Nuclear Power: The Jobs Myth

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Nuclear energy today

Source: https://media.farsnews.ir/Uploaded/Files/Images/1400/12/16/14001216000113_Test_PhotoN.jpg
The best days of nuclear construction are over three decades ago.
Share of Electricity

About 40 percent below historical maximum of 17.5 percent in 1996

Source: Calculations using data from BP’s Statistical Review of World Energy 2021
IAEA Projections

Nuclear power is not economically competitive: reactors cost too much to build
Other sources of electricity are cheaper… and becoming cheaper

Source: data from Lazard, as plotted in World Nuclear Industry Status Report 2021

Selected Historical Mean Costs by Technology

LCOE values in US$/MWh *

- Nuclear: 123 → 163
- Coal: 111 → 112
- Gas - Combined Cycle: 83 → 59
- Wind: 135 → 41
- Solar PV-Crystalline: 359 → 37

* Reflects total decrease in mean LCOE since Lazard’s LCOE VERSION 3.0 in 2009.

Several reactors shutting down because of high operational costs and cheap alternatives

Another Reactor Closes, Punctuating New Reality for U.S. Nuclear Power

As Vermont Yankee shuts down, the U.S. has yet to address industry issues that span decades.

By Christina Nunez, National Geographic
PUBLISHED JANUARY 31, 2016

Nuclear Renaissance

Source: My calculations, based on IAEA PRIS data
### Nuclear Renaissance - USA

<table>
<thead>
<tr>
<th>What was expected</th>
<th>What Materialized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Around 30 reactors ordered</td>
<td>Only 4 reactors began construction</td>
</tr>
<tr>
<td>Nearly 15 GW of new capacity before 2021</td>
<td>2 reactors abandoned after $9 billion spent</td>
</tr>
</tbody>
</table>

What’s left?

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*Southern Company’s Troubled Vogtle Nuclear Project*  
Units 3 and 4 Now Expected to Cost More Than $30 Billion and Are at Least Six Years Behind Schedule
Nuclear Renaissance - UK

EDF will turn on its first nuclear plant in Britain before Christmas 2017 because it will be the right time…It is the moment of the power crunch. Without it the lights will go out.” Vincent de Rivaz, EDF, 2007.

Hinkley Point C Cost has gone up from 16 to 22 billion pounds

According to World Nuclear Association, April 2011

<table>
<thead>
<tr>
<th>Proponent</th>
<th>Site</th>
<th>Type</th>
<th>Capacity (MW(e) gross)</th>
<th>Start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFR Energy*</td>
<td>Hinkley Point C, Somerset</td>
<td>FPR x 2</td>
<td>3340</td>
<td>Late 2017 &amp; mid-2019</td>
</tr>
<tr>
<td>FFR Energy*</td>
<td>Sizewell C, Suffolk</td>
<td>LFR x 2</td>
<td>3340</td>
<td>2020 &amp; 2022</td>
</tr>
<tr>
<td>Horizon (RWE + E.ON)</td>
<td>Oldbury B, Gloucestershire</td>
<td>FPR x 2 or AP1000 x 3</td>
<td>3340-3750</td>
<td>2022</td>
</tr>
<tr>
<td>Horizon (RWE + E.ON)</td>
<td>Wylfa B, Wales</td>
<td>FPR x 3 or AP1000 x 4</td>
<td>3340-3750</td>
<td>2022</td>
</tr>
<tr>
<td>NuGeneration (Iberdrola, GDF-Suez, Scottish &amp; Southern)</td>
<td>Sellafield, Cumbria</td>
<td>?</td>
<td>Up to 3000</td>
<td>2020</td>
</tr>
<tr>
<td>Total planned &amp; proposed</td>
<td></td>
<td></td>
<td>Up to approx 10,000 MW(e)</td>
<td></td>
</tr>
</tbody>
</table>

The WNA Reactor Database has 4 LFRs as “planned” (8600 MW(e)) and 9 units (12,000 MW(e)) “proposed”
Will Small Modular (Nuclear) Reactors solve the problems of nuclear power?
What are Small Modular Reactors?

<table>
<thead>
<tr>
<th>Capacity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>&lt; 300 MWe</td>
</tr>
<tr>
<td>Medium</td>
<td>300 to 700 MWe</td>
</tr>
</tbody>
</table>

Assembled from factory-fabricated modules

Each module represents a portion of finished plant
All properties will not be realizable in a single design.
Small also means...

More cost

More spent fuel/waste/proliferation risk
“Learning” might make plants more expensive

Even if there was learning, too many “loss leaders” have to be built


Schematic comparison of cost of electricity generation from SMRs, large reactors, and modern renewables
The Jobs Dilemma

Will investing in SMRs create jobs?

Yes - but that is the wrong question

Will the number of jobs created by investing a certain amount of money in SMRs exceeds the number of jobs created by investing the same amount of money in a different low-carbon energy technology?
The Oklo Example

“expected to be installed as part of the clean energy grid in remote and off-grid communities, of populations around 1,000 or more”

“approximately 15 full-time jobs...available to local residents with a high school education...up to 40 temporary construction employees”

Economic Implications

1.5 MW plant => 11826 MWh at 90 percent CF

Annual pay for US nuclear power plant operators, distributors, and dispatchers = $111,220 (in 2021)

Operating labour expenses = 15 X annual pay/energy = $141/MWh (cost of electricity assuming zero cost for building reactor and buying fuel and dealing with waste and...), which is roughly four times solar and wind
Efforts to reduce requirements for operators

"in the area of operators...our (StarCore) plant will be fully automatic, and will not need any onsite. However, we are planning to have operators on the first plant, and they will be trained and certified in accordance with CNSC requirements. We will keep them at the plant until we are convinced that our automatic controls meet all of the requirements, and we can make the safety case to CNSC to take the on-site operators off."

https://www.nuclearsafety.gc.ca/eng/pdfs/Discussion-Papers/16-04/DIS-16-04-comment-received-StarCore.pdf
The more labor which can be performed in a factory, the lower the over all costs... Factory manufacture lowers labor costs in several ways. First serial production leads to the division of labor, which in turn typically increases labor productivity. The division of labor decreases the skill set required from individual workers. Decreased labor skill sets decrease labor wage expectations. Factory work settings, as opposed to field work settings also decrease wage expectations. Thus serial production of small reactors in factories would tend to lower labor costs of nuclear manufacture.

More jobs => more uneconomical
Academic Studies

A sunset industry?

Sa-90 High Bias Audio Cassette
Brand: TDK

Price: $14.96

Get a $15 Amazon Gift Card instantly, plus up to 5% back for 6 months after approval.

Report incorrect product information.

NAC has always been proud to say our cassettes are made in the USA. For decades National Audio has assembled and loaded custom lengths of cassette tapes using domestic and imported parts. We have been a service for library systems and education producing books, magazines and tests on cassette. When large audio production houses and music labels stopped producing cassettes, National Audio began accumulating equipment to become the largest duplicator of music recordings on tape as well. Now, some of the larger companies that got out of the audio tape duplication business are regular customers of National Audio Company.

Recently, new capabilities have been added so the magnetic tape itself is also manufactured here in our facility in Springfield, Missouri, USA. The sources for the tape we used over the years no longer
Conclusion

Nuclear energy facing severe economic challenges
Priority for industry is reducing jobs
Nuclear jobs - more geographically concentrated and high paying => more political power