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Tunisia: Derisking Renewable Energy Investment 2018

Selecting Public Instruments to Promote
Renewable Energy Investment for the Tunisia Solar Plan

FULL RESULTS

June, 2018

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This "**Full Results**" document is accompanied by the following materials

- A "**Key Points for Decision Makers**" summary
- A "**Methodology and Assumptions"** document
- The related **modelling tools** in Excel

All materials may be found at www.undp.org/DREI

1. Introduction

- **The objective of this study is to analyse the most cost-effective public derisking measures to promote private sector investment in renewable energy (wind and solar PV) in Tunisia.** The study sets out the results from a quantitative, investment-risk informed modelling analysis. Modelling data was obtained from structured interviews with private sector investors and developers

- The analysis in this study forms part of United Nations Development Programme's (UNDP) assistance to develop a Nationally Appropriate Mitigation Action (NAMA) in support of the Tunisian Solar Plan (TSP). UNDP is providing this support under a Global Environment Facility (GEF)-financed project entitled "NAMA support to the Tunisia Solar Plan" (NAMA TSP Project). The project's national implementing partner is the Tunisian National Agency for Energy Conservation (Agence Nationale pour la Maîtrise de l'Energie, ANME). The project is being implemented between 2016 and 2018.

    - This 2018 study is an update to an initial 2014 study (UNDP, 2014), that was performed at the time of the NAMA TSP Project's design.

- The Tunisia Solar Plan, originally formulated in 2012, and updated since, is Tunisia's official long-term plan for attracting renewable energy investment in the power sector. With this plan, Tunisia has an official target to reach 30% renewable electricity production in its power mix by 2030. A large share of this investment is envisioned to come from the private sector.

- Tunisia is undertaking voluntary measures to reduce its greenhouse gas emissions under the United Nations Framework Convention on Climate Change (UNFCCC). Its Nationally Determined Contribution (NDC) envisions an economy-wide carbon intensity reduction by 41% in 2030 compared to 2010. In the energy sector, the aim is to reduce the carbon intensity by 46% over the same timeframe (Republic of Tunisia, 2015). In addition, Tunisia is developing a small number of NAMAs, including the NAMA TSP, with the aim of attracting international climate finance.

2. Current Status of Renewable Energy in Tunisia

Tunisia General Country Data [i]

- **Population 2016**: 11.4 m
- **Land Area**: 162,155 km^2
- **GDP (USD) 2016**: 42.1 billion
- **GDP/Capita (USD, PPP) 2016**: 11,596
- **Sovereign Rating 2017**: B1 (Moody's)
- **UNDP HDI 2017**: 0.725 (97th rank)
- **WB Ease of Doing Business 2017**: 77th of 190

2030 Targets for Renewable Energy

- Renewable energy holds strong potential in Tunisia. Wind and solar photovoltaic (PV) provide the opportunity to improve Tunisia's energy security, to meet growing energy demand, and to create a future power-export industry for Tunisia. Wind and solar can also support Tunisia's contributions to climate change under the UNFCCC
- The Tunisian Solar Plan (TSP) has an official target for total RE share of 30% of the power mix by 2030 (ANME, 2012)
    - The modelling in this study uses 2030 TSP targets for private sector, utility-scale investment of 940 MW for wind, and 835 MW for solar PV
        - These targets were developed under the NAMA TSP project, in consultation with key stakeholders

Power Sector Context

- Tunisia's power sector is currently characterized by rising power demand, the dominance of gas-powered generation (with imported gas), and the pre-eminent role of STEG, the country's main energy producer and its distributor
- Tunisia currently has 5,224 MW in installed capacity (STEG, 2015)
    - 91% of generation is from STEG, 9% is from IPPs (STEG, 2015)
    - Gas-powered generation dominates. Wind currently accounts for 4.9% of generation (STEG, 2015)
    - Annual demand is projected to increase by between 2% and 5% (STEG, 2015)
- Power sector subsidies in Tunisia take the form of (i) non cost-reflective tariffs and fiscal transfers to STEG, and (ii) subsidized gas input prices. Tunisia has undertaken significant reforms, starting in 2014
    - Retail tariffs are being reformed, with a number of increases in recent years
    - Gas subsidies for the power sector are being reformed, but annual flows are impacted by global prices and currency fluctuations. Subsidies peaked at EUR 1.7 bn (2013), fell to EUR 82 m (2016), and back to EUR 576 m (2017) (HuffPost, 2017)
- The model assumes a marginal baseline of 100% gas combined cycle technology (CCGT). Or in other words, in the absence of RE, the model assumes private sector CCGT plants are built. The baseline grid emission factor is 0.374 $tCO2e/kWh_{el}$ (@$54\%_{HHV}$ plant efficiency).

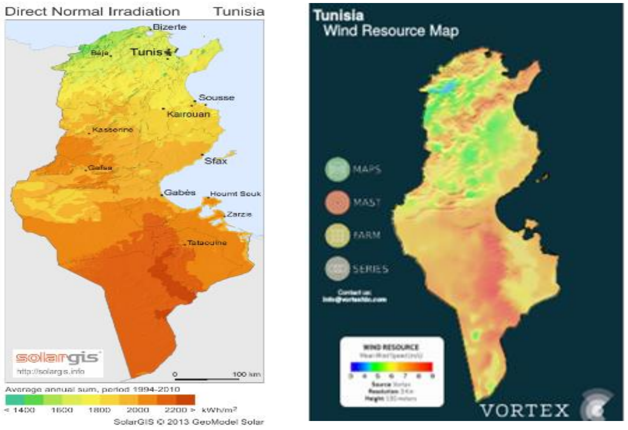
(i) Sources: EIU, 2018; WB, 2018; UNDP, 2018; Moody's, 2018

2. Current Status of Renewable Energy in Tunisia

Renewable Energy Resources

- Tunisia has good renewable energy resources. Please see Figure 1.
    - Favorable wind sites are found along the northern coast, as well as in central and southern regions
    - The strongest solar radiation is in the south of the country
- The modeling uses a capacity factor of 35.0% for wind (STEG, 2017a) and 19.4% for solar PV (STEG, 2017b).

Figure 1: Resource maps for wind and solar in Tunisia



Source: Solar map: solargis.info/doc/88; Wind map: www.vortexfdc.com

Current Status of Renewable Energy Investment

- Current installed capacity is 244 MW for wind, all operated by STEG. There is no utility-scale investment in solar PV
    - Wind consists of: Sida Daoud (54 MW, commissioned 2009); Bizerte (120 MW, 2012); further additions have been envisioned by STEG (STEG, 2017b).
    - While there is private sector interest, there has been no private-sector owned utility-scale RE project in Tunisia to-date
- In 2017, the first stage of tender process totaling 210 MW (140 MW of wind, and 70MW of solar PV) was launched. The tender is based on a build-own-operate model, with a standard PPA and STEG as the off-taker
    - In the first stage, for 140 MW, 69 offers were received. Winning bits will be notified in May 2018.
    - This 2017 tender process follows various earlier renewable energy legislative regimes, including a feed-in tariff
- In 2018, a further tender for 800 MW will be launched (Le Monde de l'Energie, 2018)
- A number of international organizations are providing assistance to Tunisia on wind and solar energy. Please see Table 1 below.

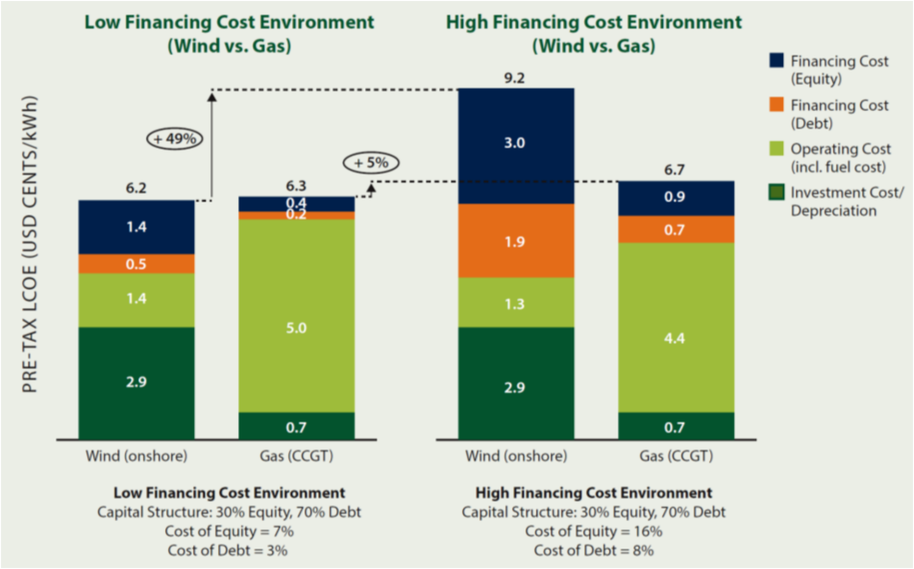
Table 1: International support to utility-scale renewable energy in Tunisia

Organisation	Description of Activities
GIZ	• Support for the implementation of the Tunisian Solar Plan, in particular improving the framework conditions to facilitate the implementation of the TSP. The duration of the project is 5 years (2016-2021)
EBRD	• Reinforce STEG Network; support ANME in defining legal framework and updating the PPA for the authorization regime of the TSP; offering support to IPPs during tender processes
EU	• "Energy Transition Goal" Programme, with a budget support of EUR 50m over the period 2018-2022 to reinforce the Energy Transition Fund, support the improvement and operationalization of regulatory and technical measures to develop RE with regards to grid reinforcement and the implementation of an independent regulating authority of the electricity sector
AFD	• Support energy efficiency in social buildings

3. DREI Methodology: Key Concepts

The Impact of High Financing Costs on Renewable Energy

Figure 2: Comparing wind energy and gas LCOEs in high and low financing cost environments



Source: Derisking Renewable Energy Investment (Waissbein et al., 2013), subsequently updated as of 2017. All assumptions besides the financing costs are kept constant between the low and high financing cost environments. Wind energy technology assumptions: investment cost: 1,520,000 EUR/MW, O&M: 31,600 EUR/MW/year, capacity factor: 30%, annual inflation: 2%; Gas (CCGT) assumptions: investment cost: 910,000 EUR/MW, O&M: 35,100 EUR/MW/year, full load hours: 5,000/year, fuel efficiency: 58%, annual Inflation: 2%; fuel costs are projected using IEA's New Policies Scenario, based on 2016 EUImport Prices for Natural Gas as the starting point. For more detail on data sources, please refer to Annex B. Operating costs appear as a lower contribution to LCOE in developing countries due to discounting effects from higher financing costs.

- A key focus of the Derisking Renewable Energy Investment ("DREI") methodology is on financing costs for renewable energy. Private sector investors in many developing countries still face high financing costs for renewable energy. These reflect a range of investment risks that exist in early stage markets. Investors seek to be compensated for these risks

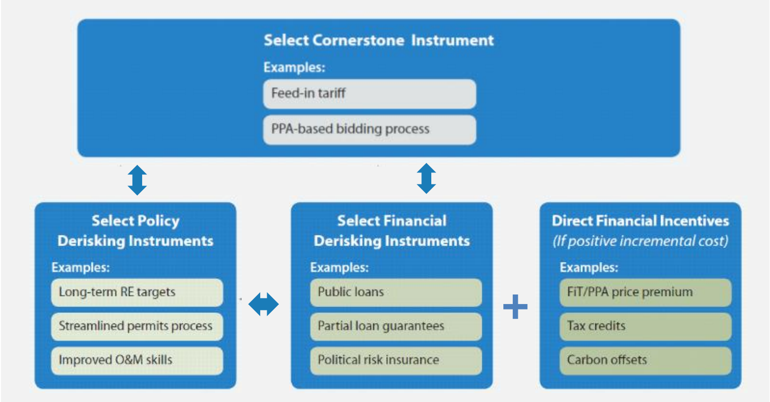
- Figure 2, from the original DREI report, illustrates how high financing costs can impact the competitiveness of renewable energy, due to its upfront capital intensity. The figure shows UNDP modelling to compare the levelised cost of electricity (LCOE) of onshore wind and combined-cycle gas in a high and low cost financing environment.

- The theory of change underlying the DREI methodology is that a key entry point for policy-makers in developing countries is to address these investment risks, therefore lowering overall life-cycle cost.

3. DREI Methodology: Key Concepts

Identifying a Public Instrument Mix to Promote Renewable Energy

Figure 3: Typical components of a public instrument package for large-scale renewable energy



Source: Derisking Renewable Energy Investment (Waissbein et al., 2013)

- In seeking to create an enabled investment environment for renewable energy, policy-makers typically implement a package of public instruments. A key concept from the DREI methodology is that of the public instrument package, represented in Figure 3.
- The **cornerstone instrument** is the centerpiece of the public instrument package, and is critical to market transformation. For large-scale renewable energy, the cornerstone instrument is typically a Power Purchase Agreement (PPA) tender process or Feed in Tariff, either of which allows independent power producers (IPPs) to enter into long-term (e.g. 15-20 year) power purchase agreements with grid operators.

- Complementing the cornerstone instrument, the DREI methodology identifies three core types of public measures, addressing the risk-return profile of renewable energy:
    - **Instruments that reduce risk**, by addressing the underlying barriers that are the root causes of investment risks. These instruments utilise policy and programmatic interventions. An example might involve barriers related to a lack of technical requirements for renewable energy project developers to connect to the grid. The implementation of a transparent and well-formulated grid code can address this barrier, reducing risk. The DREI methodology terms this type of instrument "**policy derisking**".
    - **Instruments that transfer risk,** shifting risk from the private sector to the public sector. These instruments function by transferring investment risks to public actors, such as development banks. These instruments can include public loans and guarantees, political risk insurance and public equity co-investments. For example, the credit-worthiness of a PPA may often be a concern to lenders. A development bank guarantee can provide banks with the security to lend to project developers. The DREI methodology terms this type of instrument "**financial derisking**".
    - **Instruments that compensate for risk**, providing a financial incentive to investors in the renewable energy project. When risks cannot be reduced or transferred, residual risks and costs can be compensated for. These instruments can take many forms, including price premiums (either as part of a PPA or FiT), tax breaks, and proceeds from the sale of carbon credits. The DREI methodology calls these types of instruments "**direct financial incentives**".

4. Modelling of Renewable Energy Promotion in Tunisia

4.1 Risk Environment (Stage 1)

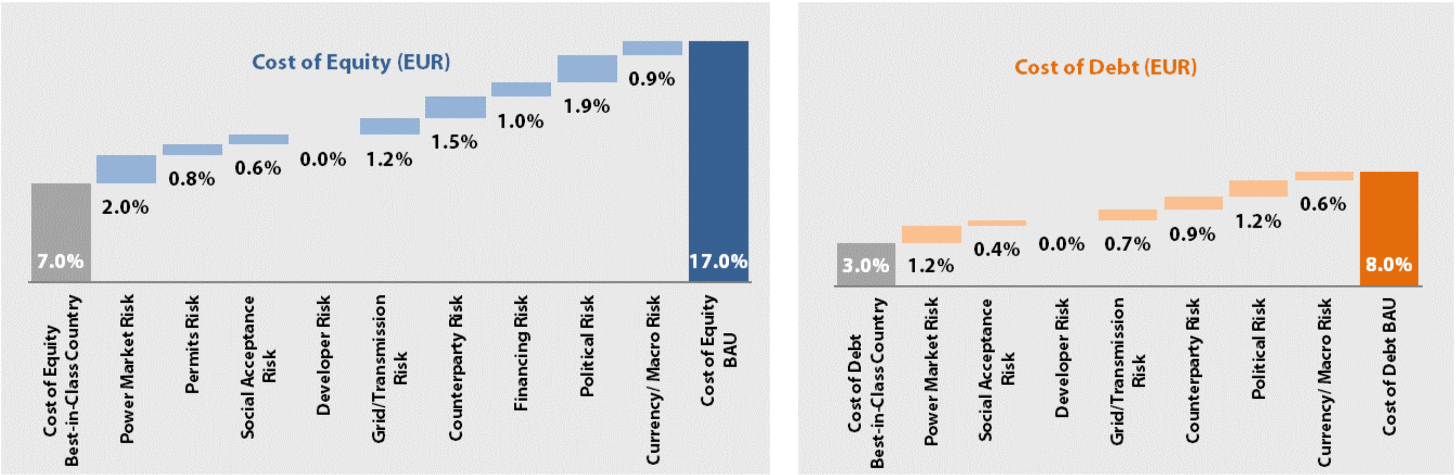
Interviews

- Data on the risk environment were gathered from interviews held with 8 project developers and investors (debt (2)/equity(6)).

Financing Cost Waterfalls

- The contribution of investment risks to higher financing costs is shown in Figure 4. The analysis was performed jointly for wind and solar energy.
    - 3 risk categories – power market risk, counterparty risk and political risk – all have a particularly high impact on financing costs
    - Developer Risk has no impact on the CoE/ CoD, as its risk perception is lower in Tunisia than in the best-in-class country
- A summary of the qualitative feedback shared in interviews is found in Table 2.

Figure 4: Impact of risk categories on financing costs for renewable energy investments in Tunisia, business-as-usual scenario



Source: interviews with investors; modelling; best-in-class country is assumed to be Germany; see “Methodology and Assumptions” document for further details.

4. Modelling of Renewable Energy Promotion in Tunisia

4.1 Risk Environment (Stage 1)

Table 2: Qualitative investor feedback on risk categories for Renewable Energy investment in Tunisia

Risk Category	Impact on financing costs	Qualitative investor feedback
Power Market Risk	• High	• Concerns: Monopoly of STEG who is not perceived as progressive and can exert influence on the public policy; competition with STEG on land-use, e.g. it was stressed that STEG is developing its public program of wind (80 MW by 2020) and PV (20 MW, 50 MW x 4, 80 MW by 2020) without limitation on project sizes whereas IPPs are limited to 30 MW for wind and 10 MW for PV; the current version of the PPA is often criticised (risk of political force majeure, non-guarantee of the PPA by the government, etc.); absence of an independent regulator for fair arbitrage between STEG and investors; high subsidy on fossil fuel for electricity generation.
Permits Risk	• Moderate	• Positive: The degree of flexibility in the documents proving the allocation of land for the project (promise to lease and lease contract are accepted in this first round of the tender process under the licensing regime) • Concerns: Worries about the complexity of the procedures (particularly in case of collective or state-owned land) .
Social Acceptance Risk	• Moderate	• Positive: Risk can be controlled in advance by dialogue with local communities and associating local communities during the project development process. Projects have positive co-benefits, such as creating local job opportunities. • Concerns: Risk has been increasing due to an increasing concern about the functioning of State security services.
Grid/ Transmission Risk	• Moderate	• Positive: The RE integration capacity is considered sufficient over the short- to mid-term, also in view of RE targets to 2020 (1 GW). • Concerns: In the long run, grid integration may constitute a bottleneck for RE capacity development if STEG does not invest in adequate infrastructure upgrades.
Counterparty Risk	• High	• Concerns: Perceived as significant risk given STEG's financial situation which is receiving yearly subsidies to preserve its financial equilibrium; In the current PPA model, the State does not provide a guarantee for the PPA payments that would alleviate the counterparty risk, which (from the developers' perspective) may likely deter international investors.
Financing Risk	• High	• Positive: Based on the past experience, there seems to be trust in the international banks' willingness to finance SPVs and to support RE projects. • Concerns: Local banks may not yet have the capacity to evaluate the risk profile of RE projects or to do SPV financing; some banks may lack liquidity; concerns about unfavorable loan conditions, i.e. high interest rate and short loan tenors.
Political Risk	• High	• Concerns: Due to the ongoing political transition process, unstable political and security environment; unsecure economic outlook: in February 2017, rating agency Fitch lowered the Tunisian rating from "BB-" to "B +", but with stable perspective.
Currency/Macro-economic Risk	• Moderate	• Positive: In the current PPA, the selling price is indexed to the Euro or Dollar. • Concerns: There remain concerns about the inflation of the Tunisian dinar and the fact that majority of the investment would be in foreign currency.

Source: Interviews with investors

4. Modelling of Renewable Energy Promotion in Tunisia

4.2 Public Instrument Selection (Stage 2)

Selection of public instruments

- Having identified the key investment risks, a package of public instruments can then be assembled to address them. The modelling adopts a systematic approach to identifying policy instruments: if the financing cost waterfalls (Figure 4) identify an incremental financing cost for a particular risk category, then matching public instruments from the public instrument table (Appendix B) is considered for inclusion. Table 3 below lists the recommended public instruments.

Table 3: The selection of public instruments to achieve the envisioned investment targets for renewable energy in Tunisia

Risk Category	Policy Derisking Instruments	Financial Derisking Instruments
Power Market Risk	• Ongoing legislative reform to put in place effective policies/ revise them • Well-designed standard PPA and tender process • Independent regulator	NA
Permits Risk	• Streamlined process for permitting (e.g. dedicated one-stop shop for RE permits) • Enforcement and recourse mechanism	NA
Social Acceptance Risk	• Awareness-raising campaigns • Promote/ pilot community-based approaches	NA
Developer Risk	• Resource assessment (only for wind energy) • Research and development into technology standards (Support to pilot projects on solar PV in desert environments) • Technology support and O&M assistance	NA
Grid/Transmission Risk	• Transparent, up-to-date grid code • Grid management/ planning (develop and update long-term national transmission/ grid plan to include intermittent RE) • Capacity building for the supervision center to organize/ control dispatching	• Take-or-pay clause[i] in PPA
Counterparty Risk	• Strengthen the utility's management • Implementing sustainable cost recovery policies	• Government (sovereign) guarantee
Financing Risk	• Domestic financial sector reform	NA
Political Risk	NA	NA
Currency/Macro. Risk	NA	• Partial indexing

Source: modelling. See Annex B for a more detailed description of instruments. "NA" indicates "Not Applicable"

(i) A 'take of pay' clause is a clause found in a PPA that essentially allocates risk between parties in the scenario where transmission line failure or curtailment (required by the grid operator) result in the IPP being unable to deliver electricity generated by its renewable energy plant1

4. Modelling of Renewable Energy Promotion in Tunisia

4.2 Public Instrument Selection (Stage 2)

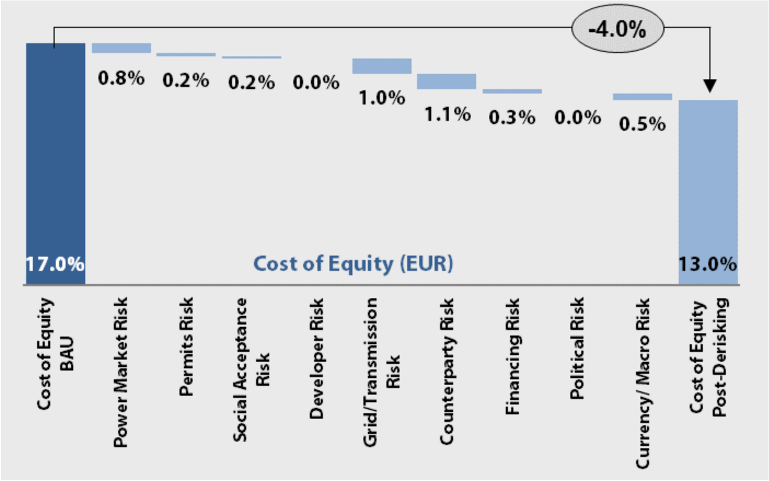
Costing of public instruments

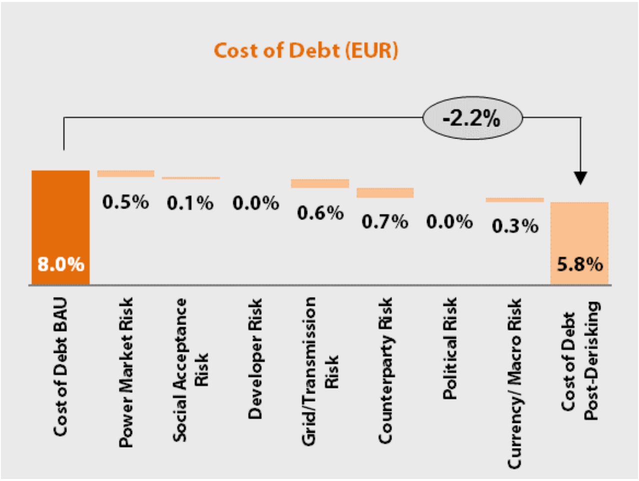
- The public costs of each selected public instrument are also modelled:
    - For wind energy (2030 target: 940 MW), the total public instrument cost 2018-30 is estimated as being EUR 11 million in policy derisking instruments and EUR 93 million in financial derisking instruments (post-derisking).
    - For solar energy (2030 target: 835 MW), the total public instrument cost 2018-30 is estimated as being EUR 9 million in policy derisking instruments and EUR 45 million in financial derisking instruments (post-derisking).
- The full breakdown of each selected public instrument and its cost is provided in Tables 8-10 in Appendix A

Impact of public instruments on financing costs

- The impact of the public instruments on reducing financing costs for wind and solar PV in Tunisia is shown in Figure 4.
    - Based on the modelling, this reduces the average cost of equity until 2030 by 4% down to 13%, and the cost of debt by 2.2% down to 5.8%.
    - Developer Risk has no impact on the CoE/ CoD, as its risk perception is lower in Tunisia than in the best-in-class country
- A brief summary of the qualitative investor feedback on the public instruments discussed in the interviews and on their effectiveness in reducing financing costs in Tunisia is provided in Table 4.

Figure 5: Impact of risk categories on financing costs for wind and solar PV investments in Tunisia, post-derisking scenario





Source: interviews with investors; modelling; see "Methodology and Assumptions" document for further details. Note: the impacts shown are average impacts over the modelling period, assuming timing affects

4. Modelling of Renewable Energy Promotion in Tunisia

4.2 Public Instrument Selection (Stage 2)

Table 4: Qualitative investor feedback on the impact of public instruments to address risk categories for Renewable Energy investment in Tunisia

Risk Category	Instruments	Qualitative investor feedback
Power Market Risk	• Ongoing legislative reform/policy revision • Well-designed standard PPA/tender process • Independent regulator	• These policy derisking instruments are considered highly effective. • However, investors seem to be in doubt about their implementation, in particular about the degree of independency to be expected from the power sector regulator and about the transparency of the tender procedures and reward criteria.
Permits Risk	• Streamlined process for permitting (e.g. dedicated one-stop shop for RE permits) • Enforcement and recourse mechanism	• The derisking instruments are considered moderately effective. • Some doubt were expressed about the recourse mechanism in the context of absence of an independent regulator and the dominant position of the national utility (STEG).
Social Acceptance Risk	• Awareness-raising campaigns • Promote/ pilot community-based approaches	• These policy derisking instruments are considered effective • Concerns exist about how long potential public opposition can be prevented/handled that way (in view of the perceived increasing weakness of the State security services and some signs of increased vandalism and project opposition).
Developer Risk	• Resource assessment (only for wind energy) • R&D into technology standards • Technology support and O&M assistance	• These policy derisking instruments are considered moderately effective. • Large developers would use the services of internat. specialized companies for the wind resource assessment and for O&M • It was argued that the iinstruments would benefit mostly local small developers, but larger developers may not require them.
Grid/ Transmission Risk	• Transparent, up-to-date grid code • Grid management/ planning • Capacity building for the supervision centre to organise/ control dispatching • Take or pay clause in PPA	• A transparent, up-to-date grid code is considered highly effective. Since currently STEG has the sole authority to perform grid connection feasibility studies required for an application by IPPs, some developers have doubts about the transparency of the results, also in view of the absence of a trustworthy recourse mechanism. • Grid management/planning is considered moderately effective. No problems are foreseen in the short term, but this might change in the future, given the perceived lack of effective grid infrastructure planning. • Capacity building for dispatching best practices is not considered to be a strong need at STEG. • A take-or-pay clause in the PPA is considered a must, and it is acknowledged that it is already included in the current Tunisian PPA model. However, the issue raised by some developers is linked to the risk of "political force majeure" which is not covered by the State in the current PPA.
Counterparty Risk	• Strengthen the utility's management • Implementing sustainable cost recovery policies • Government guarantee of PPA	• Strengthening STEG's managerial capacity is not considered to be effective. The main concern is the perception of STEG as a monopolist which would be reflected by the way STEG's activities are governed. • Implementing sustainable cost recovery policies is considered moderately effective because it appears to be difficult to fully implement in the short- to medium-term (in view of the country's current social and political vulnerability). • A government guarantee on PPAs is considered highly effective. However, of utmost concern to investors is that the current PPA model does not include such guarantees, despite STEG (the counterparty) being 100% publicly owned. The lack of a sovereign guarantee has been mentioned to be the primary reason (among others) why the current PPA model may be perceived as not bankable by international donors and investors.
Financing Risk	• Domestic financial sector reform • Concessional public loans from international financial institutions to IPPs	• Domestic financial reform could be effective but is considered not practicable in the short- to medium-term. Also, it was mentioned that for the intention to deploy RE alone may not suffice to trigger a reform of the financial sector. • Concessional public loans from IFIs are considered effective. However, the concern was mentioned that given the currently prevailing currency risk, a foreign concessional interest rate may be even higher than the rate from local banks.
Currency/Macro econ. Risk	• Partial indexing of PPA tariffs to foreign currencies	• This financial derisking instrument is considered highly effective. Indexation is already included in the current Tunisian PPA. • Some international investors underline the complexity of procedures to transfer revenues from projects out of the country because of the current central bank exchange regulation.

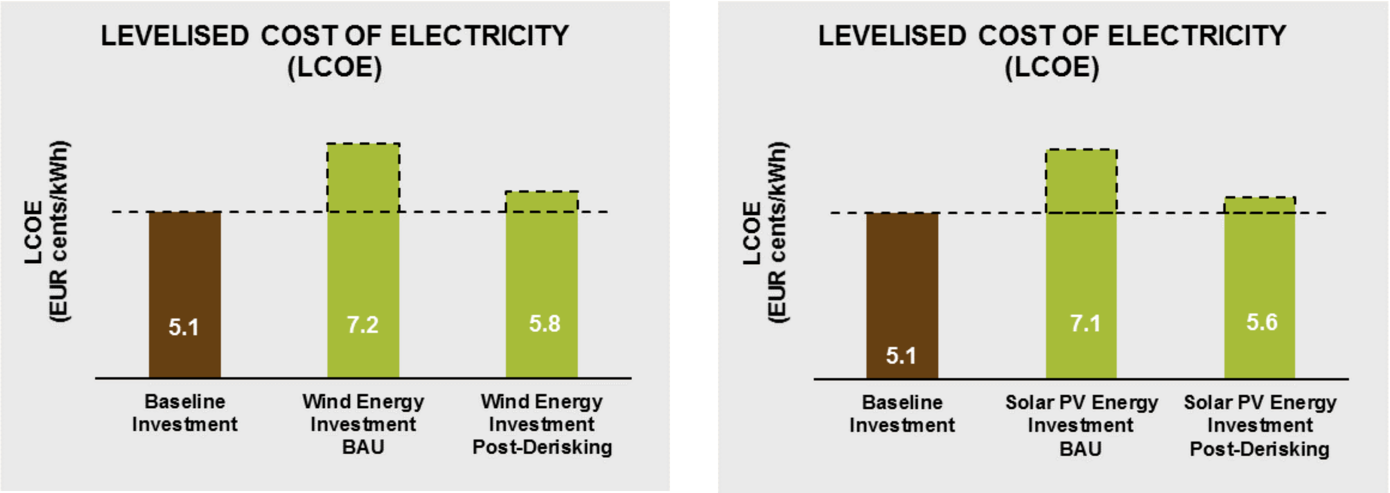
Source: Interviews with Investors

4. Modelling of Renewable Energy Promotion in Tunisia

4.3 Levelised Cost (Stage 3)

- The modelling outputs in terms of levelized cost of electricity (LCOE) for wind and solar PV are shown in Figure 6.
- The marginal baseline LCOE, based on private sector investment in CCGT, is estimated as being EUR 5.1 cents per kWh (unsubsidized).
- **Wind energy** is shown to be more expensive than the baseline in business-as-usual and slightly more expensive in the post-derisking scenarios. The public instrument package reduces the LCOE for wind energy from EUR 7.2 cents per kWh (business-as-usual scenario) to EUR 5.8 cents per kWh (post-derisking scenario), reducing the price premium required from EUR 2.1 cents per kWh to EUR 0.6 cents per kWh.
- **Solar energy** is also shown to be more expensive than the baseline in business-as-usual and slightly more expensive in the post-derisking scenarios. The public instrument package reduces the LCOE for solar PV from EUR 7.1 cents per kWh (business-as-usual scenario) to EUR 5.6 cents per kWh (post-derisking scenario), reducing the price premium required from EUR 1.9 cents per kWh to EUR 0.5 cents per kWh.

Figure 6: LCOEs for baseline and wind and solar PV investment in Tunisia



Source: modelling; see Table 7 (Appendix A) and "Methodology and Assumptions" document for further details.

4. Modelling of Renewable Energy Promotion in Tunisia

4.4 Performance Metrics (Stage 4)

- The model's performance metrics, evaluating the impact of derisking on the envisioned 2030 targets for wind and solar PV in Tunisia, are shown in Figures 7 and 8.

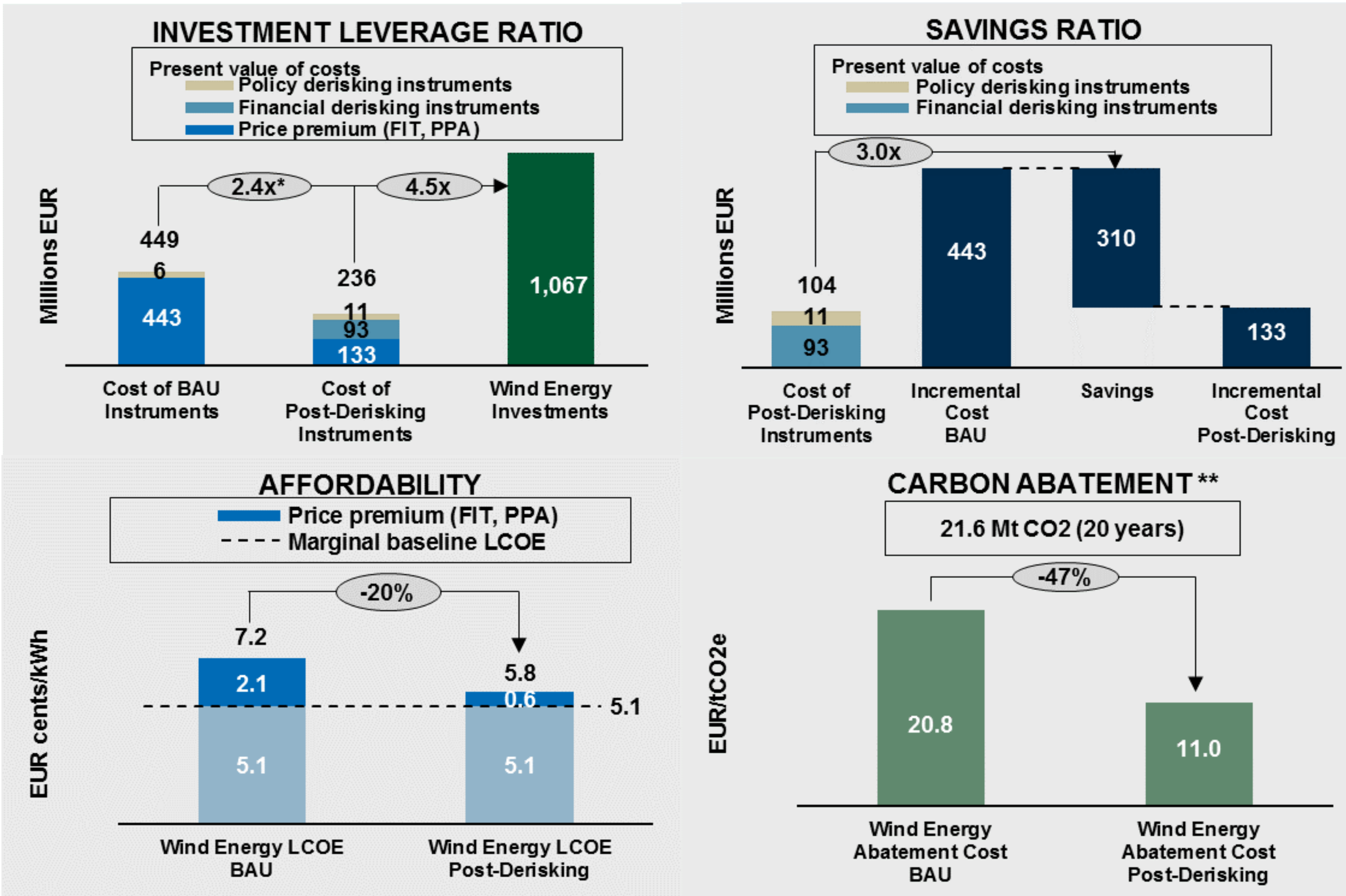
- Each of the four performance metrics takes a different perspective
    - The **investment leverage ratio** shows the efficiency of public instruments in attracting investment, comparing the total cost of public instruments with the resulting private-sector investment.
    - The **savings ratio** takes a social perspective, comparing the cost of derisking instruments deployed versus the economic savings that accrue to society from deploying the instruments.
    - The **affordability metric** takes an electricity consumer perspective, comparing the generation cost of wind energy or solar PV in the post-derisking scenario with the original BAU scenario.
    - The **carbon abatement** metric takes a climate change mitigation perspective, considering the carbon abatement potential and comparing the carbon abatement costs (the cost per ton of CO2 abated). This can be a useful metric for comparing carbon prices.

- Taken as a whole, the performance metrics demonstrate how the deployment of public derisking instruments can significantly increase the competitiveness and affordability of wind and solar PV in Tunisia.
    - For instance, the investment leverage ratio shows that derisking is an efficient use of public funding.
        - For **wind energy**, the 940 MW 2030 target is estimated to require EUR 1067 million in private sector investment. The modelling shows that in the business-as-usual scenario EUR 449 million (policy derisking and price premium payments) leverages private sector investments by a factor of 2.4x. In the post-derisking scenario, a package of derisking instruments valued at EUR 104 million will reduce the price premium payments from EUR 443 million to EUR 133 million over 20 years, and this will increase the investment leverage ratio to 4.5x.
        - For **solar PV**, the 835 MW 2030 target is estimated to require EUR 532 million in private sector investment. The modelling shows that in the business-as-usual scenario EUR 206 million leverages private sector investments by a factor of 2.6x. In the post-derisking scenario, a package of derisking instruments valued at EUR 54 million will reduce the price premium payments from EUR 201 billion to EUR 51 million over 20 years, and this will increase the investment leverage ratio to 5.1x.

4. Modelling of Renewable Energy Promotion in Tunisia

4.4 Performance Metrics (Stage 4) - Wind

Figure 7: Performance metrics for the selected package of derisking instruments in promoting 940 MW of wind energy investment in Tunisia

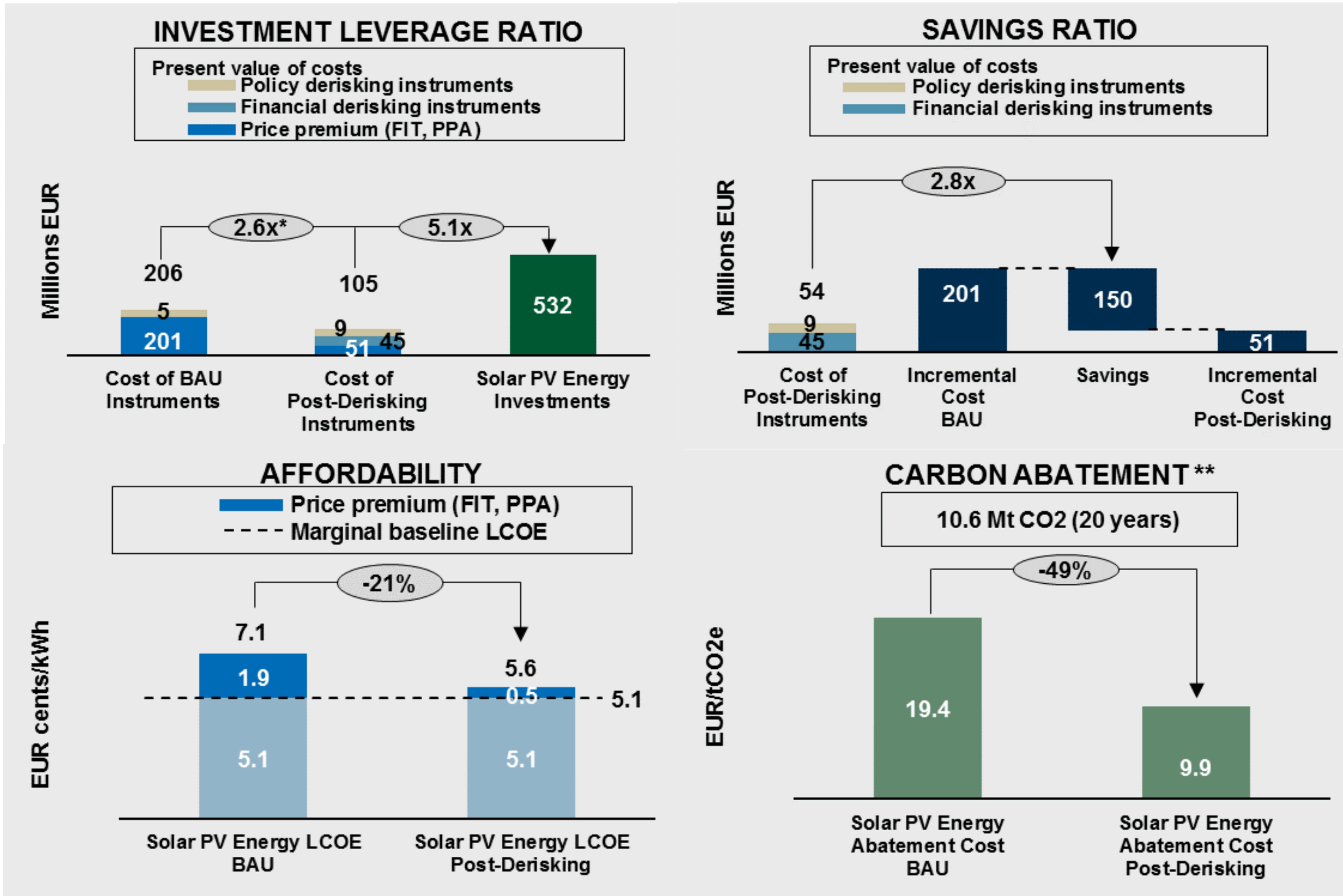


Source: modelling; see Table 8 (Appendix A) and "Methodology and Assumptions" document for further details.
*In the BAU scenario, the full 2030 investment target may not be met.
** The Carbon Abatement metric can be broken down into the costs of policy derisking instruments, financial derisking instruments and the price premium. While in the BAU scenario, the total of EUR 20.82 per tCO2e can be broken down to EUR 20.53 for the price premium and EUR 0.30 for the policy derisking instruments, in the post-derisking scenario, this breakdown for the total of EUR 10.97 per tCO2e is EUR 6.16 for the price premium, EUR 4.29 for the financial derisking instruments and EUR 0.52 for the policy derisking instruments, respectively.

4. Modelling of Renewable Energy Promotion in Tunisia

4.4 Performance Metrics (Stage 4) – Solar PV

Figure 8: Performance metrics for the selected package of derisking instruments in promoting 835 MW of solar PV investment in Tunisia



Source: modelling; see Table 9 (Appendix A) and "Methodology and Assumptions" document for further details.
*In the BAU scenario, the full 2030 investment target may not be met.
** The Carbon Abatement metric can be broken down into the costs of policy derisking instruments, financial derisking instruments and the price premium. While in the BAU scenario, the total of EUR 19.37 per tCO2e is broken down to EUR 18.90 for the price premium and EUR 0.47 for policy derisking instruments; in the post-derisking scenario, this breakdown for the total of EUR 9.92 per tCO2e is EUR 4.76 for the price premium, EUR 4.28 for financial derisking instruments and EUR 0.87 for policy derisking instruments

4. Modelling of Renewable Energy Promotion in Tunisia

4.5 Sensitivities (Stage 4)

- The objective of performing sensitivity analyses is to gain a better understanding of the robustness of the outputs and to be able to test different scenarios.
- Sensitivity analyses have been performed for key input assumptions: investment costs (including O&M costs), capacity factors, fuel costs, financing costs

Key Input Assumptions - Wind

Table 5: Wind: summary of LCOE outputs for sensitivity analysis on key input assumptions [EUR cents/kWh]

TYPES OF SENSITIVITY	DESCRIPTION OF SENSITIVITY	BASELINE LCOE	WIND BAU LCOE	WIND POST-DERISKING LCOE
Base Case		5.13	7.24	5.76
Investment and O&M Costs	Higher investment and O&M costs: investment 1,375,000 EUR/MW and O&M costs 29,117 EUR/MW/y Base case 1,135,540 EUR/MW and 24,264 EUR/MW/y		8.75	7.01
Capacity Factor	Higher capacity factor 40% vs. Base case is 35%		6.33	5.04
Fuel Costs	20% higher fuel cost projections	5.88	-	-
	20% higher fuel cost projections	4.38	-	-
Financing Costs	1% point higher financing costs: CoE=18%, CoD=9%	-	7.56	6.01
	1% point lower financing costs: CoE=16%, CoD=7% vs. Base case CoE=17%, CoD=8%	-	6.92	5.52

Source: modelling; see Table 8 (Annex A) and "Methodology and Assumptions" document for further details.

4. Modelling of Renewable Energy Promotion in Tunisia

4.5 Sensitivities (Stage 4)

Key Input Assumptions – Solar PV

Table 6: Solar PV summary of LCOE outputs for sensitivity analysis on key input assumptions [EUR cents/kWh]

TYPES OF SENSITIVITY	DESCRIPTION OF SENSITIVITY	BASELINE LCOE	SOLAR PV BAU LCOE	SOLAR PV POST-DERISKING LCOE
Base Case		5.13	7.07	€5.62
Investment and O&M Costs	Higher investment and O&M costs: investment 1,000,000 EUR/MW and O&M costs 19,276 EUR/MW/y Base case 636,627 EUR/MW and 16,065 EUR/MW/y	-	10.71	8.42
Capacity Factor	Higher capacity factor 25% vs. Base case is 19.4%		5.49	4.36
Fuel Costs	20% higher fuel cost projections	5.88	-	-
	20% higher fuel cost projections	4.38	-	-
Financing Costs	1% point higher financing costs: CoE=18%, CoD=9%	-	7.40	5.87
	1% point lower financing costs: CoE=16%, CoD=7%	-	6.75	5.38
	Base case CoE=17%, CoD=8%			

Source: modelling; see Table 9 (Annex A) and "Methodology and Assumptions" document for further details.

4. Modelling of Renewable Energy Promotion in Tunisia

4.6 Comparison to DREI 2014 analysis

- In the year 2014, a DREI analysis was performed for utility-scale solar PV and wind energy in Tunisia.
- The present study is intended to serve as an update to the 2014 study (UNDP, 2014) and to possibly reveal interesting developments in the Tunisian RE investment risk environment

Similarities and key differences

- Significant change in (assumed) RE installation targets (1404 MW wind target in the 2014 study compared to 940 MW in the 2018 study; 736 MW solar PV target vs. 835 MW in this study)
- Capacity factor for wind technology significantly increased assuming strong technology advances
- Capacity factor for solar PV technology dropped slightly
- Relative investment costs for wind only slightly decrease, while relative investment costs for solar PV drop by almost 50%
- Cost of capital (CoE/CoD) increases compared to 2014
- Decrease in natural gas price
- Introduction of an annual degradation rate (only for RE) which didn't exist in the 2014 study
- Effectiveness of some derisking instruments decreased (e.g. power market, grid)

Interpretation and discussion

- Revised RE installation targets have high impact on investment costs per RE as well as public costs
- More unstable environment increases CoE/CoD
- Decrease in the natural gas price has led to a lower baseline LCOE for CCGT
- All the above leads to overall higher LCOEs for wind and solar compared to the 2014 study, compensated in part by projected technology advances
- Decrease in the effectiveness of some instruments likely due to recent experience with the PPA tender, general current political environment in Tunisia

5. Conclusions

- The results in this report should not be interpreted as a definitive quantitative analysis of wind and solar in Tunisia but, rather, as one contribution to the larger policy decision-making process.

- The results confirm that financing costs for wind and solar in Tunisia are currently high, particularly in comparison to countries with more favorable investment environments.
    - The cost of equity for wind and solar PV in Tunisia today is estimated as being 17%, and the cost of debt as 8% .
    - The modelling evaluates three risk categories - power market, counterparty and political risk - contribute more than 1.5% (150 basis points) to higher financing costs (cost of equity).

- The modelling examines the selection and cost-effectiveness of public derisking measures to meet the 2030 investment targets. These public derisking measures, consisting of a collection of policy and financial instruments, systematically target the identified risks. Table 3 itemizes these measures. The modelling also estimates the public cost of these measures (see Tables 8 and 9).

- For wind energy, 2030 investment target: 940 MW, the modelling identifies a targeted set of public derisking measures with an estimated cost of EUR 104 million until 2030. When implemented, this results in the following benefits:
    - Catalyzing EUR 1067 million in private sector investment in wind investment
    - Lowering wind generation costs due to derisking from EUR 7.2 cents to EUR 5.8 cents per kWh
    - Creating economic savings related to derisking of wind of EUR 310 million over 20 years
    - Reducing carbon emissions by 21.6 million tons of CO_2 over 20 years, relative to the baseline

- For solar PV, 2030 investment target: 835 MW, the modelling identifies a targeted set of public derisking measures with an estimated cost of EUR 54 million until 2030. When implemented, this results in the following benefits:
    - Catalyzing EUR 532 million in private sector investment in solar PV investment
    - Lowering solar generation costs due to derisking from EUR 7.1 cents to EUR 5.6 cents per kWh
    - Creating economic savings related to derisking of solar of EUR 150 million over 20 years
    - Reducing carbon emissions by 10.6 million tons of CO2 over 20 years, relative to the baseline

- In conclusion, the modelling clearly shows that investing in public derisking measures should in every case be more cost-effective for Tunisia, compared to an alternative of paying higher generation costs.

Annex A: Summary Modelling Assumptions Table

Table 7: Summary modelling data and assumptions for Wind Energy and Solar PV in Tunisia

Targets and Country Inputs	
Wind Energy	
2030 Target (in MW)	940
Capacity Factor (%)	35%
Total Annual Energy Production for Target (in MWh)	2,882,040
Solar PV	
2030 Target (in MW)	835
Capacity Factor (%)	19.4%
Total Annual Energy Production for Target (in MWh)	1,419,032
MARGINAL BASELINE	
CCGT	100%
Grid Emission Factor (tCO_2e/MWh)	0.374
GENERAL COUNTRY INPUTS	
Effective Corporate Tax Rate (%)	25%
Public Cost of Capital (5)	7%

Financing Costs (Wind Energy and Solar PV)	**Business-As-Usual Scenario**	**Post-Derisking Scenario**
Capital Structure		
Debt/Equity Split	30%/70%	27.5%/72.5%
Cost of Debt		
Concessional Public Loans	N/A	4%
Commercial loans with public guarantees	N/A	N/A
Commercial loans without public guarantees	8%	5.8%
Loan Tenor (in years)		
Concessional Public Loans	N/A	20 years
Commercial loans with public guarantees	N/A	N/A
Commercial loans without public guarantees	11 years	12 years
Cost of Equity	17%	13.0%
Weighted Average Cost of Capital (WACC) (after tax)	9.3%	6.4%

Source: modelling; see “Methodology and Assumptions” document for further details.

Annex A: Summary Modelling Assumptions Table, Cont.

Table 8: Summary modelling data and assumptions for Wind Energy in Tunisia

Investment (Wind Energy)	Business-As-Usual Scenario	Post-Derisking Scenario
Total Investment (EUR million)	**1,067.4**	**1,067.4**
Debt (EUR million)		
Concessional Public Loans	0.0	232.2
Commercial loans with public guarantees	0.0	0.0
Commercial loans without public guarantees	747.2	541.7
Total	**747.2**	**773.9**
Equity (EUR million)	**320.2**	**293.5**
Cost of Public Instruments (Wind Energy)		
Policy Derisking Instruments (EUR million, present value)		
Power Market Risk Instruments	5.1	5.1
Permits Risk Instruments	1.3	1.3
Social Acceptance Risk Instruments	N/A	0.8
Developer Risk Instruments	N/A	0.7
Grid/Transmission Risk Instruments	N/A	1.3
Counterparty Risk Instruments	N/A	1.2
Financing Risk Instruments	N/A	0.8
Total	**6.4**	**11.2**
Financial Derisking Instruments (EUR million, present value)	N/A	12.1
Grid/Transmission Risk Instruments	N/A	13.9
Counterparty Risk Instruments	N/A	N/A
Financing Risk Instruments	N/A	58.0
Public Loans	N/A	N/A
Public Guarantees for Commercial Loans	N/A	N/A
Political Risk Instruments	N/A	8.5
Currency/Macro Risk Instruments	N/A	**92.5**
Total		
Direct Financial Incentives (EUR million)		
Present Value of 20 year PPA Premium	**442.5**	**132.7**

Annex A: Summary Modelling Assumptions Table, Cont.

Table 9: Summary modelling data and assumptions for Solar PV in Tunisia

Investment (Solar PV)	Business-As-Usual Scenario	Post-Derisking Scenario
Total Investment (EUR million)	**531.6**	**531.6**
Debt (EUR million)		
Concessional Public Loans	0.0	115.6
Commercial loans with public guarantees	0.0	0.0
Commercial loans without public guarantees	372.1	269.8
Total	**372.1**	**385.4**
Equity (EUR million)	**159.5**	**146.2**
Cost of Public Instruments (Solar PV)		
Policy Derisking Instruments (EUR million, present value)		
Power Market Risk Instruments	4.0	4.0
Permits Risk Instruments	1.0	1.0
Social Acceptance Risk Instruments	N/A	0.6
Developer Risk Instruments	N/A	1.1
Grid/Transmission Risk Instruments	N/A	1.0
Counterparty Risk Instruments	N/A	0.9
Financing Risk Instruments	N/A	0.7
Total	**5.0**	**9.3**
Financial Derisking Instruments (EUR million, present value)	N/A	5.8
Grid/Transmission Risk Instruments	N/A	6.7
Counterparty Risk Instruments	N/A	N/A
Financing Risk Instruments	N/A	28.9
Public Loans	N/A	N/A
Public Guarantees for Commercial Loans	N/A	N/A
Political Risk Instruments	N/A	4.1
Currency/Macro Risk Instruments	N/A	**45.5**
Total		
Direct Financial Incentives (EUR million)		
Present Value of 20 year PPA Premium	**200.6**	**50.5**

Annex B: Derisking Table, Part I

Table 10: Derisking table for utility-scale Wind Energy and Solar PV in Tunisia, Part I

BARRIERS				PUBLIC INSTRUMENTS			
				Policy Derisking Instruments		Financial Derisking Instruments	
Risk Category	Description	Underlying Barriers	Key Stakeholder Group	Activity	Description	Activity	Description
1. Power Market Risk	Risk arising from limitations and uncertainties in the energy market, and/or sub-optimal regulations to address these limitations and promote energy markets and access to it	*Market access and prices:* limitations related to energy market liberalization; uncertainties related to access, the competitive landscape and price outlook for renewable energy; limitations in design of standard PPAs and/or PPA tendering procedures	Power sector policymakers, legislators, regulators	Establish a harmonized, well-regulated energy market, with cornerstone instruments to address price and market-access risk for renewable energy projects	(i) Ongoing legislative reform to implement well-designed and harmonized policies; (ii) establish an independent energy market regulator; (iii) Further Implement PPA tendering*, including well-designed standard PPA		
		Market distortions: such as high fossil fuel subsidies		*Policy derisking instruments addressing this barrier, e.g. ongoing fossil fuel subsidy reform are not included in this analysis. Outside scope of analysis*			
2. Permits Risk	Risk arising from the public sector's inability to efficiently and transparently *administer* renewable energy- related licensing and permits	*Bureaucracy:* Labour-intensive, complex processes and long time-frames for obtaining licences and permits (generation, EIAs, land title) for renewable energy projects	Public sector administrators	Streamline processes for permits	Establish a one-stop-shop for renewable energy permits; reduction of process steps; clear timelines for processing; harmonisation of requirements		
		Transparency: Perceived corruption. No clear recourse mechanisms		Contract enforcement and recourse mechanisms	Enforce transparent practices and fraud avoidance mechanisms; establish effective recourse mechanisms, with clear timelines for resolution		
3. Social Acceptance Risk	Risks arising from lack of awareness and resistance to renewable energy from end-users, special interest groups	*Awareness* : Lack of awareness of renewable energy amongst key stakeholders including: end-users, local residents and special interest groups (e.g. unions)	End-users, general public, media, special interest groups	Awareness-raising campaigns	Implement active publicity, media and awareness campaign targeting key stakeholder groups		
		Resistence: Social and political resistance related to NIMBY concerns, special interest groups		Promote community based projects	Establish favourable local (e.g. municipal) policies and pilot community owned renewable energy projects); assist in establishing appropriate legal vehicles for community models		
4. Resource & Technology/ Developer Risk	Risks arising from use of the renewable energy resource and technology (resource assessment; construction and operational use; hardware purchase and manufacturing)	*Resource assessment and supply* : inaccuracies in early-stage assessment of renewable energy resource ; where applicable (e.g. bioenergy), uncertainties related to future supply and cost of resource	Project developers, supply chain	For wind energy only: assistance on resource assessment	For wind energy only: dissemination of national resource assesment findings		
		Planning, construction, operations and maintenance: uncertainties related to securing land; sub-optimal plant design; lack of local firms offering construction, maintenance services; lack of skilled and experienced local staff; limitations in civil infrastructure (roads etc.)		Technology support and O&M assistance	Industry conferences; grant funding for pre-feasibility studies (depending on technology); training, apprenticeships and university programmes to build skills (planning, construction, O&M)		
		Purchase of hardware : purchasers' lack of information on quality, reliability and cost of hardware; lack of suitability of hardware to local climatic and physical conditions		For solar PV only: research and development into technology standards	For solar PV only: Support to pilot projects on solar PV in desert environments		

* Note: This instrument can be/have elements of a direct financial incentive

Source: authors; adapted from Derisking Renewable Energy Investment (Waissbein et al, 2013) and updated from DREI Tunisia 2014 study (UNDP, 2014).

Annex B: Derisking Table, Part II

Table 10: Derisking table for utility-scale Wind Energy and Solar PV in Tunisia, Part II

BARRIERS				STUDY'S PUBLIC INSTRUMENTS			
				Policy Derisking Instruments		Financial Derisking Instruments	
Risk Category	Description	Underlying Barriers	Key Stakeholder Group	Activity	Description	Activity	Description
5. Grid/ Transmission Risk	Risks arising from limitations in grid management and transmission infrastructure	*Grid code, management and connection:* Lack of standards for the integration of intermittent, renewable energy sources into the grid; limited experience or suboptimal track-record in grid management and stability; lack of responsiveness and delays in connection of new renewable energy sources to the transmission network	Transmission/ grid operator (utility)	Strengthen transmission operator's operational performance, grid management and formulation of grid code	(i) Develop a grid code for new renewable energy technologies; (ii) sharing of international best practice in grid management; (iii) capcacity building for the supervision centre to organise/ control dispatching	Include a "take-or-pay" clause in the standard PPA	"Take-or-pay" clause in PPA whereby an IPP is reimbursed for grid failure (black-out, brown-out) and/or curtailment (due to mismatches in grid management of supply/demand)
		Transmission infrastructure: inadequate or antiquated grid infrastructure, including high transmission losses, and lack of lines from the renewable energy source to load centres; uncertainties for construction of new transmission infrastructure		Policy support for national grid infrastructure planning and development	Develop and regularly update a long-term national transmission/grid plan to include intermittent renewable energy	*Financial derisking instruments addressing this barriers, e.g. public loans for grid infrastructure, are not included in this analysis. Outside scope of analysis.*	
6. Counterparty Risk	Risks arising from the utility's poor credit quality and an IPP's reliance on payments	Limitations in the utility's credit quality, corporate governance, management and operation track-record or outlook; unfavourable policies regarding the utility's cost-recovery arrangements	Utility	Strengthen the utility's performance	Establish international best practice in the utility's management, operations and corporate governance; implement sustainable cost recovery policies	Government guarantees or backing for PPA payments	Government (Ministry of Finance) letter of support for PPA payments to IPPs
7. Financial Risk	Risks arising from general scarcity of investor capital (debt and equity) in the particular country, and investors' lack of information and track record in utilty-scale renewable energy	*Capital scarcity:* Limited availability of local or international capital (equity/and or debt) for green infrastructure due to, for example: under-developed local financial sector; policy bias against investors in green energy	Investors (equity and debt)	Domestic financial sector reforms	Promote domestic financial sector policy favourable to long-term infrastructure, including project finance	Financial products by development banks to assist project devekioers to gain access to capital/funding	Public loans from international financial institutions to IPPs
		Limited experience with renewable energy : Lack of information, assessment skills and track-record for renewable energy projects amongst investor community; lack of network effects (investors, investment opportunities) found in established markets; lack of familiarity with project finance structures		*Policy derisking instruments addressing this barriers, e.g. sponsoring industry conferences, are not included in this analysis, following investor feedback.*			
8. Currency/ Macro-economic Risk	Risks arising from the broader macroeconomic environment and market dynamics	*Uncertainty due to volatile local currency*; unfavourable currency exchange rate mouvements	National level			Risk sharing to address currency risk	Partial indexing of local currency tariffs in PPAs, so that IPPs are reimbursed for local currency depreciation of tariff
		Unertainty around inflation , interest rate outlook due to an unstable macroeconomic environment					
9. Political Risk	Risk arising from a mix of cross-cutting political, economic, institutional and social characteristics in the particular country which are not specific to utility-scale renewable energy	*Limitations and uncertainty* related to conflict, political instability, economic performance, weather events/natural disaster, legal governance, ease of doing business, crime and law enforcement, and infrastructure in the particular country	Macro risk			Financial derisking instruments addressing this category, e.g. , political risk insurance, are not included in this study, given its non applicability in the Tunisian context	
		Uncertainty due to high political instability; poor governance; poor rule of law and institutions					
		Uncertainty or impediments due to government policy (currency restrictions, corporate taxes)					

Source: authors; adapted from Derisking Renewable Energy Investment (Waissbein et al, 2013) and updated from DREI Tunisia 2014 study (UNDP, 2014).

Annex C: Key Modelling Assumptions

- The studies methodology and assumptions are set out fully in the separate "Methodology and Assumptions" document.
- The following key issues associated with the modelling merit highlighting:
  - **Variability**. An inherent characteristic of wind energy and solar PV is their variability and lack of flexible dispatchability. Energy planners typically need to balance such renewable energy technologies with dispatchable capacity, and LCOE-based comparisons using variable energy sources can have limitations in not capturing this balancing cost, nor generation costs at peak demand. The modelling does not include balancing costs. The targets for private sector investment into utility-scale wind parks and solar PV farms would account for less than 6% of Tunisia's projected electricity and heat demand in 2030. However, together with small-scale renewable energies and projects built by STEG, the share of intermittent renewables might be considerably higher by 2030.
  - **Transmission Lines**. In order to keep the modelling manageable, the modelling assumes that all the wind energy and solar PV sites to meet the envisioned 2030 investment target are within 10 km of the existing grid. Capital costs related to the upgrade and maintenance of the grid infrastructure in Tunisia are excluded from the analysis.
  - **Baseline approach.** A 100% build margin is used, in line with the DREI Tunisia (2014) analysis. That is, we assume that due to the projected high growth in electricity demand, capacity expansions are mandatory. Hence, the modelling compares LCOE's for newly installed capacity of conventional technologies with renewable technologies. It is assumed that no conventional power plant will be shut down prematurely in favour of renewable energy generation. A private sector perspective to baseline investment is used and as such private sector financing costs are modelled. This reflects the fact that Tunisia is seeking to attract private-sector investment irrespective of energy technology. At least, it is assumed that newly installed conventional capacity in Tunisia would be comprised of 100% combined cycle gas turbine plants, because this is the most favourable technology in the Tunisian context. Accordingly, a baseline grid emission factor of 0.374 tCO_2e/MWh is assumed.
  - **Unsubsidized baseline fuel costs.** Fuel costs have been extrapolated using the latest gas price projections by the World Bank, starting from 16 EUR/MWh of gas excl. VAT in 2018. This starting point is in good agreement with the actual gas price for Tunisian large consumers who do not profit from subsidies (ca. 17 EUR/MWh excl. VAT in 2015, as published by STEG). Hence, the baseline LCOE modelling assumes unsubsidized fuel cost. More generally, it is to be noted that issues of subsidization of existing power generation in Tunisia, whether via subsidies on imported gas, or non-cost-reflective tariffs, are outside the scope of this exercise and have not been captured in the modelling.
  - **Installed costs and O&M costs for renewable energy**. The assumptions for the installed costs (i.e. the cost of hardware, such as wind turbines and solar panels) and for the operations and maintenance (O&M) costs have particular potential for improving the overall competitiveness of wind energy and solar PV in Tunisia. Globally, the costs of renewable energy hardware have been falling consistently over time, and they are expected to continue to do so. The same is true for O&M costs, which is partly due to technology improvements and better forecasting, and partly also due to the increasing competition for O&M contracts as the number of service providers keeps growing. This study assumes installed and O&M costs for onshore wind energy and solar PV expected to prevail at the end of the year 2023, i.e. the year that reflects the mid-point of the modelling period 2017-2030. The 2023 cost estimates are derived from the latest projections elaborated by the International Renewable Energy Agency and published in June 2016 (IRENA, 2016). The projections for Solar PV installed costs have been reduced by 15% to account for the rapid cost reductions observed as of today (May 2018) in the utility-scale solar PV sector worldwide.

Annex D: Acronyms

AFD	Agence Française de Développement
ANME	Agence Nationale pour la Maitrise de l'Energie
CCGT	Combined cycle gas turbines
CoD	Cost of Debt
CoE	Cost of Equity
DREI	Derisking Renewable Energy Investment
EBRD	European Bank for Reconstruction and Development
EIU	Economist Intelligence Unit
EU	European Union
EUR	Euro
FiT	Feed-in-Tariff
GEF	Global Environment Facility
GIZ	German Corporation for International Cooperation
GDP	Gross Domestic Product
HDI	Human Development Index
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
LCOE	Levelized cost of electricity
MW	Megawatt
NAMA	Nationally Appropriate Mitigation Action
N/A	Not applicable
NDC	Nationally Determined Contribution
O&M	Operation & Maintenance
PPA	Power Purchase Agreement
PPP	Purchasing Power Parity
RE	Renewable energy
STEG	Société Tunisienne de l'Eléctricité et du Gaz
TSP	Tunisian Solar Plan
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar
WACC	Weighted average cost of capital
WB	World Bank

Annex E: References

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Appendix F: Acknowledgements

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