World Petroleum Industry Perspectives and Recommendations for Tunisia

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WORLD PETROLEUM INDUSTRY PERSPECTIVIES AND RECOMMENDATIONS FOR TUNISIA

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2. Renewable Energy Economics and Developments
3. Impacts on the Petroleum Industry
4. Carbon Tax
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1. Short-Term Impact of Covid-19

- The COVID-19 pandemic will have significant short-term impact on the petroleum industry.
- The oil price declined sharply in March-April 2020 as the pandemic began.
- The lower prices have had significant impact on a rapid decline of North American oil production.
- The decline in prices, with the strong OPEC+ arrangement, will most likely result in an average oil price of at least $45/bbl in 2020.
- A long-term price of $50/bbl seems a good target, as higher prices would bring North American shale oil production back rapidly.

2. Renewable Energy Economics and Developments

1. The cost of solar photovoltaics (PV) and onshore wind will be lower than producing electricity in combined natural gas cycle plants.

2. The levelized cost of electricity (LCOE) from natural gas generated in combined cycle plants is currently priced in the 4.4–6.8 cents/KWh range based on Lazard's North American LCOE 2020 estimates.

3 Costs of Solar Utility-Sized Photovoltaics (2020)

- International Renewable Energy Agency (IRENA) information indicates the average 2020 auction price (power purchase agreement, PPA) for solar utility size PV is 4.8 cents/kWh.
- The price range for PV is 2.8–10 cents/kWh. PPAs of about 3 cents/KWh have been achieved in Mexico, Peru, the UAE, and other countries.
- Bloomberg New Energy Finance indicates that solar PVs in Australia, China, Chile, and the UAE may achieve LCOEs of between 2.3 and 2.9 cents/kWh.
- Dubai received a record low auction offer for 900 MW of 1.6953 cents/kWh, indicating that the **costs of solar PV is now below the level of the cheapest new combined cycle gas plants in the United States.**

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Solar PV: Future Costs

More research and development and increases in production capacity will lower costs of utility-based solar PV further.

Before 2030, solar utility-based PV will have the capacity to produce power in the range of 1.5–6.5 cents/kWh, with a probable average LCOE of about 3.0 cents/kWh in 2020. The lower end of this range applies to areas in the world with optimal solar conditions, which are typically between the latitudes of 40 degrees north and south.

New solar energy plants in these central latitudes will deliver electricity at a significantly lower LCOE than any fossil fuel plant in the United States and below the marginal cost of operation of an existing coal plant in the United States.

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Onshore Wind: Current 2020 Costs

- The IRENA information indicates that the average auction price (PPA) for onshore wind in 2020 is 4.5 cents/kWh in a range of about 1.8 cents to 9.0 cents/kWh.
- The BNEF data base shows an average of 4.4 cents/kWh for 2020 with recent LCOEs for the United States, India, and Spain in the 2.6 to 2.9 cent/kWh range.
- The latest bid round organized in Turkey for a 1,000 MW wind farm resulted in a price of 3.48 cents/kWh.
- Therefore, the cost of supplying onshore wind is now at and below the LCOE of the lowest cost combined cycle natural gas plants in the United States.

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Onshore Wind: Future Costs

- Future technology improvements, including better blade aerodynamics and larger turbines, will lower costs further.
- Before 2030, onshore wind will likely produce power in the range of 1.5–6.0 cents/kWh, with a probable average LCOE of about 3.5 cents/kWh (2020).
- In the future, onshore wind energy will be cheaper than a new fossil fuel plant in the United States and will equal the marginal costs of operating coal plants in the United States.

Energy Storage

In evaluating the future of energy storage, two issues will be reviewed:

- The cost of batteries
- The cost of utility scale storage systems, including the costs of the inverters, connection, construction, and engineering

The costs are often expressed in US dollars per MWh. For instance, a 60 MW storage system could deliver electricity for 4 hours, meaning that the total capacity is 240 MWh. A 240 MW system that delivers power for 1 hour is also 240 MWh.

However, the costs of the system will be higher because large inverters and connection systems are required. The levelized costs of storage (LCOS) are determined based on a cash flow of the system.

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Energy Storage: Current and Future Costs of Batteries

- Battery costs have fallen significantly since 2010.
- In 2010 the lithium-ion battery cost $1000/kWh, but in 2019 the costs were reduced to $150/kWh.
- It is expected that battery costs will continue to fall due to small improvements in technology and larger volume battery production. BNEF estimates that battery costs will be $96/kWh in 2025 and $70/kWh in 2030.
- **Battery costs in 2025 will make electric cars fully economic, which will have a large impact on possible oil demand.**

9 Energy Storage: The Costs of Utility Scale Storage

- The Lazard estimate of current utility scale storage LCOS is between 16.5 and 30.5 cents/kWh for a 100 MW system that delivers 4 hours, 400 MWh of electricity, based on lithium-ion batteries.
- This estimate includes charging costs with solar electricity priced at 4.2 cents/kWh.
- The estimate of current utility scale storage should be compared with the gas peaking costs, which depend on the costs of natural gas. Low costs in the United States are 12.2 to 19.9 cents/kWh. In other words, utility scale storage is already competitive in several countries, including parts of the United States, such as Hawaii.

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Energy Storage: Utility Scale Storage
Engaging Uncertainty and Risk

- For 2030, the Lazard LCOS can be adjusted by considering an estimate of the costs of solar at 3 cents/kWh and battery costs at $70/kWh.

- With lithium-ion batteries, the adjustment results in an LCOS of between 12 and 24 cents/kWh. In other words, solar becomes competitive in a large part of the world, with gas peaking after sunset.

- Experts believe that flow batteries may be cheaper and longer lasting with more technical developments.

3. Impacts on the Petroleum Industry
Renewables: Two Revolutions

Between 2020 and 2035, the petroleum industry will be subject to TWO revolutions:

Revolution # 1
2020–2030
Strong penetration of low-cost renewable energy for power generation

Revolution # 2
2025–2035
Utility scale energy storage based on renewables will replace natural gas in the energy mix for power generation

Revolution #1: Penetration of Low-Cost Renewables

1. By 2030, the costs of solar PV are estimated to be, on average, 3.0 cents/kWh.
2. Onshore wind would be 3.5 cents/kWh.
3. Many parts of the world that have poor solar conditions have good onshore wind conditions.
4. For instance, northwest Europe, Eastern Canada, northern Russia, Mongolia, Patagonia, Alaska, and the interior states of the United States have excellent wind conditions.
5. By 2030, the LCOE of solar PV or onshore wind will be cheaper in most of the world than a new fossil fuel plant. This will result in a rapid penetration of solar PV and onshore wind by 2030.

Revolution # 2: Utility Scale Storage

- Solar PV plus utility scale storage is already economic in several parts of the world.
- For instance, the United States has 40 projects in operation, mainly in Hawaii, California, and Florida. A 690 MW project by Quinbrook Infrastructure Partners for Nevada received approval.
- The oil company Total is building a 25 MW/25MWh system in France. Penso Power is adding 50 MW to the 100 MW project in the United Kingdom. AGL Energy has received approval for a 100 MW/150MWh project in Queensland.
- The company Tesla is in the market for economic large utility-scale storage.

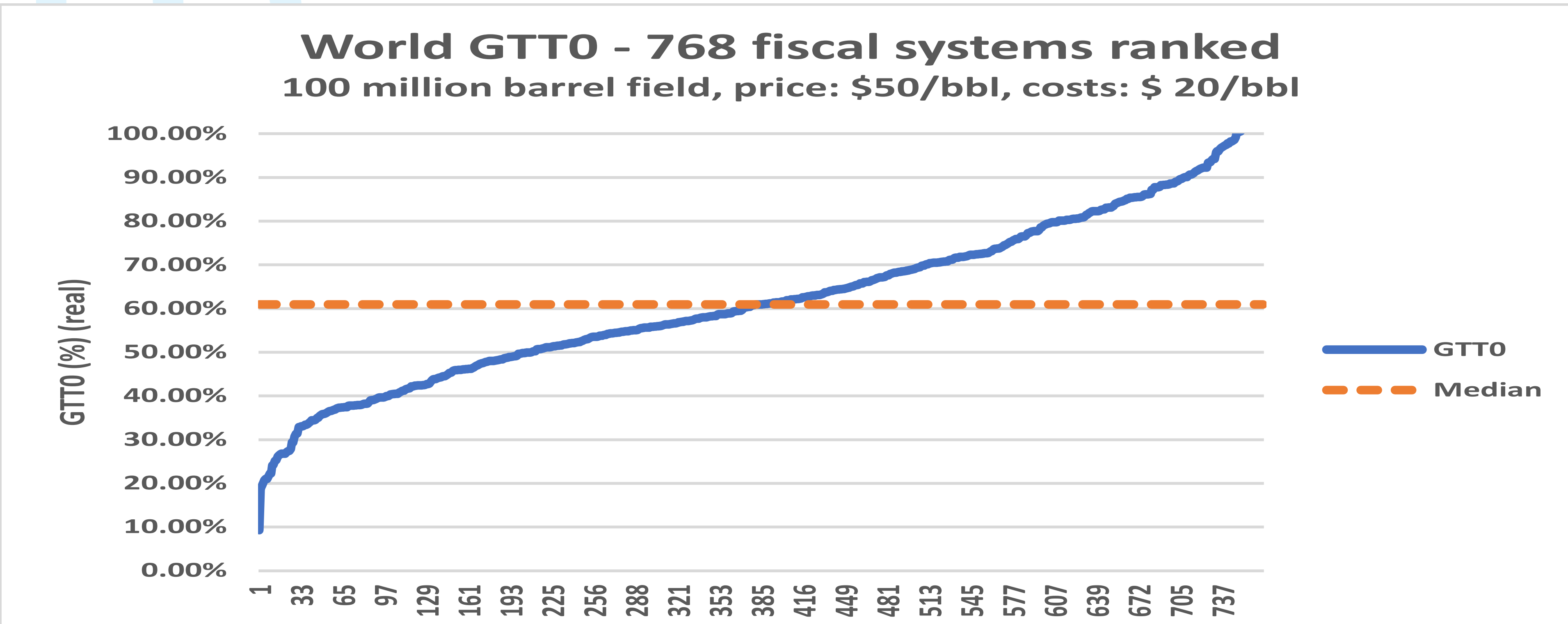
Revolution #2: Reduction of Natural Gas for Power Generation

- By 2030, the LCOS of utility scale storage will be in the 12–24 cents/kWh range due to lithium-ion batteries. The cost will be competitive with natural gas–based peaks after sunset in most of the world.
- LCOS is anticipated to drop gradually, and the role of natural gas to produce electricity in the energy mix will gradually erode.

4. Carbon Tax

1. Detailed information about carbon trading and taxation can be found in the annual World Bank report *State and Trends of Carbon Pricing*. The information in this presentation is based on the 2019 report.
2. In total, there are 57 carbon pricing initiatives around the world, covering 46 national and 28 subnational jurisdictions.
3. The carbon price varies between a low of about $1/tCO2e (ton CO2 equivalent) in Mexico to $127/tCO2e in Sweden, covering 11 GCO2e or about 20% of the world emissions including greenhouse gases. Governments received about $44 billion in carbon pricing revenues.
4. In order to achieve the goals of the Paris Agreement, the carbon price must be between $40 and $80/ton CO2 in 2020 and $10 higher in 2030, as recommended in the Carbon Pricing Leadership Coalition report.
5. It is recommended that countries adopt carbon taxes in this range.

Fiscal Systems: Current Level of Undiscounted Government Take



The chart illustrates that the government take ranges from a low of 9% to a high of over 100%. The median value for the field size, price, and cost levels indicated is 60.9%. There is a projected decline in the government take to about 55% by 2030.

5. Fiscal Systems

The following slides describe the structure of the fiscal systems based on 10 different criteria.

The current structure of most fiscal systems is not adequate to deal with the future petroleum industry framework.

Recommended structures for the future framework will be discussed.

Structure of the Fiscal Systems

FISCAL STRUCTURAL CLASSIFICATION				
Volume/Production Level and GTT0	Regressive	Neutral	Progressive	
Price Level and GTT0	Regressive	Neutral	Progressive	
Cost Level and GTT0	Regressive	Neutral	Progressive	
Profitability and GTT0	Regressive	Neutral	Progressive	
Timing of GTT0	Front End	Neutral	Back End	
Geological Risk and GTT0	Risk Averse	Neutral	Risk Supportive	
Marginal Project Incentive	High	Average	Low	
Cost Efficiency	High	Average	Low	Gold Plating
Price Efficiency	High	Average	Low	Inefficient
MER Efficiency	Enhancing	Average	Inhibiting	Reserve Loss

This table illustrates the 10 criteria with which fiscal systems can be classified.

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Transformation of Fiscal Systems

- **In anticipation of a scenario with lower oil and gas prices, the current world fiscal systems should be restructured to optimize the benefit from remaining oil and gas resources and to maintain a healthy petroleum industry.**
- **This applies to non-OPEC countries as well as OPEC countries that aspire to maintain or increase oil and gas production, such as Nigeria and Angola.**

Transformation of the Fiscal Systems

TRANSFORMATION OF WORLD FISCAL SYSTEMS		
	CURRENT	FUTURE
Volume Progressivity	The world is mainly volume progressive or neutral	Somewhat more volume progressivity could be introduced
Price Progressivity	About one third of the world is price progressive for high prices, half the world is regressive	Most juridictions should become price progressive at low prices
Cost/Profit Progressivity	About 20% of the jurisdictions is cost/profit progressive and 70% regressive.	More jurisdictions should become modestly cost/profit progressive.
Timing of GTT0	The world is strongly Front End loaded	Front End loading should be reduced in particular in developed countries

This table offers an overview of the required fiscal changes. The most important recommendation is for jurisdictions to become more price progressive at low oil and gas prices.

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Transformation of the Fiscal Systems

TRANSFORMATION OF WORLD FISCAL SYSTEMS (continued)		
	CURRENT	FUTURE
Geological Risk and GTT0	The world is strongly Risk Averse	Jurisdictions with large resource bases should become considerably less Risk Averse
Marginal Field Incentive	Most countries do not promote strongly marginal fields	Lower prices require that stronger provisions for marginal fields should be introduced
Cost Efficiency	Most systems in the world are cost efficient	Gold Plating should be removed
Price Efficiency	Almost all systems in the world are price efficient	Price Inefficiency should be removed.
MER Efficiency	Many systems In the world inhibit MER	MER enhancement should be significantly expanded

This table offers an overview of the required fiscal changes. The most important recommendation is for jurisdictions with large resource bases to become less risk averse.

Transformation of the Fiscal Systems

TRANSFORMATION OF WORLD FISCAL SYSTEMS (continued)		
	CURRENT	FUTURE
Gas Fiscal favorability	Many jurisdictions have already gas-favorable fiscal systems.	The scope and level of gas-favorability should be significantly expanded
Oil GTT0	The current median world GTT0 at $ 50/bbl, $ 20/bbl costs for a 100 million barrrels field is 61%	Governments should create more flexibility in competitive bid rounds to maximize government revenue collection.

Governments should apply greater flexibility during licensing rounds to determine the GTT0 based on market forces, rather than adjust the government take based on preconceived ideas of what the government take should be.

5. Recommendations for Tunisia: Short Term

- **Given the analysis of the short-term framework for Tunisia, the earlier economic and fiscal recommendations made under the World Bank project should be used: that is, $50 per barrel rather than the $60 per barrel that was used in 2019.**
- **Because gas prices for local producers are linked to oil prices, this also points to a somewhat lower price scenario for gas.**

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Tunisia: Solar PV and Onshore Wind

1. Tunisia is blessed with excellent solar conditions across the country. In the mountains, the onshore wind potential is also attractive.
2. Therefore, onshore wind and solar PV are cheaper sources of electricity than electricity production based on established gas prices.
3. Tunisia must aim to generate 30% of electricity with renewable energy by 2030 in line with current plans. The percentage can be increased.
4. In order to optimize benefits from low cost renewables, utilize an auction system based on PPAs.
5. The LCOE is mainly determined by the weighted average cost of capital, which depends on the risk perception of the investors.
6. A regulatory framework and PPA contract must be implemented to minimize the perception of risks associated with developing solar PV and onshore wind in Tunisia.
7. The goal should be to sign PPAs in the 2–5 cents/kWh range.

Tunisia: Carbon Tax

- To accelerate the benefits associated with possible low cost solar and wind for Tunisia, provide incentives for using these resources. The introduction of a carbon tax of about $60/tCO2 is effective.
- In order to be revenue neutral and have an acceptable impact on the population, a VAT of 19% could be reduced proportionately.
- Norway has no VAT on electric cars. If Tunisia followed this model, it would result in a strong growth of electric vehicles, thereby offering greater benefits from the low cost of solar and wind and moving Tunisia rapidly into energy transition.
- An increase in electric vehicles would help Tunisia reduce imports of natural gas and petroleum products.

26 Tunisia: Impact of Current Developments on the Proposed Fiscal Terms

1. The proposed fiscal terms have been tested under a broad range of international oil price levels (from $40 to $120/bbl).

2. The main goal in the design of the fiscal terms was to make exploration and developments of oil opportunities attractive under the target $60–$70/bbl long-term oil price.

3. The proposed fiscal terms are based on a price- and volume-progressive royalty and a corporate income tax. This is still recommended. However, under low oil prices, the royalty becomes too harsh for larger fields due to strong volume progressivity.

4. Volume progressivity is a desirable feature, but it could be reduced to improve the economics under low international oil prices.

Tunisia: Impact of Current Developments on the Proposed Fiscal Terms

1. To prevent windfall profits under high oil or gas prices, the price progressivity should be strengthened.
2. Larger fields are usually lower cost operations. Therefore, the proposed changes should continue to encourage exploration under $50/bbl.
3. New fiscal terms are proposed for all conventional fields. Therefore, a special regime is no longer needed despite the proposal in Chapter 7.6 of the World Bank report for high risk–high reward fields.
4. **No changes are proposed for nonconventional hydrocarbons. However, under a $50/bbl scenario it is unlikely that shale oil and shale gas are economic in Tunisia.**

Tunisia: Adjustments to the 2019 Oil Terms

A possible adjustment to the 2019 oil royalty structure follows.

Volume-based royalty

For the volume-based oil royalty, the slope could be reduced while the production levels could remain the same.

Production levels (barrels per day)			Royalty rate (2019 Proposed terms)	Royalty rate (2020 adjustment)
Onshore	Shallow water	Deep water		
5,000	10,000	20,000	**5.0%**	**5.0%**
10,000	20,000	40,000	**12.5%**	**10.0%**
20,000	40,000	80,000	**22.5%**	**15.0%**
50,000	100,000	200,000	**27.5%**	**18.0%**

This would reduce the volume-based effective royalty for larger fields.

Tunisia: Adjustments to the 2019 Oil Terms

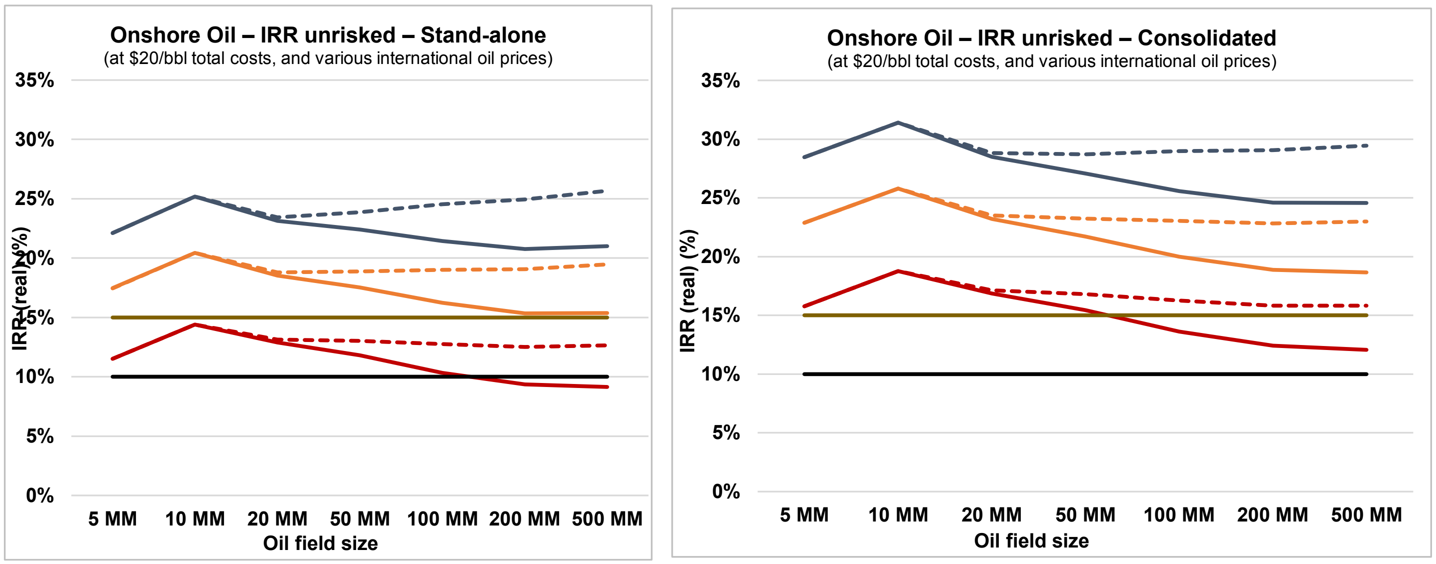
Price-based royalty

To compensate the government take under higher oil prices, the price-based oil royalty could be increased.

2019 Proposed terms		2020 adjustment	
International oil price levels ($/barrel)	Oil royalty rate (2019)	International oil price levels ($/barrel)	Oil royalty rate (2020 adjustment)
$40.0	**0%**	$40.0	**0%**
$70.0	**3.0%**	$60.0	**2.0%**
$100.0	**10.0%**	$100.0	**15.0%**
$120.0	**15.0%**	$150.0	**25.0%**

As the result, with low oil prices, the price-based royalty will remain zero or very low. Higher prices will allow for an increase to compensate for the decrease in volume-based royalty.

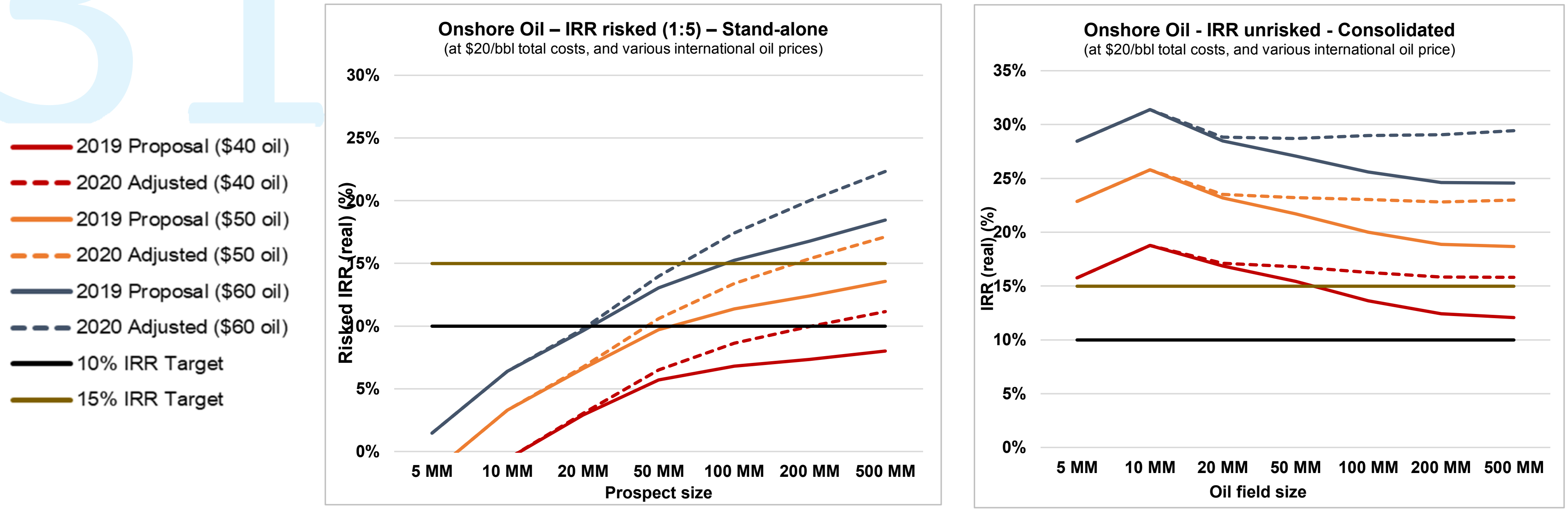
Tunisia: Adjustments to the 2019 Oil Terms



2019 Proposal ($40 oil)
2020 Adjusted ($40 oil)
2019 Proposal ($50 oil)
2020 Adjusted ($50 oil)
2019 Proposal ($60 oil)
2020 Adjusted ($60 oil)
10% IRR Target
15% IRR Target

Based on the onshore example, the economics of developing larger fields is improved under low oil prices.

Tunisia: Adjustments to the 2019 Oil Terms



- **On a risked basis (20% success), the exploration for smaller fields would remain very marginal, especially on a stand-alone basis. A company would have no existing upstream projects in Tunisia. The results improve on a consolidated basis.**
- **To improve the economics of smaller fields, a waiver from withholding tax could be introduced, as well as volume- or time-based royalty holidays.**

Tunisia: Impact of Current Conditions on 2019 Gas Terms

- **The fiscal framework for gas consists of two components: the gas price and the fiscal terms.**
- **The domestic gas prices in Tunisia are oil-linked (80% of low-sulfur fuel oil). As a result, they decrease with low international oil prices.**
- **For the fiscal terms of gas, recommendations are similar to oil: reduce the volume-based royalty and balance the reduction with the increase in price-based royalty.**

Tunisia: Adjustments to the 2019 Gas Terms

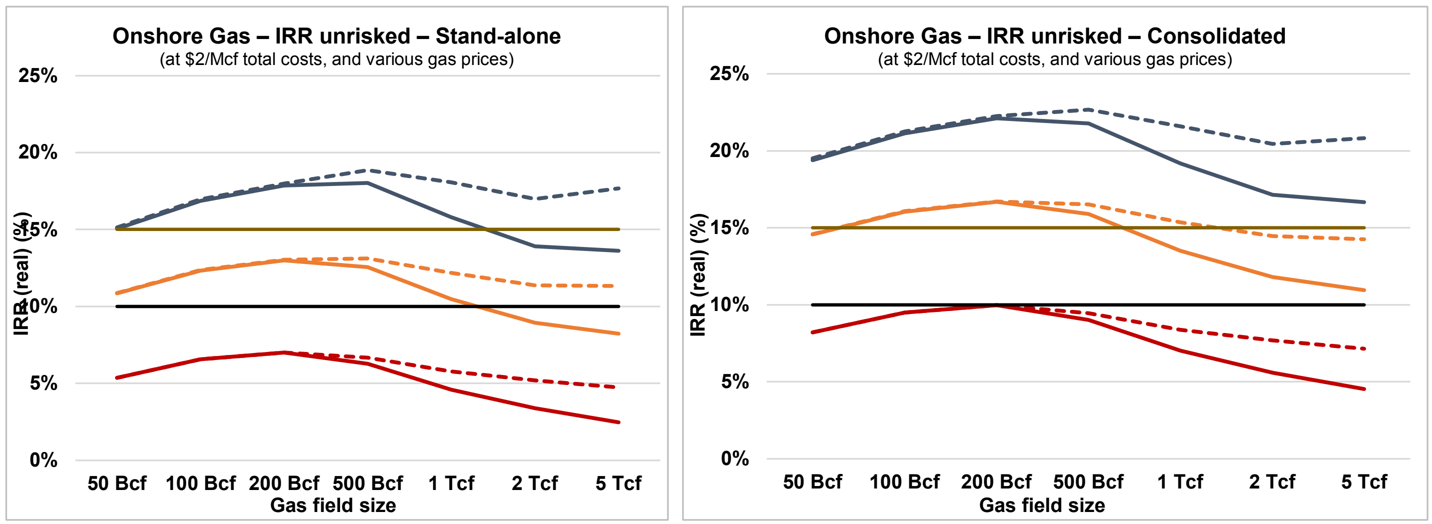
Volume-based royalty adjustment

Production levels (Mcf per day)			Gas royalty rate (2019 Proposed terms)	Gas royalty rate (2020 adjustment)
Onshore	Shallow water	Deep water		
50,000	100,000	200,000	**5.0%**	**5.0%**
100,000	200,000	400,000	**12.5%**	**10.0%**
200,000	400,000	800,000	**22.5%**	**15.0%**
500,000	1,000,000	2,000,000	**27.5%**	**18.0%**

Price-based royalty adjustment

2019 Proposed terms		2020 adjustment	
Gas price levels ($/MMBtu)	Gas royalty rate (2019)	Gas price levels ($/MMBtu)	Gas royalty rate (2020 adjustment)
$4.0	**0%**	$4.0	**0%**
$7.0	**3.0%**	$7.0	**2.0%**
$10.0	**10.0%**	$10.0	**15.0%**
$12.0	**15.0%**	$15.0	**25.0%**

Tunisia: Adjustments to the 2019 Gas Terms



2019 Proposal ($40 oil / $3.27 gas)
2020 Adjusted

2019 Proposal ($50 oil / $4.33 gas)
2020 Adjusted

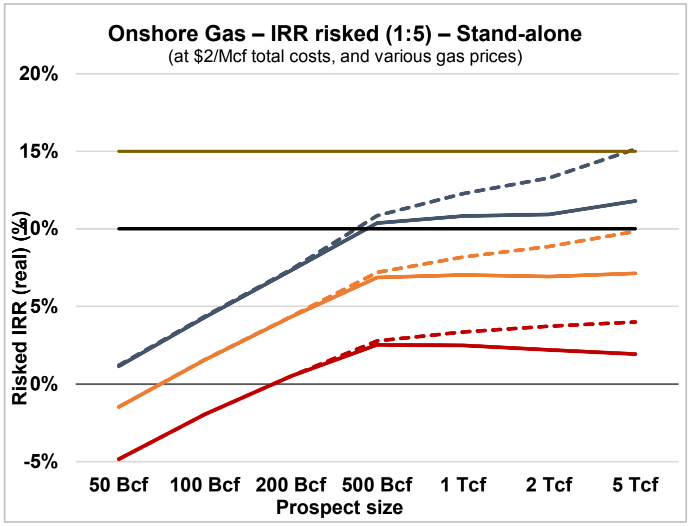
2019 Proposal ($60 oil / $5.40 gas)
2020 Adjusted

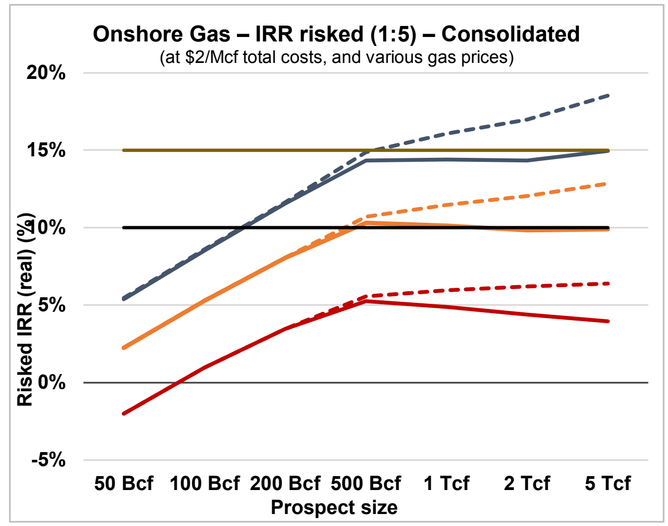
10% IRR Target

15% IRR Target

Based on the onshore example, the long-term oil price of $50/bbl is reasonable under dry gas economics. It results in $4.33/MMBtu at a field measurement point with a $1/Mcf tariff.

Tunisia: Adjustments to the 2019 Gas Terms





2019 Proposal ($40 oil / $3.27 gas)
2020 Adjusted
2019 Proposal ($50 oil / $4.33 gas)
2020 Adjusted
2019 Proposal ($60 oil / $5.40 gas)
2020 Adjusted
10% IRR Target
15% IRR Target

On a risked basis (20% success), the exploration economics for dry gas remain very marginal for smaller fields, particularly on a stand-alone basis.

Thank you for your attention!

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