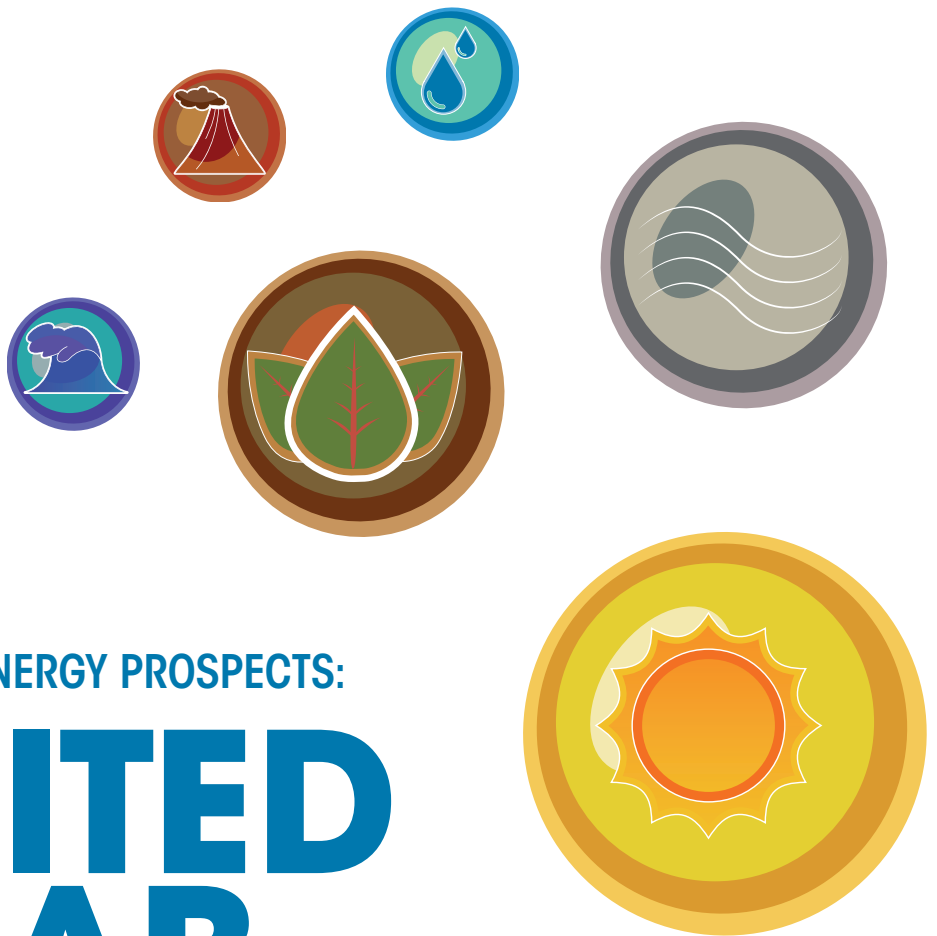


 REmap 2030  
A Renewable Energy Roadmap

## EXECUTIVE SUMMARY



RENEWABLE ENERGY PROSPECTS:

# UNITED ARAB EMIRATES

## About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

## About Masdar Institute of Science and Technology

Masdar Institute is the world's first graduate-level university for sustainability and clean energy fields, located in Abu Dhabi and developed in partnership with the Massachusetts Institute of Technology.

## About the Ministry of Foreign Affairs, Directorate of Energy and Climate Change

The Ministry of Foreign Affairs' Directorate of Energy and Climate Change (MOFA-DECC) is the UAE's international lead on energy and climate change issues and supports elaboration of domestic policy. It serves as the UAE representative to IRENA.

IRENA and Masdar are grateful for the generous support of the Ministry of Foreign Affairs, UAE, which made the publication of this report a reality.

The full country report for the United Arab Emirates, the REmap 2030 report, summary of findings and other supporting material are available at [www.irena.org/remap](http://www.irena.org/remap)

For further information or to provide feedback, please contact the REmap team at [remap@irena.org](mailto:remap@irena.org)

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## Disclaimer

This publication does not represent the official view of the UAE government; rather it is an academic study designed to contribute a credible perspective for energy planning and policymaking purposes.

While this publication promotes the adoption and use of renewable energy, the parties do not endorse any particular project, product or service provider.

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# HIGHLIGHTS

- Renewable energy is now economically attractive in the United Arab Emirates (UAE). In fact, a 10% share of renewable energy in the total energy mix – as detailed in this study – could generate annual savings of USD 1.9 billion by 2030 based on avoidance of fossil fuel consumption. When accounting for health and environmental benefits additional net annual savings of USD 1 billion to 3.7 billion by 2030 could be generated.
- Rapidly increasing natural gas prices and decreasing renewable energy costs are the main drivers. As recently as 2010, natural gas was available in the UAE at less than USD 2 per million British thermal units (MBtu). Today, marginal import prices are in the range of USD 9-18/MBtu, even after accounting for the potentially temporary price decline of late 2014 and early 2015. New domestic gas production is approaching USD 8/MBtu in cost and is insufficient to limit growing import requirements. By contrast, local solar photovoltaic (PV) module prices have fallen around 75% since 2008.
- A number of renewable energy technologies – such as solar PV, wind power, and waste-to-energy – are already economic in the UAE above USD 8/MBtu, with solar PV potentially competitive with gas prices as low as USD 4.5/MBtu. There is a clear financial rationale for accelerated and greater deployment, surpassing the UAE's existing targets in the power sector. A 25% share of renewables in power generation by 2030 could be cheaper to achieve than the current targets.
- The most important enabling factor for renewable energy in the UAE will be the empowerment of government agencies to take holistic, comparative views of energy costs – and to act on these through regulation and/or tendering. The governance model in the Emirate of Dubai, and the creation of the UAE federal energy policy taskforce, are key local references.
- In November 2014 the results of a bid for a 100 MW solar PV plant in Dubai were released, setting a world-record low for cost at just US 5.98 cents per kWh and highlighting solar PV's competitiveness in the Gulf region.

## The big picture

A major rethinking of the UAE national and emirate-level energy strategies is due: as of 2014, renewable energy is cost-competitive in the country for the first time – and possibly even the cheapest source of new power supply. Based on current incremental energy prices, the UAE could achieve at least 10%

use of renewable energy in its energy mix by 2030 (and 25% in its power generation mix) with estimated net savings for the economy of USD 1.9 billion annually. This is before considering health and environmental benefits or the potential to export hydrocarbons liberated from domestic consumption. The country's pioneering push into renewables – based on longer-term, 'patient capital' goals

like economic diversification, sustainability, and job creation – can now be justified by short-term economics.

## The REmap report and findings

REmap 2030, a global roadmap project by the International Renewable Energy Agency (IRENA), examines the realistic potential for higher renewable energy uptake in a variety of countries and markets. This country-level analysis covers all parts of the UAE’s energy system, including power, industry, buildings and transport. Importantly, REmap 2030 benchmarks against alternative sources of supply like natural gas, oil, coal and nuclear power, using a combination of local and international cost data. The analysis takes a moderate approach: the first case assumes USD 90/barrel oil and USD 8/MBtu natural gas (below current UAE marginal gas prices), the second assumes USD 120/barrel oil and USD 14/MBtu gas (similar to recent UAE marginal gas prices). While the price of oil has fallen by around 50% since mid-2014, the gas price is the more critical reference for renewable energy competitiveness in the UAE – and remains consistent with the analysis assumptions even as of early 2015. It also conservatively projects gradual cost changes for all technologies, avoiding favouritism for renewable energy, which has actually experienced the most dramatic cost declines in the energy sector in recent years.

The report lays out a “business as usual” scenario (known as the “Reference Case”) derived from current policies and plans, which projects that 0.9% of total final energy consumption (TFEC) would come from renewable energy by 2030. It then presents the REmap 2030 Case, which applies current and

projected cost data to measure the economic attractiveness of different technologies that could achieve – without net costs – 10% renewable energy in the national mix. The percentage was selected as a relatively modest, achievable number, though higher penetration of renewables is of course possible. Since some technologies are cheaper than others, the report assumes that the savings these generate are reallocated to offset costs for more expensive technologies when estimating the total substitution cost of the portfolio.

The building and power sectors dominate in the REmap 2030 findings, achieving renewable energy shares of 29% and 25%, respectively. The industry and transportation sectors follow with 5.5% and 1.1% renewable energy shares, respectively. The difference owes largely to the cost of deployment and related technology maturity, as well as the UAE’s subsidisation of natural gas for industry and gasoline for transport.

Five key insights emerge from the results:

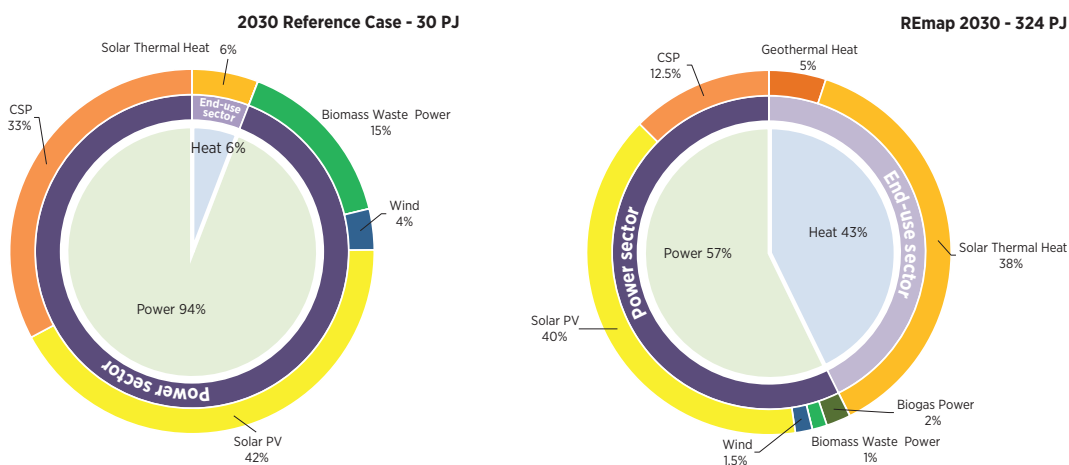
- Deployment of PV, wind, and landfill gas (for power and industry) and solar water heating (for buildings) represent low-hanging fruit for the UAE. These investments – such as a capacity addition of 17.5 gigawatts (GW) of solar PV – would “pay for themselves” at natural gas prices of USD 8/MBtu or even as low as 4.5/MBtu for solar PV, much lower than current marginal prices. Delaying in anticipation of further cost reductions is counter-productive, as it could mean missing the opportunity already afforded and because scaling up takes time.
- Solar is the critical resource and focus for the UAE. Different forms of solar

energy would account for more than 90% of renewable energy use in REmap 2030.

- There would be major opportunity costs, as well as health-environmental costs, if renewables are not deployed. For instance, domestic consumption of oil – which cuts into lucrative exports – could be reduced by up to 8.5%, and gas by up to 15.6%. Avoided national carbon dioxide (CO<sub>2</sub>) emissions could total 29 megatonnes (Mt) per year, and avoided health and environmental costs could reach USD 1 billion to USD 3.7 billion annually by 2030. Such benefits, although not financially accounted for in the analysis, suggest significant implications for energy policy, even based simply on a net view of the economy.
- The potential for renewable energy deployment in industry is large – and renewable energy penetration could be

higher if industries were encouraged to make investment decisions based on actual, and not subsidised, gas prices. Geothermal and solar thermal energy for industry could all be economically viable between USD 8 and USD 14 per MBtu, depending on the application. Solar PV could even be competitive as low as USD 4.5/MBtu if the Dubai bid results are considered.

- While dispatchable renewable energy technologies like concentrated solar power (CSP) with thermal energy storage are more expensive compared to conventional energy counterparts, these additional costs can be offset by savings achieved with other renewable energy technologies. The combination enables a network that can mimic and complement the UAE’s gas-fired generation at a competitive total cost and with lower socio-environmental impact.



## Energy cost dynamics

The REmap 2030 findings stem from two key, recent shifts in the UAE. First, the cost of renewable energy continues to decline dramatically. Local installed costs for utility-scale solar PV, for instance, have fallen from USD 7/Watt in 2008 to less than USD 1.5/Watt in mid-2014, a roughly 75% drop. For the price of a 10 megawatt (MW) plant in 2008, the UAE can now build 46 MW. This high rate of cost decline can also be seen in the recent bid results for a 100 MW solar PV plant in Dubai, with bids coming in as low as US 5.98 cents per kWh.

Second, incremental (marginal) natural gas costs in the UAE are increasing, which reframes the attractiveness of renewable energy. Historically, the UAE was able to produce or import gas for less than USD 2/MBtu. Today, due in part to high sulphur content, new domestic production could cost up to USD 8/MBtu, while liquefied natural gas (LNG) imports – which started in 2010 in Dubai and may begin on a larger scale in Abu Dhabi as early as 2016 – cost USD 12-18/MBtu, with some cargoes temporarily available at 9-10/MBtu because of the oil price decline. Additional pipeline imports reportedly cost USD 14.4/MBtu. Import requirements continue to grow despite the cost. Solar PV, by contrast, is cost-competitive with high-efficiency natural gas plants for incremental daytime power supply at USD 8/MBtu, and possibly now even USD 4.5/MBtu – and is already cheaper than LNG. In terms of avoiding gas consumption, mainstream renewables like solar PV and wind are, moreover, estimated to be cheaper than nuclear energy and potentially imported coal, which, if deployed, would reverse many of the UAE's gains in reducing greenhouse gas emissions.

## Government action

The new business case for renewables, however, will not be realised without policy reform and stakeholder awareness. The federal and emirate-level governments will need to clarify their respective responsibilities for project initiation and implementation, regulate the integration of renewable energy technologies where needed, and set timelines. To date, many governing institutions have now been empowered to take a holistic view of the energy sector (comparing different supply options), or to introduce a deployment programme and schedule that could incentivise local industry development and further bring down costs. The Dubai Supreme Council of Energy provides a valuable domestic model, bringing the emirate's key producers and consumers to the table for policy formulation. The UAE's new federal energy policy taskforce also represents a crucial, initial action to facilitate policy and investment coordination across the seven emirates, which are largely sovereign in their energy policy.

Key government planning documents and processes – like Vision 2021, the Abu Dhabi Economic Vision 2030, and the Dubai Integrated Energy Strategy (DIES) – must also be continually updated to reflect changes in energy costs. For instance, solar power prices today are already lower than those predicted for 2020 by the DIES when it was produced in 2010.

On a smaller but important level, the UAE could also revisit its tariff system for waste disposal to support waste-to-energy conversion, and could consider federalisation of existing emirate-level regulations for both metering (of decentralized renewable energy)

and solar water heating (which has been cost-effective for some time under the current power pricing).

## An economic tipping point for the industry?

The UAE has overturned many assumptions about the Middle East and hydrocarbon-exporters with its embrace of renewable energy. The cost-competitiveness of renewable

energy gives the country the opportunity to dramatically increase its ambition and demonstrate the industry's financial viability in the region, while also securing a stable and very low-risk supply of energy, thereby extending the lifetime of its fossil fuel reserves. While energy costs may vary by location, the implications of solar PV parity with gas at prices of USD 4.5-8/MBtu stretch beyond the UAE. This amounts to a clarion call for all energy producers, as well as energy importers, to closely examine their investment choices.



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