

# Life Cycle Assessment of Cooking Fuel Systems in India, China, Kenya, and Ghana

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# Purpose of Presentation

- Cover current status of cookstove fuel life cycle assessment (LCA) work at US EPA
- Discuss capabilities of current phase of US EPA research that builds upon LCA work conducted in both initial US EPA research and data developed for the Alliance's FACIT
- Describe key features of the US EPA Cookstoves LCA Decision Tool

# EPA Activities

- Phase 1 LCA Study
  - Published April 2016 (EPA/600/R-15/325)
  - LCA study for India and China
  - Data included in Alliance Report
- Phase 2 LCA Study
  - Going through QA and Peer Review
  - Expanded analytical scope for technical audience
  - Addressed several research needs identified in the Alliance report and feedback from EPA researchers
- Developing an LCA web-based tool to interact with study data and perform comparative, scenario-based analyses

# Benefits of EPA Cookstoves LCA Research and Decision Tool

- Provides scientific information for a technical audience interested in reducing environmental impacts from traditional fuel use in cookstoves
  - Target audience: scientists, engineers, and practitioners with a deep understanding of technical concepts driving results
- Facilitates comparisons of potential shifts in overall national cookstove environmental impacts by examining LCA results of cooking fuel mixes
  - Predefined and customizable scenarios reveal most impactful strategies to mitigate impacts from cooking fuel mix such as shifting fuel, stove type, stove performance, electrical grid etc.
  - Results' analyses focused on fuel mix/technology strategies may be communicated with policy makers

# Phase 2 LCA Study: Expanded Scope

- Increased geographic scope by adding Ghana and Kenya
- Assessed range of stove types and efficiencies
- Developed additional variations in grid electricity
- Updated stove emissions covered from latest research
- Expanded cooking fuel mix scenarios

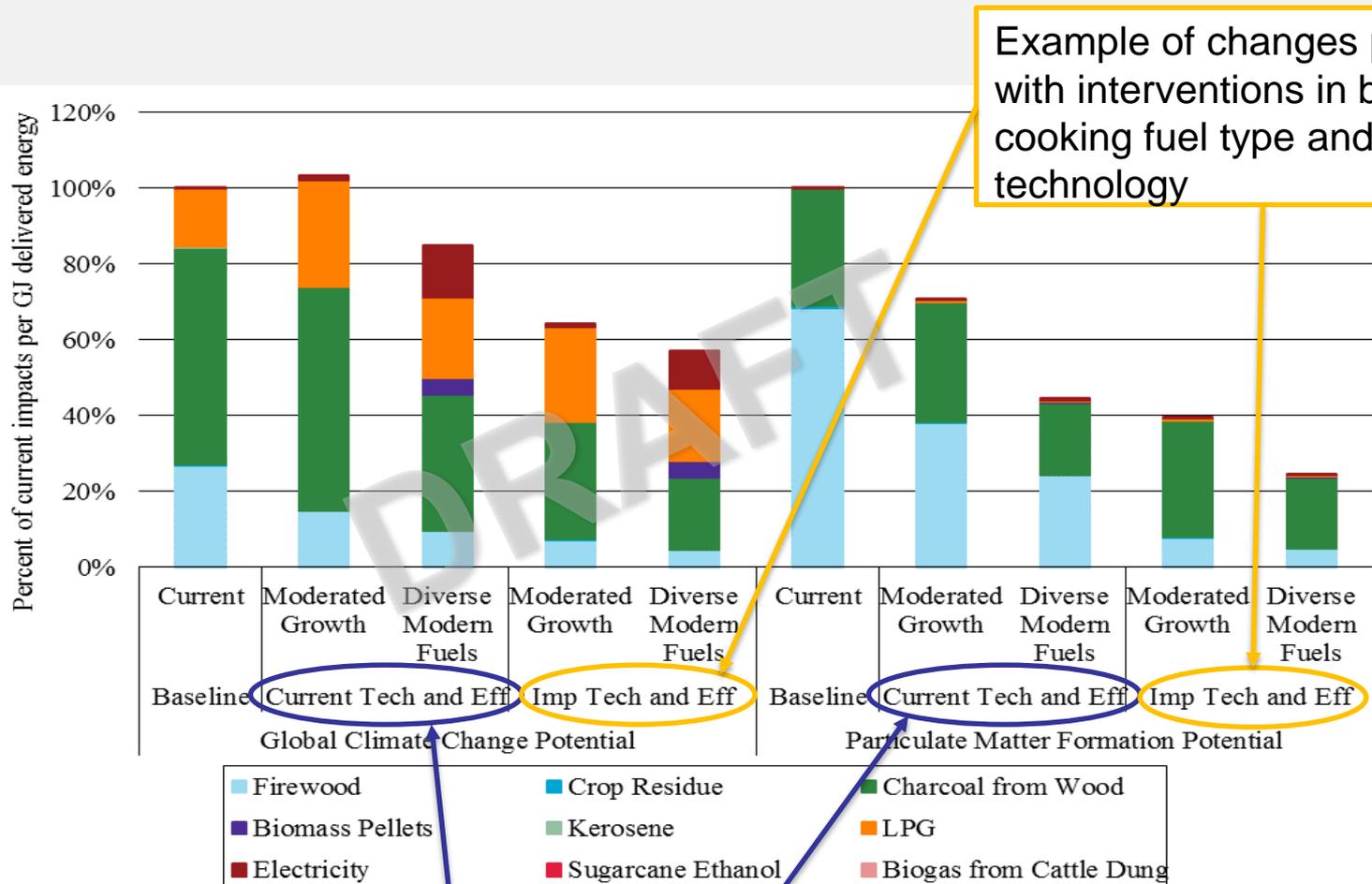
		Fuels Used for Cooking			
		India	China	Kenya	Ghana
Fuel	Fuel Type				
Firewood	Traditional	✓	✓	✓	✓
Crop Residue		✓	✓		
Dung Cake		✓			
Coal		✓	✓		
Charcoal		✓		✓	✓
Kerosene	Modern	✓	✓	✓	✓
LPG		✓	✓	✓	✓
Electricity		✓	✓	✓	✓
Biogas		✓	✓	✓	✓
Biomass Pellets		✓	✓	✓	✓
Ethanol		✓		✓	✓
Piped Natural Gas		✓	✓		
Coal Gas			✓		

 Additional fuels added in Phase 2 EPA study that were not included in the Alliance study

# Phase 2 LCA Study Results

- Permits analysis of cooking fuel mix scenarios
  - Compare current/baseline to projected future fuel mix scenarios
    - Fuel mix scenarios explore continuation of current trends, feasible substitution of modern and improved fuels, increase in usage of various electrical grids
    - Incorporates likely changes in stove mix technology
  - Create a custom fuel mix to assess impact on environmental indicators to evaluate policy options
- Sensitivity analyses included
  - Better understand the full range of results associated with LCA modeling inputs and assumptions

# Example of Cooking Fuel Mix Scenario Results (Ghana)



Example of changes possible with interventions in both cooking fuel type and stove technology

Example of changes possible with interventions in cooking fuel type only

# Phase 2 LCA Study Results (cont.)

- Monte Carlo uncertainty analyses included
  - Quantify variability in the environmental performance of stove groupings and fuel life cycle models
- Includes a normalized presentation of results
  - Normalization compares cooking sector impacts to national estimates of characterized environmental impact in each country. Provides an indication of the relative contribution that the cooking sector makes to environmental impact across the assessed categories in the country of focus

# EPA LCA Tool: Key Features

- Provides advanced, scenario-based analyses
- Compare Fuels
  - By single fuel
  - By predefined fuel mix
- Customize Analyses
  - Create a custom fuel mix
  - Adjust multiple parameters
    - Stove efficiency,
    - Stove technology
    - Electrical grid mix
  - Specify methodology
    - Allocation method
    - Forest renewability
  - Compare to pre-defined fuel mix scenarios
- Explore Data
  - Explore pre-generated study results
  - Corresponding background LCI data
  - LCA modeling assumptions and choices
- Specify Results View Preference
  - Compare
    - Single fuel
    - Fuel mix
  - View By
    - Life cycle stage
    - Normalized

# Life Cycle Assessment of Cooking Fuel Systems In India, China, Kenya, and Ghana – Data Analysis Tool



## Compare Fuels

Compare LCA study results either by single fuels or pre-populated cooking fuel mix scenarios



## Customize Analyses

Create a custom cooking fuel mix scenario, varying multiple parameters, to analyze effect on environmental impacts



## Explore Data

Explore and download study results and corresponding background data and information used to support LCA modeling

The study quantitatively demonstrates through the application of life cycle assessment (LCA) that both cooking fuel mix substitutions and stove technology upgrades provide an opportunity minimize environmental impacts associated with cooking. This interactive LCA tool supports analyzing potential effects on environmental impacts to support cookstove policy development in India, China, Kenya, and Ghana.

# Life Cycle Assessment of Cooking Fuel Systems In India, China, Kenya, and Ghana – Data Analysis Tool

Kenya



Compare Fuels



Customize Analyses



Explore Data

## Specify Methodology

Allocation Method:  ▼

Forest Renewability:  High Estimate of Renewability  
 Low Estimate of Renewability

## Customize Parameters

Stove Efficiency:  ▼

Stove Technology:  ▼ [Set Custom Mix](#)

Electricity Grid:  ▼ [View Grid](#)

## Select Results View

Normalized Results  Cooking Fuel Mix Results

## Create Fuel Mix

Fuel Type ▼	Baseline Fuel Mix ▼	Custom Fuel Mix ▼
Firewood	65%	<input type="text"/>
Charcoal from Wood	17%	<input type="text"/>
Biomass Pellets	0%	<input type="text"/>
Kerosene	12%	<input type="text"/>
LPG	5%	<input type="text"/>
Electricity	1%	<input type="text"/>
Biogas	1%	<input type="text"/>
Ethanol	0%	<input type="text"/>

## Include Predefined Scenarios ?

[Add More](#) [Clear All](#)

- BAU 2030 Imp Tech-Imp Eff-Current Grid
- Diverse Modern Fuels Imp Tech-Imp Eff-Current Grid
- Diverse Modern Fuels Imp Tech-Imp Eff-Low Carbon Grid

[View Results](#)

# Alliance and EPA Cookstove LCA Tool Guide

## EPA LCA Tool Unique Features

- Investigate environmental LCA results from changes to cooking fuel mixes
  - View possible changes resulting from projected shifts in fuel mix and technology
- Dynamically vary and run results for key study parameters, including:
  - Stove efficiency
  - Stove technology
  - Electrical grid mix
- Generate custom normalized results to determine level of magnitude of impact at the national level
- Dynamically view static results for additional in-depth sensitivity and uncertainty analysis

Advanced  
Technical User

## Tool Commonalities

Compare single  
fuel static  
environmental LCA  
impact results

## FACIT Unique Features

- Analyze individual cookstove fuel economic indicators
- Assess individual cookstove fuel social indicators

Screening-Level  
Overview User

**Audience:** Academics, LCA practitioners, policymakers, NGOs

# EPA LCA Tool & FACIT

- EPA data set covers India, China, Kenya and Ghana
  - Future plans to expand geographic scope to align with all countries covered in FACIT
- EPA study data anticipated to be offered via RESTful web services
  - Facilitates use by other tools
- FACIT can link to EPA tool for updated LCA data (for four countries) and advanced LCA analyses
- EPA Tool can link to FACIT for economic and social data, as well as other Alliance resources for additional context

# Next Steps

- Final Phase 2 LCA Study Report
  - Anticipate Report will be available in late 2017
- Continue development of LCA Tool
  - Anticipate an initial version will be available in the Fall 2017
- Questions or Comments – Contact:
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