



Renewable Resources

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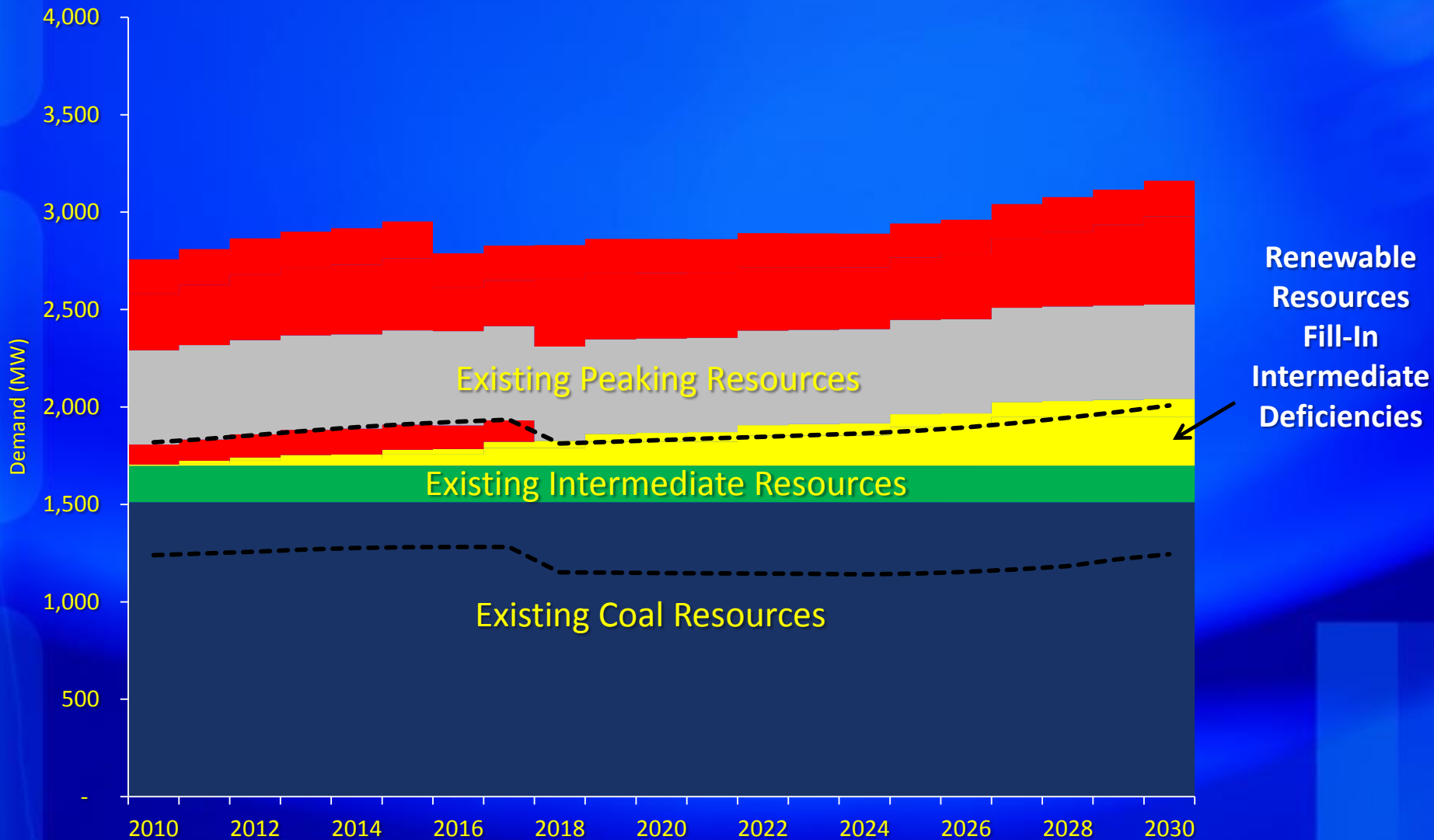
Manager, Resource Planning and Procurement



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Tucson Electric Power

Capacity Requirements with 15% Energy Efficiency Target by 2020 and 15% Renewable Energy Target by 2025

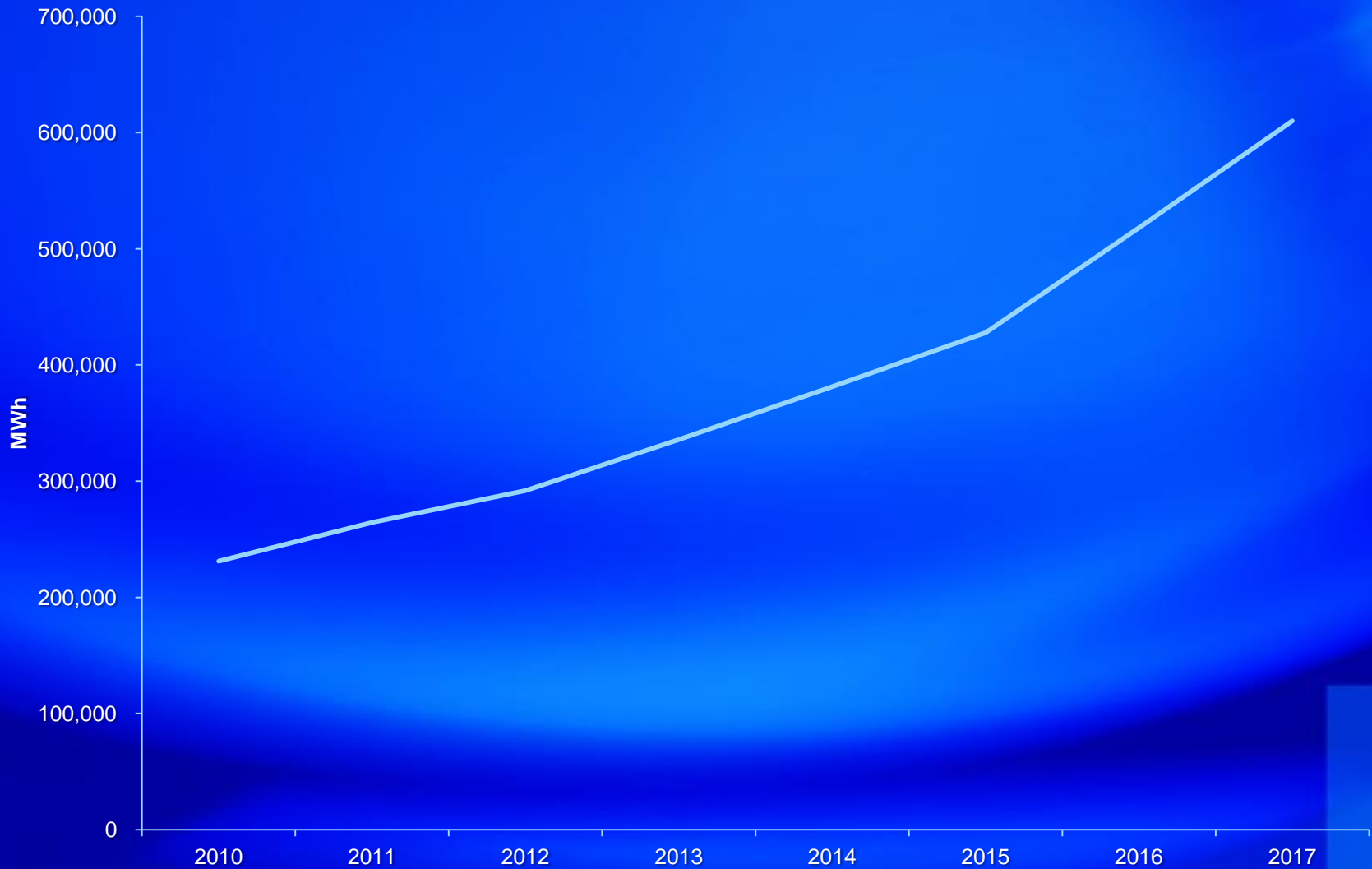


IRP and Renewable Resources

- No longer “Least Cost” but “Reasonable Cost” plan
- Resource plan balances desire for clean, renewable energy with the need to deliver low cost and reliable power
- State and Federal Regulatory Considerations
- Customer Desires
 - Customers Want Solar
 - Local Project Emphasis
 - Low Water Portfolio

RES Requirements

Annual Requirements Excluding Distributed Generation



Wind Power

- Mature technology
- Short development time
- Most low hanging fruit taken
- Southern AZ has marginal to poor wind resource
- Northern and central AZ has better potential, still not excellent
- Transmission needed in most cases
- Intermittent, “wrong time”

Solar Photovoltaic (PV)

- **Several technologies**
 - Fixed panels
 - Single Axis tracker
 - Double axis tracker
 - Concentrating
- **Intermittent - significant variance with clouds**
- **Comes up quickly – drops off just as quickly**
- **Good AZ resource potential**
- **Land requirements - good news/bad news**

Solar Thermal

- **Several technologies**
 - Parabolic trough
 - Power tower
 - Dish-Stirling Engine
- **High water consumption unless dry cooled**
- **Thermal inertia dampens cloud effects, extends capacity later into the afternoon**
- **Good AZ resource potential**
- **Thermal Storage or Gas-Hybridization firms output**

Biomass/Biogas/Biodiesel

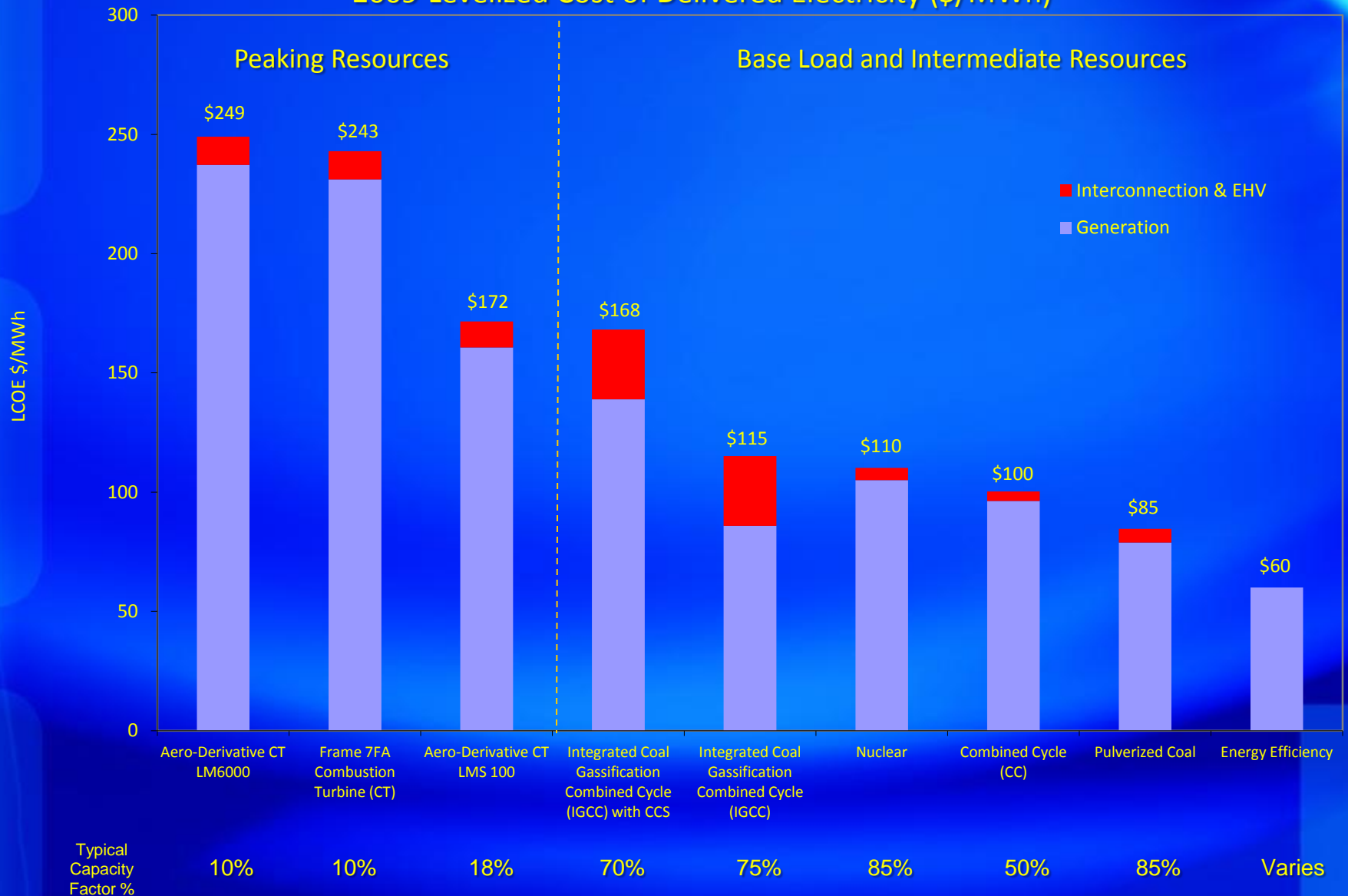
- **Biomass:**
 - Diversity of solid fuels available, but limited
 - Relatively low cost resource
 - Direct fired, cofired or gasified
- **Biogas – Landfill or Anaerobic Digestion**
 - Relatively low landfill gas production due to dry climate, but widespread
 - Animal manure based projects are feasible
- **Biodiesel - Competes with transportation use**
- **Base load and firm resources**
- **Carbon Neutral emissions**

Geothermal

- Mature technology
- Base load and firm resource
- Transmission needed in most cases
- Minimal resource potential in AZ
- High and uncertain exploration costs

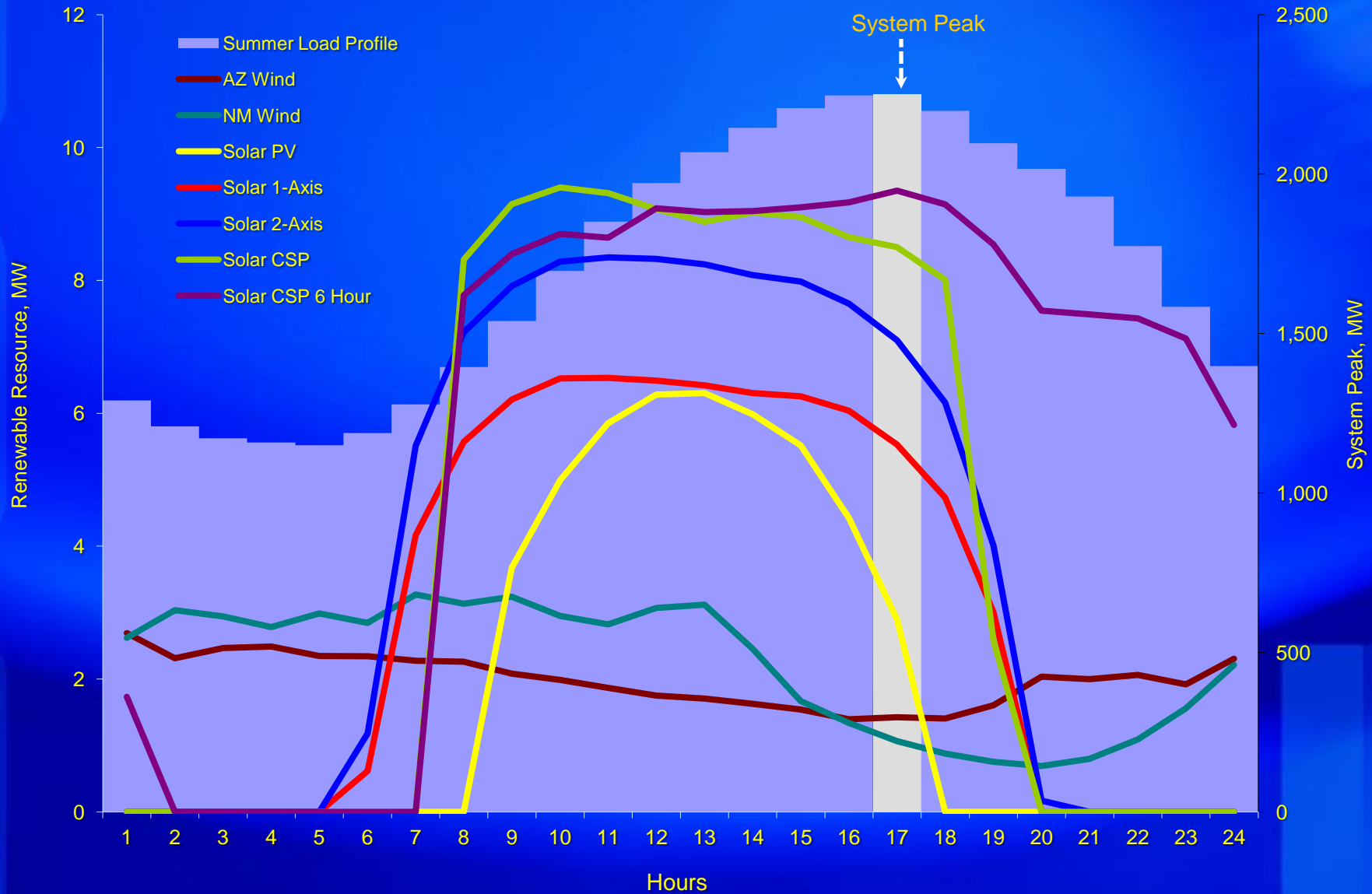
Conventional Resources

2009 Levelized Cost of Delivered Electricity (\$/MWh)



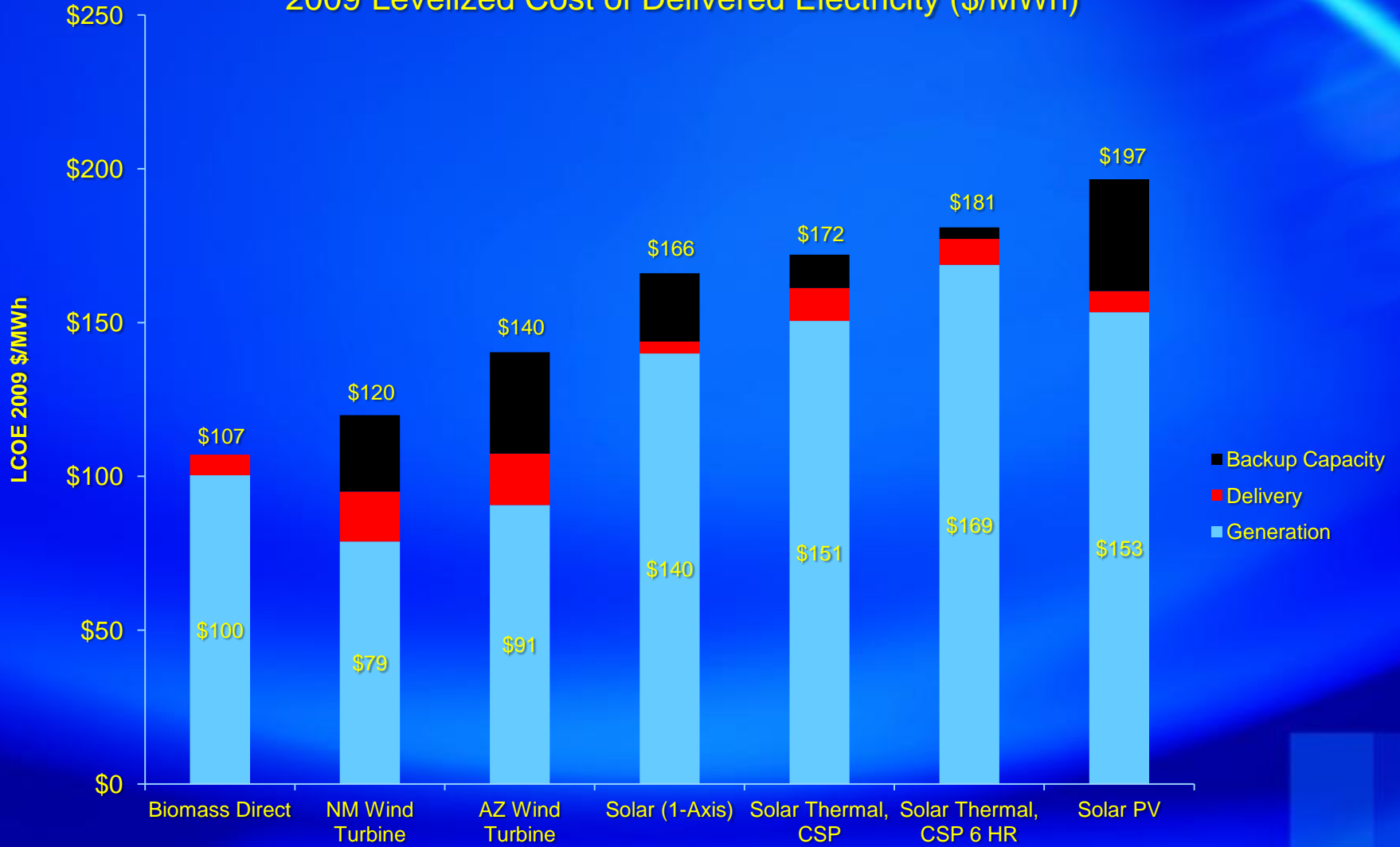
Renewable Resource Capacity Profile

Typical Summer Load Profile versus Renewable Availability



Renewable Resources

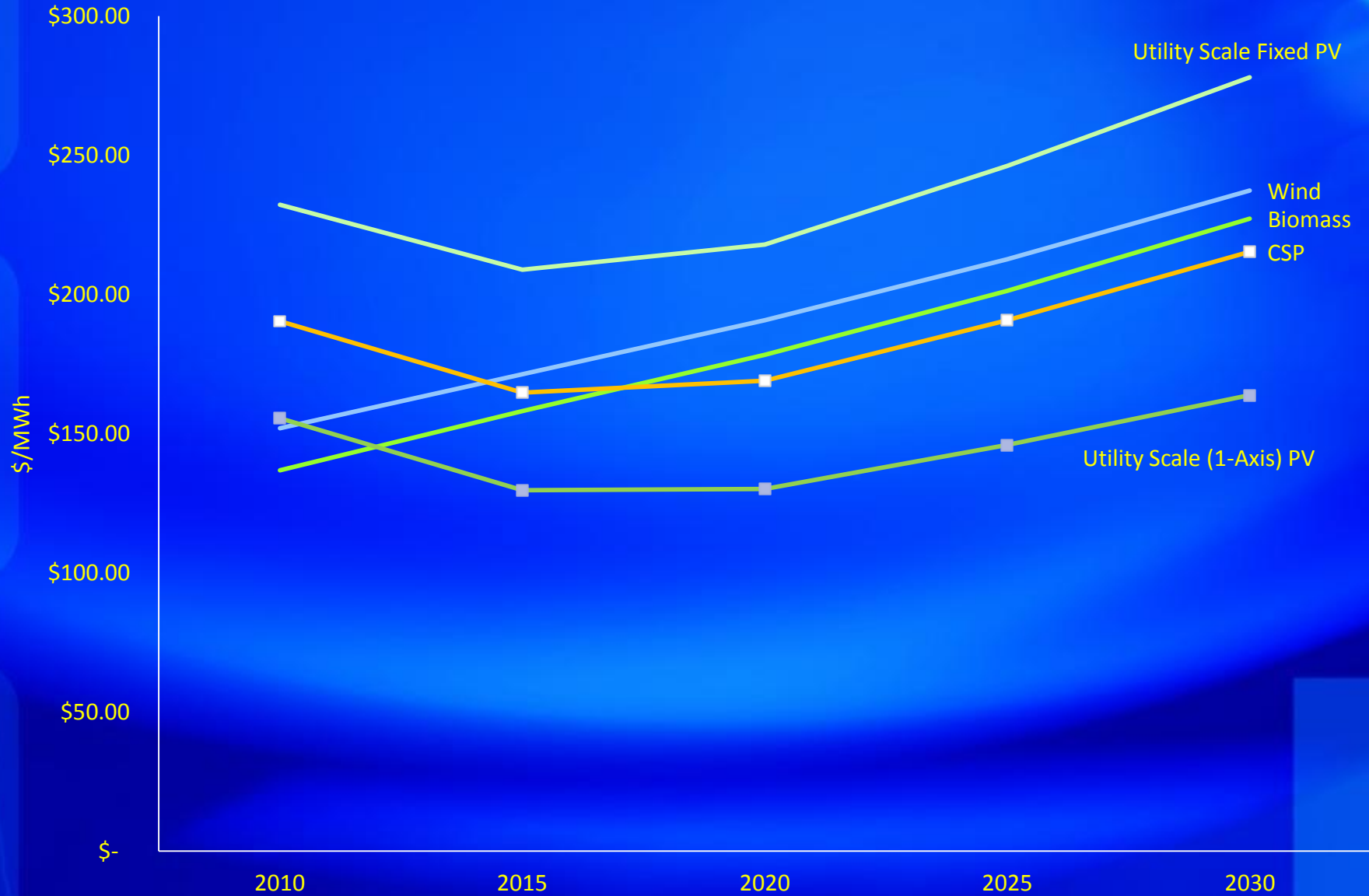
2009 Levelized Cost of Delivered Electricity (\$/MWh)



Capacity Factor %	83%	38%	30%	24%	30%	38%	17%
System Peak %	100%	9%	9%	51%	70%	87%	24%
Water Usage		Low	Low	Low			Low

Renewable Technologies (Delivered)

Costs Adjusted for Technology Innovations, \$/MWh



Renewable Resource Strategy Summary

- **First – Meet RES**
- **Available, Proven Technologies**
- **Small Involvement with New Technologies (R&D)**
- **Competitive, Viable, Cost-Effective Projects**
- **Portfolio Balance, No Big Bets**
- **Maximize Community Benefits**
- **Environmental Benefits**
- **Diversified Technologies**

RFP Process

- **Competitive Solicitation**
 - Followed ACC Procurement Best Practices
 - Independent Monitor
 - Open Process
 - Bidder's Meetings
 - Solid Participation
 - Diverse Technologies and Proposals

RFP Process continued

- **Thorough Analysis**
 - Threshold Screening, Sufficient Response
 - Deliverability, Transmission
 - Technology Risk
 - Viability of Project, Bidder's Strength, Permitting
 - Levelized Cost of Energy Calculated
 - LCOE Adjusted for TEP's System
 - Energy Value, Timing of Generation
 - Capacity Value, Coincident Peak Contribution
 - Intermittency, Effects on System
 - Delivery Costs

PV - Single Axis

- Renewable Energy Ventures
- 25 MW
- Sited in Tucson area
- Connected directly to TEP grid, no transmission requirements
- On-line Late 2010, early 2011
- Expected output of 57,000 MWh/year

Thermal Solar with Storage

- Bell IPC
- 5.5 MW
- Connected directly to TEP grid, no transmission requirements
- Partially an R&D project
- On-line early 2012
- Expected output of 18,000 MWh/year

Landfill Gas

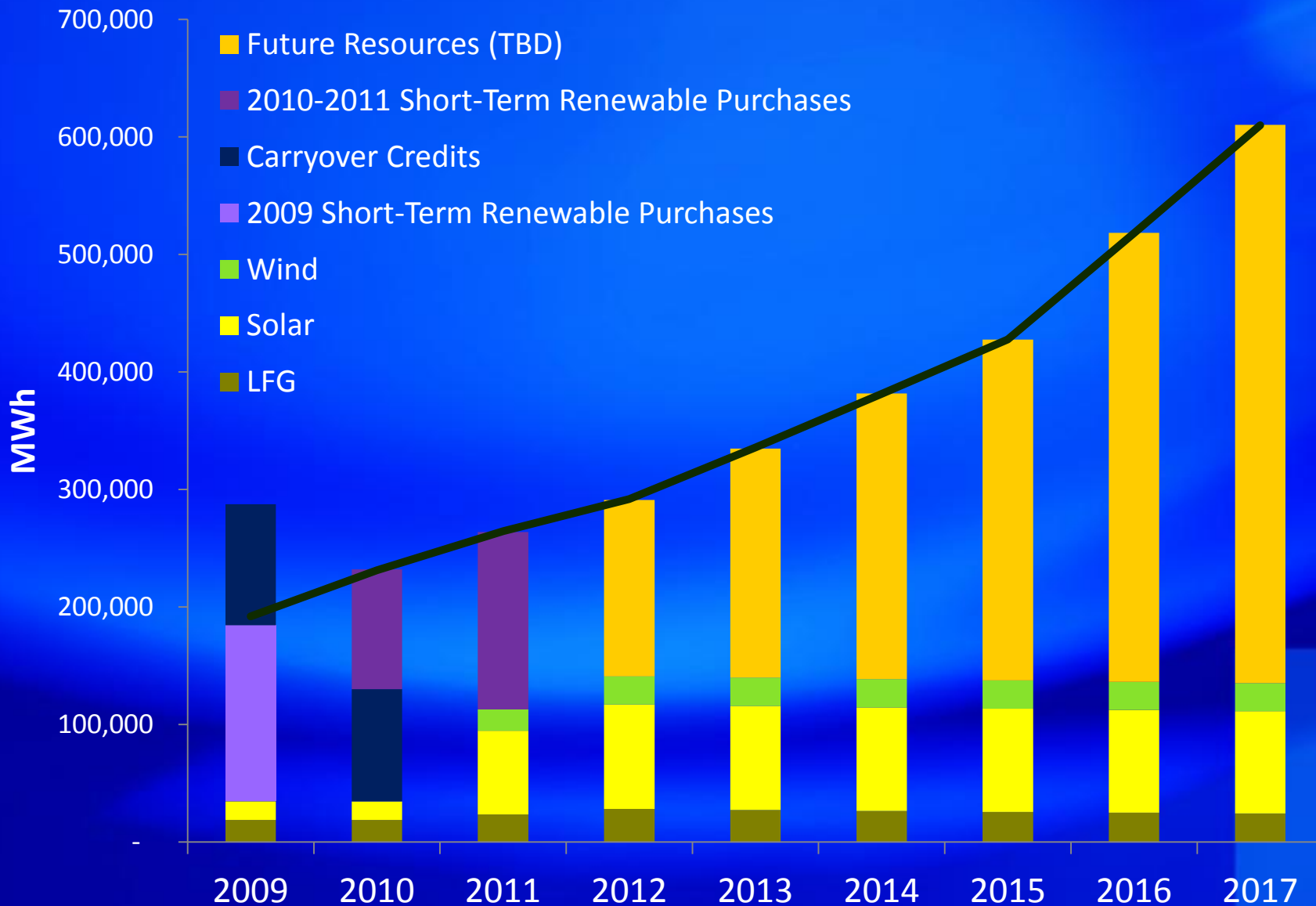
- DTE
- 1.5 MW
- Connected directly to TEP grid, no transmission requirements
- On-line early 2011
- Expected output of 11,000 MWh/year
- Base load resource

Wind with Solar PV – Fixed

- Western Wind Resources
- Combined project - 10 MW wind + 300 kW solar PV
- Sited in UNS Electric service territory
- Connected directly to UNSE grid, no transmission requirements
- On-line early 2011
- Expected output of 18,000 MWh/year

REST Compliance Plan

Excluding Distributed Generation





BRIGHT SOLUTIONSSM

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