AIM-Country Model
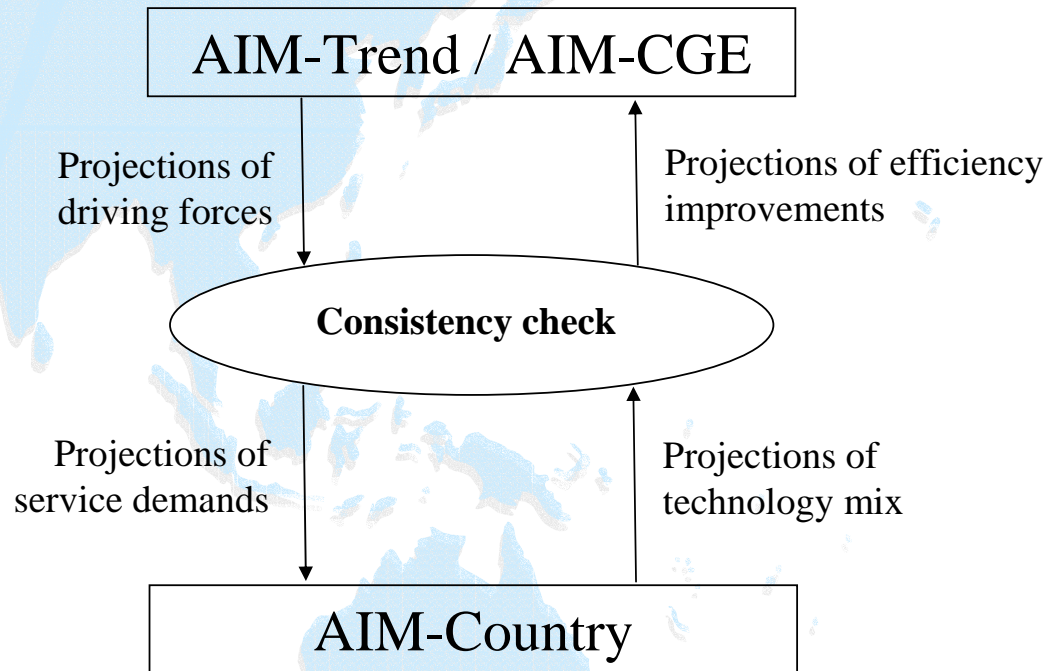
- Analysis of GHG mitigation and co-benefits

- Coverage of counties is over 20

- Bottom-up type model using GAMS

- Detailed technology / process representation

- Integration of energy flows between supply and demand sectors

- User friendly interface (Reformed AIM-Local's)

GHG mitigation analysis

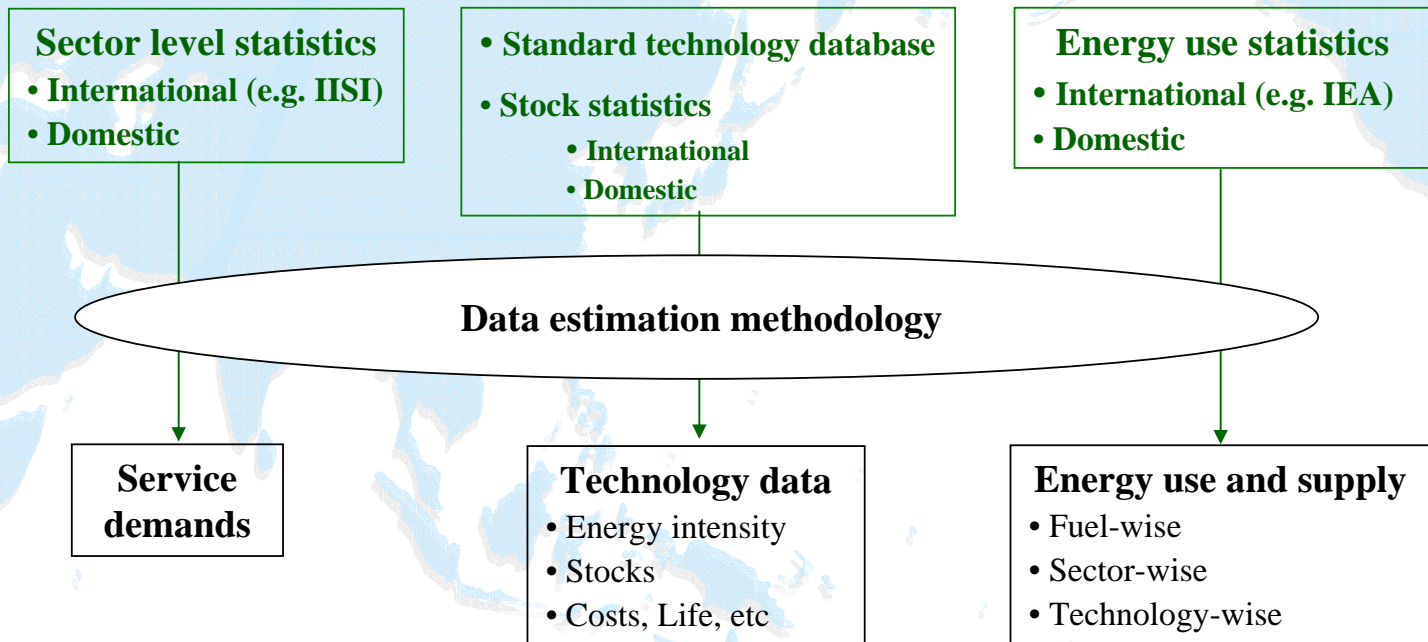|	Global Warming	Air Pollutants
Gases	CO2 emission	SO2 emission NO2 emission
Counter-measure	Energy saving Renewable energy Lifestyle change	Pre-combustion In Site combustion Post-combustion
Policy	Regulation (Emission & Energy consumption) Tax (Emission & Energy)	

Linkage with other models

AIM-Trend / AIM-CGE

Projections of driving forces

Projections of efficiency improvements

Consistency check

Projections of service demands

Projections of technology mix

AIM-Country

Coverage of counties

	AIM-TREND	AIM-Country		AIM-TREND	AIM-Country
Australia	D		Nepal	D	
Japan	D	D	Pakistan	D	
New Zealand	D		Philippines	D	
P.R.China	D	D	Singapore	D	
Korea, DPR	D		Thailand	D	
Vietnam	D		Chinese Taipei	D	
Bangladesh	D	S	Iran	D	
Indonesia	D	S	Kazakhstan	D	
India	D	D	Kyrgystan	D	
Korea	D	D	Tajikistan	D	
Sri Lanka	D		Turkmenistan	D	
Myanmar	D		Uzbekistan	D	
Malaysia	D				

D : Detailed model , S : Simple model

Two major problems of data

Sector level statistics
• International (e.g. IISI)
• Domestic

• Standard technology database

• Stock statistics
    • International
    • Domestic

Energy use statistics
• International (e.g. IEA)
• Domestic

Data estimation methodology

Service demands

Technology data
• Energy intensity
• Stocks
• Costs, Life, etc

Energy use and supply
• Fuel-wise
• Sector-wise
• Technology-wise

- **Non-availability of disaggregated data**

- **Lack of consistency between data sources**

Estimation of disaggregated data

• **International statistics**

• **International stock statistics**
• **Assumptions for device efficiency**

• **International statistics (IEA)**

Adjustment of Energy intensities and Shares/Stocks to calibrate with IEA energy balance information and per capita figures for India/China

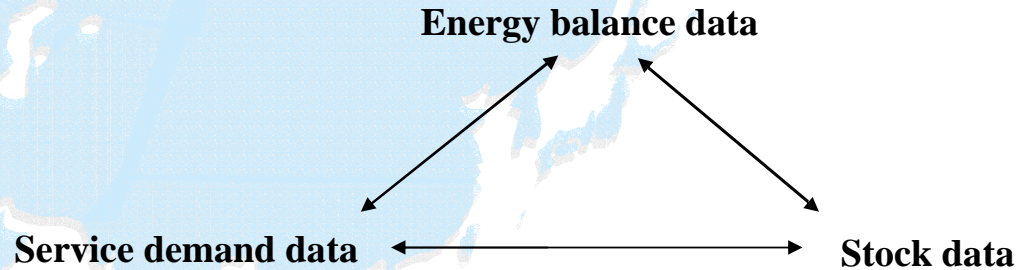**Service demands**

Technology data
• Energy intensity
• Stocks
• Costs, Life, etc

Energy use and supply
• Fuel-wise
• Sector-wise
• Technology-wise

• Lack of even minimum required disaggregated data for service demands, particularly in residential and commercial sectors

• Fuel and efficiency characteristics of technologies may differ across countries, particularly in some industries, residential and commercial sectors

• Energy per capita differs across countries due to difference in life-styles, modernization, food-habits, availability of indigenous resources

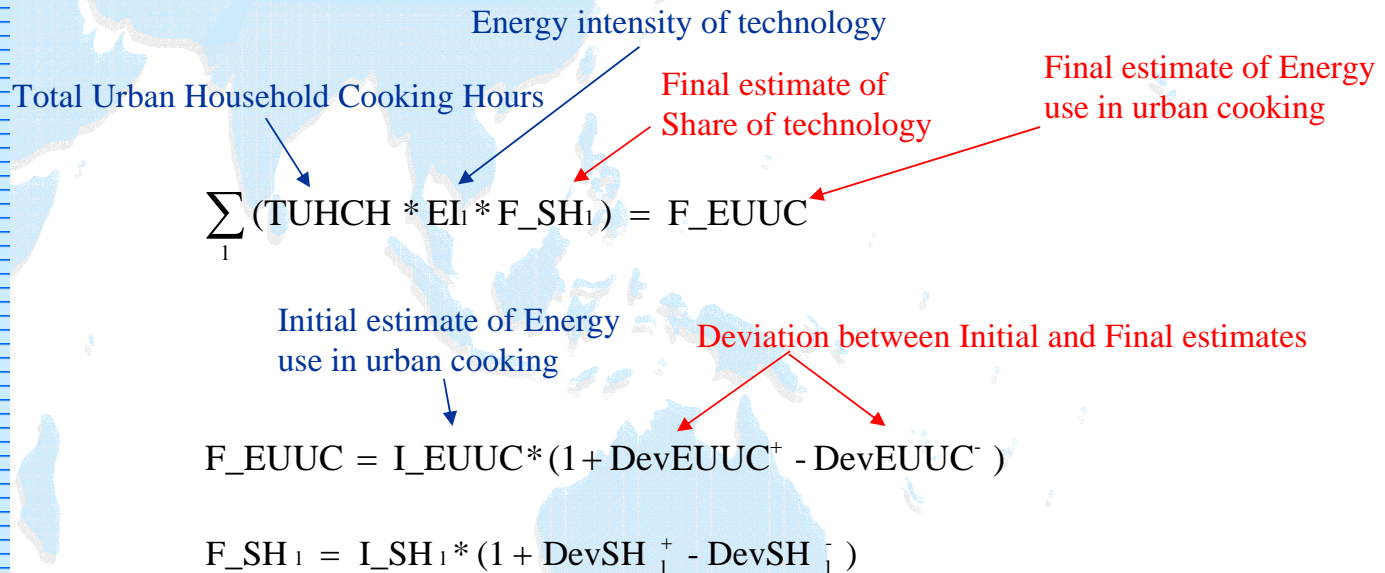# Tackling lack of consistency between data sources

Energy balance data

Service demand data ⟷ **Stock data**

- **'Data Adjustment' methodology comprising LP framework**

- **'Initially estimates' taken from various data sources or assumed**

- **Simultaneously changes energy uses, service demands, and stock levels, to minimize weighted sum of deviations between initial and final estimates**

- **Penalty weights assigned to 'deviations' depending on reliability of data sources**

A more systematic idea of data estimation

Illustration for residential sector

$Minimize$ $[\sum_l \{wsh_l * (DevSH_l^+ + DevSH_l^-)\} + weuuc * (DevEUUC^+ + DevEUUC^-) +$

Similar deviations in other residential services + Deviation in total energy use in residential sector]

Energy intensity of technology

Total Urban Household Cooking Hours

Final estimate of
Share of technology

Final estimate of Energy
use in urban cooking

$$\sum_l (TUHCH * EI_l * F\_SH_l) = F\_EUUC$$

Initial estimate of Energy
use in urban cooking

Deviation between Initial and Final estimates

$$F\_EUUC = I\_EUUC * (1 + DevEUUC^+ - DevEUUC^-)$$

$$F\_SH_l = I\_SH_l * (1 + DevSH_l^+ - DevSH_l^-)$$

… Similar equations for other residential services

Future work for AIM-Country applications

- Develop methodology for 'robust data estimation' for reference year. The methodology will combine both quantitative and qualitative approaches. Development of this methodology and access to domestic data sources will be done in collaboration with various experts.

- Estimate reference year data of service demands, technology efficiencies, stocks, etc, for all countries in Asia-Pacific.

- Estimate other input data (New technologies, Future scenarios, Removal processes).

- Set up detailed AIM-Country model for all countries in Asia-Pacific.

Additional information required for countries excluding J, C, I, K

Sector	Additional information required	Information available in international statistics
Industry	- Energy consumption by fuel in major industries like Iron & Steel, Cement, Aluminium, Pulp & Paper, Nitrogenous Fertilizer, Phosphatic Fertilizer, Textiles, Brick, Chemicals & allied (e.g. Caustic Soda, Soda Ash), Petrochemicals - Above energy consumption information by major technological processes in each industry, **OR** Energy-intensity numbers for each major technological process	- Production data by product or industry (Industry Commodity Statistics) - Energy consumption data by fuel in aggregate industry categories (e.g. Total industry, Non-metallic minerals) (IEA Energy Balance)
Transport	- Passenger demand (in MPKM) and Freight demand (in MTKM) for Road - Energy consumption by fuel in Road-Passenger, Road-Freight, Rail-Passenger, Rail-Freight, Air-Passenger, Air-Freight, **OR** Average energy intensity numbers for 2-Wheeler, Car, Bus, Light Truck, Heavy Truck, Electric Locomotive, Diesel Locomotive, Steam Locomotive	- Stock of 2-Wheelers, Cars, Buses and Trucks (World Road Statistics) - MPKM and MTKM demand data (World Marketing Data & Statistics) - Energy consumption by fuel in aggregate Road, Rail, Air and Other Transport sectors (IEA Energy Balance)
Residential	- Energy consumption by fuel in Urban residential and Rural residential sectors - Energy consumption by fuel in Cooking, Lighting, Space heating and Other Appliances, in Urban and Rural residential sectors, **OR** Average energy intensity numbers for various devices of Cooking, Lighting, Space heating and Appliances.	- Urban and Rural population data (World Development Indicators) - Energy consumption by fuel in aggregate Residential sector (IEA Energy Balance)
Agriculture	- Land area irrigated by energized pumps - No. of Electric pumps and Diesel pumps - Average energy intensity of Electric pumps and Diesel pumps	- Total irrigated land area (World Development Indicators and FAOSTAT, FAO) - Energy consumption by fuel in aggregate Agriculture sector (IEA Energy Balance)
Commercial	- Building floor area in commercial sector, **OR** Value added in Commercial sector - Above information by major Commercial sector categories like Hotel & Restaurants, Hospitals & Health Care, Offices, etc.	- Energy consumption by fuel in aggregate Commercial sector (IEA Energy Balance)

Feedback/suggestions welcome

- National level sources of information on service demands, energy intensity and share/stock of technologies, for Asia-Pacific countries.

- Methodology for robust estimation of data for reference year.