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AGRICULTURAL RESEARCH
FOR DEVELOPMENT

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Agricultural residues for energy

What does the CDM experience of India tell us about their availability?

Introduction

- Context
  - Increasing energy needs
  - Predicted exhaustion of fossil energy reserves
  - Climate change

Agricultural residues as alternative for energy production?

- Some interesting characteristics that are supposed:
  - Low cost of resource
  - Abundance
  - Complementarities between food and energy uses
  - Suitable for decentralized energy production

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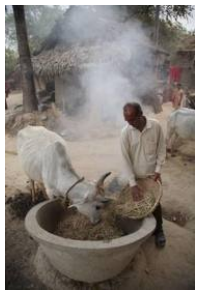
The issue



- Crop residues potential has been assessed by many studies
  - Availability for energy is limited by uses in competition
    - soil, cattle, domestic fuel, building materials…
  - Volumes of potentially available residues are non-negligible for energy production
- But little investigation has been made on existing commercial energy uses of residues
- **Indian experience** with hundreds of CDM projects
  - Compare availability with consumption for energy
  - Conditions allowing energy production from residues and how far they can be sustained

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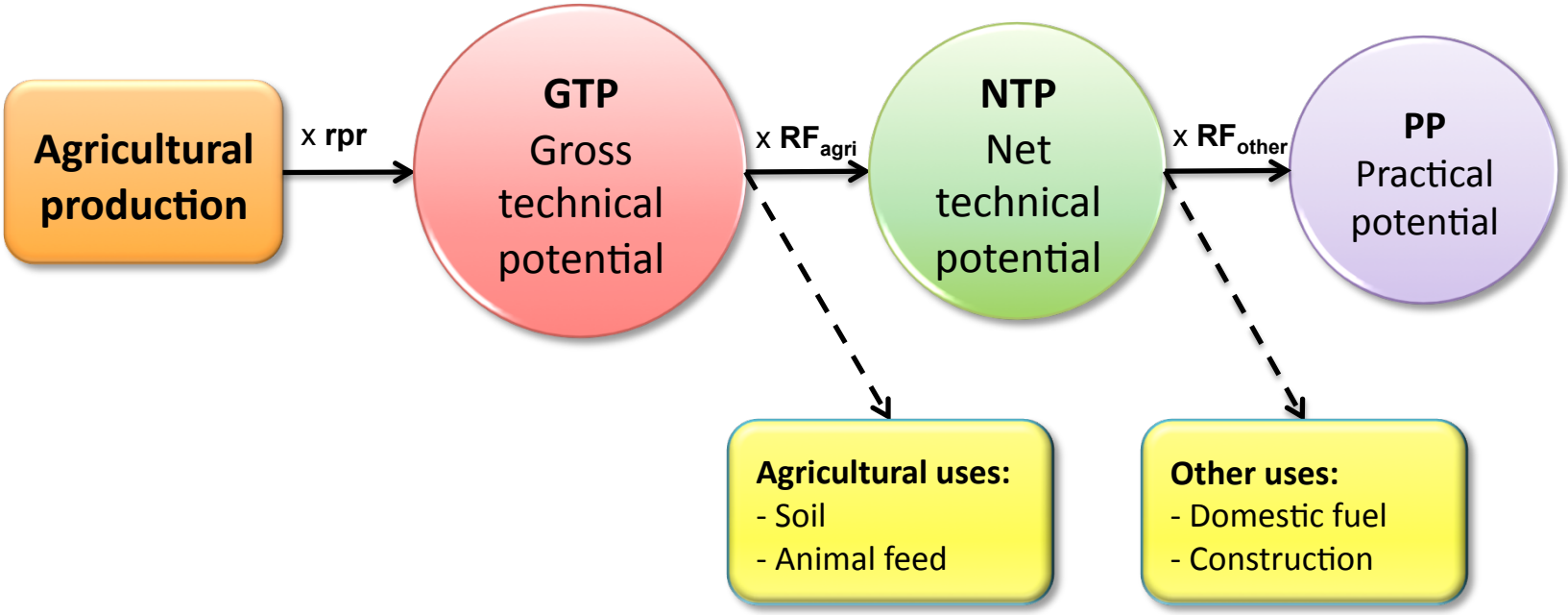
Assessing crop residues potential for energy



- Crop production data are the most recent available
- Residue to Product ratios fit to the Indian context
- Recoverability factors are based on assumptions concerning the uses in competition.

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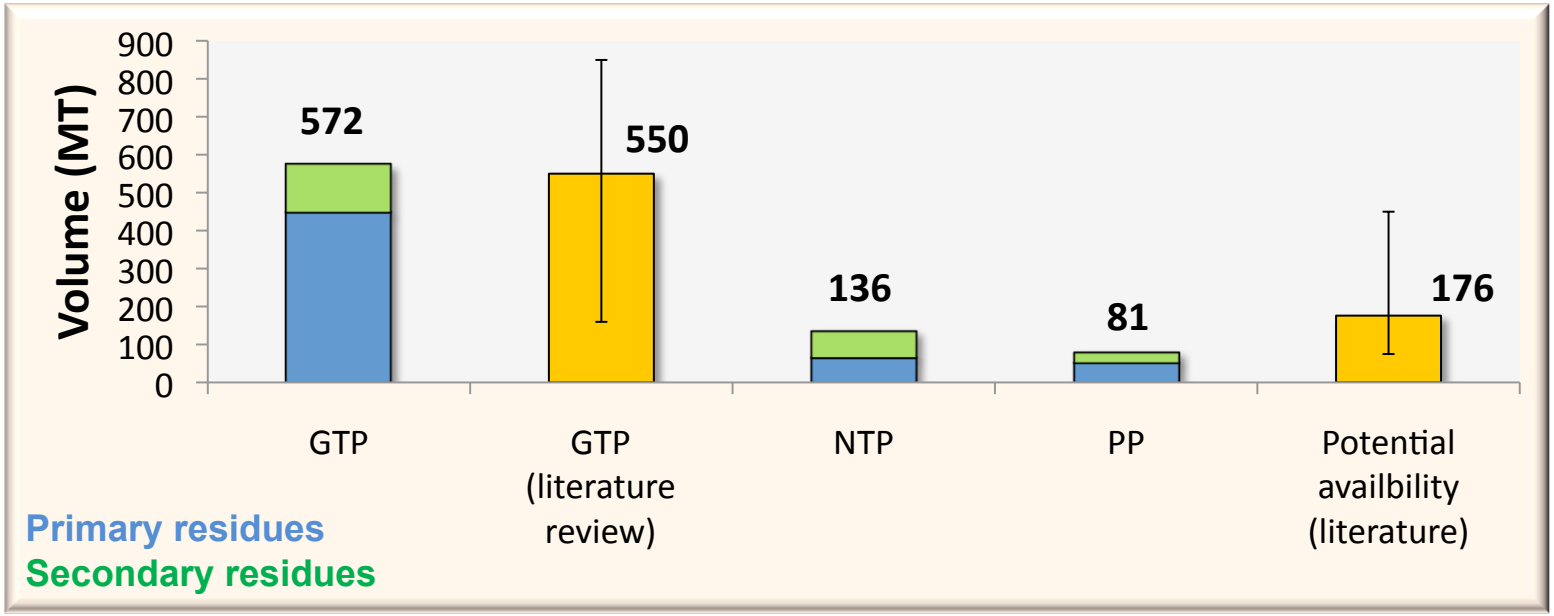
Crop residue potential availability

- Results based on 22 residues from 15 crops
- Comparison with other assessments shows large range of potential → boundary conditions are not the same



- **How realistic are such potential assessments?**
- **Are those volumes of crop residues really available for new energy projects?**

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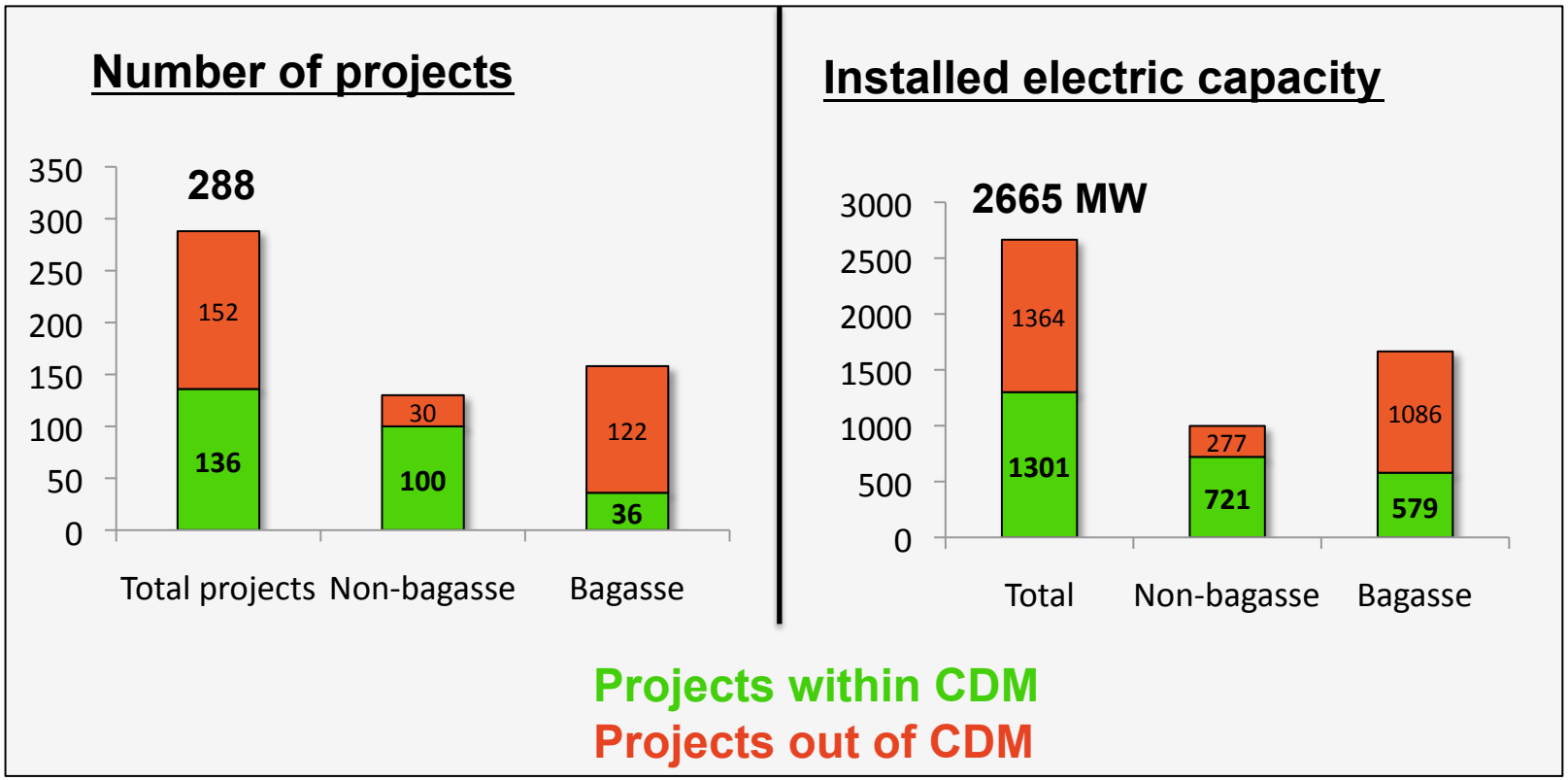
Analyzing energy production from residues through the CDM experience

- Data from 136 registered projects is analyzed
  - Project Design Document
  - Monitoring Report
- Representativity of the sample



Source: MNRE, government of India

Residue consumption within CDM projects

- 24 different crop residues are used
  - Mainly secondary residues, bagasse and rice husk above all
  - Only 7 projects relying entirely on primary residues

- Comparison between volumes required and potentials

As on 01/08/2010	Volumes required for **the 136 MDP projects registered**			Volumes required for the **registered and under registration projects**		
	GTP	NTP	PP	GTP	NTP	PP
Whole India						
All residues	2,5%	10%	17%	7%	28,5%	47.5%
Bagasse	8.5%	15%	38%	26%	48%	**119.5%**
Rice husk	15.5%	28.5%	71.5%	41%	75%	**187.5%**
Primary residues	0.1%	0.7%	0.9%	-	-	-
State of Uttar-Pradesh						
Bagasse	10%	19%	47%	26.5%	48%	**120.5%**
Rice husk	17%	31%	78%	64%	**116%**	**290%**

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Residues needs for CDM projects

- Considering the whole amount of residues:
  - Current requirement: 10 -17% of the potentially available residues
  - Future requirement: up to 50% of the potentially available residues
- All types of residues are not equally solicited:
  - Primary residues: little used (<1%)
  - Secondary residues: main resource exploited, expected saturation in the near future, especially on bagasse and rice husk
- Easier accessibility and lower collection cost for secondary residues explain the difference.
- Demand analysis based on residue requirements of CDM projects:
  - They represent half of the total energy production from residues in India

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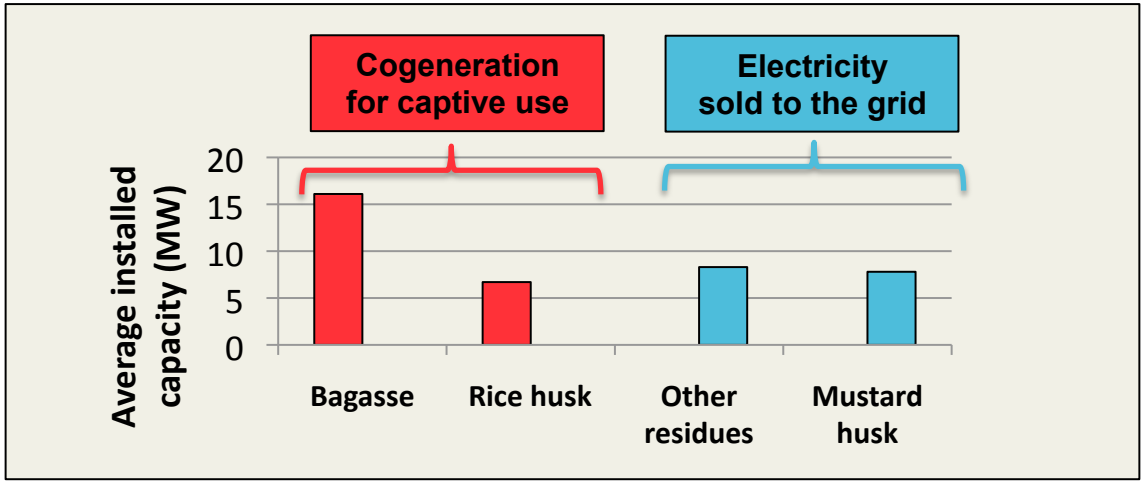
Energy production from residues within the CDM

- **Total installed electric capacity:** 1300MW
  - 0.8% of the Indian installed capacity
  - 1.6% taking into account projects out of CDM



- Technology used
  - Combustion
  - Low efficiency: 0,6kWh/kg
  - CDM is not inducing new technology adoption

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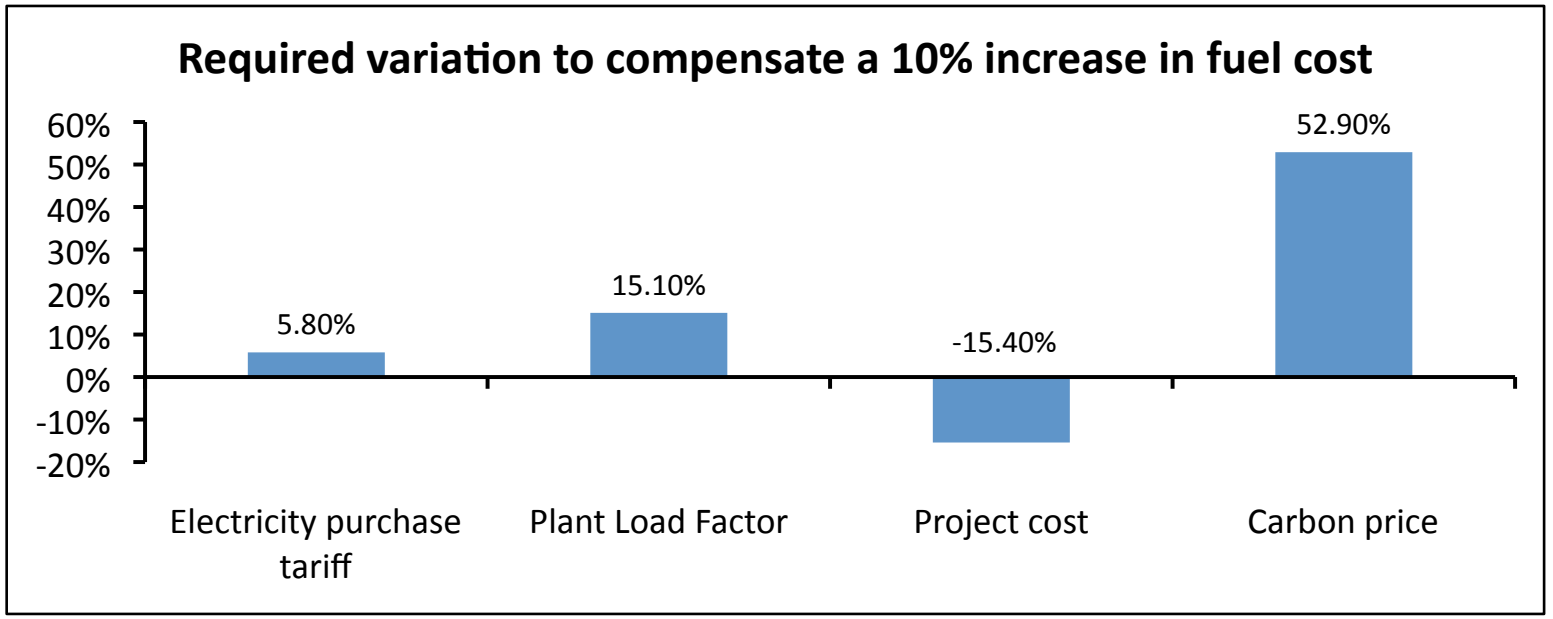
Conditions for the exploitation of residues

- **Financial analysis**, based on IRR, gives information concerning important parameters for energy production from residues:
  - Electricity purchase tariff and crop residues cost: most determinant factors to ensure viability of projects.
  - Carbon credits: impulse projects implementation but cannot compensate for fuel cost increase.



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Scenarios storylines

- **Business-as-usual:**
  - Residue demand for energy increases without any specific change or adaptation.
  - Residue price increases
  - Rapidly unsustainable

- **Price-driven technological progress:**
  - Higher prices of biomass → technological adaptation, better efficiency
  - Less constraints on the resource, slowdown of price increase
  - Quality requirements on residues, higher selectivity

- **Back to agricultural needs:**
  - Agricultural issue of degraded soil → change of practices and reallocation of residues
  - Availability and potentials for energy decrease.
  - Price increases

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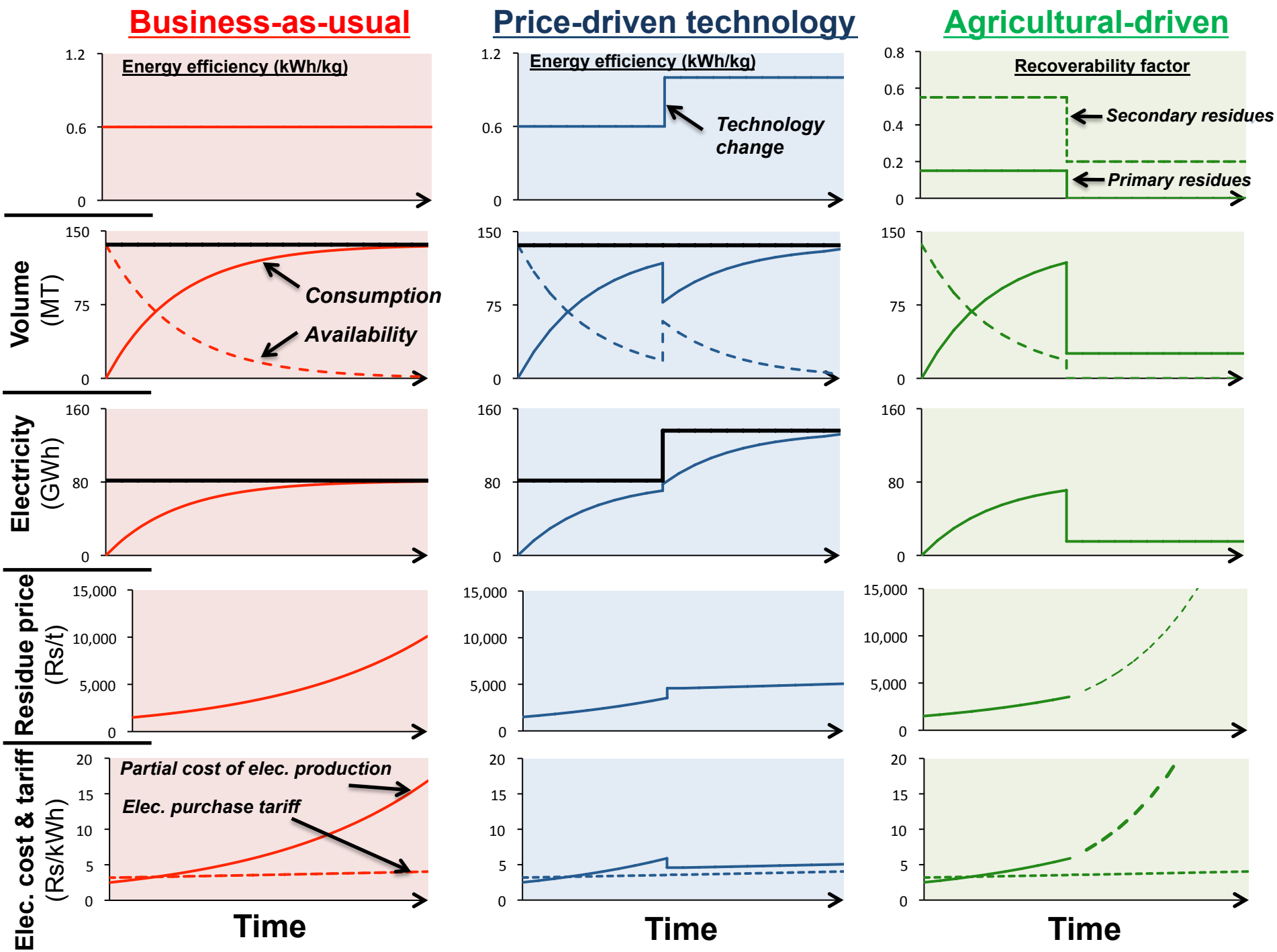
Business-as-usual
Price-driven technology
Agricultural-driven
Energy efficiency (kWh/kg)
1.2
0.6
0
Technology change
Recoverability factor
0.8
0.6
0.4
0.2
Secondary residues
Primary residues
Volume (MT)
150
75
Consumption
Availability
Electricity (GWh)
160
80
Residue price (Rs/t)
15,000
10,000
5,000
Elec. cost & tariff (Rs/kWh)
20
15
10
5
Partial cost of elec. production
Elec. purchase tariff
Time

Discussion

- Scenarios allow to explore:
  - Possible trends and thresholds
  - Possible effects of use of residues for energy:
    - On energy production
    - On resource access for residues consumers
    - On competition with other uses
- Scenarios are the basis for a model construction
  - Uncertainties remain about price behavior (elasticity) and required more investigation
  - More investigation on residue markets is need

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Conclusions and further steps

- Actual success of bioenergy projects in India rely on a set of favorable conditions

  → In other contexts, crop residue might remains a more untapped potential

- Availability, cost of biomass and electricity tariff, change over the time:
  - Residues prices have been increasing faster than electricity tariff
  - Actual energy production could not be sustained for long without technological change
  - Will residue price be enough to trigger innovation?

- Agricultural issues of degraded soils would lead to drastic changes for energy production
  - Primary residues would be available only where soils are little susceptible to erosion (alluvial soils)

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Thank you for your attention

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