The Electric Co-op Market: Replacing Rural Lines with PV

Tom Hoff
Clean Power Research

Matt Cheney
Utility PhotoVoltaic Group

UPEx' 99 October 5, 1999
Tucson, Arizona

www.clean–power.com

Background

- There are 900 rural electric cooperatives
- They deliver one-tenth of the nation's power
- They own half the nation's distribution lines or more than 2 million miles of wire - this is enough wire to circle the earth 80 times

The Opportunities

- Line Replacement
  - 1 million miles of distribution lines were originally installed over 40 years ago
  - The age of these lines may necessitate their replacement in the near future
- Grid Expansion
  - Some expansion occurring in low density areas
- Distributed hybrid-PV systems offer an alternative to line replacement/grid expansion

PV's Advantages in Low Load Density Areas

- PV's capital cost is much more closely proportional to the load it serves than a distribution system's capital cost
- Relocating PV systems is much less costly than relocating distribution systems

Is Distribution System Cost Key Factor in Determining Total Cost?

$$\text{COST} = \frac{\text{Annual Distribution System Cost}}{\text{Load Density}}$$

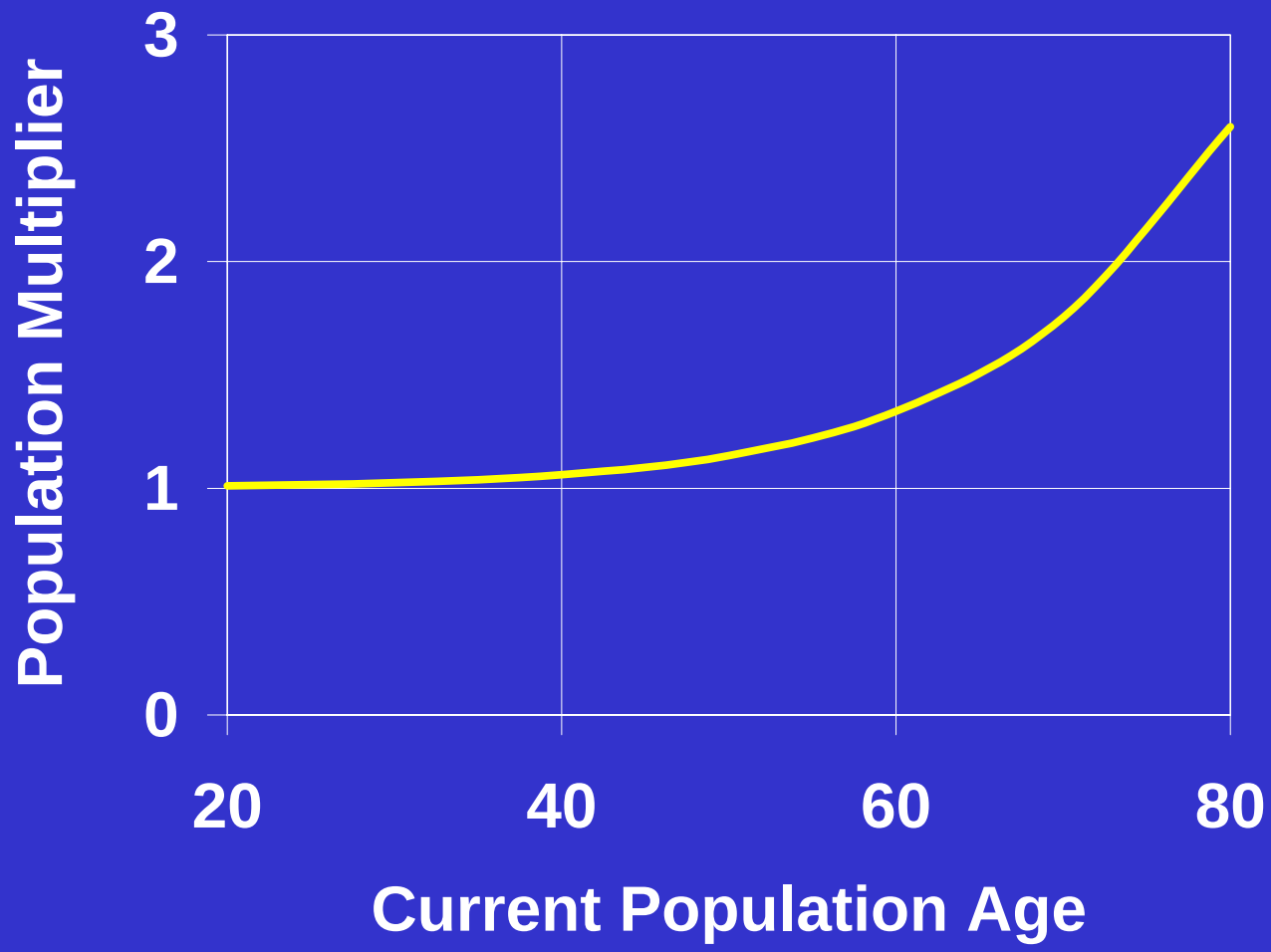
+ Generation, Losses, & Admin. Costs

Load Density & Population Age Can Have An Even Greater Effect on Cost

$$\text{COST} = \frac{\text{Annual Distribution System Cost}}{\text{Load Density}} \times \text{Population Multiplier}$$

+ Generation, Losses, & Admin. Costs

Population Multiplier



Population Multiplier is based on 5% discount rate, 30-year investment life

New Mexico Co-op: Line Replacement

- Line is near end of its life; assume:
  - 20 poles per mile
  - $1,000 per pole
  - 2 poles replaced per year for next 10 years
  - 5% discount rate
- Present value cost of new poles is $16,215
- Annual O&M cost is $221/mile

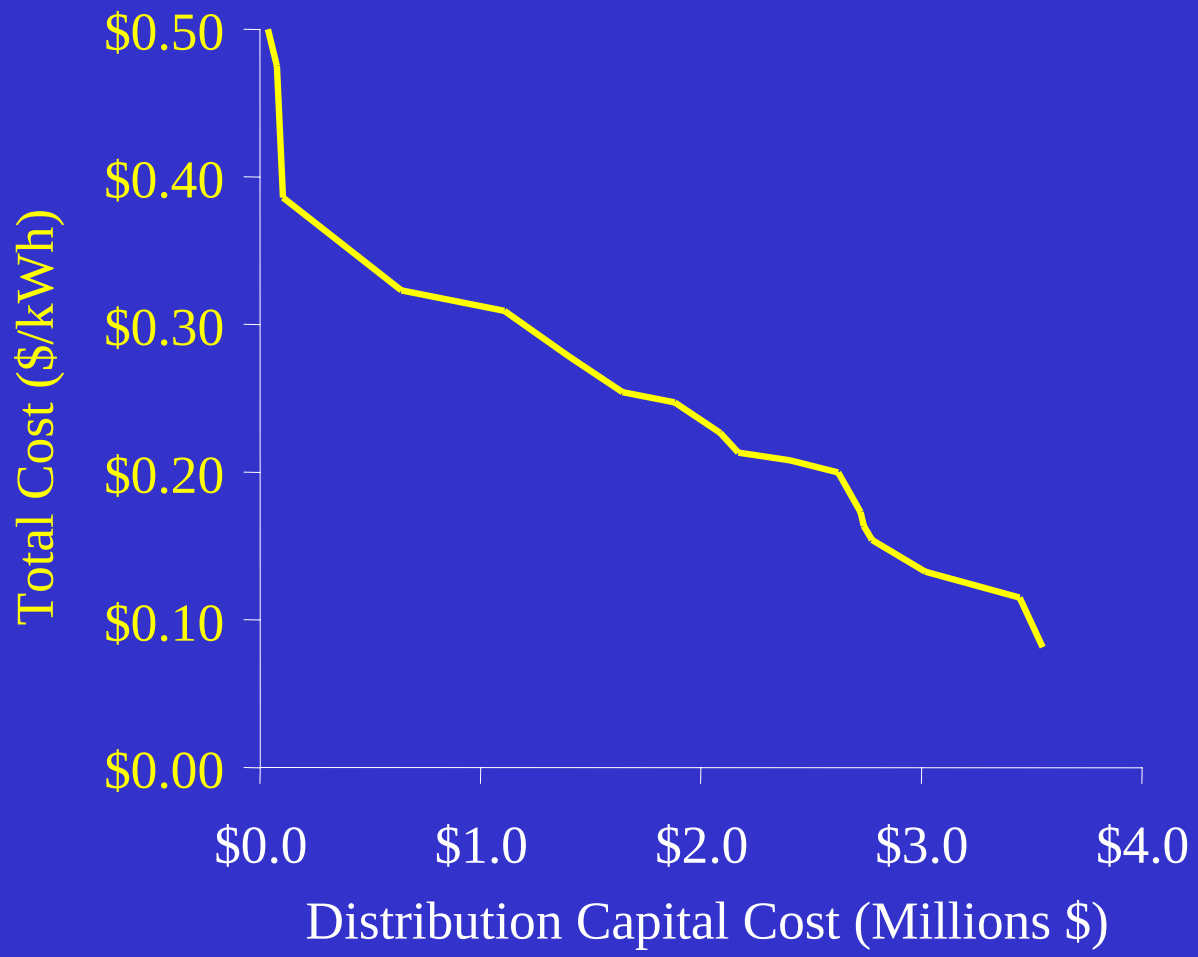
All data are for actual New Mexico co-op except pole replacement scenario;
The co-op has average costs compared to other co-ops in New Mexico

New Mexico Co-op: Load Density and Population Age Drive Cost

$$\text{COST} = \frac{\$1{,}275/\text{mile}}{\text{Load Density}} \times \text{Population Multiplier} + \$0.096/\text{kWh}$$

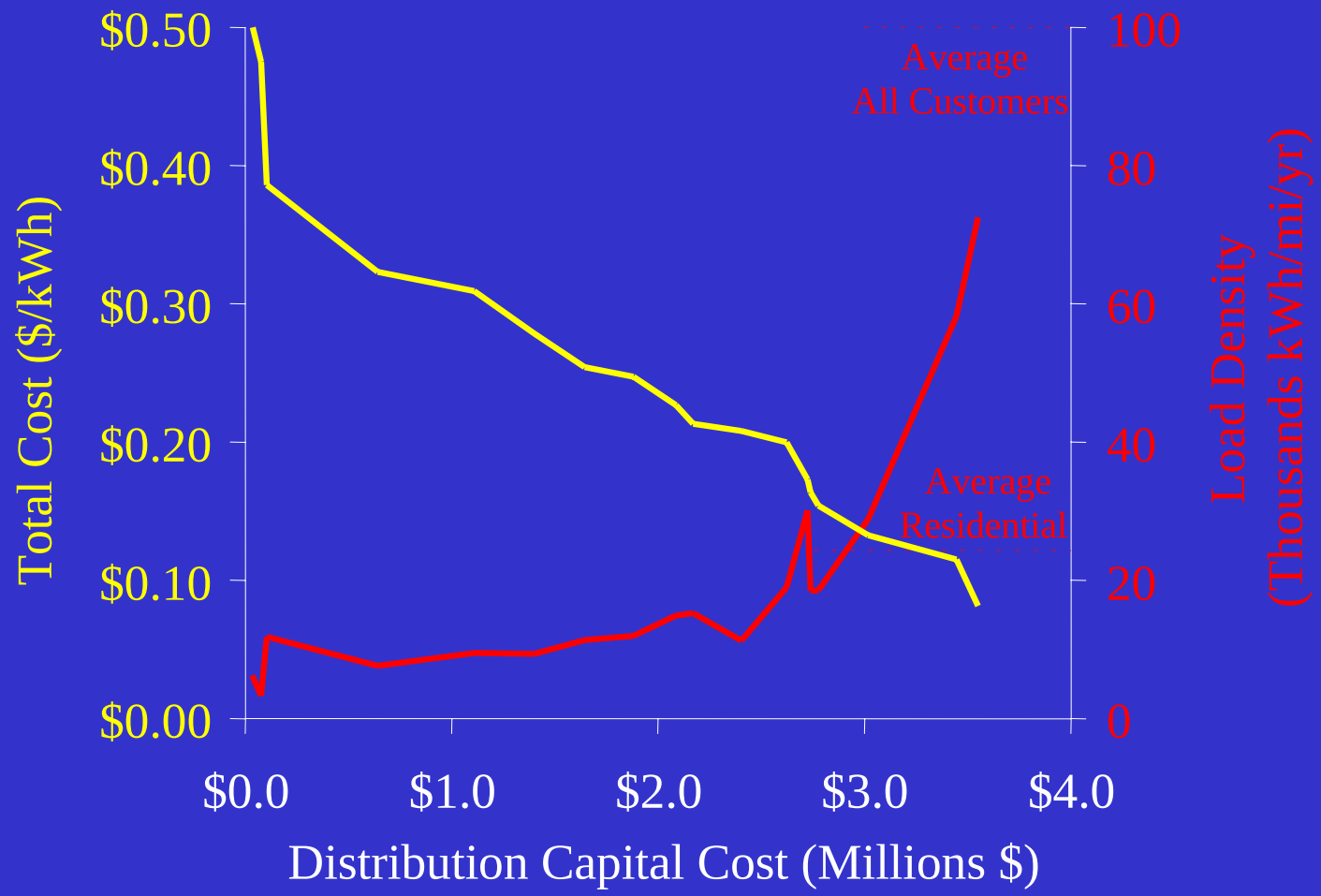
	40-year old Population	74-year old Population
Average Density (30,696 kWh/mile)	$0.14/kWh	$0.18/kWh
Low Density - 1 Res. Cust. (4,157 kWh/mile)	$0.40/kWh	*$0.71/kWh*

Arizona Co-op: Distribution System Costs from RUS Construction Work Plan

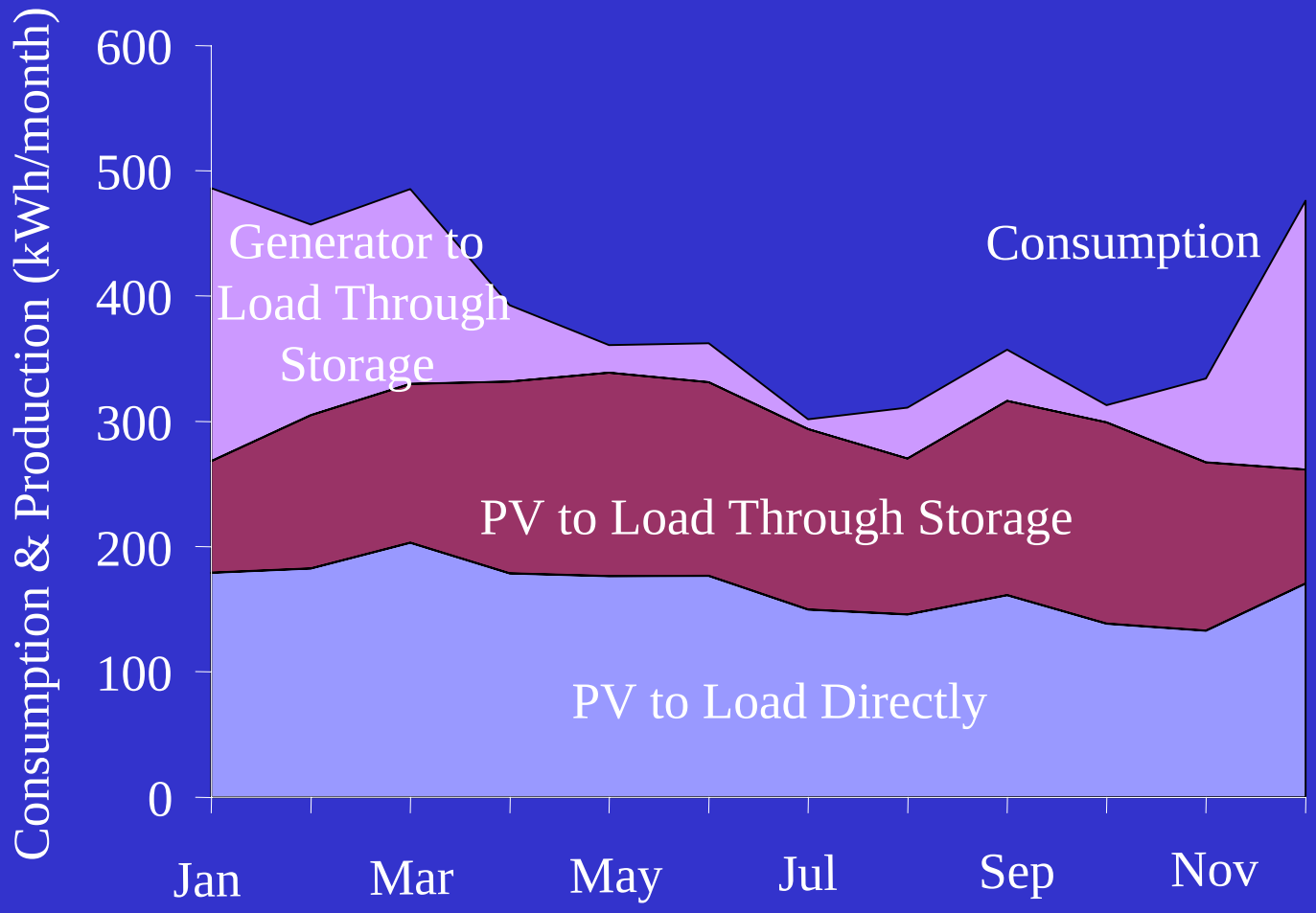


Ben Norris was involved in data collection efforts

Load Density Drives Cost

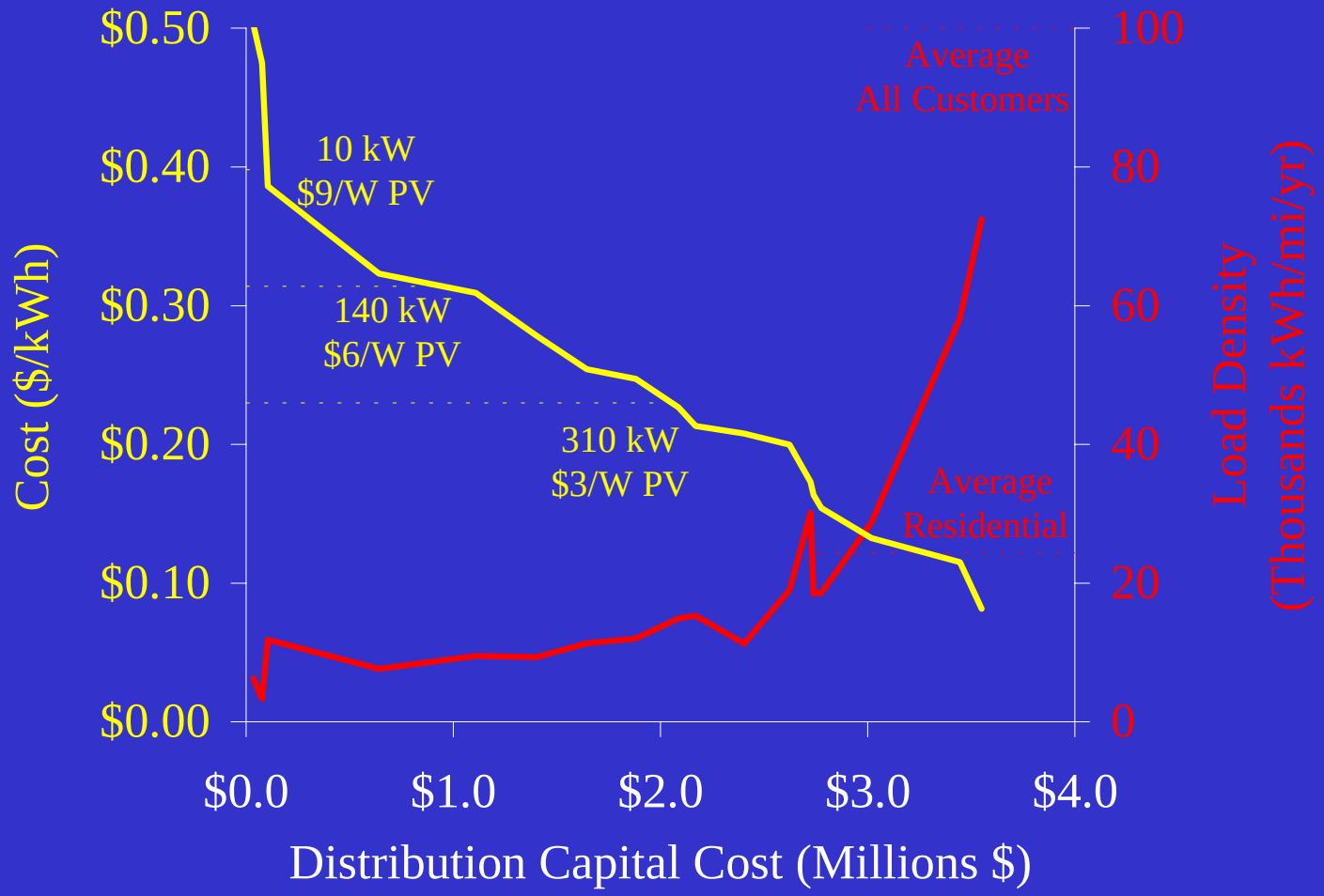


Hybrid PV System Alternative: Electricity Production Profile

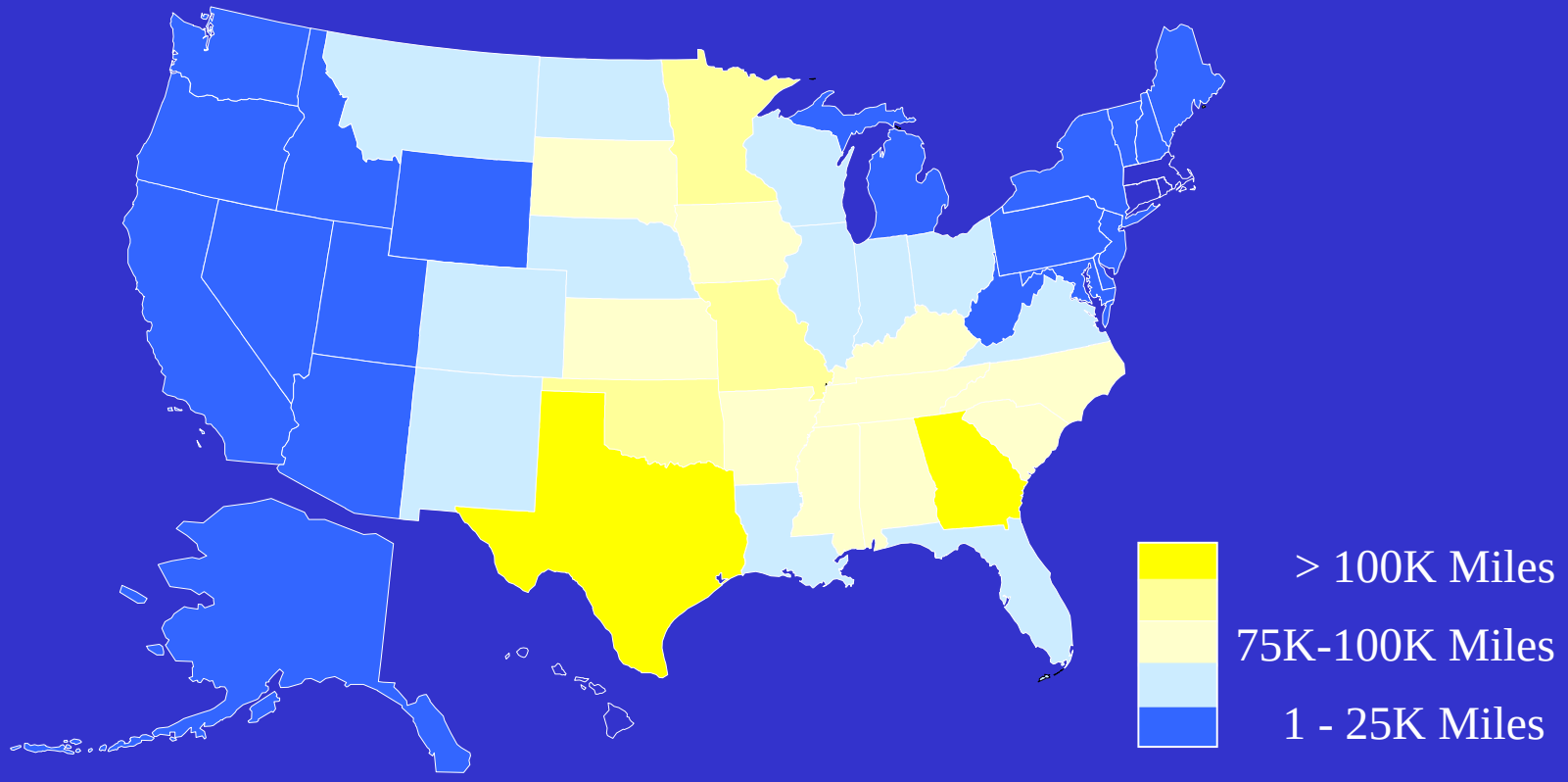


PV supplies 78% of load

Hybrid PV is More Cost-Effective Than Grid Expansion in Some Cases

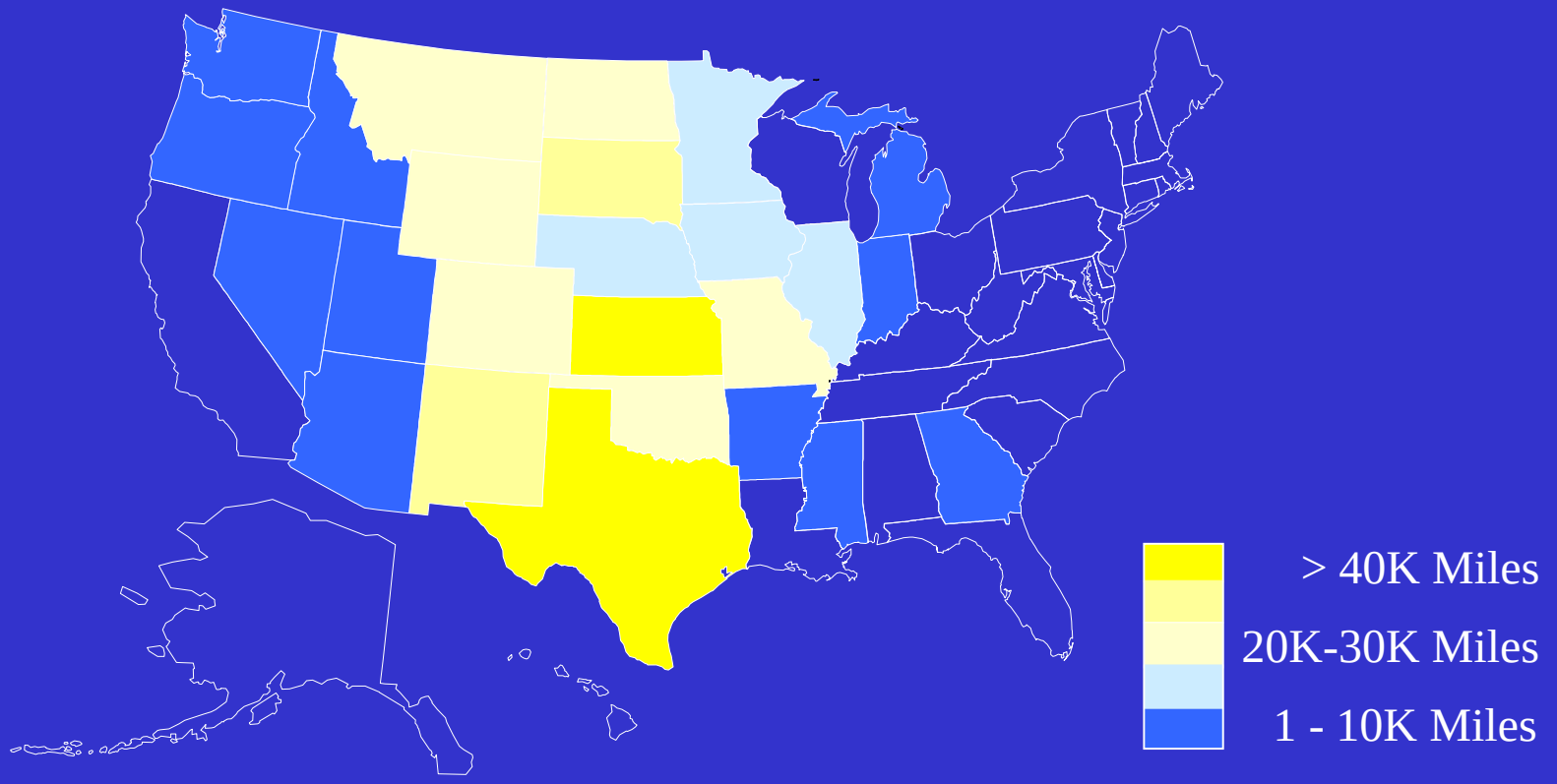


Location of Co-op Distribution Lines (miles per state)



Data source: RUS

Estimated Location of Low Density Lines (miles per state)



Low load density: estimated average residential load density is less than 40,000 kWh per mile; assumed that the residential distribution system miles are proportional to the number of residential customers.

Conclusions

- Load density and population age are critical factors in finding applications for PV
- Load densities vary widely within co-ops
- Annual load densities under 10,000 kWh/mile are good potential candidates
- Co-op billing records can be used to identify low load density areas
- Complete study will be available later this year