

## Davis-BesseNPEm Resource

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The following eight pages reproduce the slides that were used in the presentation by A. Compaan on 12/18/2010. Minor formatting changes were made and references moved beneath the related slides.

## The case for replacing Davis Besse with efficiency improvements and renewable energy sources

Davis Besse re-licensing community hearing  
St. Mark's Episcopal Church, Toledo, OH  
December 18, 2010

Alvin D. Compaan  
Distinguished University Professor of Physics, Emeritus  
The University of Toledo

### Overview of presentation

1. History of Davis Besse indicates that 20 more years of operation will seriously endanger the surrounding communities.
2. Davis Besse provides only 8.3% of First Energy's base-load generation and can readily be replaced.
3. Ohio Senate Bill 221 and the Advanced Energy Standard **requires** FE to:
  - achieve higher efficiency by reducing demand 22% by 2025,
  - achieve 12.5% generation from renewables by 2025,
  - achieve 12.5% generation from "advanced energy" by 2025, which may include **new advanced nuclear**, but a continuation of D-B will not qualify.
4. Distributed Generation will qualify for SB 221 credit.
5. Alternative sources are very attractive in Ohio:
  - Wind near or in Lake Erie (class 3 to class 6 -- better than Texas!)
  - Solar PV (costs are decreasing rapidly; FE used data 14 years old!)

## What happens to the highly radioactive spent fuel rods?

- Expectation when Davis Besse was built—a federal repository would be constructed for storing the high level radioactive components as needed for thousands of years.
  - Yucca Mountain—still does not have an operating license and no funding was proposed in the federal 2011 budget.
  - For 33 years, all high-level radioactive components including fuel assemblies have been stored on site at Davis Besse. Initially in a cooling pond and then in above-ground containers.
- ***No nuclear plant license extensions should be granted until a long-term storage facility is operating.***

## A troubling indicator: *Where does the tritium in the Davis Besse ground water come from?*

**From Appendix E: Davis Besse Environmental Report p. 2.3-2:**

“Another well, MW-105A, which has been on a slow increasing trend since the spring of 2009, had a tritium level of 4,158 pCi/l. As a result, FENOC is pursuing a root cause approach to identify the source of the tritium in the wells. No tritium concentrations have been detected at or above the USEPA drinking water limit of 20,000 pCi/l (40 CFR 141.66).”



## About tritium and its radioactivity:

- Tritium or hydrogen-3 (1 proton and 2 neutrons) is not naturally occurring. It has a half-life of 12.3 years.
- Tritium is produced in nuclear reactors by neutron bombardment of Lithium-6 and Boron-10. [A small amount is produced in the upper atmosphere by cosmic rays.]
- Tritium is radioactive and decays by emitting a high energy electron (beta particle) plus an anti-neutrino.
- The beta particle has an average energy of 5.7 kilo-electron volts. It will not penetrate the outermost skin layers but is very dangerous if inhaled as hydrogen (H<sub>2</sub> or HT) or water vapor or swallowed as water—not H<sub>2</sub>O but as HTO.

## Excellent alternatives exist to extending the license 20 years and their costs are declining

- The incident and accident record of Davis Besse and the uncharted territory of extending the life of any nuclear plant 20 years beyond the 40-year design life of the original should stimulate FE to get serious about alternatives.
- The best alternatives for Ohio are (IMHO):
  1. Energy conservation
  2. Wind
  3. Solar
- *These are already mandated by the State of Ohio. FE is required to develop these alternatives anyway AND is allowed by Ohio law to pass the costs through to the ratepayers.*

# Essential features of SB221

(passed in the spring of 2008)

## 1. Alternative Energy Portfolio Standard (O.R.C. 4928.64-.65)

- 25% electricity generation by advanced energy by 2025
- 12.5% by renewables with solar set-aside of 0.5%
- Remaining 12.5% may include “advanced energy” such as:
  - Clean coal (w/o CO<sub>2</sub> emissions)
  - Advanced nuclear (NRC Generation III technology) [Gen III incorporates *passive safety systems* and is *designed* for 60 years of operation]

## 2. Net metering (O.R.C. 4928.67, 4905.31, 4928.01)

## 3. Energy Efficiency Standard (O.R.C. 4928.66)

- 22% reduction by 2025 through energy efficiency
- 7% peak demand reduction by 2018

➤ Costs may be passed through to customers!



## Ohio Senate Bill 221 Alternative Energy Portfolio Standard

Alternative Energy Technologies	2025 R.P.S. Benchmarks	In-State Requirements	Renewable Energy Credits	Enforcement/ Compliance Payments																																																			
<b>Renewable</b> ORC 4928.01(A)(35) <ul style="list-style-type: none"> <li>• Solar – Photovoltaic</li> <li>• Solar – Thermal</li> <li>• Wind</li> <li>• Hydropower</li> <li>• Certain Solid Waste</li> <li>• Biomass</li> <li>• Bio-Methane Gas</li> <li>• Fuel Cells</li> <li>• Wind Turbines – Lake Erie</li> <li>• Off Peak Storage Facilities Utilizing Renewables</li> <li>• Distributed Generation Facilities Utilizing Renewables</li> </ul>	Renewable and Solar Benchmarks: 12.5% + ORC 4928.64(B)(2) <table border="1"> <thead> <tr> <th>Y</th> <th>R</th> <th>S</th> </tr> </thead> <tbody> <tr><td>2009:</td><td>.25%</td><td>.004%</td></tr> <tr><td>2010:</td><td>.50%</td><td>.010%</td></tr> <tr><td>2011:</td><td>1.0%</td><td>.030%</td></tr> <tr><td>2012:</td><td>1.5%</td><td>.060%</td></tr> <tr><td>2013:</td><td>2.0%</td><td>.090%</td></tr> <tr><td>2014:</td><td>2.5%</td><td>.120%</td></tr> <tr><td>2015:</td><td>3.5%</td><td>.150%</td></tr> <tr><td>2016:</td><td>4.5%</td><td>.180%</td></tr> <tr><td>2017:</td><td>5.5%</td><td>.220%</td></tr> <tr><td>2018:</td><td>6.5%</td><td>.260%</td></tr> <tr><td>2019:</td><td>7.5%</td><td>.300%</td></tr> <tr><td>2020:</td><td>8.5%</td><td>.340%</td></tr> <tr><td>2021:</td><td>9.5%</td><td>.380%</td></tr> <tr><td>2022:</td><td>10.5%</td><td>.420%</td></tr> <tr><td>2023:</td><td>11.5%</td><td>.460%</td></tr> <tr><td>2024:</td><td>12.5%</td><td>.500%</td></tr> </tbody> </table>	Y	R	S	2009:	.25%	.004%	2010:	.50%	.010%	2011:	1.0%	.030%	2012:	1.5%	.060%	2013:	2.0%	.090%	2014:	2.5%	.120%	2015:	3.5%	.150%	2016:	4.5%	.180%	2017:	5.5%	.220%	2018:	6.5%	.260%	2019:	7.5%	.300%	2020:	8.5%	.340%	2021:	9.5%	.380%	2022:	10.5%	.420%	2023:	11.5%	.460%	2024:	12.5%	.500%	At least 1/2 of renewable energy resources to be implemented by the utilities shall be met through facilities located in Ohio.  The remainder shall be met with resources that can be shown to have been delivered into this state. ORC 4928.64(B)(3)	Utilities may use R.E.C.s in any of the 5 calendar years following acquisition to comply with both the renewable and solar energy resource requirements.  1 R.E.C. shall equal 1 Mwh Hour of electricity from renewable resources. ORC 4928.65	1) <b>Annual PUCO Review</b> ORC 4928.64(C)(1)  2) <b>If Not in Compliance:</b> ORC 4928.64(C)(2) A) Solar Benchmark \$ per Mwh hour : 2009: \$450 2010: \$400 2012: \$350 2014: \$300 2016: \$250 2018: \$200 2020: \$150 2022: \$100 2024: \$50  B) Renewable Benchmark 2009: \$45 Adjusted annually per CPI
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<b>Advanced</b> ORC 4928.01(A)(34) <ul style="list-style-type: none"> <li>• Clean Coal</li> <li>• Advanced Nuclear</li> <li>• Energy Efficiency</li> <li>• Fuel Cells</li> <li>• Co-gen</li> <li>• Certain Solid Waste</li> </ul> Mercantile Sited ORC 4928.01 (A)(1) <ul style="list-style-type: none"> <li>• Real/Reactive Power</li> <li>• Waste Heat Efficiency</li> <li>• Demand/Load storage</li> <li>• Advanced/Renewable</li> </ul>	Advanced Energy Requirement: 12.5% ORC 4928.64(B)(1)																																																						

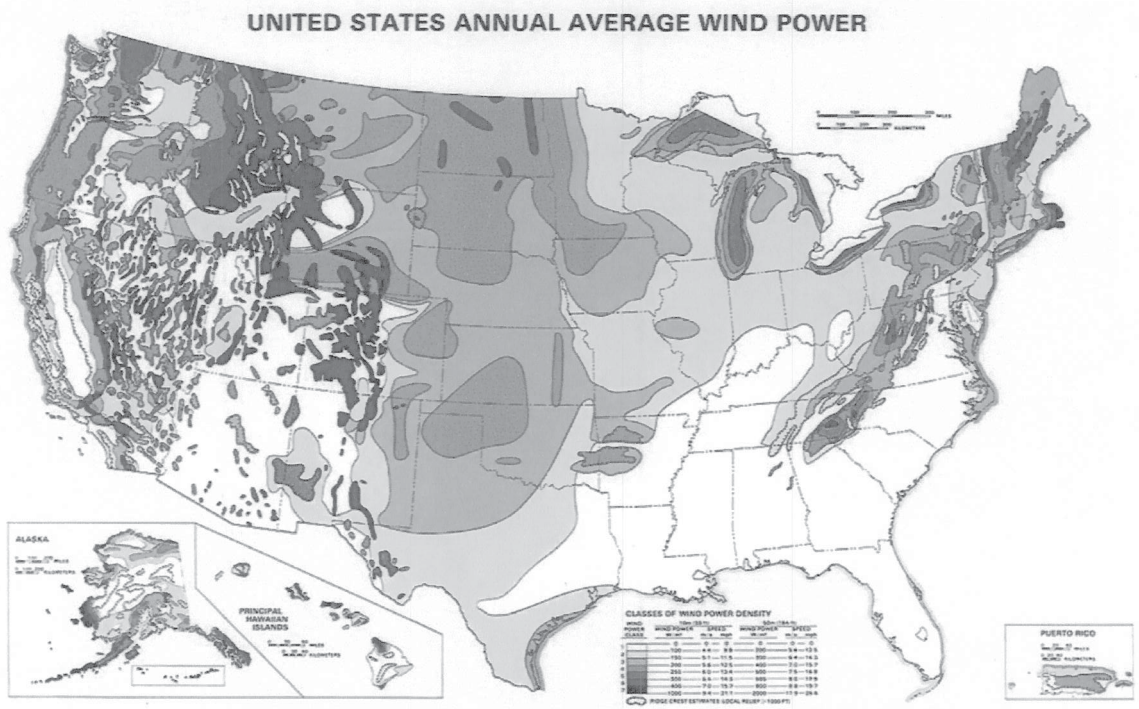
### Key A.E.P.S. Cost Containment Mechanisms

3% Cost Cap	Force Majeure Provision
Utilities not required to comply with benchmark to the extent compliance will result in 3+% increase in electricity production or acquisition costs. ORC 4928.64(C)(3)	Utility may request PUCO to determine whether renewable resources are sufficiently available to enforce R.P.S. benchmark requirement. If utility shows good faith effort to comply with renewable benchmarks but cannot, PUCO may reduce obligation. Modification does not automatically reduce future benchmarks. ORC 4928.64(C)(4)

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Lake Erie and the Lake Erie shore is a great resource for wind energy

Map showing average wind power in Lake Erie better than Texas and the plain states



<http://rredc.nrel.gov/wind/pubs/atlas/maps.html>

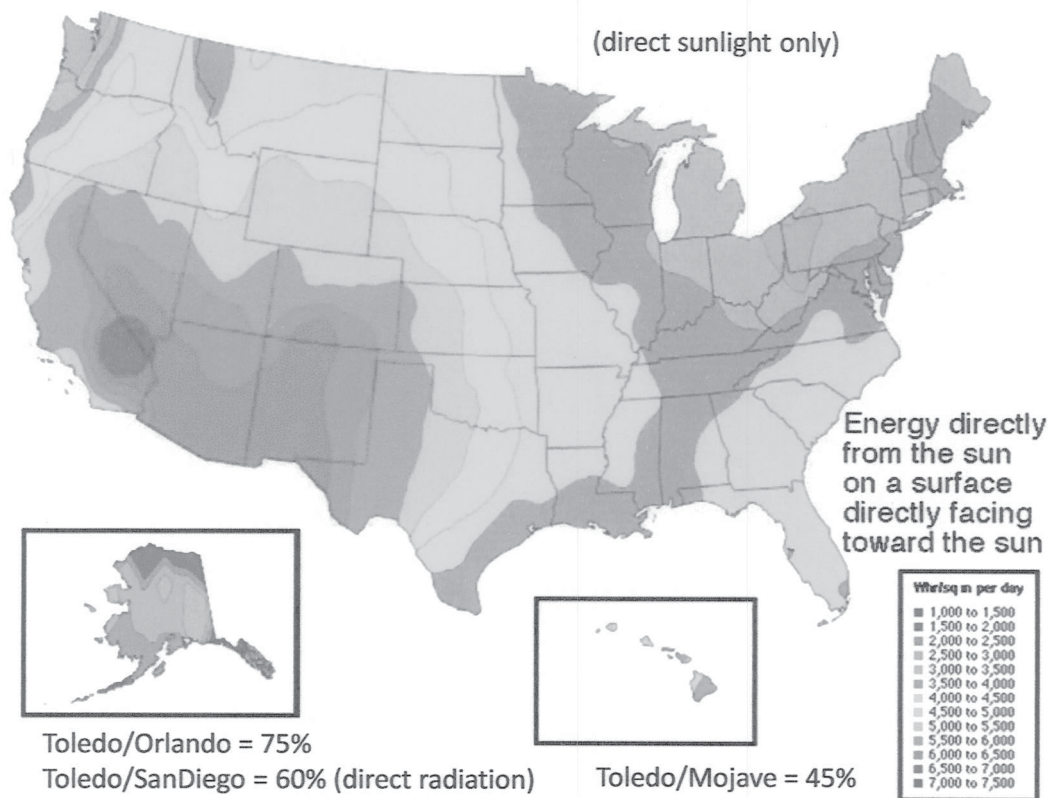


## Ohio, and particularly NW Ohio, has excellent solar insolation well-suited for photovoltaics (PV)

Errors in the First Energy Environmental Report (Appendix E):

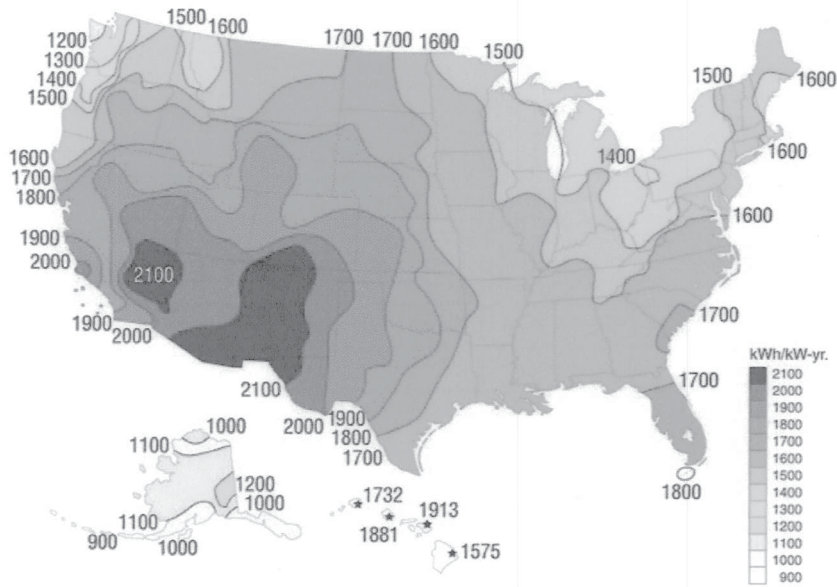
- must consider full-sky insolation, not just direct solar
- must use current costs and cost projections for PV, not data from 1998!

### Average Daily Solar Radiation 1961-1990



<http://www.nrel.gov/gis/solar.html>

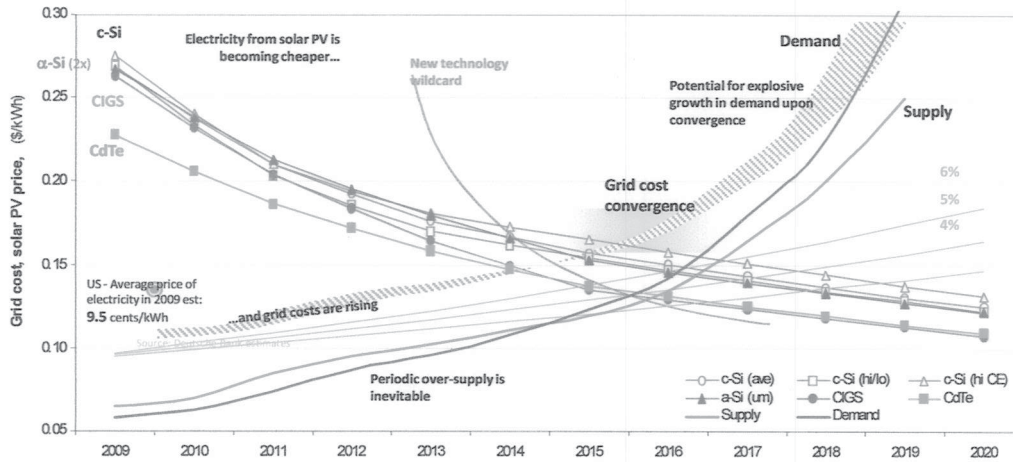
# PV Energy kWh/kW-yr



Toledo/Orlando = 86%      Toledo/San Diego = 79% (full sky radiation)

## Electricity Price Convergence – 5 to 6 Years

Solar PV industry – long-term outlook



### Definitions:

- First Generation PV: bulk crystalline silicon (monocrystalline, multicrystalline)
- Second Generation PV: Inorganic thin films (CdTe, a-Si:H, a-SiGe, nc-Si:H, CIGS)
- Third Generation PV: nanostructures, organic/hybrid, advanced concepts

Source: Deutsche Bank 2009

<http://www.slideshare.net/gwsolar/pv-status-and-pathways-stephen-orourke>

# Stimulating alternatives creates Ohio jobs

- **Energy conservation / efficiency** is a big job creator and saves the consumer money.
- Ohio has a large number of manufacturers that are suppliers for **wind turbines**.
- **Maintenance** of wind turbines creates many jobs.
- In 2009 the largest PV manufacturer in the world was First Solar with all of its U.S. **manufacturing** in Perrysburg.
- Several other PV manufacturers are starting up in Ohio.
- **PV design and installation** creates many jobs.

## References

<http://www.bricker.com/documents/publications/1533.pdf>  
<http://rredc.nrel.gov/wind/pubs/atlas/maps.html>  
<http://www.nrel.gov/gis/solar.html>  
<http://www.slideshare.net/gwsolar/pv-status-and-pathways-stephen-orourke>

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