

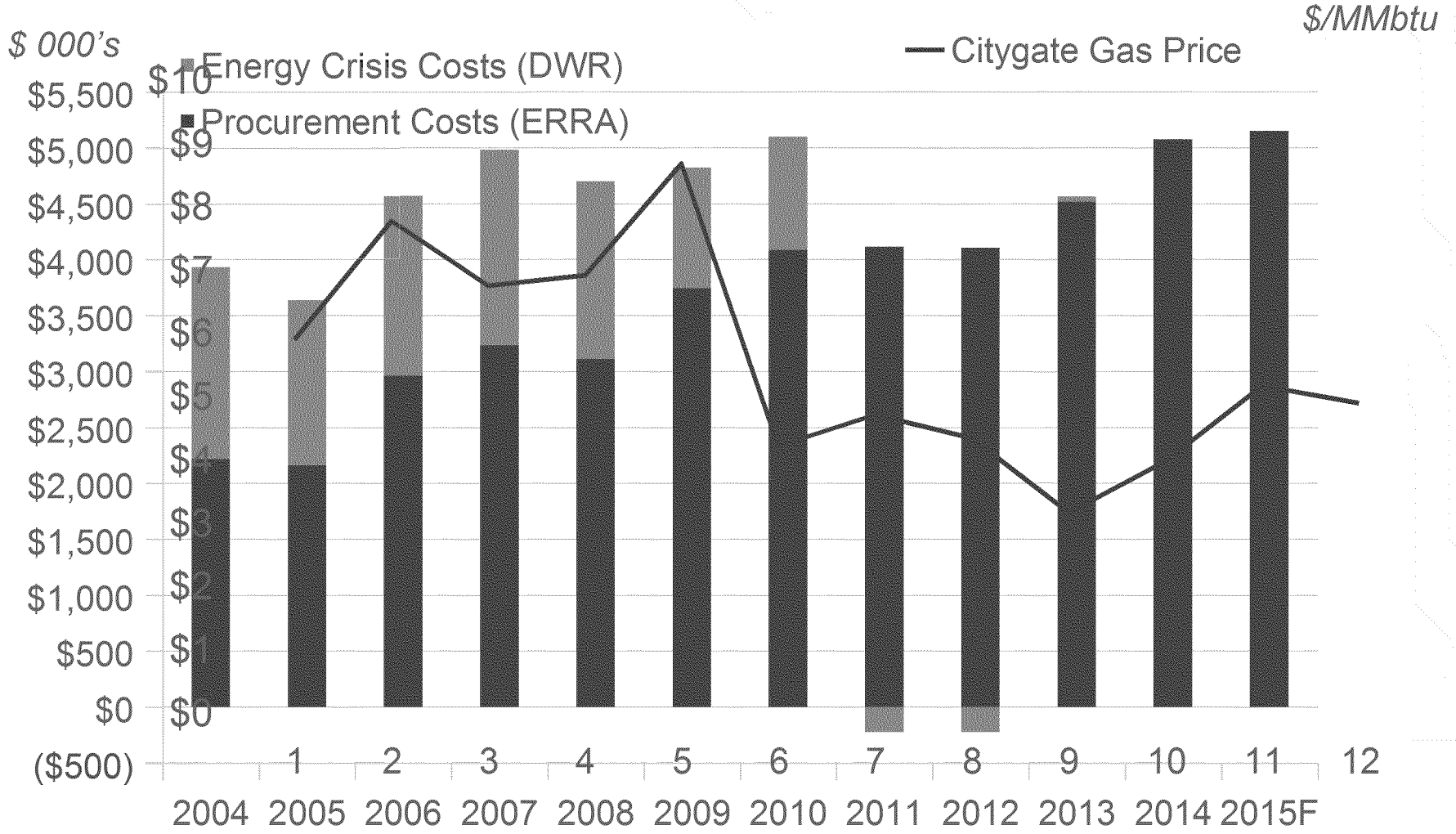


# Renewable generation is no longer a technical challenge, but an economic and operational challenge



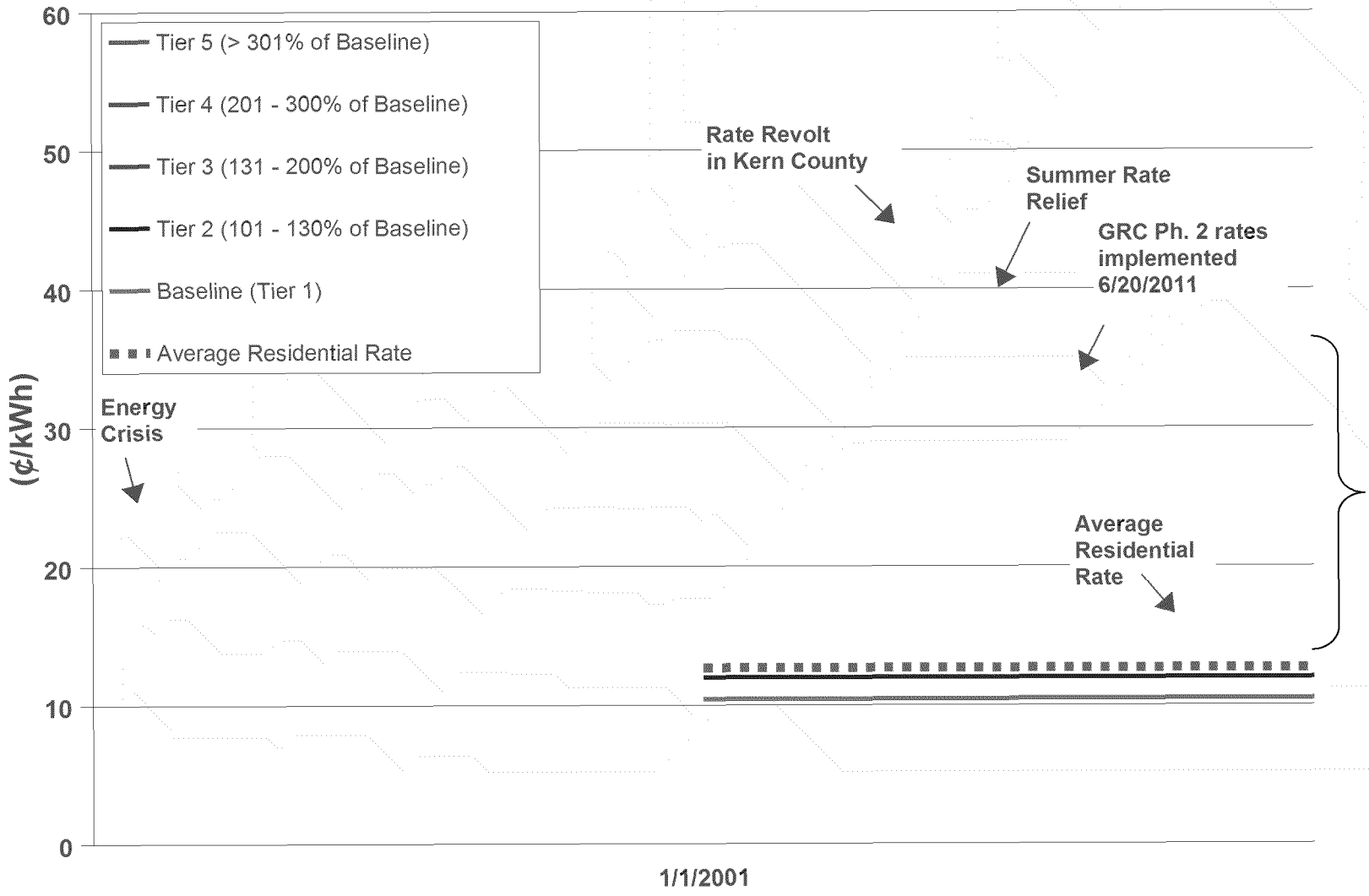


# PG&E's Portfolio Costs are Rising





# PG&E's Electric Rate History



Data as of May 1, 2014



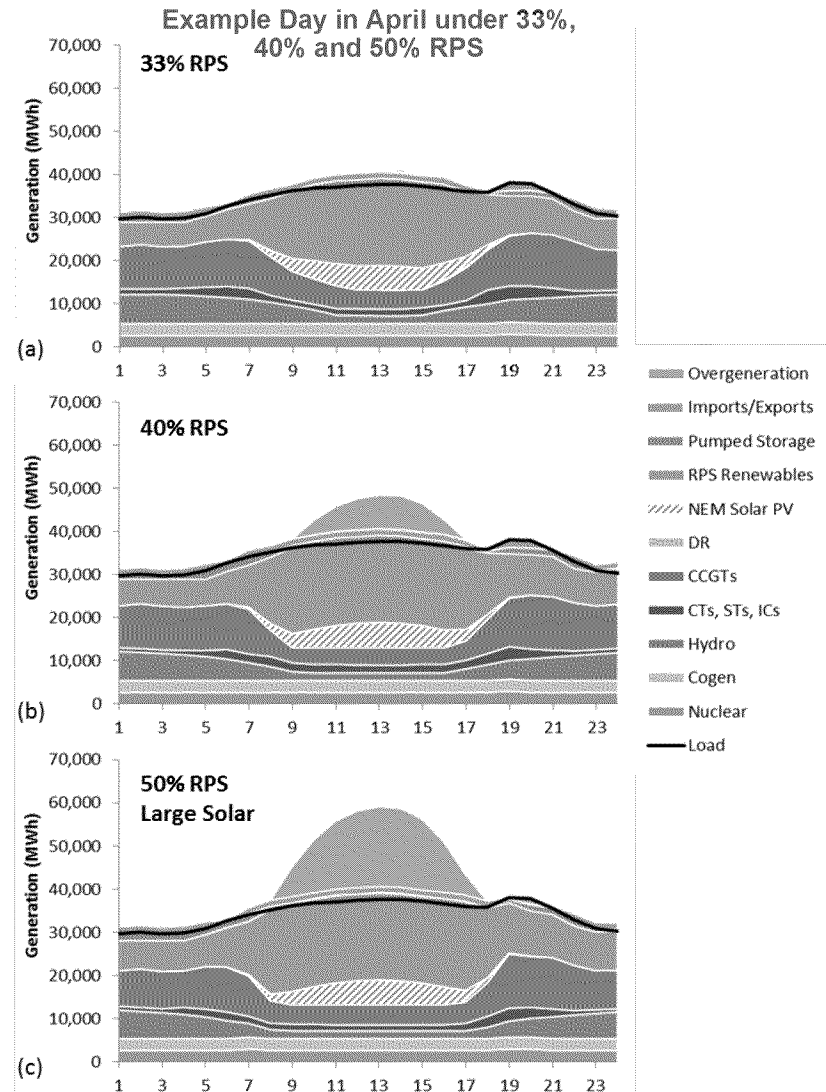
# Beyond 33% RPS, Integration is Increasingly Challenging and Costly

PG&E and other large California utilities studied challenges and solutions to implementing a higher RPS

Over-generation emerges as a problem above 33%

- Grid cannot absorb all energy generated
- Over-generation is very high on some days
- Flexible fossil generation helps mitigate daily swings

Without additional solutions, grid operator must curtail solar to maintain reliability



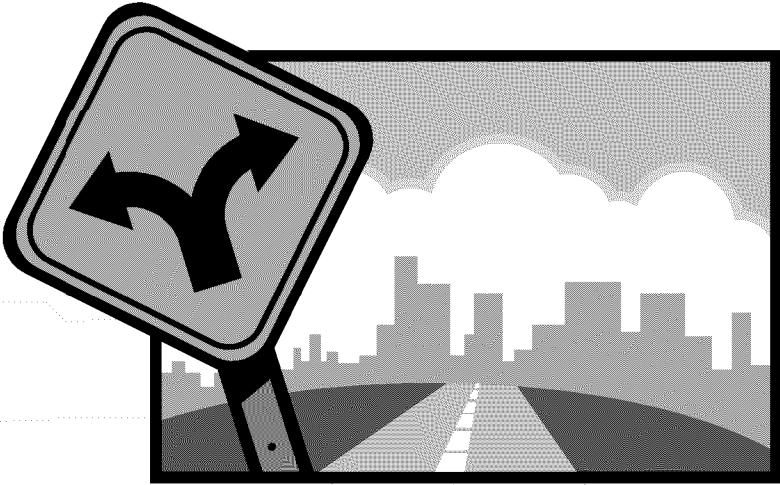
Source: Energy + Environmental Economics

# What Does the Future Hold?

**More renewables?**

**More demand response?**

**More storage?**



**More EVs?**

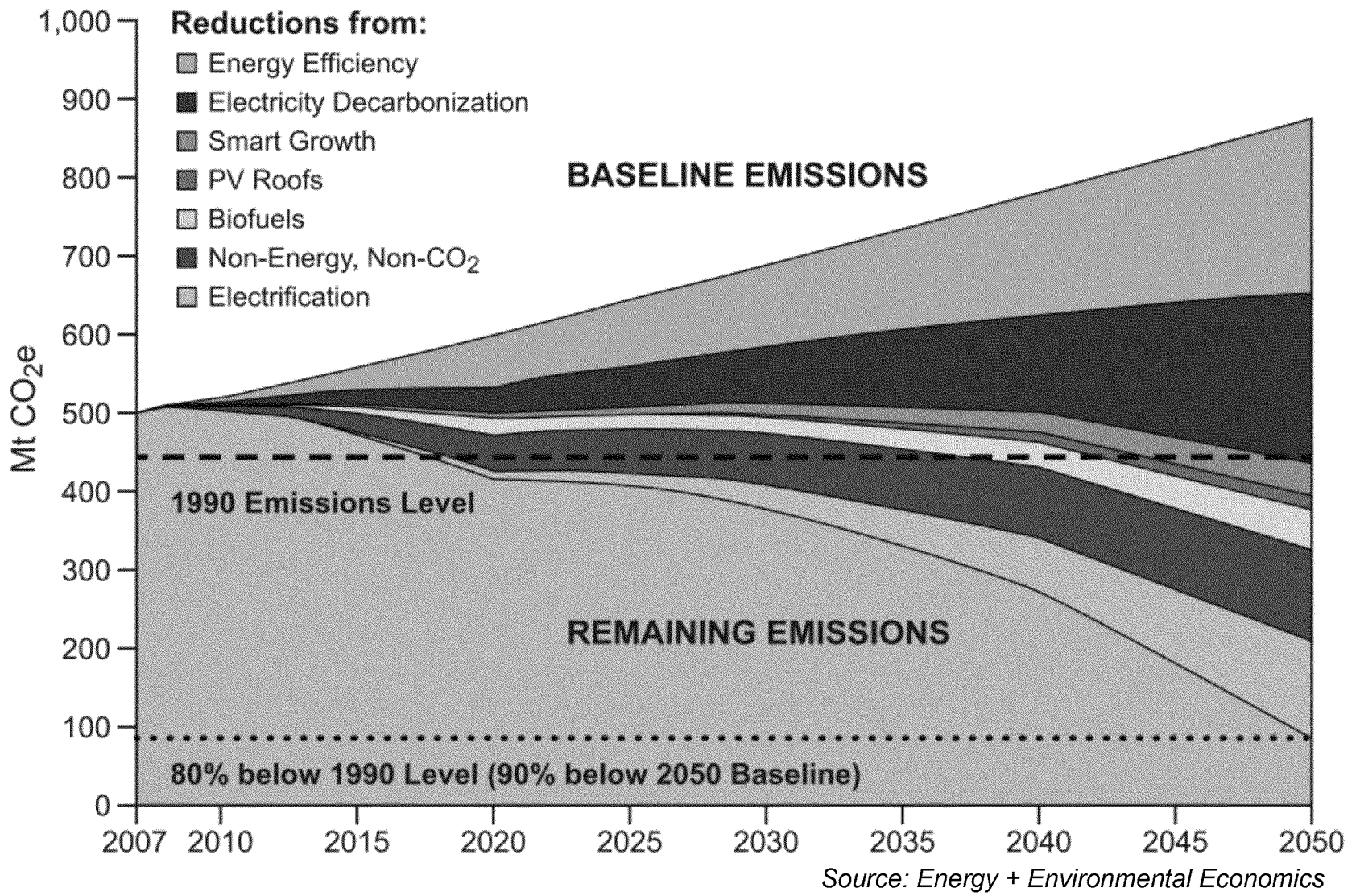
**More energy efficiency?**

**Will electricity replace natural gas usage?**





# Achieving CA's 2050 GHG Goal





# Integration Solutions Will Be Critical to Success

## Increased regional coordination

- Make best use of latent flexibility in current system

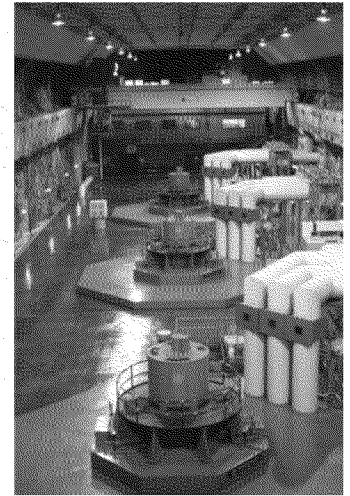
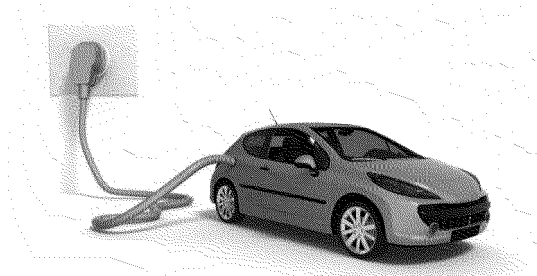


## Renewable resource diversity

- Reduces over-generation and need for flexible resources

## Flexible loads

- Shifting loads from one time period to another, sometimes on short notice



## Flexible generation

- Need generation that is fast ramping, starts quickly, and has minimum generation flexibility

## Energy storage

- Deep-draw (diurnal) storage is important

