



METHODS FOR TOTAL WATER CONSERVATION AND REPORTING

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WHERE IS WATER?

PLANNING

Water conservation receives a small fraction of the attention from our planning efforts

COSTS

Water prices are geographically specific but typically range from \$10 – \$30 per kGal for water and sewer combined service

FUTURE

Water rate inflation is between 4-9% nationally with many areas facing water shortages in the near-term

WHERE ARE WE USING THE WATER?

Typical district energy water consumption

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graph TD; A[Typical district energy water consumption] --> B[Electrical consumption]; A --> C[HVAC and Steam Cycle Heat Rejection]; A --> D[Hydronic Make-up]
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**Electrical
consumption**

**HVAC and
Steam Cycle
Heat Rejection**

**Hydronic
Make-up**

WATER USED FOR ELECTRIC GENERATION

161 BILLION
GALLONS OF WATER
PER DAY

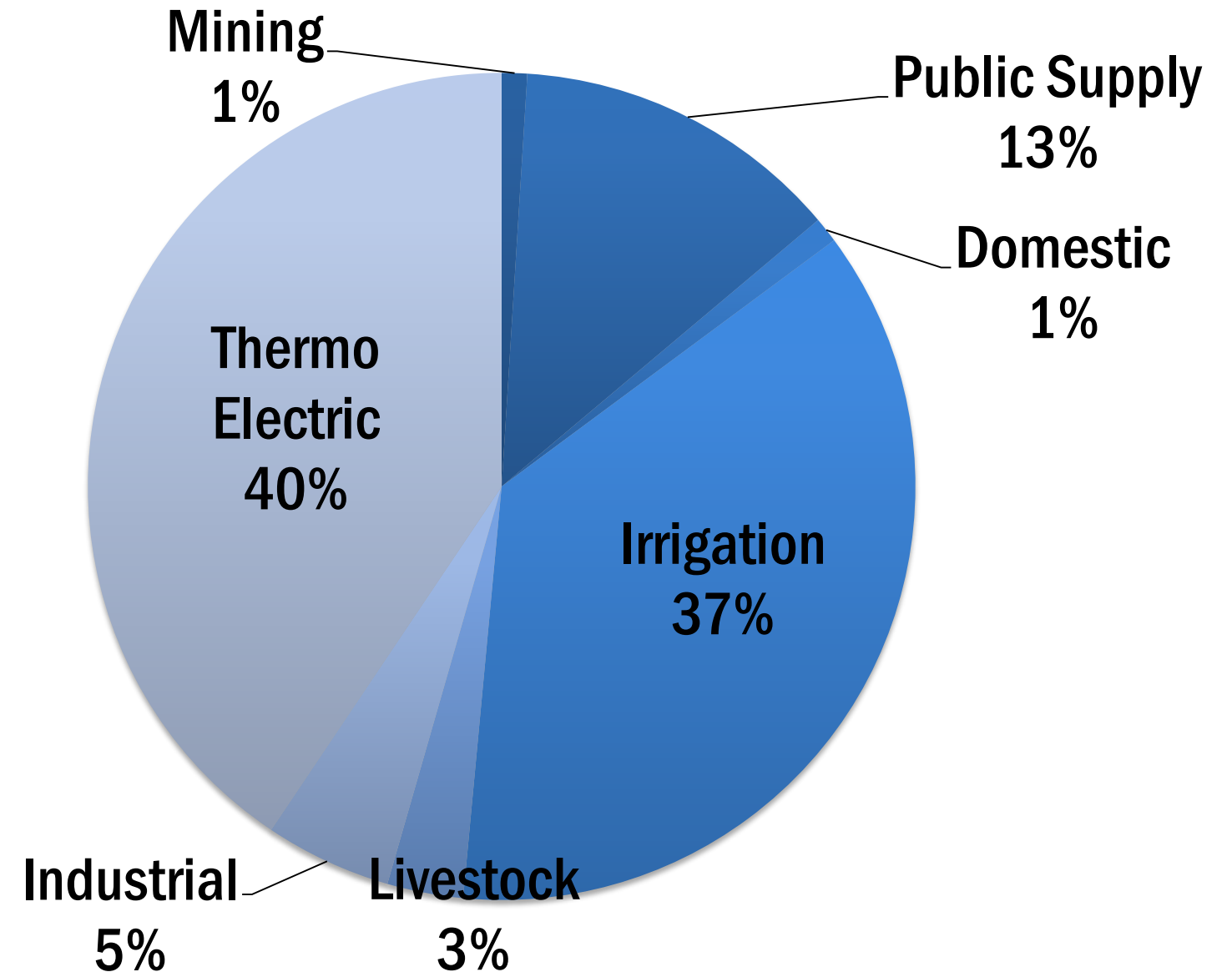
withdrawn for electrical generation in 2010 alone

2 GALLONS
OF WATER EVAPORATED FOR EVERY
KWH PRODUCED

WATER USED FOR ELECTRIC GENERATION

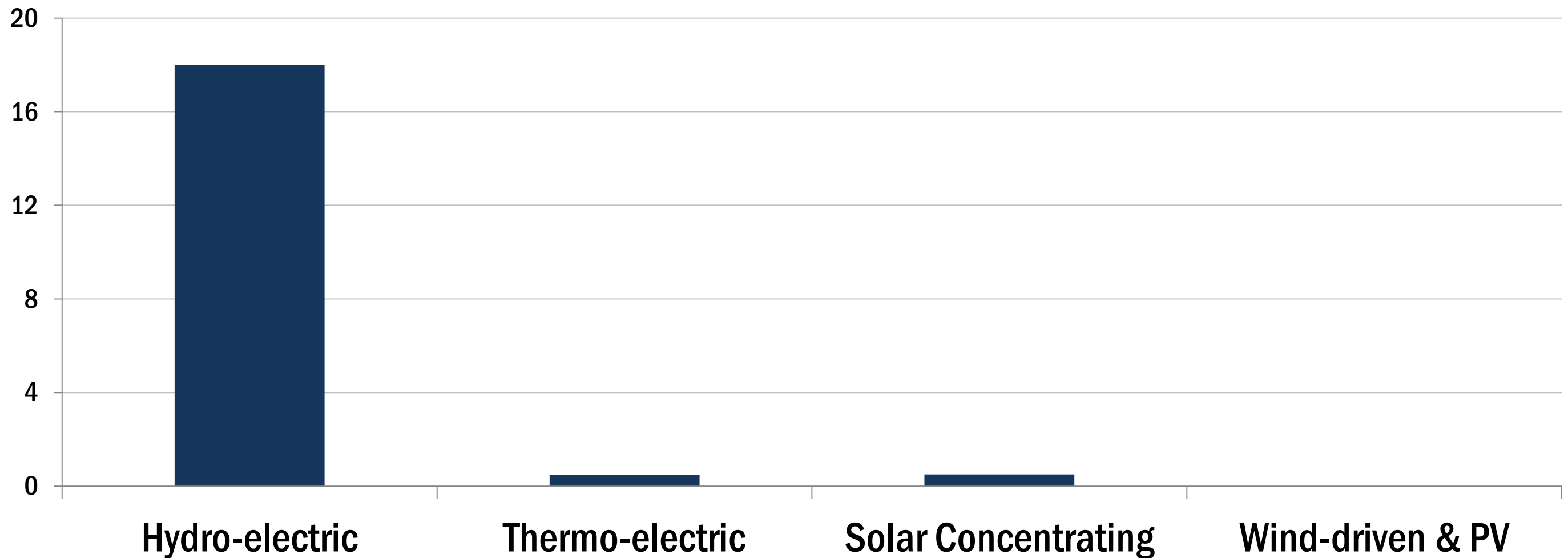
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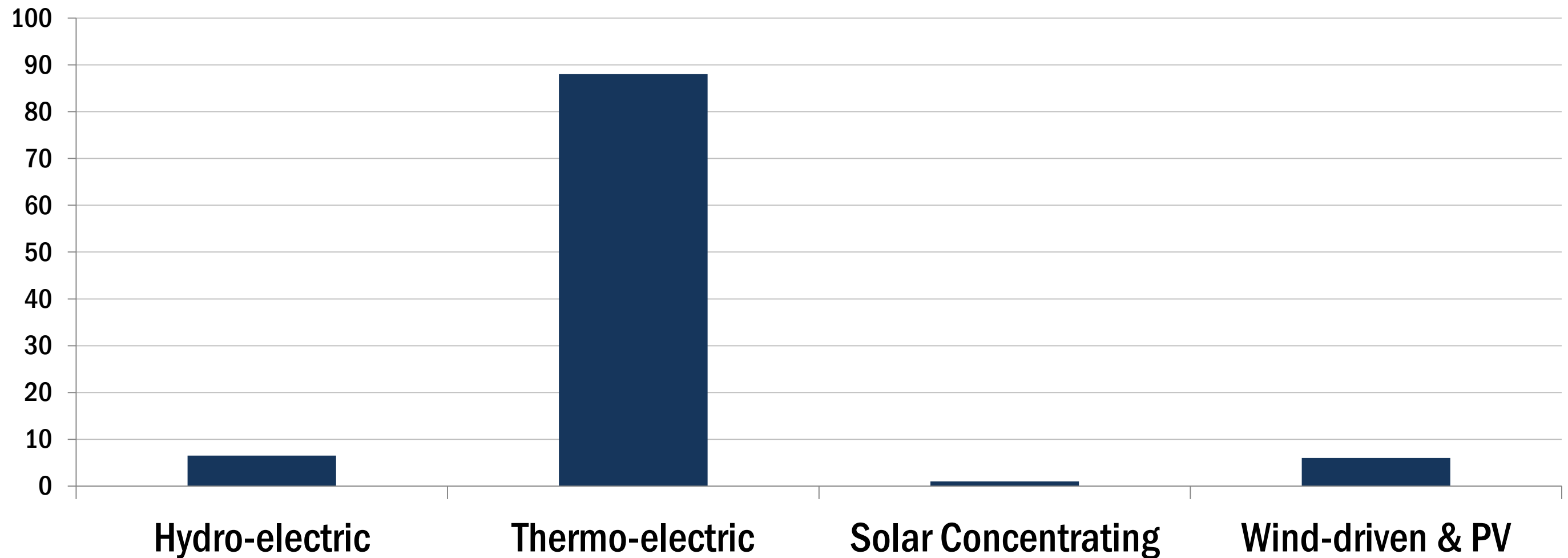
WATER USE BY GENERATION TYPE

Gallons per kWh (avg)



WATER USE BY GENERATION TYPE

Percentage of Generation



SOURCE WATER/POWER RATIO

Source Water Ratio

The energy mix between hydroelectric and other forms of generation in a particular area

US Averages

Min: 0.0 gal/kWh (MA / RI)

Avg: 2 gal/kWh

Max: 72.6 gal/kWh (SD)

WATER USED FOR HVAC AND CONDENSER HEAT REJECTION

- Water cooled chillers require a dedicated heat rejection water loop
- When chiller heat rejection is provided by cooling towers, water consumption can equate to **2.5-3.5 gallons (or more) per ton-hour**
- Some heating-centric and steam turbine generator systems will require heat rejection for a primary feed water system

WATER FOR MAKE-UP

**Hydronic Heating
and Cooling Systems**



HIGH
supply / return volume

**High-efficiency Steam
Heating Systems**



MEDIUM
supply / return volume

**Aged Steam
Heating Systems**



LOW
supply / return volume

WHERE DOES DISTRICT ENERGY FIT?

- Eliminates distribution losses
- More water-efficient electrical generation
- Thermal load shifting and air cooled equipment
- Infrastructure investments in high efficiency heating and cooling systems
- Future opportunities
- Planning and reporting

ELIMINATION OF DISTRIBUTION LOSSES AND WATER EFFICIENT GENERATION

Distribution system losses typically range from **4% to 9%** with corresponding losses of source water.

Distributed generation in CHP applications can **replace water intensive, grid electricity** with water efficient local generation

THERMAL LOAD SHIFTING / ENERGY-EFFICIENT SYSTEMS

Air cooled equipment can reduce total water consumption in some areas (source water ratio)

Thermal load shifting can utilize ambient relief for site or source water savings

Capital investment in long-term or “forever” facilities incentivizes long term water planning

PLANNING AND REPORTING

Most district energy systems save water



REPORT THESE SAVINGS!

PLANNING AND REPORTING

Most energy planning efforts already uncover necessary data for site and source water consumption reporting



USE THIS DATA!

FUTURE CONSIDERATIONS

- ✓ Hybrid wet/dry heat rejection
- ✓ Air cooled cooling and generation systems
- ✓ Implementation of AHU condensate recovery
- ✓ Steam to hot water system conversions
- ✓ Sewer/wastewater heat rejection



Data sources

DATA SOURCES

U.S. Energy Information Administration

- <https://www.eia.gov/tools/faqs/faq.php?id=427&t=3>

Consumptive Water Use for US Power Production; 2003

- P. Torcellini, N. Long, and R. Judkoff
- <http://www.nrel.gov/docs/fy04osti/33905.pdf>

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