Resource Adequacy in Western Australia

Alternatives to the Reserve Capacity Mechanism (RCM)

PRESENTED TO

The Australian Institute of Energy

PRESENTED BY

Samuel A. Newell and Kathleen Spees on behalf of EnerNOC, Inc.

October 9, 2014

THE Brattle GROUP

Agenda

I. Executive Summary
II. Why Capacity Markets?
III. Key Design Elements of Centralized Capacity Auctions
IV. Recommended Next Steps to Implement a Capacity Market

Appendix: Deeper Review of Energy-Only Alternative

Recommendations

- Western Australia's wholesale market is under review as part of broader concerns about high rates, and specific concerns that the RCM is procuring excess capacity and not necessarily the right types of capacity
- RCM's excess capacity explains less than 2% of total electricity costs in WA, but it pays too high a price to too much capacity
- **WA could more efficiently meet resource adequacy objectives** with:
  - Centralized forward capacity auctions and incremental auctions; complements bilaterals
  - A "demand curve" for capacity, with prices falling more steeply than the RCP function, but not vertical or as steep as in larger U.S. markets
  - All resource types competing to earn the same capacity price to the extent that they provide the same reliability value (while energy and ancillary service markets pay some types of capacity more than others for their differential value in those areas)
  - Competition supported by structural reform and market monitoring and mitigation
  - Market stability and sustainability supported by good initial design informed by lessons learned
- We recommend that WA transition to such an approach if it seeks a competitive market framework for meeting resource adequacy objectives
  - Spend a year establishing details with stakeholders, aiming to hold in auction in 2016 for '19
  - In the meantime, start to ratchet down the RCP function; consider ways to address Synergy's size/structure; consider reforms to energy and ancillary services markets

Comparison to Alternatives

- As one alternative, WA could maintain the existing RCM but steepening the RCP
  - The Lantau curve is steeper, but still not very steep
  - If steepen much more, suppliers face high risks committing before knowing the price
- As one alternative, WA could impose a resource adequacy requirement on retailers, who could meet it bilaterally-only, without centralized auctions
  - But this would preclude market monitoring and mitigation, which are critical in a market with such supply concentration and demand inelasticity
  - This would also preclude imposing a forward requirement (which has many advantages)
  - Purely bilateral markets are also much less efficient when prices are very sensitive to small changes in supply/demand and difficult to guess
- As another alternative, WA could move to an "energy-only" NEM gross pool market, but this would pose some challenges for a market as small and concentrated as WA
  - Market power harder to address than in capacity market (many more transactions; difficulty distinguishing between market power and true scarcity)
  - Even if addressed those challenges, such a small market would experience wide variations in reserve margins; the prospect of intervention can undermine investment

Agenda

I. Executive Summary

II. **Why Capacity Markets?**

- Why resource adequacy requirements?
- Centralized vs. bilateral-only markets
- U.S. experience with capacity markets
- Challenges

III. Key Design Elements of Centralized Capacity Auctions

IV. Recommended Next Steps if Implementing a Capacity Market

Appendix: Deeper Review of Energy-Only Alternatives

Resource Adequacy Supports Reliability

- Most electric systems define planning reserve margins high enough so the probability of having to shed load due to inadequate supply is extremely low
- Not all impose a *requirement* (e.g., NEM, Texas, Alberta), letting the market determine the reserve margin
- But most do impose resource adequacy requirements

	Definition of Reliabilty Standard	50/50 Peak Load in MW	Reserve Margin Above 50/50 Peak
Western Australia	Greater of: (a) 7.6% margin or largest contingency above 90/10 peak load, plus load following, or (b) 0.002% unserved energy	4,337	18%
New Zealand	1-in-60 hydro year for energy standard, plus economic capacity standard	4,281 North, 6,500 Total	18% North Island
Maritimes (CA)	Greater of 0.1 events per year and 20% reserve margin	5,449	20%
Ireland	8 hours per year	6,781	~19%
Singapore	3 days per year	6,814	30%
Alberta (CA)	1,600 MWh per two years	11,100	n/a
British Columbia (CA)	0.1 events per year plus expected hydro energy assessment	11,681	14%
Duke Carolinas (US)	Consider minimum customer cost and 0.1 events per year	12,376	14.5%
Southern Company (US)	Minimum customer cost, plus a risk premium	17,985	15%
Netherlands	4 hours per year	19,900	n/a
Ontario (CA)	0.1 events per year	22,770	19.2%
ISO New England (US)	0.1 events per year	29,790	13.6%
Tennessee Valley (US)	Minimum customer cost, plus a risk premium	34,000	15%
Australia NEM	0.002% unserved energy	35,800	n/a
United Kingdom	3 hrs per year based on economic evaluation	56,040	~18%
Texas (US)	0.1 events per year	67,000	13.75%
Midcontinent ISO (US)	0.1 events per year	124,212	14.8%
PJM (US)	0.1 events per year	164,479	15.7%

Market Designs for Resource Adequacy

	Regulated Planning (Customers Bear Most Risk)			**Market Mechanisms** (Suppliers Bear Most Risk)		
	Regulated Utilities	**Administrative Contracting**	**Capacity Payments**	**Requirement on Retailers (bilateral only)**	**Centralized Capacity Markets**	**Energy-Only Markets**
Examples	SPP, BC Hydro, most of WECC and SERC	Ontario	Spain, South America (WA sort of goes here currently)	California, MISO (both also have regulated IRP)	PJM, NYISO, ISO-NE, Brazil, Italy, Russia	NEM, ERCOT, Alberta, Scandinavia
Resource Adequacy Requirement?	Yes (Utility IRP)	Yes (Administrative IRP)	Yes (Rules for Payment Size and Eligibility)	Yes (Creates Bilateral Capacity Market)	Yes (Mandatory Capacity Auction)	No (RA not Assured)
How are Capital Costs Recovered?	Rate Recovery	Energy Market plus Administrative Contracts	Energy Market plus Capacity Payments	Bilateral Capacity Payments plus Energy Market	Capacity plus Energy Markets	Energy Market

See Also:

Pfeifenberger & Spees (2009). *Review of Alternative Market Designs for Resource Adequacy*.

Spees, Newell, & Pfeifenberger (2013). "Capacity Markets: Lessons Learned from the First Decade," *Economics of Energy & Environmental Policy,* Vol. 2, No. 2, September 2013.

Rationale for Imposing *Requirements* Instead of Letting the Market Determine Reliability

In most industries, the market alone determines the level of investment

Electricity is different because…

- With peaky demand and no storage, a certain amount of capacity is needed to prevent power from occasionally being unavailable to some (and WA is especially challenging with its isolation from neighbors and its size relative to resources)
- Most electric systems are not set up to support the efficient or politically desired amount of resource adequacy, nor to satisfactorily ration scarce supplies
  - Energy and ancillary services prices below the true marginal cost cause suppliers to invest below the economically optimal level (see appendix).
  - Buyers will not contract for enough capacity to reliably meet their own load if system operators cannot differentially shed them; they can free-ride off those who do, while paying a price below their value of lost load
  - This means involuntary load shedding might be needed, for which most developed countries have a low political tolerance

Most electric systems thus impose resource adequacy requirements

"Energy-Only" Alternative to Requirements

An alternative is to reform real-time pricing so the market provides economically efficient investment and rationing, e.g., NEM, Texas, & Alberta

Challenges with this approach include…

- Energy pricing reforms involve a difficult combination of administrative energy pricing adders (Texas) or much looser bidding rules (NEM and Alberta), where it may be difficult to distinguish true scarcity from the exercise of market power
- The resulting level of reliability may be below traditional targets even if it achieves the risk-neutral economic optimum reserve margin
- The volatility of prices and reserve margins may be politically unsustainably high in small systems

See appendix section on Energy-Only markets

Market-Based Approaches to Meeting Requirements

Resource adequacy requirements are defined administratively, but market mechanisms can be used to meet those requirements at least cost

- Imposing requirements creates the market "demand" for capacity
  - Need a clear definition of the resource adequacy requirement (e.g., MW of capacity that are available during summer peak or other periods of scarcity)
- All resources that provide the same product compete (and receive the same price), which minimizes costs
  - Need clear rules for qualifying resources to meet that need and determining the MW they can reliably contribute

Generally two market-based approaches

- Impose a resource adequacy requirement on retailers to create a bilateral market
- Or, supplement the bilateral market with centralized capacity auctions, where the IMO procures capacity to meet residual loads on behalf of all customers (then allocates the costs to retailers)
- The current RCM is not really a market-based approach, since resources aren't really competing, and the market does not determine the overall payment level (P*Q is determined administratively, perhaps at too high a level)

Centralized vs. Bilateral-Only Markets

Some favor imposing requirements on retailers, without a centralized auction

- Might protect consumers from over-procuring based on an IMO forecast error
  - But overage would be no more than a few % under best forecasting practices, and mitigation mechanisms can reduce the impact
  - If forecasting is so hard, private parties might misestimate too, with reliability consequences
- Some think this will procure a more efficient mix of resources, but this is incorrect

But centralized has major advantages in the WA context

- Can prevent economic withholding even in a concentrated market, which is critical in WA, esp. under excess supply conditions
- Can procure 3-years forward even in a retail choice environment; this matches the lead-time of some resources, enabling rationalization of supply/demand and avoiding boom-bust
- Can use a demand curve to mitigate price volatility, supporting investment and rate stability vs. vertical demand reflecting a retailer requirement to procure a fixed reserve margin
- More efficient than bilateral if prices are difficult to predict due to inelastic demand and lumpiness; can also reduce transaction costs by assessing and backstopping credit risks
- Price transparency benefits parties to transactions, planners, etc.

In larger U.S. market areas, centralized capacity markets (PJM, NYISO, ISO-NE) are considered more successful than bilateral-only (CA, MISO)

- Both of those are moving toward centralized markets

Uniform vs. Discriminatory Pricing Approaches

We've seen proposals to pay different amounts to different types of resources

- Such proposals have included paying less to DSM than generation
- Or paying more (or less) to baseload vs. peaking generation
- Or paying less to existing capacity than new, or paying less to resources with lower fixed cost

But to the extent various resource types contribute the same to the resource adequacy objective, they should receive the same capacity payment

- Capacity markets are simply a market-based way to meet resource adequacy objectives, which are only about having enough supply during potential shortage conditions
- Capacity markets complement energy and ancillary services markets, which reward other attributes, such as low variable costs and flexibility
- Together, these price signals should procure the overall least-cost mix of resources
- Differentiating capacity prices based on non-resource adequacy attributes would distort the resource mix away from the economic optimum

Capacity payments should be differentiated only to the extent that resources contribute different amounts to the resource adequacy objective, e.g.,

- Different expected availability during summer peak
- Limited run hours/seasonality significantly affecting availability when shortages are possible
- Potentially: unavailability during common-mode failures from fuel scarcity or freeze-offs

Experience with U.S. Capacity Markets

The last decade demonstrated the efficiency and effectiveness of centralized capacity markets:

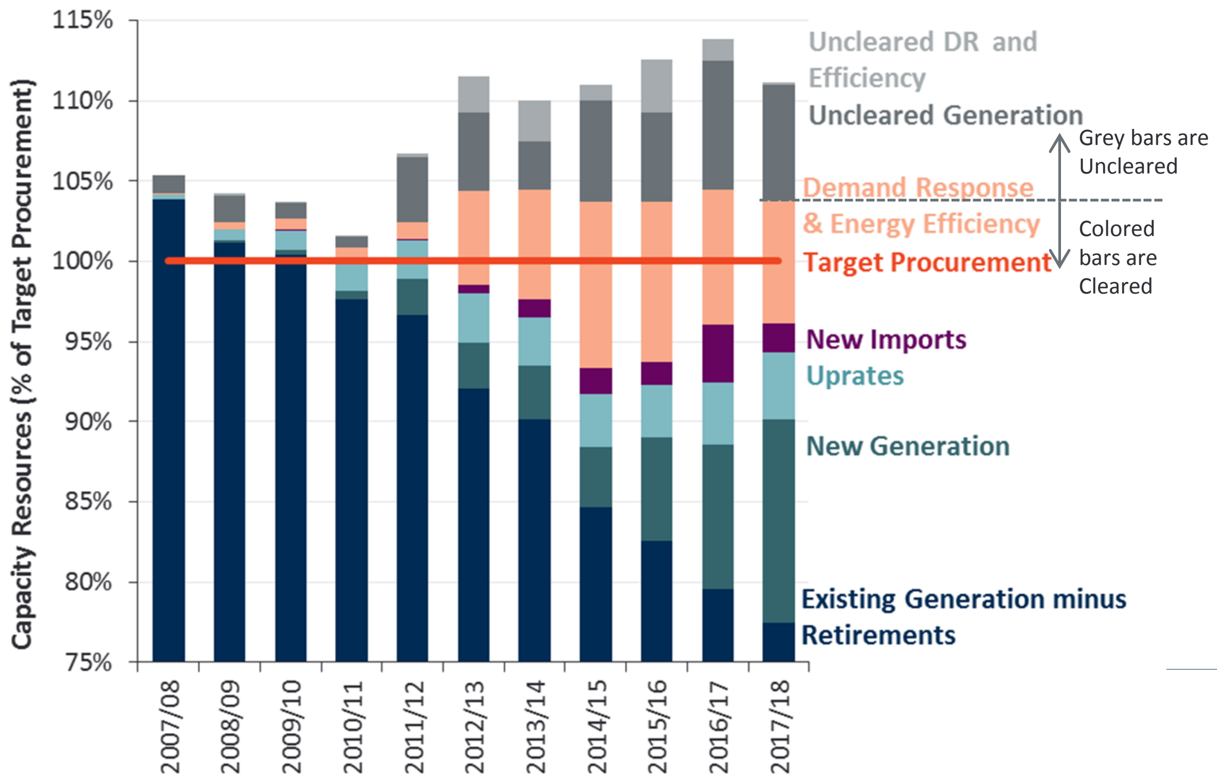
- Attracted and retained resources of significantly lower cost than new plants
  - Demand response, retained generation, retrofits, repowering, uprates, imports
  - Kept prices low and delayed the need for new generation by several years
- Quickly and efficiently adjusted to economic and regulatory "shocks"
  - Sharply lower prices (and consumer costs) after economic downturn
  - Replaced 25,000 MW of coal plant retirements in PJM at low market prices
  - Quickly restored resource adequacy in import-constrained zones (PJM, NY, ISO-NE)
- Merchant investment (i.e., private sector without regulatory-based contract support) in new and existing generation despite significant market risks
  - Avoids shifting investment risks to consumers through long-term contracts
  - Stimulates innovative approaches to financing and hedging
  - Recent merchant entry at costs substantially below common estimates for cost of new plants (ERCOT, PJM, NYISO) and well below long-term contract prices

PJM Example of Competitive Procurement

PJM implemented its capacity market in 2007

- Attracted 28,400 MW in the first eight years
- Most additions were from DR, uprates, and other low-cost sources
- Delayed the need for new generation for several years; prices stayed below the cost of new entry
- Replaced 20 GW of environmental retirements in a timely manner

PJM Offered and Cleared Capacity



Capacity Market Challenges

Price volatility is high even with demand curves (see next slide)

Administratively-determined rules and parameters are contentious and continually being refined

- Load forecast
- Demand curves, incl. benchmark price at/near reserve margin target
- Performance incentives/penalties
- Transmission constraints

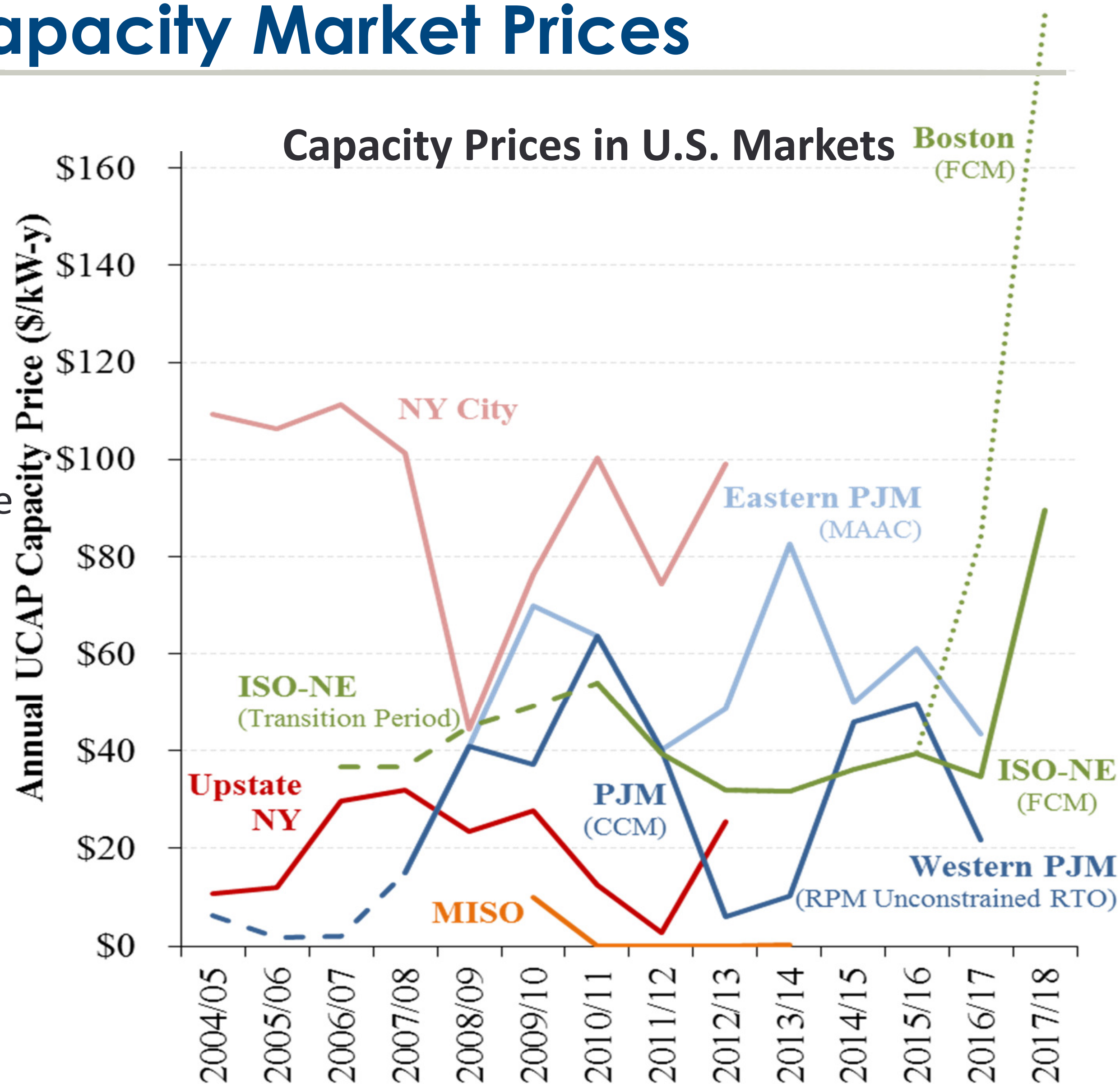
Entities doing self-supply under traditional regulation claim "buyer market power" rules interfere with their planning

New challenges are emerging regarding reliability outside of summer peak

- Esp. fuel adequacy, and flexibility for balancing renewables
- Best to address through changes to energy and A/S markets or refinements to capacity market products?

Uncertainty of Capacity Market Prices

- Price volatility due to
  - Low elasticity of supply and demand
  - Shifting market fundamentals
  - Rule/design changes
  - Uncertain administrative parameters (e.g. load forecast, Net CONE, transmission limits)
- Partially mitigated by demand curves
- Has not prevented merchant generation investment in U.S. markets



Agenda

Clear Definition of Objectives

Resource Adequacy Objectives

- Most systems define their resource adequacy target as a planning reserve margin over weather-normalized peak load; WA's target is in line with international norms
- Recognizing that reserve margins will fluctuate yearly, it is also helpful to define a minimum acceptable reserve margin in any single year before intervening

Other Reliability-Related Objectives

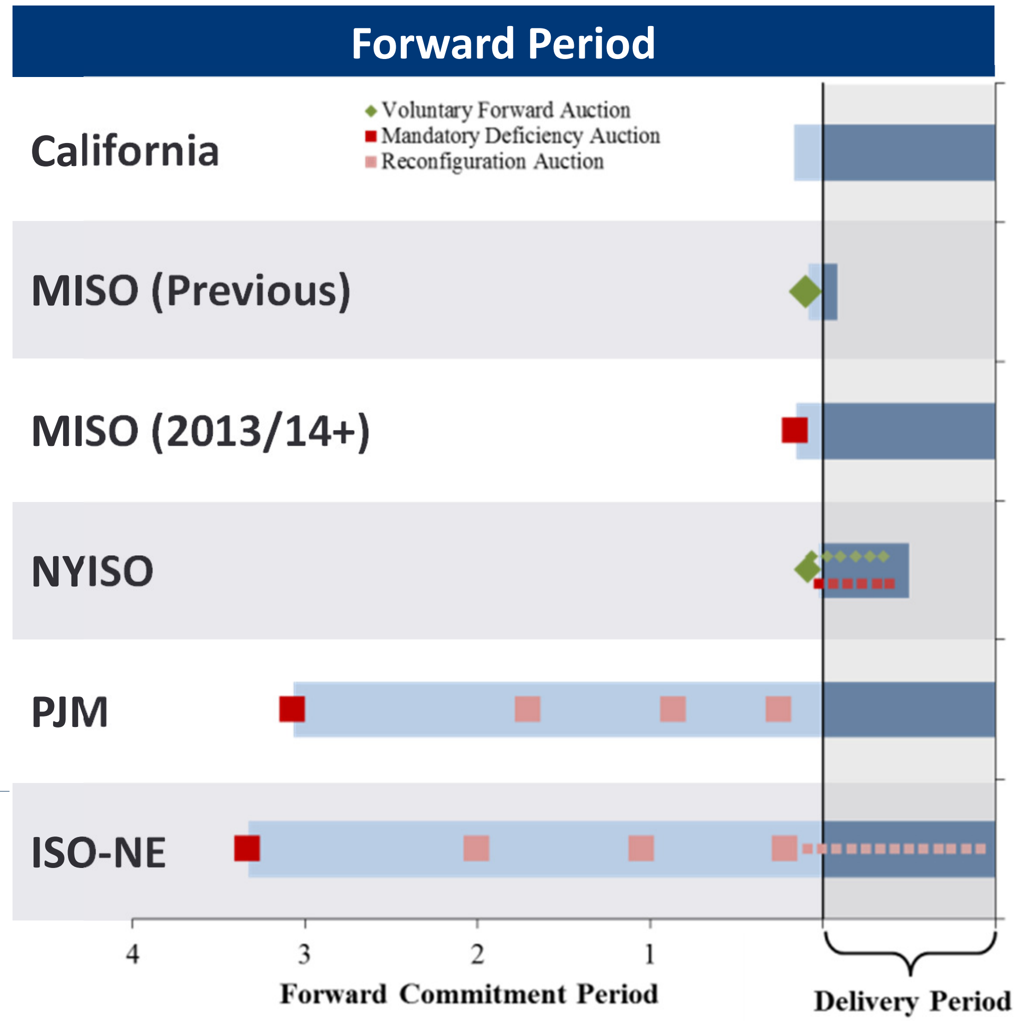
- U.S. system operators now asking if the mix of capacity can address all types of supply challenges other than just meeting the summer peak, e.g., winter fuel availability challenges, ramping needed to balance intermittent resources, etc.
- Such considerations have caused PJM to propose a minimum amount of always-available resources, in addition to distinguishing limited summer DR from others

Market Objectives

- What are the objectives for reducing price volatility and the sensitive to small changes in supply/demand (including from the exercise of market power)?
- Recognize that designing demand curves will involve tradeoffs between price uncertainty and quantity uncertainty

Forward Period

- Can match lead-time for some resources, e.g., 3 years
- Allows supply to adjust to demand
  - Avoids boom-bust
  - Avoids shortfalls under environmental or other retirement pressures
  - More reliable than depending on the market's guesses
- Downside: over-procurement if over-forecast
- **Special Considerations for WA**
  - Rationalizing supply/demand especially important in a small market subject to lumpiness
  - Avoid over-procurement by improving load forecast and using reconfiguration auctions (and consider a holdback)

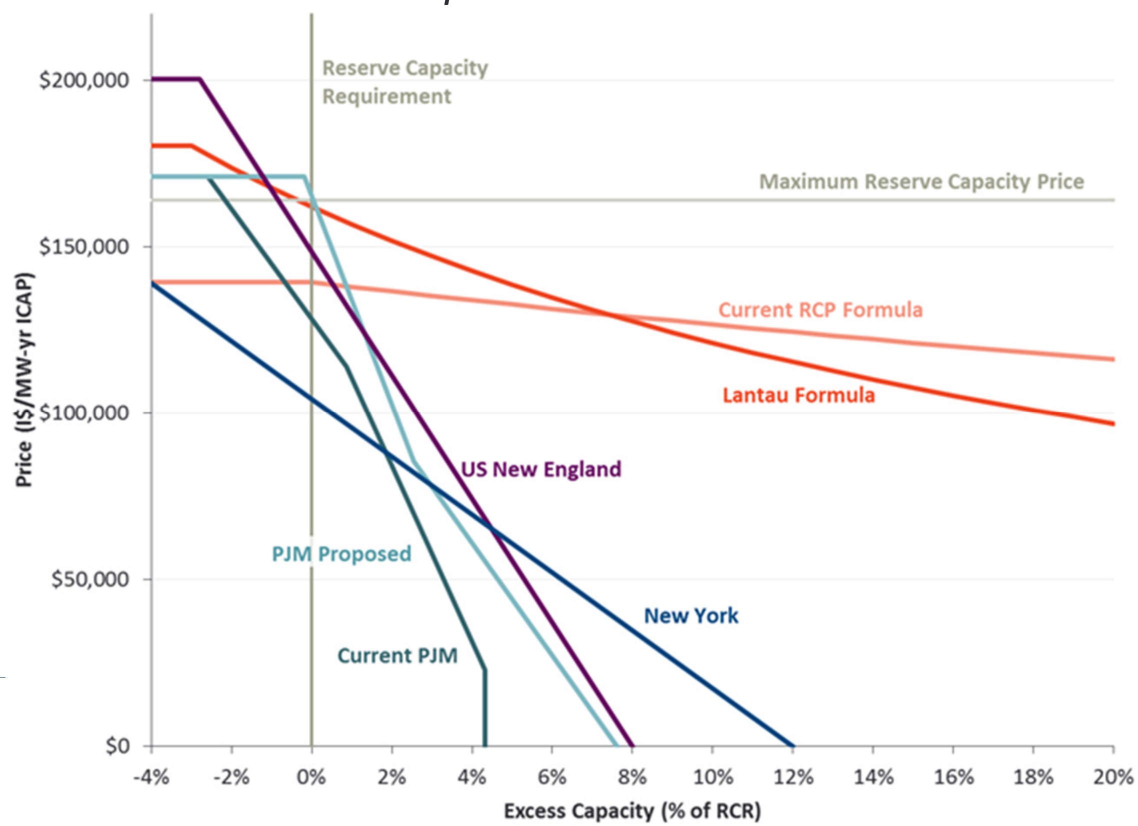


Demand Curves

- Can be steeper than RCP in an auction that lets the market determine the price needed to approximately meet the target
- Not as steep as vertical (inherent in bilateral-only), which can have excessive price volatility and susceptibility to market power
- Typically drawn as follows:
  - Set benchmark price at/near the resource adequacy target set to the Net Cost of New Entry
  - Establish slope and price cap
- **Special Considerations for WA**
  - Small market needs less steep curve than U.S. curves else one plant can move the price from cap to floor

Various U.S. Demand Curves

with comparison to RCP Formula



Supply Qualification

One of the most important design objectives of capacity markets is to maximize competition by allowing all resource types to meet the need

The IMO would qualify each resource (supply or demand side)

- Check that existing resources have adequate performance
- Planned resources might need to post credit and demonstrate progress
- Qualify a certain MW value
  - Based on the number of MW it can reliably provide during scarcity conditions (e.g., generators typically derated for forced outage rates)
  - Or the number of MW-equivalent reduction in loss of load expectation for intermittent or run-limited resources

Qualification occurs over several months leading up to an auction

Performance Penalties and Rewards

How to ensure that resources perform as promised?

- Need to develop penalty schedule for poor performance
- Can also reform energy and ancillary service prices to strengthen the signals for resources to meet the full range of needs

Market Monitoring and Mitigation

Capacity markets are especially susceptible to market power due to price sensitivity with a steep demand curve

- **Supplier market power**
  - New entry helps discipline the market, but not when there's excess capacity
  - Even un-concentrated capacity markets have pivotal suppliers,
  - Existing resources' offers may be capped at avoidable going-forward costs, which should work even in a relatively concentrated market
- **"Buyer market power"**
  - The prospect of the state, on behalf of all buyers, subsidizing uneconomic new entry to crash the price chills investment
  - Need rules to disallow this, like PJM's Minimum Offer Price Rule
- **Special considerations for WA**
  - Market concentration makes market monitoring essential
  - Consider ways to address Synergy's size/structure to foster more competition

Cost Allocation to Retailers

If the IMO procures forward on behalf of all load, the costs would have to be allocated to retailers

Cost allocation is straightforward

- Typically based on each retailers' *current* customers' share of prior summer's peak
- This easily accommodates load shifting under retail choice

Agenda

Recommended Next Steps for WA

WA already has many of the elements needed to transition smoothly to a capacity market framework

Spend a year…

Establishing rules with stakeholders (see next slide)

Addressing Synergy's size?

Hold a forward auction in 2016 for 2019?

Transition: in the meantime, consider ratcheting down the RCP

- Consider starting with Lantau recommendation
- Could ratchet down further, but beware that making the curve too steep imposes price uncertainty on suppliers when they commit
- Could ratchet down a little for 2016, more for 2017 and 2018

In parallel, consider energy and ancillary service market reforms

- Increase competition and efficiency (not addressed in this presentation)
- Further strengthen performance and investment against reliability challenges

Market Design Elements to Address

Design Element	Current Approach in Western Australia RCM	Changes to Adopt Capacity Market International Best Practice
Resource Adequacy Standard	• The greater of: (a) 7.6% margin or largest contingency above 90/10 peak load plus load following, or (b) 0.002% unserved energy • Some have questioned the standard	• Already in line with international norms • Could be re-evaluated to ensure consistency with policy objectives • Define the standard and related objectives regarding the volatility of capacity prices and reserve margins
Resource Qualification	• Rules already exist for qualifying capacity credits	• No essential changes although refinements can be anticipated over time
Administrative Demand Curve	• All non-bilaterally contracted resources are eligible to receive the RCP price, subject to pro-rating when there is excess capacity	• Develop a more steeply-sloped demand curve
Competitive Procurement Auctions	• Capacity suppliers make a non-binding declaration of intent to sell capacity, and receive a payment that declines slightly as the level of excess increases • No auctions have taken place	• Develop centralized, competitive auctions • Also need short-term auctions or other adjustment mechanisms like PJM
Monitoring and Mitigation	• None needed currently with purely administrative pricing outside of bilaterals	• Develop rules for determining whom, when, and how much to mitigate supply offers • Consider including “buyer market power”

Agenda

I. Executive Summary
II. Why Capacity Markets?
III. Key Elements of Centralized Capacity Auctions
IV. Recommended Next Steps if Implementing a Capacity Market

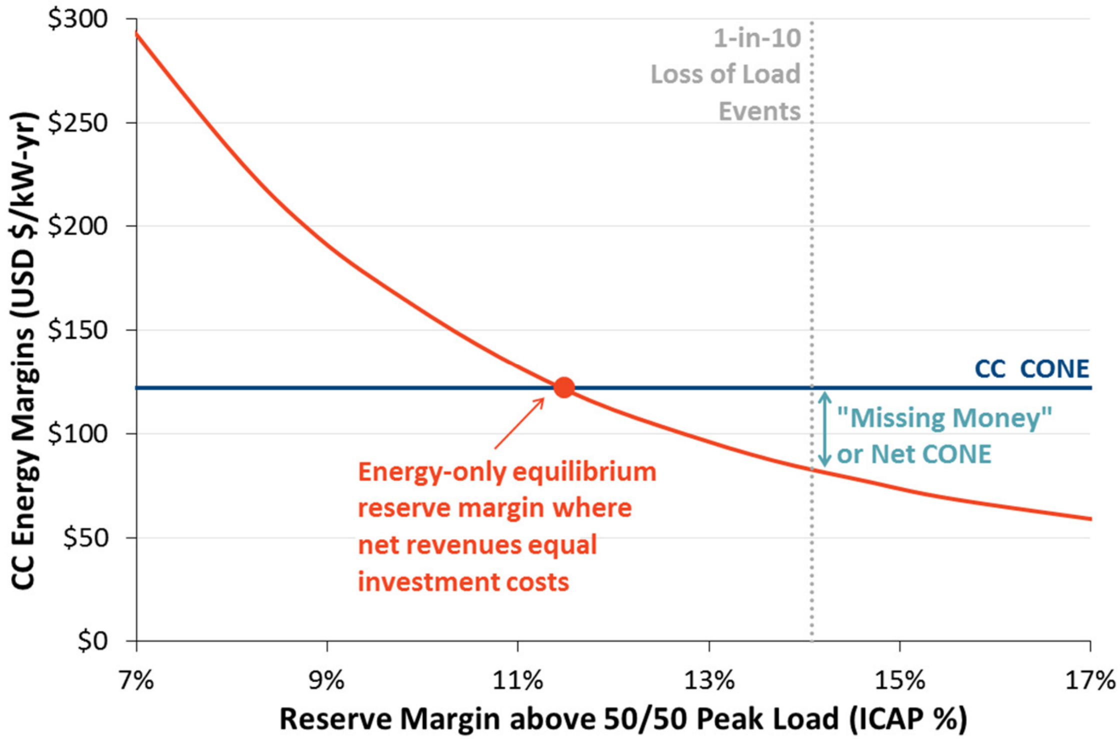
Appendix: Deeper Review of Energy-Only Alternative

Energy-Only Market Concept

Energy-only markets have no required reserve margin

- Investment depends instead on energy market prices
- Low reserve margins will lead to high prices, and attract new investment in generation
- Reserve margin should reach an equilibrium where investments earn an adequate return
- Equilibrium reserve margin increases if energy prices are allowed to go higher, through looser market monitoring and/or higher scarcity prices
  - Need to solve "design gaps" (see next slide)
  - Even if fill the gaps, reserve margin may be lower and more volatile than traditional targets

CC Energy Margins and Equilibrium Reserve Margin



Energy-Market Design Gaps Contributing to "The Missing Money"

Energy market design gaps often undermine adequate generation investments:

- Price caps below the value of lost load when shedding
- Weak scarcity pricing to express the marginal value of system-reliability-protecting operating reserves as they become depleted
- Poor integration of demand-response (DR) resources
- Substantial locational differences not reflected in market prices
- Absence of liquid and transparent balancing energy markets (e.g., 5-minute real-time energy markets)
- Operational actions (e.g., out-of-market dispatch of emergency resources) that depress clearing prices

Market design gaps often include incomplete or poorly-designed ancillary service markets

- Absence of liquid and transparent markets for ancillary services
- Missing ancillary service products (e.g., ramping capability)
- Not co-optimized with imbalance energy market
- Operational (out-of-market) actions that depress clearing prices

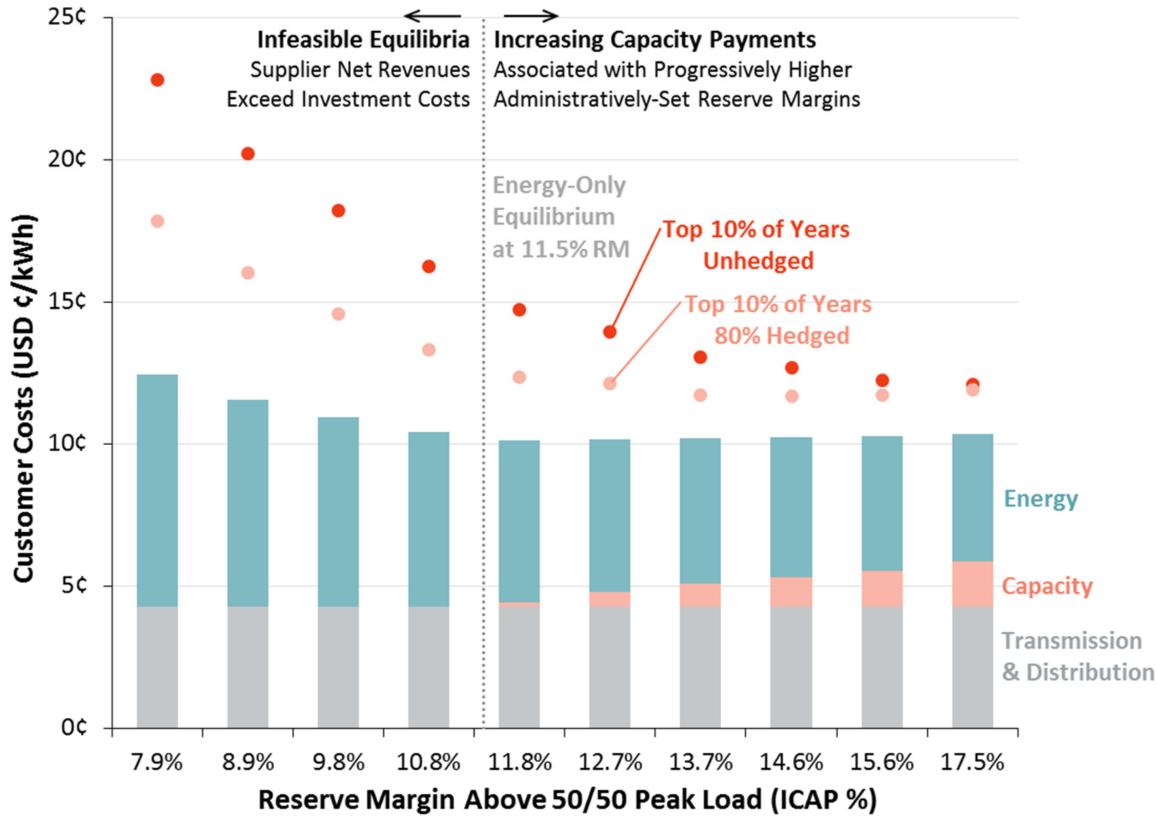
Capacity Markets Provide "Missing Money" Needed to Meet Higher Reserve Margins

Capacity prices should equal *Net* Cost of New Entry in the long-term

- Capacity payments increase as reserve margins increase
- Higher reserve margins lead to lower energy margins
- So, cost to customer is less than all capacity payments, due to declining energy prices

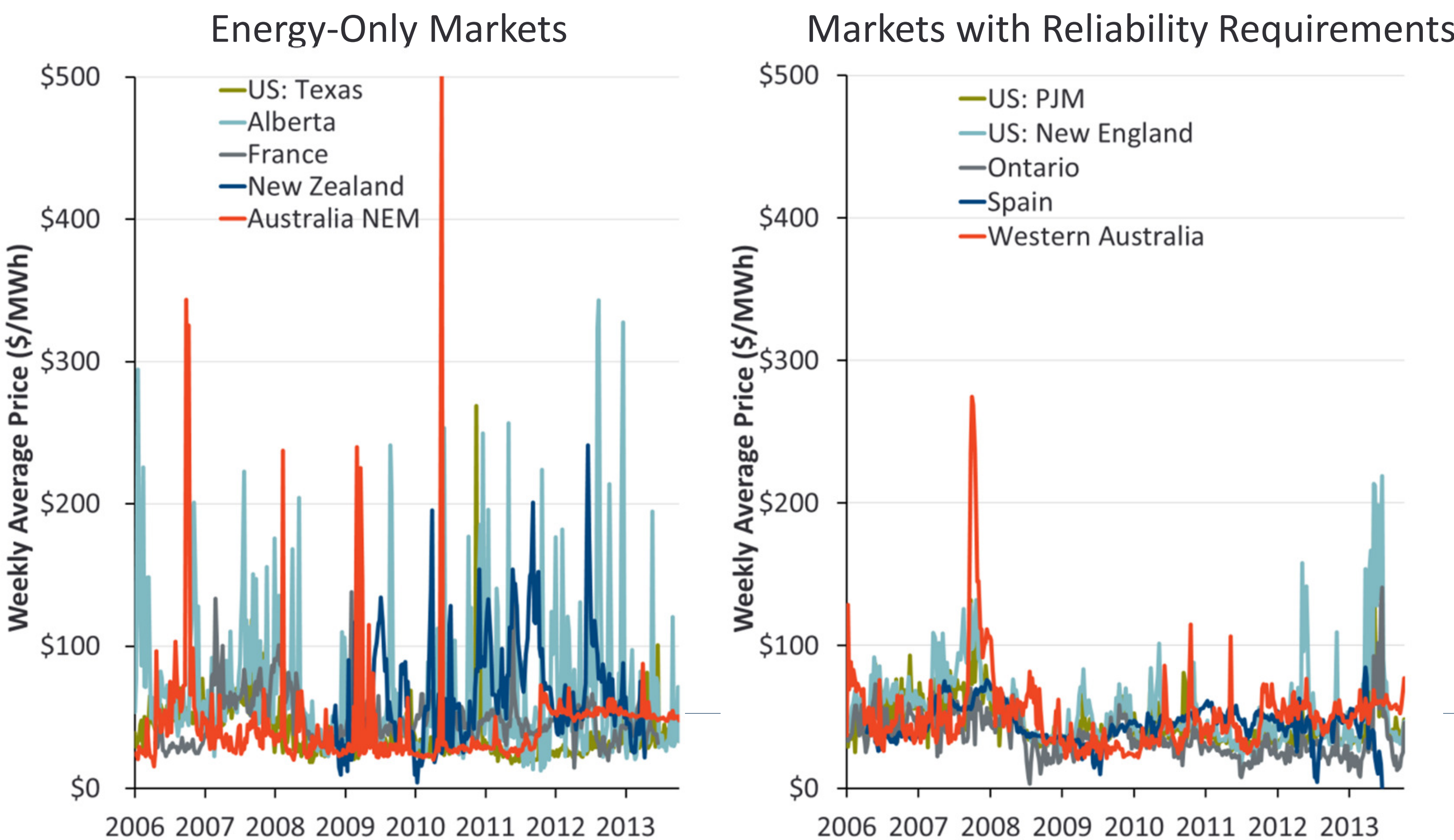
Total Customer Costs

on Average and in Highest 10% of Years



Energy Prices in Energy-Only vs. Capacity Markets

Energy-Only markets have more volatile energy prices



Weekly average prices for US: PJM, US: New England (ISO-NE), Texas (ERCOT), Alberta, and Ontario from Ventyx (2014); Weekly average prices for Australia are from AEMO (2014); Weekly average prices for New Zealand from the New Zealand Electricity Authority (2014); Weekly average prices for France from EPEX (2014); and Weekly average prices for Spain are from OMIE (2014). ISO-NE prices are at the System. NEM prices are at New South Wales.

Approaches in Select Energy-Only Markets

	NEM	Alberta	Texas
Price Cap	• $13,500/MWh • Price cap estimated to achieve reliability objectives	• $1,000/MWh CAD ($991/MWh AUD)	• $9,000/MWh ($9,600/MWh AUD) by 2015 • Loosely tied to VOLL, but not supported by a formal study
Administrative Scarcity Pricing	• "Intervention pricing" corrects for administrative interventions during scarcity events • Price set at the cap during load shed	• Only in load shed (price set at cap)	• Administrative scarcity pricing mechanisms push prices up to VOLL as operating reserves deplete
Allowing High-Price Supplier Offers	• Suppliers allowed to offer substantially above marginal cost up to the price cap	• "Portfolio bidding" above marginal cost is explicitly allowed up to the price cap	• Only "small fish" with less than 5% market share are allowed to offer above cost
Integrating Demand Response into Energy Price Formation	• Price-dependent demand bids allowed, but requirements for strict adherence to consuming exact cleared quantities prevent participation	• Offers allowed in wholesale, with small amounts of participation	• DR offers allowed to set prices, through a combination of administrative pricing for emergency DR calls and market-based DR offers
Monitoring and Mitigation	• The AER monitors behavior with some guidelines but minimal enforcement	• Offer control limited to a maximum of 30% for any one large supplier	• Strict monitoring and mitigation with offers no more than 10% above cost for most suppliers
Preventing Extreme Sustained High Prices	• Cumulative Price Threshold limits persistent high prices	• None	• Peaker Net Margin limits persistent scarcity prices over the year

Comparison of Energy-Only vs. Capacity Markets

	Energy-Only Markets	Energy+Capacity Markets
Reliability	• Reserve margin and reliability determined by market (can be advantage or disadvantage)	• Minimum reliability and reserve margin standard mandated by regulator
Average Prices	• Higher energy prices (due to the lower reserve margin, relaxed monitoring and mitigation, higher price cap, and administrative scarcity pricing) • No capacity prices	• Lower energy prices • Offset by capacity prices high enough to attract investment when needed • Net customer cost impacts are modest (estimated in Texas at 1% net customer costs increase to increase reserve margin by 2.6%)
Price Volatility	• Higher price volatility, with suppliers earning their investment costs during periodic severe price spikes during shortage events	• Lower price volatility • Some markets have introduced higher administrative scarcity pricing and associated volatility to increase energy market efficiency (but realized volatility is still lower overall if reserve margins are higher)
Total Costs	• Can be the same or lower than with capacity market (if the realized reserve margin is lower)	• Can be the same or slightly higher than energy-only (if the mandated reserve margin is higher)
Monitoring and Mitigation	• Oversight has to strike a difficult balance between the need for high prices sufficient to attract investment, and preventing uneconomic excess exercise of market power	• Regulators can impose relatively strict monitoring and mitigation measures, as long as suppliers are able to bid up to marginal cost for energy and net going-forward costs for capacity

Acknowledgements

This presentation is based in part on the following reports and presentations:

- Spees, Newell, ***Resource Adequacy in Western Australia: Alternatives to the Reserve Capacity Mechanism***, prepared for EnerNOC, Inc. and submitted to The Electricity Market Review Steering Committee September 12, 2014.
- Pfeifenberger, Newell, Spees, ***Energy and Capacity Markets: Tradeoffs in Reliability, Costs, and Risks***, Harvard Electricity Policy Group, February 27, 2014.
- Spees, Newell, Pfeifenberger, ***Capacity Markets: Lessons Learned from the First Decade,*** Economics of Energy & Environmental Policy, Vol. 2, No. 2, September 2013.

Biography

SAM NEWELL

Principal | The Brattle Group, Cambridge, MA, U.S.A.

Sam.Newell@brattle.com

+1.617.864.7900

Dr. Samuel Newell, a Principal of The Brattle Group, is an economist and engineer with experience in electricity wholesale markets, the transmission system, and RTO/ISO rules. He supports clients in regulatory, litigation, and business strategy matters involving wholesale market design, generation asset valuation, transmission development, integrated resource planning, demand response programs, and contract disputes. He has provided testimony before the FERC, state regulatory commissions, and the American Arbitration Association.

Dr. Newell earned a Ph.D. in Technology Management and Policy from MIT, an M.S. in Materials Science and Engineering from Stanford University, and a B.A. in Chemistry and Physics from Harvard College. Prior to joining Brattle, Dr. Newell was Director of the Transmission Service at Cambridge Energy Research Associates.

About Brattle

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world. We aim for the highest level of client service and quality in our industry.

We are distinguished by our credibility and the clarity of our insights, which arise from the stature of our experts, affiliations with leading international academics and industry specialists, and thoughtful, timely, and transparent work. Our clients value our commitment to providing clear, independent results that withstand critical review.

Our Practices

PRACTICES

- Antitrust/Competition
- Commercial Damages
- Environmental Litigation and Regulation
- Intellectual Property
- International Arbitration
- International Trade
- Product Liability
- Regulatory Finance and Accounting
- Risk Management
- Securities
- Tax
- Utility Regulatory Policy and Ratemaking
- Valuation

INDUSTRIES

- Electric Power
- Financial Institutions
- Health Care Products and Services
- Natural Gas and Petroleum
- Telecommunications and Media
- Transportation

Offices

NORTH AMERICA

Cambridge

New York

San Francisco

Washington, DC

EUROPE

London

Madrid

Rome