

## Pollution and Clean Energy in Asia

- Development, Carbon Dioxide and Pollution
- Polluted Cities Deteriorating Longevity
- Sources of Power Generation
- Age of Clean Energy to Reduce Carbon Footprints
- Asia Bearing the Brunt of More Natural Disasters

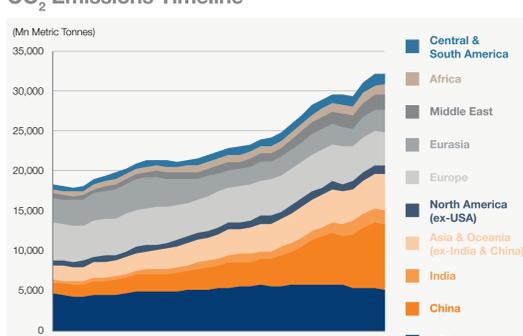
## Are You Invested in Asia?



### Development, Carbon Dioxide and Pollution

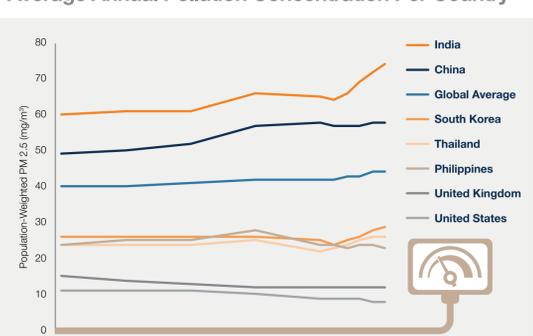
- As the world has industrialized, global carbon dioxide (CO<sub>2</sub>) emissions have grown in tandem from the burning of fossil fuels to power the large-scale economic development during the latter half of the 21<sup>st</sup> century.
- However, in line with the enormous strides made in gross domestic product (GDP), countries in Asia - predominantly India and China - have experienced among the most notable surges in concentrations of pollution.\*

#### CO<sub>2</sub> Emissions Timeline



Source: Bloomberg, Mirae Asset Global Investments (2017)

#### Average Annual Pollution Concentration Per Country



Source: State of Global Air, Mirae Asset Global Investments (2017)

\* Annual Pollution Concentration denotes population-weighted averages to give increasing weight to areas in proportion to population



### Polluted Cities Deteriorating Longevity

- At a local level, 14 of the 20 most polluted cities in the world are located either in India or China, urban areas home to tens of millions that are becoming increasingly aware of related health hazards.
- This toxic smog takes a human toll in the form of higher mortality rates - Asia as a whole makes up 65% of the 83 million years of life lost to outdoor air pollution.

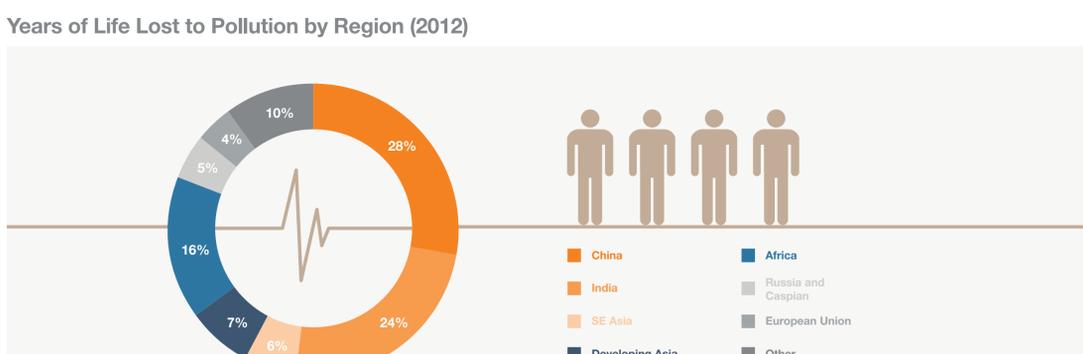
#### Top 20 Most Polluted Cities

| Rank | Country      | City         | Population | Annual Average PM <sub>2.5</sub> (ug/m <sup>3</sup> ) |
|------|--------------|--------------|------------|---|
| 1    | Iran         | Zabol        | 130,642    | 217   |
| 2    | India        | Gwalior      | 2,030,543  | 176   |
| 3    | India        | Allahabad    | 1,315,000  | 170   |
| 4    | Saudi Arabia | Riyadh       | 5,845,000  | 156   |
| 5    | Saudi Arabia | Al Jubail    | 224,430    | 152   |
| 6    | India        | Patna        | 2,240,000  | 149   |
| 7    | India        | Raipur       | 1,385,000  | 144   |
| 8    | Cameroon     | Bamenda      | 440,000    | 132   |
| 9    | China        | Xingtai      | 765,000    | 128   |
| 10   | China        | Baoding      | 1,360,000  | 126   |
| 11   | India        | Delhi        | 25,735,000 | 122   |
| 12   | India        | Ludhiana     | 1,740,000  | 122   |
| 13   | Saudi Arabia | Dammam       | 1,045,000  | 121   |
| 14   | China        | Shijiazhuang | 3,535,000  | 121   |
| 15   | India        | Kanpur       | 3,065,000  | 115   |
| 16   | India        | Khanna       | 128,130    | 114   |
| 17   | India        | Firozabad    | 585,000    | 113   |
| 18   | India        | Lucknow      | 3,260,000  | 113   |
| 19   | China        | Handan       | 1,820,000  | 112   |
| 20   | Pakistan     | Peshawar     | 1,785,000  | 111   |

Source: WHO Global Urban Ambient Air Pollution Database (2016), Mirae Asset Global Investments

Latest dates available (vary between 2010 and 2014)

#### Years of Life Lost to Pollution by Region (2012)



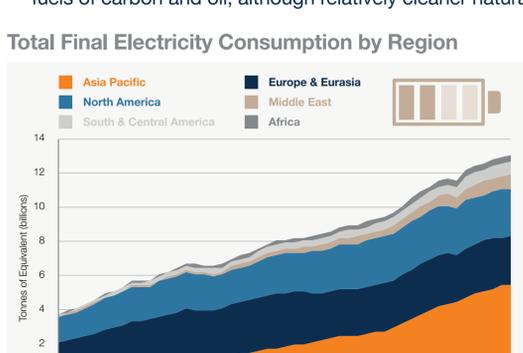
Source: World Energy Outlook, Energy & Air Pollution (2016), Mirae Asset Global Investments



### Sources for Power Generation

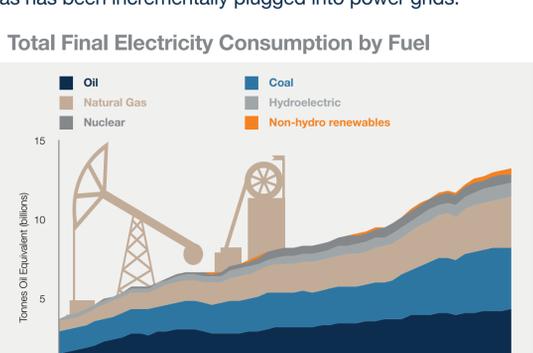
- In 1965, Asia represented approximately 10% of global electricity consumption; in 2015, the region's consumption demand exceeded 40% on the back of massive modernization.
- More than 80% of global energy consumption draws from fossil fuels, historically tilted toward more carbon intensive fuels of carbon and oil, although relatively cleaner natural gas has been incrementally plugged into power grids.

#### Total Final Electricity Consumption by Region



Source: BP Statistical Review of World Energy 2016, Mirae Asset Global Investments

#### Total Final Electricity Consumption by Fuel



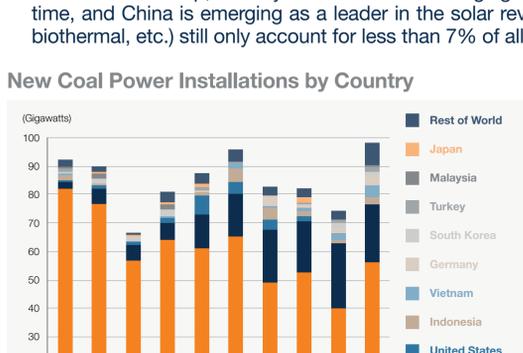
Source: BP Statistical Review of World Energy 2016, Mirae Asset Global Investments



### Age of Clean Energy to Reduce Carbon Footprints

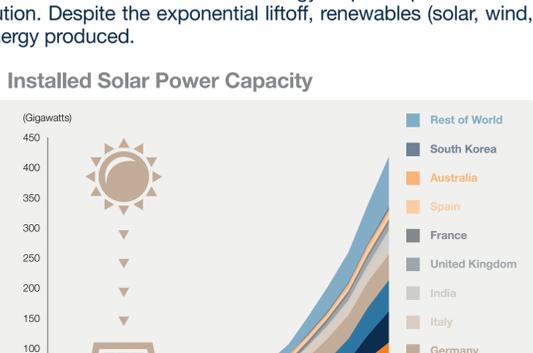
- In Asia, coal remains a major contributor to the electricity demand as more than half of total on lower costs and availability, with hundreds of new coal plant installments expected in decades ahead.
- Amid this backdrop, cost dynamics are ever-changing in favor of renewable sources of energy as prices plummet over time, and China is emerging as a leader in the solar revolution. Despite the exponential liftoff, renewables (solar, wind, biothermal, etc.) still only account for less than 7% of all energy produced.

#### New Coal Power Installations by Country



Source: Global Coal Plant Tracker, Mirae Asset Global Investments (2017)

#### Installed Solar Power Capacity



Source: Bloomberg, Mirae Asset Global Investments (2017)



### Asia Bearing the Brunt of More Natural Disasters

- A discernible uptrend is apparent in the number of global disasters that coincides with the greater release of CO<sub>2</sub> into the atmosphere.
- Asia's vulnerability to risks, as evidenced in the scale of past natural disaster damages, make the shift to renewable energy a pressing issue for the private sector, governments, and society alike.

#### Global Disasters: Value and Frequency



Source: CRED/OFDA International Disaster Database (emdat) - Université Catholique de Louvain, Mirae Asset Global Investments (2017)

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