The Brattle Group

# IRP Challenges of the Coming Decade

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# Why Resource Planning Is So Difficult

IRP has become as much a question of regulatory philosophy as an analytic problem (though also that, and very difficult).

- Not just least-cost planning under cost-of-service, but also:
  - Competitive procurement/fostering wholesale (& retail) markets
  - Risk management – to limit customer bill volatility
  - Credit protection – to help developers & protect the utility
- Likely obsolescence of conventional technologies
- New possibilities, and old ones that need to work better
  - Some alternatives don't affect all customers
  - Some alternatives only work if we also change pricing and service delivery model
- And, there is extreme uncertainty surrounding all the major elements

# Markets vs. (Re) regulation

Are wholesale markets working well enough? Retail? Should utility procurement be altered to improve or work around problem?

- If utilities reintegrate upstream, (gradually or partially), how will they alter market conditions?
  - Buy baseload units under very long-term contracts? Cost of Service?
  - Wholesale market just for "topping off?"
- Long-term contracts for secure development financing tend to exacerbate customer-switching risk
- Does public input improve resource decisions, or put more cost and risk on customers?

# Credit Constraints Shaping Procurement

Developers often claim to need a long-term PPA (or feed-in tariffs) to obtain financing.

- Is this a market failure, or a market warning sign?
- Effectively saying customers should bear risks that unregulated shareholders won't (despite diversification and liquidity of their positions)

How much risk can utilities absorb for suppliers and customers, before their own health is jeopardized?

- Imputed debt from PPAs
- Mark-to-market and collateral obligations
- Counter-party risk if push exposure upstream

Should customer bear more cost-risk, in exchange for lower risk-premiums?

# Risk Management Complications

Risk Management turns Least-Cost Planning on its head: *What plan/resource has least risk (highest benefit) for given expected cost? Not, What has least cost for given benefit?*

- Don't reduce risk for its own sake; do it to solve the problems the risk creates

- Risk not well-defined in common use
  - *Ex-ante* certainty or *ex-post* regret?
  - Absolute or relative?
  - Steady changes or abrupt (boiled frog)?
  - Time horizon?

- No free lunch: can't make the risk vanish, only change who bears it (suppliers, utility, customers)

- Requires regulatory collaboration: new goals, new tools, new standards

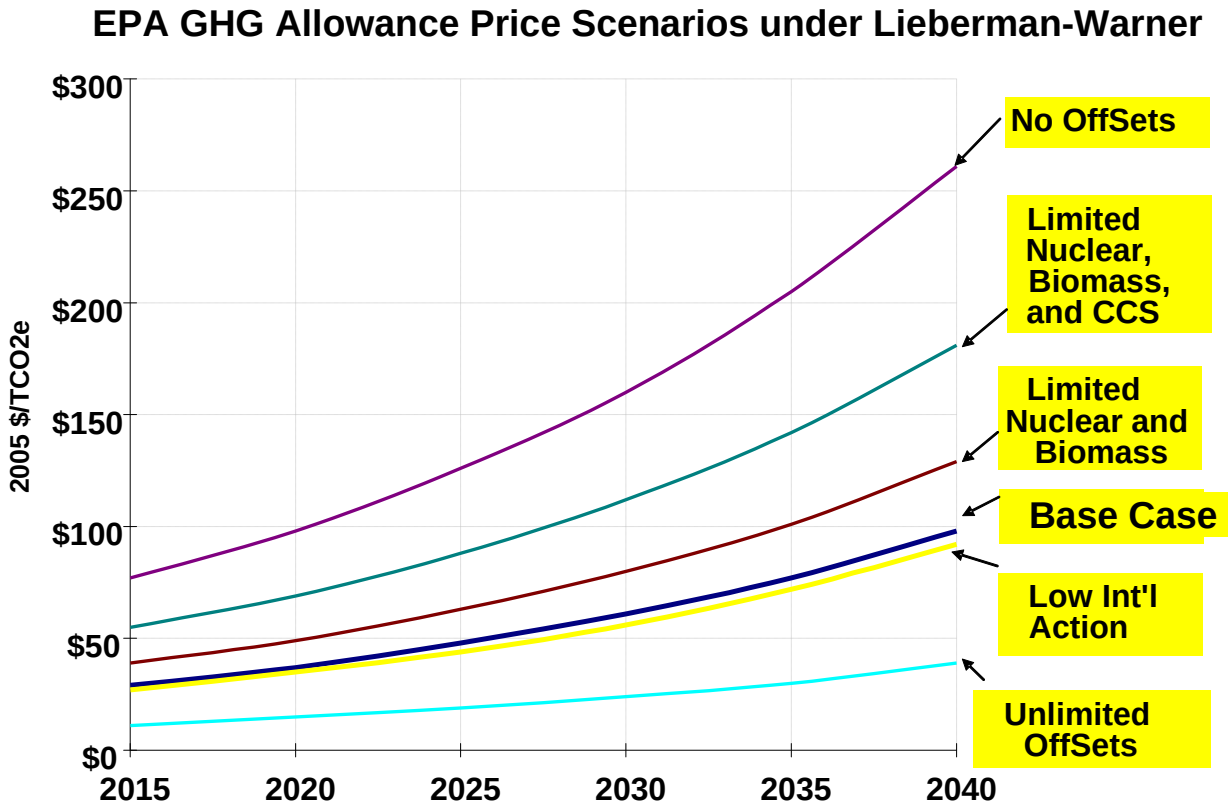
# Driving Beyond the Headlights?

Traditional IRP takes a very long view. Unfortunately, about 10-15 years ahead, we can't see much with any confidence:

- $CO_2$ regs – how soon, how costly
  - Policy caps = ?
  - Fuel feedbacks?
  - Offsets?
  - RD&D support for critical technologies?
- Oil/OPEC/natural gas/LNG?
- Construction costs?
- Technology improvements in renewables'?
- Success of DR and RPS programs?
- New demands – PHEV?

# $CO_2$ Cost Risk

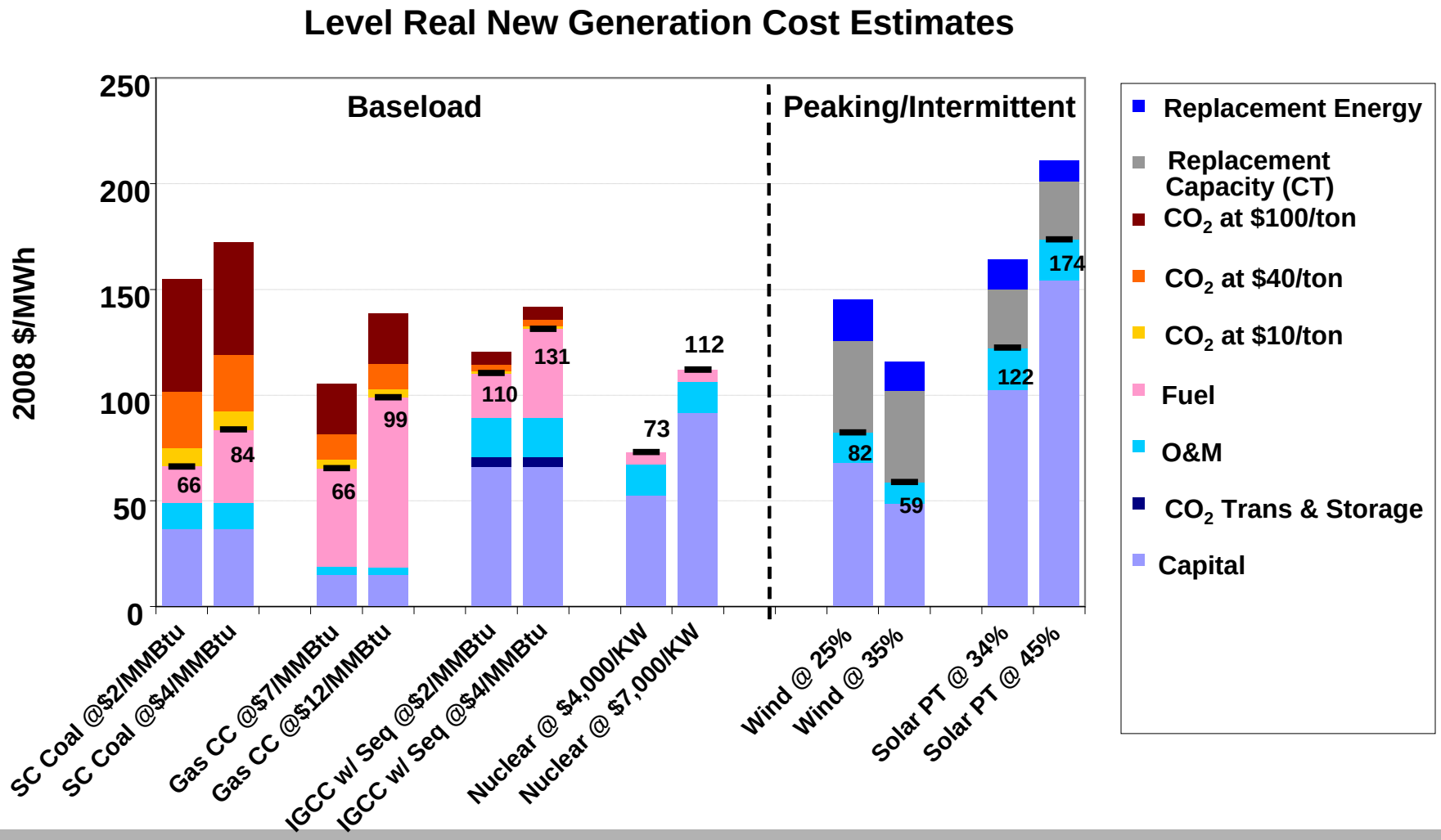
$CO_2$ prices are likely to be as or more volatile than natural gas.




- Annual volatility greater than natural gas (40-50%/yr) plausible
- +/- $10/ton $CO_2$ changes wholesale energy prices by about +/- $6/MWh
- $CO_2$ potentially a large portion of wholesale electricity prices

# Comparative Gen BusBar Costs

Least-cost resource depends critically on $CO_2$ and fuel prices:



# Diversification

Given the fog, and lack of market hedges greater than a few years ahead, many utilities and commissions look to portfolio diversity as a partial cure for risk. But…

- Won't work like it does in financial markets, because many more attributes of electric service than just risk and return
  - Securities actually price risk: high risk ⟶ low cost ⟶ high returns
  - For gen, also care about location, dispatchability, emissions, time to build, etc.
  - Utility asset positions not liquid – can't get in and out
- Not just one kind of electricity risk, so no simple/single "efficient frontier"; many, each with its own tradeoffs (nuke vs. solar as $CO_2$ hedge)
  - Fuel
  - $CO_2$ exposure
  - Reliability
  - Construction

As a result, it is difficult to use diversity as more than a tiebreaker.

# Planned Obsolescence

In several areas, regulatory policy is fostering a new paradigm:

- Conventional fossil gen ⟹ clean gen ⟹ distgen
  - We are probably embarking on a path to zero net carbon emissions
  - $CO_2$ prices by 2030s should materially penalize coal and gas use, absent CCS
  - RPS standards promote new techs – but often more political basis than economic, and overlap between externality penalties
- Load growth and gen expansion

  ⟹ conservation, DR, and decoupling
- AMI ⟹ Smart Grid ⟹ even Smarter Grid

We are in the transition phase, when old techs still need to be used knowing they could become unattractive, and new techs are emerging.

# New Value-Proposition

Traditional utility planning is paternalistic, engineering- driven:
*We buy what is good for customers, and they pay its costs.*

- With Smart Grid, DR and conservation, distgen and CHP, possibility of a new business model:
  - Decentralized
  - Customer-driven
  - Adaptive
  - Customized
- Can the utility participate in value-added from improving customers' energy use?
  - Have to really know customers to make it work
  - Many new systems and capabilities needed: AMI, smart appliances, RTP, micro-grid controls, educated customers, new billing capabilities, incentives and performance metrics
- What is the boundary of utility services vs. ESCO, SEU, or deregulated subsidiary?

# What to do?

- **Maintain/manage realistic expectations –** no one can get this complex problem "just right"
- **Minimize conflict** – e.g., with collaborative, exploratory and information sessions in lieu of formal hearings
- **Get educated** – in the new techniques of analysis (risk management) and engineering that will be needed
- **Specify problems explicitly** – don't explore solutions without knowing what they are supposed to cure
- **Pursue flexibility** – modular, adjustable plans that don't require placing large, long-term bets
- **Recognize inconsistencies** – between goals and policies that are in opposition (e.g., customer choice and long term fixed pricing)
- **Specify performance standards in advance** – that are related to what is controllable, and knowable; hold harmless for uncontrollable outcomes
- **Value long-term, but evaluate short term impacts**
- **Preserve/respect the market** – it is telling you something useful, even if you don't believe it

# Appendix: BusBar Cost Assumptions

| Current Year 2010 | New Plants US | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SC Coal Low | SC Coal High | Adv CC Low | Adv CC High | IGCC Low | IGCC High | IGCC w/ Seq Low | IGCC w/ Seq High | Adv Nuclear | Adv Nuclear | Wind | Wind | Solar | Solar |
| Overnight Cost | 2,900 | 2,900 | 1,175 | 1,175 | 4,275 | 4,275 | 5,275 | 5,275 | 4,000 | 7,000 | 1,925 | 1,925 | 4,000 | 8,000 |
| Interconnection Cost (Tx, Water) | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Overnight + Interconnect | 2,950 | 2,950 | 1,225 | 1,225 | 4,325 | 4,325 | 5,325 | 5,325 | 4,050 | 7,050 | 1,975 | 1,975 | 4,050 | 8,050 |
| Charge Rate | 9.3% | 9.3% | 9.0% | 9.0% | 9.3% | 9.3% | 9.3% | 9.3% | 9.7% | 9.7% | 7.6% | 7.6% | 7.6% | 7.6% |
| FOM | 46.3 | 46.3 | 18.1 | 18.1 | 54.7 | 54.7 | 68.4 | 68.4 | 90.7 | 90.7 | 31.3 | 31.3 | 58.6 | 76.2 |
| CO2 transport cost (250 km) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 31.4 | 31.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CO2 storage cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| VOM | 5.9 | 5.9 | 1.5 | 1.5 | 7.1 | 7.1 | 9.7 | 9.7 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Nuclear Spent Fuel & Decomm. Charge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fuel Price | 2.00 | 4.00 | 7.00 | 12.00 | 2.00 | 4.00 | 2.00 | 4.00 | 0.54 | 0.54 | 0.0 | 0.0 | 0.0 | 0.0 |
| Heat Rate | 8,721 | 8,721 | 6,683 | 6,683 | 8,922 | 8,922 | 10,505 | 10,505 | 10,400 | 10,400 | 10,022 | 10,022 | 10,022 | 10,022 |
| CO2 Rate | 203 | 203 | 119 | 119 | 197.00 | 197.00 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| NCF | 85% | 85% | 85% | 85% | 85% | 85% | 85% | 85% | 85% | 85% | 25% | 35% | 34% | 45% |
| | | | | | | | | | | | | | | |
| **2008$/MWh** | | | | | | | | | | | | | | |
| Capital Costs | 36.72 | 36.72 | 14.81 | 14.81 | 53.84 | 53.84 | 66.28 | 66.28 | 52.71 | 91.76 | 68.13 | 48.66 | 102.73 | 154.27 |
| CO2 Trans&Storage | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.26 | 4.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FOM | 6.22 | 6.22 | 2.43 | 2.43 | 7.35 | 7.35 | 9.18 | 9.18 | 12.18 | 12.18 | 14.28 | 10.20 | 19.68 | 19.33 |
| Fuel | 17.44 | 34.88 | 46.78 | 80.20 | 17.84 | 35.69 | 21.01 | 42.02 | 5.62 | 5.62 | 0.00 | 0.00 | 0.00 | 0.00 |
| VOM | 5.87 | 5.87 | 1.55 | 1.55 | 7.07 | 7.07 | 9.68 | 9.68 | 2.51 | 2.51 | 0.00 | 0.00 | 0.00 | 0.00 |
| CO2 Cost @ $10/tCO2 | 8.85 | 8.85 | 3.98 | 3.98 | 8.79 | 8.79 | 1.03 | 1.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CO2 Cost @ $40/tCO2 | 26.56 | 26.56 | 11.93 | 11.93 | 26.36 | 26.36 | 3.09 | 3.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CO2 Cost @ $100/tCO2 | 53.11 | 53.11 | 23.86 | 23.86 | 52.73 | 52.73 | 6.18 | 6.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| O&M | 12.09 | 12.09 | 3.97 | 3.97 | 14.42 | 14.42 | 18.86 | 18.86 | 14.69 | 14.69 | 14.28 | 10.20 | 19.68 | 19.33 |
| **Total** | **66.25** | **83.69** | **65.56** | **98.98** | **86.10** | **103.94** | **110.42** | **131.43** | **73.02** | **112.07** | **82.41** | **58.87** | **122.40** | **173.60** |
| **Total @ $10/tCO2** | **75.10** | **92.55** | **69.54** | **102.96** | **94.89** | **112.73** | **111.45** | **132.46** | **73.02** | **112.07** | **82.41** | **58.87** | **122.40** | **173.60** |
| **Total @ $40/tCO2** | **101.66** | **119.10** | **81.47** | **114.89** | **121.25** | **139.09** | **114.54** | **135.55** | **73.02** | **112.07** | **82.41** | **58.87** | **122.40** | **173.60** |
| **Total @ $100/tCO2** | **154.77** | **172.21** | **105.33** | **138.75** | **173.98** | **191.82** | **120.72** | **141.73** | **73.02** | **112.07** | **82.41** | **58.87** | **122.40** | **173.60** |