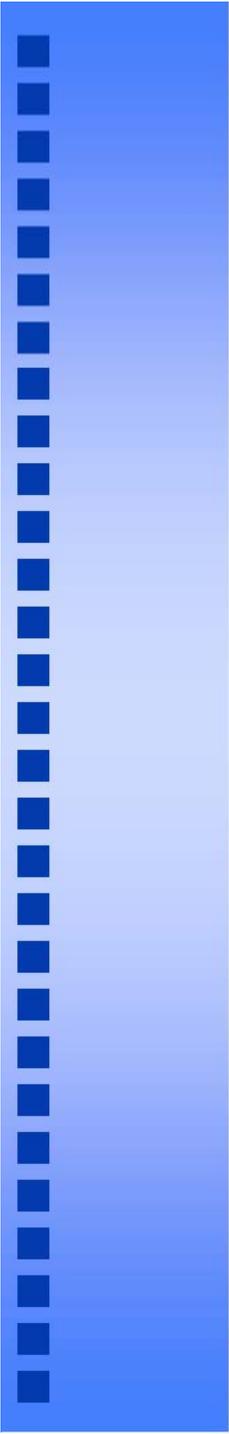


Impact of Carbon Charges on Generation Mix with Elasticity of Demand

Presented at the 20th Annual North American
Conference of the USAEE/IAEE

August 31, 1999

by Stan Hadley



Basic effects of carbon charges

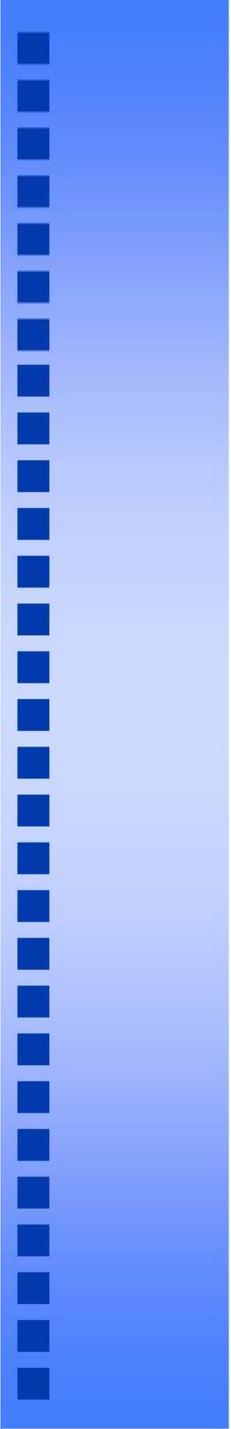
- Raise variable cost of coal relative to other fuels
 - Coal generation called on less often
 - Less generation to cover fixed costs lower profitability
 - Low-carbon technologies displace coal
- Raise electricity prices
 - Marginal-based prices affected more than the average
 - Benefits low- and non-carbon sources
 - Lowers electricity demand

ECAR region used in study

- Coal-intensive region
- Ohio PUC and EPA interested in study
- Year 2010 modeled
- Power plant and demand data available from the PUC, RDI, and EIA

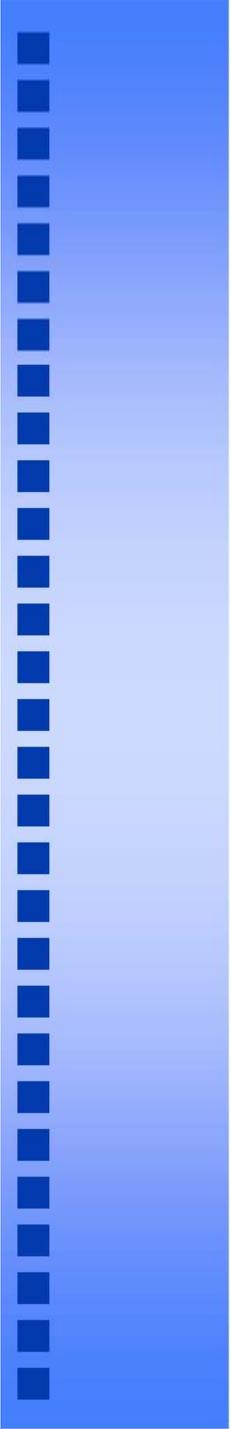
Generation Capacity

Source	Ohio	ECAR	National
Coal	86%	82%	51%
Gas	3%	7%	20%
Nuclear	3%	7%	20%
Oil	2%	3%	8%
Hydro	0%	1%	5%



ORCED Model

- Bulk power market with marginal cost pricing
- One- and two-region versions
- Up to 51 power plants
- Covers one year only
- Microsoft Excel
- Allows optimization through Excel add-ins
- Used in carbon emission and restructuring studies
- Soon available at <http://www.ornl.gov/ORCED>

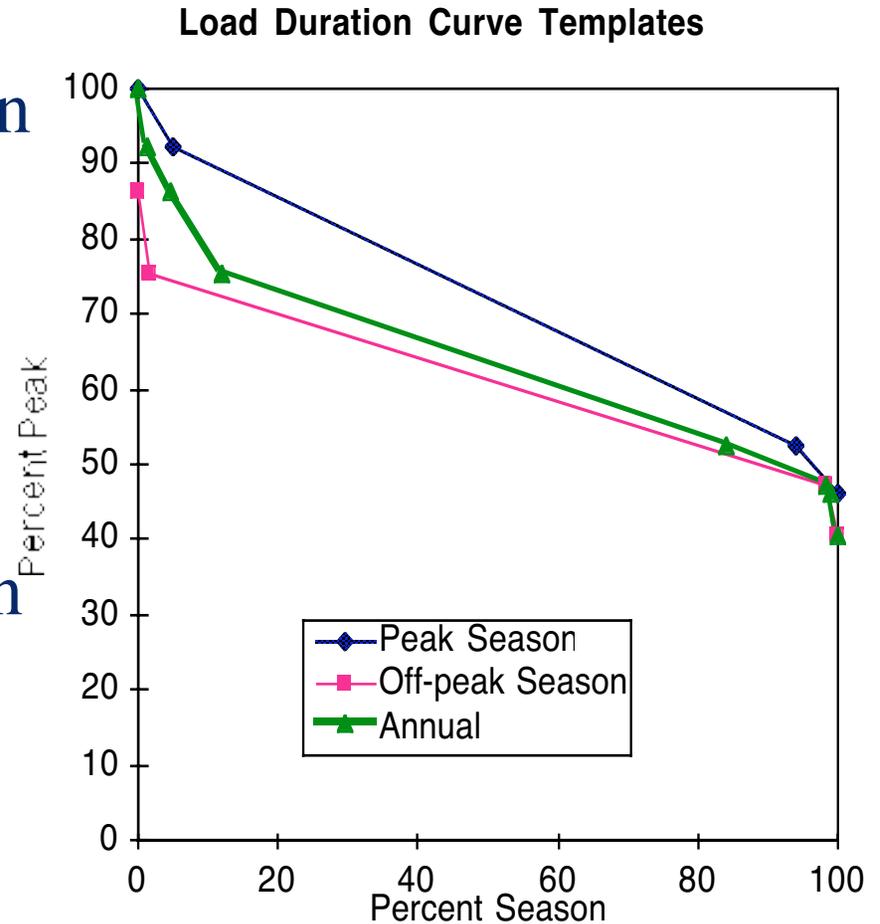


ORCED Data Details

- Plants in region put in 50 bins
- All hydro put in 51st
- Representative parameters input
 - Capacity
 - Fuel cost
 - Heat rate
 - Fixed and variable O&M
 - Capital cost and year of construction
 - Planned and forced outage rates

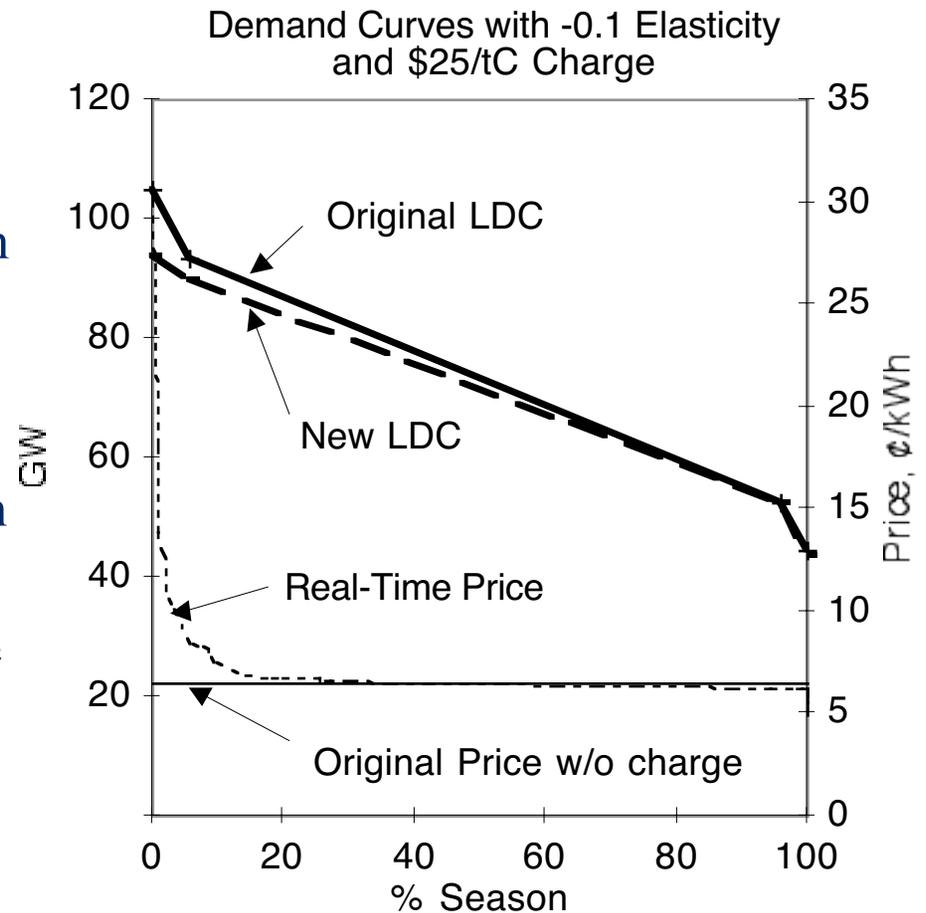
Load Duration Curves Define Demands

- Two seasons based on hourly load data
- Three-segment LDC calculated for each period
- LDC's for sectors can be calculated and combined



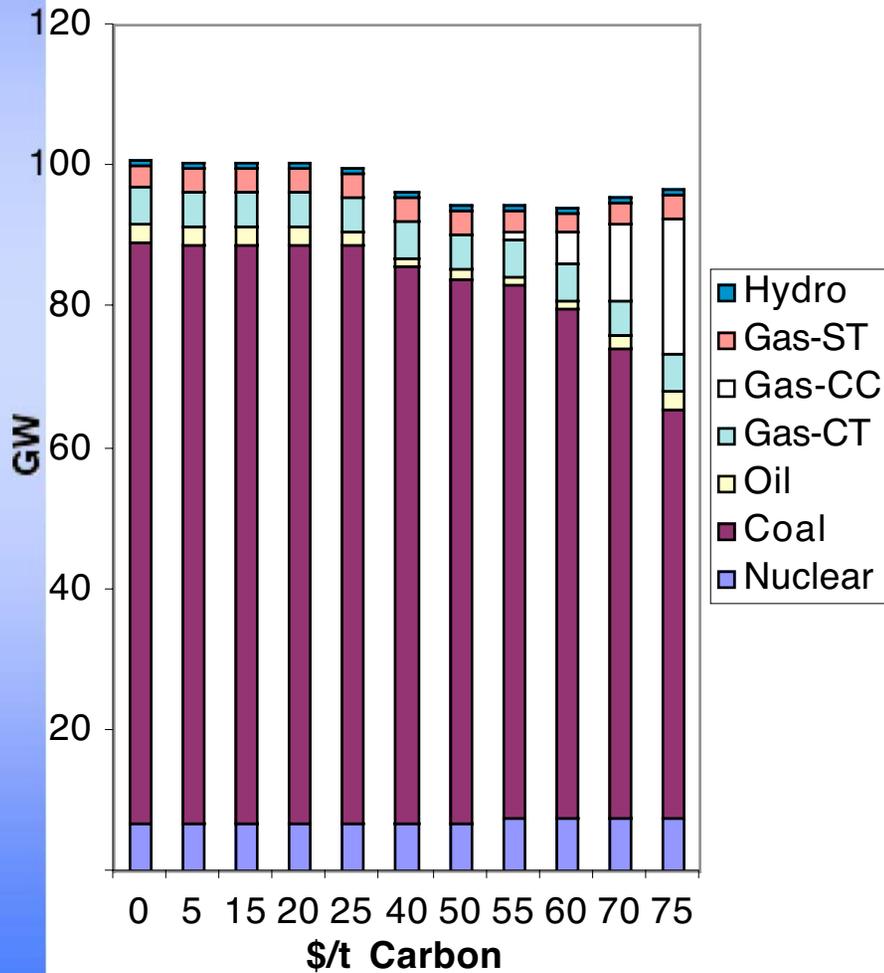
Adjust reference LDC based on price and elasticity

- Price impacts can raise or lower demand in each segment.
- A separate elasticity based on the average price can raise or lower the whole LDC
- Carbon charge raises marginal prices depending on plant on the margin
- Demand changes will change plant loads and thereby prices, which can require iteration

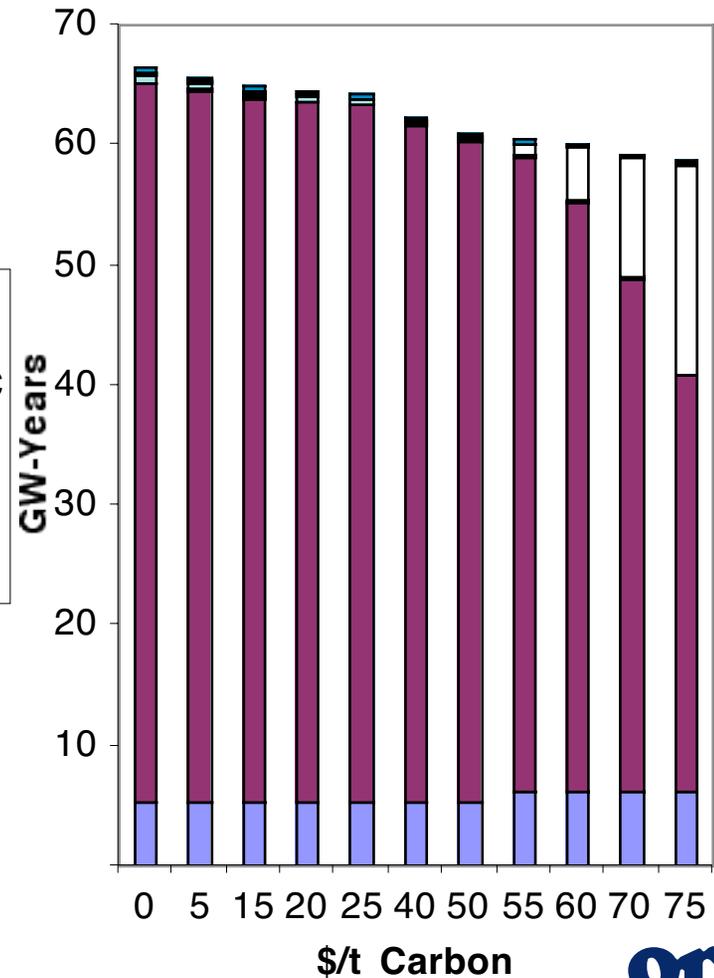


Production changes with carbon charge

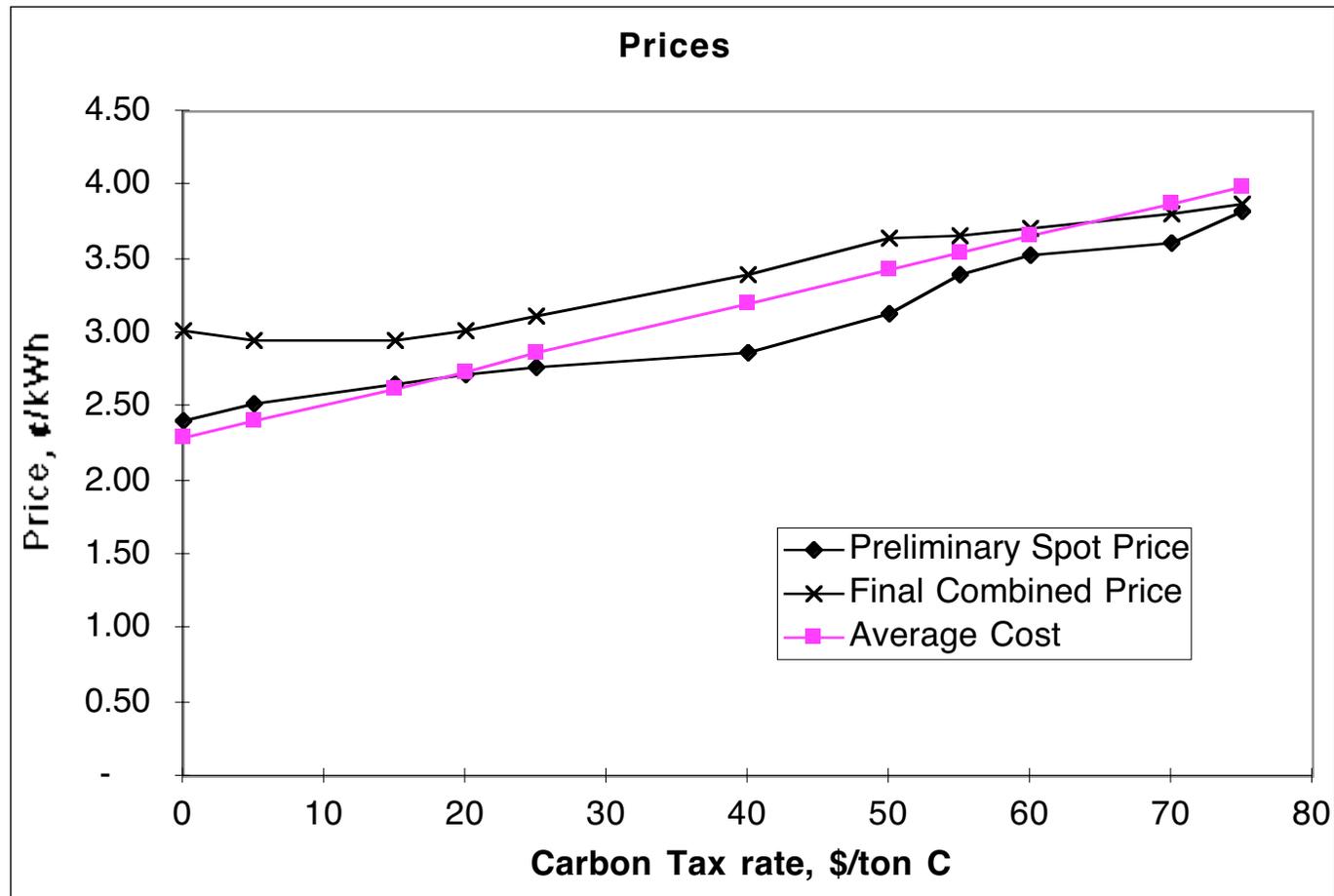
Capacity Changes



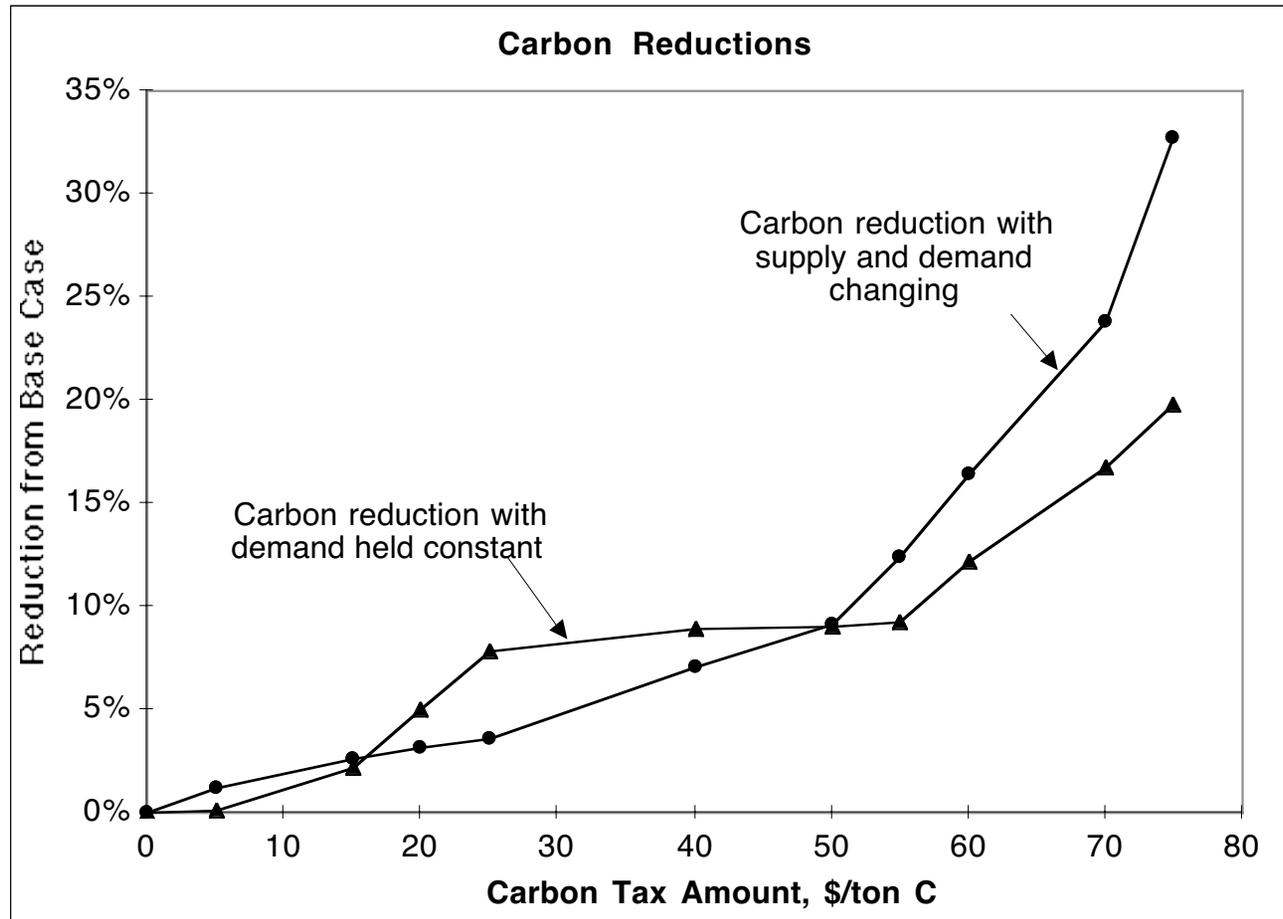
Generation Changes



Price changes slower than cost changes



Demand reduction lowers carbon savings at low charge rates



Impacts of Charges

