ABOUT SAUDI ARABIA

• Located on the Arabian Peninsula
• Monarchy – King Salman
• 5th largest Asian country by area
• Population: 32.28 million (2016)
• World's largest oil producer and exporter
• GDP (PPP): $1.75 trillion (2017)
OIL PROFIT

- Represents 1.04% of the world economy
- All time high in 2014 of $756.35 billion
- All time low in 1948 of $4.19 billion
WHO OWNS ELECTRIC

- Saudi Electric Company (SEC)
  - Government-owned company
  - Provide most of the electricity for the country
  - Generation cap of 69 GW (2015)
- Residential - 18 halalas per kWh
  - 30 halalas after 6000 kWh
  - 25 halalas = $0.07
WHO OWNS OIL AND GAS

• Saudi Aramco
  • Government-owned company
  • Manages oil and gas production
  • Works with SEC to provide power
WHAT ENERGY THEY USE NOW

• 60% of electricity relies on petroleum including natural gas, with the rest of their energy coming from solar (25MW) and geothermal (44MW)
• Use of solar and geothermal began in 2016
• First wind turbine built in January 2017
• Very little oil used
  • Make too much in exporting to use
HAWIYAH GAS PLANT

- Hydraulic turbine electric generator, also called a turbocharger, was launched in a pilot demonstration in early 2015
- Converts normally wasted hydraulic energy to electrical power
- 300 kW of anticipated average energy output
- Goals for this technology include lower costs and reduced carbon footprint
- If successful, more turbochargers will be implemented
## ENERGY BREAKDOWN AND COMPARISON TO USA

<table>
<thead>
<tr>
<th>Country</th>
<th>Gross Domestic Product</th>
<th>Energy Production</th>
<th>Electricity Consumption</th>
<th>Carbon Dioxide Emissions</th>
<th>Electricity per Population</th>
<th>Carbon Dioxide per Population</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAUDI ARABIA</strong></td>
<td>$672.21 billion 2010 USD</td>
<td>648.61 Mtoe</td>
<td>313.06 TWh</td>
<td>531.46 Mt</td>
<td>9.93 MWh/capita</td>
<td>16.85 t CO₂/capita</td>
</tr>
<tr>
<td><strong>UNITED STATES</strong></td>
<td>$16597.45 billion 2010 USD</td>
<td>2018.53 Mtoe</td>
<td>4128.51 TWh</td>
<td>4997.50 Mt</td>
<td>12.83 MWh/capita</td>
<td>15.53 t CO₂/capita</td>
</tr>
</tbody>
</table>
FUTURE ENERGY PREDICTIONS

- Power generation capacity will need to expand from 77GW in 2014 to an estimated 156GW in 2040
  - This will require a yearly investment of approximately $5 billion in generation and $4 billion in distribution from the government
- All electric generation will be privatized by 2020
- Improving the country’s energy efficiency by just 4% per year could save the equivalent of 1 million barrels a day of crude oil by 2030
CHANGES ALREADY PLANNED

• To reduce energy waste:
  • Upgrade and replace old transformers, substations, and other infrastructure by 2023.
• To meet power demands:
  • Modernize the power grid and to increase connectivity
• To provide more energy sources:
  • Diversify the sources of energy used including adding more alternative and renewable forms of energy.
  • Installation of solar and wind power sources
RENEWABLE ENERGY OPTIONS

- Hydro
- Biomass
- Geothermal
- Wind
- Solar
- Tidal
GEOTHERMAL

- Geothermal resource exploration started in 1980
  - Aramco
- Large volcanic fields
  - Western region near Jeddah and Makkah
- 10 thermal springs found around 120°C
  - 6 in Jizan
  - 4 in Al-Lith area
GEOTHERMAL

• Desired growth in global installed capacity
  • 10.5 GW to 31 GW by 2020
• Criteria – High Enthalpy
  • Geothermal Fluids <150°C
  • Near volcanic areas
  • Flow Rate <70 L/s
Aramco launches Saudi Arabia's first wind turbine (Jan 2017)
Utilizing these wind stations, average windspeeds at 100 meters were the fastest at 6.73 m/s in 2016.
Utility-scale wind power plants require minimum average wind speeds of 6 m/s (13 mph).
SOLAR ENERGY
## The Cost of Renewable Energy

<table>
<thead>
<tr>
<th>Renewable</th>
<th>Installation Cost</th>
<th>Energy Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal</td>
<td>$3400 per kilowatt</td>
<td>$0.01-$0.03 per kWh</td>
</tr>
<tr>
<td>Wind</td>
<td>$1.3-2.2 Million per MW</td>
<td>$0.082 per kWh</td>
</tr>
<tr>
<td>Solar</td>
<td>$1 per watt</td>
<td>$0.122 per kWh</td>
</tr>
</tbody>
</table>
MOVING FORWARD...

- Saudi Arabia already has plans in place to implement renewable energy. These plans include:
  - Geothermal
    - Expected power output 10.5 GW to 31 GW by 2020
  - Wind Energy
    - Expected power output 400-megawatt wind plant by 2030
  - Solar Energy
    - Expected power output 300 MW for the new photovoltaic project set to begin use in 2018
- The total power output from these changes is 31.7 GW
REFERENCES

- https://www.worldenergy.org/data/resources/country/saudi-arabia/gas/
- https://tradingeconomics.com/saudi-arabia/gdp