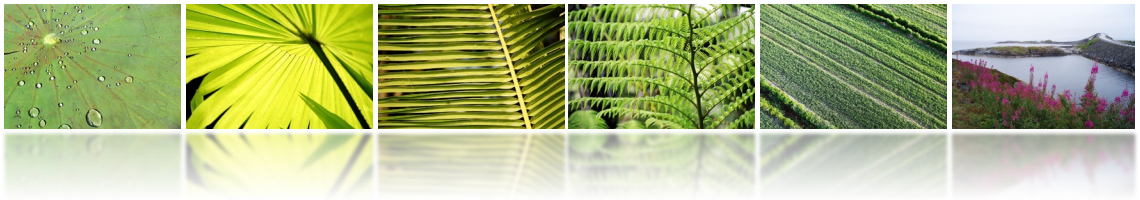
United Nations
Statistics Division

Methods for grossing up, Modelling and projections



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Workshop on the Strategic Framework for the African Bioenergy Data Management

24-26 April 2023 | Lomé, Togo

Outline

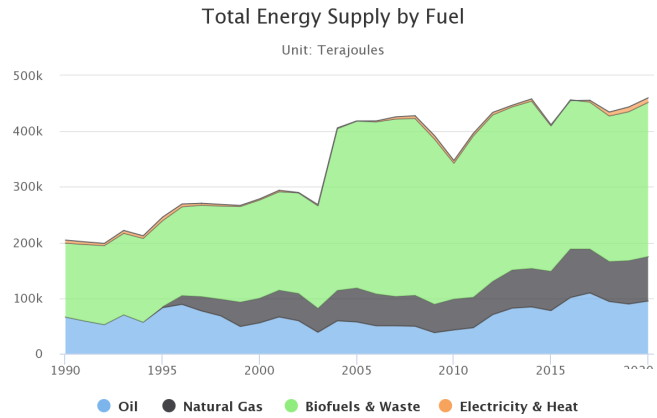
- Introduction
- Grossing up data from other surveys (or modeling to fill gaps)
- Modeling to enable projections
- Exercise

Introduction

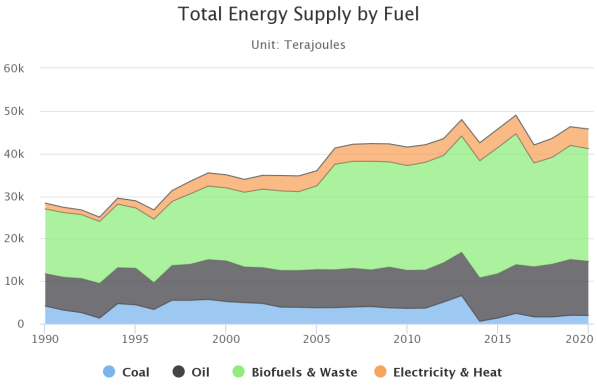
- Bioenergy is fundamental for socio-economic development in Africa
- It is main component of the energy supply of many countries
  - If not, at least bioenergy constitutes an important source to satisfy residential energy needs

Bioenergy in the energy supply

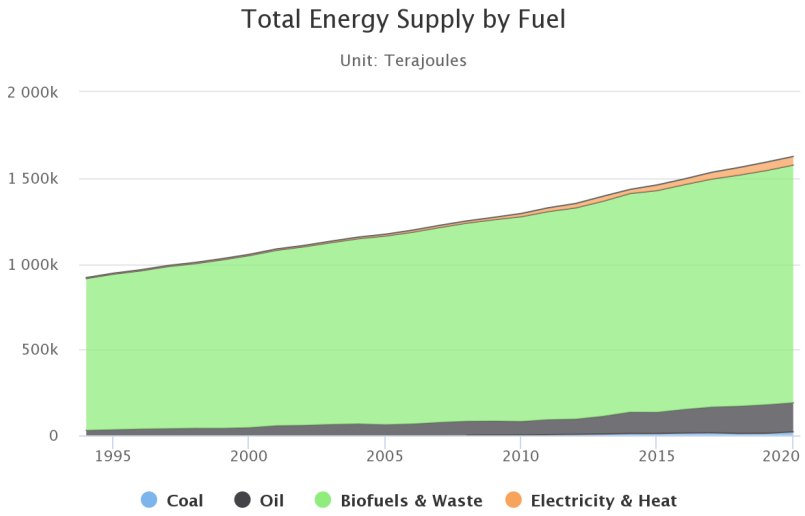
Côte d'Ivoire



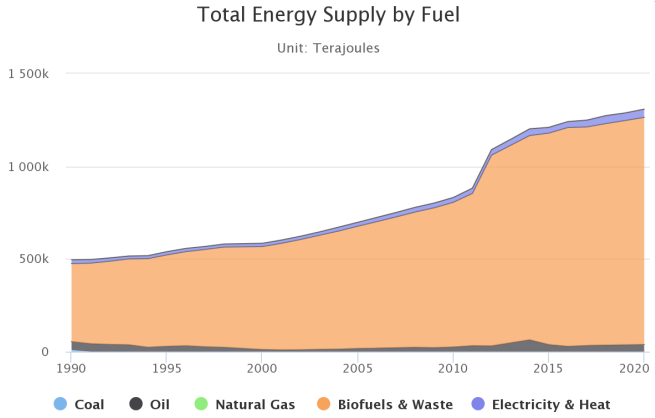
Eswatini



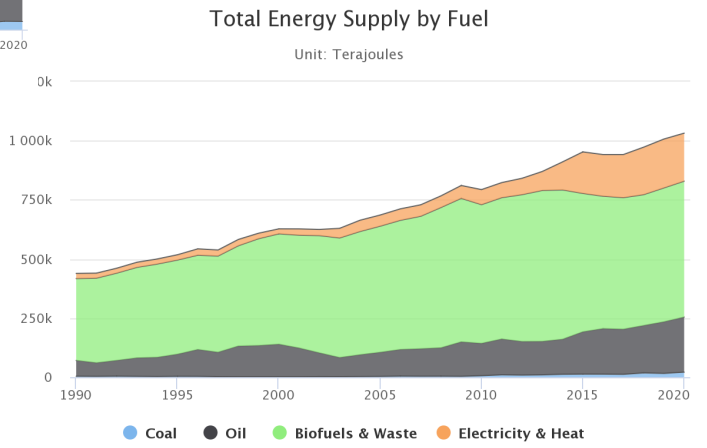
Ethiopia



Democratic Republic of Congo

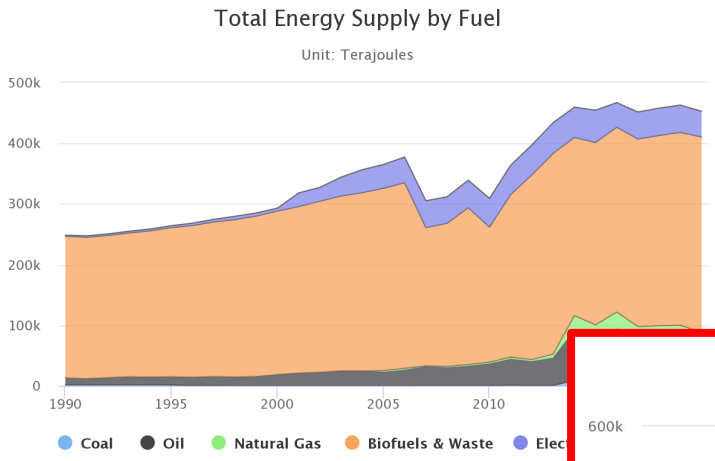


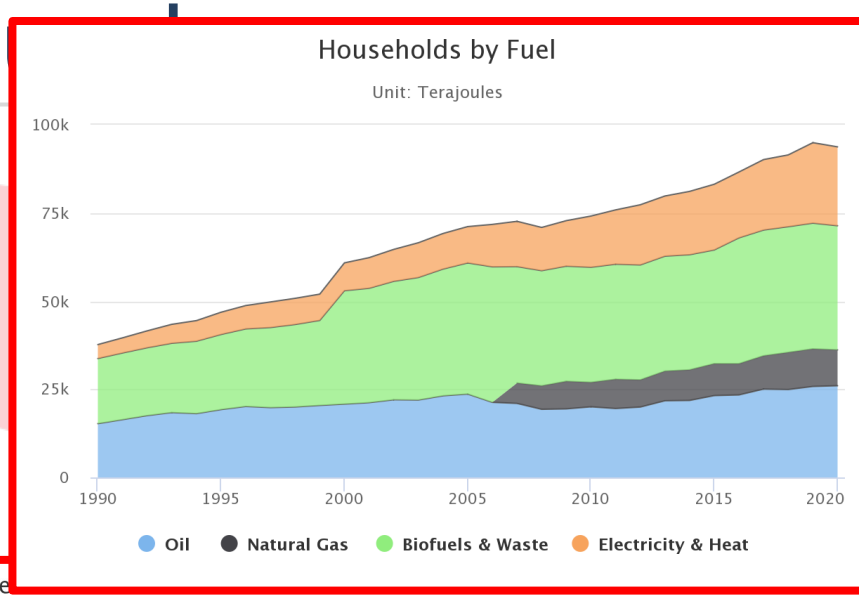
Kenya



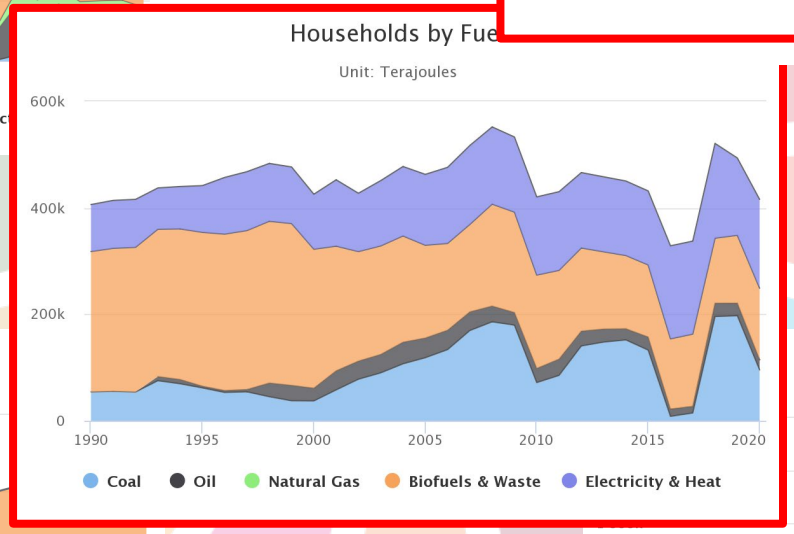
Bioenergy in the energy s

Mozambique



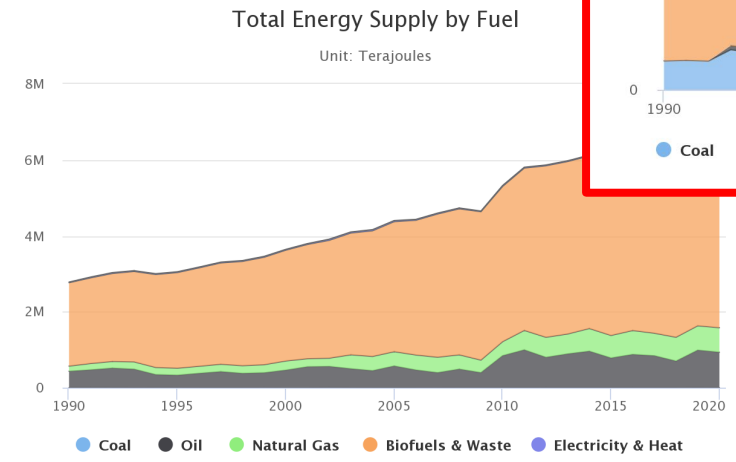


South Africa

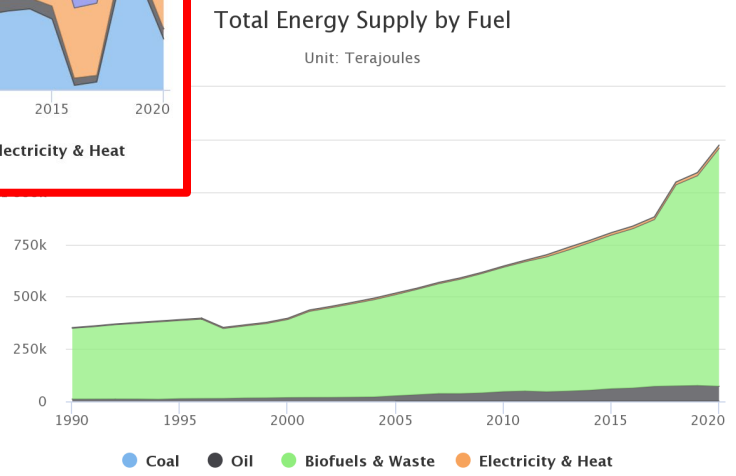


Tunisia

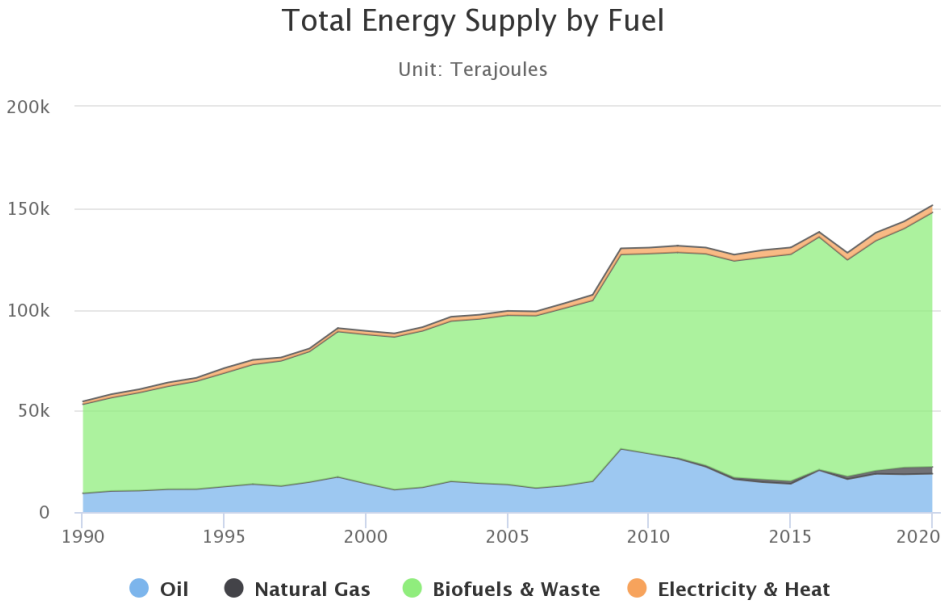
Nigeria

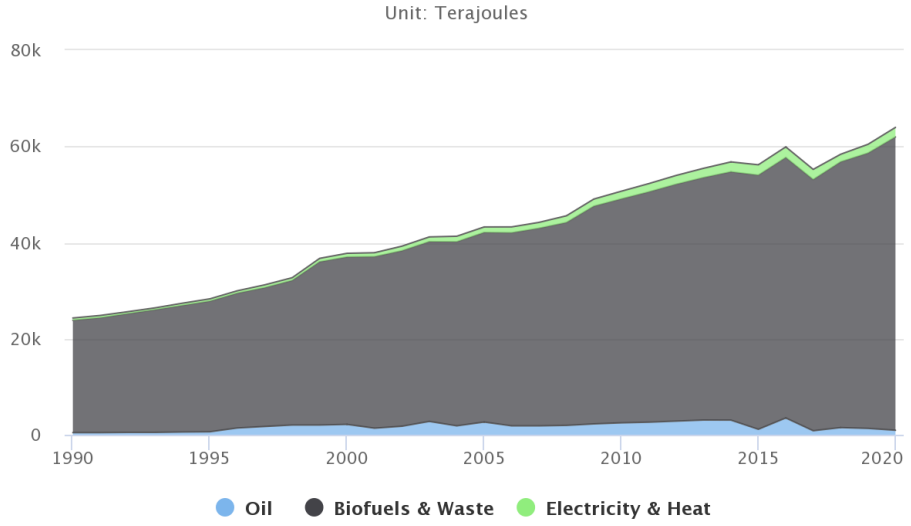


Uganda



Bioenergy in the energy supply of Togo





Source:
https://unstats.un.org/unsd/energystats/dataPortal/

Introduction

- Yet, the unavailability of good data makes it difficult to understand (bio)energy needs and associated problems
  - And, consequently, to design policies and define associated targets
- Ideally all bioenergy data will be collected through specific surveys, but while we don't live in this ideal world…
  - We can use related data from other surveys/sources to arrive at better estimates of bioenergy use

Introduction

- Moreover, modeling bioenergy production & consumption can support (bio)energy planning along three main levels:
  - Integrating key driving forces in a consistent & disciplined way
  - Exploring alternative scenarios and understanding uncertainty
  - Exploring how different technological options can meet policy goals and supply requirements

Grossing up using modeling

- It makes sense to use modelling to fill gaps in bioenergy knowledge until better data sources are available
  - Just remember they may never be available if we don't go after them, for example by establishing a new survey or piggybacking on an existing survey

(But even where data are available, we may want to model such data so as to enable scenario-based projections)

Grossing up using modeling

- Where are the gaps?
  - It may be useful to compile an inventory of possible biofuel products and data sources for the country
  - With a legend and a list of data sources (potential or realized)

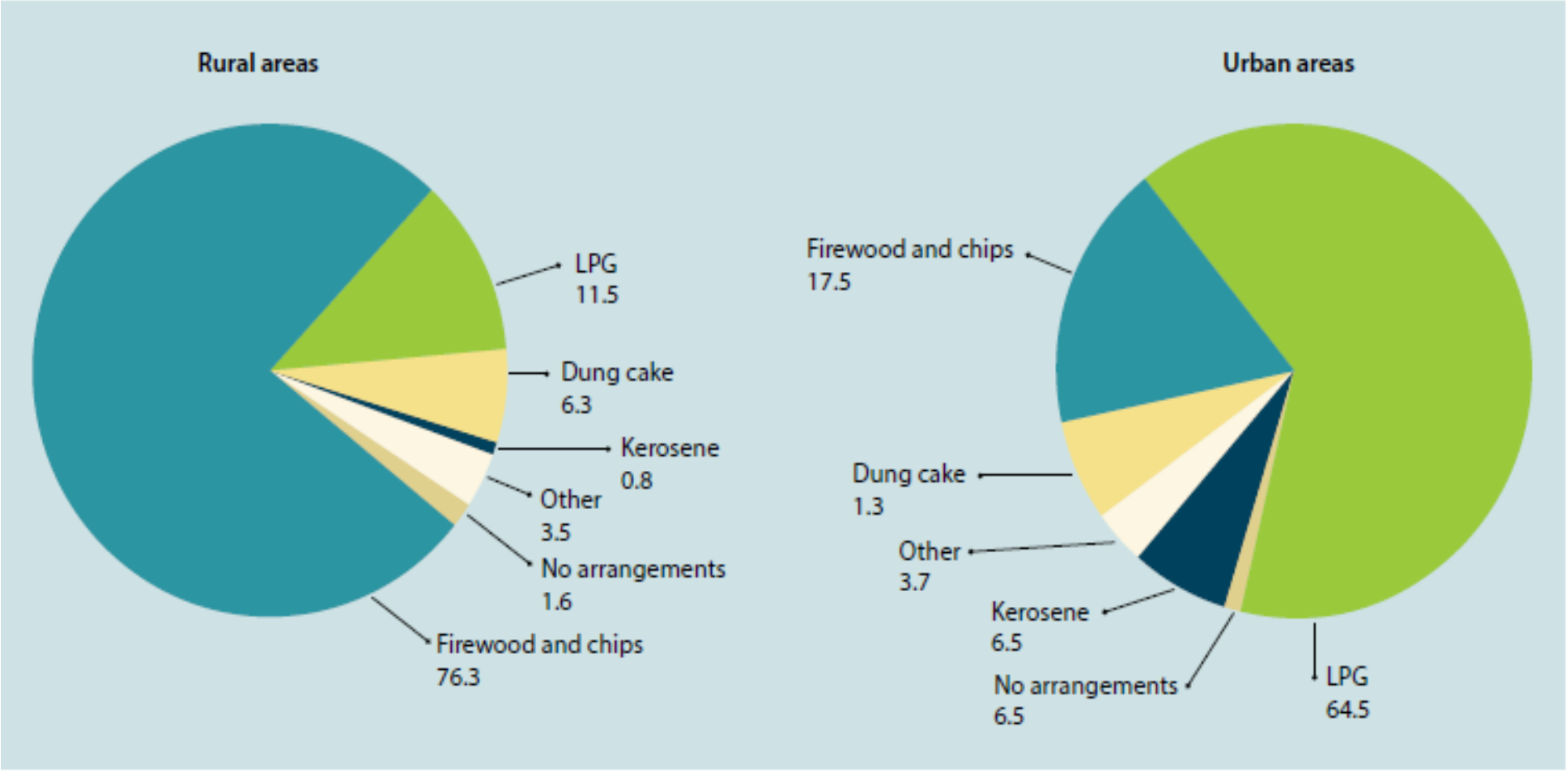
		Wood	Charcoal	Bagasse	Vegetal waste	Biogas	ETC.
For electricity production				SOURCE	SOURCE	SOURCE?	SOURCE
For charcoal production	Household	SOURCE	SOURCE		SOURCE?	SOURCE?	SOURCE?
	Industry						
Industry	Ceramic						
	Food/Beverage						
	Sugar						
	ETC.						
Transport							
Other	Residential						
	Commerce						
	Public services						
	Agriculture						
	ETC.						

Grossing up using modeling

- Let us see a case where information from standard (non-energy) household surveys can be grossed up using modeling.
  - It makes it easier to make projections for these quantities later
- Suppose we have little idea of how much energy/fuel is used by households for cooking. How would we approach it?

Modeling to fill gaps: example

Energy sources used for cooking in rural and urban areas in India, 2009–2010



Source: Energy Sources of Indian Households for Cooking and Lighting, NSS 66th round, Ministry of Statistics and Programme Implementation

Ex: existing source is a household survey on cooking fuels (or you procure one such survey)

What other data do we need?

Having results on the % of cooking fuel (total or split b/w rural and urban) allows for grossing up figures by using population and average quantities used by person.

Each fuel to be analyzed separately

Ex: total FUEL used for cooking =

$Total_{rural}$ + $Total_{urban}$ =

[$\%FUEL_{rural}$ x **Coefficient on FUEL per person (rural)** x rural population] + [$\%FUEL_{urban}$ x **Coefficient on FUEL per person (urban)** x urban population] .

See exercise 1 (India 2010)

Data for the exercise

1 - Shares of cooking fuel by fuel (urban and rural)		
	Rural	Urban
Firewood and chips	76.3%	17.5%
LPG	11.5%	64.5%
Dung cake	6.3%	1.3%
Kerosene	0.8%	6.5%
Other	3.5%	3.7%
No arrangements	1.6%	6.5%
Total	100.0%	100.0%

3 - Coefficients (average fuel use per person per year)			
[These are made-up numbers.]			
	Rural	Urban	Unit
Firewood and chips	240	200	kg/person/year
LPG	40	32	kg/person/year
Dung cake	292	240	kg/person/year
Kerosene	44	36	kg/person/year
Other	120	100	kg/person/year
No arrangements	-	-	

2 - Urban and rural population				
	Rural	Urban		Total
Population	856,023,660	384,590,340		1,240,614,000
(India 2010 - source https://population.un.org/wpp/Download/Standard/Population/)				

After multiplication: energy for household cooking

Quantities (kt)	Rural	Urban		Total
Firewood and chips	156755.1	13460.7		170215.7
LPG	3937.7	7937.9		11875.7
Dung cake	15747.4	1199.9		16947.3
Kerosene	301.3	899.9		1201.3
Other*	3595.3	1423.0		5018.3
No arrangements	0.0	0.0		0.0

Calorific values (for building energy balances)				
	Rural	Urban		Unit
Firewood and chips	15.6	15.6		MJ/kg
LPG	47.3	47.3		MJ/kg
Dung cake	13.6	13.6		MJ/kg
Kerosene	43.8	43.8		MJ/kg
Other*	25.8	25.8		MJ/kg
No arrangements	0	0		MJ/kg

For energy balance (TJ)	Rural	Urban		Total
Firewood and chips	2445378.8	209986.3		2655365.1
LPG	186253.6	375464.8		561718.4
Dung cake	214164.8	16318.9		230483.7
Kerosene	13197.8	39417.4		52615.3
Other*	92758.7	36713.0		129471.7
No arrangements	0.0	0.0		0.0

* Other replaced by coal

Need for good data

- Most models are designed to answer specific questions, with their strengths and weaknesses.
  - Models need to be tailored to the circumstances and goals

- In order to build a bioenergy statistics model, it is necessary to first gather good information
  - Quantitative
  - Qualitative

- Only with a baseline built on good information it is possible to build a reliable model that will allow for good demand estimation and forecasting

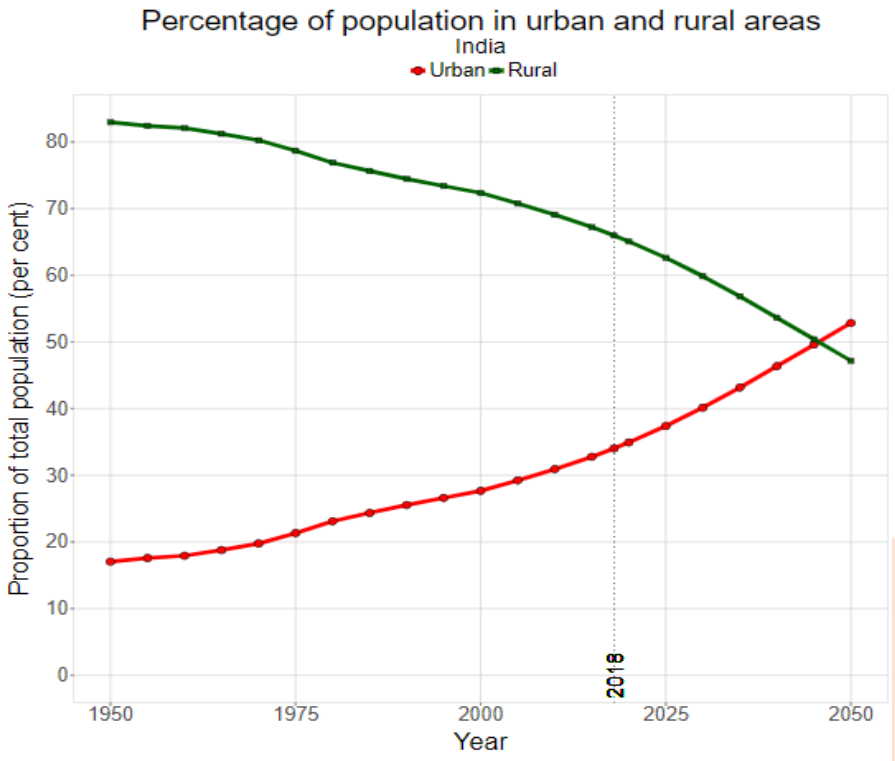
Modeling using proxies/coefficients

As we just saw, proxies and coefficients were employed to estimate some bioenergy flows we could not measure

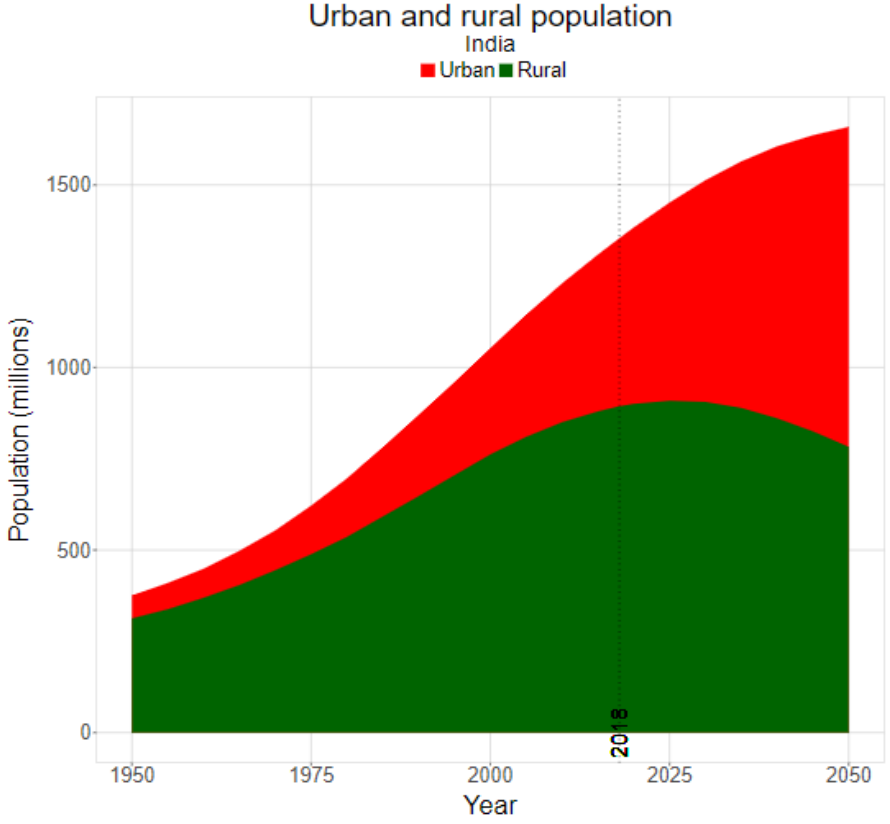
- Proxy information is needed, and expert modeling is necessary to adjust coefficients
  - For example, do the estimates for cooking or other uses create an imbalance between supply and use? (Assuming data on the supply and on other uses are available.)
  - If they do create such an imbalance, the coefficients may need to be adjusted by country experts: you!

How to use it for projections?

- To project residential fuel use for cooking, models can be simple and assume shares and coefficients don't change.
  - In this case population projection is needed, rural and urban.



Note: Urban and rural population in the current country or area as a percentage of the total population, 1950 to 2050.



How to use it for projections?

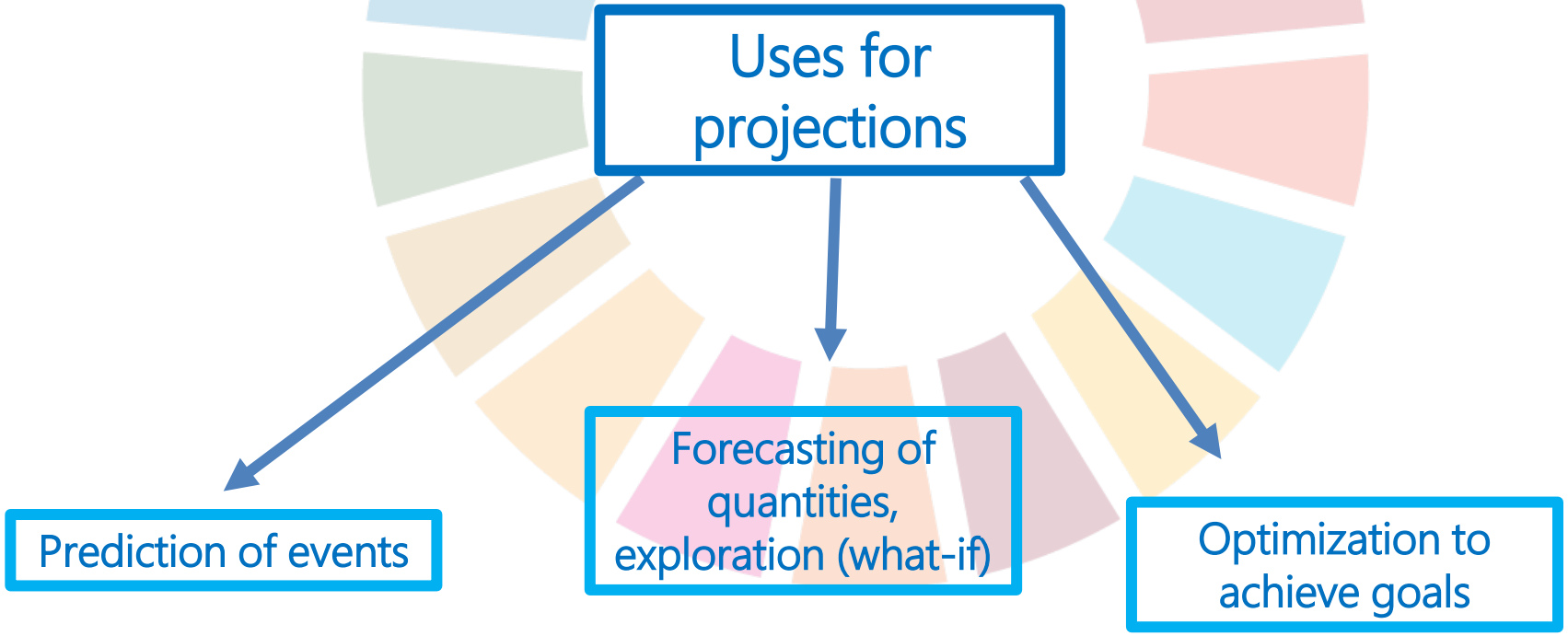
- However, projections can become more sophisticated by incorporating other expected changes.
  - For example, is there a policy to encourage clean cooking?
  - Are there efficiency gains in cooking technology that will reduce amount of fuel/person?
  - Conversely, is average income raising so that people are cooking more and therefore using more fuel?
  - How is that going to affect the quantities/shares of each fuel?
- Also, it may be wise to explore different scenarios.
- It is recommended that new measurements are taken every few years, so past projections can be revised/interpolated.

Different uses for projections:

- Trying to predict what will happen

- Forecasting, What-if analysis (exploratory scenarios), robustness analysis

- Try to investigate what should happen for achieving (policy) goals: optimization.



Residential wood use for cooking

- With a higher urbanization rate, less fuelwood is used for cooking, but more charcoal
  - Which counterintuitively leads to the harvest of more wood
  - Important to consider when analyzing relationships b/w energy and environment

Unités : Milliers de tonnes équivalent pétrole (ktep)	Biomasse,	Charbon d
Unité de production de charbon de bois	-1862	614

Tableau 4.19 : Principale source d'énergie utilisée pour la cuisson par les ménages par milieu de résidence en 2015

Sources	Lomé	Autre urbain	Rural	Ensemble
Electricité/Gaz	23,3	5,7	0,9	8,5
Charbon	74,4	66,4	11,5	40,2
Bois	1,3	26,5	86,9	50,4
Autres	1	1,4	0,7	0,9
Ensemble	**100**	**100**	**100**	**100**

Source: QUIBB 2015, estimations INSEED

Tableau 2.2 : Population urbaine et taux d'urbanisation

Année (1er janvier)	Population urbaine (en millier)	Taux d'urbanisation (%)
2011	2 338,5	37,7
2012	2 433,9	38,3
2013	2 533,1	38,9
2014	2 636,4	39,5
2015	2 744,2	40,1
2016	2 856,2	40,8
2017	2 972,8	41,4
2018	3 094,1	42,1
2019	3 220,4	42,8
2020	3 351,8	43,5

Thank You!

Questions/comments?

Contact

UNSD – Energy Statistics Section

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