The ScottMadden ENERGY INDUSTRY UPDATE

IT'S THE END OF THE WORLD AS WE KNOW IT (AND I FEEL FINE)

Webinar

May 19, 2017

Volume 17 – Issue 1

Today’s Agenda and Your Presenters

Stuart Pearman
Partner and
Energy Practice Leader

Welcome and Introduction

Chris Vlahoplus
Partner and Clean Tech
& Sustainability Practice
Leader

A Look Down Under: Distributed Generation Lessons from Australia

- Australia Fact-Finding Mission
- Australia – Some Basics
- Heavy Penetration of Distributed Solar
- Explosive Growth
- Timeline of Events
- Managing Penetration – Grid-Connected Water Heaters
- A Few Key Learnings

Paul Quinlan
Clean Tech Manager

Innovative Solar PPAs: Finding Win-Win Solutions for Excess Solar Power

- State of the Solar PPA?
- Addressing Curtailment with New PPA Models
- Key Questions for Solar PPA Innovation

Stuart Pearman
Partner and
Energy Practice Leader

Unlocking Smart Cities: What and How…

- Smart City – What Is It?
- Smart City – What Is It Made Of?
- What’s Happening on the Ground?
- What’s the Utility’s Role?
- How Do You Get Started?

Greg Litra
Partner and Energy, Clean
Tech, and Sustainability
Research Leader

Questions and Answers

Paul Quinlan
Clean Tech Manager

Paul Quinlan joined ScottMadden in 2013. Prior, he worked as managing director of the North Carolina Sustainable Energy Association, a nonprofit organization focused on renewable energy and energy efficiency policy issues. In this role, Paul conducted policy analyses which informed legislative and regulatory outcomes, built a market research team to track industry dynamics in North Carolina, and formed collaborative partnerships with industry stakeholders. In addition, he has lectured on energy topics at North Carolina State University and serves on the board of directors of Clean Energy Durham, a nonprofit organization providing innovative delivery of residential energy efficiency solutions. Paul earned a master of public policy and a master of environmental management from Duke University and a B.S. from the University of Notre Dame.

State of the Solar PPA?

Tried and True?
"You Can Take It to the Bank!"

- Common elements of traditional solar PPAs:
  - ***Price for purchase and sale of electricity:*** The rate that will be paid for electricity; may include an annual escalator
  - ***Term:*** Length of contract: can generally range from 15 to 30 years
  - ***Environmental attributes and incentives:*** Ownership of renewable energy certificates or tax incentives
  - ***System repair and maintenance:*** Party responsible for maintaining and operating the solar system
  - ***Curtailment:*** Circumstances when the solar system must reduce output, usually related to grid operations
  - ***Force majeure:*** External circumstances that prevent parties from meeting contract obligations

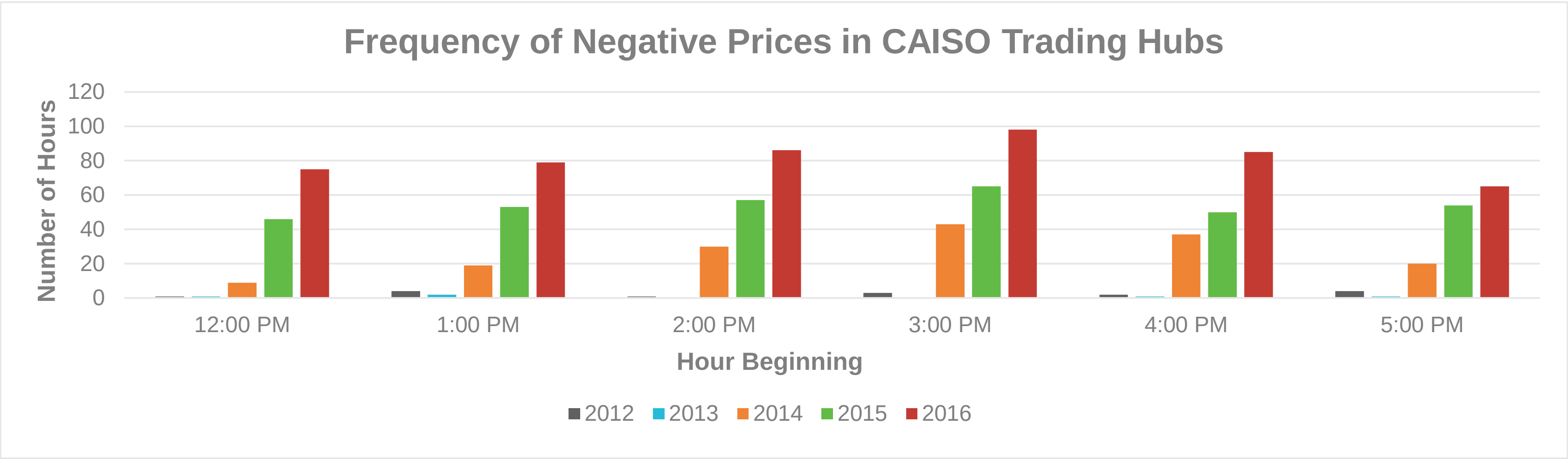
State of the Solar PPA?

Tried and True? "You Can Take It to the Bank!"

- Common elements of traditional solar PPAs:
  - ***Price for purchase and sale of electricity:*** The rate that will be paid for electricity; may include an annual escalator
  - ***Term:*** Length of contract: can generally range from 15 to 30 years
  - ***Environmental attributes and incentives:*** Ownership of renewable energy certificates or tax incentives
  - ***System repair and maintenance:*** Party responsible for maintaining and operating the solar system
  - ***Curtailment:*** Circumstances when the solar system must reduce output, usually related to grid operations
  - ***Force majeure:*** External circumstances that prevent parties from meeting contract obligations

Rigid and Outdated? "There Must Be a Better Way!"

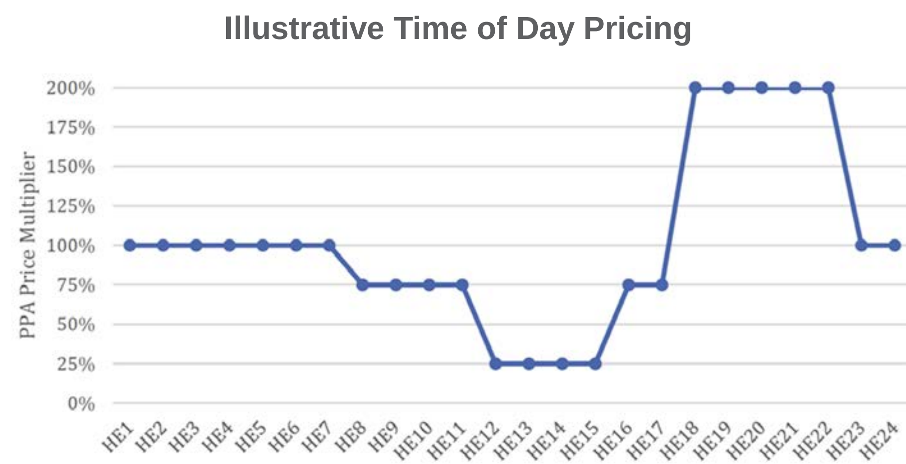
- Recent market developments:
  - ***Hawaii:*** Utility-scale renewables are curtailed by vintage
    - Newest contracts shutdown first; developers must price curtailment risk into PPA prices
  - ***California:*** Growing frequency of negative hour-ahead prices signals oversupply risk
    - Curtailment has also increased dramatically in recent months
  - ***North Carolina:*** PURPA-qualifying facilities (QF) currently receive a 15-year contract at avoided cost rates
    - NC now ranks #2 for solar capacity, prompting debate around "duck curve" impacts and QF model

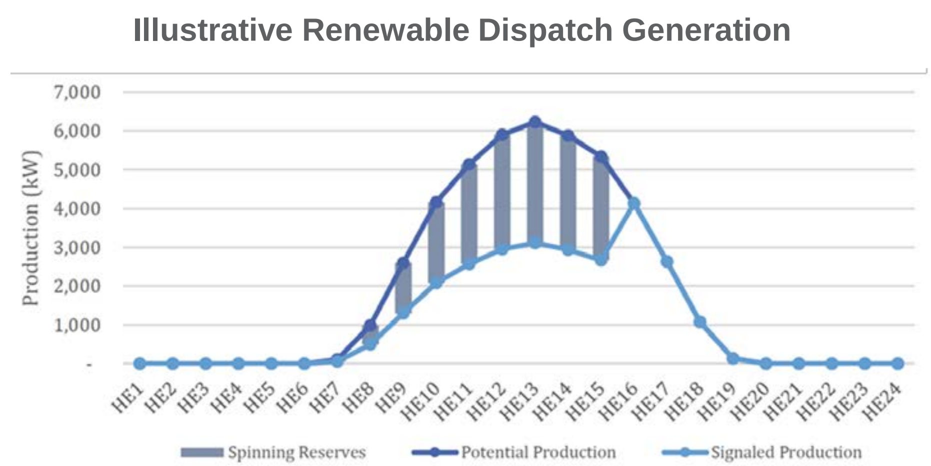


scottmadden MANAGEMENT CONSULTANTS

Addressing Curtailment with New PPA Models

- In January 2017, the Smart Electric Power Alliance and ScottMadden released a report analyzing potential alternative PPA approaches to address curtailment in Hawaii
  - Paper was submitted to the Hawaii Public Utilities Commission in December 2016
- The report analyzed three new PPA models:
  - ***Capacity and Energy:*** Pricing includes capacity ($/MW-month) and energy ($/MWh) components
    - Solar developers could set pricing during an RFP process
  - ***Time-of-Day Pricing:*** Pricing for energy is lower (or even negative) during expected low-load periods and higher during peak periods
    - A PPA price multiplier could be used to determine hourly pricing
  - ***Renewable Dispatch Generation:*** Pricing includes fixed monthly payment to ensure the project can obtain financing and a variable component ($/MWh) to cover O&M costs
    - The electric utility schedules the percentage of potential production to be used each day and controls output on a real-time basis
    - Undelivered available energy provides spinning or system reserves





Innovative PPA approaches can allow solar projects to provide additional value to the electric grid, thereby reducing price risk and increasing flexibility. In return, the PPAs allow solar projects to remain profitable, even if operating below maximum capacity.

scottmadden
MANAGEMENT CONSULTANTS

Key Questions for Solar PPA Innovation

- The following questions should be considered when designing any alternative PPA structures:

PPA Component	Key Questions
▪ Variable Energy Pricing	▪ Will energy pricing vary by time of day? Day of week? Month or season? ▪ Will energy prices be tied to market prices?
▪ Capacity and Ancillary Services	▪ What capacity or ancillary services will be provided to the electric grid? ▪ Under what condition will capacity or ancillary services be provided? ▪ How should the solar system be compensated for capacity or ancillary services? ▪ What outages are permitted without penalty?
▪ Curtailment	▪ Can PPA structures make planned curtailment financially viable for solar assets while reducing overall system costs? ▪ Can PPA structures reduce the amount of unplanned curtailment? ▪ How should curtailment risk be shared between system owners and the electric utility?
▪ Industry Standards	▪ Does the alternative PPA structure require any special technical specifications that must be met before interconnection to the grid?
▪ Operational Control	▪ Can the electric utility see the output originating from the solar system? ▪ Can the electric utility control the output from the solar system?
▪ Ease of Administration	▪ Is the PPA structure overly complicated or cumbersome? ▪ Does the PPA structure require new processes or procedures for the electric utility?

scottmadden
MANAGEMENT CONSULTANTS

Chris Vlahoplus

Partner and Clean Tech & Sustainability Practice Leader

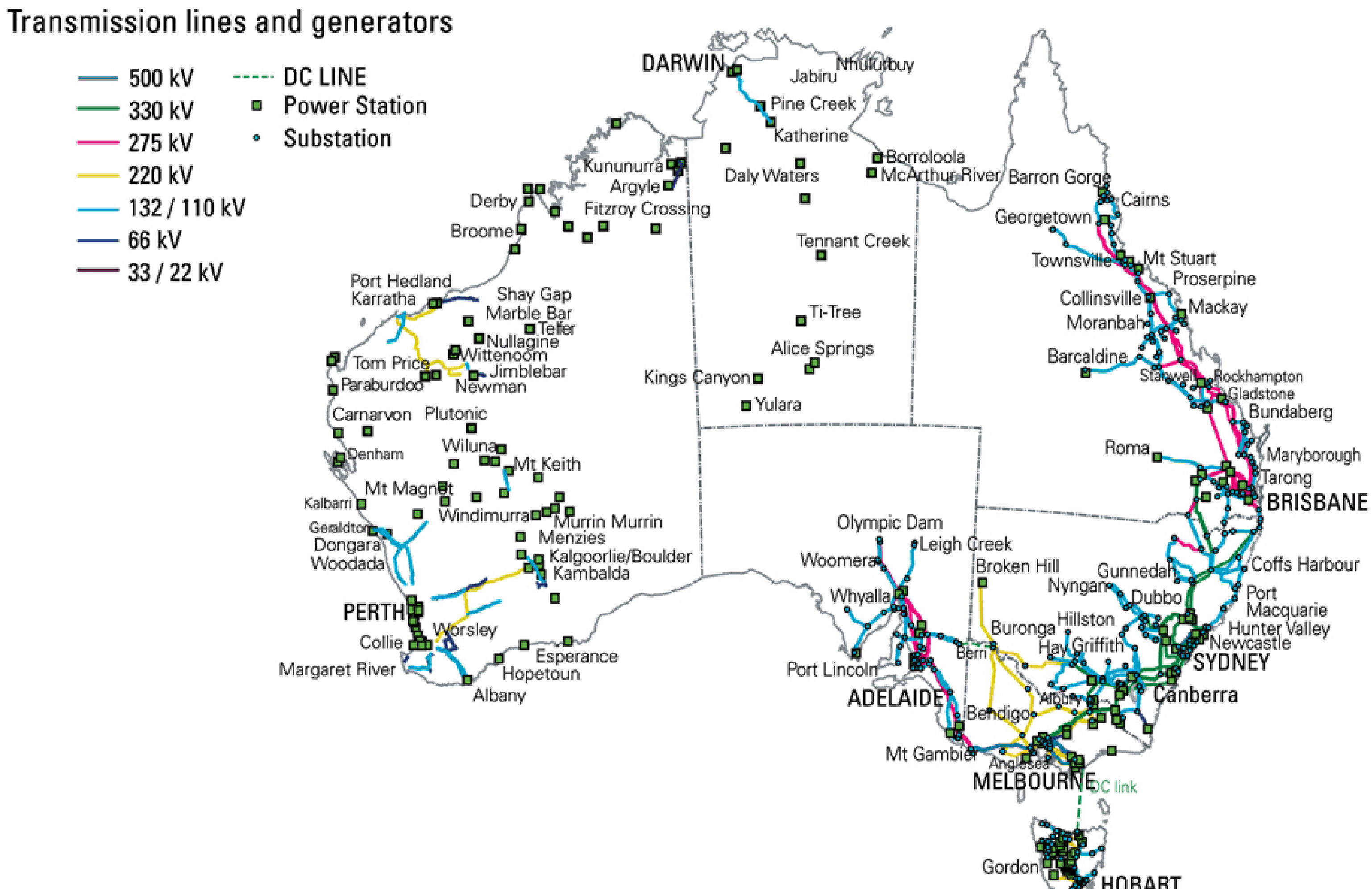
Chris Vlahoplus has been a management consultant to the energy and utility industry for 25 years. He leads ScottMadden's clean tech & sustainability practice area, including a role as co-leader of the firm's nuclear consulting practice. He has assisted more than 40 companies focusing on electric generation business management, merger integration, strategic and business planning, organizational restructuring, and management models. Chris earned a B.S. in mechanical engineering from the University of South Carolina, an M.S. in nuclear engineering from the Massachusetts Institute of Technology, and an M.B.A. from the University of North Carolina at Chapel Hill. Prior to joining ScottMadden, Chris worked in nuclear safety at Duke Power Company.

A Look Down Under: Distributed Generation Lessons from Australia

Australia Fact-Finding Mission

- Smart Electric Power Alliance (SEPA) and ScottMadden took a group of approximately 25 energy industry executives to Brisbane and Melbourne to learn about the renewable transformation currently underway in Australia
- Industry executives on the trip included officials from utilities, solar, other distributed energy resource (DER) companies, industry organizations, and experts representing the following organizations:
  - Arizona Public Service (APS)
  - ChargePoint
  - CPS Energy
  - CSIRO
  - Energy Excelerator
  - EnergyHub
  - Energy Queensland
  - Ergon
  - HECO
  - GELI
  - Kansas Municipal Utilities
  - Landis + Gyr
  - Pacific Gas & Electric
  - PPL Electric Utilities
  - PowerFIn Partners
  - Sacramento Municipal Utility District (SMUD)
  - Salt River Project (SRP)
  - ScottMadden
  - SEPA
  - Southern California Edison (SCE)
  - STEM
  - Tacoma Public Utilities
  - Tendril
  - Tucson Electric Power/UNS

Australia – Some Basics

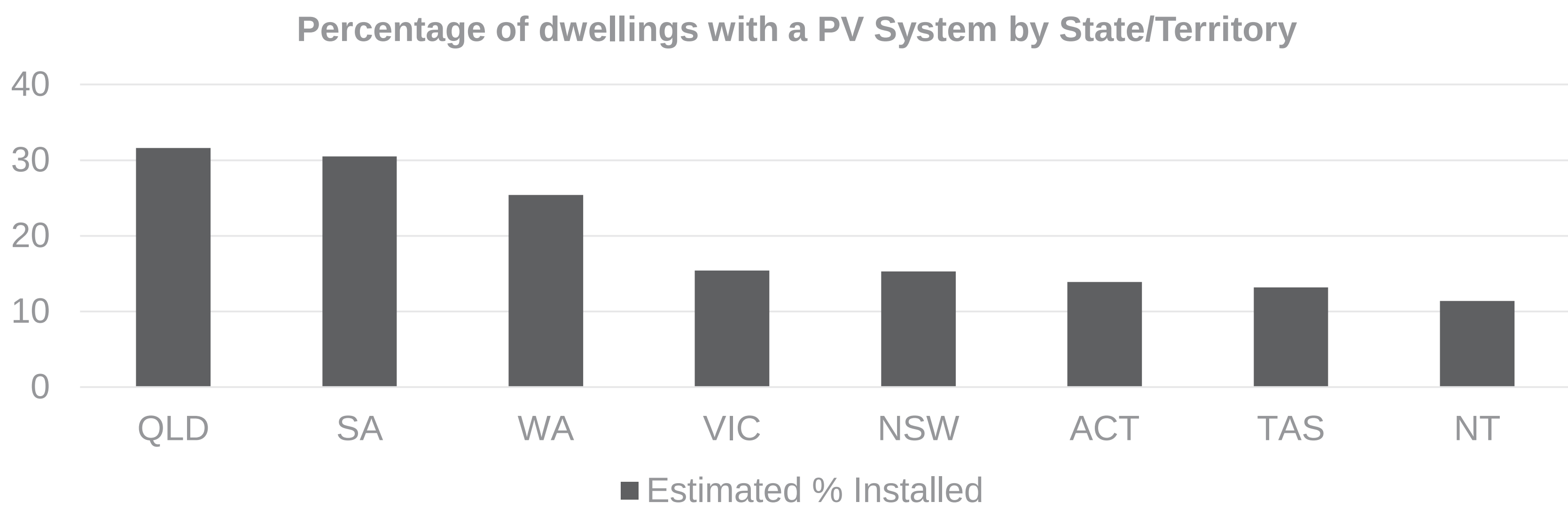


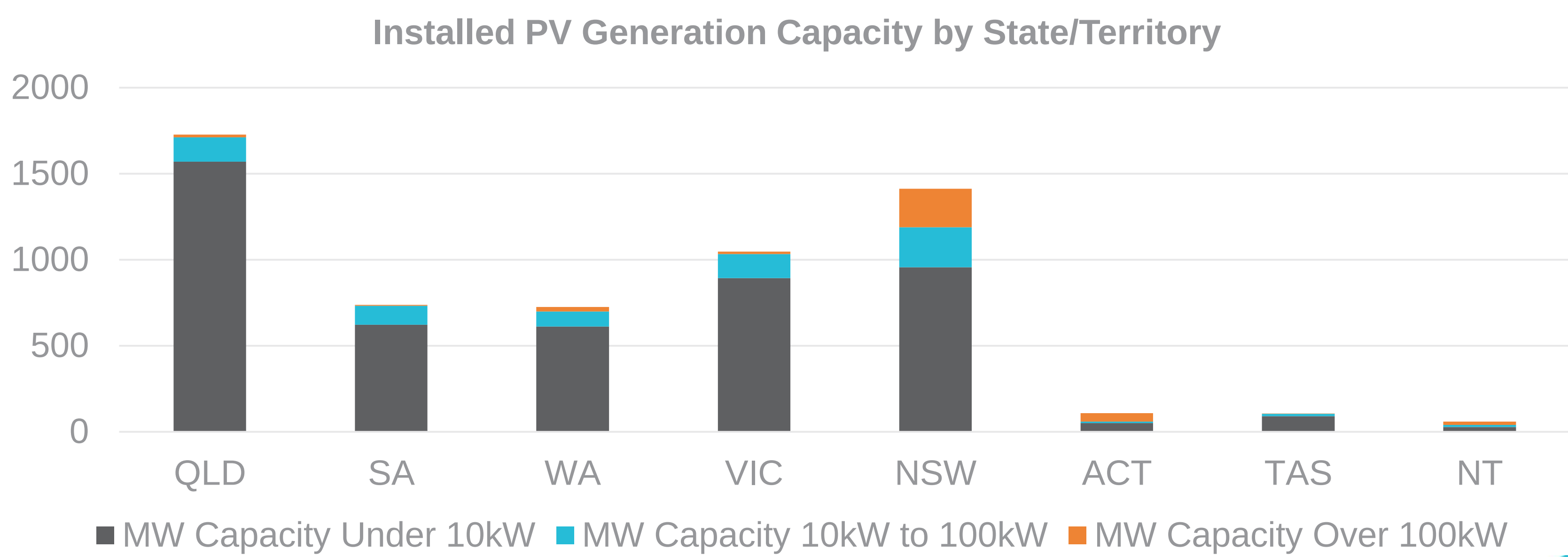
Locations are indicative only.

Sources: NEMMCO, NT PowerWater, WA Office of Energy

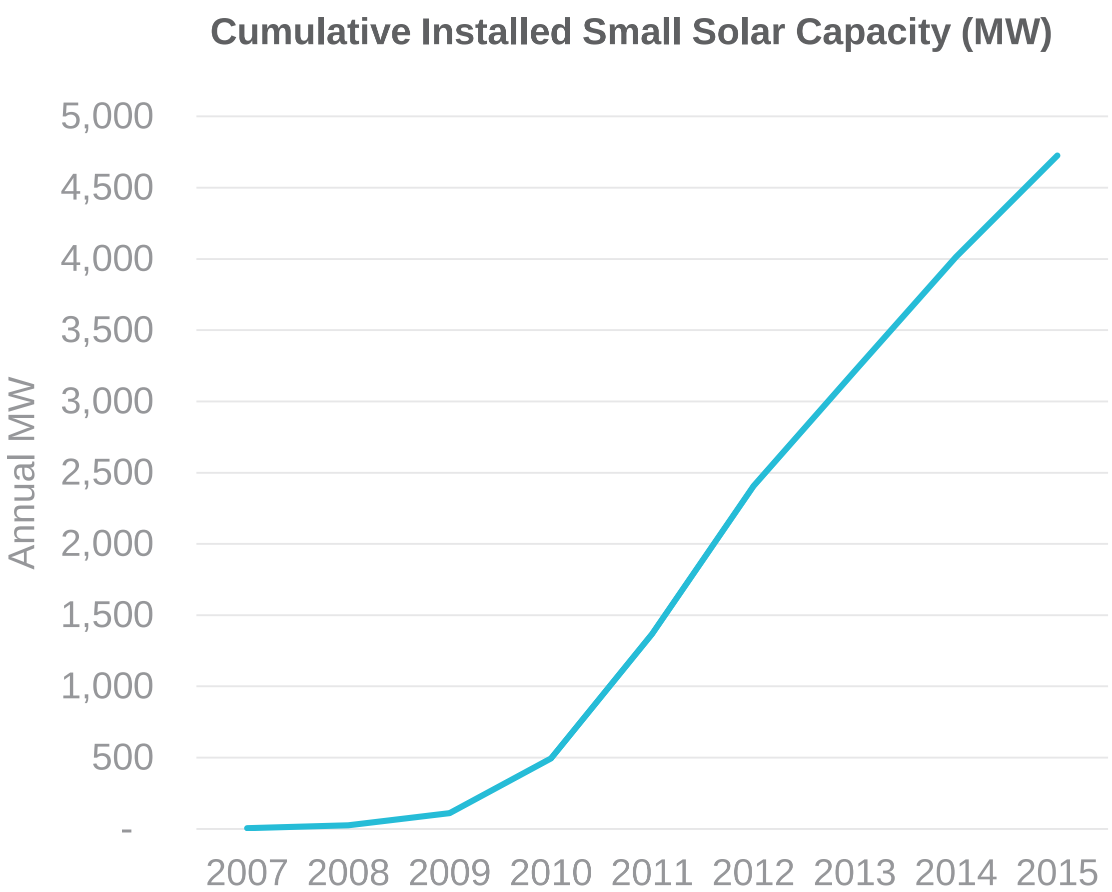
Source: CSIRO

Heavy Penetration of Distributed Solar





Explosive Growth

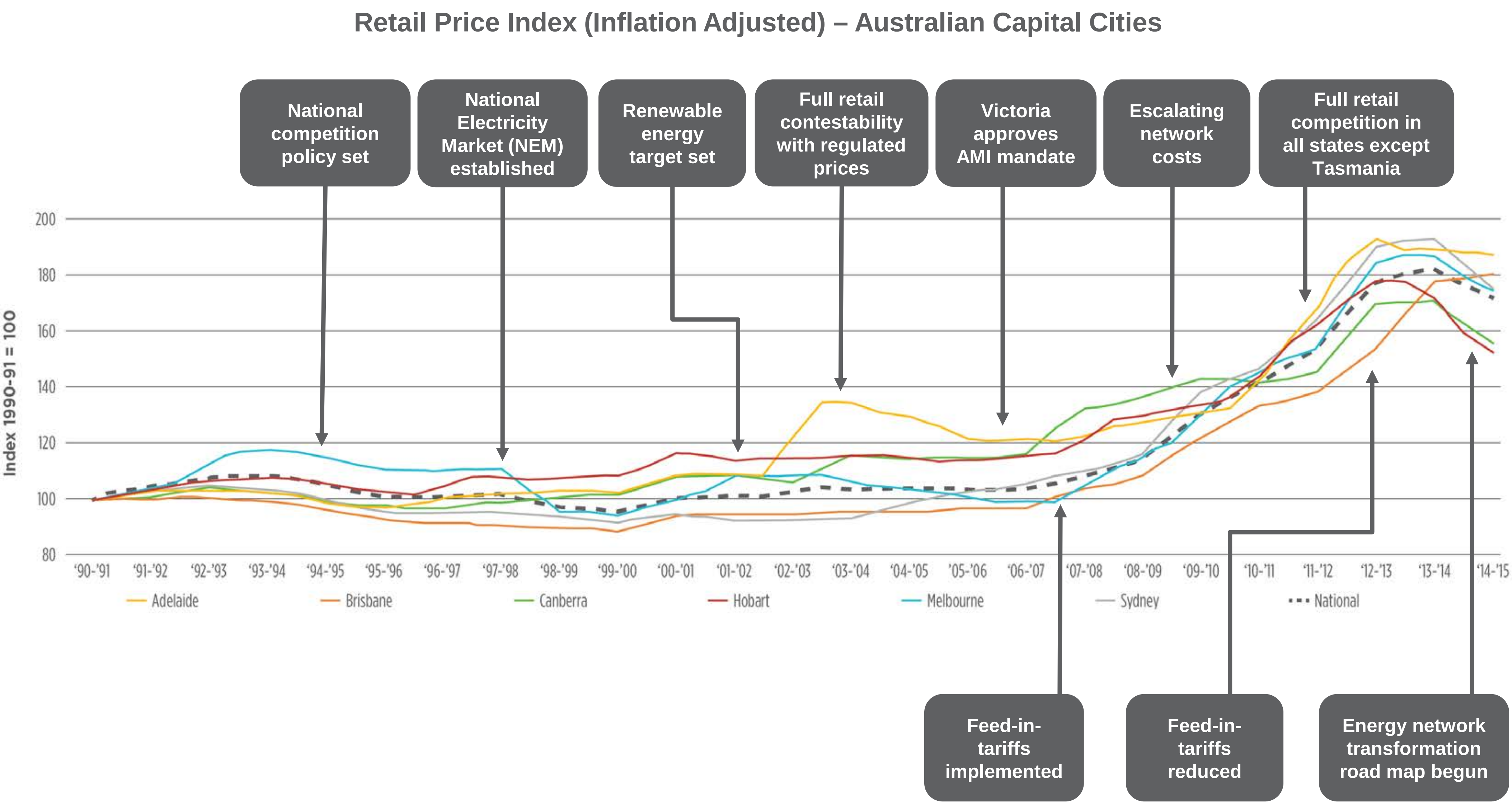


Drivers of Growth

- Generous Feed in Tariff
- Improvements in Install Cost
- Increase in retail rates

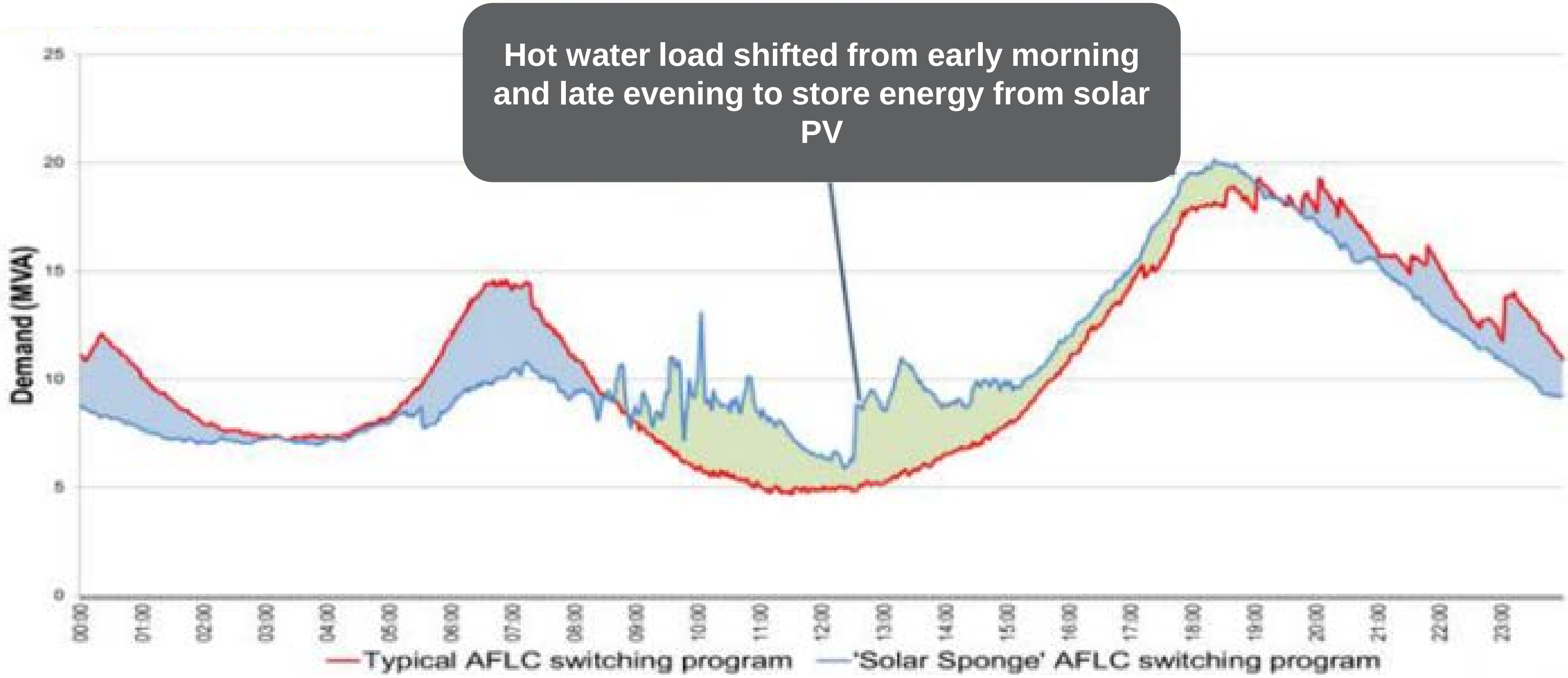
Notes: "Small solar" includes up to 100 kW; 2007 includes pre-2007 installations
Source: Clean Energy Council

Timeline of Events



Sources: Australian Energy Regulator, ScottMadden analysis

Managing Penetration: Grid-Connected Water Heaters



Source: Energex

A Few Key Learnings

- PV has become a discretionary purchase
- Grid is holding up with today's technology
- Utilities must deliver value and manage the message
- Beware the cautionary tale of grid investment and impact on rates
- Operational and data standards are critical: set them early
- The utility can be an enabler with process

Stuart Pearman
Partner and Energy Practice Leader

Stuart Pearman is a partner with ScottMadden and leads the firm's energy practice. As a management consultant for 21 years and a partner for 15, he has performed more than 190 projects for more than 60 clients. Stuart has expertise in energy utilities, related businesses, and several other industries. He is also a seasoned practitioner, with experience in both line and staff management roles. Stuart earned a B.A. in psychology from Williams College and an M.B.A. from the University of North Carolina Kenan-Flagler Business School, where he won the Best Industry Analysis Award and graduated at the top of his class. In addition to his full-time work at ScottMadden, Stuart is Professor of the Practice at Kenan-Flagler, teaching consulting and leadership.

Unlocking Smart Cities: What and How…

Smart City – What Is It?

Definition

A "smart city" is one that employs a network of digital sensors, information controls, Internet-of-things technology, and automation to create a system that improves quality of living by reducing costs; creating new and better services; improving sustainability; and helping the city grow and compete for businesses, institutions, and residents.

What's the Vision?

- Modernize and incorporate new technologies
- Integrate sustainable resources and methods
- Increase the city's attractiveness and productivity
- Improve citizen satisfaction

What's Driving Interest in It?

- Infrastructure
- Urbanization
- Internet of Things
- Green development/growth
- Social policy

Smart City – What Is It Made Of?

Sector	Energy	Transportation	Water and Waste	Buildings
Objectives	❑ Efficiency ❑ Low cost ❑ Low pollution ❑ Low CO_2 emissions ❑ Synergies with water and transport ❑ Resilience	❑ Time savings ❑ Low cost ❑ Efficient resource utilization ❑ Universal access ❑ Low emissions	❑ Integrated system: water, flood control, agriculture, and sanitation ❑ Resilience	❑ Affordability ❑ Healthy environments ❑ Resilience ❑ Comfort ❑ Efficiency
Technologies	❑ Distributed renewables ❑ Cogeneration ❑ District heating and cooling ❑ Efficient lighting ❑ Smart grids ❑ Microgrids and virtual power plants ❑ Demand response ❑ Energy efficiency ❑ Energy storage	❑ Multi-modal integration via technology ❑ On-demand digitally enabled transport ❑ Electric vehicle infrastructure ❑ Traffic and congestion management ❑ Autonomous vehicles ❑ Parking management ❑ Technology-enabled transportation pricing	❑ Smart water meters ❑ Sensor networks ❑ District and building water re-use ❑ Digital water distribution control and leak detection	❑ Energy efficient and adaptive construction designs, technologies, and standards ❑ Sensors, actuators for real-time space management ❑ Energy management systems ❑ Smart equipment and appliances ❑ Advanced HVAC ❑ Building retrofits

scottmadden
MANAGEMENT CONSULTANTS

What's Happening on the Ground?

Smart City Example: Amsterdam

- Ambitious mission
  - "Challenging businesses, residents, the municipality, and knowledge institutions to test innovative ideas and solutions for urban issues. This contributes to the livability of the Amsterdam Metropolitan Area, promotes sustainable economic growth, and helps develop new markets"
- More than 150 projects currently underway across six themes
  - Infrastructure and Technology
  - Energy, Water, and Waste
  - Mobility
  - Circular City
  - Governance and Education
  - Citizens and Living
- Takeaways
  - Engaging citizens as engines for innovation (e.g., annual "Smart City Challenge" accepting proposals for initiatives that fit within the framework)
  - Experimenting with pilots, learning from them, and building iteratively
  - Creating new data sources and connecting projects with integration built into design

North American Cities

- Still more sizzle than steak
- Testing various elements
- No "canned" solutions or approaches – depends upon:
  - Budget
  - Engagement
  - Demographics
- But many green shoots are coming up, for example:
  - San Antonio – CPS Energy
    - Smart thermostats
    - Utility-owned, customer-sited DER
  - New York – Consolidated Edison
    - NY REV
    - Petition for new tariff to provide communications service
  - Charlotte – Duke Energy, Cisco, city planner collaborative ("Envision Charlotte")
    - Energy program founded in 2011 to improve building energy efficiency in the city center
    - Additional efforts focused on four pillars
      - Energy
      - Air
      - Water
      - Waste

scottmadden
MANAGEMENT CONSULTANTS

What's the Utility's Role?

Smart City Phased Approach for Utilities

PHASE 1

- Starting with easy wins
- Leveraging existing infrastructure
- Focusing on proven applications

PHASE 2

- Pilot testing newer technologies with promise
- Developing partnerships with vendors
- Seeking innovative sources of funding

PHASE 3

- Coalescing around a mode-integrated, comprehensive plan

	Phase 1	Phase 2	Phase 3
Objective	Getting more out of the utility energy network	Leveraging the utility assets to enable non-energy smart city initiatives	Expand into entirely new areas leveraging capabilities
Focus	Energy optimization	Non-energy expansion	New frontiers, integration
Outcomes	Save money, prove ROI	Test ROI in new areas	Engage customers/ citizens
Sample Initiatives	Street lighting, smart thermostats	Water/ wastewater system automation	EVs for mass transit

scottmadden
MANAGEMENT CONSULTANTS

How Do You Get Started?

A First Killer App: Smart Street Lighting

- Street lighting projects have enormous potential to deliver a strong (and fast) return on investment and serve as a platform for piloting future initiatives
  - Street lights represent a substantial portion of city energy budget, up to 40% by some estimates
  - Smart street lights, according to those who sell them, can save 50%–70% of this cost by dimming when activity is low
- Lights can be remotely dimmed to reduce energy usage, and they can also be managed by smart devices that adjust lighting in response to traffic patterns and help identify roadway hazards
- Networked LED lights can provide not only energy savings but information about outages or other anomalies in the energy network
- Networked lighting systems can be a viable "platform" on which to build future sensing, data gathering, and communications capabilities
- For example, networked lights can be connected, communicating with video cameras, parking sensors, environmental sensors, weather sensors, etc. through the same network infrastructure

How Do You Get Started? (Cont'd)

Utility grid communications infrastructure

- The communication network represents the backbone of almost all smart city initiatives
- Energy utilities possess a physical network with a ubiquitous footprint, underpinned by a data a control network, funded by citizens who are utility customers, and in many cases being digitally upgraded in support of advanced metering infrastructure initiatives
- It may be more efficient and less expensive for cities to piggyback on the energy utility network already in place rather than build one from scratch

"Louis, I think this is the beginning of a beautiful friendship."

Greg Litra

Partner and Energy, Clean Tech, and Sustainability Research Leader

Greg Litra is a partner with ScottMadden, with principal expertise in financial, economic and regulatory analysis, strategic planning, corporate governance, risk management, and transaction support. He specializes in the energy and utilities business sectors. He also leads the firm’s energy, clean tech, and sustainability research activities and spearheads publication of ScottMadden’s Energy Industry Update. Prior to joining the firm in 1995, Greg was a corporate lawyer and business litigator on Wall Street and in Atlanta. As a lawyer, Greg worked with utilities, investment banks, and other companies in equity and debt offerings, project and secured financings, corporate litigation, and transaction due diligence. Greg earned a J.D. from the University of South Carolina School of Law, where he was editor-in-chief of the South Carolina Law Review, and an M.S. in industrial administration from Carnegie Mellon University. Greg is a Phi Beta Kappa graduate of Wofford College, where he earned a B.A. in economics and philosophy.

Questions and Answers

Contact Us

Paul Quinlan

Clean Tech Manager

ScottMadden, Inc.
2626 Glenwood Avenue
Suite 480
Raleigh, NC 27608
pquinlin@scottmadden.com
O: 919-781-4191

Smart. Focused. Done Right.

Chris Vlahoplus

Partner and Clean Tech &
Sustainability Practice Leader

ScottMadden, Inc.
2626 Glenwood Avenue
Suite 480
Raleigh, NC 27608
chrisv@scottmadden.com
O: 919-781-4191

Smart. Focused. Done Right.

Stuart Pearman

Partner and
Energy Practice Leader

ScottMadden, Inc.
2626 Glenwood Avenue
Suite 480
Raleigh, NC 27608
spearman@scottmadden.com
O: 919-781-4191

Smart. Focused. Done Right.

Greg Litra

Partner and Energy, Clean Tech,
and Sustainability Research Leader

ScottMadden, Inc.
2626 Glenwood Avenue
Suite 480
Raleigh, NC 27608
glitra@scottmadden.com
O: 919-781-4191

Smart. Focused. Done Right.

See the link below for the latest Energy Industry Update
www.scottmadden.com/energy-industry-update

Thank You for Attending!

See the link below for the latest Energy Industry Update

www.scottmadden.com/energy-industry-update

scottmadden
MANAGEMENT CONSULTANTS