

## The Global Energy Challenge: The Intersection of Policy, Technology and Economics



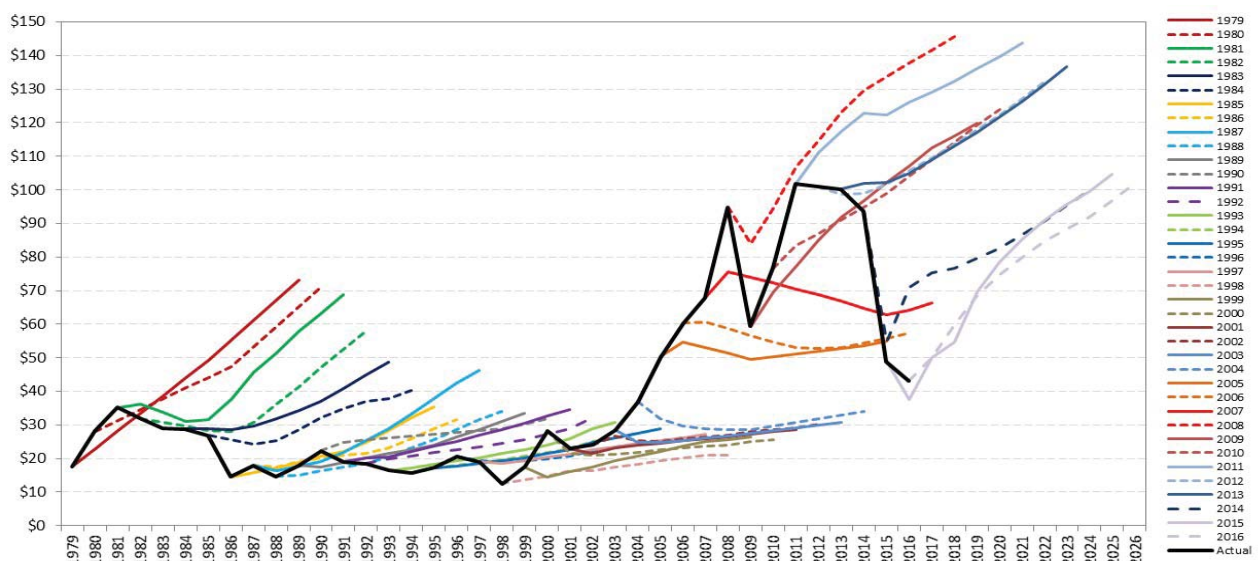
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## Forecasting 101 – Precision is Folly!

- Long term price projections are rarely accurate, and appear adaptive.
- Too much emphasis on the recent past, can ignore long run fundamentals.
- “The best cure for high (low) prices is high (low) prices”



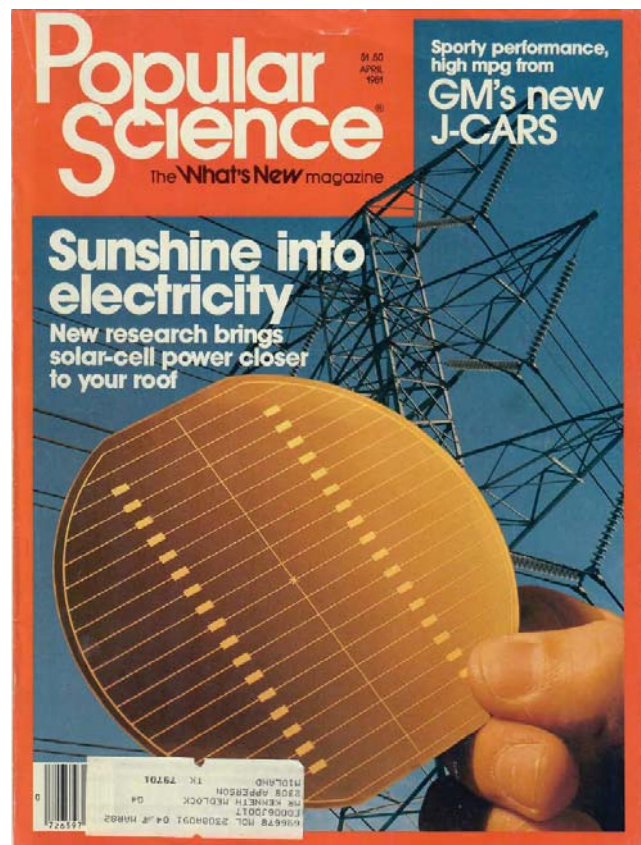
Source: US EIA

## The past, present and future of energy? The story is the picture, but the devil is in the details...



### Does history repeat itself?

- The early 1980s was a period of robust promise for renewable energy and distributed generation. Why?
  - High oil prices and energy security.
  - Natural gas supply concerns.
- What happened?
  - Incumbent fuel costs fell and efficiency increased.
  - Fixed costs of adoption matter.
  - Coal expanded.
- How is the present different?
  - Costs are lower and coal is encumbered, each aided by policy.
  - Energy *and* environmental security.
  - Natural gas supply is robust.
- Are recent developments lasting?



## This is a *long run* story...

- Economic growth and population drive energy demand. As such, developing nations, not developed nations, will dictate future energy demand growth as well as composition, or the “energy mix”.
- Technology, scale and legacy are each important factors.
  - Technology signals how fuels will ultimately compete. This can work in multiple, sometimes competing, directions by raising the efficiency of use of existing fuels *and* by introducing new competitive energy sources.
  - Scale matters because energy systems must accommodate expanding access.
  - Legacy of infrastructure and fuel delivery systems is the footprint for change.
- Scale and legacy affect the diffusion of new technology.
- Economics matter. The cost-benefit must be favorable for sustainable diffusion of new technologies because, in the long run, fundamentals win.
- Finally, policy and geopolitics shape, and are shaped, by all of the above.

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## Closing Remarks

- Non-OECD nations comprise 6.1 billion people compared to 1.3 billion in the OECD. Non-OECD developments will dictate the future of energy.
- New technologies will play a critical role, but scale-up can be a challenge.
  - Rapid EV diffusion requires infrastructure overhaul, rapid build-up of vehicle production capacity, and assurances of no supply chain constraints.
  - Renewables will capture market share, but they face supply chain challenges, some of which have yet to be realized.
- When considering the entry of new technology, one cannot forget that price response is dynamic, so no one extreme change can occur without a reaction that re-establishes competitive margins.
- Energy efficiency is a virtual source of supply. It will play a significant role in defining the economic viability of energy sources by establishing the “cost of service” for energy-intensive activities.
- There are many “frontier” resources, which will have significant bearing on markets and price for next 20+ years.
- And, of course, laying over it all, is the shifting geopolitical landscape.

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