Derisking Renewable Energy Investment

Finance Case Study

[Insert Event]

[Insert Location, Date]




Aims and Agenda

Aims

- Design two alternative RE policy frameworks that both have the objective to attract private investment into 500MW of on-shore wind energy
- Compare both RE policy designs 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. Step 2: Designing the cornerstone instrument RE policy
    3. Step 3: Designing the instrument package RE policy
    4. Step 4: Comparing both R
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 receives a tariff at the LCOE, the plant operates exactly at the profitability threshold (NPV=0)**

⇒ LCOE is a good concept to calculate tariffs for Feed-in tariffs and PPA auctions

⇒ 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)

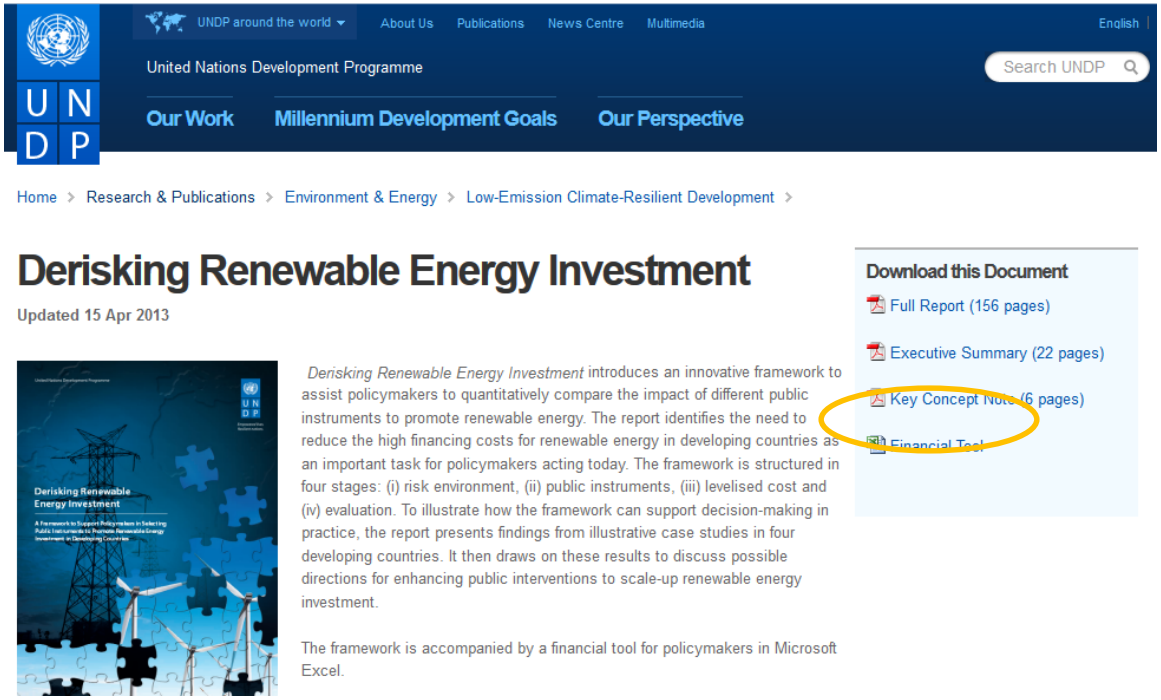
- The discount rate in LCOE represents the financing costs
- In the model we use an equity perspective, hence the formula is more complicated

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

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**



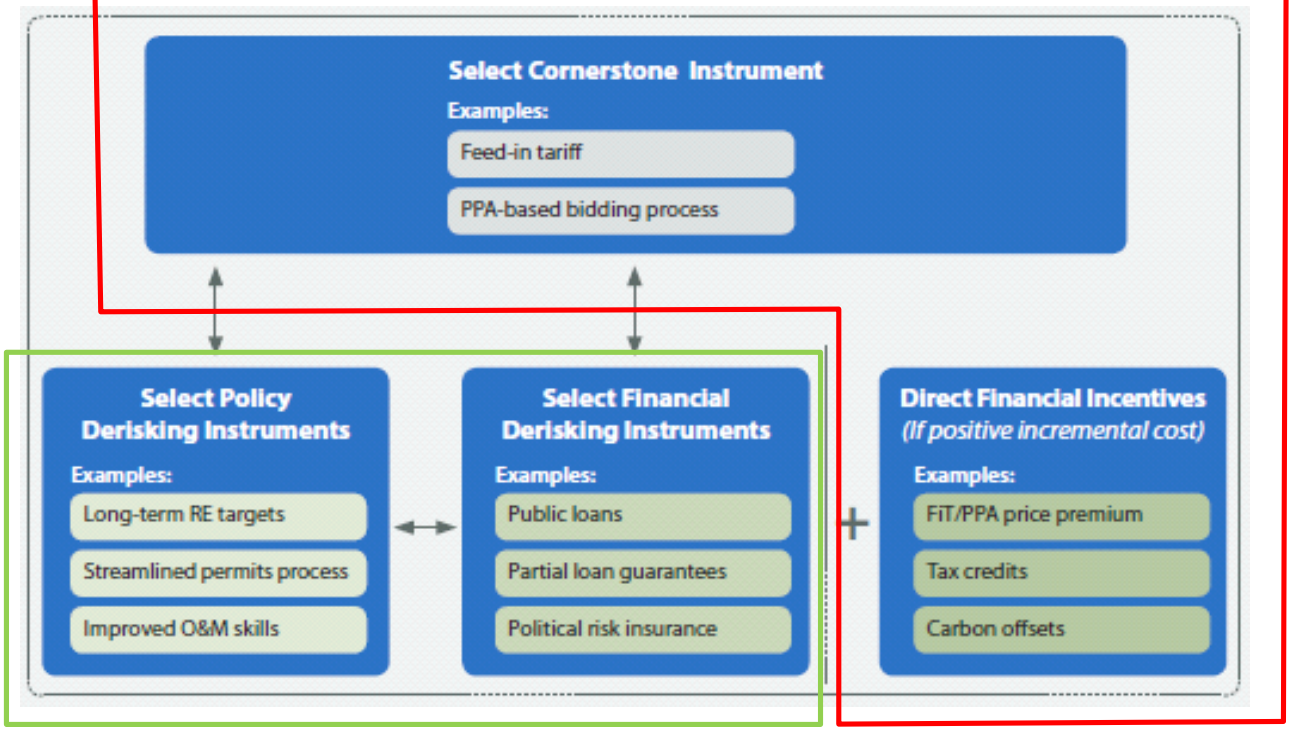
Let's have a look at the tool

3. Case study – Introduction

- You as a team are asked to assist Country X in designing its RE policy
- Electricity shortages, state-owned Electricity Supply Company (ESC) not in good shape.
- As there are good wind resources, the idea is to design a RE policy 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 RE policy*
  - *A public instrument package RE policy*
- Both RE policy designs to be compared regarding costs and effects
- We will use the DREI tool and proceed in 4 steps

2. Case study – Intro: Two RE policy designs

Cornerstone instrument only RE Policy



Additional public instruments

3. Case study – Step 1: Modelling the baseline

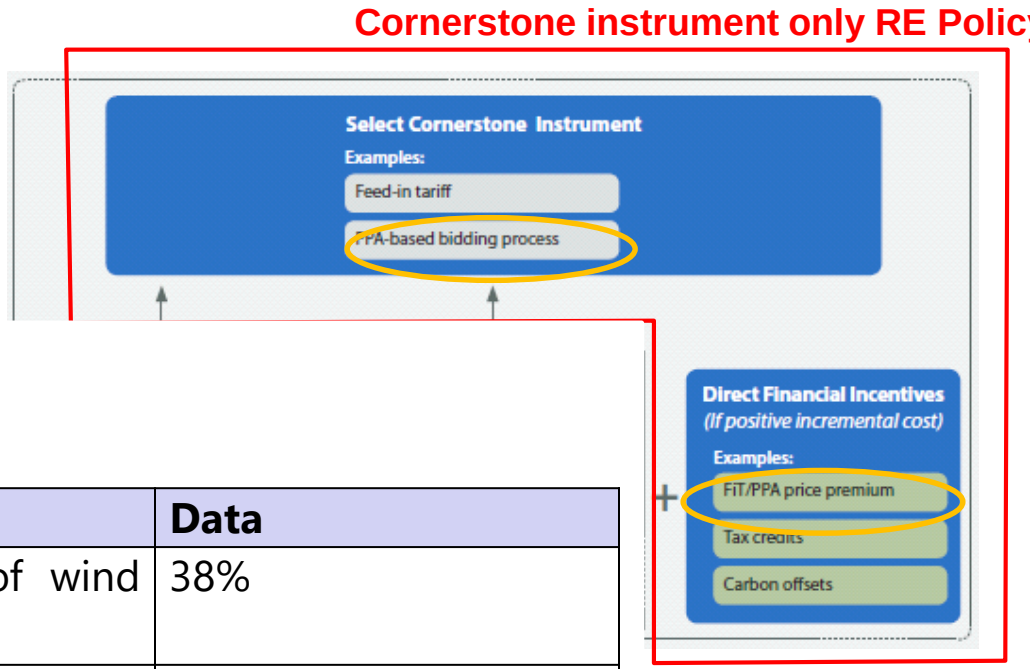
- In order to design and compare the two RE policy designs, a good starting point is to analyze the baseline and model its costs
- In the DREI tool please use the "II. Inputs, Baseline Energy Mix" tab and enter the data from the table to the right into the respective yellow cells

Please proceed in Excel and enter the numbers

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

3. Case study – Step 2: Designing the cornerstone-only RE Policy

- Please design a RE policy 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 "Pre-Derisking Column" columns

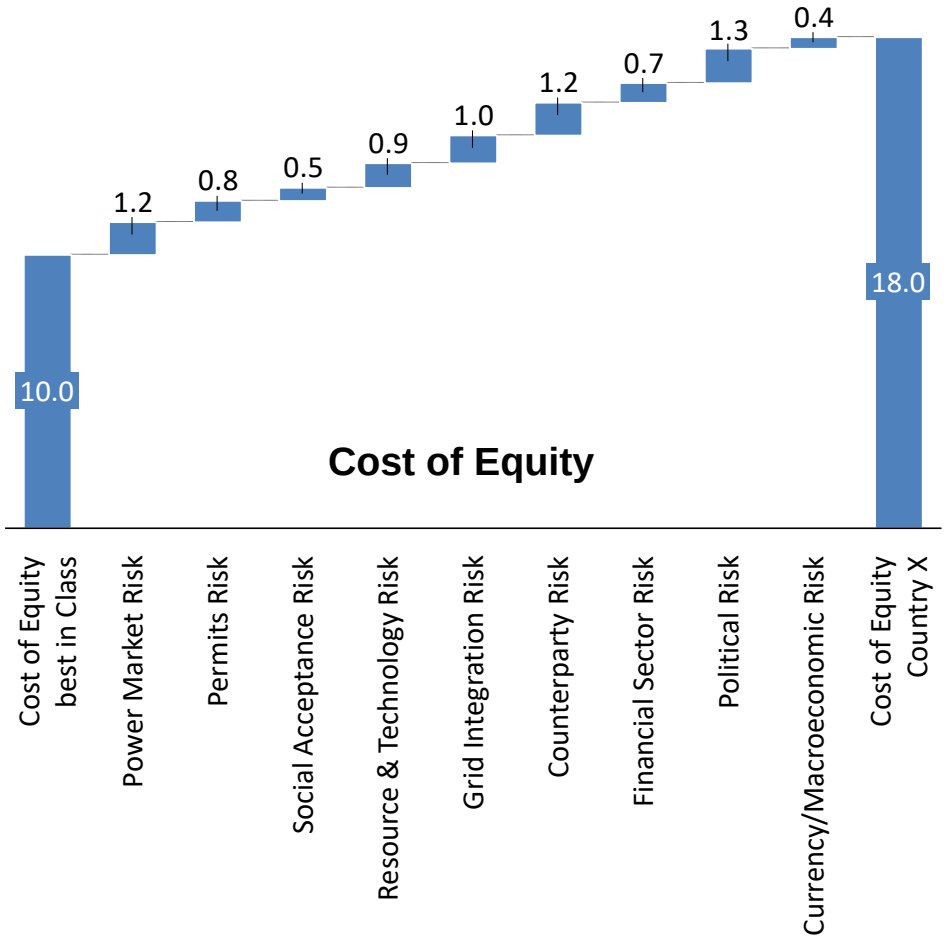


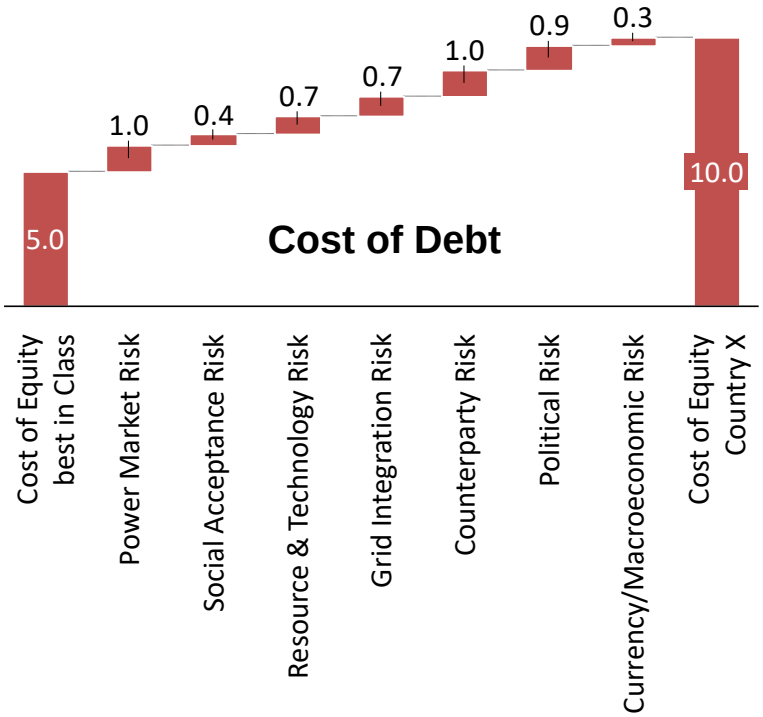
Input	Data
Estimated capacity factor for 500MW of wind energy	38%
Investment costs	USD 2 million per MW
Life expectancy of assets	20 years
Cost of equity	18%
Cost of debt	10%
Capital structure	70% debt/30% equity
Loan tenor	12 years
Corporate tax rate (effective)	25%
Administrative costs of the FiT over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

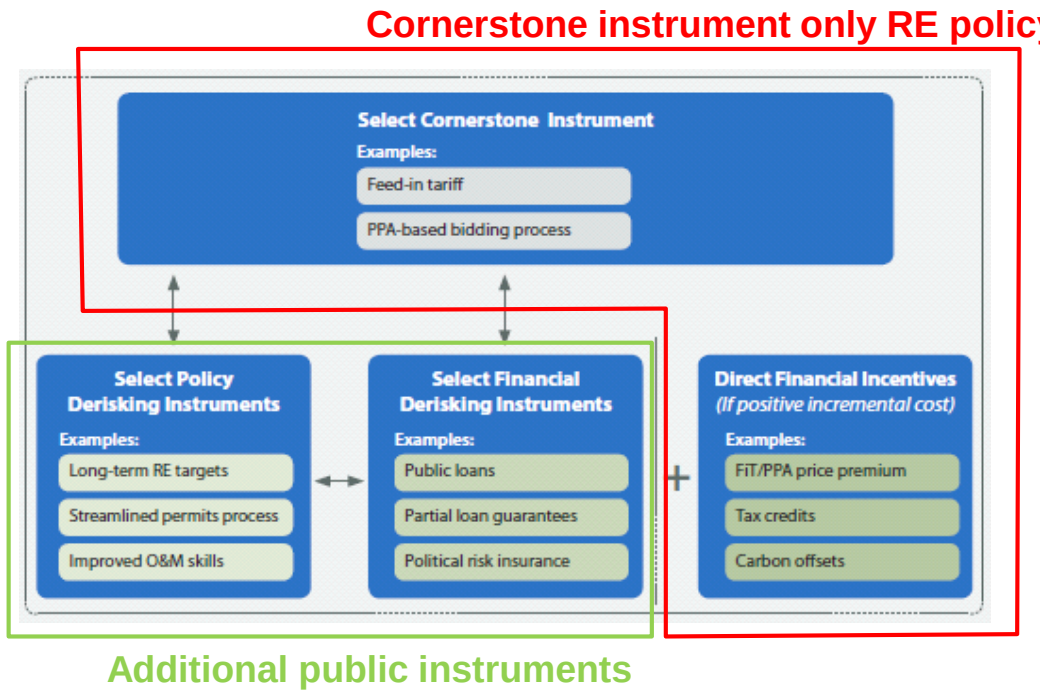
- The investment environment of Country X suffers from many risks
- These drive the financing costs (see below)





3. Case study – Step 3: Designing the instrument-package RE policy

- Please design a RE policy 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 "Post Derisking" columns



Risk Category	Estimated Cost
Power Market Risk	$1,100,000 (above the administrative costs of the PPA bidding process)
Permits Risk	$1,000,000
Social Acceptance Risk	$500,000
Resource & Technology Risk	$1,200,000
Grid Integration Risk	$1,500,000
Counterparty Risk	$1,800,000
Financial Sector Risk	$800,000

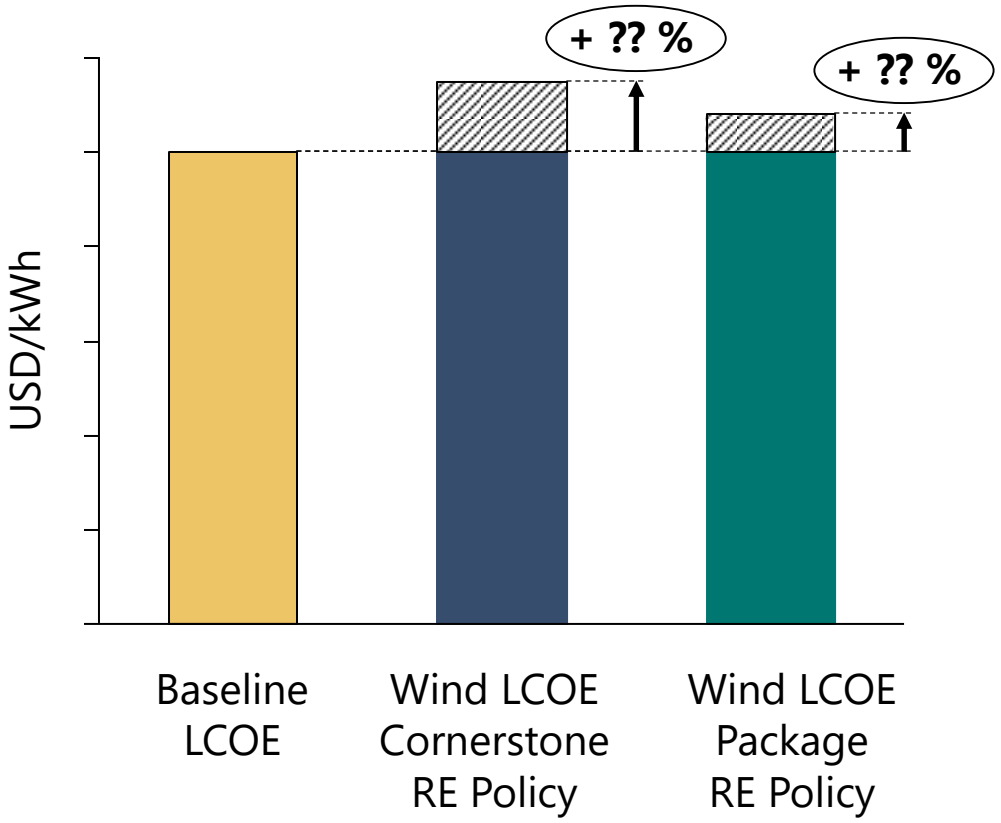
Please proceed in Excel and enter the numbers

3. Case study – Step 4: Comparing the two alternative RE Policy designs

Question 4.1:

- How do the on-shore wind LCOE differ between the two RE policy 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

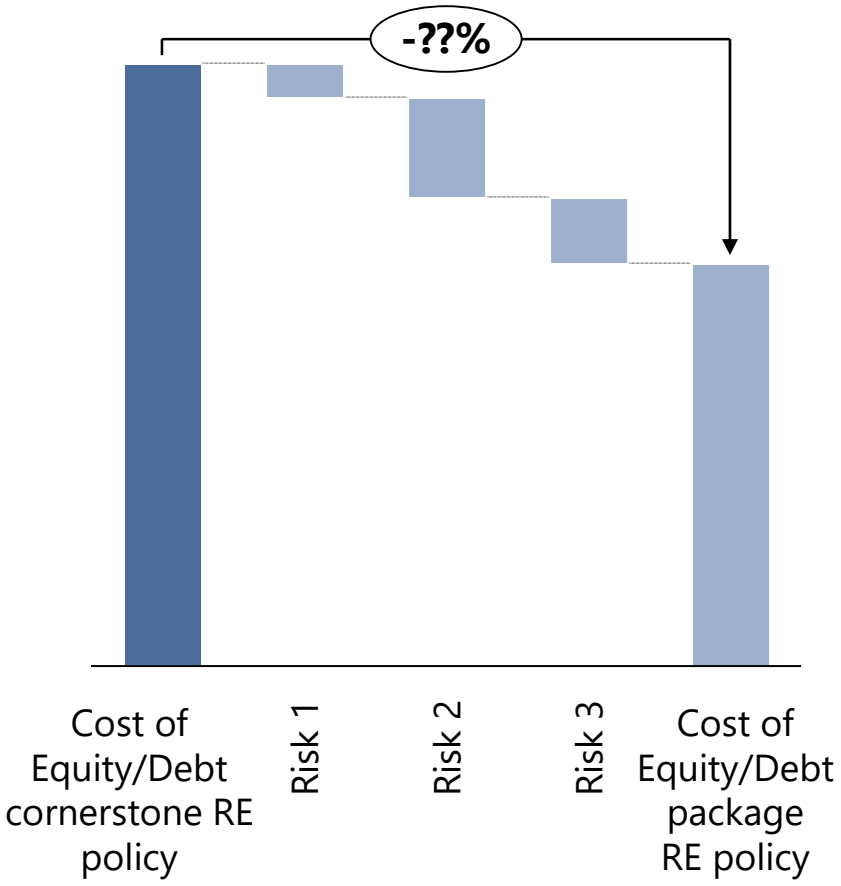


3. Case study – Step 4: Comparing the two alternative RE policy designs

Question 4.2:

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

Financing costs differential



3. Case study – Step 4: Comparing the two alternative RE policy designs

Question 4.3:

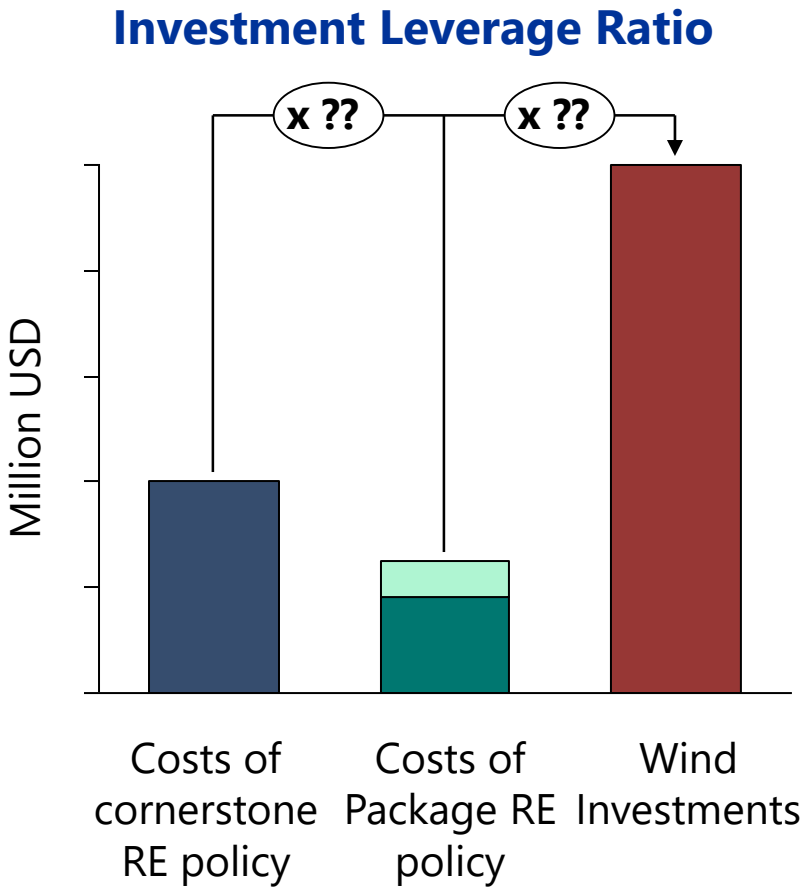
- How much private sector investment will the RE policy designs trigger?

Question 4.4:

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

Question 4.5:

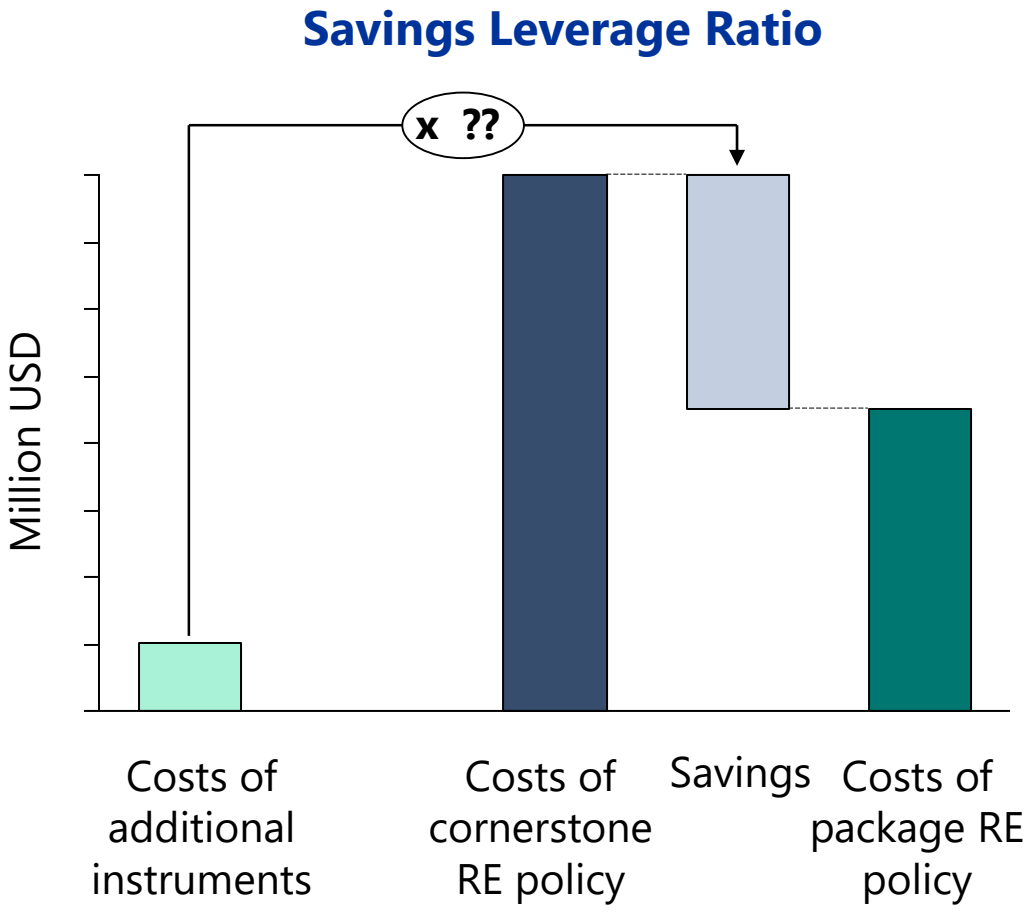
- How does the investment leverage ratio compare between the two alternative RE policy designs?
- What is the main public cost component that drives the investment leverage ratio in Country X?



3. Case study – Step 4: Comparing the two alternative RE policy designs

Question 4.6:

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



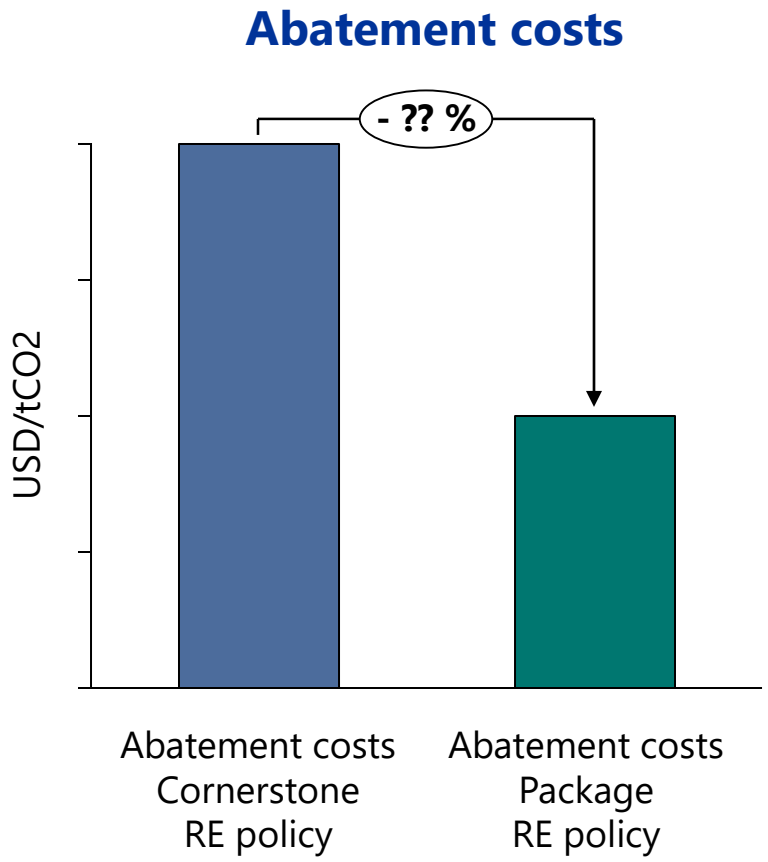
3. Case study – Step 4: Comparing the two alternative RE policy designs

Question 4.7:

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

Question 4.8:

- What are the carbon abatement costs of both RE policy designs?



4. Discussion Questions

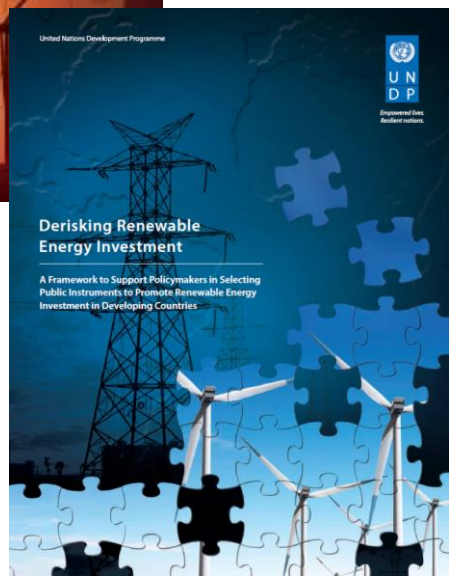
D1: Funding the RE Policy

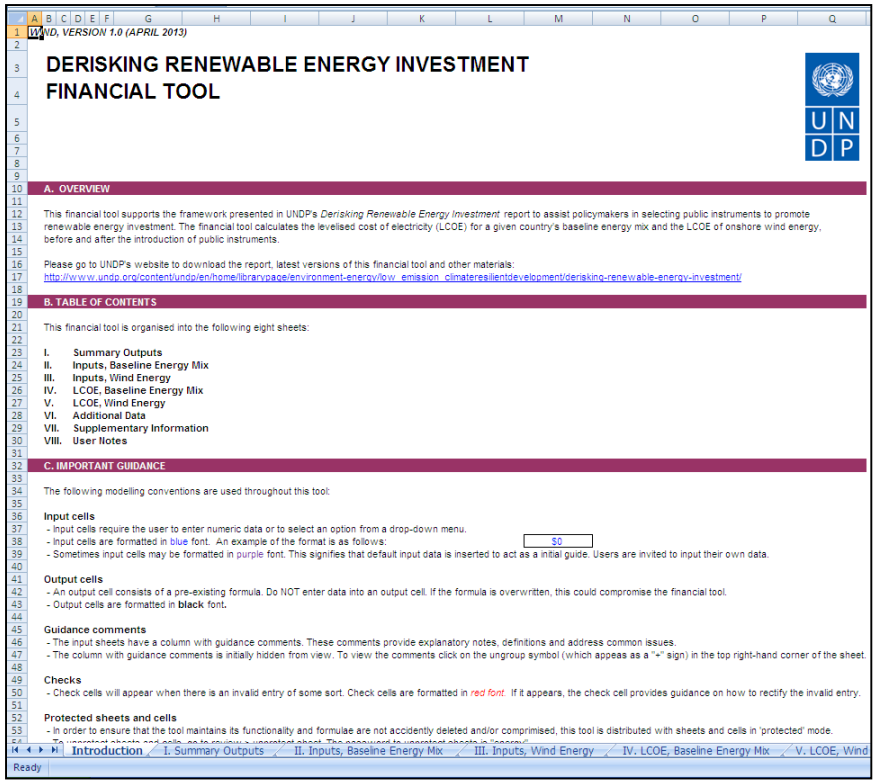
- Who among the main actors (national government, private sector, international donors, etc) could fund the various components in the proposed RE policy designs?
- Which instruments are well suited for MRV, which are less?

D2: The role of fossil fuel subsidies.

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

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 appeas 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