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# UNDP NAMA finance case study

## UNFCCC Asia Pacific Regional Workshop on NAMAs

Vientiane/Lao PDR, April 24, 2014

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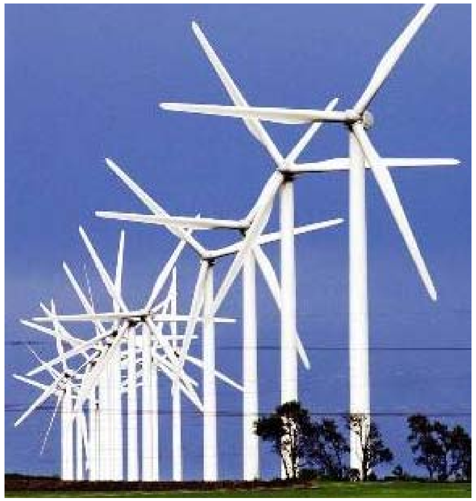



# Aims and Agenda

**Aims**

- Design two alternative NAMAs that both have the objective to attract private investment into 500MW of on-shore wind energy
- Compare both NAMAs in terms of their costs and effects

**Agenda**

1. The concept of LCOE
2. Introduction to the UNDP DREI tool
3. Case study
    1. Step 1: Modelling the Baseline
    2. Step2: Designing  the cornerstone instrument NAMA
    3. Step 3: Designing the instrument package NAMA
    4. Step 4: Comparing both NAMAs
4. Discussion

# 1. LCOE – concept and formula (1)

- LCOE stands for "Levelized Cost of Electricity"
- LCOE is given in cost per unit of energy (e.g., USD/MWh)
- LCOE represents the constant unit cost over the entire life cycle of a plant (i.e., lifecycle costs), considering the financing costs

$$LCOE = \frac{\sum_{t=1}^{n} \frac{Expenditures_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{Electricity\ generated_t}{(1+i)^t}}$$

$n$: $lifetime$

$t$: $year$

$i$: $Discount\ rate$

- **If a plant owner is remunerated the LCOE, the plant operates exactly at the profitability threshold (NPV=0)**

⇒ LCOE is a good concept to calculate Feed-in tariffs (a FIT should provide the LCOE and potentially a premium)

⇒ LCOE is a good indicator to compare technologies (even with different life times)

⇒ Commonly used by policy makers, planners, researchers and investors

# 1. LCOE – concept and formula (2)

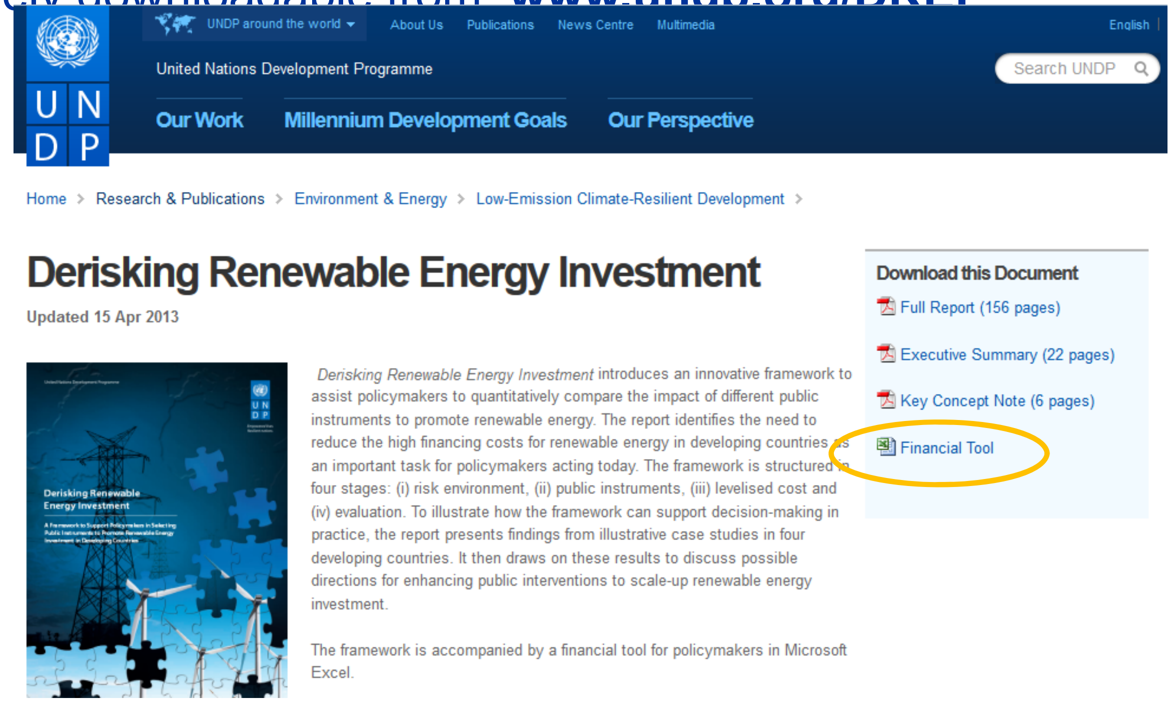
- The discount rate in LCOE represents the financing costs
- In the model we use an equity perspective, hence the formula is more complicated

$$\frac{\%\,\text{Equity Capital} * \text{Total Investment} + \sum_{\tau=1}^{T} \frac{(\mathit{O\&M\ Expense})_\tau + (\mathit{Debt\ Financing\ Costs})_\tau - \mathit{Tax\ Rate} * (\mathit{Interest\ Expense}_\tau + \text{Depreciation}_\tau + \mathit{O\&M\ Expense}_\tau)}{(1 + \mathit{Cost\ of}\ \text{Equity})^\tau}}{\sum_{\tau=1}^{T} \frac{\mathit{Electricity\ Production}_\tau * (1 - \mathit{Tax\ Rate})}{(1 + \mathit{Cost\ of}\ \text{Equity})^\tau}}$$

Where,
% Equity Capital = portion of the investment funded by equity investors
O&M Expense = operations and maintenance expenses
Debt Financing Costs = interest & principal payments on debt
Depreciation = depreciation on fixed assets
Cost of Equity = after-tax target equity IRR

# 2. UNDP DREI Financial Tool

- Excel-based tool to compare the effects and costs of different policy designs to support renewable energy technologies (on-shore wind power)
- Freely downloadable from **www.undp.org/DREI**




Let's have a look at the tool

- The model we use in this exercise has been slightly adjusted from the downloadable version

# 3. Case study – Introduction

- You as a team are asked to assist Country X in designing a NAMA
- Electricity shortages, state-owned Electricity Supply Company (ESC) not in good state
- As there are good wind resources, the idea is to design a NAMA that attracts private sector investments into 500MW of on-shore wind power
- An important topic is to use scarce public resources effectively and efficiently
- Two alternative designs will be developed:
  - *A cornerstone-instrument only NAMA*
  - *A public instrument package NAMA*
- Both NAMAs shall be designed and compared regarding costs and effects
- We will use the DREI tool and proceed in 4 steps

# 3. Case study – Step 1: Modelling the baseline

- In order to design and compare NAMAs, a good starting point is to analyze the baseline and model its costs
- In the DREI tool please use the "II. Inputs, Baseline Energy Mix" tab and enter the data from the table to the right into the respetive yellow cells

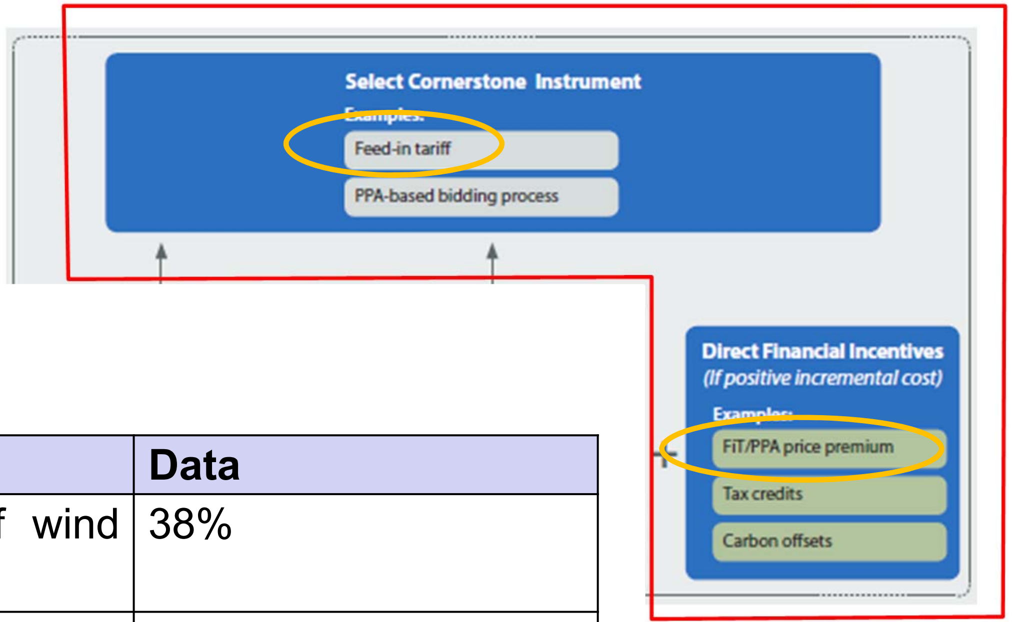
| Input | Data |
|---|---|
| **Current baseline energy generation mix** | Hydro: 75%<br>Biomass: 10%<br>Diesel: 15% |
| **Marginal baseline energy generation mix**<br>As a percentage: | Hydro: 69%<br>Diesel: 31% |
| Most recent 5 private sector investments in new generation: | 800MW Hydro (4.4 TWh/year)<br>15 MW Diesel (0.1 TWh/year)<br>100 MW Diesel (0.6 TWh/year)<br>50 MW Diesel (0.3 TWh/year)<br>150 MW Diesel (0.9 TWh/year) |
| **Emission factors** | |
| Individual grid emission factors: | Hydro: 0.000 tCO2/Mwhel<br>Diesel: 0.700 tCO2/Mwhel |
| Total marginal baseline grid emission factor: | 0.212 tCO2/Mwhel |

Please proceed in Excel and enter the numbers

# 3. Case study – Step 2: Designing the cornerstone instrument only NAMA

- Please design a NAMA in which you pick one cornerstone instrument: a feed-in tariff for wind
- In the DREI tool please use the "III. Inputs, Wind Energy" tab and enter the below data into the respective yellow cells
- Specifically refer to the "Cornerstone-only NAMA" columns

Cornerstone instrument only NAMA

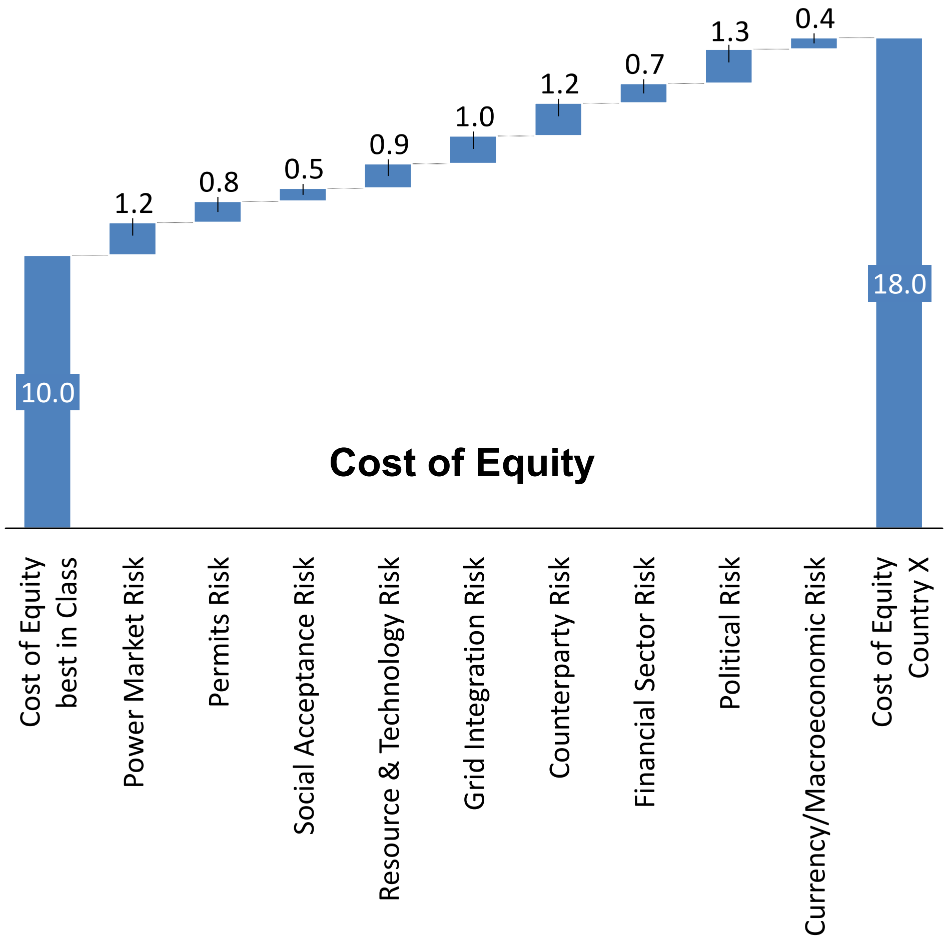


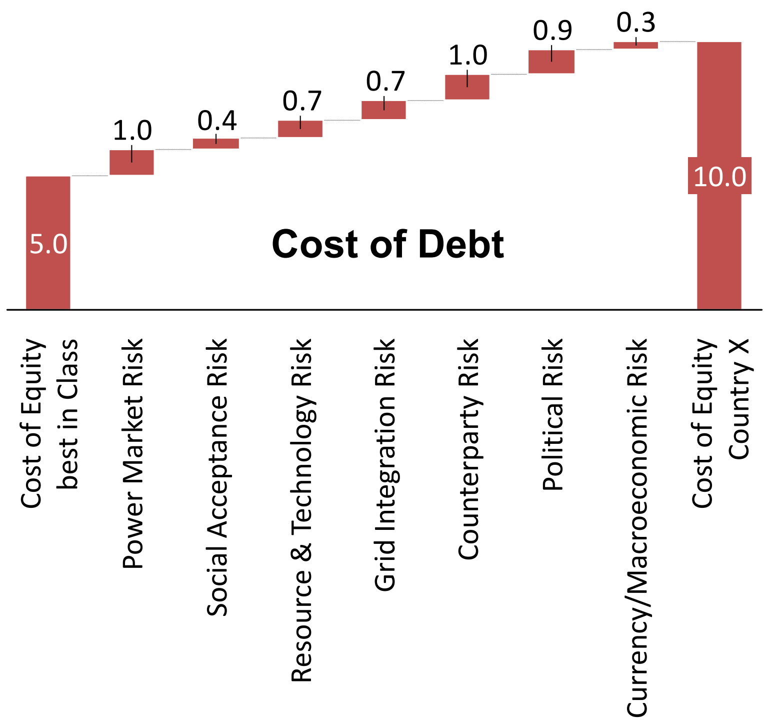

| Input | Data |
|---|---|
| Estimated capacity factor for 500MW of wind energy | 38% |
| Investment costs | USD 2 million per MW |
| Life expectancy of assets | 20 years |
| Cost of equity | 18% |
| Cost of debt | 10% |
| Capital structure | 70% debt/30% equity |
| Loan tenor | 12 years |
| Corporate tax rate (effective) | 25% |
| Administrative costs of the FiT over 20 years | USD 1.7 million |

Please proceed in Excel and enter the numbers

# 3. Case study – Step 3: The risk environment in Country X

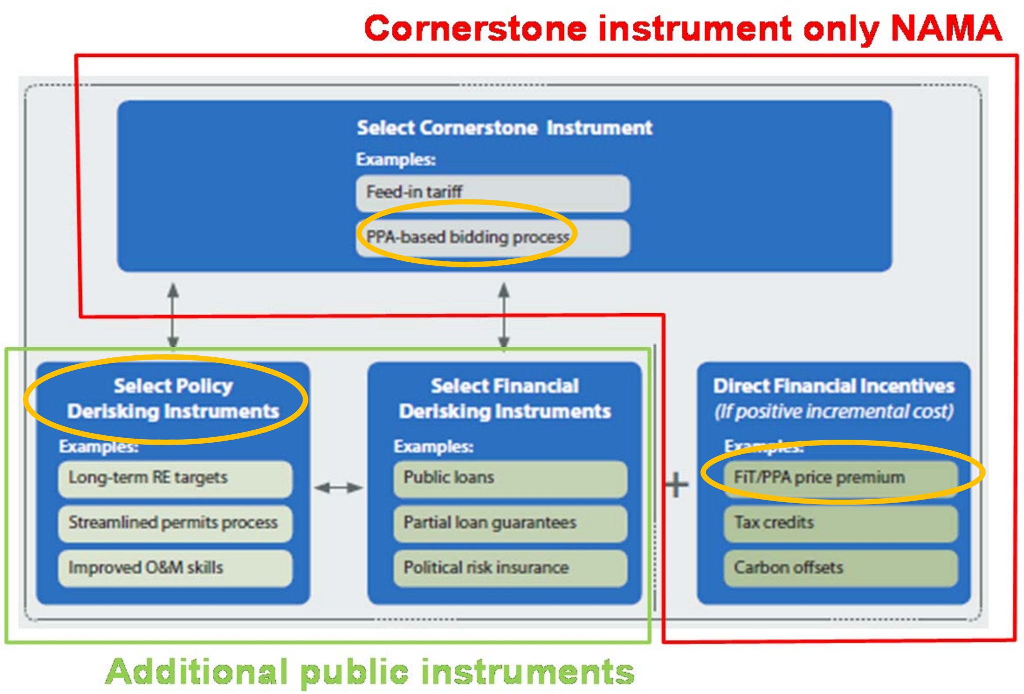
- The investment environment of Country X suffers from many risks
- These drive the financing costs (see below)



# 3. Case study – Step 3: Designing the public instrument package NAMA

- Please design a NAMA in which you select public instruments which complement the cornerstone instrument (FiT for wind)
- In the DREI tool please use the "III. Inputs, Wind Energy" tab and enter the below data into the yellow cells
- Specifically refer to the "Instrument package NAMA" columns




| Risk Category | Estimated Cost |
|---|---|
| Power Market Risk | $1'100'000 (above the administrative costs of the FiT) |
| Permits Risk | $1'000'000 |
| Social Acceptance Risk | $500'000 |
| Resource & Technology Risk | $1200000 |
| Grid Integration Risk | $1'500'000 |
| Counterparty Risk | $1’800'000 |
| Financial Sector Risk | $800'000 |

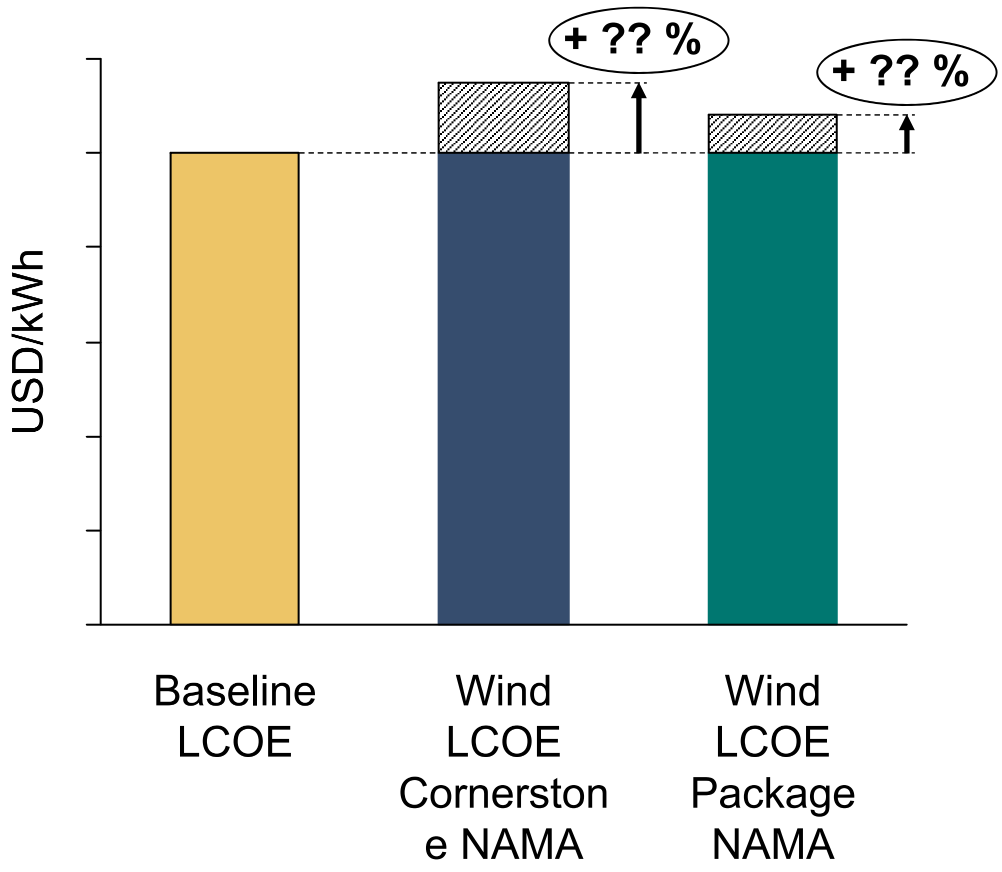
Please proceed in Excel and enter the

# 3. Case study – Step 4: Comparing the two alternative NAMA designs

**Question 4.1:**

- How do the on-shore wind LCOE differ between the two NAMA designs?
- And how do the incremental costs (i.e., the additional costs of wind over the baseline) differ?
- What does this imply for the affordability of electricity for the end consumer in Country X?

**LCOE and incremental costs**

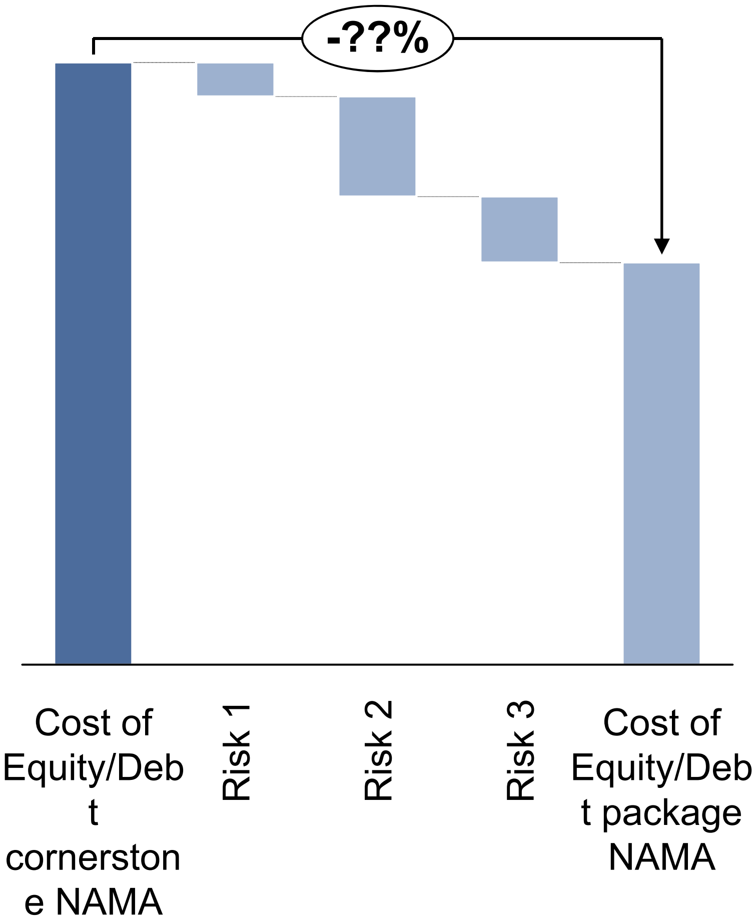


# 3. Case study – Step 4: Comparing the two alternative NAMA designs

**Question 4.2:**

- What is the difference in financing costs for wind energy between the two NAMA designs?
  - Cost of equity
  - Cost of debt

## Financing costs differential



# 3. Case study – Step 4:
# Comparing the two alternative NAMA designs

**Question 4.3:**

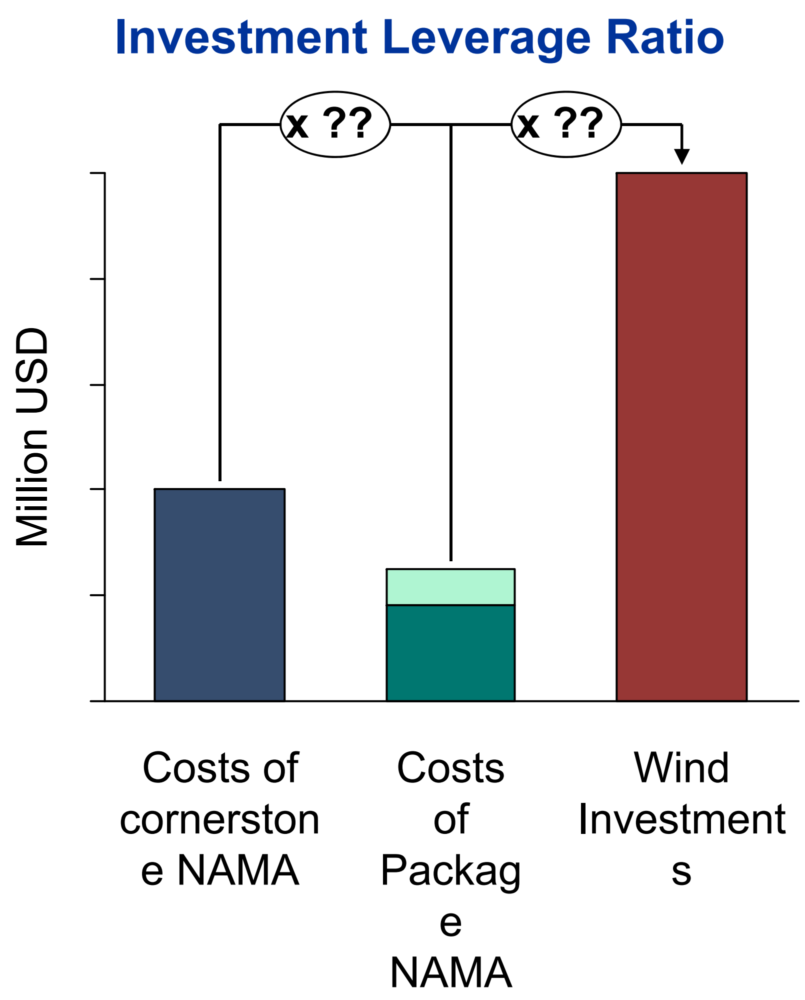
- How much private sector investment will the NAMAs trigger?

**Question 4.4:**

- What are the total public costs of the two alternative NAMAs?
- What is the breakdown between policy derisking instrument costs and incremental cost (FIT premium)?

**Question 4.5:**

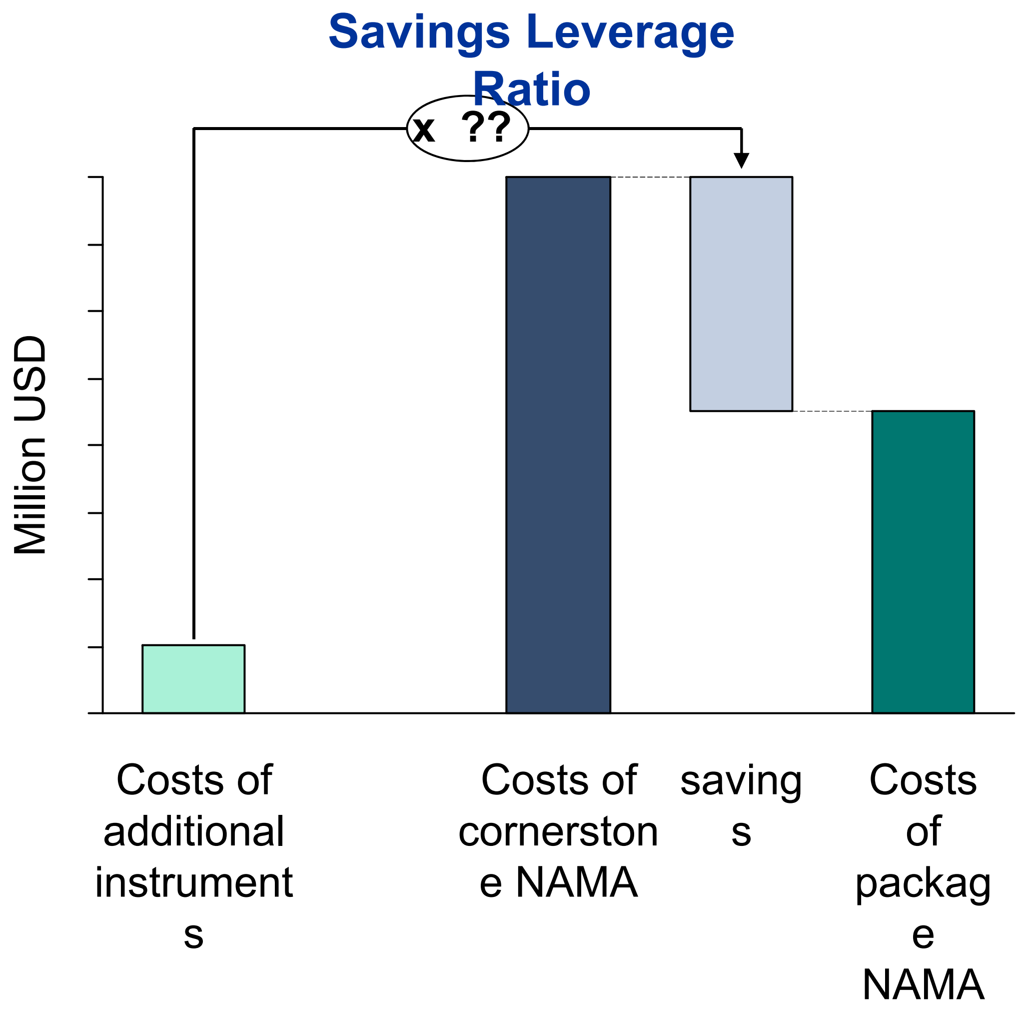
- How does the investment leverage ratio compare between the two alternative NAMAs?
- What is the main public cost component that drives the investment leverage ratio in Country X?



# 3. Case study – Step 4: Comparing the two alternative NAMA designs

**Question 4.6:**

- What is the savings leverage ratio of the additional instruments in the public instrument package NAMA?



# 3. Case study – Step 4: Comparing the two alternative NAMA designs

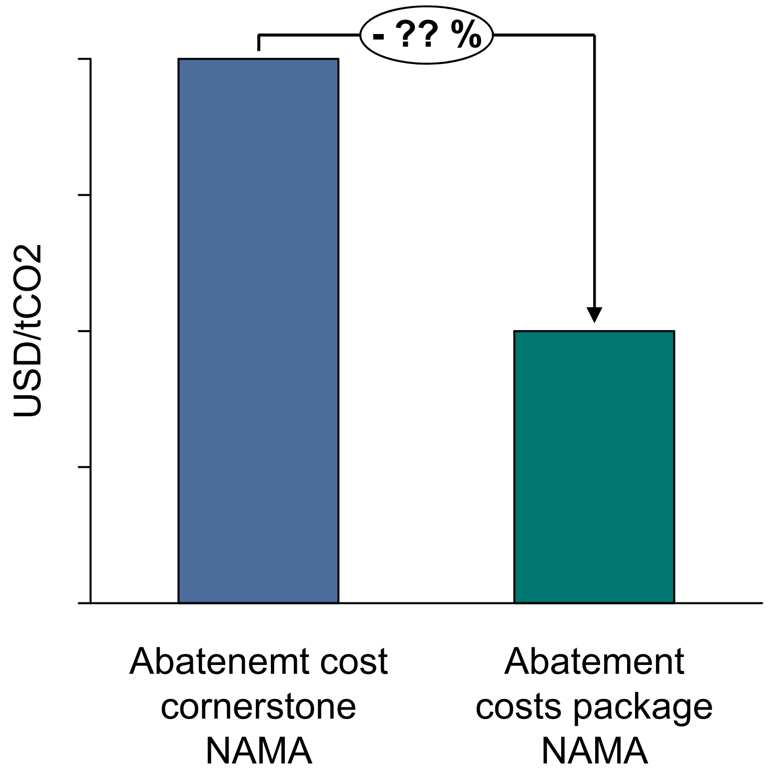
**Question 4.7:**

- Over the 20 year lifetime, what are estimated emission reductions that result from the wind energy investment in the NAMAs?

**Question 4.8:**

- What are the carbon abatement costs of both NAMAs?

**Abatement costs**



# 4. Discussion Questions

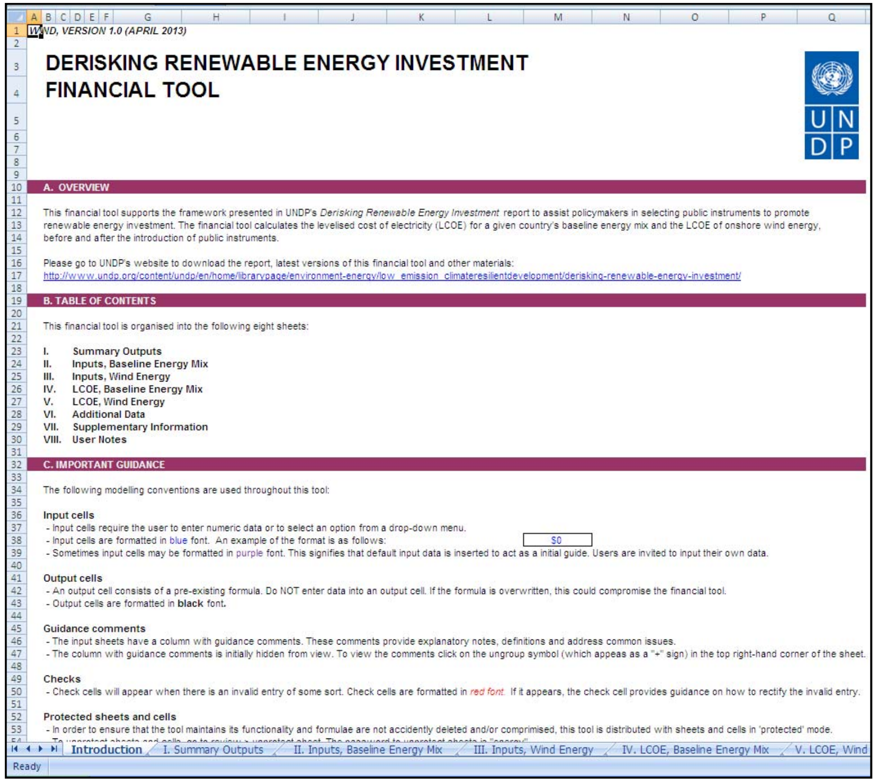
### D1: Funding the NAMA

- Who among the main actors (national government, private sector, international donors, etc) could fund the various components in the proposed NAMA designs?
- Which instruments are well suited for MRV, which are less?

### D2: The role of fossil fuel subsidies.

- What are the impacts of a 20% diesel fuel subsidy on the costs of both NAMAs?

# Reports & Financial Tool

WIND, VERSION 1.0 (APRIL 2013)

DERISKING RENEWABLE ENERGY INVESTMENT
FINANCIAL TOOL

A. OVERVIEW

This financial tool supports the framework presented in UNDP's *Derisking Renewable Energy Investment* report to assist policymakers in selecting public instruments to promote renewable energy investment. The financial tool calculates the levelised cost of electricity (LCOE) for a given country's baseline energy mix and the LCOE of onshore wind energy, before and after the introduction of public instruments.

Please go to UNDP's website to download the report, latest versions of this financial tool and other materials:
http://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/derisking-renewable-energy-investment/

B. TABLE OF CONTENTS

This financial tool is organised into the following eight sheets:

I. Summary Outputs
II. Inputs, Baseline Energy Mix
III. Inputs, Wind Energy
IV. LCOE, Baseline Energy Mix
V. LCOE, Wind Energy
VI. Additional Data
VII. Supplementary Information
VIII. User Notes

C. IMPORTANT GUIDANCE

The following modelling conventions are used throughout this tool:

**Input cells**
- Input cells require the user to enter numeric data or to select an option from a drop-down menu.
- Input cells are formatted in blue font. An example of the format is as follows: $0
- Sometimes input cells may be formatted in purple font. This signifies that default input data is inserted to act as a initial guide. Users are invited to input their own data.

**Output cells**
- An output cell consists of a pre-existing formula. Do NOT enter data into an output cell. If the formula is overwritten, this could compromise the financial tool.
- Output cells are formatted in **black** font.

**Guidance comments**
- The input sheets have a column with guidance comments. These comments provide explanatory notes, definitions and address common issues.
- The column with guidance comments is initially hidden from view. To view the comments click on the ungroup symbol (which appears as a "+" sign) in the top right-hand corner of the sheet.

**Checks**
- Check cells will appear when there is an invalid entry of some sort. Check cells are formatted in *red font*. If it appears, the check cell provides guidance on how to rectify the invalid entry.

**Protected sheets and cells**
- In order to ensure that the tool maintains its functionality and formulae are not accidently deleted and/or comprimised, this tool is distributed with sheets and cells in 'protected' mode.

Introduction | I. Summary Outputs | II. Inputs, Baseline Energy Mix | III. Inputs, Wind Energy | IV. LCOE, Baseline Energy Mix | V. LCOE, Wind

Ready

**Available at www.undp.org/DREI**