Modelled Business Case

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<th>National grid connection</th>
<th>Consumers included</th>
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<td>Scenario 1 (base case)</td>
<td>Grid connected (Y)</td>
<td>Tea factories, rural consumers</td>
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<td>Scenario 2 (grid connected)</td>
<td>Grid connected (Y)</td>
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<td>Scenario 3 (stand-alone)</td>
<td>Stand-alone (N)</td>
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Main Results

- Grid connection & export of surplus electricity is key to financial viability.
- Hydro FIT is sufficient without supplying excessive rent under base assumptions. Project break-even price and Hydro FIT are similar.
- Wind FIT is not sufficient to provide full cost recovery under base assumptions. Project break-even price is higher than the wind FIT.
- Project economics benefit from rural consumer participation. Tea factory savings increase when rural consumers are included.
- On-grid hydropower provides lower cost electricity than on-grid wind or the national grid. All consumers benefit from hydropower. Wind price is too high for domestic consumers - exploration of cost allocation.

Methodology and Model Design

- Input parameters and assumptions from the literature, where possible.
- Consumers: 4 tea factories, 800 domestic & 100 small businesses.
- Wind & hydropower projects assessed using cost-benefit financial models.
- Break-even (average cost) electricity price for plants is key decision criterion.
- Present value of savings found for tea factories and rural consumers.
- Sensitivity analysis on cost allocation rules calculated using a simple demand-supply model.
- Sensitivity analysis on prices in VBA.

Results

- All consumers treated equally in Option 1 (base case). Wind power is too expensive for domestic consumers. Rent transferred from rural consumers to tea factories.
- Ownership options: Tea factories are shareholders in power plant & may want to take advantage of rural consumers. When rural consumers pay FIT, plus mini-grid surcharge, tea factories make same savings as selling to the national grid without rural electrification scheme.

Cost Allocation

- What tariff structure should be applied to the mini-grid?

Policy Recommendations

- Kenyan Government should review FIT policy, in particular the small wind FIT.
- Regulators have an important role to play in mini-grid tariff determination and standardization to encourage efficient, fair and equitable cost allocation and prevent ownership issues influencing pricing.

Research Questions

1. Can small wind/hydropower supply tea factories with low cost electricity?
2. Could these plants deliver low cost electricity to local rural consumers?
3. Does the Kenyan feed-in-tariff (FIT) support investment in small RE?
4. Can changes in cost allocation lead to fairer, more equitable electricity pricing within the small rural electrification scheme?

Methodology and Model Design

- Input parameters and assumptions from the literature, where possible.
- Consumers: 4 tea factories, 800 domestic & 100 small businesses.
- Wind & hydropower projects assessed using cost-benefit financial models.
- Break-even (average cost) electricity price for plants is key decision criterion.
- Present value of savings found for tea factories and rural consumers.
- Sensitivity analysis on base case (Scenario 1).
- Different cost allocation rules calculated using a simple demand-supply model.
- Sensitivity analysis on prices in VBA.

Potential for wind (yellow/red-high) and hydropower (blue) power in tea-growing regions (Data from: WRI, 2007; IED, 2008; RisoeDTU, 2008; Nordman, 2014; IRENA, 2015; KTDA, 2017).