

*A Path Forward:
Western Resource Advocates'
Review of APS's Resource Plan*

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on the 2012 Integrated Resource Planning Assessment
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Resource planning provides an opportunity to address several major issues

1. Wasted energy
2. Air pollution from power generation
3. Vulnerability of conventional generation to fuel price increases and fuel price volatility
4. Vulnerability of conventional steam generation to water scarcity
5. A relatively inflexible power supply system
6. Reasonable costs where reasonableness is judged by comparing costs among options under uncertainty

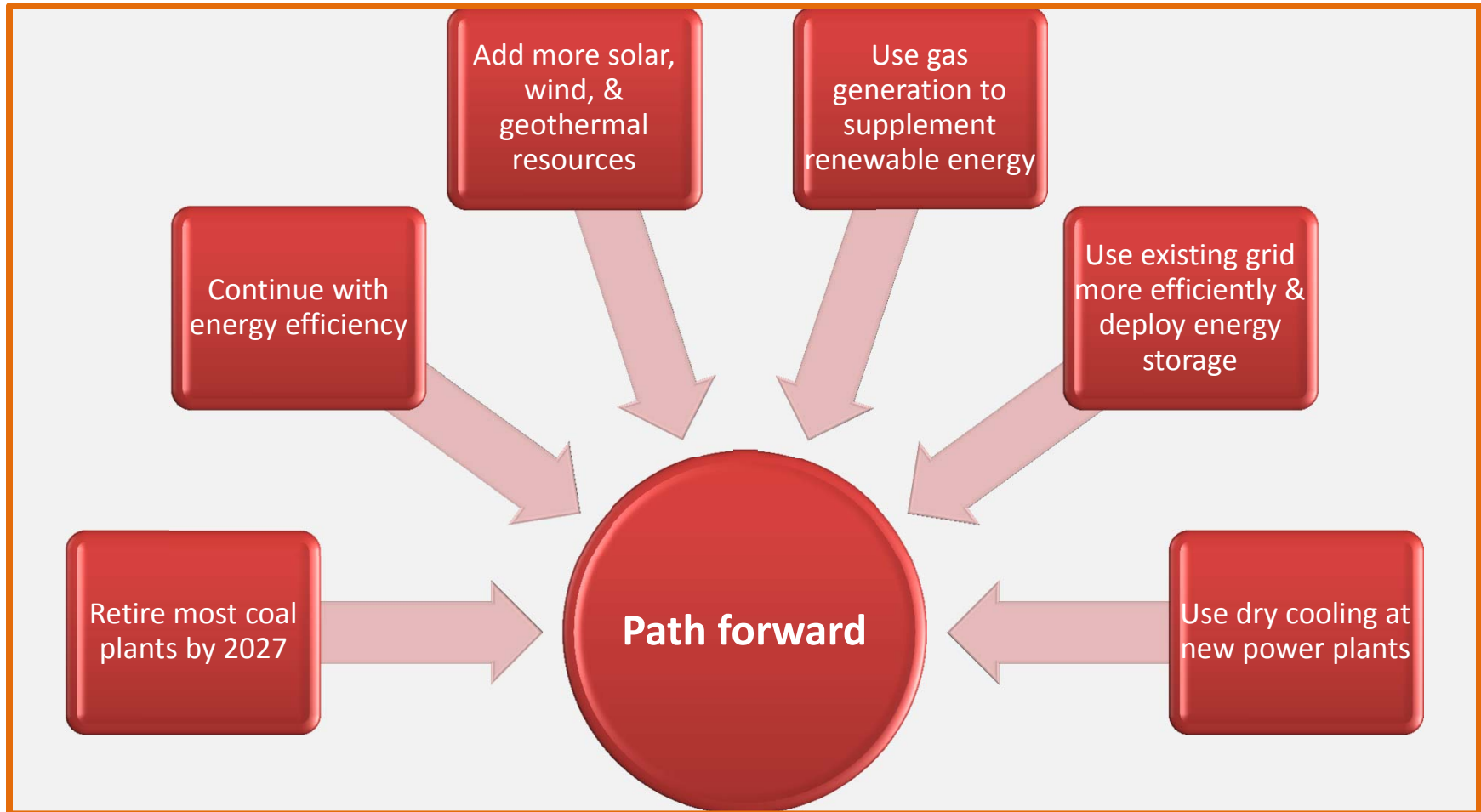
Recommendations (tentative)

- ➡ **APS's 3 year action plan should be approved**
- ➡ **The Commission should acknowledge APS's enhanced renewable energy and coal retirement portfolios and direct APS to prepare a plan for the next IRP cycle that blends the enhanced renewable energy and coal retirement portfolios**
- ➡ **The Commission should proceed with a workshop process to develop a policy to promote early adoption of energy storage**

Analytical framework

- For resource planning to be useful, it is necessary to compare a wide range of options under uncertainty.
- APS analyzed four widely different portfolios and investigated the sensitivities of those portfolios under a range of assumptions.
- The scope of APS's analyses is a model for resource plans going forward.

How to move forward



Benefits of WRA's Path Forward

- ✓ It reduces wasted energy
- ✓ It hedges against fossil fuel price risk by substituting stably priced renewable energy and energy efficiency for fossil fuels whose future prices are uncertain
- ✓ It hedges against water scarcity
- ✓ It protects the environment and human health through reduced air emissions
- ✓ It improves the flexibility of APS's system
- ✓ It reflects the priorities of many of APS' customers who desire clean energy resources at reasonable cost
- ✓ It would result in reasonable costs, i.e., in costs that are not significantly different than the costs of APS' base case portfolio, given the large uncertainties around factors that affect future costs

Energy Efficiency: APS' planned energy efficiency reduces wasted energy and reduces revenue requirements by ~8.7% relative to what costs would have been without efficiency savings

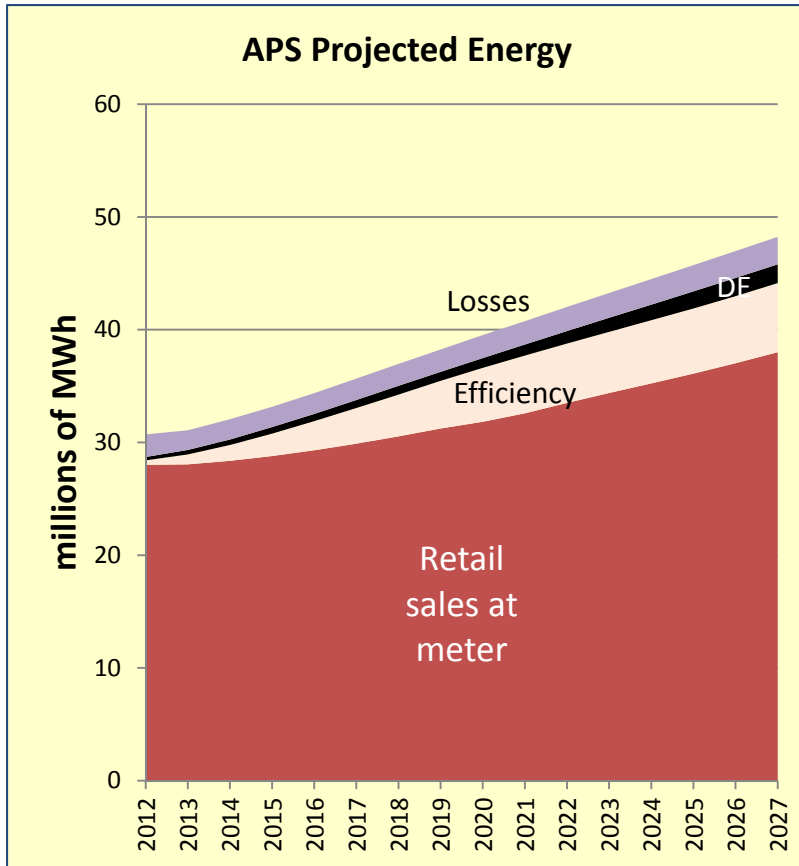
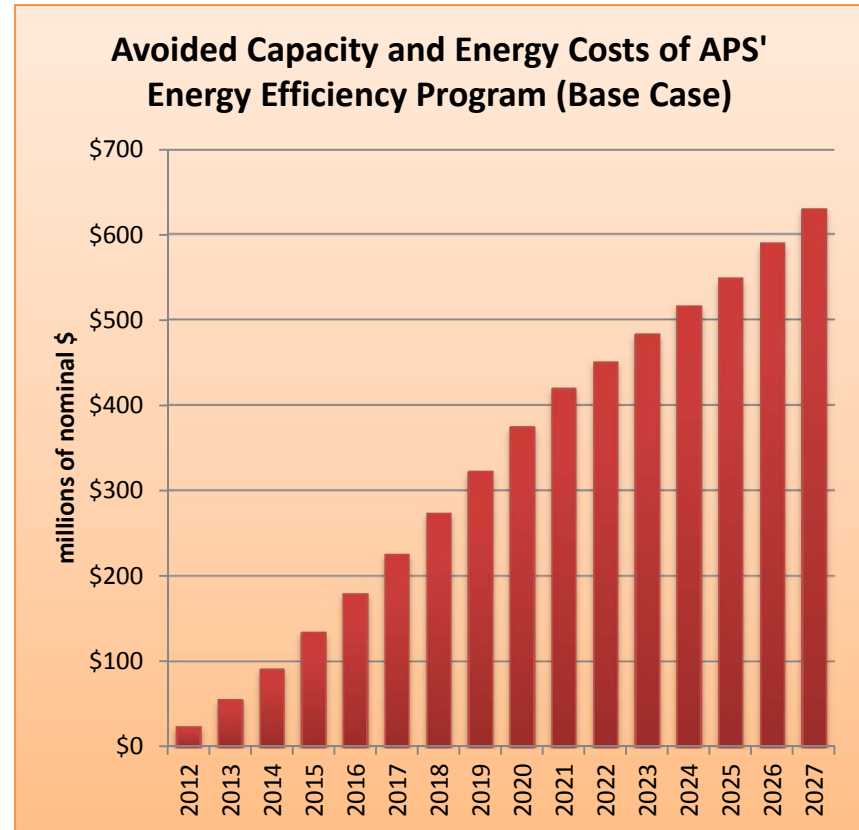


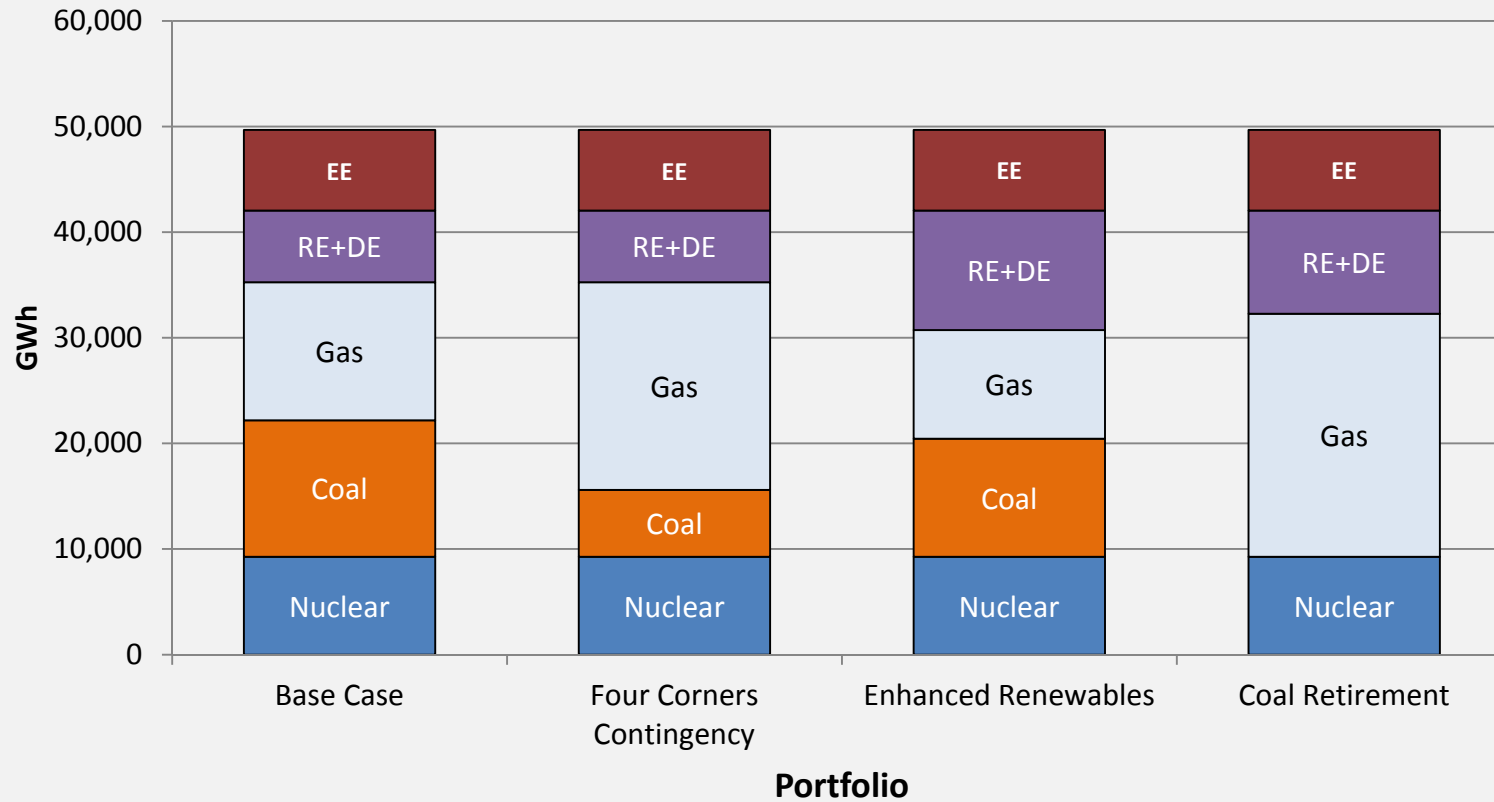
Chart excludes sales for resale



Present value (2012-2027) of avoided costs @7.95% nominal discount rate = \$2.5 billion

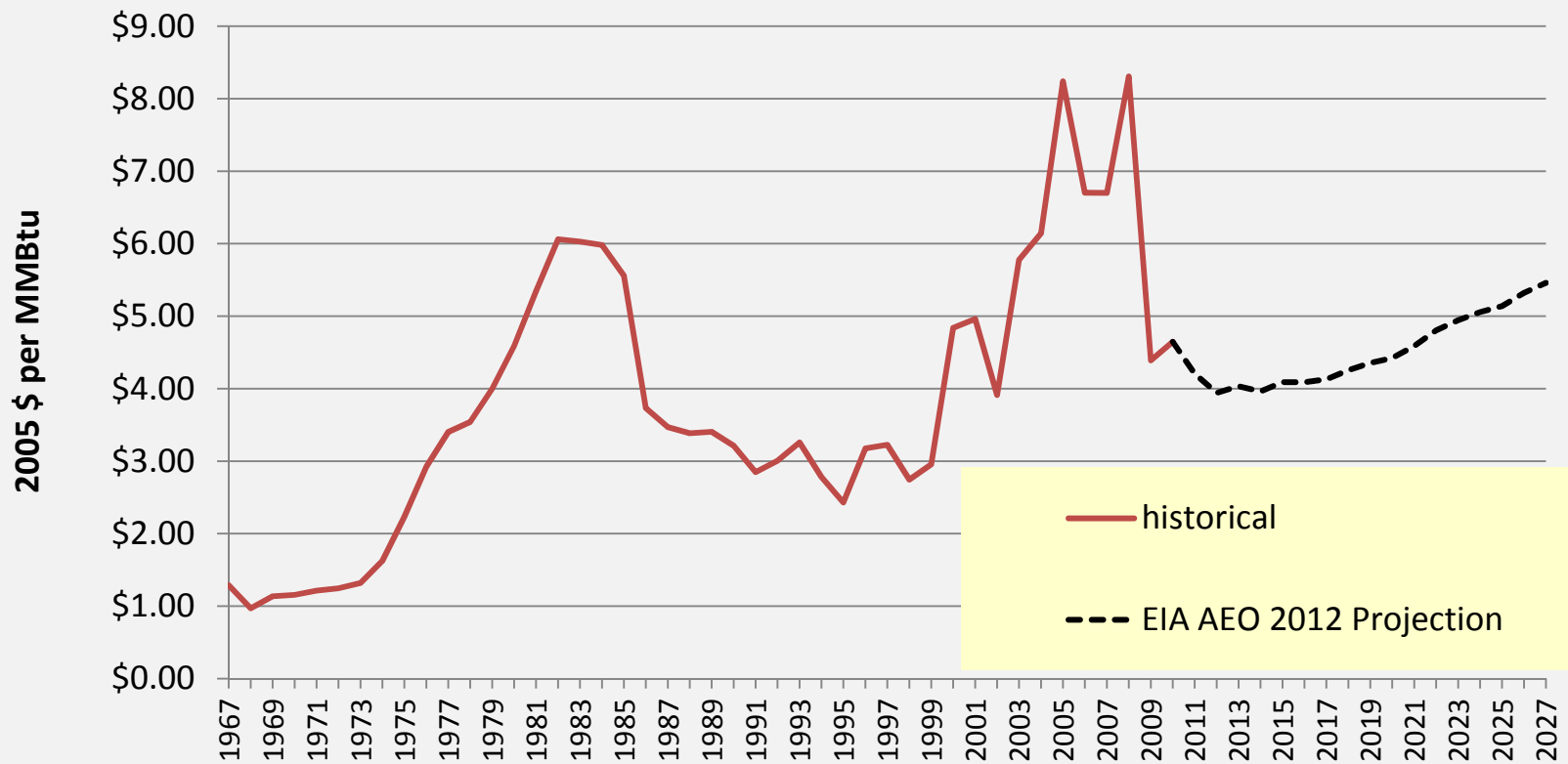
Energy Mix: APS plans to rely heavily on coal, natural gas, and nuclear resources

APS 2027 Energy Mix by Portfolio (GWh)



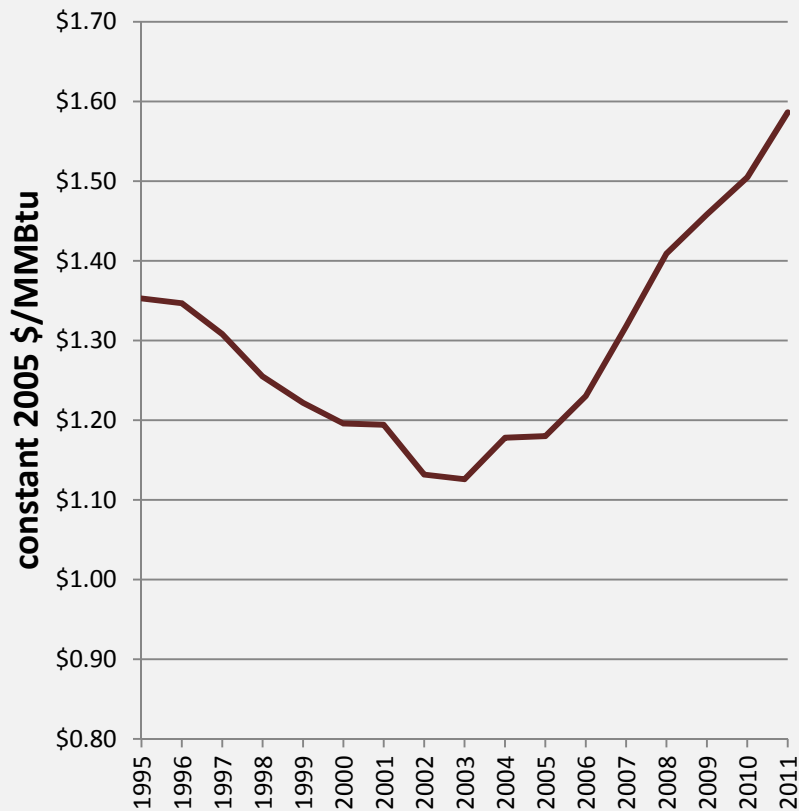
Coal, natural gas, and uranium are subject to price increases: Natural gas prices behave erratically & forecasts abstract from the volatility

Price Paid for Natural Gas by Electric Power Sector

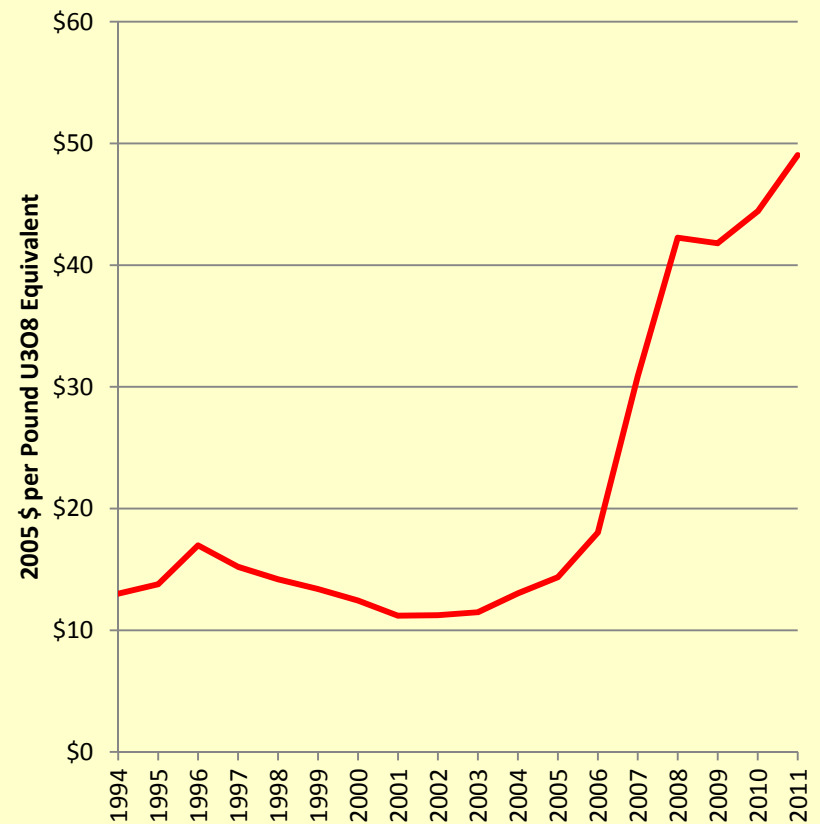


Coal, natural gas, and uranium are subject to price increases: Coal and uranium prices have been trending upward

Price of Coal Paid by Electric Utilities in the Mountain Region



Uranium Prices for US Civilian Nuclear Power Reactors



Renewable energy and energy efficiency are stably priced and are hedges against fuel price risk



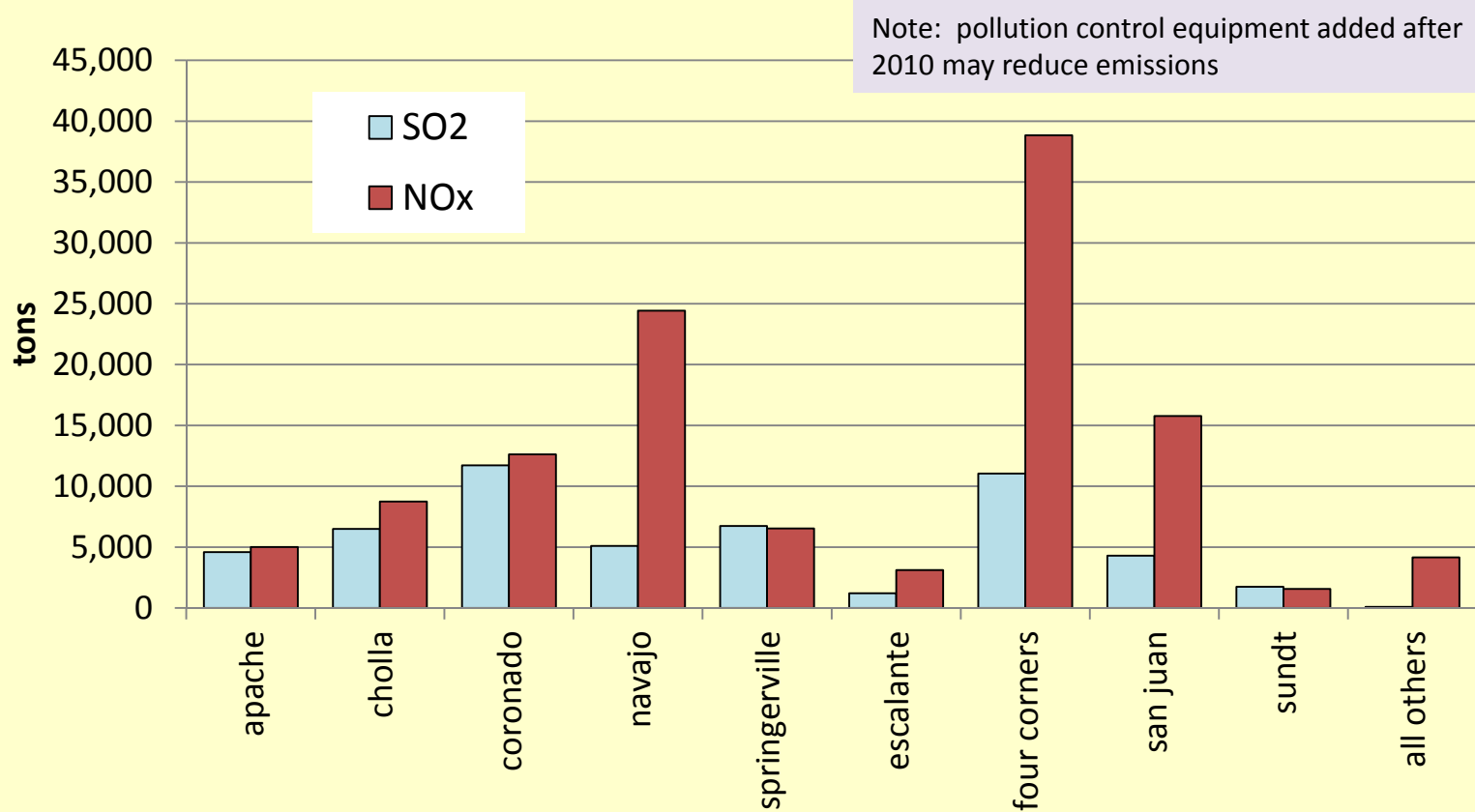
Hedges at Mills Rose Garden (http://en.wikipedia.org/wiki/File:Mills_Rose_Garden-1.jpg)

Environmental effects of generating electricity with fossil fuels

- Health impacts resulting from formation of fine particulate matter from SO₂ and NO_x and other compounds
 - Asthma
 - Bronchitis
 - Heart attacks
 - Premature death
- Carbon dioxide emissions contribute to climate change
- Other effects on fish & wildlife, visibility, and human health due to mercury and other air toxics emissions, aerosols, ground level ozone, impingement & entrainment of fish, coal ash, etc.

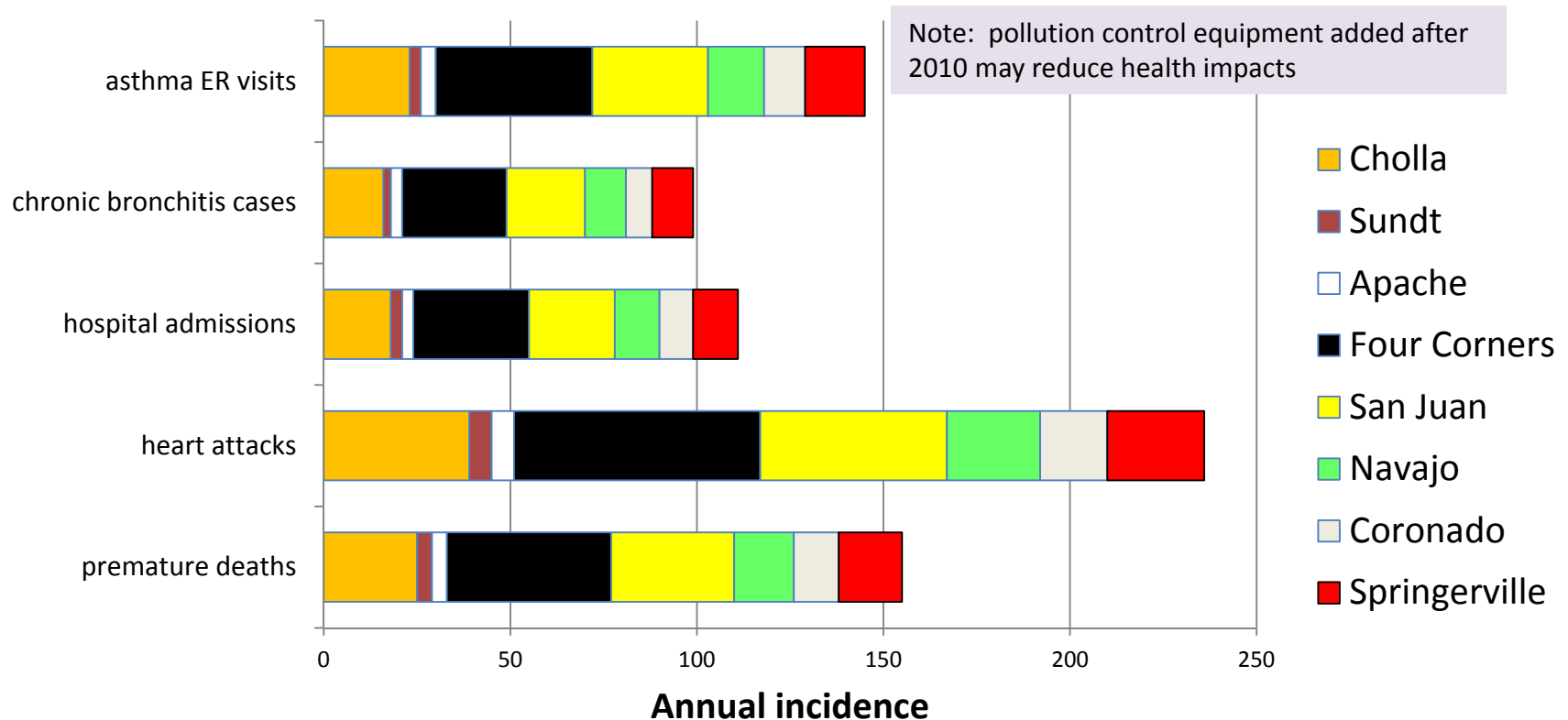
Emissions: In 2010, coal-fired power plants in AZ & NM emitted 53,000 tons of SO₂ and 117,000 tons of NO_x

2010 SO₂ and NO_x Emissions from Power Plants in AZ & NM



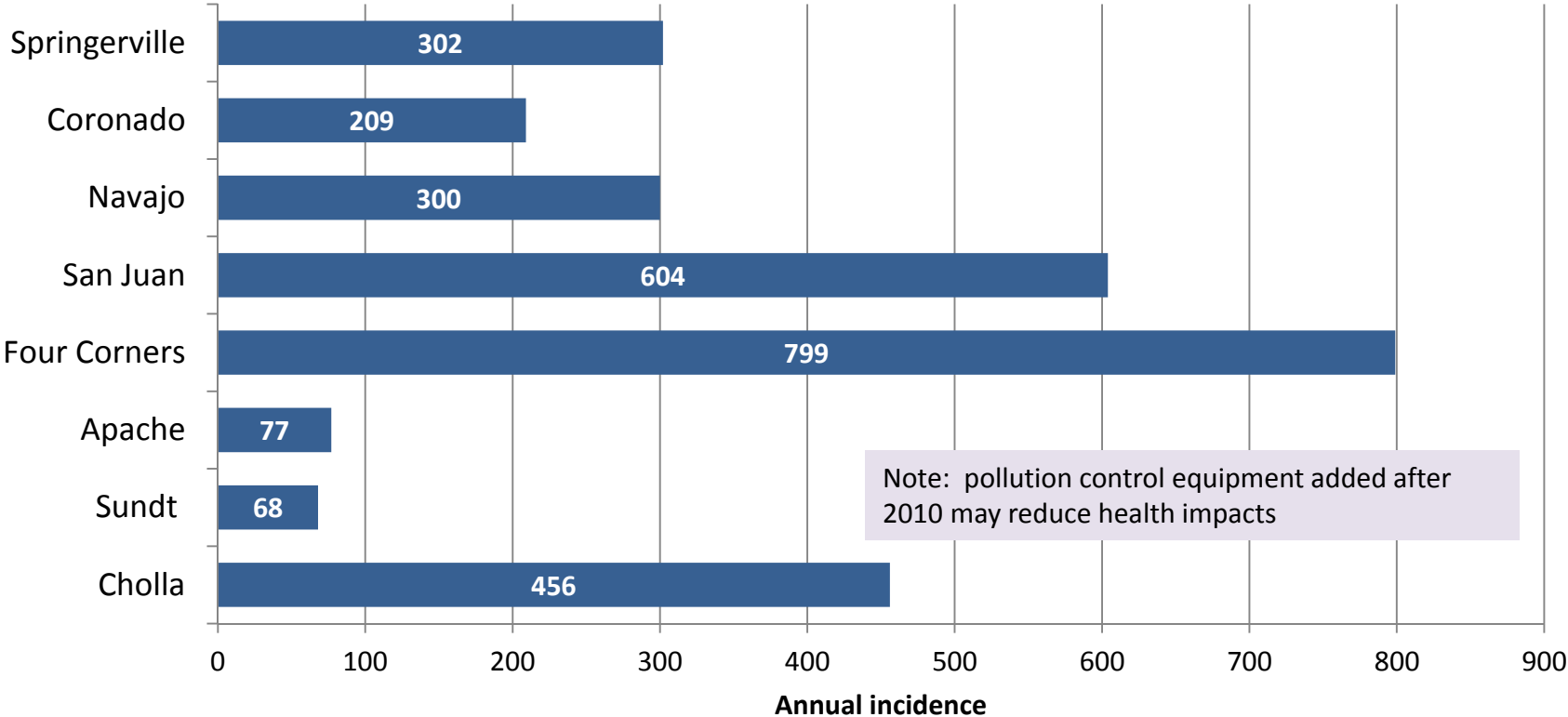
Emissions: Coal-fired power plants impose significant health impacts (part 1)

2010 Health Impacts Due to Fine Particulates Associated with Coal-Fired Power Plants in AZ & NM (Source: Clean Air Task Force)

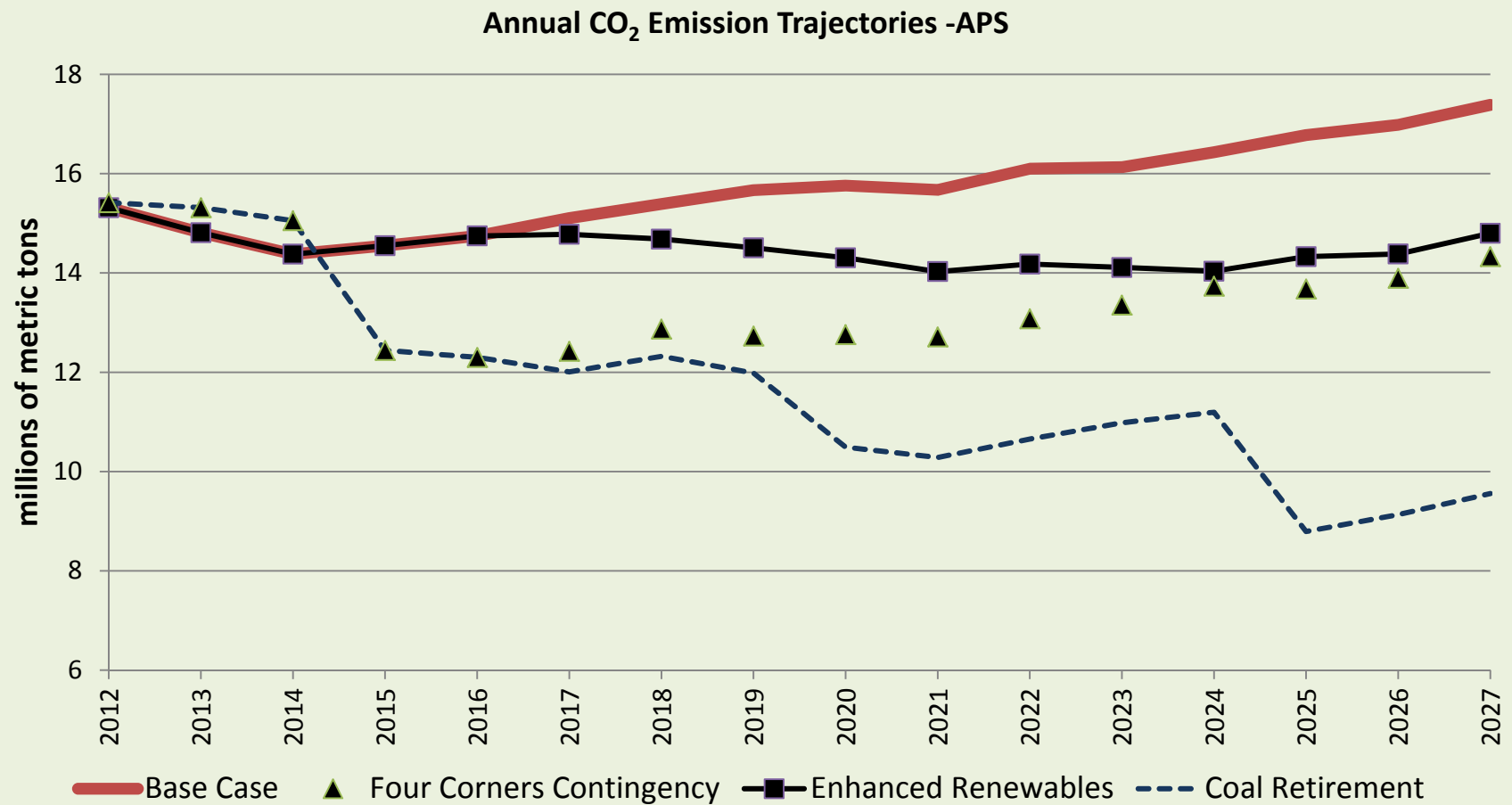


Emissions: Coal-fired power plants impose significant health impacts (part 2)

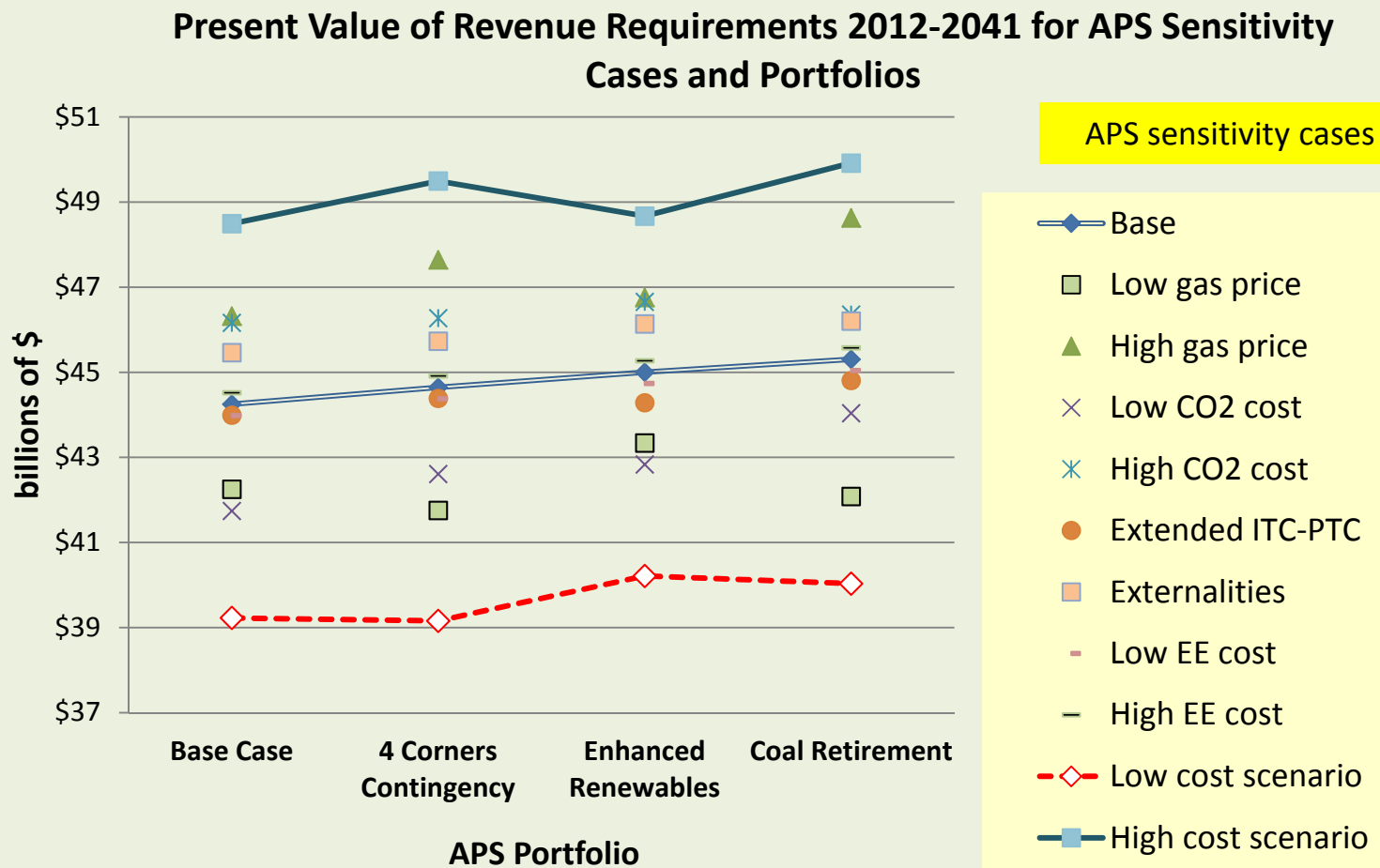
Asthma Attacks Attributable to Fine Particulates from 2010 Emissions from Coal-Fired Power Plants in AZ & NM (Source: Clean Air Task Force)



Emissions: Of APS's 4 portfolios, only the coal retirement portfolio makes a sustained dent in CO₂ emissions



Costs: APS analyzed the sensitivity of each portfolio
Within any sensitivity case, variations in cost across portfolios are small compared to projected cost



Are these small cost differences across portfolios meaningful?

- **No**
- **APS did not analyze the sensitivity of revenue requirements to all possible uncertainties**
- **Projections are imprecise**

- **APS's analysis indicates that the coal plant retirement portfolio and the renewable energy portfolio are not significantly more costly than any other plan analyzed by APS**
- **Therefore, retiring coal plants & increasing reliance on renewable energy can be accomplished at reasonable cost**

Just how imprecise can forecasts be? The US in 2010 as seen from the 1992 EIA *Annual Energy Outlook*

Factor	EIA AEO 1992 forecast for 2010	Actual 2010	Forecast as % of actual
Retail electricity sales (GWh)	3,996,000	3,754,493	106% 😊
Natural gas generation (GWh)	765,000	987,697	77% 😞
Coal generation (GWh)	2,317,000	1,847,290	125% 😞
Natural gas price 2010 \$/MMBTu	\$8.36	\$5.08	164% 😞
US Wind generation (GWh)	11,340	94,652	12% 😞 😞 😞
US geothermal generation (GWh)	59,270	15,219	389% 😞 😞 😞
US PV MW	10	2,153 (grid connected)	0% 😞 😞 😞 😞

The future is a lot foggier than projections might lead one to believe



- Hedging against major risks puts boundaries on uncertainties
 - Stably priced renewable energy and energy efficiency are a hedge against high fossil fuel prices
 - The next slide addresses hedges against water scarcity

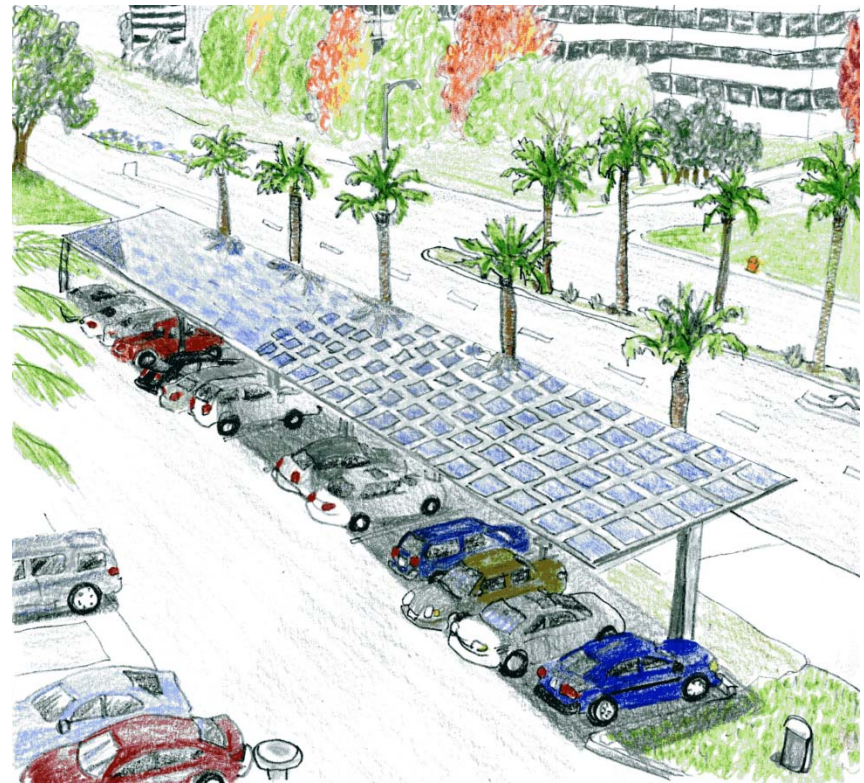
Hedging against the risk of water scarcity

- Drought affects the electricity sector in several ways, including: increased demands for power, reduced hydroelectric generation, & reduced water available for cooling thermoelectric facilities
- The cost of obtaining water rights is a function of water scarcity
- APS's Coal Retirement portfolio provides the most substantial reductions in water use, reducing the volume consumed (relative to 2012 use) by 16,617 AF in 2027.
- APS manages the risk of water scarcity by planning to install dry cooling on any new combined cycle gas units
- Energy efficiency and some renewable energy technologies require little or no water

A missing ingredient: energy storage

- **Technologies include batteries, flywheels, pumped storage, compressed air, thermal storage**
- **Energy storage could shift the time when PV or wind energy is consumed:**
 - After sunset
 - During periods when demand is high instead of when the wind is blowing
- **Energy storage could also provide ancillary services in conjunction with intermittent PV or wind**
- **Policies to encourage early adoption of energy storage**
 - Colorado – case by case review of storage projects
 - NY – consortium among universities, industry, utilities to commercialize energy storage technologies
 - California – development of energy storage targets
- **Recommendation – the ACC should conduct workshops to develop a policy to encourage **early adoption** of energy storage in AZ**
 - Our comments contain a suggested outline of workshop topics

Think about the future you want to have



Sketches by Valarie Vousden