization increases greatly, there has been a gradual rise in people's travel by car. Corresponding to this, growth of travel by public transport has been slow. Profound changes have occurred to the urban transportation structure in the last 10 years. The Chengdu government has long paid great attention to the development and building of urban public transport. In the last few years, the government has continuously increased inputs to urban transport infrastructure building, but its development still lags residents’ demand for public transport. How to increase the percentage of people's travel through urban public transport, improve upon the current backward public transport and form a sustainable transport structure in Chengdu is the focus of the transport bulling and development in our city.

Chengdu is a big city with a population of 3.8 million and a build-up area of 283 Km2. In recent years, the city has scored notable achievements in its urban road construction (road area grows at about 6% annually). This is particularly true of its Smooth Transport Project. All this has eased urban transport congestion in the city., But in the long term, it is difficult to sustain urban transport by merely relying on adding road resources. Currently, Chengdu has yet to give approval to track transport, which will therefore be hard to play a backbone role in the near term. As a way of medium traffic and fast public transport, BRT offers the advantages of short construction cycle, low investment and good economic returns. It is therefore good for serving as a public transport means between track and ordinary public transport. In recent years, we have got a great amount of information on BRT development in foreign countries through various channels and particularly the US Energy Foundation. Curitiba in Brazil has deeply impressed us: 3/4% of the households has cars, 3/4 of the population use public transport as commuting means, 3/4 of automobile fuels are saved and automobile exhaust is reduced by 3/4. Meanwhile, we are also very interested in the practice of BRT building in cities like Beijing and will adopt mature domestic technologies as much as possible. Here, I would to make a brief introduction to the plan to develop BRT in Chengdu.

I. Opportunities and challenges for developing BRT in Chengdu

There are both opportunities and challenges for developing BRT in Chengdu. Topping the opportunity list is the opportunities of the current era. Chengdu is now in a stage of fast
transport mechanization. It is also in a key stage of public transport development. If public transport lags behind, the development of urban motor vehicles will further reduce the growth space for public transport by way of urban restructuring, making it difficult for public transport to achieve its set goals. A greater price may even have to be paid. Therefore, it is necessary to formulate corresponding measures for developing BRT and seize the first opportunity. Secondly, it is the policy opportunity. According to the Ministry of Construction’s Opinion Concerning Giving Priority to the Development of Urban Public Transport, public transport should account for 30% of the total outings in urban transport in China in the next 5 years, average driving speed should be over 20KM/hour and punctuality rate over 90%. For a radius of 300m, station coverage rate should be over 50% in the build-up area and over 70% in the downtown area. This task is beyond the reach of ordinary public transport. The requirement can only be met through planning the construction of BRT as soon as possible and making it the core and backbone of the public transport system. Thirdly, it is the planning opportunity. In its new overall urban planning thinking, Chengdu has proposed to establish a multi-center urban spatial system featuring “One Primary Road, Two Supplementary Roads and Multiple Cores”, which will provide new development opportunities for building BRT in the city. An axial development layout has been adopted in Chengdu’s urban planning and land development will follow a TOD model. This creates excellent conditions for the development of BRT. If the city can seize the good opportunity if its current urban restructuring, smooth out public transport development mechanisms, introduce new technical means and provide public transport passengers with multilevel and high quality services, a very great proportion of pedestrians and bike users to public transport. Fourthly, underground rail construction lags behind. Track rail is a big traffic volume transport system that serving as a key support for urban development. As early as in 1987, Chengdu put forward the idea to develop track transport in its urban transport plan. But for various reasons, no construction has started yet. Even if No.1 Underground Line is built in the near term, it will still be unable to play a fundamental role in adjusting the public transport structure due to its limited radius of attraction to passenger flows. Also given the huge investment involved, large-scale implementation of track transport will not be possible in a considerable length of time in the future. As far as Chengdu is concerned, track transport can only serve as the backbone and main force of important passenger corridors but is not likely to take a dominant position in the whole public transport system. In the foreseeable future, it will be difficult for urban track rail system as the center of the urban public transport system to play the role of the mainstream or backbone public transport. This leaves a full room for BRT to grow in the near- and mid-term.

As a new transport model, BRT has found successful applications in many cities in South America, Europe, Australia and Asia. Many cities in China have also been making active exploratory efforts. With the progress of technology, there will still be rooms for its improvement. But as fast as its business and social benefits are concerned, BRT has already demonstrated outstanding features over other comparable systems (such light rail and trolley). Firstly, it is its economy. Under the precondition of meeting the basic technical and environmental requirements, business vitality and economy are the factors of primary consideration for huge public transport systems. In terms of constriction price and operating cost, BRT offers tremendous advantages over other systems. After the projection that 80% of the operating fee needs to be subsidized after its underground rail systems comes into operation, Los Angeles eventually gives it up. We must seek a system whose technical
indicators (transportation capacity and transportation speed) and environmental protection indicators can meet Chengdu’s requirements and that concurrently posses good economy to join the city’s medium- and large-transport volume fast public transport system and avoid over-reliance on tract rail system. Secondly, it is its applicability. Analysis of future public transport passenger corridors in Chengdu shows that among the some 800KM passenger transport corridors in the city, large transport volume (>200,000 person-times/day) corridors are around 150Km long (accounting for 20%), medium transport volume corridors (80,000–200,000 person-times/day) are about 250Km (accounting or 30%) and ordinary bus corridors (40,000–80,000 person-times/day) are around 400Km (accounting for 50%). Passenger transport corridors that truly need to adopt large transport volume fast public transport means account for less than 1/5. Underground rail should be in principle adopted for them. Medium volume passenger transport corridors account for 1/3 and can be met by adopting BRT. Ordinary passenger transport corridors account for 1/2. Ordinary bus transport, special lanes, priority lanes, mixed fast road and mixed transport thoroughfare may be flexibly adopted to meet the needs of such corridors. Here, the public transport class of medium volume passenger transport corridors is set as medium volume BRT. BRT system is made a priority choice for the system. As far as transport capacity is concerned, the system has room for further expansion. It can also extend downwards. Based on the status of urban society, economy and transport, it can be flexibly adjusted to offer operational flexibility. Because BRT’s suitable transport capacity is in the range of 80,000–300,000 person-times/day it has already reached the lower limit for large transport volume systems.

In the future, high standard BRT in the strict sense can only account for some of the passenger corridors and public transport lines in Chengdu. It is not possible for most ordinary passenger transport corridors or public transport lines to adopt high standard BRT system. Taking into account the grand public transport system’s comprehensiveness, openness, convenience and economy, the future BRT system in Chengdu should be one with both standard lines as ordinary lines, with closed lanes as well as special lanes, priority lanes and even mixed lanes, and with both multiple vehicle groups and individual vehicles running together and one that mainly runs on fast public transport corridors but may also travel on ordinary lines. But the vehicle, platform, ticket office, signal and maintenance aspects must be unified to form a complete system. We propose that high standard BRT should be in principle set upon medium volume passenger transport corridors adopting special lanes or closed lances, closed platform and ticketing systems ad independent signal control system. Ordinary BRT and special lanes or priority lanes and closed platform and ticketing systems may be adopted on some medium volume passenger transport corridors and the high-end part of ordinary passenger transport corridors which do not have the conditions for setting up high standard BRT. BRT services may even be extended to ordinary public transport lines. These lines may be used to improve BRT, open liaison lines, supplementary lines and extension lines and better organize passenger sources for the BRT system. BRT on these lines may be simpler and no longer require special lanes or priority lanes, but the ticketing system must be unified. There is a need to adopt various ways at various levels to gradually promote BRT the leading form of public transport on the ground and make the system bigger and stronger so as to bring into play its advantages of scale, convenience and economy. Thirdly, it is its good business prospects. Thanks to its good business prospects and the fact its BRT belongs to a public service sector, it will not become a financial burden for the government as long as good project planning is made and sound market operations are
performed. On the contrary, it may bring returns to the government. For demonstrative or new BRT projects, the government may implement them along with special lanes, platforms and lines and then transfer out the right to operate and let operators to take charge of implementing vehicle, ticketing, signal and maintenance systems. In the promotional stage, various means may be adopted, such as transferring the operation right and letting operators to take responsibility for implementing the whole project.

II. Chengdu’s BRT development strategy and near-term construction plan

Based on research, we have put forward a direction for public transport development in Chengdu, which is to build an advanced and rational public transport system with track transport and BRT as the backbone and ordinary ground public transport as the basis. In other words, build track and BRT systems on main passenger transport corridors and an ordinary public transport system that connects with the track and BRT systems and covers the whole urban area.

It has been more than one year since Chengdu started BRT research work in July 2003. Under the unified leadership of the city government and in accordance with the requirements of Smooth Transport Project and the urban transport development needs, all functional departments of the whole city, relevant planning, design units and universities have carried out a series of BRT research and practice work and successively completed Research on Chengdu’s BRT Strategy, Research on Chengdu’s BRT System and Research on Second Ring Road Reconstruction Planning in Chengdu. With this, the city has basically completed the early preparatory work for building BRT in Chengdu.

Our investigation and analysis show that passenger transport corridors in Chengdu are currently mainly concentrated in Second Ring Road and the urban area inside it. Therefore, BRT construction in the near term should be mainly set up in these roads with a big public transport flow to solve the public transport problem in the major passenger transport corridors in the city. This will enable BRT construction to play its due role as quickly as possible. In the near term, 5 BRT corridors are planned to form a preliminary BRT network featuring “Cross Axes + Ring + Two Sections”. Reconstruction of Shudu Avenue and People South Road, which form the central axes of the cross, were all already completed in October this year. They now have the basic conditions for deploying BRT. In relation to the BRT research results, we will initiate BRT system building as soon as possible. Reconstruction of Second Ring Road (with a total length of 28Km) will start at the end of the year. Upon completion, it will form Chengdu’s first ring-shaped BRT passage. Based on full research, we have put forward the preliminary control requirements for BRT in Chengdu: BRT will mainly follow plane layout and enjoys the right to exclusive use to road and other vehicles are prohibited to use special BRT roads. One-way transport capacity should reach 6,000 persons/hour and minimum one-way vehicle dispatch interval should be 45 seconds/shift. The whole line will take some 45 minutes and average operating speed will be 25-30 Km. One-way transport capacity should reach Given its large volume, medium distance and fast transport features, average BRT station interval is set as sound 1.0Km, with a total of 30 stations to be established along the whole line. Changeover between all kinds of public transport tools and BRT will be rationally arranged. 4 main transit hubs will be built along the line. Consideration needs to be made to connect BRT stations with ordinary public
transport operating on supplementary lanes and people flows in transit can be connected through pedestrian bridges or ground passages. Walking distance between BRT stations and ordinary public transport stations and underground stations should be controlled to be within 200m. Automatic ticket check systems will be set up on platforms. BRT support systems such as system scheduling center, parking lot and maintenance yards will be gradually improved.

On this basis, we will continue to deepen and improve the planning of public transport systems in Chengdu and fully integrate and give rational work tasks to all kinds of public transport resources. We will specify the positioning and functions of track, BRT and ordinary public transport in the city, strengthen the connection and switchover between the various systems, improve overall public transport efficiency and truly meet residents’ growing travel needs.

Ladies and gentlemen: From the early BRT research to the research on Second Ring Road planning and to the forthcoming constriction of Chengdu’s first BRT passage, we have continuously deepened our understanding of BRT. As work deepens, we will continue to pay attention to and research on such in-depth work as establishment of modern BRT enterprises, hub layout and earn-term line constriction, ticket system reform and application of intelligent transport in BRT. We think that as BRT has just emerged, changes to the traditional ground public transport system have also just begun. There may be more pains of reform to the traditional public transport system. But waiting for BRT will be hardships of opening a new system. We believe that the more profound impact will on the reform of the existing public transport system. In a certain sense, it may be even more critical.

We look forward to an early operation and fast development of BRT in Chengdu.

Thank you!
Zürich’s Regional Public Transport System

Dr. Elmar Ledergerber
Mayor of Zürich

Zürich is the largest city in Switzerland. It serves as a work and service centre for a larger region (approx. 1.25 million inhabitants) and partly for the whole country. Before 1990 the city of Zürich and especially the region had a large number of different transport operators (municipalities, cantonal, regional and national operators). A common transport strategy for the region was lacking. There was also no strategic marketing, no common tariff policy and no effective coordination. At the same time, it experienced a rapid increase in its private vehicle population leading to traffic congestion, delays, pollution, and noise and deteriorating service in the public transport system.

This situation is the reason the Zürich Regional Transport Association was established in 1991 with the objective of improving public transport in the city and region of Zürich. Forty-one different public transport operators in the region were brought together under one organisation and a new legal basis for public transport was created. A regional transport authority was created with the responsibility on transport policy, transport strategies, finance, and general services. Under this authority eight different companies with market responsibilities are active in the operation of the transportation system. They also employ subcontractors on certain routes.

The following are achievements of this integrated transport system:
- An efficient coordination of transportation services throughout the city and the region of Zürich
- An optimized travel chain for the customers
- A zone based fare system
- One ticket system for bus, tram, train, and boats.

Results are today visible: there are 80 percent more passengers on commuter trains in 12 years. This means that the public transport system is attractive to the customer.

Ticket sales and the revenue from other services cover nearly 60 percent of the cost of this regional transport network. Approximately 20 percent comes from the canton of Zürich (provincial level) and 20 percent from the municipalities served by the system (approx. 170 communities).

There are a number of lessons that can be drawn from the experience in the last 14 years:
- A coordinated and user-friendly transit system increases the number of passengers
- Travel has to be made easy and simple for the passengers (one ticket, time-table links, and connections, etc.)
- Clear rules for financing and clear responsibilities for the different stakeholders are critical
- A regional transportation system needs centralisation of some strategic functions (policy, strategy, pricing, coordination etc.), but can very well function on the services of decentralised and autonomous transit operators
- The interests of the region and of the regional network can create tension with local interests; mechanisms to solve such issues have to be created
- Long-term political support is a precondition for success
Of significance, the creation of a regional public transportation system is not only a technical matter, but also an organisational, legal, financial, administrative, ecological, social and political matter and has to be seen in such a broad way.

Within the city of Zürich there is one main transportation operator (not including the railway system). The principles for the construction of the public transportation network are a walking distance of maximum of 300 metres to the next stop within the city boundaries and a frequency of 7.6 minutes for buses/trams during daytime. It operates from 5 a.m. to 1 a.m (20 hours per day) with special night bus services on weekends. The travelling time between any two stops within the city boundaries is one hour at the maximum.

The cooperation between Zürich and Kunming in the transportation sector has benefited from these experiences. But it is also clear that a transformation process was and is necessary. Solutions have to be adapted to the local situation and not everything is transferable.

The cooperation in the transport sector started in 1993 with the establishment of a Master Plan for Public Transport in Kunming. Main features of this plan are:
- The establishment of separate bus lines and of bike – paths
- Safe pedestrian crossings
- Traffic management at main crossings
- Regional transport planning and linking it up with the city transport plan
- Planning a high capacity short-range railway system.

This partnership program has certainly been an advantage for both cities and has created not only technical and professional relationships, but also important personal friendships.

Let me conclude on some basic ideas behind the promotion of public transport in Zürich as well as in other European cities:

- Public Transportation enhances road capacity: the fundamental role of a transportation system is to move people and goods, not vehicles. If space for traffic is limited (and this is always the case in urban areas) you have to search for solutions that allow the transport a higher number of people on less space
- Public Transportation saves road space: public transport demands less infrastructure as it operates with much less roads space
- Public Transportation is less harmful to the environment than private cars
- Public Transportation saves energy and permits the transport a high number of people at a lower price
- Public Transportation is cost efficient and time saving
- Public transportation creates cities that are attractive for living, working, recreation, and entertainment.

Only public transportation systems are able to transport large number of people in urban areas in an efficient way, at low cost and low pollution and at the same time develop these cities into lively centres of business activities, services, providing good living standards, government services as well as recreation and entertainment.
Sustainable Urban Mobility – The Berlin Strategy

Ms Maria Krautzberger
State Secretary of Transportation and Environment, Berlin

With 3.4 million inhabitants Berlin is Germany’s largest city as well as its capital. Striving for sustainable urban development has always been a high priority on Berlin’s political agenda. And the results are remarkable. To name just a few: 15% reduction of CO₂ emissions since 1990, the eco efficient refurbishment of 600,000 flats (= 750,000 t CO₂ reduction), a reduction of more than 80% of sulphurdioxide and NOx since 1987.

However, the reduction of hazardous substances caused by motorized traffic in general has not been as significant. CO₂ emissions are even increasing. New strategies are required in order to reduce noise and air pollution due to traffic, if Berlin is to meet the new threshold values of the respective EU regulations by 2005. The preconditions are not bad: Berlin has a polycentric structure with short distances between living, learning, shopping, etc. areas. The sub-urbanisation process is rather insignificant. Berlin is located in one of Germany’s lowest density areas with comparatively few commuters. This somewhat limits private car traffic, but we still face a slow but steady increase. In the inner city we have a modal split of 33% to 67%, striving for a split of 20% to 80% (percentage of private motorized traffic to traffic on foot/by bike/by public transport).

In order to cut emissions and to ensure a high quality of life Berlin decided to set up a new "Urban Mobility Concept" (STEP Mobility). It comprises of goals, strategies and concrete measures to reduce the traffic volume and improve the environmental situation.

The Urban Mobility Concept is comprised of 60 measures and policies which are to be implemented at the latest by 2015. Key elements of our concept are the promotion of bicycle traffic, reducing the impacts of road transport, sustainable investment strategies and transport innovations improving the existing infrastructure. Concerning the demand for public transport, we are focusing on a combination of legislative action, soft policies and a client-orientated improvement of the quality of public transport services.

- Following a decade of reconstruction and growth after the fall of the wall, the Berlin public transport network is rather complete – as far as the mere infrastructure is concerned. The focus is now on quality: in order to meet the time-advantage of cars, Berlin will implement a multitude of rather small but, nevertheless, efficent measures (e.g. improving intra- and inter-modal connections, automatic priority at traffic lights for busses and trams, more safety and comfort at stations etc.).

Furthermore Berlin will carefully extend the areas of public management of parking space in the inner city. While residents are exempt, the parking fees will convince commuters to choose public transport. Research shows that this can lead up to a 9% increase in the use of public transport.

- The most controversial aspects of the concept are measures concerning the road network and private car use. The road network in Berlin is sufficient – with a few exceptions. Berlin needs intelligent ways to make better and more efficient use of the existing infrastructure. At the same time, these measures have to contribute to the reduction of car emissions. In the inner city, motorized traffic should be limited to commercial traffic as
well as originating and terminating traffic. This might even imply a shrinking of oversized inner city streets of eight or more lanes which are nowadays attracting excessive through traffic, and severely lowering the quality of urban living for residents as well as for neighbouring shop-keepers.

- Promotion of the number one "Zero Emission Vehicle," the bicycle, by creating an even denser network of bicycle paths, safe parking and service facilities, better route information, and, first and foremost, a better interoperability with the public transport systems.

- In the future, our policies in the traffic research and development sector will offer traffic solutions of a higher efficiency and, at the same time, help reduce the waste of natural resources. Telematic traffic management - an integrated service encompassing public transport, road transport and private car use – is being implemented right now.
Congestion Pricing in the UK - Central London and Beyond

Dr. Rana Roy, FCLIT

The Central London congestion charging scheme, which commenced operation in February 2003, has been heralded across the world as a success story - and rightly so. It is however important to recognise that, although the scheme has been entirely successful when judged according to its own aims, it is strictly limited in its scale of operation and hence in its scope of ambition. Rather, its true significance can only be understood as part of the larger context and dynamic of pricing reform across the UK and indeed across the EU - and in the role that it has played in accelerating this larger process of reform.

Hitherto, and in line with the Mayor's original Transport Strategy, the London scheme has been limited to a charging zone bounded by the Inner Ring Road. It has deployed a relatively limited set of instruments: a £5 daily charge on cars, vans and lorries driven or parked within the charging zone between the hours of 07.00 and 18.30, supported by a strong enforcement regime, a range of complementary traffic management measures, and a much-improved service provision for buses. Importantly, if implicitly, the scheme is also underpinned by the extent and intensity of pre-existing on-street parking controls within the Inner Ring Road.

On each of the key indicators, the results to date have been positive. These include a reduction in congestion of around 30% - resulting from a 25% reduction in potentially-chargeable vehicle kilometres driven within the charging zone - and a reduction in CO2 emissions of around 20% - resulting from a 20% reduction in fuel consumed by road traffic within the charging zone. Annual gross and net economic benefits have been estimated at £165 million and £50 million, respectively. First year gross and net revenues came in at £165 million and £68 million, respectively, with net revenues estimated at £80-90 million from the second year onward. To date, however, the scale of operation of the London scheme has been very limited - the charge applies to only around 100,000 vehicles entering the charging zone each day. For comparison, let us note that more than 200,000 vehicles pay to enter Manhattan each day - even if they constitute only around 22% of the total. In a comprehensive study for the European Conference of Ministers of Transport, modelled results indicated that optimal pricing for both traffic and parking for all of Greater London would deliver welfare gains of around £2.8 billion per annum and revenue gains of around £2.6 billion per annum. Hence, of the gains available from transport pricing reform, London has yet to collect by far the greater part.

The true significance of the London scheme is that, by demonstrating that "pricing works", it has served as a trigger in accelerating the process of reform. The London administration is now preparing a limited extension of the current scheme - and the coming years are likely to witness a multiplicity of initiatives by London and by several other local authorities in extending congestion pricing to other areas of Greater London and to other cities across the UK. Nationally, the Government has committed itself to implementing a distance charge for lorries by 2007, with the aid of GPS technology, and to "leading the debate" on the benefits of introducing comprehensive road-user pricing for all vehicles by 2014, technology permitting.

London's initiative is a landmark in the progress toward comprehensive road-user pricing across the UK - estimated by Government to deliver welfare gains of £10-12 billion per annum, very much in line with the ECMT estimate of £11 billion per annum. It is also, along...
with parallel initiatives by Rome, Stockholm and others, a landmark in the progress toward comprehensive transport pricing reform across the EU - as proposed by the European Commission in 1998 and endorsed by all the ECMT Ministers in 2003. And it is part of a still larger programme of pricing and tax reform: namely, the full taxation of externalities and economic rents across the several key sectors in which these arise - transport, energy and land use.
Saving Energy, Money, and Pollution with Building Standards in California

Arthur Rosenfeld
California Energy Commissioner

The US has energy efficiency standards for cars, appliances, and new buildings. Most of the appliance standards are federal and they “preempt” the individual states, but California adopts a number of standards where the Congress has not yet acted (an interesting one is that thermostats must have clocks and be programmable to save heat on winter nights and save air conditioning on the very hottest summer afternoons).

New “model” building standards are recommended by national bodies (International Energy Conservation Code – IEEC – www.EnergyCodes.gov, and ASHRAE – www.ASHRAE.org), but adoption and enforcement is left to the 50 states or cities, which I think is similar to your division of responsibilities in China.

Appliance and building standards are calculated so as to be cost-effective to the consumer over the life of the appliance or building, and typically have a “Simple Payback Time” (SPT) of ~ 5 years or < half the service life of the appliance or building.

Why speakers from California and Seattle? Among the 50 states, California takes efficiency very seriously and is nearly the most energy efficient. We update our standards every three years and enforce them strictly. Hence your Forum organizers decided to invite a California Energy Commissioner to urge you to follow our example and our successes.

Other places dedicated to energy efficiency are the Pacific Northwest and New York. In particular the city of Seattle, WA, has an excellent record, and so your forum sponsors also invited John Hogan of Seattle to give you details on how many code officials, plan checkers, building inspectors you will need to train and employ in each major city or jurisdiction. This will include training in the use of several computer tools.

Emphasis on Electricity. In California the largest energy bill is for transportation, but buildings use 2/3 of all electricity. Our total annual electric bill is ~$1000/capita, and about ⅓ of that goes to pay for retail electricity used in buildings. By contrast, natural gas costs much less; annually about $300/capita. Hence most of my slides and commentary will focus on electricity.

Successes of California Energy Efficiency Standards and Programs.

First to give you the “bottom line” I’ll show you a figure of annual kilowatt hours/capita (kWh/person) for all electric use in California. Starting in 1975, as we recovered from the OPEC oil embargo and from higher oil prices, and as we started our Efficiency programs, we have stayed constant at 7000 kWh/person, while the US as a whole (including California) has grown 2%/year and now at 12,000 kWh/capita. (If one removes the efficient states of CA and NY, the rest of the US is up 70%), so, while capturing the benefits of 5-year payback time, we have avoided adding ~50% to our electric supply system and to our electricity bills. (Below I’ll explain why only 50% and not 70%).
Because building standards always incorporate the latest appliance and equipment standards it is difficult to disentangle the successes of buildings standards alone, so I’ll show time series of appliance standards alone, and then of combined building/appliance standards.

Thus, since 1972, air conditioner (a-c) efficiency has doubled, but for a new single-family home, the floor area has also doubled (from about 100 m² to 200 m²); yet, because of improvements in the building shell and contents the a-c use for a new (larger) home has dropped to 1/3, meaning that the kWh intensity per m² has dropped to 1/6!

It is interesting to compare this gain in new home a-c use with all nuclear power generated in the US on a hot afternoon, which is about 100 GW. Even without taking into account the effect of the California building standards (because the whole US has not followed them) just the better appliance standards have avoided a coincident US demand of about 130 GW, or more than the capacity of our nuclear investment. My conclusion is that although all countries need some more generating plants to power our growing economies, we probably need less new power than we thought after we factor in the potential for end use efficiency.

**California Programs and Policies.** Above I said that California has avoided to 50%-70% increase in electric use compared to the US, or to the US with CA and NY removed. Here I must qualify this claim by noting that about half of this difference is structural (we don’t make aluminum) or climatic (ours is mainly mild), but at least half can be attributed to state programs and to standards. To accomplish this we have been paying a fee of close to 2% on our electric bills (called the Public Goods Charge – PGC). These PGC dollars are administered by the electric and gas utilities to improve efficiency, through buildings design assistance, rebates on appliances and buildings which beat the standards, training of contractors, plan checkers, and code officials, and for public information.

My guess is that China should adopt a Public Goods Charge, at the few percent level, first to offer rewards for new buildings which comply with your new standards, later to reward buildings which beat the standards in ways I’ll describe in my talk. Chinese PGC funds could cover all the training I mentioned above, and generally help implement your new standards.

**Beyond Your Present Standards.** I will discuss and recommend two additions:

**Cool (white or colored) Roofs** to reduce urban heat islands, reduce a-c loads, and reduce “smog” (ozone). I invite you to send Chinese researchers to visit the Heat Islands Group at Lawrence Berkeley Lab. <EETD.LBL.gov/HeatIsland>

**Demand-responsive tariffs, interval meters, and smart thermostats to avoid demand spikes from a-c.**

See Borenstein, Jaske, and Rosenfeld http://www.ef.org/energyseries_dynamic.cfm
See CEC Workshop of 30 Sept.04 http://www.energy.ca.gov/demandresponse/documents
Implementation of Energy Codes and Standards:  
- Training, Plan Review, and Inspection

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INTRODUCTION

The City of Seattle has been recognized for its leadership in the adoption and enforcement of Energy Codes for building construction. While the first comprehensive Seattle Energy Code for all buildings took effect in February 1980 (Seattle 1980), Seattle has had residential insulation requirements since 1974 (Seattle 1974) and the first furnace sizing and duct insulation requirements took effect in 1927 (Seattle 1927).

The 1980 Seattle Energy Code contained building envelope requirements, mechanical system criteria, and lighting power allowances and control requirements that achieved significant energy savings to relative to ASHRAE Standard 90-75 (ASHRAE 1975), and included requirements for alterations to existing buildings.

During the process of making subsequent updates to the Seattle Energy Code in 1984, 1986, 1991, 1994, 1997, 2001, and 2003 (Seattle 2003), Seattle reviewed the latest versions of ASHRAE Standard 90 and consistently found opportunities to achieve greater energy savings. As a result, in 2001, the City adopted a policy (Seattle 2001) that directed the Seattle Department of Planning and Development (DPD) to bring forward options every three years to achieve up to 20% enhanced energy efficiency beyond the current version of ASHRAE Standard 90, the national energy standard in the United States.

However, to achieve the energy savings, good intentions alone are not enough. It is necessary to have a comprehensive program for implementation. The three important components are: (1) training for both staff and public; (2) plan review prior to issue of a building permit; and (3) on-site inspection prior to issue of a certificate of occupancy.

Implementation for a Seattle Energy Code update are described below.

IMPLEMENTATION COMPONENT #1: TRAINING

Soon after adoption, DPD used its newsletter, mailings, and e-mailings to announce the revisions to the Seattle Energy Code. Publications and compliance forms were revised. Prior to the effective date, the Seattle Energy Code website was updated to reflect the new code language.

Internal staff training is done early on so that staff can be prepared to answer questions from designers. Separate training sessions are held for plan reviewers and inspectors, and for the separate specialties of building envelope, mechanical, and lighting. The training is tailored to each particular work group.

While representatives of many organizations may have been involved in the code development process, it is essential that training be done to reach the broadest audience. The
goal of this training is to achieve the desired energy savings while minimizing the impact on designers and contractors as well as City building department staff. Training design professionals should result in modifications of standard specifications so that the initial applications that the designers submit will more closely correspond with the code requirements and require fewer revisions prior to building permit issuance. This will save time for both designers and City building department plan review staff as correction lists should be shorter.

Training manufacturers representatives and contractors should result in the initial construction being more code-compliant and require fewer revisions prior to certificate of occupancy issuance. This will save time for both designers and City building department inspection staff as correction lists should be shorter and extra inspections minimized.

DPD arranged and conducted initial public training for the Seattle Chapter of AIA (architects), the Puget Sound Chapter of ASHRAE (mechanical engineers), and Puget Sound IESNA (lighting designers) within a month of adoption. Training for each group was tailored to their areas of responsibility. For example, the training for architects focused primarily on the building envelope requirements, with an overview of the mechanical and lighting requirements. As revisions to fenestration criteria were an important feature of this update, the architect training included a detailed review of the National Fenestration Rating Council (NFRC) rating and certification procedures. The NFRC Label Certificate procedure for curtainwalls was discussed, with references made to the NFRC website at http://www.nfrc.org/ for more information.

The training for mechanical engineers focused on the mechanical requirements, but also included a review of the calculation procedures for building envelope tradeoffs as the mechanical engineer often performs these calculations for the designer if the prescriptive compliance option is not used. Seattle developed a variation of the ASHRAE EnvStd software that reflected the prescriptive building envelope requirements in the Seattle Energy Code. An overview of the Seattle EnvStd software was given in the general training. In addition, a separate training session was given solely on Seattle EnvStd software and references made to the Seattle Energy Code homepage at http://www.seattle.gov/dpd/energy where this software could be downloaded for free. In addition, DPD updated the Director’s Rule containing the computer modeling requirements for those wishing to use the annual energy analysis option for code compliance. The training for mechanical engineers baseline included a review of key assumptions in the modeling and reference was made to the Seattle DPD webpage where publications and forms could be downloaded for free (http://www.seattle.gov/dpd/codes/dr/dr2002-11.pdf).

The training for lighting and electrical designers and contractors focused on the requirements for lighting and transformers. The training included important feature, such as requirements for more efficient lamps and ballasts and for occupancy sensors and automatic control of lighting in the daylight zone. When lighting designers and contractors requested more detailed guidance on the requirements for automatic control of lighting in the daylight zone, DPD developed and published a Director’s Rule and provided training with references made to the Seattle DPD webpage where the publication could be downloaded for free (http://www.seattle.gov/dpd/codes/dr/dr2003-2.pdf).

IMPLEMENTATION COMPONENT #2: PLAN REVIEW
Though training is very important, it is not wise to rely on training alone to achieve Energy Code compliance. Another key component of successful implementation is plan review prior to permit issuance.

Seattle’s experience with the first comprehensive Energy Code in 1980 left a strong impression. For the first six months, while Energy Code staff were being hired, the City of Seattle accepted architects’ and engineers’ stamps in lieu of doing plan review. After Energy Code staff were hired, inevitably some plans that had previously been approved for permit were returned for revisions. When Energy Code staff reviewed those plans, they found many instances of noncompliance.

This is not to say that the designers were consciously cheating. Most likely there was a lack of knowledge and designers simply followed the same techniques that they had used in previous projects. There will always be a large segment of the design community that does not attend the training. For example, while 50 members of the Seattle Chapter of the AIA (architects) attended training sessions on the Seattle Energy Code revisions, the Seattle Chapter has over 1,000 members. Consequently, only 5% of the local AIA members attended one of the training sessions. In addition, designers have many codes that they must keep up with, from Land Use and Zoning through to Building, Mechanical, Boiler, Plumbing, Electrical, Elevator.

Consequently, the City of Seattle specifically reviews plans before issuing construction permits. Four staff solely perform review of the Energy Code and Mechanical Code for nonresidential buildings and for multifamily residential buildings. (Energy Code review for single-family projects is handled by the Building Code plan reviewers.) Given the widespread use of electronic documents, it is especially important to perform detailed plan review during the first six months to one year of a new or revised Energy Code. Plan reviewers must conscientiously send out correction lists to make sure that the architects’ and engineers’ standard notes get updated. This includes everything from maximum window U-factors (K-factors) and solar heat gain coefficient to minimum insulation R-values, from minimum mechanical equipment efficiencies to economizers on small units and electronically-commutated motors in fan terminal units, and from maximum installed lighting wattages to occupancy sensors and automatic controls for dimming of electric lights in daylighting zones.

There are several benefits from this thoroughness. First of all, it should make the plan reviewers work easier in the future – once a designer has updated their standard notes, this issue should not come up again until the next code cycle. Secondly, if the correct information is on the permit drawings, then those bidding on the project will have a contractual as well as a legal responsibility to comply with the code. The architect and engineer thus also assumes more of a role for enforcing the code requirements as they are now in the bid package. Thirdly, the designers are more likely to make a good faith effort to comply with the Energy Code as they see that everyone is being checked. Now, the designer has a clear incentive to comply with the Energy Code, knowing that if they don’t they will receive a correction list and it will take longer for the permit to be issued for their project. Finally, by getting things right on the drawings, the plan reviewers will make life a lot easier for the inspectors who come later. It is much easier to change a note on a drawing with a window U-factor or equipment efficiency than it is to take out a piece of equipment once it has been installed.
IMPLEMENTATION COMPONENT #3: INSPECTION

While training and plan review guide the project in the right direction, they clearly do not eliminate the need for field inspection. Similar to the designers before them, the contractors may simply wish to construct a new project the same way as they did the last project. In addition, anyone familiar with the construction process knows that the project continues to evolve until it is completed. While all the earlier efforts should limit problems coming up in the field, there will always been multiple requests for change orders. Sometimes these change orders are due to issues that were not addressed in the design. However, the contractor also has an incentive here to find a lower cost means of completing the project. Not all of the field alternates will have equivalent energy efficiency.

Consequently, the City of Seattle performs field inspections for Energy Code compliance prior to issuing certificates of occupancy. There are nine building inspection districts where staff inspect for compliance with the Energy Code building envelope requirements as well as other Building Code requirements. There are four mechanical inspectors who inspect for compliance with the Energy Code building envelope requirements as well as other Mechanical Code requirements. There are nine electrical inspection districts where staff inspect for compliance with the Energy Code lighting requirements as well as other Electrical Code requirements. In addition, boiler inspectors check boiler efficiencies, plumbing inspectors check water heater efficiencies and pipe insulation, and elevator inspectors check motor efficiencies. On the inspection side, the challenges are greater when some installed feature does not comply with the code. In some cases, the contractor may be able to make an improvement somewhere else to compensate. However, Seattle has required that contractors remove single-glazed windows in retail storefronts and remove non-complying mechanical equipment.

Here again, there are benefits to this thoroughness. First of all, it should make the inspector’s work easier in the future – once a contractor has had to make a change, this issue should not come up again until the next code cycle. Secondly, the contractors are more likely to make a good faith effort to comply with the Energy Code as they see that everyone is being checked. Now, the designer has a clear incentive to comply with the Energy Code, knowing that if they don’t they may be required to remove some component that they have already installed.

CONCLUSIONS

Advanced Energy Code development and implementation is most successful when there is clear policy direction from the Mayor and City Council and when there is participation by designers, engineers, contractors, labor, and public interest representatives.

It is important that training for both City staff and building permit applicants occur both prior to initial implementation and within six months of the effective date (when more designers and contractors are aware that there has been a code change).

Plan review prior to building permit issuance and on-site inspection prior to certificate of occupancy issuance are essential to create a level playing field and to achieve the desired energy savings.
REFERENCES


Seattle. 1927. Ordinance 52113, regulating the construction, installation, and maintenance of warm air heating furnaces.


Pursuing a Sustainable and “Scientific Approach” to Development and Enhancing Building Energy Efficiency

Speech by Xu Ruisheng, Vice Major of Guangzhou

Guangzhou, a key city in southern China, has experienced fast-paced economic development in recent years and, consequently, is facing an energy shortage that has become a bottleneck for maintaining growth. Guangzhou is hot in the summer and warm in the winter, with high temperatures lasting much of the year. For about six months per year, air conditioning is needed to reduce heat. Since most of the urban buildings do not have good thermal engineering, air conditioners continue to consume a lot of energy. Statistics show that energy consumption in buildings accounts for 30% of the city’s total energy consumption. In the summer (from June to September), air conditioning for buildings consumes 40% of city's total electricity. Therefore, we should consider the geographic features of Guangzhou and learn from the Lingnan style architecture, which take into account local climate features. We need to adopt adequate building energy efficiency measures to reduce energy consumption in buildings (particularly for air conditioning). It is important to alleviate the electricity shortage, reduce energy consumption, and ensure sustainable economic development for the city.

Now I will talk briefly on the current situation and our future plans regarding building energy efficiency in Guangzhou.

I. The current situation of building energy efficiency in Guangzhou

We are quite new to building energy efficiency work and lack experience in this field. In recent years, the municipal government has made the following efforts to enhance building energy efficiency.

1. The government has attached great importance to building energy efficiency

Energy conservation is a fundamental national policy of China. It has been proven that we cannot do this work well by sole reliance on the market. The government has to play a leading role. In recent years, the Guangzhou municipal government has attached great importance to energy conservation. In May 2001, a special agency was set up to research, promote and oversee building energy efficiency. In July 2003, a joint conference on wall material renovation and building energy efficiency was established. It was led by a Deputy Secretary-General of the Guangzhou Municipal Government and consisted of leading officials from respective government departments. The conference coordinated government organs for urban construction, planning, land use, industry, and commerce to tackle tough issues on building energy efficiency and boost building energy efficiency.
2. We have actively conducted publicity and training to raise the awareness of citizens on building energy efficiency.

In order for society to better understand and support building energy efficiency, and enhance their awareness of energy conservation, environmental protection, and participation, the municipal government has done a great deal in publicity and training. It has worked to popularize policies on building energy efficiency and advocate the importance and necessity of the work through mass media like newspapers, magazines, radio, television, and the Internet. We have taught people how to conserve energy during the annual "Science and Technology Week" and the "Energy Conservation Publicity Month." We have held several training sessions on "Building Energy Efficiency Standards," and we have incorporated building energy efficiency into continuing education programs for engineers. Through the above-mentioned efforts, citizens have a better understanding of building energy efficiency.

3. We have carried out joint research to address technology application problems on building energy efficiency

We have carried out many scientific research projects on building energy efficiency, such as the "Residential Buildings Energy Conservation Research in the Hot-Summer Warm-Winter Region", "Energy Conservation Parameters of Common Heat Insulation Products," and "Shading and Heat Insulation Technology for Energy Conservation in Guangzhou." We have also supported many research institutes and universities to establish testing systems and set up labs to conduct research and development of new technologies and materials, to facilitate building energy efficiency.

4. We have established some demonstration projects to boost application of building energy efficiency

In the past few years, we have established a number of building energy efficiency demonstration projects. For example, the first phase of the Guangzhou Huijing New City project was one of the "Demonstration Communities for New Wall Materials Application and Energy Conservation in Guangzhou." With a construction area of 160,000 square meters, the project used many new energy-conservation materials and technologies and was appointed by the Ministry of Construction as a "Certified 3A Demonstration Community." Moreover, key projects such as the Guangzhou Conference and Exhibition Center and the Guangzhou New Baiyun Airport have all used coated glass with thermal emittance and low-radiation LOW-E hollow glass screens. They are effective in reducing energy consumption. These projects have set good examples and played a positive role in promoting building energy efficiency.

II. Some thoughts on carrying out building energy efficiency initiative in the future

Based on years of research on building energy efficiency, we believe that building energy
efficiency work must be done from the beginning, and should be carried out in a multi-phased, region-by-region, and step-by-step manner. The Guangzhou municipal government will intensify its leadership and promotion in the following aspects:

1. Establish a building energy efficiency system with Guangzhou characteristics

The situation on energy conservation across the country is unbalanced. Each region has a different climate, lifestyle, and values. We should try to integrate building energy efficiency efforts with the municipal energy efficiency system. First, we should integrate the concept of energy conservation in urban development planning and construction, protect the urban environment, foster a favorable microenvironment, and reduce energy consumption by improving urban construction. Second, underground construction can be part of the energy conservation system, i.e., subways, underground transportation systems, underground commercial streets, and parking lots. Additionally, we should combine building energy efficiency with nurturing an urban environment with Lingnan characteristics. The special features of a city come from respecting the natural environment, adapting to local climate, and protecting the local culture and historical traditions. Many buildings in the 1960s and 1970s in Guangzhou have shown high respect for climate and were called "Lingnan Style Buildings." In future construction, we should advocate for more energy-efficient buildings of a subtropical and Lingnan style that suit Guangzhou's urban environment.

2. Establish a complete policy and regulatory system in building energy efficiency

Policies and regulations are fundamental to building energy efficiency. The municipal government will gradually establish a policy and regulatory system that includes three aspects: 1) Formulate and promulgate management regulations for building energy efficiency. We will promulgate regional regulations and relevant supplementary policies in line with local conditions through legislation of the local People's Congress or administrative ordinances based on existing policies and regulations at the national, provincial and municipal level. 2) Improve supervision and management on building energy efficiency. Based on the current management system, we will clarify responsibilities of relevant administrative offices, strengthen supervision and management, and carry it out as a systematic project. 3) Establish an incentive and restriction system. We will reward organizations and individuals that fully comply with building energy efficiency standards. We will study multi-stage electricity pricing, aiming to change the task of building energy efficiency from government-driven into self-driven.

3. Establish and improve a scientific and technological guarantee system for building energy efficiency

A complete scientific and technological guarantee system is an important aspect for building energy efficiency. We will work on three aspects: 1) Establish and improve supporting technical specifications for building energy efficiency standards. Based on
"Residential Building Energy Code for the Hot-Summer Warm-Winter Region” promulgated by the Ministry of Construction, we will formulate detailed local implementation rules and standard drawings, and establish energy efficiency measures for other buildings. 2) Improve technical skills in handling building energy efficiency projects, solve technical problems through research, testing and jointly tackling difficulties, and produce energy conservation products, technologies, and architectural structures suitable for Guangzhou. 3) Build a platform for scientific and technological research on building energy efficiency, give full play to the initiative of experts and technical personnel and provide an efficient communication platform to provide consultation to decision makers. 4) Speed up transformation of scientific and technological breakthroughs into urban planning, project designs, and actual construction.

4. Strengthen publicity and training on building energy efficiency

Publicity and training are important aspects in building energy efficiency. We will educate the public on the significance of building energy efficiency through television, newspapers, Internet, seminars, and exhibitions. We will advocate high-performance energy-efficient buildings, educating people on their economic and social benefits, raise public awareness, and meet their demands for better living conditions. Considering the technical nature of building energy efficiency, we will conduct specialized and intensive training to different stakeholders through training, lectures, seminars, to popularize technologies on building energy efficiency.

5. Guide and nurture an orderly market for building energy efficiency products

We will transform potential needs into real market demands through policy and effective market guidance. We will strengthen macro-control over the market, guide investment on technological research and production, optimize distribution of natural resources, and facilitate the healthy and orderly development of building energy efficiency related industry. These can be done by publicizing catalogues of recommended, restrictive, or phased-out technologies, products, and equipment, or by certifying energy-efficient materials and products.

6. Strengthen the role of the government in promoting building energy efficiency

The municipal government will further enhance its role in leading and promoting building energy efficiency. We will incorporate it into our target management plan and regard it as an important long-term task. We will give full play to initiatives of relevant government functionaries, especially those responsible for planning, design, construction, supervision, inspection, and approval. We will enhance supervision and control over building energy efficiency. In order to build Guangzhou into a pioneering model city of building energy efficiency in southern China, we will establish a system for designing and inspection for building energy efficiency and a system for supervision, inspection and approval, and recordkeeping as soon as possible. We are trying to fully implement the “Residential
Building Energy Code for the Hot-Summer Warm-Winter Region" in newly-built residential buildings. Responsible government departments will strengthen supervision and control to achieve this goal. Additionally, the municipal government will conduct research and establish a mandatory labeling system on the performance of energy-efficient buildings, and draw up a five-year implementation plan, to ensure the building energy efficiency initiative be carried out step by step. We hope that by carrying out the above-mentioned activities, we can promote building energy efficiency.

Building energy efficiency is a global trend. Stepping up efforts on building energy efficiency is instrumental to pursuing a sustainable and “scientific approach” to development and to fostering a harmonious relationship between man and nature. I believe that with the support of high-level leaders and relevant organizations, and through our persistent efforts and practice, Guangzhou will usher in a new phase of building energy efficiency.
Implementing “Scientific Development” and Advancing Building Energy Efficiency
-- A Report on Beijing’s Building Energy Efficiency Progress

by Zhang Xingyue
Beijing Construction Commission

1. Building Energy Efficiency Work in Beijing

(1) Implementation of the 50 percent Energy Efficiency Standard for Residential Buildings
Since 1991, Beijing has been implementing mandatory energy-saving design standards on new housing. Residential buildings that have not been designed according to the energy-efficiency standards are not allowed to start construction. By the end of 2003, a total of 120 million square meters of energy-efficient residential buildings have been built – more than half of the existing residential area, of which 60 million square meters of residence have met the energy-efficiency design standard, which requires a 50 percent reduction in energy use. Energy-efficient buildings have brought about substantial social benefits. This standard alone can save 660,000 tons of coal in heating annually. And it has drastically reduced dust, carbon dioxide, sulfur dioxide, and nitrogen oxide emissions. The average room temperature in an energy-efficient residence during the winter has been raised to over 18 degrees Centigrade.

(2) Taking the Lead in Issuing and Implementing the 65 percent Energy Efficiency Standard for Residential Buildings.
In June 2004, Beijing issued an energy efficiency building standard requiring a 65 percent reduction in energy use for residential buildings. Starting on October 1, construction work plans that have not met the new specifications will not be approved. The reason that Beijing took the lead in implementing this standard is that although Beijing has implemented the 50 percent energy efficiency design standard, it still lags behind advanced international levels. The difference is not in material, equipment, or construction techniques, but in the design standard. Beijing is going to hold the 2008 Olympic Games and must meet international standards in building function, environmental quality, and management level. On the basis of its technological and financial conditions, Beijing should strengthen its building energy efficiency standard. In recent years, the area of newly started and resumed construction in Beijing has stayed above 100 million square meters annually. With such large-scale construction, if weaker energy efficiency standards continued to be implemented, the result would be heavy energy consumption too difficult and costly to remedy in the future.

(3) Compile “Inspection and Acceptance Criteria for Insulation Projects in Energy Efficient Residential Buildings”

In order to raise the quality of construction and ensure compliance with the energy efficiency design, Beijing began to compile a local standard for the Inspection and Acceptance Criteria
for Insulation Projects in Energy Efficient Residential Buildings. It is also the first of its kind in China. The standard will list requirements for material quality, construction technology, quality inspection and management, supervision and inspection and acceptance involved in building energy efficiency and insulation projects. It calls for random onsite inspections to supplement project monitoring. Experts are now examining the standard and we expect to have it issued by the end of this year.

2. Main measures adopted by the government to promote building energy saving

(1) Issuance of regulations in accordance with the law
On August 14, 2001, Beijing issued the Beijing Building Energy Efficiency Regulations (Order No.80 of the municipal government), which sets provisions for: implementing the building energy efficiency design standard in new projects, banning the use and production of clay bricks, renovating existing buildings, reforming heating methods and heating pricing systems, popularizing advanced building energy efficiency technology, and penalties for violators. This is the first local government regulation on building energy efficiency in China.

According to Order No.80, the Beijing Construction Committee and Beijing Municipal Commission on Urban Planning issued the 65 percent energy-saving design standard and listed four groups of building materials that are banned or restricted. It lists 19 materials related to building energy efficiency, including clay bricks, solid and hollow steel casement windows, common aluminum alloy casement windows, common single-sheet and double-sheet exterior glass windows, clay perlite insulating bricks, magnesite compound wall boards, cement poly benzene boards, certain kinds of wall insulating slurry and foundry iron and steel radiators. These materials or products are banned or restricted in use in construction projects to ensure compliance with the building energy-saving design standard is guaranteed and construction quality is improved.

(2) Promoting technological progress, building a solid foundation
Beijing has encouraged and guided research and development of new materials, technologies, and systems. The government has supported over 103 projects, totaling 19.1 million RMB. Among these new materials were cast in situ exterior insulation system for high-rise residential buildings, insulation mould cast in situ bearing wall system, insulation bearing ornamental block, baseboard radiator, localization of heat-conducting index monitor and assembling concrete examination instrument. Many of them filled scientific and technological gaps in Beijing.

After achieving preliminary R&D results, we began to organize pilot projects with buildings in residential areas. The pilot projects consisted of: (1) the concrete bearing block structure system in the nine story Qingta residential building, (2) exterior wall insulation and low-temperature floor radiation heating in Beiluyuan residential area, (3) terrestrial heating in Hongfuyuan residential area, (4) rational utilization of heat and water source heat pump, (5)
heating supply homeostasis in the Jingtai residential area, and (6) a comprehensive pilot of various technologies for low energy-consumption and high comfort living in the Fengshang Apartment Complex. The experience and lessons learned from these pilots have provided the technical basis for compiling design regulations for building energy saving, standard diagram books, and construction regulations.

(3) Improving departmental coordination and advancing in a comprehensive and systematic way.
The Beijing Construction Committee has been selected by the Beijing municipal government as the leading unit in working on building energy saving and is responsible for the citywide building energy-saving work on legal construction, development planning, policy investigation and research, and publicity. It is also responsible for organizing scientific research and pilot projects, popularizing new materials, technologies, techniques, and systems. The Committee also supervises and approves the implementation of the energy-saving design for construction projects. The Beijing Municipal Commission of Development and Reform is responsible for evaluating proposed projects. The Beijing Municipal Commission of Urban Planning is responsible for checking on building energy saving during the examination and organization of construction design plans. The Beijing Municipal Administration Commission together with other relevant departments is responsible for citywide reform of heating systems. The various departments carry out work according to their own respective responsibilities and in close cooperation to move work forward.

(4) Intensifying publicity work and creating a progressive environment
For years, Beijing has used various means—government edicts, conferences, exhibitions, periodicals, and public education campaigns—to foster a favorable environment for building energy efficiency. Many construction companies have realized that the implementation of the building energy efficiency standard is not only their legal responsibility, but also an indicator of the quality and construction level of their buildings and can improve their reputation and profits. Some real estate developers have voluntarily adopted many advanced technologies and built residences whose standards are even higher than the existing standards. They are both highly comfortable to live in and highly energy-efficient. They have become known nationwide as energy-saving and environmentally-friendly model residential areas and stand out in Beijing’s commercial housing market. The popularization of building energy efficiency concept has increased public attention to work on building energy efficiency, enabling work on building energy saving to develop faster. In recent years, some delegates to the People’s Congress have begun to submit resolutions for speeding up the work on building energy efficiency. When purchasing houses, people have begun to pay attention to the energy efficiency level of the doors and windows, insulation, and heating.

3. Next Steps
(1) Speed up energy efficiency standards for public buildings
After the Ministry of Construction issues the energy efficiency standard, we will immediately organize the compilation of detailed implementation rules for Beijing and issue them.
(2) **Accelerating energy efficiency renovation work on existing buildings**  
We will focus on surveying energy consumption in buildings, search for fundraising methods and construction management methods for the renovation of existing buildings, organize pilot projects, and gradually extend implementation work.

(3) **Accelerating the reform of heating meterage system**  
Beijing is working hard to issue the reform policy to substitute open subsidies for hidden subsidies as soon as possible. In the meantime, we will speed up the pace on the heat metering pilot and will impose compulsory implementation once conditions are suitable.
Leveraging the Role of the Government to Promote
Building Energy Efficiency Technologies:
An Overview of the Energy Efficiency Technical Mission
of the Tianjin Municipal Construction Commission

Yan Dingzhong, Vice Director & Chief Engineer
Tianjin Municipal Construction Commission

Leaders and Experts,

I would like to extend my sincere thanks to the organizing committee for giving me the opportunity to discuss energy efficiency technologies with you.

Tianjin, situated in the east of the North China Plain, is a major sea gate in northern China. With an annual average temperature of 11.1-12.5°C, Tianjin enjoys a continental monsoon climate. Its coldest period covers three months, from December to February with a monthly average temperature of below 0°C. As a cold region, Tianjin has a heating period of 119 days in winter and consumes 25 kilograms of coal equivalent per square meter for winter heat.

With a population of 10.11 million permanent urban residents, Tianjin boasts a total residential building area of 230 million square meters, with an average per capita of 23 square meters. With a centralized residential heating area of 74 million square meters, the urban centralized heating coverage is 77%. The buildings and heating consumes quite a lot of energy.

Because of this, the Tianjin Municipal Government has been promoting energy efficiency technologies. Over the past decade, due to support from the Ministry of Construction and the Building Energy Efficiency Center, significant progress has been achieved in building and heating energy efficiency in Tianjin.

I. Leveraging the pivotal role of government, and actively promoting building energy efficiency technologies

1. Three technical development phases of building energy efficiency in Tianjin
Phase I: 1993-1997. We formulated the first Tianjin building energy code (for heating residential buildings), which emphasized energy-efficient building design projects, promoted energy-efficient building materials, and adopted all necessary measures.

Phase II: 1998-2003. We formulated the second phase Tianjin building energy code, which required an energy savings of 50% from building energy efficiency technologies in addition to qualitative measures.

Phase III: 2004. This phase summed up experiences, accelerated promotion work, and formulated the third phase energy efficiency code, “Tianjin Residential Building Energy
Code (65% Energy Savings)”. According to the code, the residential building heat consumption target should be below 14.4w/m² in the future. The specific indices for each envelope structure are as follows:

Table 4.3.1 Heat Transfer Cap for Each Envelope Structure $K_i$ [W/(m² • K)]

<table>
<thead>
<tr>
<th>Envelope</th>
<th>Roof</th>
<th>Exterior Wall</th>
<th>Non-Heating Staircase</th>
<th>Window (incl. transparent balcony door)</th>
<th>Bottom Board for Balcony Door</th>
<th>Floor Slab</th>
<th>Upper Floor Slab for Non-Heating Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floors</td>
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Statistics show that over the last decade 45.9 million m² energy efficient residential buildings have been constructed under the code, accounting for 26.7% of the total residential building area in Tianjin.

2. Several Measures on leveraging the pivotal role of government, and promoting building energy efficiency technologies

(1) Formulated and enacted a series of key policies and regulations for building energy efficiency

Over the past several years, we have taken advantage of the macro-control role of policies and regulations, and promulgated “Tianjin Municipal Energy Efficiency Regulations,” “Tianjin Municipal Administrative Regulations for Wall Material Innovation and Building Energy Efficiency,” and “Tianjin Municipal Administrative Implementation Rules for Residential Building Energy Efficiency.” The formulation and implementation of these rules and regulations have greatly promoted the application of building energy efficiency technologies in Tianjin.

(2) Accelerating the perfection of the legal system for building energy efficiency technologies

With a focus on the coordination and unification of energy efficiency technologies in the past several years, we have consecutively formulated and implemented the “Phase Three Building Energy Codes (65% Energy Savings),” “Tianjin Municipal Technical Procedures for Residential Building Energy Efficiency Construction,” “Tianjin Municipal Acceptance Standards for Residential Building Energy Efficiency,” and “Tianjin Municipal Inspection & Testing Standards for Residential Building Energy Efficiency.” These codes and standards have formed a complete system of technical standards for building energy efficiency, and thus ensured the viability, reliability, and consistency of building energy efficiency.

(3) Pioneering in demonstration projects, and actively pushing for comprehensive execution

In order to promote the application of building energy efficiency technologies, we implemented two demonstration projects—Long Tan Lu Project and Hua Yuan Qi Hua Li.
Project in 1998. We attempted to integrate building energy efficiency and marketing, and used technology as the means of marketing, turning them into the best selling projects in this region. This shocked developers, and helped spur energy efficiency technical applications in Tianjin. The Long Tan Lu Project was awarded the 2nd Class Tianjin Technological Progress Award in 2001 and the Advanced Level Award by the Ministry of Construction, and is regarded as a model for the national pilot project.

(4) Strengthening international cooperation, and implementing 3-stage energy efficiency pilots

With government leadership, we actively seek international technologies and funds through collaboration. In 2002, we reached an agreement with the World Bank to cooperate in planning and developing demonstration projects for building energy efficiency. With an area of nearly 1 million square meters, the project is mandated to meet the requirements to reduce energy consumption by 65 percent. In this year alone, three 3-stage pilot projects will be kicked off with a total building area of 200,000 square meters. Through our collaboration with the World Bank, we have introduced advanced technologies, further realized the urgency of the task, solved funding problems, created a greater space for products, and laid a solid foundation for implementing the Phase 3 energy efficiency standards for next year.

(5) Firmly focusing on design, and promoting management of building energy efficiency

Design is the first step for building energy efficiency. Therefore, we attached increased importance to this aspect. From 1993 to 1999, we trained our design personnel on applying energy efficiency technologies. We selectively checked design drawings, and implemented energy efficiency technologies. We made building energy efficiency the focus on drawing reviews and the precondition for issuing project permits. We conducted a city-wide project inspection on energy efficiency implementation, and punished the violators. It is through such a rigorous actions that 93 percent of the projects met the energy efficiency requirements (for six urban districts) in the second phase, reaching a better-than-average level in China.

(6) Actively developing new structural system and application technologies

We have seized upon the importance of energy efficiency application, continually developed and researched new building systems, raised the technological content of new walls, explored the new building material application market, and provided adequate conditions for building energy efficiency. In the past, we have conducted building system studies such as “Medium & High Heat Insulation Block Residential Building System,” “Steel Structure Residential Building System,” “Applying Concrete Porous Brick Trail Building System,” “RBS Building System,” and “CS Board Structure Residential Building System.” We also formulated such technical standards as “Multi-Layer Bearing Brick Composite Exterior Wall Heat Insulation Technical Research and Standard Formulation” and “Shale Rock Modulus Brick Composite Exterior Heat Insulation Technical Standard Formulation.” Through research and experimentation on building systems, we have created a building system with better energy efficiency, expanded the application scope for new building materials, and laid the foundation for promoting building energy efficiency technologies in the city.
II. Government restructuring of the heat supply system to increase efficiency

In the planned economy, the heat supply fee collection system and heat supply operating mode did not reflect the principles of “Consumer Pays” and “Paying for More Consumption, and Saving Money through Energy Saving,” thus, it was difficult to collect money for heat supply. There was low quality of heat supply and excessive consumption. This not only affected the normal operation of heat suppliers and created massive energy waste, but also influenced building energy efficiency. Therefore, the Tianjin Municipal Government has been dedicated to restructuring the heat supply operating mode and fee collection system. It has centralized the market operation for heat supply and has achieved noticeable results.

1. Government measures to reform the heating supply system

(1) Implementing a ‘Reform of the Heating Fee Collection Mechanism’
In 2000, we started restructuring the heating fee collection system, identified the market players, and delineated property ownership relationship, and formed a market mechanism. Specifically, we:

-- Specified payer and heat supply enterprises. We have shifted from reimbursing employers for heat supply to signing contracts between users and heat suppliers and clarified heat suppliers’ corporate responsibilities and market position to make consumers pay the bill.

-- Reduced the price and subsidy for heat supply. In accordance with the actual income and affordability of the residents in Tianjin, we reduced the heating price from 18.5 yuan to 15.4 yuan per square meter, and organized heat suppliers to improve the fee collection rate, minimized the operating costs, and compensated for the price differential.

-- Formulated preferential policies. Heating fee reductions or exemptions are provided to residents with minimum incomes, key subsidized people, and laid off workers receiving basic living expenses and unemployment insurance.

(2) Changing heat supply operating mode and promoting heat supply metering
Under the guidance of experts from the Ministry of Construction and the World Bank, we perfected the heating price composition and cost quota standard for the city in 2003 through statistical calculations, and, in particular reviewed the metering account records for the past six years. We set the average heat consumption index per square meter for the municipality. With the continuous intensification of heat metering, most users have a better understanding of metering based fee collection. At the same time, we have been actively promoting the heat supply household-by-household user metering system and laid a sound foundation making consumers pay the bill.

(3) Actively formulating policies and regulations, and regulating heat supply administration.
In recent years, the Tianjin Municipal Construction Commission has: (1) enacted the “Notice on the Interim Administrative Measures for Tianjin Indoor Heating System Design,” specifying that newly built residential building heating systems must be designed pursuant to metering heat supply; (2) promulgated the “Technical Provisions for Implementing ‘Tianjin Municipal Interim Methods for Indoor Heating System Design ’” to provide uniform design methods for expanded and newly built residential building heating design and for old indoor residential building heating system; and (3) issued the “Notice for Installing Heat Metering
Devices to All Newly Built Indoor Residential Heating systems “to enhance heat metering implementation. We also formulated the Tianjin Municipal Project Construction Standards—“Design Procedures for Centralized Heating Residential Metering Heat Supply.” The Tianjin Municipal Heat Supply Office forwarded the “Interim Administrative Methods for Implementing ‘Three-Year Heating project’ Secondary Net and Indoor Heating System.” Through six years of heat metering experimentation, we have made substantial technical progress. The Tianjin Municipal Construction Commission consecutively issued technical standards such as “Design Procedures for Centralized Heat Supply Residential Metering” and “Centralized Residential Heat Supply Metering Construction Quality Acceptance Procedures” to standardize design and construction.

(4) Pilot Operations

In accordance with municipal government requirements to accelerate the metering of heat supply, Tianjin started heat supply metering pilot operation in 1998. Over the past six years, we mainly focused on the following two task:

1. We developed five small pilot districts with a total area of 478,600 square meters and 5,068 apartments. The indoor single pipe concurrent leap-type system is adopted together with a one household-one loop separate user system. We also used the German Viterra evaporation type heat allocation meter, Danfoss temperature control valve, and imported heat meters. Each radiator is installed with control valves made in China. Through extensive pilot efforts, and we achieved excellent results, laying a solid foundation for further promotion of the heat metering method.

2. We have expanded the experimental area of 600,000 square meters on the basis of piloting results. The heat meter and temperature control valve are installed in residential buildings. Currently, the complete metering of the heat supply system is already in place though metering based fee collection has not yet been implemented.

2. Initial achievements for heating energy efficiency in Tianjin

(1) Enhanced the vigorous development of heat supply in Tianjin. With the diversification of investment entities, the heat supply construction is becoming market driven, shifting from the original passive situation in which the municipal treasury department assumed overall responsibility.

(2) Encouraged heat supply enterprises to foster a strong sense of market operation, and strengthened their industrial self-discipline. With restructuring, the heat supply enterprises have realized that it is natural for residents to demand good service. Many enterprises have actively invested money and manpower. In recent years, the heat supply compliance rate is consistently at above 98%, and the maintenance timeliness is held at more than 95%.

(3) Expedited heat supplier’s corporate structural readjustment, and accelerated heating supply through science and technology. Reform has strengthened the energy efficiency awareness of heat suppliers, making them conscientiously utilize energy-efficient equipment. The public is increasingly calling for metered heating supply. The room-by-room temperature control and household-by-household metering design procedures have been effectively implemented in the new heating area.
(4) Fee collection rate is on the rise. Thanks to appropriate measures, the fee collection rate has been consistently more than 90% in Tianjin after the reform.

In conclusion, we have achieved initial success through six years of pilot work. Now, people have a better understanding of heat metering. The huge amount of data acquired has laid the foundation for us to formulate various heat metering policies and strengthen heat metering management.

III. We need to further solve problems in energy efficiency technologies

Despite our progress in energy efficiency technology, there are still many problems that need to be solved:

(1) Further raising the sense of urgency for energy efficiency

We have promoted building and heating energy efficiency and provided an important condition for the municipality to achieve sustainable development. A large volume of data shows that by promoting building and heating energy efficiency, we can save resources for our country, reduce pollution, save on households expense, and provide a more comfortable living environment. Currently, most developers have successfully implemented the building technical standards though some developers still lack a strong understanding of energy efficiency and enthusiasm for constructing energy-efficient residential buildings. As a result, they fail to adopt energy efficiency measures. Therefore, we must strengthen developers’ awareness of energy efficiency. Also, we must raise public awareness of energy efficiency, and ensure the actual results achieved in applying energy efficiency technologies.

(2) Further perfecting the legal system for building energy efficiency

Currently, China still lags far behind developed countries. There are no laws, rules, or regulations for many energy efficiency technical issues. Therefore, it is imperative to formulate relevant laws and regulations as early as possible by drawing on international experiences and taking into account China’s specific conditions.

(3) Reducing heating costs through new technologies is crucial.

According to our experience, the major obstacles for implementing energy efficiency technologies lie in the relevant costs. Energy efficiency technological application has been hindered by the costs either for building energy efficiency materials or for energy-efficient heating equipment. For example, the upfront investment for heat metering is relatively high, and the cost for a household meter is RMB 1300 yuan, coupled with the checking and installation fee of RMB 100 yuan, the yearly average payment will be over RMB 200 yuan over six years. Given the annual heating fee of RMB 924 yuan for an apartment of 60 square meters, it still falls short of the meter costs, even when with 20% cut in energy use. The high metering costs have hindered the promotion of heat metering. Therefore, it is crucial to adopt new technologies and equipment, improve the technology of the heat operating system, and minimize the costs for energy efficiency technologies.
Strengthening Building Energy Efficiency,

Constructing a Beautiful Homeland

Qiao Mingjia, Deputy Director
Chongqing Construction Commission

Energy is the backbone of our society, supporting our economic and social development. Natural resources provide crucial material for sustainable social and economic development. The more developed our society becomes, the higher our demand for energy, and the more serious our energy crisis becomes. The energy issue is not only a resource utilization issue, but also an environmental issue. China is far below the world average in per capita resources of cultivated land, fresh water, forest, oil, natural gas, and coal. Energy supply shortages have become serious barriers to both social and economic development and to “building a well-off society.”

As a result of the 1970’s energy crisis, most countries have focused their attention on energy issues and the growing deterioration of the global environment. Several effective measures for energy conservation have been implemented to raise energy efficiency. With such rapid economic development, China’s energy supply fails to meet the demands of rapid economic growth. The energy shortage has become a key factor influencing its future development and energy security. Low per capita energy resources combined with high GDP induced energy consumption have long been an overriding issue in the national economic and social development of China.

While all levels of leadership have focused their attention on industrial energy consumption, energy consumption by buildings has been chronically neglected. Energy consumption by buildings has risen from approximately 10% of total energy consumption in 1978 to nearly 30%. The ratio is likely to reach 35% to 40% as living standards improve. The construction industry will become the largest energy consumer in China, surpassing industry, transportation, and agriculture.

Given that buildings have a lifespan of 50 years in China, throughout that lifespan, they will impose heavy demands on energy resources and cause severe pollution due to direct or indirect energy consumption. Therefore, building energy efficiency has become a critical issue influencing energy security, energy structural optimization, energy utilization, and sustainable development. Enforcing building energy efficiency will undoubtedly help protect natural resources, reduce environmental pollution, boost national economic and social development, and enhance living standards.

1. Advocate resource conservation and make building energy efficiency a social responsibility.

Resource conservation is everyone’s responsibility: the government, business, and the public. Therefore, improving public awareness will benefit building energy efficiency.
Ever since Chongqing became a municipality, its residential building construction has grown from over 7 million m² in 1997 to 15 million m² this year. Nearly 100 million m² of new residential buildings have been constructed in the past seven years. Yet, most building energy codes and standards were formulated in the 1980s. Additionally, Chongqing is in the Hot-Summer Cold-Winter (HSCW) Zone and its urban air conditioner ownership and utilization rate is much higher than that of other cities. Given the building sector’s huge energy consumption in the summer and winter, Chongqing faces a daunting task to improve building energy efficiency.

In order to “build a well-off society” established in the 16th National Party Congress, China is forecasted to continue its pace of rapid economic growth while significantly improving living standards over the next two decades. The increase in urban and rural incomes will result in demands for improved living conditions and standards, mainly in terms of the building quality and comfort level. As an important domestic market that drives our economic development, the building sector has witnessed swift growth in energy consumption and substantial increases in CO₂ emissions, which in turn challenge sustainable energy development and energy security in China. Due to huge energy consumption and dependency on energy, the building sector has exerted an exacerbating impact on the environment. Therefore, we must increase public awareness on energy conservation, strengthen commitment, and give the public the opportunity to see the actual benefits of energy conservation. This will shift public opinion toward advocating energy conservation. At the same time, we should implement a “high comfort, energy-efficient” building strategy, reassess the concept of “building energy efficiency,” and adapt it to the current social and economic development environment in China. By so doing, we can reduce energy consumption, protect the environment, and follow a sustainable development approach.

2. Uphold the “scientific development” approach to establish building energy efficiency.

With respect to building energy efficiency, we shall follow the “scientific development” approach and take into consideration the following factors: (1) the relationship between buildings and the environment, (2) coordinated economic development, (3) improved living standards, and (4) sustainable development of society, economy and natural environment. Therefore, building energy efficiency is not only an issue of saving energy and enhancing energy efficiency, but also an issue of respecting the environment.

Consumption and sustainable development.

In a market economy, companies are driven to obtain a greater market share and economic benefits. The energy supply sector will explore new consumption markets by whatever means available, take various measures to stimulate energy consumption, and encourage end-use consumption. This is illustrated by increasing surges in buildings energy consumption today. With the prevalence of air conditioners, air conditioning electricity consumption accounts for approximately 40% of the peak load in the summer, and it is one of the major causes for blackouts. Additionally, due to the surge in energy demand, the call for energy conservation is overshadowed by the economic benefits for energy suppliers and other related social benefits. Therefore, long-term energy balance and security naturally linked to direct short-term economic profitability is difficult and is a major factor for weak energy
conservation today. With weak building energy codes and standards, buildings in China have poor heat insulation and low energy efficiency, and inefficient air conditioners. Most residents do not practice energy conservation, although the potential is great. Adopting reasonable measures to reduce building energy consumption can save resources, protect the environment, and avoid unnecessary investments in new power plants. In addition, this can reduce building expenses for consumers. Building energy efficiency is a good thing that benefits the nation and people alike.

**Integrate energy supply and demand mechanisms with management mechanisms.**

With the market economy, the energy supply and demand situation has changed dramatically. Because of deregulation, the previous approach to energy conservation based on government control of supply, investments, and projects has been substantially weakened. Fiscal expenditures for energy conservation are virtually nonexistent. Except for the enhancement of energy efficiency through market constraint and industrial upgrades, government administration of energy conservation has been minimal.

Considering China’s current economic environment, energy efficiency improvements cannot solely rely on the market. Instead, the government must play a pivotal role. In addition to raising public awareness on resource scarcity and social responsibility, and leveraging the natural role of the market economy, appropriate policy measures must be adopted. Besides information, standards, and technology promotion measures, the government needs to further consider long-term energy pricing policies, capitalize on the momentum of environmental protection, follow the design and guidance of sustainable development based on consumption, uphold the green GDP calculation method, and reintegrate the energy supply & demand with administrative mechanisms. These will become important factors in sustainable energy policy.

**Combine long-term efficiency and incentive mechanisms.**

Taxes should be levied to promote energy conservation. The energy consumption tax should be levied on building developers and users that fail to comply with building energy efficiency requirements, and the funds collected should be used to enhance renewable energy development. By so doing, we can establish a long-term incentive mechanism for building energy efficiency. The energy and environment tax should be imposed on inefficient and polluting technologies. Tax exemptions should be granted to technologies with high energy efficiency and low pollution. Subsidies should be offered to renewable energy and pollution-free technologies. We should promote fair competition for various technologies to develop and use effective energy-saving and environmentally-friendly technologies. With government supervision, we should foster fair competition, thereby raising energy efficiency, reducing resource waste and environmental pollution, and effectively and pro-actively conserving energy.

**Emphasize energy efficiency and energy conservation.**

Energy shortages are an undisputed global problem. Enhancing energy efficiency is not only an important means of easing energy shortages but also a smart approach. We should promote both energy efficiency and energy conservation through various governmental
policies, energy and environmental protection measures, and through educating the public. The following are some examples:

- Initiate summer time energy conservation
- Promote the use of environmental protection technologies and higher energy conservation standards for building construction and decoration;
- Prohibit overnight lighting and control illumination projects;
- Encourage the utilization of energy efficient facilities, equipment, and lighting fixtures;
- Encourage business and public sectors to implement optimal energy saving measures; and
- Stress energy conservation in government organizations.

In conclusion, in order to encourage energy saving, the government should establish a set of legislative assurances and policy guidance for enhancing energy efficiency and energy conservation.

Increase public awareness and foster energy conservation habits.

We should set up energy conservation websites, disseminate energy conservation tips, popularize effective energy conservation practices for outdoor nighttime lighting, and promote new types of energy saving light fixtures. We should focus on fostering public awareness of energy conservation, leveraging the role of non-governmental organizations, gain public support of energy conservation and environmental protection, to achieve better energy conservation results.

3. Focus on sustainable development and intensify building energy efficiency.

With such a wide focus, building energy efficiency is an integrated multidisciplinary project. A successful energy efficiency project should use several policies and various mature energy efficiency technologies, and fully reflect sustainable development. The expected return on building energy efficiency renovation or investment is less than the incremental investment. In addition, the incremental investment is less than the comprehensive benefits, including resource savings, environmental improvement, and contribution to economic growth. It is difficult to encourage energy efficiency solely through market mechanisms. Therefore, it is imperative to promote energy efficiency through the following mandatory measures:

1. We should establish and perfect the relevant policies and regulations to promote, guide, and standardize energy efficiency. Building energy efficiency is an important aspect of government functions for public affairs, and it is an area of social and public interest. It will not work if we solely rely on the market mechanisms. Therefore, we should incorporate building energy efficiency into national fiscal and monetary policy, and enact special promotion policy and regulations for building energy efficiency based on the Energy Conservation Law. We should also provide substantial economic policy and requisite capital support, promulgate economic incentive policies such as financial and taxation policies for energy efficiency renovation for existing buildings, and speed up energy efficiency renovation, if necessary, for the building envelope structures of many existing buildings.
2. The government should strengthen market supervision and market guidance for building energy efficiency, and foster the emerging building energy efficiency market. We should make building energy efficiency administration an important part of the government’s regulatory functions, define the regulatory authority, functions and staffing for building energy efficiency at each level of government, minimize administrative approval procedures, and administrate building energy efficiency through legal channels. Effective mechanisms should be available to normalize the building energy efficiency market, and consumers should be informed of whether a building complies with energy codes or whether its doors and windows are energy efficient.

3. Focus on the priorities and promptly seize the opportunity to enhance building energy efficiency. We should incorporate building energy efficiency into the agenda for governmental decision-making, and make it a part of the resource and sustainable development strategy. Civil building energy renovation is an important measure for improving people’s quality of life, increasing domestic demand, and spurring economic growth. Existing building energy efficiency renovation should be seen as an important function of government to render public services, intensify strategic resource management, strengthen environmentally friendly construction, and create a new civil building energy efficiency structure led by the government.

4. We should emphasize legislation and mandatory standardization, making it compulsory for new buildings to comply with the building energy codes, and transform the potential demand for building energy efficiency to an effective and realistic demand. We should formulate a law and regulation system for building energy efficiency based on the “Administrative Rules for Residential Building Energy Efficiency”, make building energy efficiency for new buildings mandatory, and push for corresponding requirements for existing building energy efficiency renovation. We should specify executive functions and responsibilities, fully disclose building energy efficiency work, and formulate a technical law and regulation system based on the design standards for building energy efficiency. At the same time, we should promulgate associated technical policies and guidelines, and release a catalogue of promotional, restricted, and phased-out technologies at the appropriate time.

5. Implement an economic incentive policy for promoting building energy efficiency, and push forward building energy efficiency work. Different economic incentive policies and mechanisms should be adopted for new buildings and existing buildings respectively for building energy efficiency. For new buildings, the policies adopted should be consistent with the policies to drive economic growth, reduce income gaps, and establish appropriate housing prices and reasonable residential housing consumer demand. The pricing for the public buildings like hotels and shopping malls and general residential buildings shall be made via market mechanisms. The pricing for affordable housing primarily for low and medium income families should be calculated by splitting the costs between government and residents. For existing buildings, government, residents, and property owners should share energy efficiency renovation costs. The portion of costs assumed by government shall be incorporated
into the fiscal system. As for the lowest income groups, residential energy energy efficiency renovation costs should be covered by the government, and incorporated into the social security system. Special regulation taxes should be levied on developers and consumers that fail to comply with building energy efficiency standards.

6. Strengthen technical innovation for building energy efficiency, implement a certification, endorsement and evaluation system, and foster healthy market development. We should establish an innovative system based on enterprises, promote industrial structural readjustments and technical upgrades, intensify efforts to promote, restrict and ban technologies (products), increase government investment in basic research for building energy efficiency, strengthen the research and development of building energy efficiency technologies (products), develop the related industry, and enhance industrialization for energy-efficient technologies. We should formulate corresponding industrial policy and technical policy, accelerate information dissemination, and guide enterprises to attain innovative capacity. We should also institute a review system for building energy efficiency design, a certification system for building energy efficiency technologies (products), and an endorsement label for energy-efficient buildings. We should strengthen the supervision over all aspects of building planning and construction and sales. We strengthen the inspection and testing institutions for building energy efficiency, perfect the technical support system for building energy efficiency, and make energy-efficient building evaluations an important part of the government’s quality regulatory system. We should also organize and implement building energy efficiency demonstration projects.

7. Tap international resources and technologies and strengthen international cooperation to leapfrog development of residential building energy efficiency. Currently, many international organizations are closely watching building energy efficiency in China, and quite a few foreign companies are anxious to place their technologies on the Chinese market. We must consider this situation carefully. In order to leapfrog the development, we should introduce advanced concepts and technologies, formulate an international cooperation strategy for building energy efficiency, search for additional international aid and support, leverage the funds from international organizations and foreign technologies, and expedite building energy efficiency development in China.

Building energy efficiency promotion is different from promoting an individual energy conservation technology. Building energy efficiency is a systematic engineering project that involves all the industries and sectors of our society. In addition, a building is a project of vital and lasting importance. Therefore, building energy efficiency is a comprehensive and forward-looking task, and it is inevitable that the government must take mandatory administrative measures. Leveraging the role of a market economy is crucial to encouraging consumers to purchase energy-efficient buildings once they have acquired a better understanding of building energy efficiency. Only by doing so can building energy efficiency gain momentum and sustainability.
I believe, through the cooperation and collaboration all the people in Chongqing, protecting the environment and promoting sustainable development, our municipal building energy efficiency work is moving toward a bright and splendid future. Our homeland will become even more beautiful.
Improving Building Energy Efficiency,

Enhancing Sustainable Urban Development in Chengdu

Sun Ping, Deputy Mayor
Chengdu People’s Government

As the land of historical abundance, Chengdu is one of the most environmentally-friendly cities in western China. Just like other cities in China, Chengdu has encountered conflicts between rapid urban development and resource utilization with the reform and opening up policy, and especially after the implementation of the “Develop the West Policy.” To address this issue, Chengdu has significantly raised its resource utilization rate and boosted sustainable urban development by enhancing harmonious development between man and nature, using a “scientific development” approach, following a people-oriented development concept, and firmly and solidly pursuing building energy efficiency as a measure to save resources, protect the environment, and raise living standards.

I. Ensuring Building Energy Efficiency Through Strict Supervision

Building energy efficiency is not only a long-term strategy but also an evolving process. A sound administrative system holds the key to building energy efficiency. While conscientiously carrying out all the national building energy efficiency standards and codes, Chengdu has consecutively formulated building energy efficiency measures like “Interim Administrative Measures for Residential Building Energy Efficiency in Chengdu” since 1996. On the basis of such efforts, and in consideration of building energy efficiency features at different times, we have enacted relevant policies, and strived to develop a relatively complete building energy efficiency policy system. With each link of building energy efficiency held in check, it ensures that building energy efficiency proceeds along the market economic rule-of-law path in a healthy and sustainable manner in Chengdu.

1. Promoting energy-efficient wall materials through policy. Chengdu has promoted the application of new energy-efficient wall materials and products to enhance building energy efficiency. Policies have been promulgated to restrict the production of inefficient wall materials and products, encourage the development of efficient wall materials, gradually raising the thermal performance of wall materials and products. From 1996, Chengdu has been vigorously promoting plastic steel door/window and hollow glass door/window with good heat insulation, sound insulation, hermetic and water tightness, and gradually restricted and phased out energy inefficient steel windows and doors. We have also established aerocrete brick, KPI shale rock porous brick, and rectangle shale rock hollow brick etc. as the leading wall material products in Chengdu. After 2002, Chengdu become one of 170 cities that barred the use of solid clay bricks in China, when we issued the government order “Administrative Measures for Prohibiting Production & Use of Solid Clay Bricks in Chengdu ” to protect arable land and save resources. For two years after issuing the
government order, we achieved some notable results in prohibiting the use of solid clay bricks. From 2005, solid clay brick production will be prohibited in addition to solid clay brick use. Currently, there are 126 solid clay brick producers in Chengdu. Ninety-seven such producers will be shut down next year, while the remaining ones will all be closed in 2006. While prohibiting the production and use of solid clay bricks, we have vigorously conducted the “City-Wide Special Quality Treatment Campaign for Wall Materials and Some Building Materials” every year. Through our efforts, the utilization ratio of new wall materials has increased from 70% to 91.28%.

2. Implementing energy efficiency design standards, and standardizing energy-efficient building development, design, and construction. To intensively implement the “Administrative Measures for Civil Building Energy Efficiency” and “Design Standards of Energy Efficiency in Residential Buildings in the Hot-Summer Cold-Winter Zone” issued by the Ministry of Construction, we formulated the “Technical Procedures for Building Energy Efficiency in Chengdu,” issued the “Notice on Further Strengthening the Implementation and Administration of ‘Design Standard of Energy Efficiency in Residential Buildings in the Transition Zone,’,” and proposed specific requirements for the design, construction, supervision, quality inspection and approval upon completion of building projects. By so doing, we not only normalized the building energy efficiency behavior of developers, designers, constructors, and inspectors but also effectively raised the administrative functions of building energy efficiency. From January 2001, Chengdu has mandated full compliance of newly built building projects with energy efficiency standards. The projects that fail to follow energy efficiency standards are not qualified for design approval or launch permits. Since the initial project stages, we have strictly enforced energy efficiency standards, and standardized energy-efficient building development, design, and construction. With the energy efficiency standards implemented, Chengdu is moving steadily toward 50% reduction in energy use. Energy-efficient buildings totaled 7,486,300 square meters (cutting energy by 30%) from 1993 to 2003 in Chengdu.

3. Phasing out obsolete technology and material, and ensuring building energy efficiency quality. Since the very beginning, Chengdu has rigorously followed the requirements of the technical notice issued by the Ministry of Construction for building energy efficiency by promoting advanced building energy efficiency technology and systems, and prohibiting the use of obsolete technologies and materials. In order to promote advanced building energy efficiency technologies and materials, Chengdu has actively attracted many domestic and foreign building energy efficiency vendors to set up their outlets in Chengdu, encouraged the development of a new building energy efficiency industry, and supported such large enterprises as Chengdu Aircraft Company, Chuanlu Plastic Company, Tiange Group, Dongtai Group, and Guodong group to get involved in the building energy efficiency industry. There are as many as 340 new wall material enterprises in Chengdu. Not only does this provide strong support for raising building energy efficiency in Chengdu, it also ensures the quality of energy-efficient building materials.
II. Moving building energy efficiency to a new level through joint endeavors

Recent years of building energy efficiency efforts in Chengdu show that, in the new situation of gradually improving socialist market economic system and transforming government function, it is imperative for all the governmental departments to pool efforts in promoting building energy efficiency. Since it is more expensive to construct energy-efficient buildings, the developers are not willing to actively construct energy-efficient buildings in order to reduce project costs and maximize profitability. Therefore, we should not simply rely on the market to pursue building energy efficiency. We must leverage the role of government, and pool efforts to push forward building energy efficiency smoothly. With respect to building energy efficiency, Chengdu Municipal Government has played the three major roles:

First, leveraging the role of government, and conscientiously implementing each standard for building energy efficiency. Along with the continually accelerating progress of urbanization, building energy efficiency has become an important measure to save energy, protect the environment, improve building functionality and quality, raise people’s residential and living standards, and implement the sustainable development strategy. Chengdu CPC Committee and Municipal Government made building energy efficiency a top priority, and used it to strive for sustainable urban development, cultivate an emerging industry, and grow the economy. In 2003, under the attention of the Chengdu CPC Committee and Municipal Government, we have successfully imported state-of-the-art German technology, conducted pilot demonstration for “low energy consumption, high comfort” buildings, and approved the formation of the Chengdu Municipal Science & Technology Center for Building Energy Efficiency. Chengdu CPC Committee and Municipal Government have also mandated that building projects conscientiously follow the procedures of energy-efficient building design, review, record-keeping, supervision, inspection, and accept the regulatory management for building energy efficiency. We will ensure that the “Administrative Regulation for Civil Building Energy Efficiency” and “Residential Building Energy Code in the Hot-Summer Cold-Winter Zone” are actually implemented.

Secondly, leveraging the supervisory role of the construction administration, and inspecting the design review for building energy efficiency. As the regulatory department for building energy efficiency, the construction administration in Chengdu has put building energy efficiency on its agenda, and set up a special energy conservation organization to pursue building energy efficiency. Also, we combined building energy efficiency with promoting building technical progress and enhancing residential industrial modernization, and provided plans & objectives, arrangement & deployment, inspection & evaluation, and guidance & implementation for building energy efficiency. The construction administration also fully leveraged the “leading” role of energy-efficient design, and tightened building energy-efficient designs. First, design personnel are required to implement the related national and provincial regulations for building energy efficiency, and design all civil residential buildings according to the standards for building energy efficiency. Second, we have conducted special review for building energy-efficient design. The review personnel shall review the drawings based on the content of the building energy efficiency sheet. From January 2002 to December
2003, there were 102 preliminary design review projects totaling 5,904,000 square meters. Among these projects, 63 projects—totaling 4,135,000 square meters and 70% of total floor area—were mandated for building energy efficiency design. The design standards for building energy efficiency have been well implemented in Chengdu.

Third, leveraging the coordinating and collaborating role of the administrative department for building energy efficiency, and strengthening the supervision of building energy efficiency. Building energy efficiency is a complex system of engineering. In order to do a good job, all the governmental departments should pool their efforts, and work towards the same goal. In practice, the departments of planning, township enterprises, building materials, and land have fostered mutual cooperation in line with their respective functions. Through these joint endeavors, we have built a system for the municipal government at all levels to jointly supervise building energy efficiency, and for the relevant departments to interactively coordinate building energy efficiency. This has provided an organizational assurance for us to work on building energy efficiency. The supervision of building energy efficiency was strengthened in Chengdu because we tapped the role of coordination and collaboration among the administrative departments for building energy efficiency. For example, during the construction of an energy efficiency project, we have, in recent years, organized all the administrative departments to conduct an annual special supervision for building energy efficiency. For any violation, including failing to follow construction design, changing energy conservation design, or using inferior energy-efficient materials, penalties are imposed. This has effectively ensured the construction quality of building energy efficiency projects. Another example is we have focused on the completion link for energy efficiency projects, and organized all the departments to inspect for building energy efficiency. For the projects that either failed inspection or failed to comply with the energy efficiency standards, the certification and filing procedures are withheld. Through cooperation and coordination among all the administrative departments, we have specified the building energy efficiency requirements for building projects with respect to design, construction, and certification. A sound check and balance system has also been established between the regulatory departments and project entities for building energy efficiency. This has helped our building energy efficiency mission gradually move into a normalized development path.

III. Raising the overall working level for building energy efficiency through demonstration

In order to raise the overall building energy efficiency, and promptly apply new technology and products for building energy efficiency, Chengdu has vigorously pursued building energy efficiency demonstration projects. In the initial phase of building energy efficiency, we considered different building structure types and different geographic locations, adopted different energy efficiency measures, and implemented the pilot project for building energy efficiency—“Jin Xi Ming Yuan.” In the course of constructing these projects, we conducted demonstrations of heat insulation and isolation technologies for different structures and building energy efficiency, and showcased the application of such new wall materials as aerocrete brick, concrete hollow brick, and EPS polyphenylene board outer wall heat
insulation system. In addition, we conducted tests and overall economic analysis of major technical indices for energy efficiency, accumulated and summed up experiences for design and construction, objectively demonstrated the effect of building energy efficiency, and laid a solid foundation for pursing building energy efficiency on a citywide basis.

The energy efficiency demonstration projects in Chengdu show that, through building energy efficiency, we can not only achieve sound economic benefits but also garner considerable social benefits. Our previous economic analysis and comparison indicate that, for the “Jin Xi Min Yuan” Energy Conservation Complex Project (Phase 1) with a floorage of 50,000 square meters, the incremental costs of using an energy-efficient maintenance structure versus an inefficient maintenance structure are RMB 3.3 million in additional energy efficiency investment, and RMB 66 per square meter for additional wall energy efficiency investment. Compared with the non-energy-efficient residential buildings in Chengdu, it saves 26.5% electricity, and cuts energy use by 32%. Energy-efficient buildings save 22.6 tons of CO₂ and 0.8–1.1 tons of SO₂ (toxic gas and dust) per 10,000 square meters annually. If the 19 million square meters of residential buildings in downtown Chengdu had been energy efficient buildings, there would have been an annual emission reduction of 429,000 tons of CO₂ and 2090 tons of SO₂. This will play a significant role in mitigating air pollution, improving urban environment, and raising people’s residential living quality.

It is evident that, through the demonstration real-life energy efficiency demonstration projects, people have recognized and accepted the technology and concepts behind building energy efficiency, gradually forgoing their concern about applying new building energy efficiency, and helping to raise the overall building energy efficiency in Chengdu.

**IV. Boosting building energy efficiency momentum through scientific and technological innovation**

For many years, Chengdu has consistently focused on promoting building energy efficiency and closely relying on designers, academia, and research institutes to actively pursue scientific and technological innovation for building energy efficiency. In recent years, Chengdu has consecutively invested over RMB 40 million in research and development, and acquired 66 wall innovations and R&D achievements for building energy efficiency. For example, the “Chengdu Area Residential Building System Engineering Research” was awarded the 3rd Class Sichuan Science & Technology Award and the 1st Class Chengdu Urban Construction Science & Technology Award. These R&D achievements for building energy efficiency have greatly advanced the development of building energy efficiency in Chengdu. In the course of conducting scientific and technical innovations for building energy efficiency, we have been consistently upholding the following three mandatory measures.

**1. Require wall material innovation combined with building energy efficiency.**

With a focus on researching and developing new wall materials and outer wall exterior heat insulation products to substitute for solid clay bricks, Chengdu has consecutively completed
the research and development of the new wall material products like “Rectangle Shale Rock Hollow Brick Thermal Performance Research,” “Heat Insulation Concrete Hollow Mini-Brick,” “EPS Polyphenylene Board Outer Wall Exterior Heat Insulation System Application in Chengdu”, and “Plastic Steel Door & Window Heat Isolation Property Research.” In order to promote building energy efficiency in Chengdu, we have vigorously boosted the scientific research of raising the heat insulation property of building envelope structures to improve the residential environment. In addition, we have imported advanced technology outer wall exterior heat insulation and energy-efficient door and window products from Canada, France, UK, and Germany, and applied such products in the medium and top grade residential buildings in Chengdu. This has helped promote the development of energy-efficient wall material products in our city.

2. Require integration of building energy efficiency into eco-buildings. In order to ensure correct utilization of energy-efficient products and new wall materials during the design and construction and to meet the requirements of an eco-friendly building, we have compiled the “Plastic Steel Door & Window Product Application Collective Drawings,” “Outer Wall Exterior Heat Insulation Collective Drawings,” “KPI Porous Brick Building Structure Collective Drawings,” and “Building Energy Efficiency Design Review Highlights,” and effectively solved the problem of energy-efficient building products and new wall material production and application. In accordance with the 3A residential building standards issued by the Ministry of Construction, we conducted a 3A residential building evaluation. The three residential complexes of “Shu Feng Huan Yuan Cheng” and “Jin Cheng Huan Yuan” passed the evaluation. We also formulated “Chengdu Municipal Green Ecological Residential Building Index Evaluation System,” incorporated building energy efficiency standards into the system, and closely integrated building energy efficiency with ecological residential buildings. As an excellent between building energy efficiency and very comfortable residential buildings, ecological evaluations can not only raise residential comfort while promoting building energy efficiency, but also arouse the enthusiasm of developers for energy efficiency, help generate new consumer demand, and hence develop the building energy efficiency market.

3. Require scientific and technological innovation for building energy efficiency. In the course of making scientific and technological innovation for building energy efficiency, we applied to the Ministry of Construction for the research program-- “Chengdu Area Wall Material Innovation Building Energy Efficiency Comprehensive Technology Research.” The program was listed in the science and technology plan of the Ministry of Construction. With an investment of RMB3.3 million, it is intended to systematically study the methods and measures for building energy efficiency in Chengdu. In consideration of the climatic conditions and economy in Chengdu, it also undertook a systemic application research of aerocrete/ concrete hollow brick, concrete hollow brick, EPS outer wall heat insulation system, and polyphenylene particle membrane ash system. We imported the geothermal pump refrigerating and heating system from the US, the low temperature floorboard radiation heating system from Germany, and air displacement system from France to conduct research customized to local situations. Specifically, we undertook in-depth research on indoor air
environment, thermal environment, light environment, and sound environment. In addition, we have consecutively established the Chengdu Building Energy Efficiency Center, Chengdu Building Energy Efficiency Testing Center, and Chengdu Green Ecological Residential House Testing and Evaluation Center using the advanced technologies for building energy efficiency. The above facilities provide the public, developers, and designers with the visible and tangible demonstration of specific building energy efficiency and very comfortable apartments.

V. Doubling efforts to continuously promote building energy efficiency

Through our efforts, building energy efficiency is playing a more important role in driving the economy in Chengdu, and there is a stronger trend towards sustainability in the building energy efficiency industry. From 1993 to 2003, building energy efficiency reached a cumulative floor area of 7,486,300 square meters (cutting energy by 30%) in Chengdu, and the new wall material production stood at 4.286 billion bricks equivalent per annum. The new wall material application ratio as of 2003 was 91.28%. Through building energy efficiency and wall material innovation from 1990 to 2003, we saved approximately 603,100 mu of land, saved 740,600 tons of coal equivalent, and utilized 26.0911 million tons of waste. This has enhanced sustainable urban development, effectively improved residential environment, and significantly improved people’s living quality.

Despite these achievements and experiences gained in building energy efficiency, we still have a long way to go to meet the requirements for sustainable urban development in Chengdu. In recent years, along with the rapid economic development and urbanization in Chengdu, we also experienced power outages. During the drought period this winter, the daily power grid peak load will reach 2900 MW, and maximum daily power consumption will be 49 million KWh in Chengdu. However, the power grid in Chengdu can supply no more than 37 million KWh. As a result, there will be a load shortage of 500 to 800 MW and a daily power supply shortage of 6 to 10 million KWh this winter and next spring in Chengdu, the largest power shortage in history. Huge building energy consumption imposes an obvious pressure on energy supply. Therefore, Chengdu will continue to promote building energy efficiency, and enhance sustainable social and economic development in a holistic and coordinated manner.

(I) Optimizing urban energy structure
Chengdu will continue adapting renewable energy development to local conditions, vigorously promoting energy efficiency and efficient equipment, increasing the ratio of electricity and gas in urban consumers, improving urban air quality, and striving for sustainable urban development. We will formulate preferential policies to encourage the use of clean energy, and expand the utilization ratio of such clean fuels as gas. We will also gradually reduce direct coal combustion in urban areas, actively promote energy conservation and comprehensive technological utilization, minimize energy consumption, and raise the comprehensive energy utilization level.
(II) Guiding, cultivating and normalizing the market for building energy efficiency

Building energy efficiency has offered Chengdu a huge market opportunity, and it will drive the rapid development of the building energy efficiency industry. We will fully employ the government’s macro-control under the conditions of a socialist market economy, and form a standardized market for building energy efficiency. At the same time, the construction administration will propose energy efficiency targets, formulate an energy conservation plan, inspect the resource status, research new technologies, and encourage development and innovation. We will disseminate and release relevant policies and regulations for building energy efficiency, and raise public awareness on building energy efficiency.

(III) Fully leveraging the government’s administrative role to promote building energy efficiency

While fully employing the market to promote building energy efficiency, we shall strengthen the administrative functions of government, intensify supervision, perfect the related policies and regulations, and implement the economic incentive policies for building energy efficiency. The construction administration is required to strengthen the regulatory function for building energy efficiency, strictly enforce the laws, regulations and mandatory standards on new buildings, support technical innovation for building energy efficiency, institute certification, assessment and evaluation, and promote building energy efficiency in Chengdu.

(IV) Strengthening international cooperation and exchange

In accordance with leapfrog development goals in Chengdu, we shall actively conduct technical exchange and cooperation with international energy conservation organizations, energy efficiency research institutes, and major foreign energy conservation enterprises, introduce advanced technology and system for building energy efficiency, and absorb new foreign theories, standards and technologies for ecological buildings. We have conducted exchanges and collaborations several times with related energy conservation enterprises and institutions from Canada and France. Under the support and guidance of the Ministry of Construction in 2005, we hope to develop cooperative projects with energy organizations from the US, France, and Canada to upgrade the technical administrative level for energy-efficient and ecological buildings in Chengdu, minimize building energy consumption, and reduce the impact of building energy consumption on the environment.

Energy utilization and efficiency reflect the living quality and economic efficiency of a city, and demonstrate its sustainable urban development capability. We will focus on the goal set by the 10th Chengdu CPC Congress of turning Chengdu into a modernized mega-city with the best entrepreneurial environment, residential living environment, and comprehensive strength in western China, actively promoting building energy efficiency, enhancing the harmonious development of man and nature, and constantly strengthening the sustainable development of Chengdu.
Prospect on Energy Efficiency Design Standards for Buildings

Lang Siwei
China Building Energy Efficiency Association

I. Introduction

Rapid Development of Building Industry

In China, the building industry is divided into two divisions: civil and industrial. The civil sector is further divided into residential and public building divisions.

The building industry in China has rapidly developed in recent 20 years because of economic development and living standard improvement. At present, 1600 ~ 1900 million m² floor areas have been built for each year. Among them, 500 ~ 600 million m² floor areas for residential building in cites, 400 ~ 500 million m² floor areas for public and industrial buildings (mainly in cities), and 700 ~ 800 million m² floor areas for residential building in countryside. It means that at present 800 ~ 900 million m² floor areas for new residential and public buildings in cities have been completed. This situation will last a long time according to the report from the World Bank. The report said that from 2000 to 2015 the building development is the middle and later period at the height of power and splendor, and forecast the half of existing civil buildings in 2015 is built after 2000. Besides, the amount of existing buildings also is very huge. By the end of 2002 the floor areas of existing buildings in the whole country were 38,800 million m², among them 13,180 million m² in cities.

Requirement of weather for A/C and Heating

According to national standard “Thermal Design Code for Civil Building” GB 50176-93, China is divided into severe cold, cold, hot summer and cold winter, hot summer and warm winter and temperate zones from the point of view of climate characteristics and building thermotechnical design. With economic development and living standard improvement the demand of air conditioning and heating has increased. Especially after the mid-90s the demand of A/C and heating has rapidly increased. According to the weather characteristics, the requirements for air conditioning / heating in different zones are as follows: in the severe cold zone the major requirement is heating, and only buildings with high standards need air conditioning. In the cold zone the primary requirement is heating and then air conditioning; In the hot summer and cold winter zone both air conditioning and heating are needed; In the hot summer and warm winter zone the major requirement is air conditioning, and only buildings with high standards need heating; In the temperate zone, only parts of the zone need heating or heating / air conditioning.

High energy consumption in buildings

Energy consumption in buildings includes those for air conditioning, heating, lighting, appliance, cooking and domestic hot water etc. Among them the main parts are from air conditioning and heating. According to the statistics data in 2001, the consumption for
heating and air conditioning took about 55% of that in buildings. In recent years the air conditioning load has risen rapidly. In the summer season the electricity load for air conditioning occupied about 1/3 of the peak load in the electricity network.

According to the data from the Ministry of Construction (MOC), the energy consumption in buildings took 27.45% of total commercial energy consumption in the whole country in 2001. Since 2002 the output of room / packaged air conditioners has reached at first position in the world.

2. Energy Efficiency Design Standard in Building

Promulgated energy efficiency design standards for buildings

The energy efficiency efforts in China began in the early 80’s. Under the support of the former State Economic Commission and State Planning Commission, the Ministry of Construction (MOC) approved projects for investigating energy consumption by space heating and compiling energy efficiency design standards for residential building in the severe cold and cold zones. Since 2000, MOC has approved and organized the development of energy efficiency design standards for residential buildings in central (hot summer and cold winter zone) and southern (hot summer and warm winter zone) China. The standards for residential buildings covering all climate zones were issued by 2003. Since 2002 MOC has approved and developed energy efficiency design standards for public buildings and expects the standard to be carried out by the end of 2004, and implemented in 2005.

The compilation of the Standards has also won financial support from the China Sustainable Energy Program of the US-based Energy Foundation, technical support from the US Lawrence Berkeley National Lab (LBNL) and US Natural Resources Defense Council (NRDC).

Target of Energy Conservation and Design Approach

The target for energy conservation in building is to reduce 50% of the energy consumption for A/C, heating (and lighting) while maintaining comfortable indoor thermal environment condition compared with the baseline built in the 80s.

There are two approaches in the standards for controlling the energy efficiency design. One is prescriptive. If the building design meets with the prescriptions such as area ratio of window to wall, shape coefficient of building etc., the designer can look-up the maximum allowable heat transfer coefficient for the building envelope from the standards. The other is concerned with performance. If the building design can’t meet with the prescriptions, then the designer has to calculate the annual energy consumption value until the value is equal to or less than the value for reference building. We have developed a software package based on DOE-2 with the experts in LBNL to provide designers, real estate developers and local government officials a tool to design and examine whether the plan meets the standard. The prescriptive is easy and simple to operate, while the performance offers more flexibility for designers.
3. Implementation is Critical to Realizing Sustainable Development

In order to quadruple GDP (from a year 2000 baseline) by 2020, we must ensure that the incremental energy consumption in building only doubles.

Despite the energy efficiency design standards for residential buildings have been issued and implemented, but only a few new residential buildings, which meet with the Standards. The main barriers for promoting energy efficiency efforts are as follows. The law, code and administrative system are not perfect. The economic incentive policy is shortage. The supply of energy efficiency technology, material and product in market isn’t enough and their quality isn’t so good. The labeling effort for equipment has just started.

It is estimated that if implementation is not perfect, the energy consumption in buildings in 2020 may reach 1100 million tce, four times as high as now. If implementation is perfect, the energy consumption in buildings in 2020 will reach 750 million tce, only twice as high as now.

4. Conclusion

In recent years the building industry in China has rapidly developed. Every year 800 ~ 900 million m² floor area for residential and public buildings in cities have been built. With economic development and living standard raise the energy consumption in buildings has increased to a great extent year by year. In order to control and reduce the energy consumption for air conditioning, heating (and lighting) from design stage, MOC approved to develop the design standards for energy efficiency of residential and public buildings. According to the time schedule and plan of compiling standards the energy efficiency design standards for residential buildings in all of climate zones have been issued and put into effect (in Temperate Zone designer can refer to the standard in neighbor climate zones). In 2005 the energy efficiency design standard for public buildings should be issued and put into effect. In next step the Standard for residential building in severe cold and cold zones will be revised and the insulation requirement for envelope should be improved. It will deal with insulation material and product. For southern China, we should focus on research and development of windows with better isolation performance for windows (glass). For air conditioning and heating equipment and system the aim is comfort, health, energy efficiency and environmental protection, but we should pay more attention to the improvement of EER.

[Reference]
Building Energy Efficiency in Shanghai

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In October 2001, the Ministry of Construction issued the “Energy Efficiency Design Standard for Residential Buildings in the Transition Zone” in China; Shanghai belongs to this zone. Under the leadership of the Shanghai Municipal Government and Construction Commission, with the support of Shanghai residential housing administrative departments, and in collaboration with all the responsible regulatory authorities, the building energy efficiency mission in Shanghai has been, through over two years of endeavor, progressing in a steady and orderly manner.

I. Recent efforts to implement national energy efficiency standards and promote building energy efficiency in Shanghai

1. Continuous improvement of relevant codes and standard for building energy efficiency to steadily enhance building energy efficiency.

Shanghai has formulated the following local codes and standards in accordance with the national standards and in consideration of the unique situation in Shanghai.

- Shanghai Municipal Energy Efficiency Application Technology Provisions for Residential Building Envelope,
- Shanghai Municipal Energy Efficiency Inspection and Evaluation Standards for Residential Buildings
- Shanghai Municipal Energy Efficiency Design Standards for Public Buildings

2. Established the administrative and legal framework to promote building energy efficiency.

3. Increased awareness and enthusiasm amongst staff and the public through effective dissemination and training.

4. Increased scientific research investment and pilot projects.

On the basis of scientific research and practice, the energy efficiency pilot projects for residential building energy efficiency were successively undertaken in the “four high, four new” residential district, the state’s comfortable housing demonstration projects, and new wall materials and building energy efficiency piloting projects in Shanghai. Total residential housing designed and built based on the energy efficiency standard amounted to 1.07 million square meters in 2002, 3.19 million square meters in 2003, and will be over 6 million square meters this year. These efforts have elevated demonstration efforts.
5. Development of intermediary service agencies, and exploration of market-oriented operation.

The Shanghai Residential Building Energy Efficiency Certification and Testing Evaluation Office and Testing Center have been established.

6. Strengthened international cooperation and accelerated building energy efficiency process

Shanghai has established cooperation with relevant departments and organizations in France and Germany and received support from the US Energy Foundation. As a pilot city for building energy efficiency, Shanghai will further expand its international cooperation under the support of the Ministry of Construction.

In the past two years, over 8 million square meters of residential buildings in Shanghai have been designed and built based on the “Design Standard of Energy Efficiency in Residential Buildings in Transition Zone,” and resulting in significant energy efficiency. According to tests, the average energy efficiency is about 50 percent, the quality of the residential buildings is improved, and residents are comfortable.

II. Introduction to residential building envelope technology system and related projects suitable for Shanghai

Through the joint efforts of the relevant departments on scientific research, design, construction, and real estate development, we have been constantly exploring the energy efficiency technology system for residential building envelope based on practice. At present, the main systems are as following:

1. Exterior wall outer heat preservation system;
2. Exterior wall inner heat preservation system;
3. Exterior wall self-preservation system;
4. One-time pouring and pounding external heat preservation system;
5. Heat preservation measures for other parts of building envelope.

III. Main objectives and measures for accelerating future building energy efficiency work

This year’s objectives:
The projects designed and built according to the energy efficiency standard for residential and public buildings include:

- Residential building construction projects within the inner ring;
• Residential building construction projects that applied for “The State’s Comfortable Housing Demonstration Project” and “Shanghai Municipal New Wall Material and Energy Efficient Building Demonstration Project”
• Construction projects for low-rise residential complexes and one-city nine-town style residential district;
• Construction projects for office buildings, shopping malls and hotels, and the comprehensive buildings invested by Shanghai municipal government.

Objectives in 2005:
On a preliminarily basis, all new residential buildings and government-invested public buildings will be designed and built according to energy efficiency standards beginning from next year.

The promotion measures include:

1. Further intensification of information dissemination and training activities to increase the staff and public awareness and enthusiasm.

2. Conscientiously carrying out the mandates in the Document No.658 issued by three related commissions and one bureau in Shanghai in 2003, and striving to fulfill the energy efficient building targets within the time and region limit while speeding up executive legislation.

3. Accelerating the technological progress, expanding international cooperation, and continually raising the applied technological level on building energy efficiency in Shanghai.

4. Conducting research and investigation, and exploring the market oriented mechanisms.

5. Strengthening multi-faceted cooperation, pooling management efforts, and jointly pushing forward the building energy efficiency.
Energy Efficient Windows & Code Compliance in the U.S.
The NFRC Process for Obtaining Certified Ratings and Labeling Energy Performance for Fenestration Products (Windows, Doors, and Skylights)

Joe Huang, Lawrence Berkeley National Laboratory
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INTRODUCTION

The innovation that has occurred in the fenestration industry over the past two decades is astonishing: low-emissivity coatings and films, inert gas fills, low-conductivity spacers, and advanced frame materials and designs. These innovations responded to a demand for more energy efficient products, but presented a difficulty as manufacturers sought to take credit for the new technologies towards compliance with Energy Codes. Several problem areas were quickly identified. First, there needed to be a better rating system as the simple calculations of the past did not and could not adequately address the complexities of the present. Second, the new technologies did not lend themselves to visual inspection so there needed to be some way for the technologies to be verified.

The National Fenestration Rating Council (NFRC) was formed in 1989 to respond to a need for fair, accurate, and credible ratings for fenestration products. Fenestration products include all types of windows, skylights, and doors, both glazed and opaque: vertical sliders, horizontal sliders, casements, projecting (awning), fixed (includes non-standard shapes), swinging doors with frame, sliding patio doors with frame, glazed wall systems (site-built), sloped glazings, skylights, greenhouse/garden, dual action, pivoted windows, sidelites, and transoms. NFRC has adopted rating procedures for U-factor (NFRC 100), solar heat gain coefficient and visible light transmittance (NFRC 200), optical properties including emittances (NFRC 301), and air leakage (NFRC 400). To provide certified ratings, manufacturers follow the requirements in the NFRC Product Certification Program (PCP) which involves working with laboratories accredited to the NFRC Laboratory Accreditation Program (LAP) and Independent Certification and Inspection Agencies accredited through the NFRC Certification Agency Program (CAP). The complete NFRC program with the various checks to maintain a high degree of confidence and integrity is summarized below.

NFRC 100 was the first rating procedure approved and thus the first NFRC procedure adopted into State Energy Codes. Because it is also the most widely adopted, it is a good choice as an example to demonstrate the process. NFRC 100 requires the use of a combination of state-of-the-art computer simulations and improved thermal testing to determine U-factors for the whole product. Manufacturers seeking to acquire energy performance ratings for their products contact NFRC accredited simulation laboratories. These simulation laboratories use advanced computer tools to calculate product performance ratings in accordance with NFRC 100. To become accredited, each laboratory must demonstrate competence in the use of the computer programs used in the rating system and must meet strict independence criteria. Following computer simulation, a high-performing product (one within 20% of the lowest simulated U-factor in the matrix) from the matrix for each product line undergoes thermal testing to validate the computer simulations. The sample tested is required to be a production line unit (not a one-of-a-kind unit). The testing is performed by an NFRC accredited testing laboratory. These laboratories have demonstrated their ability to conduct NFRC thermal tests, are periodically inspected and evaluated by the
NFRC for continued competence, and are independent from any product manufacturer that they serve. Generally, if the test results are within 10% of the simulated values, then the simulated U-factors are considered validated and manufacturers have product ratings for that entire product line.

The next step is product certification. NFRC has a series of checks and balances to ensure that the rating system is accurately and uniformly employed. Products and their ratings are authorized for certification by an NFRC licensed independent certification and inspection agency (IA). The IA reviews all simulation and test information, conducts in-plant inspections, and provides secondary oversight to the manufacturer’s in-house quality control program. This helps to ensure that the rated products reaching the marketplace are built in the same manner as the product samples simulated and tested, that the appropriate product ratings and labels are put on the correct products, and that the manufacturer maintains an in-house quality assurance program. Licensed IA’s must demonstrate their ability to perform these services and meet strict independence criteria. The authorization for certification means that the manufacturer is able to have the product listed in the **NFRC Product Directory**. However, this does not mean that a product is certified. The actual act of certification occurs when the manufacturer labels the product.

Two labels are required: the temporary label which contains the product ratings and a permanent label, which allows tracking back to the IA and information in the **NFRC Product Directory**. In addition to informing the buyer, the temporary label provides the building inspector with the information necessary to verify energy code compliance. The permanent label provides access to energy rating information for a future owner, property manager, building inspector, lending agency, or building energy rating organization.

This process has a number of noteworthy features that make it superior to previous fenestration energy rating systems and correct past problems.

- First, the procedures provide a means for manufacturers to take credit for all the nuances and refinement to their product design, and a common basis for others to compare product claims.
- Second, the involvement of independent laboratories and the IA provides architects, engineers, designers, contractors, consumers, building officials, and utility representatives with greater confidence that the information is unbiased.
- Third, by requiring simulation and testing, there is an automatic check on accuracy. This also remedies a shortcoming of previous state energy requirements that relied on testing alone, which allowed manufacturers to perform several tests and then use the best one for code purposes.
- Fourth, the certification process indicates that the manufacturer is consistently producing the product that was rated. This corrects a past concern where manufacturers were able to make an exceptionally high quality sample and obtain a good rating in a test, but not consistently produce that product.
- Fifth, there is now a readily visible temporary label that can be used by the building inspector to quickly verify compliance with the energy code.
- Sixth, there is now a permanent label that enables future access to energy rating information.

While the program is similar for other fenestration characteristics, there are differences worth pointing out. The Solar Heat Gain Coefficient and Visible Light Transmittance ratings (**NFRC 200**), which have been referenced in several codes, are based on simulation alone.
The optical properties and emissivity (NFRC 301) are based on measurements by the manufacturer, with independent verification. The Air Leakage ratings (NFRC 400) are based on testing alone.

OVERVIEW OF PROGRAM DEVELOPMENT AND IMPLEMENTATION

The National Fenestration Rating Council (NFRC) oversees the process whereby fenestration products (windows, doors, and skylights) are rated and certified for energy performance in the United States. The NFRC Products Directory includes energy performance ratings for over 280,000 products from more than 400 manufacturers, with the list of participants growing every month.

The NFRC Board of Directors and membership have established seven standing committees to coordinate the development and implementation of the rating system:

- The Technical Committee is responsible for the research and development of each energy performance rating procedure.
- The Ratings Committee develops procedures for product certification and labeling and coordinates with code bodies, utilities, and state agencies on rating activities.
- The Certification Policy Committee and the Accreditation Policy Committee coordinate policy for product certification and laboratory accreditation, respectively.
- The Technical Interpretations Policy Committee interprets technical documents.
- The Public Relations Committee coordinates all communications and educational activities.
- The Research and Technology Committee oversees NFRC's research activities and work on optical thermo-physical properties.
- The Regulatory Affairs Committee monitors code and international activities, and works with NFRC's partners or voluntary programs.

NFRC ORGANIZATIONAL STRUCTURE FOR ACCREDITING LABORATORIES AND INSPECTION AGENCIES

The National Fenestration Rating Council, Incorporated (NFRC) consists of representatives from fenestration product manufacturers, major trade organizations, state energy offices, research organizations, utilities, specifiers, testing laboratories, energy consultants, and public interest groups. Its mission is to establish a fair, accurate, and credible national energy rating system for fenestration products and to ensure that the rating system is uniformly employed. The NFRC publishes electronically The NFRC Products Directory which contains descriptive energy rating for over 200,000 products.

NFRC has a 12-person Board of Directors and 7 standing committees whose chairmen are ex-officio members of the Board. NFRC staff oversee the day-to-day operation of the organization.

The Accreditation Policy Committee oversees laboratory accreditation of laboratories, including ongoing round-robin testing by the labs and inspection of the laboratories by NFRC staff. The Certification Policy oversees laboratory accreditation of inspection agencies, including annual review and inspection of the files of the inspection agency by NFRC staff.
OVERVIEW OF PRODUCT CERTIFICATION

Manufacturers seeking to acquire energy performance ratings for their products contact NFRC-accredited simulation laboratories. These simulation laboratories use advanced computer tools to determine product performance ratings. To become accredited, each laboratory must demonstrate competence in the computer programs used in the rating system and meet strict independence criteria.

Following computer simulation, an actual sample is taken randomly from each product line to undergo physical testing to ensure that the computer simulations provide an accurate representation of the thermal performance (U-factor) of the complete product line. This testing is performed at NFRC-accredited testing laboratories that have demonstrated their ability to conduct NFRC thermal tests. These laboratories are periodically inspected and evaluated by NFRC for continued competence, and are independent from any product manufacturer they serve.

Once agreement between the simulations and tests is established, manufacturers have product ratings for that entire product line. When the rating process is complete, the manufacturer is authorized to attach a temporary and permanent label to all products in the product line.

NFRC has a series of checks and balances to ensure that the rating system is accurately and uniformly employed. Products and their ratings are certified by an NFRC-licensed Independent Certification and Inspection Agency (IA). To certify performance, the IA reviews all simulation and test information, conducts in-plant inspections, and provides oversight for the manufacturer’s in-house quality control program. NFRC conducts annual inspections of each IA to ensure compliance with NFRC’s standards and procedures.

These checks and balances help to ensure that:

- rated products reaching the marketplace are built in the same manner as the product samples simulated and tested;
- appropriate product ratings and labels are put on the correct product; and
- the manufacturer maintains an in-house quality assurance program to support accurate and consistent energy performance ratings for its products.

Licensed IAs must demonstrate their ability to perform these services and meet strict independence criteria.
NFRC Organizational Structure for Accrediting Laboratories and Inspection Agencies

For more details, see the NFRC program documents at www.nfrc.org.
Financing Bus Rapid Transit: Options for China

By Walter Hook
With Extensive Input from Lloyd Wright and Oscar Edmundo Diaz
Institute for Transportation and Development Policy

Introduction

Financing is rarely a major barrier to BRT implementation. In comparison to other mass transit options, BRT’s relatively low capital and operational costs puts the system within the reach of most cities, even relatively modest-income cities in developing countries, and most of them do not require international or even national government support. Quito, Ecuador, for example, built a good quality BRT system, with a per capita income only around $1300 per annum, and built it entirely with municipal funds. Dar es Salaam, Tanzania is actively developing a BRT system, with per capita incomes only around $300 per annum, and though national and international funds will be needed, financing is not proving to be a stumbling block. Many Chinese cities have per capita incomes in a similar range to Ecuador. Most Chinese cities should be able to finance BRT systems entirely with their own resources, though for top quality systems support from the national government and international donors would obviously help.

Normally, the problem is not a financing problem but a problem of political commitment. If a city can afford to build highways and flyovers, it can also afford to build a BRT system. The real question is whether it can afford not to build them. Without BRT, the capacity of the road network will fall dramatically, as taxis and small private vehicles with very low capacity consume the scarce available road space.

Assuming a municipal or provincial government is committed to building a BRT system, the question changes from whether financing is available (it is), but rather what sort of financing makes most sense for a particular city.

When deciding on the best source of financing for a BRT project, the following key criteria need to be considered, not necessarily in any particular order.

a. How fast the money can be made available.
   b. How much local control can be retained over the BRT system
   c. The cost of capital
   d. The allocation of risk among stakeholders

Because these questions tend to be answered differently for different parts of a BRT project, financing for BRT is usually broken into three separate components. First, there is the financing for the planning and engineering of the system. Second is financing the infrastructure, and third is financing the procurement of the buses and the ticketing system.

For each stage of system development, there are basically the following options: a) local sources, b) national sources, c) international sources, d) private banks, and e) private investors.

The advantages and disadvantages of each of these sources of financing will be discussed for each stage, as they differ between the stages.
In our experience, the speed with which the financing can be arranged is often critical because one of the main reasons for the growing popularity of BRT is that it can show positive results within the single term of an elected municipal or provincial official, or between Party conferences, as the case may be. Often, mayors or governors rely on their own local funds because they can be mobilized more quickly than national, international, or private sources of funds.

Because the projects are frequently promoted with the intention of promoting the political career of specific politicians, these politicians want to be in full control of the project. Using municipal funds allows for the highest level of control over the funds and hence over the project. Using national funds and loans from international development banks sometimes means ceding some control of the project to national governments, diluting the credit for the project.

Many developing-nation cities tended to rely on their own resources because it is faster than getting money from the World Bank and other international donor agencies, and because these institutions were not financing BRT in the past. Recently, however, there has been a radical change in the thinking of the donor community, and the World Bank and other development banks are frequently ready to finance BRT projects.

Of course, in the past, municipalities tended to rely on their own sources of financing largely because national and international sources of financing simply weren’t available for BRT projects. In the last five years, however, an increasing number of national governments and international donor agencies have begun to finance BRT projects, while still ceding control over the project to municipal implementers.

The cost of capital is also a factor. If national development banks are offering infrastructure loans for municipal projects at lower rates of interest than international development banks, then municipalities may prefer these loans to international loans. Obviously if grant funds are available in a timely manner with few strings attached, these will be preferred.

For some elements of the project, particularly the procurement of the buses and the ticketing systems, more and more BRT systems are opting for private investment from bus operating companies. The main reason for this is that it costs the government less money, tends to reduce the bus procurement price, and ensures that the bus operators have a stake in maintaining and protecting the bus from damage. The allocation of risk between the state and private parties thus needs to be balanced with who is capturing the benefits from the system.
### Potential Financing Sources for BRT

<table>
<thead>
<tr>
<th>Activity Area</th>
<th>Financing Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Planning</strong></td>
<td>Local and national Sources</td>
</tr>
<tr>
<td></td>
<td>Bi-Lateral assistance agencies (e.g. GTZ, USAID)</td>
</tr>
<tr>
<td></td>
<td>United Nations Development Programme (UNDP)</td>
</tr>
<tr>
<td></td>
<td>Grants from the Global Environment Facility (GEF)</td>
</tr>
<tr>
<td></td>
<td>Loans from the World Bank and other Development Banks</td>
</tr>
<tr>
<td></td>
<td>Private foundations</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Local and national general tax revenues</td>
</tr>
<tr>
<td></td>
<td>Petrol taxes</td>
</tr>
<tr>
<td></td>
<td>Road pricing / congestion charging</td>
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<td></td>
<td>Parking fees</td>
</tr>
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<td></td>
<td>Improved enforcement of traffic regulations</td>
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<td></td>
<td>Land value taxation</td>
</tr>
<tr>
<td></td>
<td>Sales or leasing of commercial space near stations</td>
</tr>
<tr>
<td></td>
<td>Advertising</td>
</tr>
<tr>
<td></td>
<td>Merchandising</td>
</tr>
<tr>
<td></td>
<td>Commercial banks</td>
</tr>
<tr>
<td></td>
<td>Municipal bonds</td>
</tr>
<tr>
<td></td>
<td>World Bank</td>
</tr>
<tr>
<td></td>
<td>Regional Development Banks (e.g., ADB, IDB)</td>
</tr>
<tr>
<td></td>
<td>Emissions trading</td>
</tr>
<tr>
<td><strong>Equipment (e.g. buses)</strong></td>
<td>Private sector bus operators</td>
</tr>
<tr>
<td></td>
<td>Bus manufacturers</td>
</tr>
<tr>
<td></td>
<td>Bi-Lateral export banks</td>
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<tr>
<td></td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td></td>
<td>Commercial banks</td>
</tr>
</tbody>
</table>

### Financing of BRT Planning and Engineering

Prior to the opening of TransMilenio in Bogota, there was little international donor agency support and little national level support for the planning and engineering of BRT systems. Longer term advocacy efforts by ITDP, WRI, the Energy Foundation, the Hewlett Foundation, the Rockefeller Brothers Foundation, the Shell Foundation, W. Alton Jones Foundation, GTZ, and individuals inside the World Bank, suddenly changed the situation dramatically, in part because of TransMilenio’s success. This substantially increased the willingness of the Global Environmental Facility, the World Bank, US AID, and other donor agencies and development banks to finance the planning and engineering of BRT projects.

The Energy Foundation and the Hewlett Foundation have supported planning and design efforts in Beijing, Chengdu, Kunming, Xian, Mexico City, Sao Paulo, and Rio de Janeiro. US AID is providing about $2.5 million to ITDP for technical assistance to BRT projects in Delhi, Jakarta, Hyderabad, Accra, Dakar, Cape Town, and Dar es Salaam. GTZ financed some preliminary BRT planning in Surabaya, Indonesia, Bangkok, Thailand, and Dhaka, Bangladesh. The Shell Foundation supports the BRT planning in Mexico City and Shanghai, via WRI’s Embarq. The Swedish International Development Agency (SIDA) has supported efforts in Bangalore, India. Global Environmental Facility financing has been approved (via the World Bank) for BRT in Lima, Santiago (now dead), and Mexico City. UNEP GEF
support for BRT in Dar es Salaam, Nairobi and Cartagena, is pending. UNDP GEF support for BRT for in Dakar and Accra is pending. The Rockefeller Brothers Fund has supported ITDP’s technical assistance to review BRT plans for Guangzhou developed under the auspices of a World Bank loan. In the US, the national government through the US Federal Transit Administration began a national BRT program that started planning systems in 10 cities.

The cost of BRT Planning and Engineering

The cost of planning and engineering of the first phase of a BRT system can cost anywhere from $500,000 to $6 million. Now that many new things were learned in the Bogota TransMilenio project, probably $6 million is no longer necessary, and probably $500,000 is not enough. It depends on the size and complexity of the city and the system, on the quality of existing data, and the skill level of local experts. Some $2 million for planning is now a reasonable rule of thumb. In practice, the marginal cost of planning a BRT system can be close to zero because existing ongoing municipal or provincial budgets can sometimes be used.

It is not a good idea to try to save money on the planning costs. Proper planning can ensure that the system can be self financing almost into perpetuity with minimal ongoing maintenance costs, while poor planning can ensure that the project will never be self financing, and can cost the municipality hundreds of millions trying to fix the mistakes of poor planning.

As one BRT planner put it, BRT is performing heart surgery on your city’s clogged arteries. You should not go to the cheapest surgeon you can find, you should go to the best surgeon you can find.

Planning the system in-house is always the least expensive and the fastest, but requires municipal planning staff to be highly skilled. Quito, Ecuador probably spent the least money on planning, using only the existing budget and resources of the City Planning Agency, costing only about $100,000, but some costly mistakes were made. Bogota spent the most on planning designing the system. The costs are as below:

<table>
<thead>
<tr>
<th>Firm Contracted</th>
<th>US$</th>
<th>Paid By</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKinsey</td>
<td>3,569,231</td>
<td>UNDP</td>
</tr>
<tr>
<td>Investment Bank</td>
<td>192,308</td>
<td>Department of Transport</td>
</tr>
<tr>
<td>SDG</td>
<td>1,384,615</td>
<td>Department of Transport</td>
</tr>
<tr>
<td>Landscape Designs</td>
<td>115,385</td>
<td>Department of Transport</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,261,538</td>
<td></td>
</tr>
</tbody>
</table>

Bogota spent some $5.2 million on the planning and engineering alone. This money was well spent, as the system is highly profitable.
Sources of Planning Funds

-----Bogota

In Bogota, the largest contract was for a management consultant firm, (McKinsey), to manage the whole project and set up TransMilenio, the operating authority. This was about $3.6 million. For about three years the City of Bogota had an agreement with UNDP that the Municipality would pay a fixed amount of money into a UNDP account for international technical assistance for a range of support needs. This money came the amount did not change, it was already allocated, and its use was simply defined to hire a management consultant for the BRT system. The source of the funds was general municipal budget. The planning, design, and engineering work (another $1.5 million) was paid for largely out of the ongoing budget allocations of the Department of Transportation, but it was sub-contracted out to a world-class transportation planning firm, (Steer Davies Gleave) who in turn subcontracted some experts from Brazil (Logit). There were no costly mistakes in Bogota that have had to since be corrected, and the system is fully financially self financing and even profitable, so the money spent on planning has in fact saved the city millions of dollars into perpetuity.

-----Quito

Like Bogota, Quito used ongoing budget resources to finance all of the planning. Other than for one international UNDP expert brought in during Phase II (David Briggs,) all of the planning and design work was done in-house by the Planning Department of the Municipality of Quito under the leadership of Cesar Arias. The costs were much lower than in Bogota, and are difficult to control for, as they were covered by the normal ongoing budget of the planning department, but informal discussions with Mr. Arias indicate it was on the order of $100,000. In Quito, on the first BRT corridor, there were three mistakes made that have cost the Municipality millions of dollars and have consumed an unnecessary amount of road space. First, the first system used electric trolleybuses. This cost some $3 million per kilometre (Maybe $30 million in total) more than had they used clean diesel, largely due to the cost of the vehicles and the conduit. Secondly, because electricity prices have since increased, the system is not profitable. As a result, the municipality had to pay for the buses, rather than the private operators, costing the taxpayers another $20 million or so. Third, the operating company is not self financing since electricity prices were increased with price decontrol. As a result the operator is making deficits every year. Thus, more money should be spent on proper planning to ensure the system was self financing and appropriate technology selected.

-----Cape Town

After initial promotional work from ITDP from US AID, BRT plans in Cape Town are being financed entirely by provincial government and municipal government funds. Cape Town contracted Steer Davies Gleave for about $250,000, and a management consulting firm, Terence Smith and Associates, to do the detailed planning. The corridor is also being planned with top quality bicycling and pedestrian facilities, and another $250,000 in planning contracts allocated to five local architecture and civil engineering firms.
-----Mexico City,

Planning for a BRT system in Mexico City has attracted considerable international donor support. Total spent must be over $1 million but the exact figure we don’t know. The detailed planning work for two BRT corridors in the Federal District and very preliminary analysis in the State of Mexico was financed by a World Bank-sponsored grant from the Global Environmental Facility. The Federal District used this money to hire local consultants to develop designs on the Insurgentes (Getinsa) and Eje 8 (Eteysa). The Shell Foundation and the Hewlett Foundation paid for the review of the plans in the Federal District by international experts, primarily through WRI-Embarq’s Center for Sustainable Transport, and partly (for the pedestrian access) through ITDP. The State of Mexico plans were paid for initially by GTZ which subcontracted Cali Mayor. ITDP paid for international experts to review these plans, and to prepare a financing plan for the system (available). The State recently contracted the firm of Jaime Lerner, former Mayor of Curitiba, to do another pre-feasibility study, but it is not yet a detailed engineering design.

Currently, the intervention by WRI Embarq’s Center and ITDP were successful in forcing changes in the plans by the consulting firms contracted by the Municipality, but the final corrected plans have not yet been released.

-----India

In Delhi, about $500,000 has been spent on planning the Delhi High Capacity Bus System. The financing for planning in Delhi came roughly from three sources: the Delhi Government’s general tax revenues, a grant from US AID to ITDP, and a general grant from the Volvo Foundation to the Indian Institution of Technology’s Transportation Research and Injury Prevention Program (IIT TRIPP). The funds from the Delhi Government (now about $300,000 for the seven corridors) were used to contract out to IIT TRIPP, and to RITES, a parastatal planning firm for detailed engineering. This was supplemented by funds from US AID through ITDP to IIT TRIPP and to international consultants. The municipality did not initially accept the need for a demand analysis and operational plan prior to the infrastructure design process. In our opinion, because the design has been made without a clear demand analysis, the system is going to needlessly congest the mixed traffic lanes, though the busway passengers should see improvement in their travel times. The “cost” of this design flaw (which we tried and tried to get changed) will be in the form of congestion imposed on the mixed traffic (fuel consumption and time lost).

Hyderabad, India, has also signed an MOU with ITDP to do a pre-feasibility study for BRT, which will be done with US AID funds and will cost roughly $150,000. This is just in the beginning stages. Bangalore, India, reportedly has a BRT plan financed by the Swedish International Development Agency (SIDA). It proposed a low-grade, curb-side bus lane that is not really a BRT system.

-----Jakarta, Indonesia

Jakarta’s TransJakarta system was planned with funds from the provincial government supplemented with US AID funds to ITDP for review of the plans by international consultants. The municipal government contracted out three local consulting firms, Pamintory Cipta, Ernst and Young, and the University of Indonesia’s Center for Transportation Studies (UI CTS) for different elements of the planning. Total spending on
planning and detailed engineering will total around $1,000,000 for the whole system. US AID funds to ITDP financed all the international expert review of the local plans, as well as sub-contracts to the UI CTS to complete the demand modelling, as well as support to the NGO Pelangi for public relations and socialization of the project.

There are technical problems with the TransJakarta system, but they resulted not from the shortage of funds available for planning. The system is designed with insufficient capacity for the demand in the corridor, the routing structure of the existing buses were never changed, the ticketing system failed, the buses were procured by the Municipality rather than the private sector, the road was not paved with concrete, and no functional feeder bus system was established. As a result, ongoing maintenance costs are too high, the operations are not self-financing and need to be subsidized on an ongoing basis, the mixed traffic lanes are needlessly congested, the city paid too much for the buses, and the busway itself congests at the terminals. These needless costs are all the result of poor planning (and decision-making driven by private and political concerns rather than technical concerns), but not the result of the lack of availability of funding for the planning.

-----Dar es Salaam, Tanzania, and Dakar, Senegal

In Dar es Salaam, planning for the new BRT system there is being financed by four sources. The largest share, roughly $1 million, is coming from a loan from the World Bank as part of a larger loan package for a Central Roads Corridor improvement project. Another $500,000 is likely to come from the Global Environmental Facility of UNEP, though this has still not received final approval. Securing funds from the UNEP GEF has taken over two years and consumed large resources and still have not been secured. The Municipality has dedicated another $300,000 per year for planning for two years in a row. Another $100,000 is coming from US AID via a grant to ITDP.

In Dakar, the planning done to date has been financed by a US AID Grant to ITDP, and complimented by a UNDP GEF PDF.A. ($25,000) grant to prepare a $1 million proposal. While World Bank funds for BRT planning are ostensibly available in Dakar from a World Bank loan, the project sponsor (CETUD, a transit authority created by the World Bank) has not authorized the re-programming of these funds for BRT planning. The planning is in the early stages. Likely further support will come from the UNDP GEF, the Municipality of Dakar, US AID, and possibly French development assistance.

----US BRT

In the US, since the 1970s, the Federal Government has been heavily involved in subsidizing bus procurement and bus operations. There is a national BRT program under the US Federal Transit Administration that provided several million dollars in matching funds for BRT planning in 10 pilot cities around the country, including Los Angeles, Honolulu, Pittsburgh, Charlottesville, and Eugene. The New York State Department of Transportation also just issued the Terms of Reference for a $2.5 million BRT study for the New York Metropolitan Region.

-----China

In China, technical support in Kunming came originally from the Swiss Government via the Zurich Sister City Project. Technical support to Shejiazhuang came from the World Bank.
Technical support to Beijing, Chengdu, Xian, and Kunming is coming from the Hewlett Foundation and the Energy Foundation. Matching support has been provided in most cases by the municipalities. Most of China’s larger cities have one and often two urban transportation planning and design institutes. These urban design institutes or traffic planning institutes have hosted a number of BRT events, and have expressed considerable interest in focusing on BRT. They often have very talented experts. Their time, however, is tightly controlled by the agenda of the Mayor. When a Mayor has made a decision to design a BRT system, they are normally able to allocate sufficient resources to cover their own planning costs. The Mayors have expressed interest in receiving international technical support. If the Mayor is committed, they can find the level of resources required to hire top quality international consultants.

In the case of China, efforts to secure GEF financing have not been successful. The China GEF program prefers large scale projects, and thus the Chinese Government has not wished to use GEF funds for BRT, though the GEF Secretariat has expressed interest in supporting BRT in China.

**Financing of BRT Infrastructure**

**Costs of BRT Infrastructure**

The most significant public cost of a BRT system is the construction of the infrastructure. As with planning, the cost of the infrastructure can vary greatly based on the quality of the system being designed, the state of existing roadways, the terrain, and other factors. In almost all cases to date, BRT infrastructure has been paid for with public rather than with private funds, and the financing mechanisms do not differ greatly from the way that any road or bridge construction is financed.

Bogota’s TransMilenio by many measures is the state of the art system, and it is also by far the most expensive. Phase I of Bogota’s TransMilenio cost $6.9 million per kilometre. Phase II is costing over $13 million because they decided to build some new bridges, a new highway interchange with the BRT system, some tunnels, and had to do some land acquisition. These items can dramatically escalate your costs.
<table>
<thead>
<tr>
<th>Component</th>
<th>Total Cost (US$ Million)</th>
<th>Cost/Km (US$ Million / km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studies and designs</td>
<td>4.01</td>
<td>0.09</td>
</tr>
<tr>
<td>Exclusive Ways</td>
<td>36.69</td>
<td>0.87</td>
</tr>
<tr>
<td>General traffic</td>
<td>36.13</td>
<td>0.85</td>
</tr>
<tr>
<td>Public space</td>
<td>28.29</td>
<td>0.67</td>
</tr>
<tr>
<td>Stations</td>
<td>25.51</td>
<td>0.6</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>16.57</td>
<td>0.39</td>
</tr>
<tr>
<td>Terminals</td>
<td>15.72</td>
<td>0.37</td>
</tr>
<tr>
<td>Parking and</td>
<td>17.16</td>
<td>0.40</td>
</tr>
<tr>
<td>Properties</td>
<td>29.18</td>
<td>0.69</td>
</tr>
<tr>
<td>Network services</td>
<td>18.57</td>
<td>0.44</td>
</tr>
<tr>
<td>Maintenance</td>
<td>18.57</td>
<td>0.54</td>
</tr>
<tr>
<td>Roads for feeder</td>
<td>15.28</td>
<td>0.36</td>
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<tr>
<td>Control Center</td>
<td>3.33</td>
<td>0.08</td>
</tr>
<tr>
<td>Others</td>
<td>22.85</td>
<td>0.54</td>
</tr>
<tr>
<td>TOTAL TRUNK LINES</td>
<td>292.2</td>
<td>6.89</td>
</tr>
</tbody>
</table>

As with planning, while the costs of implementation will vary considerably based on local circumstances, probably only a fairly poor system can be built for less than $2 million per kilometre, and in most cases more than $5 million is usually not necessary.

One of the major considerations is the volume of transit traffic the busway has to accommodate. Bogota’s TransMilenio required a capacity of over 45,000 passengers per direction at the peak hour, which required two full lanes in each direction, and multiple stations at each stop, which increased the construction cost. Another major consideration is whether or not to reconstruct the entire roadway. BRT systems do impose heavy wear and tear on roads, and because repairs often require shutting down the system for a time, it is advisable to use materials able to withstand a maximum axle load with minimal repairs. Concrete is sometimes used for the entire roadbed. At a minimum the roadway in front of the stations should be in concrete. Often BRT systems are put in when a major road is due for a scheduled rehabilitation. In this way, the major of the cost can be covered from the ongoing capital budget. Another factor is the quality of sidewalks, bike paths, public space, street furniture and other amenities in the corridor. Bogota dramatically improved the TransMilenio corridors, not only for buses but also for cyclists, pedestrians, and for public
parks. All of these costs are folded into the overall cost per kilometre. These measures make a big difference in terms of the attractiveness of the system.

On the low end, BRT systems like Taipei, Kunming, Jakarta, or Porto Allegre, where existing streets are simply converted to busways, the cost is less than $1 million per kilometre. To some extent you get what you pay for, however. Most of these systems did not build platform-level pre-paid boarding stations at each stop, though Jakarta did. Most of them did nothing to improve the cycling and pedestrian environment in the corridor, though Kunming retained good cycling amenities. Most of these systems did not use concrete in the roadbed, (Quito uses it only at the stations), and as a result the roadway is rapidly deteriorating and has to be maintained on a weekly basis, adding tremendously to ongoing maintenance costs.

Some systems, like the one being planned in La Paz, Bolivia, are investing in the bus stations as if they were pieces of municipal art. As such, the aesthetic qualities of the bus stations, and landscaping in the corridor can vary greatly depending upon the wishes of the municipality.

**Sources of Financing for BRT Infrastructure**

Virtually any source of financing that has been traditionally used for major road projects or metro projects could be used to finance BRT infrastructure. Any city looking for financing for a BRT project should first look to the sources of financing currently being used in that city for major infrastructure projects. Because the costs of actually building BRT systems are much higher than for the planning, the range of funding possibilities is more restricted.

Like with the planning and engineering, in the early years of BRT (basically until 2000), virtually all BRT infrastructure was paid for by municipal governments, sometimes with modest support from national governments, using traditional sources of financing for major infrastructure projects. Recently, an increasing number of national governments have begun to finance BRT projects in municipalities, and an increasing number of large development banks, principally the Inter-American Development Bank and the World Bank, have gotten involved in financing BRT infrastructure.

Because Bus Rapid Transit exists in something of a netherworld between a Metro and a simple busway, the relevant role of the national government in BRT remains a subject of debate in a growing number of countries. Metro projects, because they are so expensive, almost invariably involve high levels of national government investment or they are impossible to implement. With BRT the necessity and advantages of involving the national government depends on local circumstances.

Lack of national government financing in developing countries for BRT is partly a result of the general withdrawal of the national government from the bus sector in the 1980s and 1990s. National level support for urban mass transit in Africa, Asia, and Latin America general enjoyed a brief upswing in the 1960s and 1970s. The vast majority of this money went to setting up and sometimes also operating bus systems. By the 1980s and 1990s, most of these nationally financed bus systems had all been transferred to municipal control and/or collapsed. In India and Mexico City large bus systems passed from national to municipal control, and shrank in size as private operators took more of the market. By and large, by 2000, the national governments had withdrawn from the bus sector.
Today, in the developing world, there is a growing consensus that national governments could play a role in financing urban bus system infrastructure like BRT, but not their operation or the procurement of buses. National level support should be restricted to supporting municipalities in the construction BRT and other bus-related infrastructure, but that the systems should be under private operators managed by municipal governments.

In the developed world, where normal bus operations are rarely self-financing, it is fairly typical to have national level support for these systems as part of general social welfare policy or transportation policy. In the US, 2% of the national gasoline tax is set aside to finance urban mass transit. Some 10 low-order BRT projects have been financed by the US Federal Transit Administration, which controls that part of the 2% of the gasoline tax earmarked for mass transit that is not further manipulated by congressional earmarks. In Europe, national governments are also supporting lower level BRT systems through normal channels through which national government subsidies to mass transit are provided.

Only a few national governments in the developing world that we know of (Colombia, possibly Ecuador) provide grant funds from national tax revenues to municipalities specifically for financing BRT infrastructure. Nevertheless, where national governments have become involved in financing metro systems, and where BRT is known as a viable alternative, (India, Mexico, Brazil, Chile) there have been considerable debates about allowing national government financing of both BRT and metro projects on a fair competitive basis, but to date only Colombia has made this decision, no doubt based on the phenomenal success of TransMilenio.

A few more national development banks provide loan funds to municipalities for BRT infrastructure (Brazil, under discussion in Mexico). In some places national road funds (often based on gasoline tax revenues) are distributed to provincial, state, or municipal level governments, where the use of the funds is under the discretion of the local or provincial government, and these funds are being used to build BRT systems (Cape Town, USA, potentially Dar es Salaam).

The Inter-American Development Bank was probably the first to finance BRT projects. They financed Phase II and Phase III of Curitiba and several other Brazilian cities, and Panama City, San Salvador, and other cities are under discussion.

The World Bank is also playing a growing role in financing BRT infrastructure (Lima, Shejiazhuang, 5 cities in Colombia including Bogota, and Dar es Salaam, Dakar, Accra, Addis Ababa, and Santiago are under discussion).

The Asian Development Bank was not traditionally involved in Urban Transport, but this is changing and they have expressed some preliminary interest in Qiongqing and Xian.

Private foundations do not generally have the resources to actually build BRT systems in most cases. Bi-lateral aid agencies, and the Global Environmental Facility to date have not financed the actual infrastructure of any BRT projects, but the possibility should not be ruled out.
-----Bogota

In Phase I of Bogota’s TransMilenio, which is currently the most expensive BRT system and also the best, a combination of international, national and local sources were used to finance the infrastructure, with the vast majority of funds coming from local sources. As Bogota is moving on to Phase II, the level of international and national level financing has increased dramatically.

The details of local financing for Bogota are as follows:

- **Local fuel surcharge (46%)**: There is a Colombian national law that allows City Councils to approve a surcharge on gasoline. In 1997, the maximum a municipality could charge was 25%. However in Bogota, the City Council had set it at only 10%. When Penalosa was elected Mayor, he convinced the City Council to take the surcharge to its maximum, and earmarked the extra 15% to go to the construction of Mass Transportation solution. The city law approved a surcharge of 25%, of which 15% would go the Mass Transportation system. In 2003, President Uribe raised the maximum surcharge to 30% and Bogota has already increased it to this new level, assuring resources for the future phases. Other Colombian cities are doing the same, especially those in which BRT systems will be built.

- **General Local Revenues and De-Capitalization of the Power Company (28%)**: The Power Company is 51% owned by the municipality and the rest is private. In 1997, the company had an excess of cash, and decided to de-capitalize it. Some of these sources financed TransMilenio infrastructure.

- **World Bank credit (6%)**: This was an initial credit given to the City of Bogota (with the authorization of the national government) to build a low-grade busway on Calle 80. They had to change the terms of the loan in order to be able to use it to build a TransMilenio corridor.

- **National Government (20%)**: Penalosa signed an agreement with the National government to finance Bogota’s Mass Transportation system in which the National government secured sources to pay for TransMilenio’s infrastructure. For Phase I, it only accounts for 20%, but for the upcoming phases the National government should pay for 60% of the infrastructure and the city the 40% left.

-----Brazilian Cities

Today, in Brazil, there are currently no national grant funds available for the construction of BRT systems, though there are extensive funds available for the Brazilia, Rio, and Sao Paulo subway systems. This has been a source of ongoing political contention, and there are possibilities that the law may change. With decentralization of financing in Brazil, however, the national government has played a much less pronounced role in urban financing in general since 1988.

When BRT was first developed in Curitiba in the 1970s, everybody thought that the Mayor Jaime Lerner was crazy, so financing was difficult to secure, and the municipality had to rely on its own resources for financing. With the success of the project, the Inter-American Development Bank agreed to provide the financing for Phase II with national government approval. Curitiba is a fairly wealthy city in Southern Brazil, with per capita incomes similar to southern Europe.
In Sao Paulo, there are BRT systems under both the control of the municipality and of the state, depending on who financed them. Because they are under the control of different political parties, there is no shared financing, and coordination problems are a serious issue. There has been no direct national level grant support for BRT in Sao Paulo. There is a state infrastructure bank, however, called BNDES, which provides low interest loans for infrastructure, and BNDES is financing several of the new BRT corridors in Sao Paulo.

There was an effort in Sao Paulo to convince private bus operators to invest in bus infrastructure. In exchange for a monopoly concession in one corridor, a private operator agreed to build some new bus stops and provide nice street furniture and other amenities. This was not a full BRT system. In the end, the municipality did not enforce the company’s monopoly, and they could not win any compensation from the city for violation of contract. This experience has soured the idea of Public Private Partnerships in BRT infrastructure provision in Brazil.

-----India

In India, the national government played a very important role in financing the Delhi and Calcutta metros. Prior to 1998 or so, virtually no one in India had ever heard of BRT. When the national government learned of BRT as a viable option, there was an extensive debate over whether the eligibility criteria for national government financing should be extended to include BRT, but before the law was finalized the BJP lost the national elections and a national urban transport policy is still under debate.

While no BRT system has yet been built in India, the Delhi Government has just agreed to finance the first 5.9 km stretch out of general tax revenues.

The Municipality of Hyderabad is at the early planning stages and infrastructure financing has not been discussed, but an unallocated $10 million from a failed large scale GEF transport project for hydrogen fuel cell buses, possible World Bank loans, and national, provincial, and local sources are being considered.

-----Mexico City

In Mexico, because of the financial crisis several years ago, the cost of getting international loans is very high. For this reason, the Federal District of Mexico, when it pays for major infrastructure projects, takes out commercial loans from private banks, which are cheaper than loans from the World Bank after the national bank BanObras adds all their national charges. As a result, Mexico City is planning to finance the infrastructure in Insurgentes Corridor by loans from commercial banks.

In the Estado do Mexico, which is so heavily indebted that it cannot get loans from a commercial bank, three sources of potential financing for the BRT infrastructure have been identified. First, the municipalities in the State of Mexico through which the busway passes still have viable credit, and they will pay for roughly 30% with either loans from commercial banks or from the World Bank channelled through the state development bank BanObras. Secondly, roughly 30% would be paid for by a special loan facility at BanObras set up to facilitate Public Private Partnerships. Third, the possibility is being explored of using the projected farebox revenue to back a bond issued by an investment bank and guaranteed by the smaller municipalities and by the national development bank BanObras. This is all being
done because the State is bankrupt, and because the State does not want to impose tolls on some new motorways being planned in the State.

Because of the poor credit rating of the Estado do Mexico, the cost of commercial credit will be high, so the financing costs done in this way will be high. The use of fare-backed bonds has no track record in Mexico. They have been used in the US without significant problems, though we would normally discourage them because they encumber the new BRT system with debts from the very beginning.

-----Infrastructure Financing Discussions in African Cities

In Cape Town, the $70 million allocated to constructing phase I of the BRT corridor is coming primarily from Provincial level road funds, which in fact are collected and distributed at the national level but controlled by the province.

In Dar es Salaam, the municipality does not have the financing to build the system on its own. The most likely scenario for financing the BRT infrastructure is a combination of municipal funds, sub-municipal funds (there are three sub-municipalities in Dar es Salaam), a new World Bank loan, and national government road funds. The World Bank has expressed considerable interest in financing the infrastructure but has cautioned that the process is slow. The Mayor would like construction to begin by the fall of 2005 for political reasons, and wants it built by 2006. World Bank financing could probably not be organized in such a short time. There is a national level road fund in Tanzania which could probably finance the system over two years from national gasoline tax revenues, but would probably require that the national government take some control over the project, and it is not clear if the political support for this exists.

Many bi-lateral donors are also active in the roads sector in Dar es Salaam, particularly the Danish, the European Union, and the Japanese. For this reason, when the detailed plans are completed, they will be presented at a donors conference to see whether other sources of bilateral aid may be faster than going through the World Bank.

In Dakar and Accra, the most likely source of financing is a new World Bank loan, the negotiations for which are scheduled to begin next year in any case. In both cities, the World Bank has expressed a high level of interest in financing the BRT systems.

-----Jakarta

In Jakarta, the infrastructure was all paid for by the DKI Jakarta Government. DKI Jakarta is a special administrative district with the status of a province, but there is no viable sub-municipal government structure. The Regional Parliament voted on and approved the financing. The infrastructure in the first phase cost around $10 million. It is widely accepted that this was not enough money to improve the sidewalks, change the intersection configurations, and make other necessary changes. An appropriation for about $70 million for the second corridor is going before the Regional Parliament in November following the national elections. There were no national or international funds involved in financing the infrastructure.
-----The US

The US BRT systems that have been built (Honolulu, Eugene, Pittsburgh, Los Angeles) and those being planned have been financed with a combination of national government subsidies and municipal and state bonds. Some 2% of the national gasoline tax revenues are earmarked for urban mass transit, and administered by the US Federal Transit Administration (US FTA). US FTA provided some capital grants for these BRT projects. The rest of the money came from state and municipal governments. State and municipal governments in the US finance most capital projects through municipal or state bonds. These financial instruments are less used in developing countries, but they are gradually spreading to emerging markets. Prague and Krakow have recently issued municipal bonds for urban mass transit projects.

-----China

In China, the infrastructure for the Kunming BRT system was financed by municipal funds. It cost only about $8 million for a 12km system. The bus shelters were paid for by advertising companies in exchange for the rights to display advertising at them. In Shejiazhuang, funds for a variety of urban transportation needs were provided by the World Bank for urban level projects.

Several World Bank loans in Chinese cities, such as the Guangzhou City Center Transportation Project and the Shanghai Municipal Transportation Project, both included funds for busways, but these components of the loan were never implemented for lack of political commitment. The World Bank nonetheless remains very supportive of BRT projects in China. The ADB has also expressed interest in financing BRT infrastructure in China.

While the Chinese national government currently provides grant financing for metros, no similar grant financing is yet available for BRT projects. Nonetheless, municipalities should approach the national government for such financing to demonstrate local commitment to BRT.

China also has several state development banks that are providing loans at very low interest rates for toll roads and other major infrastructure projects which generate a revenue stream. While thus far they have not been used for BRT projects, this possibility should be explored.

**Financing the Buses in BRT**

Buses used in BRT systems range in cost from standard buses (as low as $30,000 in India to as high as $250,000 in the developed world), to articulated buses such as those used in Bogota (between $100,000 and $250,000), to those di-articulated Euro III buses used in Curitiba (over $500,000), to hydrogen fuel cell bus driven di-articulated buses with optical positioning systems (over $1 million).

Financing options for bus and ticketing system procurement for BRT systems are quite different from the options available for the planning and construction of the system. The main difference is the much greater role played by private investment, private banks, and bilateral export credit agencies.
Not all BRT systems invest in new buses. Some of them simply use the existing buses and give them special bus lanes and special treatment at traffic signals. However, generally higher-end BRT systems are used to modernize bus fleets.

In those systems where new buses were procured, in Bogota, Curitiba, Leon, and in the second line in Quito, private operators paid all of the cost of bus procurement. These private operators in turn secured financing from export credit agencies (Bogota Phase I), local commercial banks (Bogota Phase II), and national development banks (Curitiba Phase III).

In Jakarta and Delhi (to date), in Quito Line I, and in all systems in developed countries, the municipality (sometimes with national financing) procured the buses. In the case of Quito Line I, the Spanish export credit agency provided the financing to the municipality. In Delhi, the possibility of receiving loans for bus procurement from a national development bank ICICI has been discussed, but the bus procurement process has not been finalized. In the Jakarta case, there was no international or national development bank involved.

-----Bogota

In Bogota, the Municipality was committed from the very beginning to forcing the private bus operators to pay for the buses and for the private ticketing system operator to pay for the ticketing system, and it was determined not to provide a credit guarantee to the operators. This was not, however, a simple task. The bus companies that won the bids to become the trunk and feeder bus operators in Bogota were newly formed companies that hitherto were just loose affiliations of small independent informal sector bus operators. They had no credit history, and it was difficult to secure bank loans.

Despite the personal appeals of the Mayor, the Colombian banks refused to finance their bus procurement. Ultimately, the loans were procured from the Brazilian export credit agency, as the buses being procured were initially assembled in Brazil. As it turned out, all of the bus companies that were able to supply buses that were in compliance with the technical specification set by TransMilenio were assembled or manufactured in Brazil, in the end, the Brazilian export credit agency provided the loans, largely at the behest of Daimler Chrysler’s Brazilian subsidiary. This Bank also required that the bus operating companies secure insurance on the rolling stock from local sources, which imposed an additional cost to the operator, but after many headaches, this was arranged.

After the financial viability of TransMilenio was proven, it was much easier for private operators with a contract to operate a TransMilenio trunk route to get financing for bus procurement from commercial banks. By the time Phase II began, the private operators were able to get commercial bank loans for bus procurement without municipal guarantees without any difficulties.

-----Curitiba

In Curitiba, by the time the BRT system was built, the private bus operators had already been formed into formal sector bus operators during an earlier round of bus sector reforms in the early 1960s. As such, these bus companies already had a relationship with private banks and had been operating profitable companies for many years. Curitiba’s BRT system awarded the operating contracts for each trunk line to the same bus companies that had for more than a
decade had a monopoly over bus operations in the same corridor. As such, the private bus companies had more investment capital of their own, and more ready access to bank loans.

When Curitiba recently decided to upgrade to Euro III vehicles and to a di-articulated bus, for which there is only one monopoly supplier (Volvo), the cost was prohibitive nonetheless for the bus operators. At this point, the private operators got loans from BNDES, the national development bank, to finance the bus procurement.

-----Quito

In Quito’s Line I, the municipality decided to go with electric trolley bus, which was much more expensive for both the vehicles and the electric conduits. Because of these costs, it proved impossible to find private investors for the vehicles. They were paid for and sourced by the Municipality. Quito held a competitive bid, and part of the cost determination was whether the vehicle came with financing and ongoing service support. Russian, Spanish, and Brazilian companies bid. The Spanish won the bid largely because they secured very low cost financing from the Spanish export credit agency.

In Quito Line II, standard diesel articulated buses were used, as in Bogota. The private bus operators consortium that was awarded the contract to operate Line II did not agree to pay for the buses, so the contract for the operating company requires that a percentage of the profits be repaid to the Municipality for leasing the buses. Because demonstrating the operating companies profitability has proven difficult, there are ongoing disputes between the operating company and the Municipality about the profit levels, and the private operator thus far has refused to pay anything for leasing the buses.

Other Possible Sources of BRT Financing

Commercial Revenues from Advertising and Concession Stands

The inherent attractiveness of the new transit system can open up new commercial opportunities that will produce positive revenue streams. Commercial development of stations, advertising, and merchandising are just a few the creative mechanisms that the city can take advantage of to generate additional revenues.

As strategic nodes for development and commercial enterprise, BRT systems also present many opportunities for commercialisation. The space inside and around stations and terminals holds particular value given the high volumes of persons passing through the system. Curitiba’s BRT system earns significant revenues from the leasing of shops in the transfer terminals, though some additional costs associated with cleaning the station are incurred.

Curitiba also did some land banking in the BRT corridor. By purchasing land along a new BRT corridor, and then selling part of the land after the land appreciated in value, Curitiba was able to raise money to finance high density moderate income housing in transit-friendly locations. Mass transit systems in cities such as Manila and Bangkok have used the leasing of commercial space adjacent to stations to help fund infrastructure costs. In Jakarta, real estate development rights are being used to attract investment into a new monorail project.
Likewise, the selling on advertising space at stations and within buses is often done. Kunming covered the entire cost of the bus station stops with investments from an advertising company in exchange for the right to control the advertising at the stations. Other BRT authorities in Brazil lease out the advertising space and raise revenue from the sale of advertising. Delhi is also considering selling advertising space at BRT stops.

However, the commercialisation of the system must be done with caution. Commercial signage should be discretely done, if at all, or it will risk degrading the visual and aesthetic quality of the system. When commercial signage overwhelms stations and buses, then customers are less able to distinguish signage relating to system use. The general despoiling of the aesthetic quality of the system can lower the image of the system, which is directly related to customer satisfaction and usage. Visual degradation can also lead to increased incidences of graffiti, vandalism and other criminal activities. Bogota decided not to include advertising of the system.

Some BRT systems like TransMilenio have achieved such a positive status within their communities that revenue opportunities exist with system merchandising. The sale of system t-shirts, model stations and buses, and other souvenirs can in fact provide a reliable revenue stream. The marketability of the system relates back to the quality of the initial marketing impression (system name, logo, etc.) as well as the degree of social pride attained through the delivery of a high-quality product.

Sources of Financing that Would Simultaneously Encourage BRT Use

Because part of the point of BRT is to help encourage people to take public transportation instead of driving private motor vehicles which congest the streets, it is worth considering using financing options that would simultaneously support this goal through fiscal incentives.

Nationally and municipally collected gasoline taxes were used in Bogota, Cape Town, and other cities, and have the advantage of also marginally discouraging private motor vehicle use and increasing the relative attractiveness of a BRT trip.

While the following have not been specifically used to finance BRT systems to our knowledge, they have been used to increase general municipal revenues and indirectly financed BRT planning and infrastructure:

- Road tolls and congestion pricing
- Parking fees
- Enforcement of traffic regulations
- Land-valuation taxation

Toll road revenues collected by municipalities can occasionally be used for transit capital projects. In New York, for example, the toll revenues collected by the Triboro Bridge and Tunnel Authority are used to finance municipal bonds for capital projects of the New York City Transit Authority.

Congestion charging and electronic road pricing has served as a highly effective revenue stream for public transport projects in London and Singapore, including bus priority measures, and they have the additional benefit of more efficiently distributing traffic both temporally and spatially. Jakarta and Sao Paulo are also currently actively discussing congestion...
charging as a viable option for raising additional municipal resources which would partly be used for financing BRT investments. Because they can be collected and administered locally, they have the additional benefit of being under the control of the mayor or governor.

However, road pricing schemes also need to be planned carefully, and the start up planning time and the initial capital investment require this project to be implemented in its own right and not as a merely a source of financing for a BRT project.

Parking fees can be equally as effective in discouraging vehicle use as road pricing, but the relative ease of implementation of parking restrictions makes parking control a more viable short- and medium-term option. Dar es Salaam has successfully sold a concession to a private parking operator for on-street parking, and the revenue from this concession is indirectly financing the BRT project. The city of Cuenca (Ecuador) has utilised a parking control initiative as a highly-effective mechanism for helping to finance new bus priority measures.

Relatively little time is required to set-up a parking program, making them an attractive option for financing BRT projects.

Traffic enforcement in general is an area that many developing cities have not entirely controlled. Increasing fines for traffic violations, and stepping up camera-based enforcement has already been done in China to great effect, and the proceeds could be used for BRT.

Betterment taxes and land-value taxation is an idea that has been discussed for at least 100 years, but has rarely been implemented. The idea is simply that the benefits to real estate owners in a corridor enjoying the benefits of a new mass transit option should pass on some of these benefits back to the state in the form of betterment taxes. In practice it has been politically difficult to get approval from landlords.
Bus Rapid Transit: The US Experience

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Abstract

Bus Rapid Transit (BRT) is a relatively new concept in the United States and is rapidly gaining in popularity. In 1998, the Federal Transit Administration started a program to encourage communities to invest in BRT. Today, a number of cities have begun developing BRT systems, while others are actively considering BRT investments. At the same time, recent research shows that BRT can meet or achieve the capacity and economic development potential of rail, but at a fraction of the cost.

Despite these successes, challenges remain for further BRT deployment in the United States. Communities often view rail as superior to BRT and thus demand new rail systems. Government policies tend to reflect this preference by favoring investments in rail.

As BRT continues to prove successful, interest in the technology will continue to grow. The challenge will be to ensure that BRT is evaluated on a level playing field with other technologies.

The challenge is beginning to be met. For example, changes have been proposed in federal law that would make it easier for communities to invest in BRT. These proposals have been introduced in Congress.

Moreover, some of the first BRT systems in the US are showing positive results. These results are being noticed by policy makers and transport advocates, increasing the level of interest in BRT.

Introduction

Traffic congestion and air quality continue to plague US cities. Despite massive investments in new highway and rail transit infrastructure, the problems continue to grow worse.

BRT provides a cost-effective transit alternative to help improve air quality and reduce congestion. A system generally is considered to be BRT if it includes the following features:

- Dedicated right of way
- Rail-like stations
- Low floor, low emission vehicles
- Off-vehicle fare collection
- Frequent, all day service
- Intuitive, well-designed route structure, and
- Intelligent Transportation System (ITS) technology
- Multimodal access, including feeder services and bicycle and pedestrian access.

Currently, there are no US BRT systems that contain all of these features. There are, however, a number of systems that contain some of these elements. These systems are more accurately described as “rapid bus,” not BRT. However, full-featured BRT systems are under development and will be deployed before the end of this decade.

This paper provides an overview of several current rapid bus projects. It examines three general categories: systems that operate on arterial streets, systems that use dedicated rights-of-way, and systems that use both streets and dedicated rights-of-way.

The paper is based upon research conducted
through the BTI’s BRT program, which is funded by a grant from the Blue Moon Fund.

**Arterial Street Rapid Bus -- Los Angeles**

Los Angeles has one of the best examples in the US of a low cost and highly effective rapid bus system. This system currently is in Phase I of what ultimately will become a BRT network covering over 550 kilometers.

![Future Metro Rapid network.](image1)

Known as Metro Rapid, the system carries over 110,000 passengers per day on seven rapid bus corridors. The most successful corridor, Wilshire Boulevard, carries 45,000 passengers per day.

Currently, Metro Rapid uses 40-foot, low floor, compressed natural gas buses. Larger, articulated buses have been purchased, however, substantially increasing the capacity of the system.

![Future Metro Rapid CNG Bus](image2)

During peak hours, buses on the Wilshire line depart every 90 seconds. There are 30 stations spaced about a mile apart. The stations provide shelter and have real-time passenger information systems. Phase II of the project will include fare collection in the station.

Metro Rapid currently operates in mixed traffic. However, Phase II of the project will include dedicated lanes. There currently is a dedicated lane being tested on Wilshire Boulevard.

A signal priority system forces traffic lights to remain green as vehicles approach. There also is a central control facility that helps regulate the flow of buses.

Metro Rapid is having a significant impact on air quality and congestion. Weekday ridership in the Wilshire Corridor is up 42%. One-third of this increase is people who never rode transit before. The remainder of the increase is current riders riding more often, or current riders who changed routes to take Metro Rapid. Travel times have been reduced by 29% and current average speeds are around 15 miles per hour during peak and as high as 30 miles per hour during non-peak.

**Wilshire Boulevard shows that BRT can be successful in a dense urban environment.**

Phase I of Metro Rapid has clearly shown that relatively small investments can yield tremendous benefits. Capital investment in
the Wilshire corridor was roughly $200 thousand per mile: $100 thousand for stations and $100 thousand for signal priority. By contrast, a rail investment in the same corridor could easily cost $50-100 million per mile or more.

Dedicated Right-of-Way

Pittsburgh

Pittsburgh, Pennsylvania, has been using dedicated busways for over 25 years. The city has 18.5 miles of dedicated bus lanes on three routes – the East, West, and South Busways. These busways have 51,000 weekday boardings combined.

The system began with the 4.3-mile South Busway, which opened for service in 1977. Sixteen express and local routes use the busway, and there are eight stops on the system. An interesting feature of the South Busway is that it shares a tunnel with Pittsburgh’s light rail system, known as the “T”. The busway has an average weekday ridership of 11,000 passengers.

The East Busway opened in 1983. This is a 6.8-mile, two-lane roadway constructed adjacent to an operating railroad right-of-way. In June 2003, a 2.3 mile, four station extension was opened.

Like the South Busway, the East Busway connects downtown Pittsburgh with suburban neighborhoods. Thirty-six routes offer express and local bus service along the busway. Six busway stations are within walking distance to residential, retail, and entertainment centers. The busway averages nearly 30,000 weekday riders.

Pittsburgh’s East Busway

The most recent busway is the five mile West Busway, which opened in 2000. There are six stations and several park and ride facilities, attracting 10,000 weekday riders.

Although Pittsburgh’s busway system generally is considered successful, it does not have level-boarding, advance fare collection, rail-like stations, or ITS technologies. Moreover, because of Pittsburgh’s mountainous terrain, it was a relatively expensive system, costing an average of $43 million per mile, which is significantly more than most other bus-based systems in the world.

South Miami-Dade Busway

The South Miami-Dade Busway is an 8.2 mile dedicated busway that connects with Miami’s rail system. Both full-size buses and minibuses operate on the busway, offering a combination of express and local service.

The busway has fifteen stations in each direction. Each station contains maps, schedules, and public phones. There is a
bicycle path that runs along the length of the busway.

The busway was built in the center of a former rail right-of-way, which is 100 feet wide. The bus lanes are in the middle of this right-of-way and are 12 feet wide, separated by a 4-foot striped median.

Ten local and limited stop routes operate along the busway. Feeder buses circulate through adjacent neighborhoods and connect with the busway. During peak hours, up to 20 buses operate per direction, per hour.

The busway attracts about 12,000 weekday riders. Since opening in 1997, boardings have increased by 71% on weekdays and 130% on weekends.

Construction is under way on an 11.5 mile extension of the busway. The extension will include twelve bus bays and bus shelters and five park and ride lots. The extension is scheduled to open in 2005.

Like Pittsburgh, the Miami-Dade busway is not a full-featured BRT system. For example, even though the busway itself is a dedicated right-of-way, there are sixteen major intersections crossing the route. Buses often stop at the signals, significantly reducing travel speeds.1 Moreover, the busway does not contain other BRT features, like level-boarding, real-time passenger information systems, and advance fare collection.

Unlike Pittsburgh, the Miami-Dade busway was built on flat terrain that did not require tunnels or other major construction. Thus, the capital costs were much lower – roughly $7.2 million per mile.

Combination Dedicated Right-of-Way and Arterial Street – Boston’s Silver Line

In Boston, a BRT system is being implemented that, from the beginning, combines substantial elements of dedicated right-of-way and arterial street design. When completed in 2010, it also will be one of the first US BRT system that combines all of the features necessary to be a true BRT system.

Known as the Silver Line, this system will be an extension of Boston’s heavy rail network. It will connect downtown Boston with Boston’s train station and airport. Some of the dedicated portion of the right-of-way will be underground through a tunnel.

The Silver Line is projected to carry 60,000 passengers per day, which is more than some heavy rail lines. It is being constructed in phases, and the first phase opened in 2002. This phase has been very successful, nearly doubling daily ridership compared with bus services that previously operated in the corridor.

The Silver Line operates 40-foot, low floor, CNG buses. In the future, 60-foot articulated buses will be used. These buses will depart every 2 minutes during peak hours.

1 It is interesting to note that the Miami-Dade busway originally included a traffic signal priority system, but this system was removed because of safety concerns at the intersections.
Moreover, these buses will convert to overhead electric power while operating in tunnels.

**Arterial portion of the Silver Line uses curb-side lanes with significant improvements to the sidewalks and curbs to accommodate the stations.**

The Silver Line will use a GPS-based ITS system to track bus locations along the route. Information will be provided to customers via “smart kiosks” that provide real-time schedule information, digital message boards, intercom assistance, emergency alarms, and an automatic public address system.

**What Have We Learned?**

The US experience shows that BRT provides a viable and cost-effective strategy to reduce traffic congestion, improve air quality, and enhance mobility. The evidence shows that it can attract people who otherwise would use private automobiles. Moreover, with CNG or hybrid-electric technology, BRT can be less polluting than electric rail systems, particularly where the electricity is generated from coal.²

Despite its obvious benefits and cost advantages, there are significant obstacles to BRT implementation in the US. The public frequently views bus service as slow, polluting, and unreliable, making communities hesitant to consider BRT.

At the same time, there are powerful interests that fight for rail-based solutions. These interests include engineering firms, construction companies, and others who profit from the higher cost of rail transit.

There also are policies and procedures that favor building rail transit over bus transit. For example, federal law currently favors investments in rail, despite the cost and other advantages of BRT. There are proposals to change this law.

Moreover, in most parts of the country, streets and highways are controlled by one agency, while transit service is controlled by a separate agency. This means that a successful BRT project must have the cooperation of multiple government agencies, none of which are fully accountable for the project.

By contrast, because rail systems operate in their own, exclusive right of way, they generally involve fewer agencies. This reduces the complexity of planning and implementation.

The Breakthrough Technologies Institute has been actively involved in promoting BRT in the US. We have dealt directly with many of the political, financial, and other issues that affect planning and development of BRT systems. The following are some lessons learned to date from our experience.

First, there must be an open and objective process that identifies a transportation goal and assesses technologies that can meet that goal. This process should include transit agencies, street and highway agencies, other interested governmental bodies, citizen groups, and the public.

Second, planners should consider incremental development as opposed to building a large BRT project all at one time. Once people see that the first phase of the project is working, it will be much easier to gain support to expand the project.

² See *The Electric Rail Dilemma: Clean Transportation from Dirty Electricity*² Breakthrough Technologies Institute (2003) (available at [www.gobrt.org](http://www.gobrt.org)).
Third, ensure that land use planning is integrated with the planning for the BRT system. Each station should be surrounded by high density, mixed use development and should be accessible for pedestrians and bicyclists.

Fourth, ensure that a proposed BRT system is as full-featured as possible. In other words, make it as much like rail as possible. This will help gain public support and ensure the best possible performance.

Fifth, obtain potential rights-of-way as soon as possible. Once an adequate right-of-way is secured, the planning process becomes much easier. If the right-of-way is on an arterial street, carefully consider whether it will be in the median or along the curbs. A median right-of-way generally will increase travel time and reduce encroachment by general traffic. However, a median right-of-way generally requires more space to accommodate the stations and other system components.

Finally, plan carefully for intersections between the right-of-way and existing cross streets. The Metro Rapid project has been successful largely because the local transit and street agencies worked together to change traffic signals, thus enabling buses to extend green lights without seriously impacting the traffic on the cross street.

Conclusion

BRT has an extremely promising future in the US. It offers congestion relief and air quality benefits at fraction of the cost of electric rail. It also can offer all of the amenities of rail, thus helping to attract and retain riders.

To ensure its success, local governments and communities must be educated about its benefits. At the same time, policies must be implemented to ensure that the planning process is able to assess all technologies in a neutral and unbiased manner. This will ensure that the best technology is selected to meet the particular needs of the community.

About BTI

Based in Washington, DC, the Breakthrough Technologies Institute is a not-for-profit organization dedicated to promoting advanced environmental and energy technologies. Among other things, BTI is a leading voice on hydrogen and fuel cells, air pollution policy, and innovative transit technologies. BTI’s work on BRT was made possible by a grant from the Blue Moon Fund.

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Sustainable Urban Transport: 
Progress in Mexico City and Potentials for China*

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Chinese cities face many challenges as private vehicle ownership and use skyrocket. The motorways and skyways that were empty a few years ago are now increasingly congested. Improving the fuel economy and reducing emissions from these cars (and other vehicles) is important, but that effort must be embedded in a broader effort. To improve its growing transport system, China should adopt a “multi-modal” solution set linking technology, behavior and management at local, national and international levels. Underling this approach is an analytical and policy framework set forth in this paper.

This paper describes how strengthened bus systems, built on advanced bus technology and rapid bus corridors (or “bus rapid transit”, BRT) could play an important role in meeting these challenges by putting urban transport on a more sustainable path than present trends of chaotic traffic and air pollution suggest. We do this by summarizing key results from recent efforts in Mexico City, which is re-invigorating its bus system by developing BRT. While Mexico City conditions are different from those in Chinese cities, we draw some lessons from the Mexican experiences that are certainly helpful for developing BRT in China.

1 Introduction: The Transport Conundrum

Transportation brings people and goods to people, returning enormous benefits to economies (Braudel 1992). But transportation also causes significant undesirable side effects or externalities, particularly via air pollution in urban areas and emissions of CO2 and other greenhouse gas emissions which drive global climate change. Problems are exacerbated by vehicle travel levels that are rapidly outstripping the capabilities of existing infrastructure systems, leading to traffic congestion and even more fuel use and air pollution than would otherwise occur. As a result, urban transport is increasingly unsustainable. While its undesirable side effects have long been recognized, efforts to tackle the transport problem have been limited because of its inherent complexity and the costs, disruptions and long lead times involved – all of which have militated against politicians initiating substantive interventions.

The challenges of sustainable transport are particularly acute in the developing world’s largest cities. Swollen populations and high densities of vehicles of all types mean major congestion, slow travel speeds, higher exposure to polluted air, and high rates of morbidity and mortality from traffic accidents (World Bank 1996). At the same time, growing incomes lead to mode shifts toward vehicles that add to these problems. Traditional non-motorized forms of transportation, such as walking and bicycling, give way to motorized transport: first buses, but as incomes grow, increasingly cars and, especially in Asia, motorized two-wheelers. The future of many cities therefore lies, to a large degree, in the future of their transportation systems.

2 A BROADER PERSPECTIVE: “SUSTAINABLE TRANSPORTATION” IN SUSTAINABLE CITIES

Sustainable cities meet the needs of present day citizens without sacrificing needs of the future or causing damages (such as pollution) that other cities suffer today. Sustainability is achieved through a clean environment, healthy economy in both public and private sectors, and vibrant, responsive political system with access to all. Transport has to serve, not sever these goals.

“A sustainable transport means users and beneficiaries paying their full costs, including those imposed on the future” (Schipper et al. 1996). The World Bank sharpened this description of sustainability with three characteristics:

- **Economic and financial sustainability.** “To be economically and financially sustainable, transport must be cost-effective and continuously responsive to changing demands.”

- **Environmental sustainability.** “Transport has significant effects on the environment that should be addressed explicitly in the design of programs (and systems in general [author’s addition]). Making better use of readily available and cost-effective technology is necessary, but not in itself sufficient. More strategic action is also required in the form of better-directed planning of land-use and stricter management of demand, including the use of pollution and congestion charges to correct the relative prices of private and public transport.”

- **Social sustainability, i.e. equity.** “Transport strategies can be designed to provide the poor with better physical access to employment, education, and health services.”

A key scarce resource is time: the number of private cars in China is now rising very rapidly, threatening to choke off other modes of transport. Figure 1 portrays car ownership per 1000
people vs. GDP/capita on logarithmic axes. Note China is following almost directly the path of Japan and South Korea. Note too that the most recent point for China, 2003, lies about where the US was in 1910! In other words, China is 94 years ahead of the US, because its leaders have recognized at an early stage the potential problems of rapid motorization and how they can be mitigated.

**Figure 1. Trends in Motorization: Automobile Ownership in Asia, the US and Europe**

Sources: Schipper, Marie-Lilliu, and Lewis-Davis (2001), updated with data from Feng (2004), China, Japan and Korea Statistical Yearbooks, and the U.S. Department of Transport. GDP data from national sources chained to 1990 real local currency and converted to U.S. dollars at 1990 PPP.

Figure 2, below, gives modal shares of daily trips for all U.S. cities, three cities in Europe, two in Latin America, and three cities in China. In North America or Europe, automobiles account for 50-90% of the passenger transport in cities, collective modes much of the rest. Walking and cycling account for less than 10% (in the U.S.) but as much as 30% in Denmark or the Netherlands. Relatively dense city cores or well-populated corridors are essential to the health of collective transport or the attraction of walking, since destinations are relatively close, and potential passenger numbers high. But most cities in North America are hopelessly sprawled, while even in Europe most population growth is in the suburbs where cars are irresistible. A challenge for China, it seems, is to maintain high levels of mass-transit use, walking, and cycling in the face of rising incomes facilitating car ownership and use.
Figure 2. Shares of daily trips in Chinese, Latin American, European, and US Cities.

Sources: SCTTP; Xi’an CMC and Chang-an University, Wuhan Metropolitan Transport Development Strategic Plan (2003). Mexico—SETRAVI. Sao Paulo—1997 OD Survey. Europe—authors’ analysis of surveys. All U.S. urban areas from 2001 National Household Travel Survey (Pucher and Renne 2003). Data for China adjusted to match international categories. Note that for the United States car trips are split into passenger and driver.

Note in Fig. 2 that for all three Chinese cities, the role of the car, measured as the share of all trips, is small. But compared with data from 1986, this role is rising, consistent with the car ownership curve in Figure 1. Experience from other cities suggests the time it takes for automobiles to congest cities is short, as Beijing now knows. Hence careful planning and implementation of a robust transport system must start now in China, not after it is too late.

More cars means more transport activity in an irreversible spiral: not many metropolises find it possible to restrict car use or impose land-use controls once cars are widespread, in contrast to Curitiba and Singapore, which acted relatively early. China has recognized this problem early on, and has proposed fuel economy standards to ease the increase in fuel demand for new cars. Shanghai has imposed stiff registration fees and rationing of new-car licenses at a far earlier stage in the development of car ownership than other large cities. Yet even modest forecasts, based simply on the trends shown above imply over one million cars in Shanghai by 2020, with similar prognoses for other Chinese cities. Beijing, which saw its millionth car only in the late 1990s, yet awaits its three millionth in only a few years. Thus the level of car ownership is rising very rapidly in China. Sao Paulo and Mexico City (shown in Fig. 2), and most other large cities in the developing world, are choked with traffic long when cars reach a share of only 20% of trips, or two-wheelers reach 30-40%. The challenge to Chinese authorities, therefore, is clear. Strengthen alternatives to the car, and complement these initiatives with urban planning, before transport and cities themselves become unsustainable.

3 Urban Public Transport in Developing Countries: Potential and Problems

In many developing cities, a large share of all urban passenger transportation activity is borne by buses. While still the backbone of urban transportation, buses are seen increasingly as inefficient and as major sources of pollution, noise, and road hazards. Given the inherently economical (and space-efficient) nature of bus travel, strong efforts to keep bus travel viable and increase its share of trips is warranted, and is beginning to occur. City authorities around the world have started to ask for viable, clean and affordable urban bus transit systems that will maintain or even increase their share of mobility even as incomes grow and cities expand.

1 Indeed, most of Mexico City’s “buses” today are smaller, ranging from microbuses to 36 passenger mini-buses. This creates enormous chaos on roads through the congestion these vehicles cause. Similar “buses” ply the streets of other Latin American cities, as well as cities in India and elsewhere in Asia.
And this appears to be feasible, if bus systems are reformed and modernized. In fact a growing number of cities have managed in recent years to significantly increase the share of travel carried by buses. In perhaps the best-known example, Curitiba, Brazil, a large scale bus-system that grew over three decades with the city continues to carry a large share of all traffic, as citizens of that relatively wealthy city simply use their cars less than do other Brazilians of similar income and situation. Several other cities, particularly in South America (such as Bogota, Colombia and Quito, Ecuador) are following Curitiba’s example and developing strong “bus rapid transit” systems. The decay of the system in Mexico City (Schipper and Golub 2003) represents an anomaly in Latin America and indeed in Mexico.

A) The Back(ground) of the Bus

Bus systems come in many forms and scales (Cervero 1998, Dunleavey 1999, Meirelles 2000, IEA 2002). In Curitiba, Brazil, bus rapid transit (BRT) lines form the main element of the transport system, carrying nearly 50% of all daily motorized trips with average bus speeds more than double that found in many other cities (Rabinowitch and Leitman 1993). The integration of the trunk lines (featuring high capacity double-articulated buses) with other rapid lines and feeder routes through well-designed stations allowing rapid boarding and alighting, is well known and part of the reason the system works so well. In Sao Paulo, busways play a less prominent role overall, but have been developed for several key routes and are integrated with the rail metro, other bus lines, and paratransit (mini-van) routes (Government of the State of Sao Paulo 1999). Good examples can be found even in North America. In Ottawa, Canada, the highly successful BRT consists of three main routes, and is linked to an expanding rail network. It is also linked to park-and-ride stations at the fringes of the city (Ontario Municipal Board 1999). What makes these systems attractive to riders is their speed and reliability. In Los Angeles, a city that is almost starting from scratch in terms of revitalizing mass transit systems, a recent initiative is based not on dedicated busways, but on a more modest plan to improve bus speeds on existing routes using a signal synchronization system. These “Rapidbus” routes are also being provided new stations with real-time schedules using electronic displays to indicate the timing of the next bus. While there are no dedicated lanes yet, this approach has succeeded in raising average speed 15%, attracting passengers, and even lowering fuel use/kilometer slightly, relative to other buses in the same region of Los Angeles (Department of Transportation 2001). Relative to major investments in expanding roadway infrastructure, or developing new rail lines, these measures were undertaken at very low cost. And they were not undertaken in a vacuum; all were part of wider, long-term urban transit and land-use strategies that are rapidly bearing fruit.
Compared with underground metros or surface light-rail system, bus systems have the disadvantages of taking road space and contributing to local air pollution. But they have the advantages of flexibility and very low cost (in dollars per unit of capacity [people/hour], or passengers carried per year) (World Bank 2002a, Halcrow-Fox 2000). Part of the flexibility of bus systems is that they can be built and improved quickly. Further while a well designed rail system can carry a larger number of passengers along a corridor quickly, and remove travelers from the roadway network, this often takes many passengers off of existing bus systems, and mainly frees road space for...more cars. Certainly there is room in most transport systems for contributions from more than one transit mode, but buses appear to be an appropriate “backbone” for the transit systems in most cities.

The potential for revitalizing bus systems is hampered by a number of factors. At the top of the list is the manner in which bus systems are managed and the way individual bus routes and buses themselves are regulated. Serious problems in the manner in which bus systems are regulated and managed plays a major role in preventing buses from providing efficient service, and producing significant revenues; this in turn represents a major hurdle in the viability of improving the technology and operation of buses themselves. Although the manner in which bus services are organized, managed, and licensed varies considerably from city to city, a number of problems are commonplace, as we discuss below. A second major issue is that buses are too often stuck in traffic. The sustainability of bus systems is dependant on bus speeds both from the point of view of providing a service that encourages ridership and from the point of view of raising revenues – slow bus speeds reduce the total kilometers, and therefore passenger loadings, that a bus can achieve each day.

As a result of the lack of revenues available to pay for better buses, many cities are dominated by older, poorly maintained buses with little or no pollution control; they are typically outmoded vehicles often converted from truck frames or bought used from developed countries. Budgets available for upgrading these buses or replacing them, or even replacing worn parts, are often tiny. Further, poor fuel quality – usually very high sulfur diesel fuel - combined with poor engines means most buses in the developing world are major sources of particular matter and NOx emissions, and therefore of ozone (smog) as well. Buses are often seen as a major part of the problem, not part of the solution. In part this may be due to looking at buses without considering the number of people that they move, but in any case it is clear that in order to be seen as part of the solution, buses must be made cleaner and faster, i.e. they must become a more attractive choice for riders.
B) Actions Promoting Buses to Reduce Impacts of Transportation

The key questions for cities are what to do to improve their transport systems, and how should buses fit in? Without an overall concept and goal that deals with each component of ASIF, it is hard to know what combination of new or even radical technologies, system-oriented measures, pricing reforms, financing, general transport policies, and other factors would both improve mobility and lower the total costs to society of transportation (including hidden costs referred to above)?

Clearly there are many ways that buses can help the overall situation:

- Reducing pollution from buses themselves, both by reducing fuel use/vehicle-kilometer or passenger-kilometer and by reducing pollution per kilometer using cleaner fuels and better engines or by reducing impacts from both terms through smoother traffic, which reduces the fuel used and pollution generated;
- Increasing bus load factors to reduce pollution per passenger-km;
- Increasing the bus share of overall travel principally by making bus travel faster, bus service more frequent, and buses cleaner, quieter, and more comfortable. This draws riders from other, more polluting and more congesting modes.
- Increasing bus ridership and profitability gives bus operators, whether public or private, more revenue from which to buy the cleanest emissions reduction systems and fuels. This not only reduces fuel use and pollution further, but attracts more riders because of the lower pollution.

These steps are crucial and are often overlooked by those focusing only on tailpipes of buses as sources of pollution. Buses only account for a small part of overall traffic congestion and pollution. Their greatest contribution to reducing pollution and congestion could well be in getting cars and many colectivos off the street. But clean buses stuck in otherwise polluting traffic will not attract new riders, even if fares are artificially low. But the key to attracting more riders is speeding up the buses and integrating them better with other modes of transportation. BRT is on the way.

The first goal of a BRT system is clearly to restore balance to the transport system by offering a fast, clean alternative mode of travel. The second goal of a BRT system is to provide travel that is both intrinsically low-emitting (through use of cleaner modern buses and cleaner fuels) and lower emitting than rival modes by virtue of the size of the vehicles. A fast BRT system wins travelers from other modes by both higher speeds and higher frequency than either traditional modes or other buses. Thus BRT must not simply be aimed at providing protected lanes for buses, but at providing a service that will offer speed and volume unmatched by other modes other than a metro. Ultimately a BRT system – as envisioned for Mexico City – should have dramatic positive impacts on both transport and emissions in a very cost effective way, something few other elements of a transport system can offer.

4 A Case Study in Real Time: Mexico City

The Mexico City Metropolitan Area (MCMA) has become infamous for its congestion and air pollution (Schipper and Golub 2003; IEA 2002). Its Metro, with more than 4 million trips per day, once the most exciting of such systems in the world, has stagnated and lost riders in the last dozen years. The system of large city buses collapsed during the past three decades.
Increased numbers of wide boulevards and freeways became filled with cars and microbuses almost as quickly as they were created.

After years of decay to a skeleton of what it once was, Mexico City’s bus system is about to be revived and revitalized. A series of initiatives undertaken by EMBARQ, the World Bank/Global Environmental Facility, and the Mexico City and State of Mexico authorities themselves, aided by demonstration vehicles provided by bus manufacturers will lead to demonstration of BRT corridors, procurement of clean, new buses, and development of a long-term BRT master plan (Schipper and Golub 2003; World Bank 2002b). Authorities have studied the arguments and developments summarized above and concluded that the region cannot afford not to bring back buses in a healthy form.. In early 2003, however key officials announced plans to launch a BRT system. By the fall of 2004, this planning was in full bloom.

A) Too Much Traffic and Foul Air

There is no doubt that Mexico City has some of the dirtiest air in the world (Schipper and Golub 2003). One reason is because of the high number of older vehicles with poor pollution controls. But an equally important reason is that most passenger travel takes place in small mini-buses or cars, not in buses or on the metro.

**FIGURE 3. Shares of daily trips by mode for the Mexico City Metropolitan Area. Source SETRAVI.**

Figure 3 shows how the share of daily trips, by mode, has evolved over time. In 2000 there were approximately 30 million trips per day in the region. The micro- and mini-buses, or “colectivos”, gained a larger share of total travel than either cars or the Metro since the early 1990s. These have contributed to the shrinking of the large bus fleet from over 10,000 vehicles to well under 1,000, the smallest for any large Latin American city, as well as drawing riders from the Metro and from cars (SETRAVI 2002; Zegras 2000). The colectivos cost more than normal buses, but they ply neighborhoods where large buses cannot go, and they are faster, which gives them their apparent edge. Part of their speed arises out of unsafe driving, darting in and out of traffic and stopping almost anywhere for riders. These vehicles laid down a challenge to the faster Metro but, more important, outpaced traditional buses, which were stuck in traffic. And while more than half of all cars in the region now have
modern pollution controls, very few colectivos do. Thus even if colectivos have taken some people out of their cars, this switch alone probably did not reduce pollution.

Overall vehicle traffic is dominated by private automobiles in Mexico City. But colectivos have the 2nd largest share of traffic and more than half of all trips, as evident from Figure 3. The switch from larger buses to smaller colectivos meant an increase in pollution per passenger kilometer simply because the colectivos hold so many fewer people than buses. Add the extra congestion caused by their large numbers and poor driving, and one finds an important reason why air pollution has not improved as fast as expected in the region.

Colectivos are not strictly a Latin-American phenomenon. Shared taxis are found all through S. Asia and in some cities in S.E. Asia as well. They are popular because larger buses are slower; for a slightly higher fare, they provide reasonable service, but only by polluting and congesting more than large buses. A good BRT system is an important way to win riders back to cleaner transportation.

B) The Mexican Program for BRT

BRT has come alive in Mexico City (Schipper and Golub 2003; La Reforma February, 24 2003). Initial efforts to reclaim some of the territory lost by large city buses focused on substituting large buses in place of small microbuses, using economic incentives. Soon the government realized that simply replacing smaller buses with larger was not sufficient to reverse the decimation of the bus fleet, which fell to under 1000 active city vehicles by 2002. Instead, radical reform of the institutional, financial, and legal basis for the transport system had to be achieved.

The World Bank and EMBARQ entered the fray officially in 2002. Support emerged for the institutional rebirth of a transport system, the construction of at least two model bus corridors (one in the nearby urban territory of the State of Mexico), and continued support for other aspects of the pollution reduction efforts the Bank had supported previously. The City Government had become convinced that repairing the most gaping hole in their transport system, the lack of a well organized, fleet of large fast buses was the main option for their new transport policy (SETRA VI 2002). EMBARQ brought major bus manufacturers to the table, who agreed to provide buses to test ULSD, CNG, and even ULSD hybrids.

The turnabout is not without precedent. Bogota looked hopeless only 5 years ago, as a before/after video presentation of Transmilenio itself shows. Now Bogota sports one of the world’s most exciting and successful bus systems (IEA 2002). The key element that makes Bogota’s and other’s bus systems successful is speed—fast buses stuck in traffic simply cannot carry enough riders to be profitable, not to mention modern and clean. Indeed, in Mexico City, where fares for city buses and the metro are kept low for political reasons, all three systems run chronic losses. The main reason the Metro loses is a combination of high maintenance costs and underutilization of most lines, but over-utilization of three lines as well. The small trolley bus system has very high fixed costs, high wages, and some lines are underutilized. The city’s diesel bus system also requires subsidies, and the buses compete in most markets with colectivos. Colectivos are more expensive, but by dashing in and out of traffic, stopping awkwardly, and speeding, they can outdistance larger buses on main arteries while plying smaller streets for traffic as well. Small wonder that colectivos gained so much market share from big buses and the Metro, while holding off a gain in the market share of individual cars.
A well organized BRT system in the Mexico City region will reverse these developments. First, higher speeds will attract riders, making the system itself more profitable. Initial lines will be running using existing – but unenforced – bus only lanes on major arteries, filling gaps from un-constructed metro lines or offering a better and faster service than either existing city buses or colectivos. One of these lines will come into service as early as 2005, since little construction other than building protection into the lanes is necessary. A longer term option is the construction of the two corridors. These are shown in the map (Figure 4).

One of these new corridors will run from the south to south-east of Mexico City for 12 kilometers along Eje Ocho. The other will run nearly 20 kilometers from north to south. These two corridors are to be financed by World Bank loans. The southeast route has some large buses and runs where a Metro line was planned. The north-south route, Insurgentes, is like Shanghai’s Nanjing road, a large thoroughfare known to all. Not all of this is straightforward, as Mexican streets present many hazards, such as the cars traveling the wrong way in the bus lane (Figure 5) or the cows in a pickup truck (Figure 6).

In addition to these routes, the city itself is considering upgrading of a number of wide streets where curbside or counter-flow bus lanes exist but are not carefully enforced (vis. Figure 5).
These are likely to include Eje Central, a very wide boulevard stretching some 20 kilometers north to south. The Eje Central route (on which Figure 5 was taken) is already the subject of a successful increase in trolley frequency that has increased riders per bus by about 25%. Simply enforcing the bus lanes, upgrading stations and off-bus payment, and providing better links with connecting colectivos could make these existing lines very cost effective.

Both approaches are important for the Mexico City region. The routes to be fostered by the World Bank will require modest infrastructure, particularly that in the southeast. The Insurgentes route, designed for a street of predominately 4 lanes in each direction with very heavy stop and go traffic, many important cross streets, and commercial and shopping destinations, will require tricky signal synchronization, clever station design, and strong public communications to overcome potential resistance from colectivo drivers, businesses on the route fearing loss of trade, and even residents fearing noise or traffic safety problems. Upgrading existing counterflow lanes through better demarcation, enforcement, and perhaps signal synchronization, while not full BRT, could nevertheless greatly increase the performance of the buses on those routes.

5 A New Paradigm for improving Bus Systems: How Does China Match Up?

What is the way forward? The original summary of the IEA study (Schipper and Fulton 2002) outlined important elements of any strategy for improving a bus system. We repeat this here with reference to the actions taken or anticipated in Mexico City. The logical order for considering these elements is first the system, then the bus, then the BRT system. Based on other reviews and this brief paper, there are many challenges for Chinese cities aiming to improve their transport systems and thereby improve their cities:

- **Chinese must continue its long-range, systematic approach, including strengthening transport system governance.** Any urban transport initiative plan must be part of a systematic or comprehensive plan in order to succeed. (A good example is Shanghai’s “Transportation White Paper”.) The plan must include a long-range vision of where both the region and its transportation system are headed, and how that direction might be changed. Issues of governance and transport system management (including regulation and licensing of operators) are as important as technical issues. The various policies affecting transport must be harmonized so that they work together, for example to encourage use of mass transit and discourage single-occupant car travel. Improving integration of transport and land-use planning is also very important. Improvements in single or isolated elements of a transit system or transport plan rarely have strong benefits, while the systematic approach allows synergies to strengthen the system and improve transportation.

- **Focusing only on technology without paying attention to other aspects of transportation represents a narrow approach.** Technologies gain strength in the battle against pollution and congestion as other systems that reinforce them are also strengthened. As long as competing, “dirtier” modes pay a “correct” share of their external costs – however difficult that is to determine – then the incentive to use improved technologies will be highest. And technologies must be used properly and maintained, not simply installed. This requires good management and monitoring of pollution from vehicles. People are adept at exploiting the weaknesses – and strengths – of technological systems. Policies must erase incentives for people to drive, pollute, and congest more, even if actual emissions from vehicles are reduced by technology. Indeed the greatest risk to any "multi-modal" strategy is to lavish too many resources on
promising but expensive technologies while ignoring the simple approaches that clean up and improve existing ones. The London congestion charge (picture below) has not only reduced the number of cars entering inner London, it has permitted a dramatic increase in the speeds and reliability of bus service.

- **Focusing only on transit without managing the rapid rise in car or two-wheeler use is not sufficient.** Individual transportation plays an important role in every sustainable city. But careful management of the abuse of the private automobile or two-wheeler is essential for balance. That means strong enforcement of safety and parking regulations, traffic controls, and some kind of peak-load pricing system to best use scarce road space in dense city cores. Shanghai is already considering electronic road pricing (ERP) for its Puxi area. Other cities with historical or older cores should do the same. Aside from preserving scarce road space for BRT and other modes, ERP as now deployed in Singapore or in its simpler form in London clearly makes the inner city friendlier to pedestrians and cyclists as well. By making individual vehicle users face the real costs they impose on others, ERP and other traffic controls also help tip the balance towards BRT and other collective modes of transport, as experience in London has shown. *Unfortunately Mexico City has no plan to deal with increased car use. By contrast, Shanghai has shown strong interest in using technologies to manage transport.*

- **National governments must help.** Fuel and vehicle standards need to be set firmly by national governments. Although local variations may be necessary, both fuels and vehicles are manufactured and traded within and between countries. The scale of production is usually too large to be adjusted to each locality. If the U.S. and California are any guide, authorities are willing to move to the most stringent levels of quality if they meet demands of a large market (i.e., California), rather than fragment into too many individual markets. And only national governments can negotiate standards with large multinational corporations and other countries. *China’s speed at improving fuel quality and vehicle emissions standards has closed the gap with advanced countries dramatically. The recent national Government edict supporting BRT in China is a good sign that BRT has an important role to play in many cities.*

- **The private sector must be involved.** Vehicles and fuels are made largely by the private sector. Bringing in the private sector to develop, produce, and sell the technologies needed for clean transport is a key step towards sustainable transport. Getting these actors to move ahead on their own with enthusiasm, however, is not so easy. The many premier alliances between Chinese and overseas vehicle manufacturers gives both sides a unique opportunity to work with each other. *The recently announced demonstration of a General Motors Allison Hybrid in China, following on a similar demonstration EMBARQ is conducting in Mexico City, is an important step in this direction. Shell’s provision of gas-to-liquids diesel for a bus test in Shanghai is also significant (shown below)*
• **Political sustainability must be developed.** Regardless of the present attractiveness of policies or technologies, a path must be developed that is relatively robust to changes in the political winds for the party governing a city, or indeed acceptable to more than one party should there be divided political responsibilities. The private sector will not act with full strength if it believes that rules will be changed once the next politicians take over.

The foregoing applies to the transport system in general. For improving buses, the IEA report and our experience in Mexico leads to these observations:

- **Improve bus system regulation, licensing, and brand identity.** In many developing cities, most buses are run by independent bus companies. In some cities private companies have grown up to fill vacuums created by the inability of public bus systems to provide adequate service. There are often many independent bus service providers, often quite small, surviving on a day-to-day basis. These companies are not able to make major investments in buses or bus systems. *Chinese cities in general have large bus fleets organized along different principles (private, public, or contractor). A key element of BRT is the identification of the trunk and feeder lines by new branding – colors and livery – and new vehicles.*

- **Focus not only on buses but also on other aspects of transportation as well.** Bus systems gain strength as other systems that reinforce them are also strengthened and competing systems with greater negative impacts on transport and environment, i.e., cars and two or three-wheelers are “weakened”. As long as competing modes pay a smaller share of their external costs than do buses, those modes continue to hold the advantage that propels them ahead of buses in popularity in so many cities. *BRT for Chinese cities must be used both to reinforce existing rail and metro lines as well as reach areas that fixed-rail systems cannot reach.*

- **Recognize that each additional bus provides large benefits.** Regardless of whether a bus is “clean” or “dirty”, if it is reasonably full it is displacing anywhere from 5 to 40 other motorized vehicles (including 2-wheelers as well as cars; in Mexico City, the primary displacement is of colectivos). The fuel savings, CO₂ reductions, and pollutant reductions of such displacements are relatively large – our preliminary analysis suggest that they can be much larger than the potential benefits of making a fuel or technology upgrade to the bus itself. Thus getting buses on the road, and getting riders onto buses (mainly by offering a service that riders want) is the best strategy for providing efficient, sustainable transportation systems. *The synergies of this benefit for Chinese cities are large. Less congestion means both less pollution and faster buses. The switch from smaller buses (and probably a few cars) to buses in corridors probably can be documented because of the ease of measuring the large flows of people in the selected corridors. Under those circumstances the CO₂ savings alone may be “tradable” on the emerging world-wide market for carbon emissions reductions.*
**Increasing bus speeds is a high priority.** The opportunity to increase bus travel speeds and thus move more people farther each day is probably the most important improvement that can be made to many bus systems, since it increases both revenues and the overall efficiency of the system. It can contribute to raising revenues two ways – one, by simply allowing the bus to run the length of the route more often per day, and second, by improving the level of service and attracting more riders to the system. Raising fares, in contrast, may have the opposite effect on the level of ridership. However, there is strong evidence that wealthier individuals are willing to pay considerably extra for “premium” levels of bus service, such as the guarantee of a seat, air conditioning, and reliable service. Even the poorest of cities has a large population of middle class residents capable of affording premium service. *Higher speeds in Mexico will mean more fares collected per bus per day, as the experiment running trolleys more rapidly on one route has already shown. Given the desperation Beijing and other congested Chinese cities, it is clear that a truly rapid, secure, and comfortable bus service would attract riders willing to pay more.*

**Incorporate advanced bus system technologies.** A key to developing successful bus systems is to make bus travel attractive. While obvious, this has been achieved in very few places. However, there are a number of recent innovations that may allow systems all over the world to quickly improve. Dedicated bus lanes give buses important speed advantages over other traffic modes. But other technologies, such as global positioning systems (GPS) to track bus position and relay this information to travelers in real time, and advanced signal synchronization systems that give buses an “early green” or “long green” at intersections, are near commercial viability and hold the promise for major near term benefits in cities all over the world. This may be a case where technology “leapfrogging” makes good sense. *Smart fare cards, fare dispensing machines at bus stops, and low floor buses, and IT controlling traffic would help make Chinese BRT buses fast.*

One of NY City Transit’s advanced buses.

**Advanced propulsion and fuel technologies are there, but expensive.** The most advanced propulsion technologies (fuel cell buses, even hybrids) are too expensive today for most developing countries, but cities can begin to move up the “technology ladder” toward these technologies (IEA 2002). A variety of lower-cost strategies to clean up buses includes switching to very low-sulfur diesel fuel, adding (improved, or in some cases any) exhaust gas after-treatment systems, and better maintenance. These could reduce emissions significantly over the next few years, as the prices of the more advanced technologies fall. Buses produced in LDCs that meet EURO-2 or even EURO-4 emissions standards together with cleaner fuels and in some cases retrofitted pollution controls (or diesel-emulsions) are probably within the financial reach of major cities in Asia and Latin America. Whether cities choose to clean up diesels or switch to an alternative fuel such as CNG, the costs are not zero - but the benefits are great when these first steps are taken. *China should take advantage of the aforementioned tests of clean buses to chose options against costs and benefits carefully. But advanced bus tests do not replace the*
• **Link transit system improvements with bus technology improvements.** In order for bus companies to justify the expense of advanced technology, or even EURO-II compliant, buses, these buses must earn considerably higher revenues than do the current buses. Revenues can be increased three ways: fuller buses (carrying more passengers per kilometer), faster buses (more kilometers per day), and higher fares. The first of these requires system improvements and policies that promote transit (like fuel pricing). The second can benefit both from system improvements (such as dedicated bus lanes) and from better buses (newer technologies with better engines can help improve acceleration and average speeds). The third, higher fares, can be justified once actions taken on both the system side and bus side sufficiently improve the quality of the bus experience for riders. This includes faster travel, safer and more comfortable rides, greater reliability and predictability. Thus improvements to the “system” side of the equation help pave the way to better buses, and vice versa. It will be very difficult to sustainably implement a “more expensive” bus without system improvements. *Investing in and testing the advanced vehicles noted above, which will cost somewhat more than traditional diesel buses, would hardly be sensible were the vehicles to be stuck in traffic most of the time. Ultimately the buses chosen should be optimal for the kinds of routes and topography, needed feeders, etc, and not simply for their fuel or emissions characteristics alone.*

• **Decisions regarding clean and alternative fuels (such as ULSD, CNG, LPG or Biodiesel) must take into account energy supply, cost and infrastructure considerations.** For good reasons, decisions regarding alternative fuels often get made on the basis of energy, rather than strictly environmental, considerations. Important aspects in any city are the national availability and supply of different fuels, local fuel distribution infrastructure, and relative fuel prices. Even in pursuing a path toward cleaner diesel buses, a major question is the availability and cost of ultra-low sulfur diesel (ULSD) fuel from domestic refineries or imported. In undertaking any clean or alternative fuels initiative, cities must be sensitive to these considerations. It will also be important for cities to determine whether they want to embark now down a particular path toward “next generation” buses, such as fuel cells which may require a CNG or other alternative fuel or feedstock. *EMBARQ and the US EPA are working to clean up nearly 20 existing buses in Mexico City using advanced filters and catalysts, combined with ultra low sulfur diesel fuel. The need for cleaner urban fuels in China has been recognized by leaders. While not every city has such fuels available, the buses put in service today should be chosen so they can be retrofitted easily with particle filters and catalysts soon, to take advantage of what the cleanest fuels can offer.*

6  **Conclusions and Lessons for BRT**
All of the foregoing point to the inescapable conclusions that demonstration of “Bus Rapid Transit” (BRT) corridors appears to be an important step. The task of modernizing bus systems and increasing ridership is daunting. Part of the problem is to know where to begin and what to do. Pilot or demonstration projects that focus on a single bus corridor help deal with both of these issues. They allow testing and fine-tuning a different approach to delivering bus services, and create the “seed” that can later grow into a fully established system of bus rapid transit routes. Demonstration projects typically include dedicated bus lanes, improved infrastructure such as bus stops and terminals, and (often very importantly) a new system of regulating and licensing bus services on the route. They can also offer a showcase for advanced technology (or just new, modern) buses. The demonstrations scheduled for Beijing and the planning for Shanghai and other cities represent an important first step for China.

Fully developing BRT systems should be a goal. The concept of bus travel that begins to look and feel like rail travel, and that provides comparable or even superior service to rail (not to mention compared to other modes) is a new one but is catching on fast in cities around the world, particularly Latin America. Even as Los Angeles scurried to develop its first accelerated bus line, it was developing a full-blown BRT Master plan whose development is now under way. Similarly, a long-range master plan for the MCMA will accompany the development of the most immediately available lines and corridors. Chinese cities should develop long-range BRT plans to match the vision of each city’s future with a good transport system.

BRT is more than just lines on a map indicating where passenger flow can be captured. BRT will change travel patterns, land values and land use, and ultimately raise the quality of life of many in an urban region. But there are some losers. Therefore, the development of BRT must proceed in a very open, communicative manner to be sure that political and economic support for the necessary institutional changes is forthcoming. Part of the Los Angeles system runs through a small but important community of Orthodox Jews, who were not consulted. They raised a tsimmis, which fortunately subsided after negotiations. Every BRT system will, by its nature, run by some one’s quiet community, block some ones driveway, or cause large numbers of passengers to gather in front of someone’s building. These situations must be handled delicately. In transportation there is no free parking!

A careful determination of present and possible future travel patterns is important for route planning. BRT does not simply take over for existing buses or try to win riders from microbuses or cars. Rather, BRT is an instrument of transport in the service of development itself, in Braudel’s sense. Therefore, developing the system to maximize synergies with existing fixed transport and built infrastructure while guiding future developments in land use and transport in a way that reduces congestion and pollution – as Curitiba was developed – should be the real goal. This goal can only be achieved if there is good analysis at the outset and care to pay attention to developments as they arise.

Wide-ranging publicity at all levels is needed to sell stakeholders on the idea of a rebirth of a modern bus system. Consultants have built a copy of a Transmilenio station in Lima, Peru and arranged to bring a Transmilenio bus there as well to symbolize how different this system could be from the past. Above all, the BRT system needs a strong identity of its own, through shapes, colors, and other characteristics that all will notice.

Careful monitoring of results through surveys, particularly the likely switch of passengers from cars and microbuses to faster BRT, is important for fine tuning the system. Following
the plight of the drivers of buses or mini-buses no longer needed is important for making sure there is no lingering political discontent with the system, which would hinder its further expansion. CO2 and local emissions savings can be inferred and then measured from the shifts from cars or colectivos to large buses, as we are planning on carrying out careful estimates in Mexico City. The City will “sell” the saved carbon on the budding carbon market. Proceeds will help pay for maintenance of the corridors.

Carefully implemented a BRT system can become the backbone of a transport system where there is none today, and can strengthen and supplement Metro or other rail-based options by moving quickly in to regions where these other systems cannot reach except at very high cost. If Chinese cities continue the momentum they have gained in the past few years, transport will serve city development, the strangulation by smaller vehicles seen elsewhere will be avoided, and Chinese cities will move a large step towards sustainability.

REFERENCES


Bus Rapid Transit (BRT) Development in China: Challenges and Progress

Kangming Xu
Consultant, Energy Foundation China BRT Program

Since February 2002, I have had the privilege of working on the China Bus Rapid Transit Program supported by the Energy Foundation. My topic today is “Bus Rapid Transit Development in China: Challenges and Progress.”

First, let’s review the urban transportation challenges most Chinese cities have been facing. In the 1980s, when we discussed traffic congestion, we usually meant bicycle congestion on roadways. After the late 90s, however, motorized vehicle congestion has become a critical urban development issue. The major cause of this traffic congestion was the rapid growth of motorized vehicle ownership. Using Beijing as an example, it took 48 years for vehicle ownership to increase from zero to one million vehicles. However, it only took 6 years for ownership to jump from one million to two million vehicles. According to some forecasts, by 2015, the total vehicle ownership in China will exceed the current vehicle ownership levels of the United States.

The rapid increase in vehicle ownership not only created serious urban transport problems for Chinese cities and the nation as the whole, but also forced China to pay more attention to its national energy security. In 2003, China became the second largest oil consumer in the world. It consumed 246 metric tons, of which 30 percent was imported.

On average, vehicle emissions constitute 60 percent of urban air pollution. In 2002, only 30 cities met the clean air standards among the 113 cities designated by the State Council to be monitored.

China's elderly population (age 60 and above) exceeded 130 million in 2003, making it the largest and “oldest” in the world, with 20 percent of the global total and 50 percent of the Asian elderly population.

In the past, some Chinese cities adopted an unwise strategy for urban transport development by relying on the construction of more roadways to fight traffic congestion. This approach backfired just like it did in other countries. Many cities are now experiencing even more severe congestion, because roadway construction can never keep pace with the increasing vehicle ownership.

China has 13 cities exceeding 2 million permanent residents and 42 cities that have more than 1 million permanent residents. Total GDP output from cities accounted for 60 of the national GDP. Cities play a significant role in the economic development of China. It is essential for Chinese cities to develop a sound urban transport development strategy.

Considering energy security, environment protection, and resource constraints, a car-oriented urban transport policy is not suitable for Chinese cities. Although it is difficult for city decision makers to control vehicle ownership, government must shift transportation policy to focus more on the development of public transportation, and especially the development of Bus Rapid Transit.
The previous presenters and the video shown during the lunch-break have provided you a detailed technical background about Bus Rapid Transit (BRT). My presentation will focus on the progress of BRT implementation in several Chinese cities.

Both Beijing and Shanghai have very ambitious metro development plans. For example, Beijing will eventually develop a network with the total length of 300 kilometers, but even this extensive metro network will be able to carry only 20 percent of total public transport trips, and most parts of the city will still not be covered. Shanghai plans to build a 500-kilometer metro network, which will carry only 48 percent of public transport trips. The existing metro lines in that city are already over-saturated. City governments are seeking alternative public transport modes to supplement their metro systems. Moreover, the capital investments for the metro build-outs for both Beijing and Shanghai would amount to the current annual GDP output of each city.

The Mayors of both Beijing and Shanghai realize the role that BRT can play in their cities' public transport systems. The first BRT corridor in China is under construction in Beijing right now. The planning of the Nanzhongzhou BRT corridor was kicked off in March 2003. The northern segment (6 kilometers out of the total 16 kilometers) will begin test operations in December 2004. The entire system is scheduled to open by August 2005. Meanwhile, Beijing has developed a BRT Network Development Plan that proposes a BRT network with a total length of 200 kilometers to be completed over the next ten years. In Shanghai, BRT is being considered for the Middle Ring Road, and the Urban Transportation Bureau and city planning agencies are working on a BRT Network Plan.

Kunming was the first city in China to develop a center busway system. The city plans to covert its busway systems to a full BRT system. Currently, the research work has already been completed.

Some western and northeastern cities have plans to develop metro system, but because of the macro economic adjustment, these metro plans have been put on hold by the Central Government. Like metros, BRT systems can provide high capacity, a good level of service and environmental benefits. Unlike metros, they are inexpensive to build and operate, can be implemented in far less time, and retain the inherent flexibility of conventional bus systems. Therefore, these cities intend to implement BRT in the short range as an alternative to metro. Xian completed the Short-Range BRT Development Plan recently, and is now preparing implementation plan. Last month, Chengdu wrapped up the Middle Ring Road BRT Feasibility Study to develop a 28-kilometer BRT system on its major ring road system. The bidding for the design work is underway, and it is expected the entire project will be finished in two years. Tianjin, Chongqing, Shengyan, Nanjing, Wuhan, Fuzhou and other cities have also been conducting BRT planning.

Even though BRT is still a new concept in China, its advantages have been recognized by top decision makers in both the central government and city level. BRT has a bright future in China. In the next five years, at least ten Chinese cities are going to develop BRT systems. It is estimated that 300 to 500 kilometers of BRT corridors will be built and BRT daily ridership may reach two to four million.
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