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Derisking Renewable Energy Investment (www.undp.org/DREI)
Finance Case Study
Guidance Note

GENERAL CASE STUDY BACKGROUND:

Country X is a land-locked developing country which is experiencing rapidly increasing energy demand. Country X's energy generation mix has historically depended on hydro-power, with limited biomass power. However, in recent decades, new installed capacity has been nearly entirely based on imported diesel oil, taking advantage of diesel oil's ease of deployment and low upfront costs.

As such, diesel oil now represents 31% of Country X's marginal generation. In addition, the government subsidises the cost of diesel oil to power producers. Fossil fuel imports and subsidies now create a significant economic and budgetary cost to the country, and are also among the main sources of the country's CO_2 emissions.

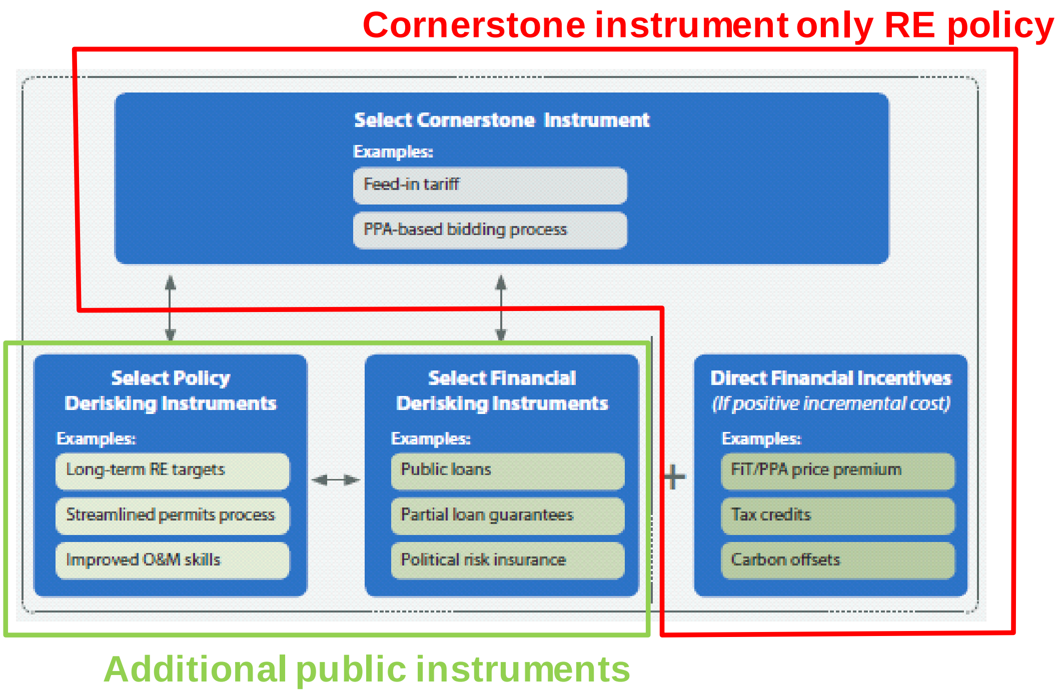
The Electricity Supply Corporation (ESC) of Country X is a 100% government-owned electric utility that generates, transmits and distributes electric power. As electricity supply cannot meet demand, load shedding (brown and black-outs) is a regular day-to-day occurrence for all but priority customers of ESC.

Further ESC has a weak balance sheet, due to poor collection of bills and not being able to pass on the full effects of government's subsidies for imported diesel fuel into its tariffs. ESC's severe cash flow constraints mean that the government has decided to open up the generation sector to private investment. At the same time the government is keen to steer the country along a more low-carbon pathway and has highlighted the utilization of the country's underexploited renewable energy resources as one of its priorities.

A recently conducted renewable energy (RE) master plan for the country has identified strong potential for onshore wind energy sector, with a 5 year target of 500 MW of utility-scale installed wind energy capacity. As such, Country X has decided to put in place an RE policy to achieve this 5 year target and is exploring options to receive international support as well as utilize its limited domestic resources. The country wants to attract private sector investment in wind energy with the preferred option of having independent power producers (IPPs) selling energy to the grid via 20 year power purchase agreements (PPAs) with ESC.

Based on an initial policy paper, the government has decided to formulate the wind energy around a cornerstone instrument of a PPA bidding process. A preliminary financial analysis indicates there is an incremental cost to wind energy in Country X, and therefore successful bids will likely include a direct financial incentive in the form of a premium price. The country is also currently considering whether an overall public instrument package, combining the cornerstone instrument (PPA bidding process) with complementary policy and financial derisking instruments, may be cost-effective. These possible components of a public instrument package are illustrated in Figure 1, below.

Figure 1: Illustrative components of a public instrument package for renewable energy



Source: Derisking Renewable Energy Investment report (UNDP, 2013), adapted.

CASE STUDY ACTIVITIES:

The team has been asked to develop two different designs for a wind energy RE policy for Country X. The team will then compare the two designs in terms of their financial costs and effects:

- ***Cornerstone instrument only RE policy design***: the only instrument implemented is a PPA bidding process.
- ***Public instrument package RE policy design***: a PPA bidding process will be complemented by a full package of other public instruments.

In both cases the 5 year target will be 500 MW of utility-scale installed capacity identified in Country X's RE master plan.

The case study uses the UNDP Derisking Renewable Energy Investment (DREI) tool to perform a financial analysis of these two design options. The DREI tool is based on the levelised cost of electricity (LCOE) approach to comparing the financial viability of different energy generation technologies. Simplified data and assumptions, representing the investment conditions in Country X, are provided in this guidance note and will need to be inputted into the DREI tool.

The case study activities follow four steps:

Step 1: Modelling baseline energy generation costs
Step 2: Designing the *cornerstone instrument only RE policy*
Step 3: Designing the *public instrument package RE policy*
Step 4: Compare both designs in terms of costs and effects

These four steps are then followed by general discussion questions.

STEP 1: MODELLING BASELINE ENERGY GENERATION COSTS

Step 1: Guidance

This step involves calculating the LCOE of the baseline energy generation mix.

For this step of the exercise, the sheet to use in the DREI tool is ***"II. Inputs, Baseline Energy Mix"***. Please use selected information from Table 1, below, and enter it into the appropriate cells of the DREI tool - the relevant cells are highlighted with a yellow background.

Specifically, please enter:

- The *marginal* baseline energy mix as a % in relevant cells in the row N15 to S15
- The total grid emission factor in cell T20.

To answer the questions below you will not have to do any own calculations. Once the data is correctly entered, the DREI tool calculates all required numbers.

Step 1: Data

Based on the initial policy paper the team has obtained the following preliminary information on the baseline energy mix.

Table 1: Baseline Energy Data

Input	Data	Source
Current baseline energy generation mix	Hydro: 75% Biomass: 10% Diesel: 15%	RE master plan
Marginal baseline energy generation mix **As a percentage:** **Most recent 5 private sector investments in new generation:**	 Hydro: 69% Diesel: 31% 800 MW 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)	RE master plan
Emission factors **Individual grid emission factors:** **Total marginal baseline grid emission factor:**	 Hydro: 0.000 $tCO2/MWh_{el}$ Diesel: 0.700 $tCO2/MWh_{el}$ 0.212 tCO_2/MWh_{el}	RE master plan

Note that, in order to have a transparent analysis of the true baseline energy generation costs, unsubsidised fuel costs are assumed for diesel-based power generation. These unsubsidised costs are already inputted in the DREI tool.

Step 1: Questions

1.1: What is the LCOE of the baseline energy mix? (The answer is displayed in cell R16 in the *"I.Summary Outputs"* sheet).

STEP 2: DESIGNING THE CORNERSTONE INSTRUMENT ONLY RE POLICY

Step 2: Guidance

This step involves modeling the LCOE of wind energy, and selecting relevant public instruments, in the scenario where a *cornerstone-instrument only RE policy* in Country X is implemented.

For this step of the exercise, the sheet to use in the DREI tool is: ***"III. Inputs, Wind Energy"***. The column and cells labelled "*Pre-Derisking*" are relevant for Step 2. Please use this information in Table 2 and Table 3 below and enter it into the appropriate cells of the DREI tool - the relevant cells are highlighted with a yellow background.

Specifically, please enter:

- Various inputs related wind energy costs in cells UV15, UV16, UV17 and UV18, and STU28, STU29, STU36, STU40 and STU45.
- The selection of a cornerstone instrument PPA bidding process in cell STU102
- The cost (administrative) of a cornerstone instrument PPA bidding process in cell R155.

To answer the questions below you will not have to do any own calculations. Once the data is correctly entered, the DREI tool calculates all required numbers.

Step 2: Data

The initial policy paper and additional rounds of stakeholder consultations, in particular with private sector investors, provided the following data, in Table 2, regarding the potential for onshore wind energy in Country X.

The data on financing assumes an investment environment where a well-designed PPA bidding process cornerstone instrument is implemented.

Table 2: Wind Energy Data

Input	Data	Source
Estimated capacity factor for 500MW of wind energy	38%	RE master plan
Investment costs	USD 2 million per MW, Assuming: high-quality manufacturer, all-in costs	Investor interviews
Life expectancy of assets	20 years	Investor interviews
Cost of equity	18%	Investor interviews
Cost of debt	10%	Investor interviews
Capital structure	70% debt/30% equity	Investor interviews
Loan tenor	12 years	Investor interviews
Corporate tax rate (effective)	25%	Investor interviews

Additional consultations focused on an estimate of the administrative cost of the PPA bidding process (design, administration, MRV). These consultations were held with national and international experts. The cost estimate is shown in Table 3, below. It was noted that this administrative cost does not include the cost of the any price premium (incremental cost) over 20 years - this premium/incremental cost is calculated separately.

Table 3: Public instrument selection and estimated costing

Risk Category	Public Instrument	Estimated Cost
Power market risk	PPA bidding process cornerstone instrument, with a well-designed standardised PPA	USD 1,700,000

Step 2: Question:

2.1: What is the LCOE of onshore wind power in Country X (in USD cents per kWh) assuming the *cornerstone instrument only RE policy design*?

2.2: What is the estimated tariff (in USD cents per kWh) in Country X in order to catalyse private sector investment?

<u>STEP 3: DESIGNING THE *PUBLIC INSTRUMENT PACKAGE RE POLICY*</u>

Step 3: Guidance

This Step 3 involves modeling the LCOE of wind energy, and selecting relevant public instruments, in the scenario where a *public instrument package RE policy* in Country X is implemented. This step builds on Step 2, but now involves selecting complementary derisking instruments and estimating how these derisking instruments can reduce the financing costs for wind energy in Country X.

For this step of the exercise, the sheet to use in the DREI tool is again: ***"III. Inputs, Wind Energy"***. The column and cells labelled "*Post Derisking*" are relevant for this Step 3. Please use this information in Table 4 below and enter it into the appropriate cells of the DREI tool - the relevant cells are highlighted with a yellow background.

Specifically, please enter:

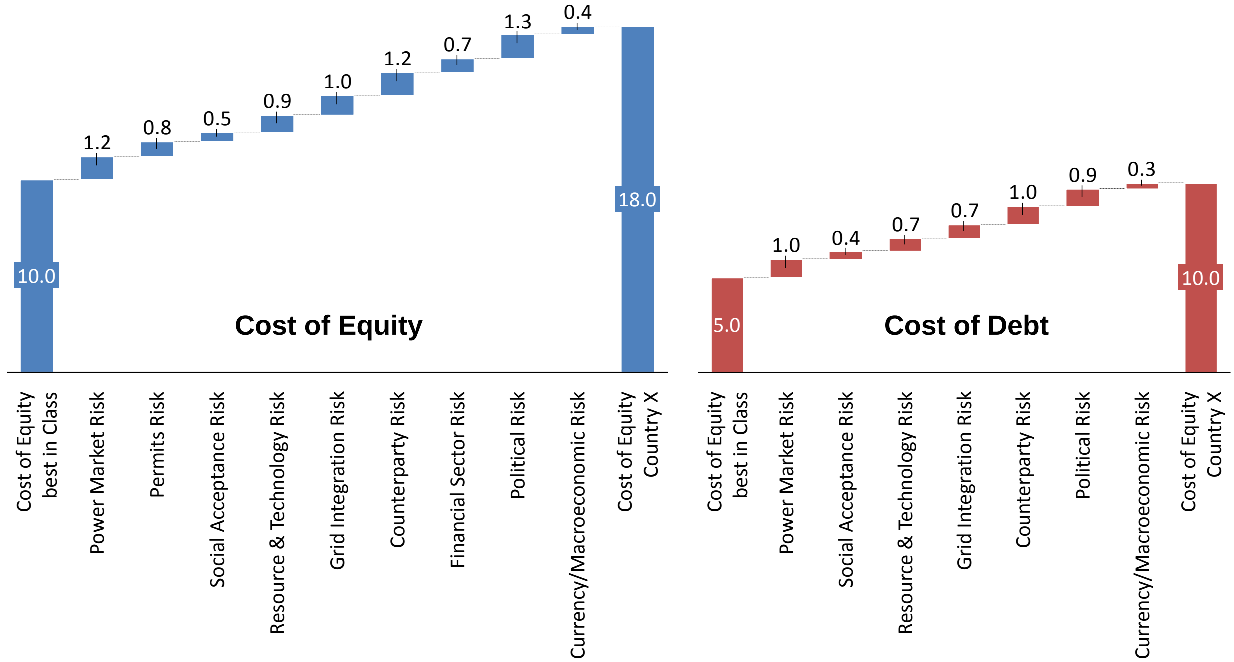
- The selection of policy derisking instruments in cells VWX102 to VWX108
- The cost of policy derisking instruments in cells V155 to V161.

To answer the questions below you will not have to do any own calculations. Once the data is correctly entered, the DREI tool calculates all required numbers.

Step 3: Data

As part of its work, the team has performed an analysis of the investment environment for wind energy in Country X to identify what investment risks may exist. Figure 2 shows the financing cost waterfalls for Country X, with data obtained from a series of interviews with national and international private sector investors and finance experts. These financing cost waterfalls illustrate how individual investment risk categories contribute to higher financing costs.

Figure 2: Upward financing cost waterfall graphs for wind energy in Country X, compared to a best in class country (in %)



Based on the analysis in Figure 2, where all risk categories in Country X are shown to contribute substantially to higher financing costs, the team makes the decision that Country X's *public instrument package RE policy* will select a policy derisking instrument, in addition to the cornerstone PPA bidding process, to target each investment risk category. The aim is to create an instrument package which both reduces financing costs and, in addition, by systematically removing barriers, increases its effectiveness.

As such, based on consultations with national and international experts, and private sector investors, the selection and an estimated costing of complementary policy derisking instruments for the *instrument package RE policy* was performed. The resulting data on selection of instruments and estimated cost (for 500MW over the lifetime of a 20 year PPA) is set out in Table 4 below.

Table 4: Selection of policy derisking instruments to complement the cornerstone PPA bidding process and their estimated costs

Risk Category	Public Instrument	Estimated Cost
Power Market Risk	Establish clear and realistic wind energy strategy and targets; well-designed and harmonized energy market liberalization (generation, transmission, distribution)	USD 1,100,000 above the existing administrative costs of the PPA bidding process (New total, including PPA bidding process is USD 2,800,000)
Permits Risk	Streamlined process for permits; establish a dedicated one-stop shop for RE permits; contract enforcement and recourse mechanisms	USD 1,000,000
Social Acceptance Risk	Awareness-raising campaigns targeting communities and end-users; pilot models for community involvement at project sites	USD 500,000
Resource & Technology Risk	Project development facility with: capacity building for resource assessment; Feasibility studies, networking, training and qualifications; research & development; technology standards; support exchange of market information	USD 1,200,000
Grid Integration Risk	Strengthening transmission company's operational performance; develop a national strategy for grid connection & management; develop a grid code for wind energy	USD 1,500,000
Counterparty Risk	Strengthening utility's management & operational performance for existing operations	USD 1,800,000
Financial Sector Risk	Strengthening investors' familiarity and assessment capacity for renewable energy	USD 800,000

Step 3: Questions

3.1: What are the LCOE of onshore wind power (in USD cents per kWh) assuming the *public instrument package RE policy design*?

3.2: What is an appropriate tariff (in USD cents per kWh) in this policy context?

STEP 4: COMPARING THE COSTS AND EFFECTS OF BOTH RE POLICY DESIGNS

Step 4: Guidance

Now that all relevant information has been entered into the DREI tool, the team would like to analyse how the two alternative RE policy designs compare.

For this step of the exercise, the key sheet to use in the DREI tool is the ***"I. Summary Outputs"*** sheet. This sheet summarises the various calculations in the DREI tool, including.

- The LCOE of the baseline energy mix
- The wind energy inputs
- The LCOE, incremental costs, investment amounts and public instrument costs for each of the *cornerstone only RE policy* and the *instrument package RE policy.*
- Performance metrics for each of the *cornerstone only RE policy* and the *instrument package RE policy.*

Step 4: Questions

4.1: How do the onshore wind energy LCOEs in Country X 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?

4.2: What is the difference in financing costs for wind energy between the two RE policy designs?

4.3: How much private sector investment in USD will be catalyzed?

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

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 leverage ratio in Country X?

4.6: What is the savings leverage ratio of the additional instruments in the *instrument package RE policy design*?

4.7: Over the 20 year lifetime, what are estimated emission reductions that result from the wind energy investment for the RE plan?

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

<u>FURTHER QUESTIONS FOR DISCUSSION:</u>

D.1: *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? Which instruments are well suited for MRV, which are less?

D.2: *The role of fossil fuel subsidies.*

Diesel fuel comprises 31% of the marginal baseline energy mix in Country X. As set out above, the assumptions used in the case study above has assumed no fuel subsidies for diesel fuel.

As an alternative scenario, the DREI tool can model the impact of fuel subsidies. To do this, please go to sheet “II. Inputs, Baseline Energy Mix”, cell Q96, and select “Manual Entry” in the dropdown menu. This selection of “Manual Entry” will activate a new data set for diesel fuel costs which assumes a 20% fuel subsidy on diesel fuel.

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

ACRONYMS

CO_2 Carbon dioxide
DREI Derisking Renewable Energy Investment
ESC Electricity Supply Corporation
FiT Feed-in Tariff
IPP Independent Power Producer
kWh Kilowatt hour
LCOE Levelized Cost of Electricity
MRV Monitoring, Reporting and Verification
MW Megawatt (1 million watts)
MWh Megawatts per hour
MRV Measuring, Reporting, Verification
PPA Power Purchase Agreement
RE Renewable Energy
TWh Terawatt hour
tCO_2 Tonnes of carbon dioxide
USD United States Dollars

DISCLAIMER

FURTHER INFORMATION

This case study was prepared by UNDP's Energy, Infrastructure, Technology and Transport (EITT) team in the UNDP-Global Environmental Finance (UNDP-GEF) unit. For further information on the case study, or on the DREI report and tool, please contact the case study's authors:

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