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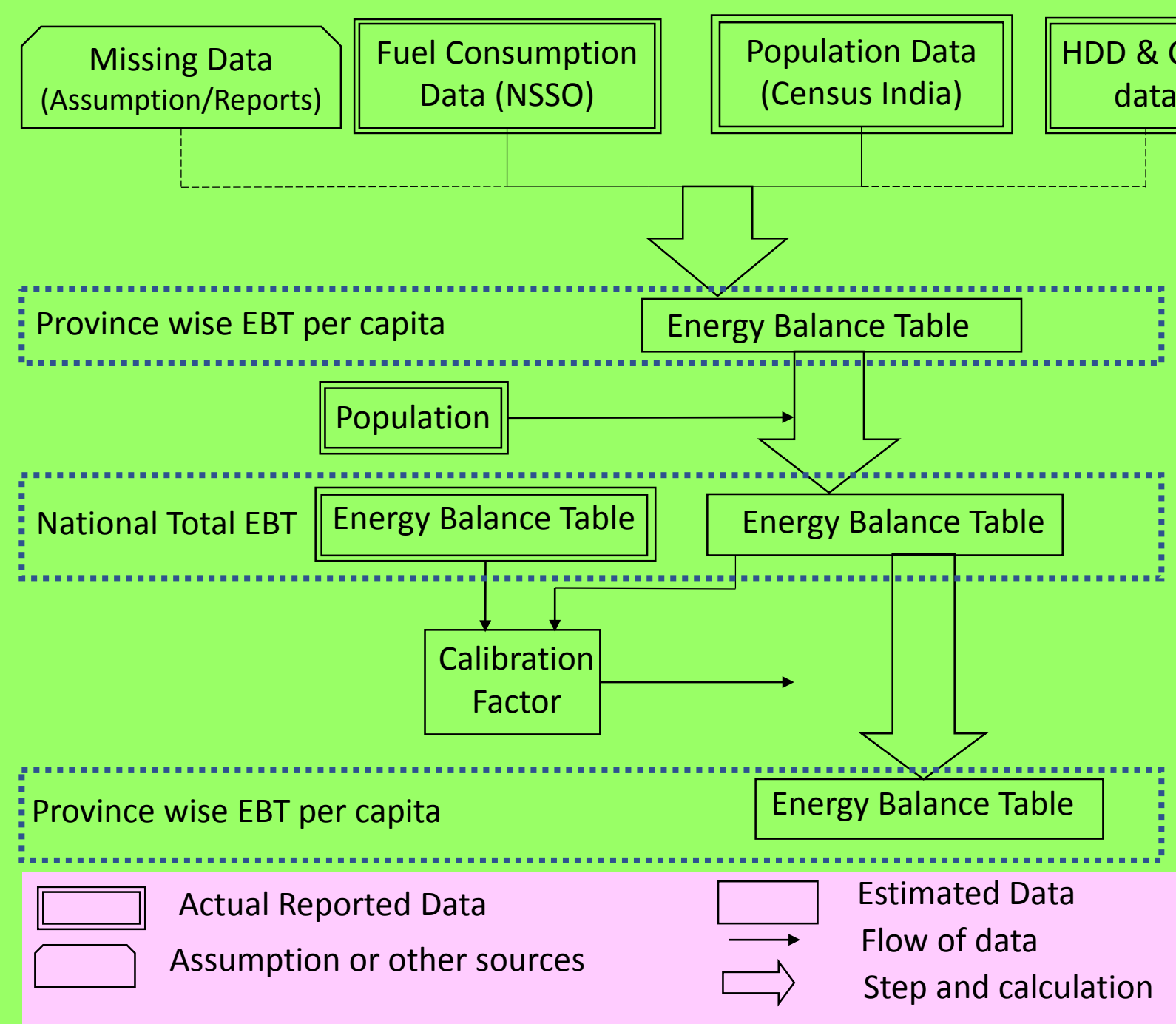
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1. BACKGROUND

- Impressive economic growth has intensified India's demand for energy in residential sector.
 - Poverty, lack of access to clean and efficient energy sources remains serious concern
- India, second-most populous country in world, is a mixture of different cultures, traditions, languages, cuisine, food habits, etc.
 - One-third of India's population residing in rural households
 - 60% of these households are in Northern part of India.
- Cooking and lighting are the major household services.
 - Drivers: household income, expenditure, household size, literacy (awareness), urbanization, location (rural / urban) etc.

2. METHODOLOGY

2.1 Framework: Energy Balance Table



2.2 Energy Balance Table: Outline

k	Energy Consumption Matrix						Energy Share Matrix						Service Share Matrix						
	CK	HW	HT	CL	OA	Total	CK	HW	HT	LT	CL	OA	CK	HW	HT	LT	CL	OA	Share
BMS																			100%
CHK																			100%
COL																			100%
OLK																			100%
OLL																			100%
COG																			100%
DC																			100%
NGS																			100%
ELYR																			100%
RHT																			100%
SOH																			100%
Total						TEC	100%	100%	100%	100%	100%	100%							100%
Share						100%													100%

Available energy balance data in urban/rural-wise, in state/province-wise
 No energy use, thus it is not necessary to consider
 Required data for energy service demand model and Endues model
 Some data are available depending on country. For example, energy share matrix for CK and LT are available in urban/rural-wise, in state/province-wise in India
 Unavailable data in urban/rural-wise, in state/province-wise, thus we need to estimate or set some assumptions. Sometimes, share data are available only in a national level in a specific year.

BMS	biomass	i	sector or sub sector	CK	cooking
COL	coal	t	simulation year	LT	lighting
CHK	charcoal	l	device or measure	HW	hot-water
OLK	kerosene			HT	space heating
OLL	LPG	ELYR	electricity	CL	space cooling
PEC	per capita energy consumption			OA	other appliances
\overline{PEC}	estimated PEC			POP	population
SHRPe	share of energy type			DRT	diffusion ratio
SHRPTe	share of total energy			HHN	household numbers
LPNT	nu. of light points per household			HD	hot days

$$\overline{PEC}_{k,j=CK,s,r,t} = \sum_j \overline{PEC}_{k,j,s,r,t} \times \frac{SHRPe_{k,j=CK,s,r,t}}{SHRPTe_{k,s,r,t}}$$

$$\overline{PEC}_{k=ELYR,j=OA,s,r,t} = \sum_j \overline{PEC}_{k,j,s,r,t} - \sum_j \overline{PEC}_{k,j=ELYR,s,r,t}$$

$$\overline{PEC}_{k=ELYR,j=HW,s,r,t} = \frac{\left(DRT_{l,k=ELYR,j=HW,s,r,t} \times HHN_{k=ELYR,s,r,t} \right) \times \left(EUA_{k=ELYR,j=HW} \times HR_{k=ELYR,j=HW} \times HD_r \times CF_{k=ELYR} \right)}{POP_{s,r,t}}$$

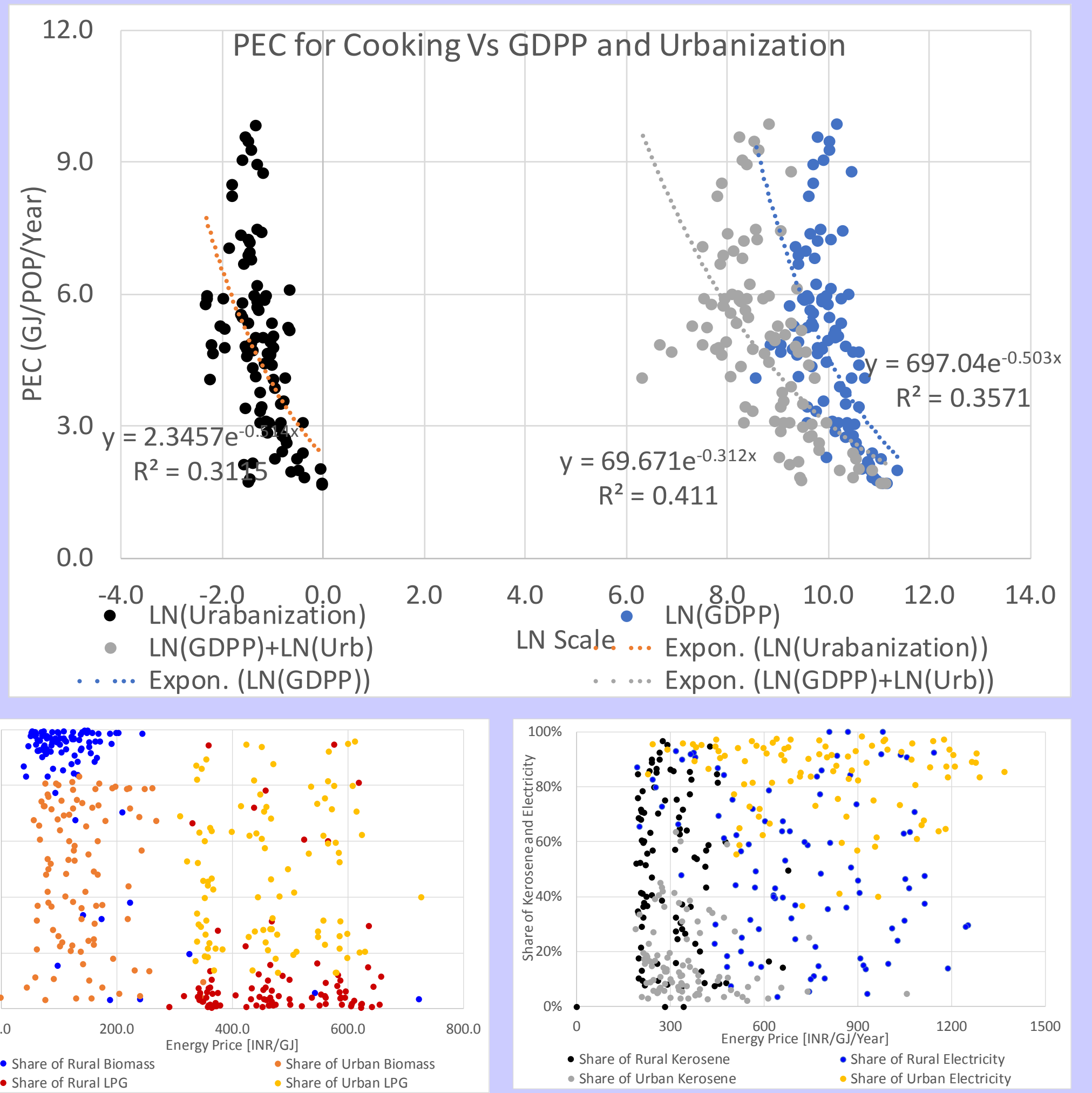
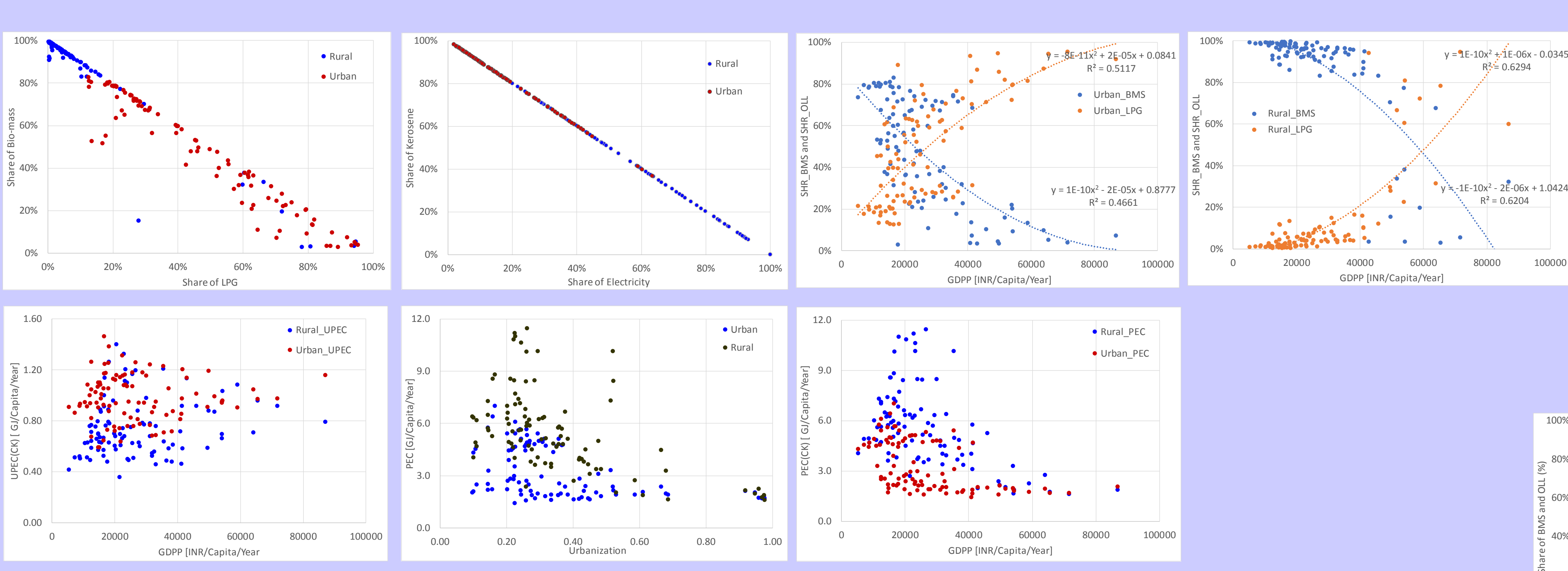
$$\overline{PEC}_{k=ELYR,j=LT,s,r,t} = LPNT_{k=ELYR,s,r,t} \times EUA_{k=ELYR,j=LT} \times HR_{k=ELYR,j=LT} \times CF_{k=ELYR} \times DPY \times \frac{1}{POP_{s,r,t}}$$

$$\overline{PEC}_{k=OLK,j=LT,s,r,t} = LPNT_{k=OLK,s,r,t} \times EUA_{k=OLK,j=LT} \times HR_{k=OLK,j=LT} \times CF_{k=OLK} \times DPY \times \frac{1}{POP_{s,r,t}}$$

$$\overline{PEC}_{k=ELYR,j=CL,s,r,t} = \frac{\left(DRT_{l,k=ELYR,j=CL,s,r,t} \times HHN_{s,r,t} \right) \times \left(EUA_{l,k=ELYR,j=CL} \times CDD_r \times CF_{k=ELYR} \right)}{POP_{s,r,t}}$$

- In India, various statistical reports are available in the unit of 'per capita energy consumption' rather than 'total energy consumption'. Thus, EBT is estimated in per capita by energy (k), by service (j), by region (r) and by regional segment (s).
- The quantity of fuels reported in survey reports were in there physical unit per capita per month, are converted to same unit in Giga Joules per capita per year.

3. RESULTS



4. CONCLUSION

- There is a wide disparity between rural and urban in energy consumption in Indian provinces.
 - Transition from bio-mass to LPG in cooking service.
 - Characteristics in rural and urban for cooking is different.
 - Transition from kerosene to electricity in lighting service.
 - It is difficult to analyze relation between energy consumption (per capita) and economic variable for all the provinces of India.
 - In reality, as household income increases, energy transition can be explained for cooking.
 - With increase in urbanization, availability of resources increases, whereas less urban availability constraint is negative impact. The relation with energy consumption is more pronounced by neglecting this negative impact income on same scale.
- GDPP is used as proxy for household income.
- Urbanization also one of the important driver to explain energy consumption.