GEH: Gas Gen Perspective

David Nilsson, VP Solutions
dnilsson@powercosts.com

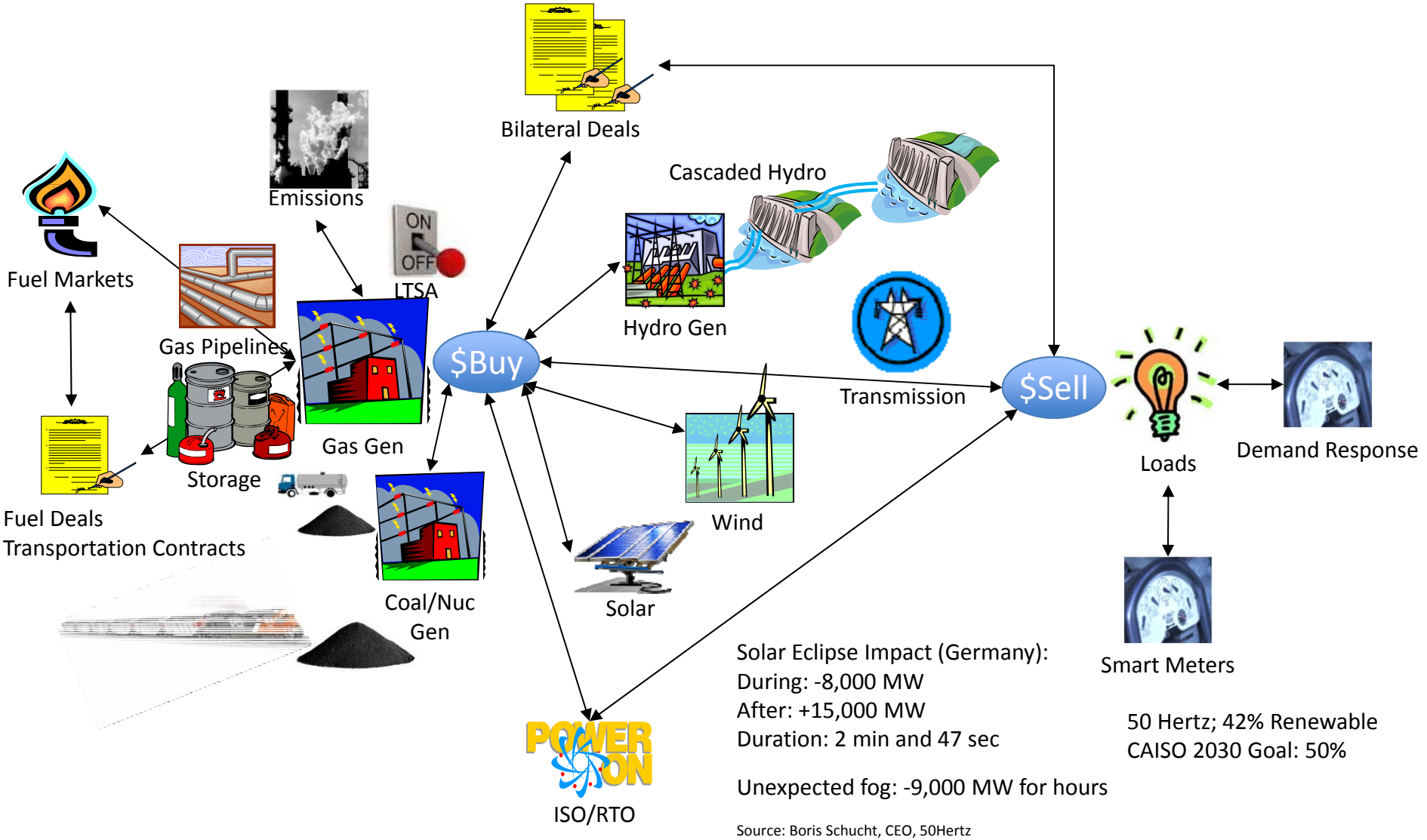
powercosts.com

PCI
ENERGY IN FOCUS.

PCI Overview

- Company:
  - Software Development for Energy Markets
  - Founded 1992 / Privately Owned
- PCI Supported NAESB standard:
  - WEQ eTag 1.8.2
  - WEQ OASIS 2.0
  - WGQ 1.9, 2.0, 3.0
- Market:
  - 61% of North American Generation Capacity do Scheduling using PCI
    - Higher among Gas-Fired Gens
  - 70% of Fortune 500 Utility & Energy companies

Gas-Fired Generator Space



Solar Eclipse Impact (Germany):
During: -8,000 MW
After: +15,000 MW
Duration: 2 min and 47 sec

Unexpected fog: -9,000 MW for hours

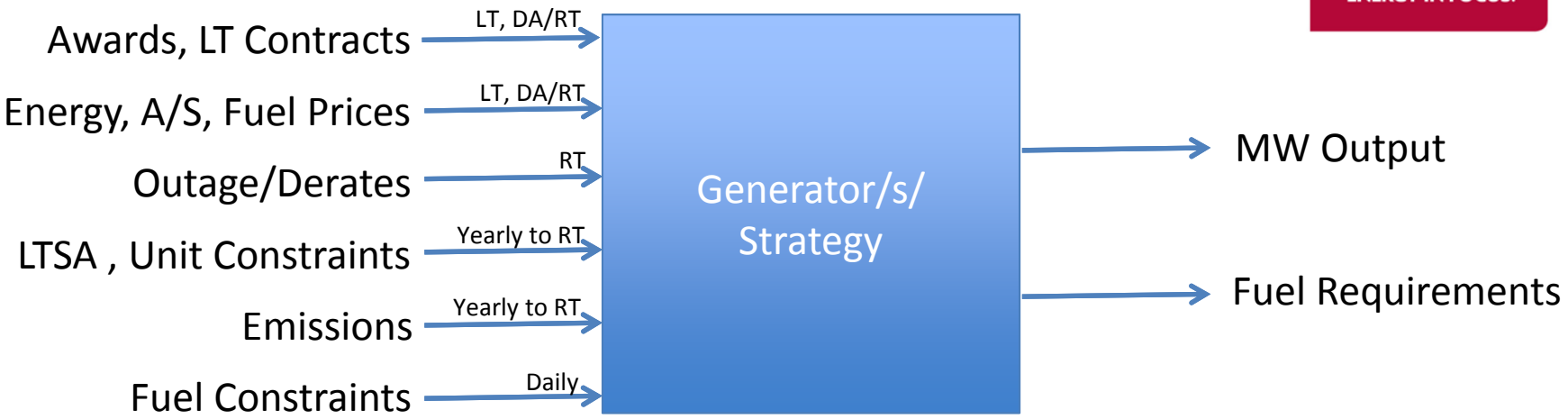
50 Hertz; 42% Renewable
CAISO 2030 Goal: 50%

Source: Boris Schucht, CEO, 50Hertz
CAISO Symposium 2015

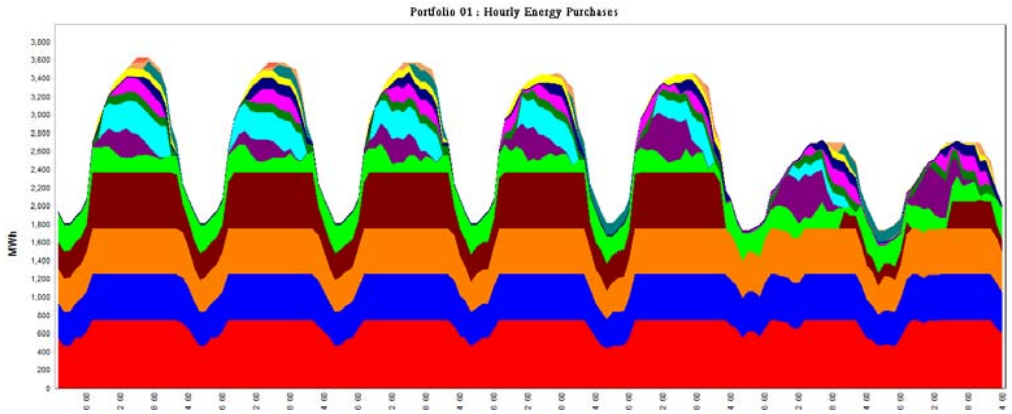
A Gas Gen's Perfect Vs Real World

- In a Perfect World…
  - Fuel Supply Availability = Generation Output Needs
  - No Start-up or Shutdown Costs or Constraints
  - No Emissions/Costs
  - No Outages or Temperature Derates
  - Perfect Linear I/O Curves over all Stages and Duct Firing
- In the Real World…
  - Daily Fuel Quantities and Electric Products/ISO Awards
  - LTSAs, Unit Characteristics
  - EPA, CARB
  - Outages and Temperature Swings
  - Multiple Configurations

Generator/s/ Strategy



Insanity: doing the same thing over and over again and expecting different results.
Albert Einstein



Key Point: Most Generators look at least 7 days out, even though markets are DA/TIM or RT/ID.

GEH Translation: Unless some of the inputs to the generator/s/ strategy changes; just running more cycles will create the same result.

Input Characteristics

- Awards, LT Contract
  - Gen Offer – ISO/Award – DA/RT
  - Gen Offer – Counterparty/Contract - LT
- Energy, A/S, Fuel Prices
  - Market – LT/DA/RT
- Outage/Derates
  - Planned or It Happens
- LTSA, Unit Constraints
  - During Construction/Utilization
- Emissions
  - During Construction/Utilization
- Fuel Constraints

Key Points:
Even if the Fuel side is perfect, there are many other aspects that drives a generator. With different time horizons.

Everything has to be monetized to optimize.

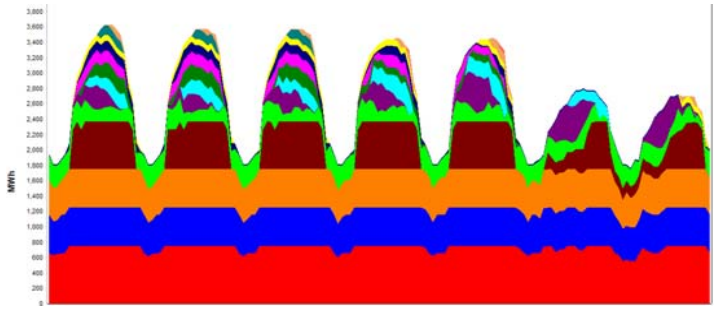
Fuel Constraints

Transportation Market?

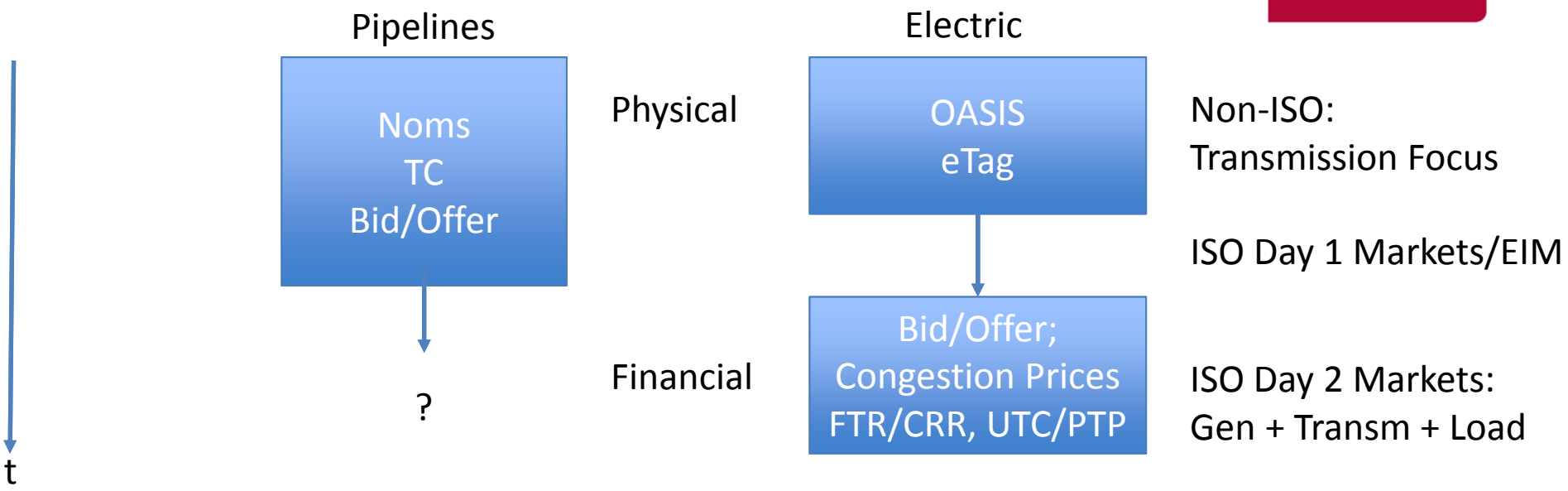
- Typically Modelled as Hard Physical Constraint, not a Price Sensitive Market
- Why?
  - Market is Too Physical
    - The Financial Components are not 100% EDI available
      - Makes scheduling more difficult
  - Capacity Release
    - Not always a liquid market.
      - Not available everywhere; even with 3.0.
    - Available too late for some to change strategy
  - Generator Fuel Cost Recovery Clause
    - Sometimes provides lack of incentives to trade even unused firm
  - Services
    - Ratable
    - Hourly Non-Ratable
    - Swing over 16 hrs
    - Sub-Hourly?

Data Set No.	Data Set Name	Creation	Download
5.4.17	Note / Special Instruction	N/A	EDI Only
5.4.20	Transactional Reporting – Capacity Release	N/A	EBB Only
5.4.21	Transactional Reporting – Firm Transportation	N/A	EBB Only
5.4.22	Transactional Reporting – Interruptible Transportation	N/A	EBB Only
5.4.23	Pre-approved Bidders List	N/A	EBB Only
5.4.24	Offer	EBB Only	EBB and EDI
5.4.25	Bid	EBB Only	EBB and EDI
5.4.26	Award Download	N/A	EBB and EDI
5.4.27	Withdrawal Download	N/A	EBB and EDI

The Result? Sub-optimal.



Evolution/Lessons Learned



	Storage	Confirms	"DA" Volume	"RT" Volume
ISO Day 2	Yes (ESR)	Yes	90%	10%
Pipeline	Yes	Yes	80-90%	10-20%
eTag	N/A	N/A	N/A	90%

The Pipeline model is not that far away from an ISO Day 2 Market.
Main difference; it's not as Financial as an ISO Day 2.

Observations

- For People to Change, there must be a Financial Incentive
- ISO Day 2 Markets have Market Instruments and Models to handle Constraint issues Financially
  - Congestion Pricing
  - UTC/PTP, FTR/CRR/TCC/TR
  - Awards, FinSched/Trade/Inter-SC/Transaction
- Generation and Pipeline Operations are much more time sequence complicated than Transmission
  - Faster scheduling helps but earlier should also be considered
- Markets and Granularity don't have to be the same
    - DA Markets are typically Hourly
    - RT Markets are typically Hourly, 15 or 10 min
    - If TIM was of hourly granularity (non-ratable) that would help

Suggestions

- Alleviate/Reduce Fuel Constraint with a more Liquid (financial) Market
  - One size does not fit all.
  - There is no Silver Bullet.
  - NAESB can help with the interfaces
    - Enhance NAESB Cap Release Spec with Bid/Offer support for full EDI
    - Allow Bid/Offer Curves
    - Encourage/Define New Services

- Look at the ISO Day 2 Markets, not eTag, for faster and more effective scheduling ideas
  - ISO Day 2 Markets include both physical and financial scheduling; while eTag is just a physical scheduling environment
    - UTC/PTP, FTR, Congestion Pricing
    - Confirmation Processes
  - NAESB can help with the interfaces

For More Information

David Nilsson
VP Solutions
(408) 806-2498
dnilsson@powercosts.com

PCI GENERATION SUPPLY MANAGEMENT SYSTEM™

- **Operations & Trading**
  - **Optimal UC/ED**
  - **Fuel Scheduling**
  - **Ancillary Services Optimization**
- **ISO Bid-To-Bill Automation**
  - **Offers & Bids Management**
  - **Evaluate Bidding Strategies**
  - **Forecast LMPs**
  - **Automate XML Communications**
  - **ISO and Shadow Settlement**
- **Deal Management**
  - **Deal Capture**
  - **Bilateral Settlement**
  - **E-Tagging/OASIS Reservations**
  - **Gas Management**
- **Contract Settlement**
  - **Post Analysis**
  - **Energy Accounting**
  - **Tolling**
- **Data Warehouse and BI Tools**
  - **ODS and DataMarts**
  - **BI Analyzer**