



# The Teal Energy<sup>SM</sup> Deal

*The fastest and least expensive way to reduce global carbon emissions with growing global energy demand*

## KEY TAKEAWAYS

- Imperative to reduce global CO<sub>2</sub> emissions
- Energy demand growing through electrification
- Source of energy supply shifting to low carbon fossil fuels and renewables
- Transition to cleaner energy can happen quickly and economically
- U.S. exporting low-cost energy to the rest of the world

To reduce carbon emissions across the globe, a transition to cleaner energy must happen.

We think this transition will be driven by two key themes: Growing global energy demand driven by electrification; and natural gas and renewables displacing coal thereby reducing carbon emissions.

This is Tortoise's view on the future of energy, what we are calling "The Teal Energy Deal".

## WHAT IS THE TEAL ENERGY DEAL?

**FUTURE OF ENERGY =**  
Natural Gas + Renewables

**BLUE =** Natural Gas    **GREEN =** Renewables

**BLUE + GREEN =**  
**TEAL**

**TEAL = Tortoise**



Electrification driving  
global energy  
demand growth

Carbon emission  
reductions driven  
by shift to natural gas  
and renewables

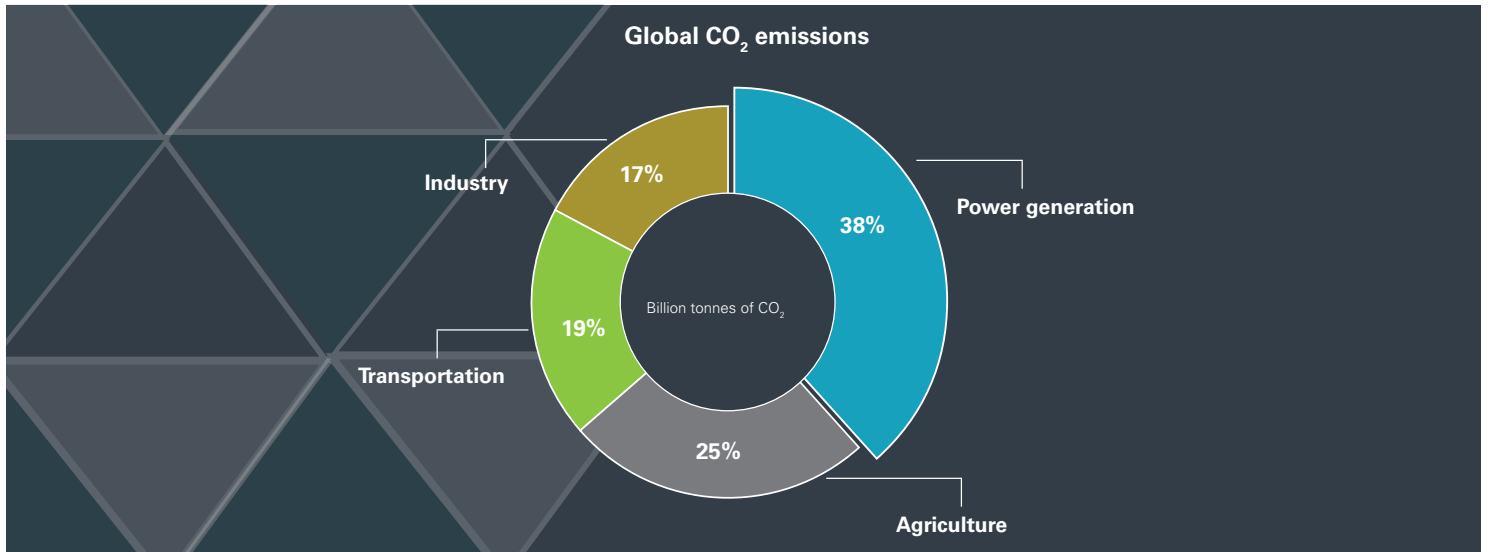
U.S. is part of the  
solution by exporting  
low-cost energy to the  
rest of the world

**Wind and solar are intermittent sources of energy, natural gas is a low-carbon complement**

- **More economical** than focusing solely on constructing renewables
- Can make an impact in a much **shorter time period**
- **Market-driven**, realistic and feasible solution

## GLOBAL CARBON EMISSIONS ARE INCREASING

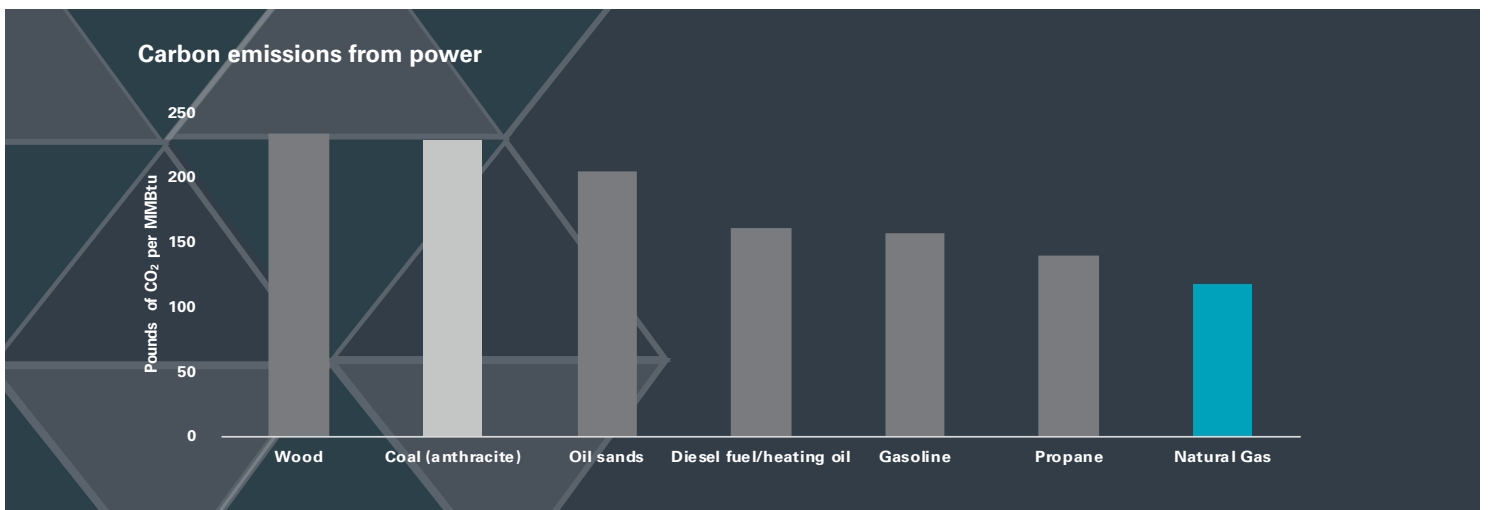
As illustrated below, the power sector, which is used to generate electricity, represents the single largest source of carbon emissions in the world. To efficiently make the biggest impact, the focus should be on shifting to cleaner energy sources for power generation.



Source: IEA, Switch. Data represents estimated 2014 global anthropogenic CO<sub>2</sub> emissions

### Not all fossil fuels are created equal

Within power generation, some fossil fuels emit more carbon than others. The chart below ranks fossil fuels by carbon emissions, with wood on the far left, followed by coal, then diesel and gasoline, with propane and natural gas on the far right. Natural gas emits approximately half the amount carbon coal emits. It is important not to lose sight of the end goal and paint all fossil fuels with a broad brush.

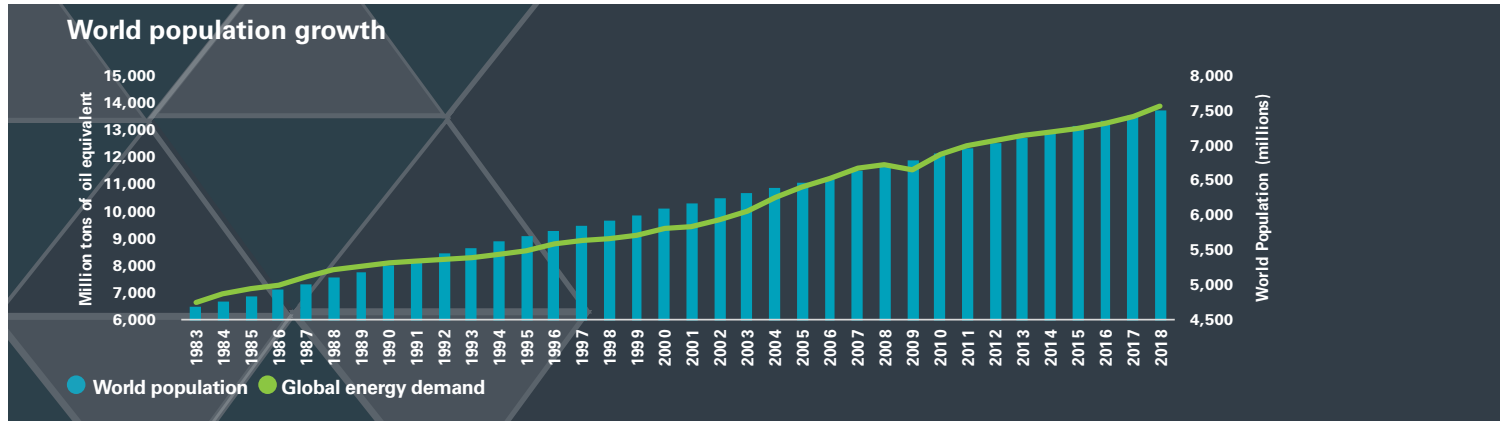


Source: EIA, EPD

## ENERGY DEMAND IS INCREASING

### Population growth

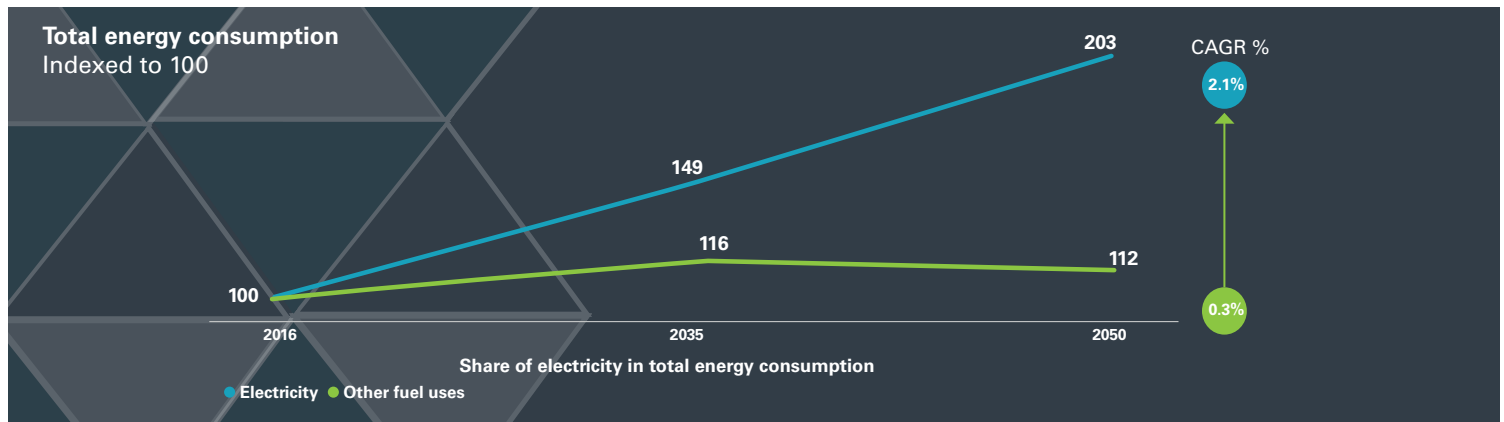
Energy is an essential asset, therefore global energy demand growth has been consistent and highly correlated with population growth. Typically, energy demand is comprised of power generation, transportation, residential, commercial and industrial sectors. The chart below shows world population and global energy demand over the past 36 years. Population has consistently grown and accordingly, energy demand has grown 35 of the past 36 years. Global population is expected to approach 10 billion by 2050 and then grow to approximately 11 billion by 2100.



Source: Bloomberg, BP Statistical Review of World Energy 2019

### Electrification

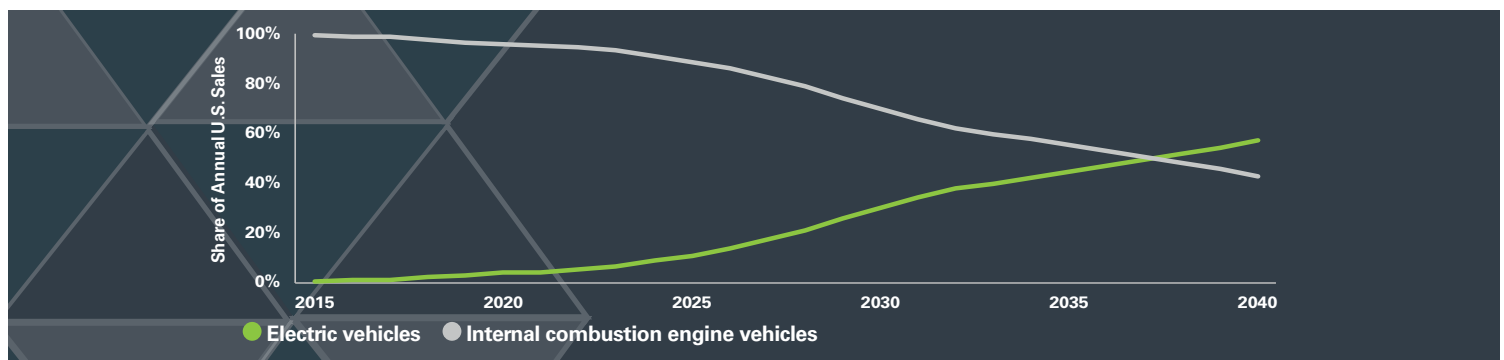
Approximately 75% of global energy demand growth over the next two decades is expected to come from power generation. Electricity demand is expected to double between 2016 and 2050. We illustrate this point to highlight the growing importance of electricity, which is the end product of power generation.



Source: McKinsey. This chart contains projections, there is no guarantee these projections will be met

### Growth of electric vehicles

Currently, electric vehicles (EVs) are a very small percentage of total vehicles, but their share is expected to grow significantly through 2040. The growth of EVs will be a key driver of electricity demand growth. It is important to note that internal combustion engine (ICE) vehicles will also remain relevant for decades to come.



Source: BloombergNEF

## WHY ARE CARBON EMISSIONS INCREASING?

### Growth of emerging market countries

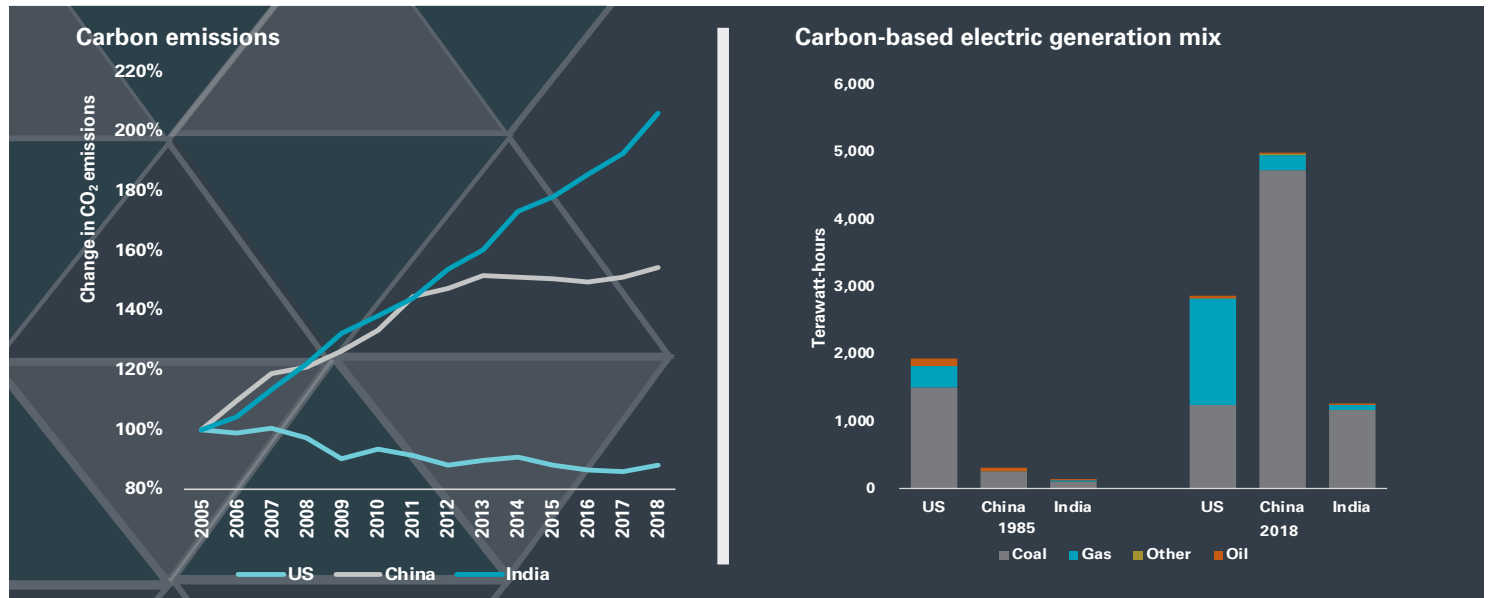
Global power demand growth is outpacing decarbonization efforts due to continued growth in emerging market coal usage. Fuel mix changes are no longer offsetting the growth in power demand and emissions are rising.

Power demand growth, represented by the blue portion of the bars in the chart below, has been positive almost every year since 1998. The gray portion of the bars represents offsets that, in many recent cases, were due to a shift away from coal. The green line illustrates CO<sub>2</sub> emissions, which have been increasing in recent years.



Source: BP Statistical Review of World Energy 2019

What is causing this trend? Carbon emissions from China and India have grown while U.S. emissions have declined due to switching from coal to natural gas and renewables. Sharp increases in emissions from China and India are overpowering the U.S.'s reductions.

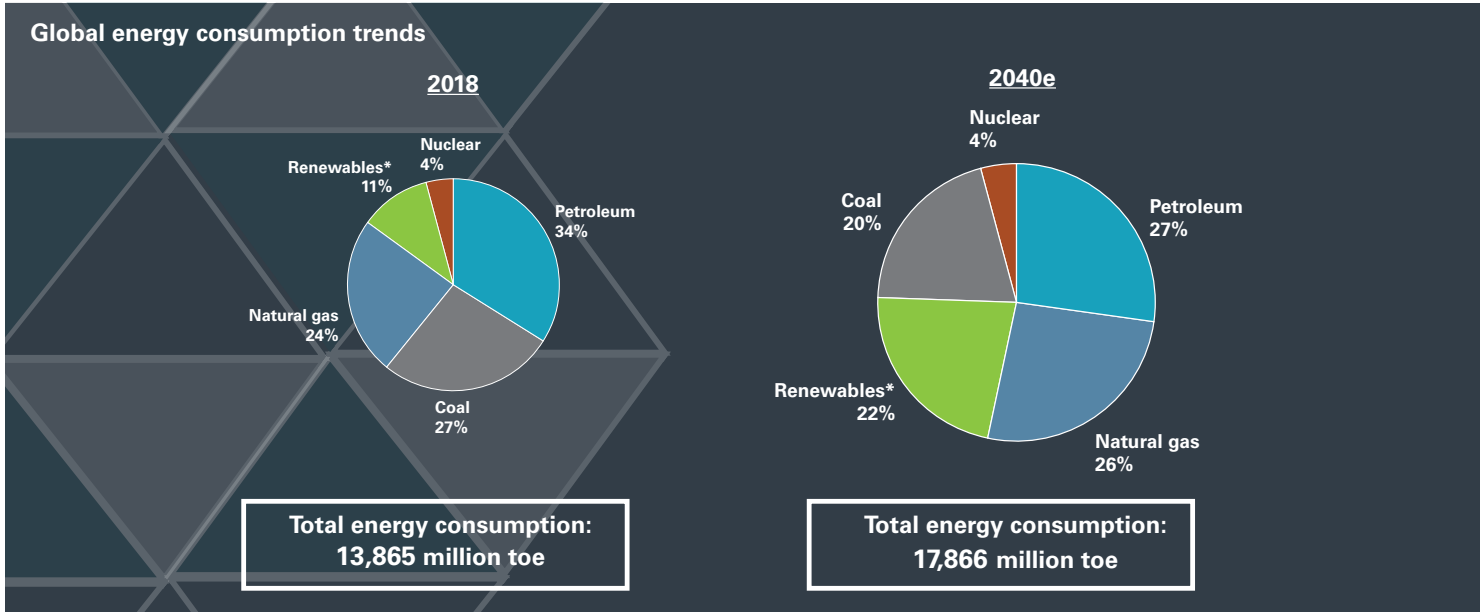


As of 6/30/2019. Source: BP Statistical Review of World Energy 2019

## HOW DO WE DECREASE GLOBAL CARBON EMISSIONS?

### Natural gas and renewables: The path forward

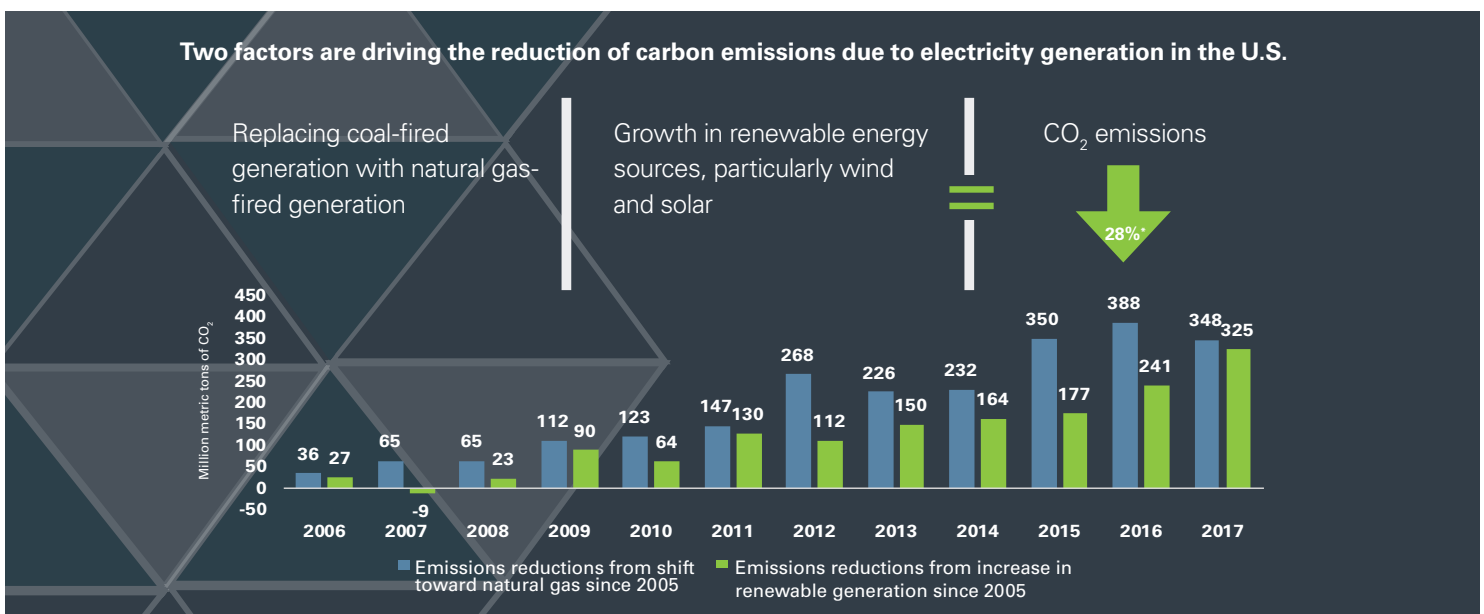
Sourcing of energy supply is driven by cost, availability and increasingly by social impacts. Over the long term, supply builds to match demand. As the global energy landscape has evolved, there has been a shift in the source of supply from coal to natural gas and more recently to renewables. These changes take time to develop. As technology advances, some incremental demand may be met by new sources of supply, such as renewables, but in the near term, shifting from coal to natural gas can be a more efficient and effective solution. As such, global demand for natural gas in power generation is expected to increase by approximately 40% from 2020-2040.



Source: BP Energy Outlook 2019. \*Renewables include hydroelectric. The projections are based on industry estimates and are no guarantee of future outcomes. Tonnes of oil equivalent (toe)

### The U.S. success story: Natural gas making the largest impact

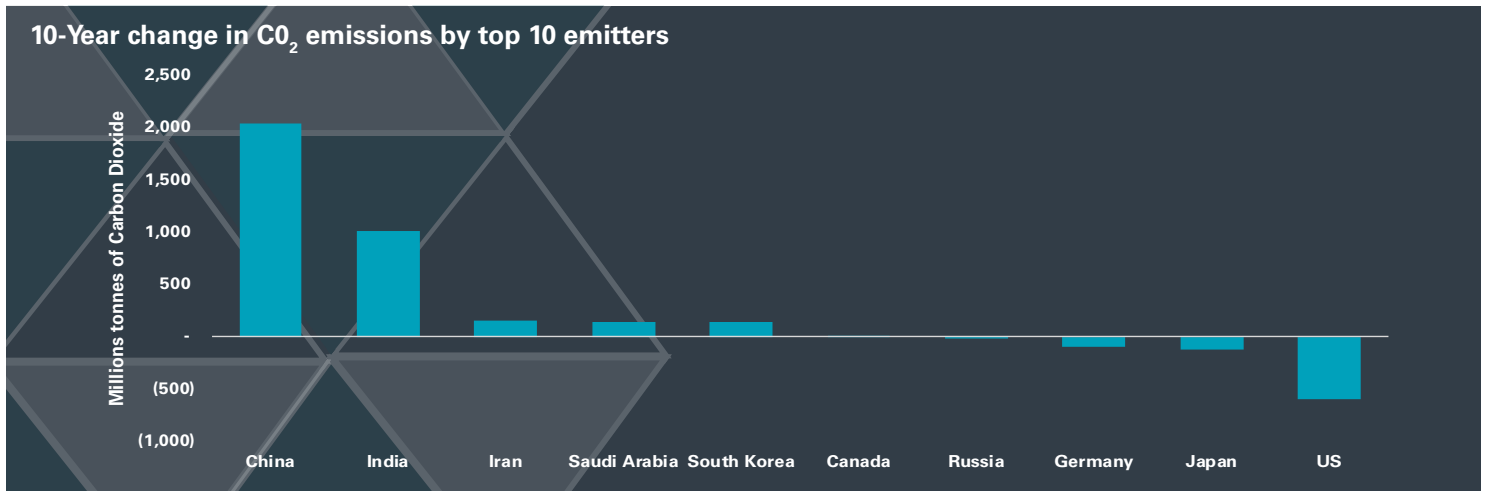
At Tortoise, we believe the future of energy is both natural gas and renewables, resulting in reduced carbon emissions globally. However, the quickest and most efficient way to reduce CO<sub>2</sub> is by replacing coal power generation with natural gas. In the U.S., the substitution of coal for natural gas and renewables has led to a 28% decline in CO<sub>2</sub> emissions from power generation since 2005, as coal consumed for power generation in the U.S. has declined from approximately 50% to approximately 30% currently. As illustrated in the chart below, the shift to natural gas has had the largest impact.



\*2006 - 2017. Source: EIA September 2018: U.S. Energy-Related Carbon Dioxide Emissions, 2017

## U.S. carbon emission reductions over the last 10 years

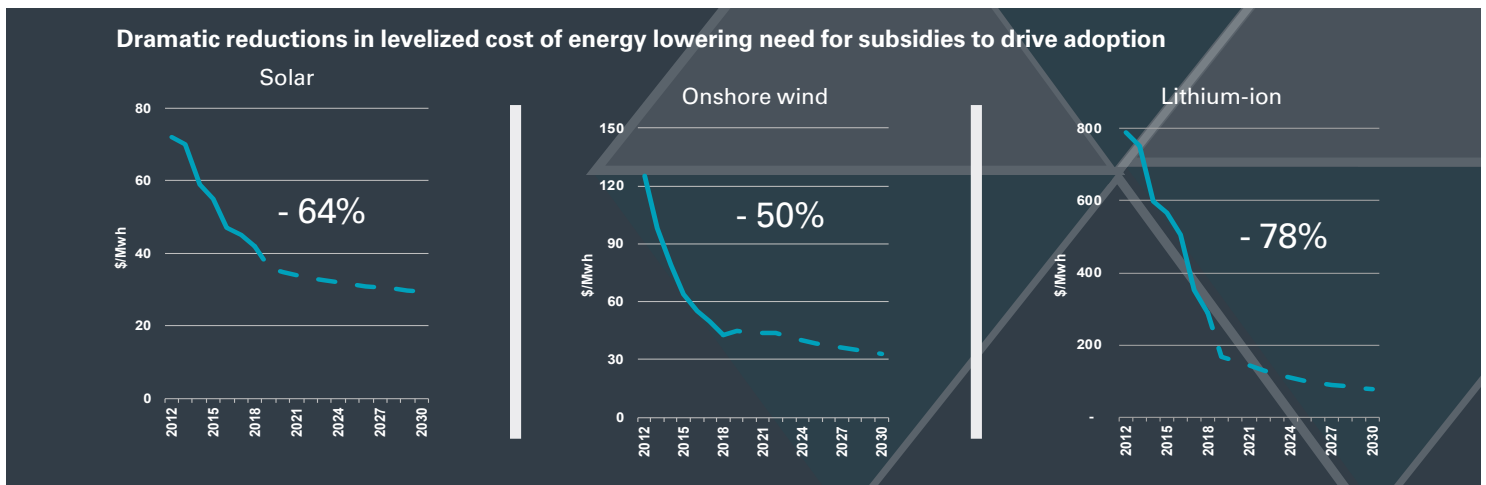
The effects of energy sources on carbon emissions is reflected in the chart below. Germany, known for rigorous growth and adoption of renewable energy sources, made some progress in carbon emission reductions, but not nearly as much as the U.S. With the combination of both natural gas and renewables, the U.S. reduced carbon emissions much more significantly. China and India have increased CO<sub>2</sub> emissions, primarily due to the high usage of coal for energy.



Source: BNEF 2019 New Energy Outlook

## Continued cost reduction should drive renewables growth

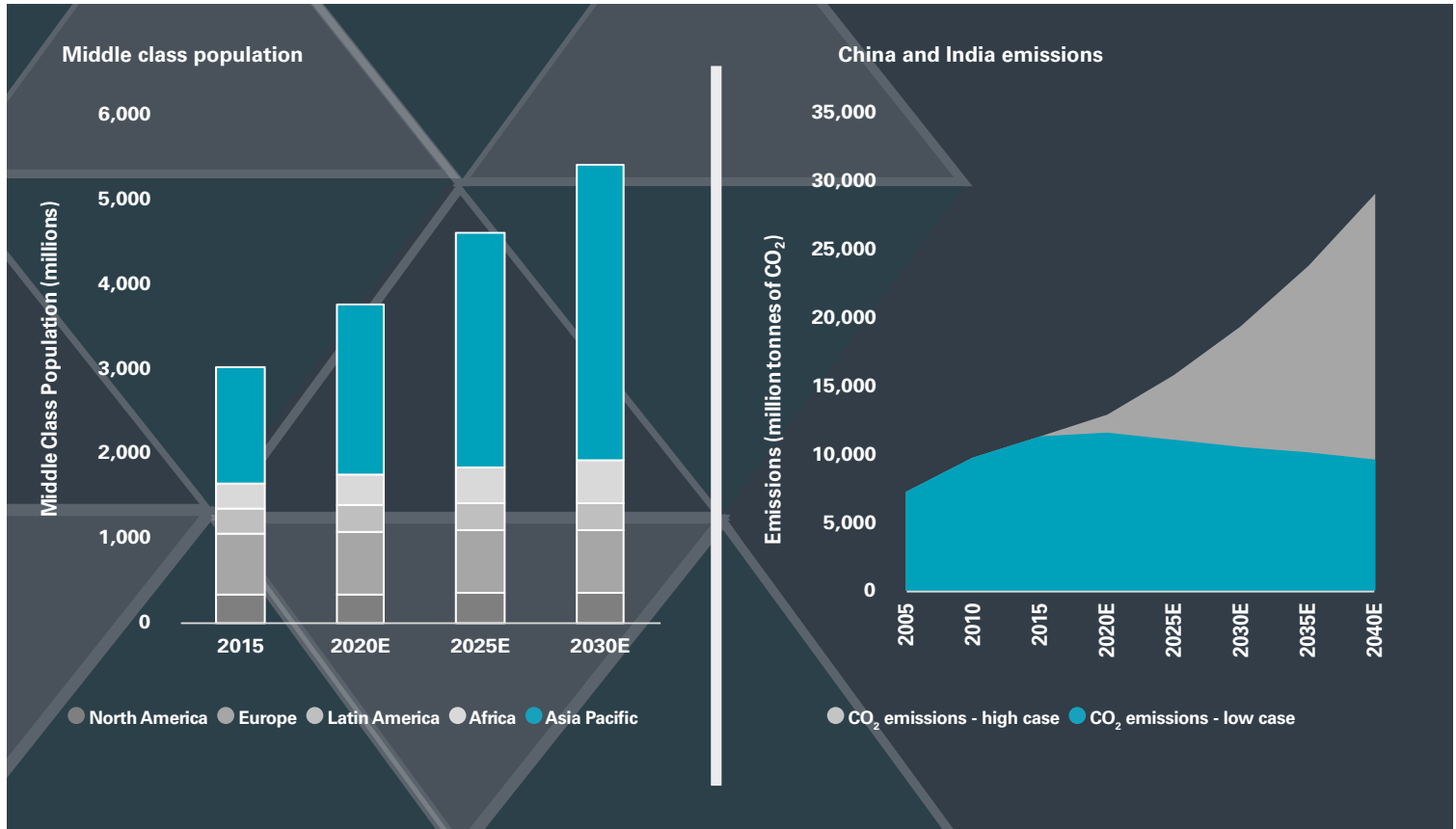
Renewables are gaining traction as technology advancements are dramatically lowering the cost of sustainable energy sources. This should drive continued adoption of renewables, without dependence on subsidies.



Source: BNEF 2019 New Energy Outlook

## China and India: At a critical crossroad

What could the impact be if China and India put themselves on the same path as the U.S.? The chart on the left shows the potential for growth in the world's middle class population, notably in Asia. On the right, the blue section shows what emissions could look like for China and India if they were to reduce emissions by approximately 1% per year, which the U.S. has done since 2005. The results could be staggering. While the world's middle class population grows, the energy transition could propel a lowering of emissions – by switching away from coal to natural gas and renewables.

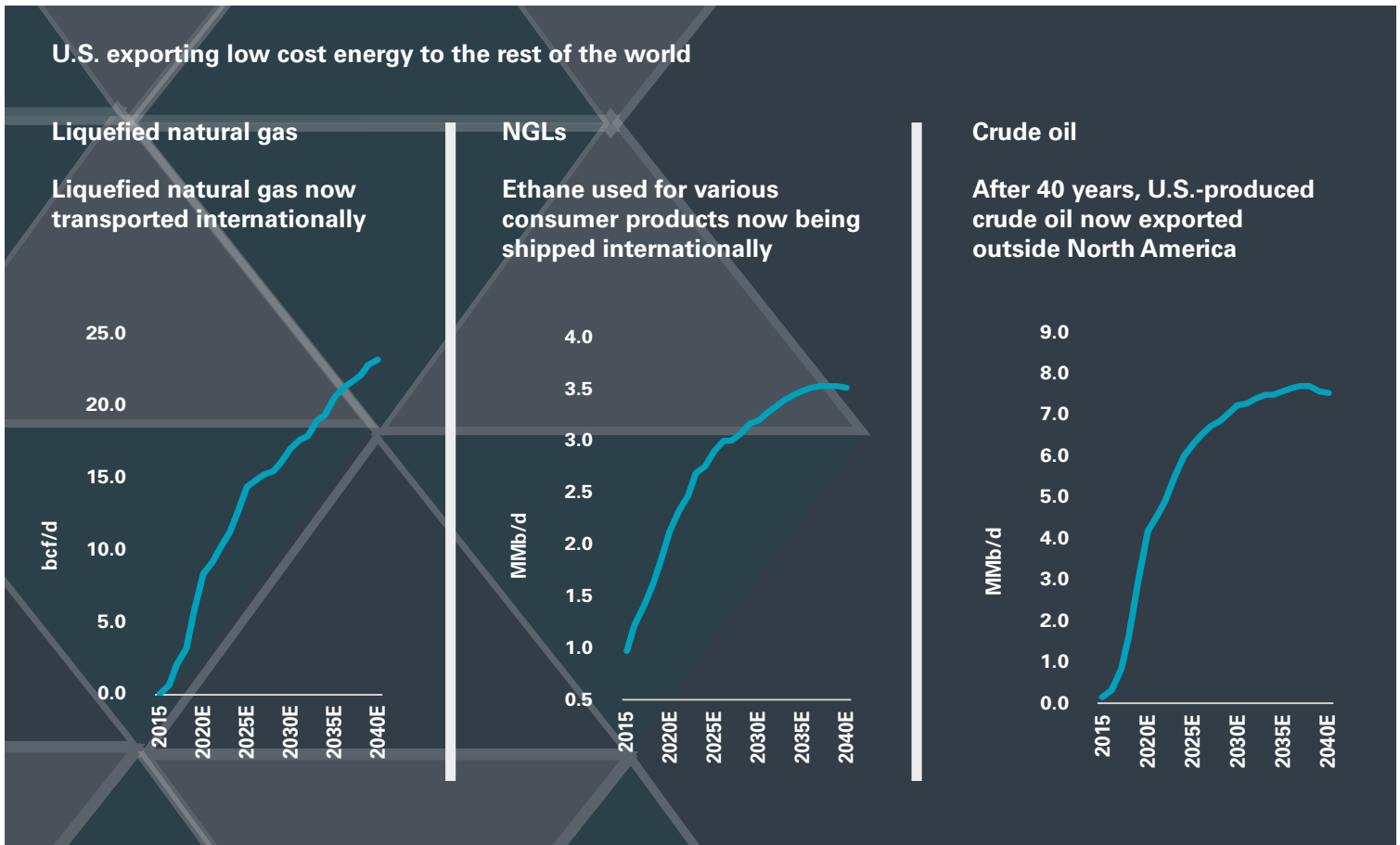


Source: Brookings Institute, BP, Federal Reserve Bank of St. Louis, Tortoise. These charts contains projections, there is no guarantee these projections will be met.



## HOW THE U.S. CAN BE PART OF THE GLOBAL SOLUTION

The U.S. has become a major exporter of low-cost energy to the rest of the world. As emerging countries evolve and seek to provide a better quality of life for their citizens with improved access to electricity and transportation, the United States can provide lower carbon fossil fuels than coal, significantly impacting global carbon emissions.

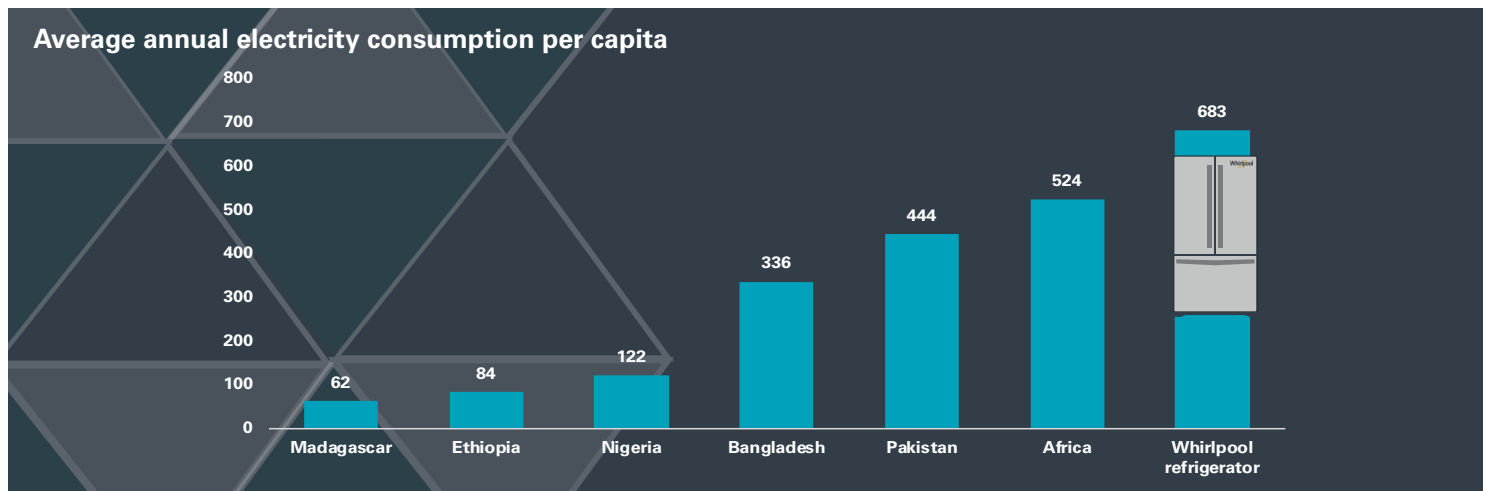


Source: WoodMac, IHS. These charts contains projections, there is no guarantee these projections will be met.

## U.S. EXPORTS: REDUCING POVERTY AND EMISSIONS

Reducing poverty requires access to energy, yet increasing energy use leads to climate concerns because of increased emissions. How do we solve the need for more energy, yet with less carbon? The answer is to transition to natural gas and renewables: The Teal Energy Deal. This energy transition aims to reduce poverty through affordable clean energy, utilizing industry and infrastructure, while taking into account climate action.

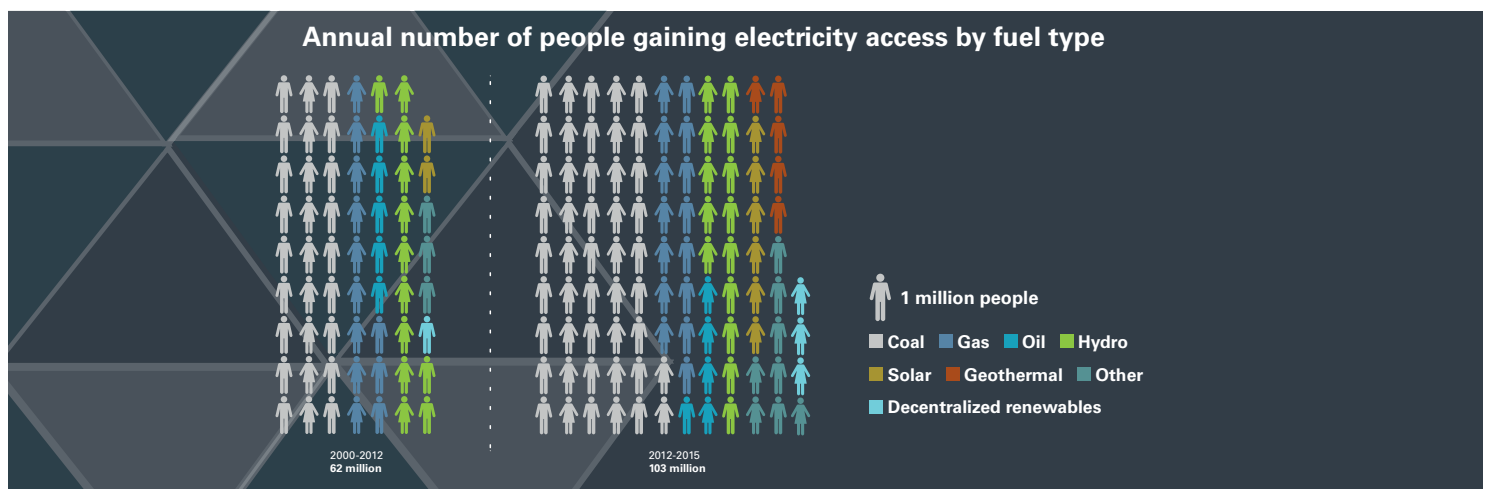
To address economic poverty, one must address energy poverty and future global energy needs. There are approximately one billion people globally without access to electricity, while 53 countries, representing 1.6 billion people or 21% of the world's population, consume less electricity on average annually per capita than a refrigerator. In fact, the UN states that more than 80% of the world's population lives in countries that consume less energy than deemed necessary for proper human development and well-being.



As of 6/30/19. Source: CIA, IEA Energy Access Outlook 2017, Whirlpool.

As emerging countries begin to prosper, more energy is required for electricity and other uses. More than 100 million people gained access to electricity over the three-year period ending in 2015. More than half of that number utilized coal as a primary fuel source.

Coal remains the dominant energy fuel source worldwide, offsetting emission and environmental benefits gained from the adoption of renewables in some countries. Carbon emissions from emerging market countries have skyrocketed, while as highlighted earlier, U.S. emissions have begun to decline due to a greater mix of natural gas and increased renewable penetration. The difference is stark. The U.S. has had declining emissions while China and India have seen dramatic increases.



## THE TEAL ENERGY DEAL ALIGNS WITH THE UNITED NATIONS' SUSTAINABLE DEVELOPMENT GOALS



### SUMMARY

The global energy sector is in transition. Led by electrification, global energy demand is forecast to continue to increase annually over the next several decades. The transition is occurring in the global energy supply mix needed to fuel the growing demand. Natural gas and renewables are replacing coal and this trend is critical globally to lower carbon dioxide emissions. All of this provides a tremendous opportunity for investment as we see at least \$15 trillion needed in global energy infrastructure. As the world transitions to a future with greater power demand, investors have the ability to capitalize on this future energy story. At Tortoise, we believe The Teal Energy Deal is the fastest, least expensive and most realistic way to reduce global carbon emissions.

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