Analysis of key factors for successful auction programs: experiences outside of Europe

Massimiliano Tarantino,
Head of Business Development Middle East
Agenda

✓ RES Market overview
✓ A typical Tender process
✓ Main characteristics of a Tender:
  • Project selection
  • Financing
  • Awarding mechanism
✓ Tender agreements
Feed in tariffs have initially boosted a critical mass of RES investments. Due to the recent success of competitive market-based mechanisms, RES costs have dropped. The bulk of subsidy programs is expected to cease to operate from 2020.
## RES Market overview

### Feed In Tariffs vs. Auctions

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Attractive even for <strong>low-risk investors</strong></td>
<td>✓ No meritocratic approach</td>
</tr>
<tr>
<td>✓ Impressive <strong>capacity boost</strong> generated by this solution</td>
<td>✓ <strong>Wrong tariff setting</strong> can lead to RES under- or over-development vs. target</td>
</tr>
<tr>
<td>✓ Simple structure, applicable to mass market technologies: E.g. <strong>decentralize energy</strong></td>
<td>✓ <strong>Limited adaptability</strong>: in case of technology rapid evolution, many changes required</td>
</tr>
<tr>
<td></td>
<td>✓ In case of large premium offered, <strong>high system cost</strong></td>
</tr>
<tr>
<td>✓ Effective use of <strong>budget</strong></td>
<td>✓ <strong>Risk of not prequalified players</strong> to under-bid disrupting competition</td>
</tr>
<tr>
<td>✓ <strong>Specific capacity targets</strong> can be set in short span of time</td>
<td>✓ Remuneration value strongly linked to <strong>competition level</strong></td>
</tr>
<tr>
<td>✓ <strong>Meritocratic mechanism</strong> with cheapest and higher quality projects selected</td>
<td>✓ <strong>Not pre-defined</strong> when a player decides to enter</td>
</tr>
<tr>
<td>✓ <strong>Learning effect</strong> over time for both parties</td>
<td>✓ <strong>Not</strong> adequate for <strong>small size</strong> projects</td>
</tr>
</tbody>
</table>

**Feed in Tariffs**

- e.g.:
  - Italy (till 2012)
  - Germany
  - Greece

**PPA through Auctions**

- e.g.:
  - Brazil
  - South Africa
  - Mexico

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### Two different approaches to develop renewables were selected globally with substantial different effects on the national energy systems
Tenders are spreading worldwide

Prices are bottoming because of increasing competition

Source: Bloomberg New Energy Finance
Technology improvements and competition are pushing down module and turbine costs

Renewables from alternative to mainstream generation sources

Source: Bloomberg New Energy Finance
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✓ Tender agreements
Stimulate private development of renewables project

Encourage foreign investment

Channel renewables private sector expertise

Develop socio-economic and sustainable growth

Boost capacity growth

Reduce long term generation cost

Tender process
Long term Governmental Program

Advantages
Tender process
From Expression of Interest to Bid Submission

1. Expression of Interest

2. RFQ sent to the Market

3. Interested firms, consortia, or SPVs submit experience and financial capacity details

4. The Authority assesses and defines a short list of firms based on published criteria

5. Draft RFP sent to short-listed firms for comments

6. Consultation process

7. RFP sent to short-listed firms

8. Explanation and Clarification Meetings

9. Site Selections: Site visits; Feasibility/Basic Design; Financing arrangements

10. Bidders submit proposals: Technical and commercial proposal; Financial proposal; Bid Bond
Tender process
Technical, commercial and financial proposal

• Bidders submit **Technical Proposals**, showing main technical aspects of the project;

Bidders provide:
• **commercial information** on the projects, **information on financial ability** to realize the project;
• Bidders declare **local content** of proposal
• Proposals assessed using **minimum “technical evaluation criteria”** (suppliers track record, local content, technical design aligned with RFP requirements etc.)
• **Technical scoring** contributes to final Bidders ranking.

Financial Criteria can be very simple:
• Bidder proposing for **lowest tariff**
• Bidder to explain the **main assumptions** behind the proposed tariff and relevant economic impact
<table>
<thead>
<tr>
<th>Guarantee</th>
<th>Set-up day</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid bond</td>
<td>Bid Submission</td>
<td>0,3 M USD</td>
<td>12 months</td>
</tr>
<tr>
<td>Performance Bond</td>
<td>Awarding date</td>
<td>1,5 M USD</td>
<td>From awarding date to Financial Close</td>
</tr>
</tbody>
</table>

Bidders exposure after Bid Submission
Ethiopia – Metehara 100 MW PV Tender

Guarantees to be provided

- **Bid Bond (0,3 M USD)**
- **Performance Bond (1,5 M USD)**

* Text taken from the first draft of the Form of Bid Proposal Security, included in the RfP.
# Bidders exposure after Bid Submission

**Zambia – Scaling Solar Tender 2x50MW r1**

<table>
<thead>
<tr>
<th>Guarantee</th>
<th>Set-up day</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid bond per 2 projects</td>
<td>Bid Submission</td>
<td>1.3 MUSD</td>
<td>6 months</td>
</tr>
<tr>
<td>Decommission Bond</td>
<td>one year before the PPA termination</td>
<td>4.4 MUSD (100 kUSD/MWp)</td>
<td>2 years: from 1y prior to the expiry of PPA to 1y after the expiry of PPA</td>
</tr>
<tr>
<td>Performance Bond</td>
<td>PPA</td>
<td>15 MUSD</td>
<td>26 years: from PPA effective date to 210 days after COD</td>
</tr>
<tr>
<td>Credit Support Letter</td>
<td>NTP</td>
<td>Amount equal to the Investor’s Equity</td>
<td>~ 1 year: from signing of SHA to COD</td>
</tr>
</tbody>
</table>

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**Timeline:**

- **10/03/2015**: RFP publication
- **10/03/2016**: Pre-Bid conference and Site Visit
- **08/04/2016**: Bid Submission
- **06/05/2016**: Opening of Financial Proposals
- **20/05/2016**: Bid Award
- **03/06/2016**: Signing of PPA and GSA
- **10/06/2016**: Signing of SHA
- **03/05/2017**: COD
- **02/2042**: Decommissioning

---

- **Guarantees to be provided**
  - Bid Bond (1,3 M$)
  - Performance Bond (15 M USD)
  - Decommissioning Bond (100K$ /MWp)
  - Credit Support Letter
### Bidders exposure after Bid Submission

Kingdom of Saudi Arabia – AlJouf and Rafha PV Tender

<table>
<thead>
<tr>
<th>Guarantee</th>
<th>Set-up day</th>
<th>Amount</th>
<th>Duration</th>
<th>Case of Bond withdrawn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bid Bond</strong></td>
<td>Bid Submission</td>
<td>5.3 MUSD</td>
<td>9 months + 21 days (to be replaced by Development Security at PPA signature)</td>
<td>a) Bidder withdraws its Proposal during the Validity Period; b) Bidder is awarded and:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- fails to enter into any or all of the Project Agreements or fails to execute them;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- breaches its obligations under the PDA;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- does not provide the Development Security.</td>
</tr>
<tr>
<td><strong>Development Security</strong></td>
<td>PPA</td>
<td>12 MUSD</td>
<td>Until COD</td>
<td>- the Project Company fails to satisfy all Conditions Precedent to the Closing Date within the Scheduled Closing Date (i.e. 90 days from the PPA Effective Date);</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- the Project Company fails to pay any LDs payable pursuant to the terms of the PPA;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- the Project Company does not comply with the insurance obligations under the PPA;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- the Project Company fails to extend the duration of the Development Security upon a notice from SEC within 14 days from the notice or 30 days prior to the expiration of the Bond, in case of delay in the scheduled COD.</td>
</tr>
</tbody>
</table>

---

**Guarantees to be provided**

- **Bid Bond** 5 MUSD
- Al Jouf Development Security 9.6 MUSD
- Rafha Development Security 2.4 MUSD
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Main characteristics of a Tender

Auction types

- Project selection
  - Bidder selects
  - Tenderer designates

- Local content
  - No requirement
  - Mandatory minimum (ON/OFF)

- Local ownership
  - No requirement
  - Mandatory minimum (ON/OFF)

- Financing
  - Same facilities available to all bidders
  - Bidder selects

- Revenue stream
  - Fixed revenue stream
  - Currency electives
  - Inflation electives

- Exit mechanics
  - Lock-up periods
  - Free disposal
  - Main sponsor PPA lockup
Project Selection
Preselected site and connection

- Site specific information are provided to the Bidders by the authority in the RFP:
  - boundary coordinates of the site area including CAD files;
  - grid connection solution including details on connection works, costs and responsible party;
  - geotechnical, hydrological and topographical reports;
  - site specific road map of permits, including timeline and responsible party;
  - resource measurement data (at least 12 months for wind plant).
- Bidders are allowed to perform site visit
- Bid Submission is usually 3-4 months after RFP issuing
Project Selection
Site and connection to be selected by Bidders

- Bidders are required to develop their own projects:
  - define the site boundaries;
  - obtain land permits;
  - find grid connection solution including details on connection works, costs and responsible party;
  - obtain all required permits for bid submission (as for RFP requirements) and for PV Plant construction;
  - perform at least 12 months of measurement campaign (for wind projects);

- RFP or a Renewable Governmental Program is published at least 12 months before Bid Submission.

South Africa: Tom Burke PV Plant
Financing

Different options

The National Bank offers financing for RES projects at very attractive conditions, no comparable with other sources of financing. The level of financing that can be obtained depends on the % of LC (Brazilian case)

Bank Termsheet included in RFP

Same facilities available for all the Bidders (Zambian case)

Financing solution to be selected by each Bidder (South African case)

Bank scouting by each Bidder in order to find optimal solutions.

<table>
<thead>
<tr>
<th>Crystalline Silicon</th>
<th>PV Module</th>
<th>Only Basic Items</th>
<th>60%</th>
<th>40%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PV System</td>
<td>Only Basic Items</td>
<td>56%</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic items + National inverter</td>
<td>76%</td>
<td>64%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ZAR</th>
<th>Short term debt (commercial banks)</th>
<th>Leverage</th>
<th>Tenor</th>
<th>Interest rate</th>
<th>DSCR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[ ] To be selected by each Bidder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bank scouting by each Bidder in order to find optimal solutions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ZAR</th>
<th>Medium term (DFIs)</th>
<th>Leverage:</th>
<th>Tenor</th>
<th>Interest rate</th>
<th>DSCR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USD</th>
<th>Long term</th>
<th>Leverage:</th>
<th>Tenor</th>
<th>Interest rate</th>
<th>DSCR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
5 Stages evaluation process

1. Evaluation of Responsiveness
   (documentation completeness and compliance with min technical and commercial info required like COD, project layout, contracted capacity, generation forecast, availability)

   Responsive Bid Proposals¹ shall be assessed on a total score of 100 marks

2. Evaluation of Technical and Commercial Proposal

3. Evaluation of Financial Responsiveness
   (compliance with min financial info required like financial model, price, cost data, USD denomination)

4. Evaluation of Financial Proposal

5. Successful Bidder selection

   Score (Max = 100 )

   70

   Criteria

   Price

   10
   Technical Capability and Bidder’s Experience

   5
   Track Record of Module

   5
   Track Record of Inverter

   Local Content in CAPEX
   (mandatory minimum threshold: 15% (0 points), max score (5 points) if >35%)

   Local Ownership
   (max score (5 points) if >10%)

1. The Bid Proposal is valid for 365 days from the Bid Submission Date
2. 21 points is the threshold to be a Technical Qualifying Bidder and qualify for the third stage of the evaluation process
A-Tariff Evaluation-Primary Ranking Criteria

Levelized Electricity Cost (SAR/MWh) = \[
\frac{NPV_p}{NPV_E} = \frac{[NPV_{\text{Total Payments}} (Al Jouf + Rafha) for net electricity of SEC to Company (SAR)]}{[NPV of net electricity assumed to be delivered (Al Jouf + Rafha) (MWh)]}
\]

B-Secondary Evaluation Criteria (No Scoring mechanism is defined for this criteria)

• Saudization: Saudi Arabian content of goods and services used in the construction and O&M. The developer will be liable for the custom duties and no 'increased costs' or similar indemnity will be given by SEC if a Project Company fails to obtain a customs duty exemption in respect of equipment/materials that can be sourced in Saudi Arabia; participation of Saudi Arabian nationals in O&M; and long term training plan for KSA nationals

• Level of project development (degree of development of project design and engineering, completeness of proposed EPC and O&M arrangements)

• Financial Criteria (timing and amount of equity funding, level of committed facilities, proposed financial structure, terms and conditions of the committed facilities and degree of commitment of financing parties, completeness of term sheet, proportion of energy charge rate not indexed to USD)

• Mark-up of the draft agreements

• Technical Aspects (use of national and international standards, technical performance, local content, environmental impacts, operating characteristics. Adequacy of cost estimate)

• Practicability of project implementation schedule
In RES sector South African government is attempting to address social issue. Local content is pushed by tender rules but it is up to investors to decide where and what
The REIPPP contribution to national objectives
Evidence from the South African government*

• The program has been designed to contribute to the development of a local green industry and creation of green jobs

• A total of ~ 2.13 Bn USD local content spend has been achieved in IPP programs up till the end of March 2016

• At least twelve new industrial facilities have been established in the country in direct response to the renewable energy program

• Since the IPP program started, a significant increase of South African based product exports can be observed on the export data as reported by South African revenue services

• Although coming off a low base, these exports create and sustain valuable jobs as well as to contribute to the country’s foreign reserves – crucial in the current economic climate

* Data includes BW 1, 2, 3, 3.5, 4 and smalls totaling 6376 MW procured. Source: South Africa Energy Department, exchange rate ZAR/US$ used as of 15 December 2016, 1 ZAR = 0.0708849 USD
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## Tender Agreements

<table>
<thead>
<tr>
<th>Signing Parties</th>
<th>Duration</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PPA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Project Company</td>
<td>25y from COD, with possibility of extension</td>
<td>Purchase of power by Buyer from the Project Company based on agreed prices and conditions</td>
</tr>
<tr>
<td>• Buyer</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GSA</strong>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Project Company</td>
<td>The same of PPA</td>
<td>Providing assistance, support and certain concessions to the Project Company including guarantees related to the Seller obligations, with particular reference to the liquidity support balance</td>
</tr>
<tr>
<td>• Government</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SHA</strong>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Bidder</td>
<td>The same of PPA</td>
<td>Define the terms of conduct and development of the business</td>
</tr>
<tr>
<td>• Governmental SPV</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lease Agreement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Project Company</td>
<td>The same of PPA</td>
<td>Grant access rights and use of the property</td>
</tr>
<tr>
<td>• Lessor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* GSA: Government Support Agreement
**SHA: Shareholders’ Agreement
Tender Agreements
Key points for a bankable PPA

- **Energy charge currency:** Energy charge paid in US $ or in local currency equivalent of the amount payable in US $ (based on the relevant date of payment as notified by the Central Bank on the day before such payment is made).

- **Energy charge Indexation:** adjusted annually to US or local CPI.

- **Liquidity Guarantee:** provide a liquidity support mechanism, such as an escrow account or an on-demand guarantee issued by acceptable bank, based on foreign currency, to be used in case of Buyer's insolvency or any other Buyer's event of default.

- **Compensation on termination in case of Buyer’s default:** in case of termination for a Buyer's event of default, the Buyer shall provide a termination payment to compensate the Seller’s debt, equity and taking into account the expected return on investment. The amount to be valued by a reputable Independent Third-party Evaluator agreed by the Parties.

- **Change in Law and economical contest:** include provisions of price adjustment in the case of law, tax regime or economical contest changing after the date of the effective date of the PPA, adversely affecting the expected return on investment.

- **Expert:** an independent person, with appropriate qualifications and experience, to be nominated either by the parties or by the International Centre for Expertise of the International Chamber of Commerce that in case of disputes.

- **Arbitration:** any dispute (not resolved thought an Expert determination) to be solved under rules generally acceptable to the International Community (e.g. UNICATRAL or ICC), the seat or place of arbitration shall be London or Paris or Zurich.
Tender Agreements
Key points for a bankable PPA

PPA:

- **Deemed energy payment**: payments of deemed energy to be guaranteed whatsoever in case of COD delays due to the Buyer, Curtailment and post COD Grid Unavailability (both planned and forced).

- **Force Majeure**: to excuse the Seller from performing its obligations if a Force Majeure Event (an event beyond the reasonable control of such Party) prevents such performance.

- **Term**: the duration of the PPA shall be 25 years, extendible.
Tender Agreements
Key points for Government Support Agreement

- **Liquidity Guarantee**: Government to ensure the liquidity support mechanism by topping up the escrow account or the on-demand guarantee, in case of Buyer’s default;

- **Coverage for Buyer’s default**: Government to ensure, in case of Buyer’s default, the payment of the Compensation on Termination;

- **Conversion Guarantee**: Government to procure the free transfer of funds (whether within the Country or cross border) of local currency or US Dollars and permit the conversion of local currency into US Dollars on market terms and make US Dollars available for conversion upon request;

- **Development rights and support**: Government to ensure the right to develop the project and benefit of land rights and facilitate the liaise with Government Related Parties;

- **Seller costs**: In case the PPA Effective Date is not met due to Buyer breach, the Seller Costs shall be reimbursed by the Government.
Tender Agreements
Key points for Shareholders’ Agreement

- **Governance**: SPV Board of Directors to be defined in accordance with law and shares ownership in order to catch benefit coming from all the shareholders’;

- **Dividend distribution policy**: dividends to be distributed according with law and with resolutions of SPV Board of Directors’ decisions on a pro-rata basis;

- **Construction funding**: each Shareholder shall take all actions required in order to ensure that the project is funded through to completion including strategy funding;

- **Governing law**: the Shareholders’ Agreement and any non-contractual obligations arising out of or in connection with it shall be governed by and construed in accordance with international law approved by International Funding Institutions;

- **Shares transferring, Shareholder Reserved Matters and Anticorruption Closes**: to be clearly defined.
Closing Remarks
Auctions
Best practices and lessons learnt

Structured pre-qualification helps to assign remuneration to solid projects and investors
- Tools to filter out speculators: upfront commitments (bid bond), penalties in case of project delays, constraints on project property before commercial operations
- Important to predict unfair competitive behaviors (e.g. ways to by-pass pre-qualification criteria)

Guarantees on energy offtake are a critical aspect, in particular for project bankability
- Long term PPAs (either with regulator or private) a key requirement from financial institutions; energy sales towards spot market without hedging are too volatile for such projects
- Critical to boost RES PPA market, either via quota obligations or auctions, with capacity targets aligned with available project pipeline

Local content constraints should be set consistent with local ability to provide service
- High local content target implies buying locally equipment with strong effect on performance
- Local content requirements can be balanced-off by incentivizing other items of the investors' cost structure (e.g. financing, fiscal)
- **Brazilian National Bank offers favorable financing (low interest rates) if 60% local content is achieved**

Communication with players when setting rules and during implementation a success factor
- So. Africa had frequent consultations when designing auctions, direct channels during auctions
The dramatic drop in technology costs and efficiency increase is turning renewables from alternative to mainstream generation sources.

RE prices are bottoming also because of increasing competition.

A well-planned tender with well-defined capacity installation program over the years in order to make the country attractive to foreign investors - Clear Instructions to bidders and selection criteria based on predefined scoring tables.

Bankable PPA (including third party guarantee, liquidity guarantee, adequate compensation on termination in case of buyer’s default, etc.) is crucial to foster competitiveness.
BACK UP
3 main criteria to select new countries

1) Abundance of resources for Wind, Solar, Hydro and Geo

2) Favorable macro-economic conditions and growing electricity demand

3) Reliable legal framework and predictable regulatory development

High Value Creation Country/Tech Cluster

Country A | Country B | Country C
---|---|---
✓ | ✓ | ✓

Attractive Country

NOT Attractive Countries
**Strengths of Renewable Technologies**

1) RES technologies are more and more **competitive**. In case of abundant resource they can compete with fossil fuel generation.

2) RES have a shorter construction time, and offer a **fast and flexible response to growing demand**.

3) RES are modular and their flexibility allows the **reduction of costs thanks to scale economies**.

4) Investment in RES can create **new local jobs** from the preliminary phase of studies (when engineers, surveyors and local specialist are requested) to the construction and the maintenance phases.

5) **RES mitigate the energy dependency and contribute to secure the energy supply**, reducing the exposure of power prices to commodities market fluctuations.

6) RES are a **environmentally-friendly** option to solve air and water pollution issue and to fight the climate change.
Where does the renewable escalation come from?
The improvement of wind technologies

- **Bigger turbines** (more MW/wtg) in the first phase of the technology evolution have led to an increase of the capacity factor (more MWh/wtg) in the second phase

- **Increased efficiency** has contributed to LCOE decrease

- Nowadays we are able to increase the power 3 times in comparison to an “old” wind farm site, reduce the numbers of turbines to 1/8 and to multiply the energy produced by 5 times

<table>
<thead>
<tr>
<th>15 years ago</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Power (kW)</td>
<td>300</td>
</tr>
<tr>
<td>Rotor Diameter (m)</td>
<td>30</td>
</tr>
<tr>
<td>Hub height (m)</td>
<td>30</td>
</tr>
<tr>
<td>Power Control</td>
<td>Stall</td>
</tr>
<tr>
<td>Rotor spin (r.p.m.)</td>
<td>34</td>
</tr>
<tr>
<td>Occupation (MW/km)*</td>
<td>3.3</td>
</tr>
<tr>
<td>WTG Units (WF 50 MW)</td>
<td>167</td>
</tr>
<tr>
<td>Grid connection features</td>
<td>no</td>
</tr>
<tr>
<td>Energy Yield increase (%)*</td>
<td>-</td>
</tr>
</tbody>
</table>

* Production factor increase with respect to an old site of the same capacity
Where does the renewable escalation come from?

The improvement of solar technologies

- **Modules**: increased efficiency, duration and producibility as key drivers of the technological improvement

- **Inverter**: increased efficiency, maximun power point tracker (MPPT) to make modules work at their best, increased reliability and duration, increased size (from KW to MW) and possibility to offer ancillary services to the grid

- **BOP (balance of plant)**: evolution driven by design to cost activities and by the emergence of more reliable materials

<table>
<thead>
<tr>
<th>Key factors</th>
<th>2000</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Module Efficiency</td>
<td>10.4%</td>
<td>16.0%</td>
</tr>
<tr>
<td>Average European Inverter Efficiency</td>
<td>97.6%</td>
<td>98.6%</td>
</tr>
<tr>
<td>Average Central Inverter Nominal AC Power kW</td>
<td>100</td>
<td>1200</td>
</tr>
<tr>
<td>Module/Inverter DC Voltage V</td>
<td>600</td>
<td>1500</td>
</tr>
</tbody>
</table>
PV technology prices are bottoming

Contingent vs. structural causes

**Contingent cause 2016-2018**

- Silicon availability 2016: 75kW of crystaline silicon cells
- Text 1 module capacity 64 55W

**Global PV new build, 2006-2015 and forecast to 2018, and availability (GW)**

Oversupply along the whole module production value chain (silicon, wafer, cells and modules) despite the strong market growth (2016-2018 mainly China and USA).

Silicon cost: 2007 >150$/kg
2016 = 16 $/kg

**PV learning curve (c-Si and TF)**

Further robust LCOE reduction foreseen for the next 10 years

**PV cells efficiency prediction 2015-2026**

- The industrial production of PV cells, modules and inverter is concentrated in hub of big dimensions with consequent economies of scale that can be reached.
- Max size big factories:
  - 2000 = 50 MW
  - 2016 = 5.000 MW

Further potential cost reduction driven by:
- Increased cell efficiency with consequent cost/Wp reduction
- Production process optimisation (Kerf losses reduction and wafer thickness) and > throughput.
The repercussions on the wind sector

Wind under attack

Levelized cost of electricity – 1H 2016

Trend LCOE PV vs. Wind: the US case

As of now solar is on average less competitive than wind with exceptions for countries particularly abundant in solar resource...

...But solar learning curve is at the moment steeper than the one of wind.

High Pressure on the wind supply chain
### 11 key factors fundamental for Regulator

To ensure stability and attract investors

<table>
<thead>
<tr>
<th>Category</th>
<th>Key Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remuneration</td>
<td>Guarantee of energy off-take (e.g. PPA) is critical, in particular for project bankability</td>
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<tr>
<td></td>
<td>Guarantee on energy dispatching in congested grids takes out the risk of curtailment</td>
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<tr>
<td></td>
<td>Stability of cash flow is key for investors: instability has a cost that is paid by the system</td>
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<td></td>
<td>Mechanism where remuneration premium is based on target vs. actual RES capacity or penalty requires continuous adjustments and generate volatility</td>
</tr>
<tr>
<td>Project risk / discount rate</td>
<td>Stability of regulator’s agenda and consistency of energy policy attract investors</td>
</tr>
<tr>
<td></td>
<td>Stability of RES strategy and scheme rules is key – smart adaptive mechanisms needed</td>
</tr>
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<td>Long-term targets (with short and medium term action plan) show RES commitment</td>
</tr>
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<td></td>
<td>Pre-defined budget &amp; funding a must to guarantee stable remuneration over proj life-time</td>
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<td></td>
<td>Transmission grid requirements need to be defined together with RES strategy</td>
</tr>
<tr>
<td>Scheme access</td>
<td>Schemes with competitive access-to-remuneration show higher efficiency for system costs</td>
</tr>
<tr>
<td></td>
<td>Structured pre-qualification helps to assign remuneration to solid projects and investors</td>
</tr>
</tbody>
</table>

A sound regulatory framework is a booster for RES development
Final Remarks
Main barriers to the deployment

- Local Governments can address up to 75% of the key identified barriers
- The renewable industry is continuously reducing Capex and O&M costs accounting for the remaining 24%
- Long term development programs envisaged by the Governments bolters investors trust and confidence