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## ***NGK's Sodium Sulfur (NAS) Battery***

### ***The Vendor's Perspective on Barriers & Issues Encountered in U.S. Deployment***

**Presented to the  
California Energy Commission**

**Staff Workshop on Energy Storage Technologies and  
Policies Needed to Support California's Renewable  
Portfolio Standard (RPS) Goals of 2020**

**April 2, 2009**

# *Abstract*

- **NGK Insulators' Sodium Sulfur (NAS) Battery has been deployed at over 200 locations world-wide, totaling over ~300 MW, 2000 MWh**
- **9 MW are currently operating at three U.S. utilities**
- **An additional 10 MW have been delayed from 6 to 12 months due to U.S. regulatory issues.**
- **These circumstances present barriers to deployment of NAS – and similar storage technologies – in support of**
  - California RPS goals
  - “SmartGrid” deployment
- **The vendor perspective on select experiences are summarized in this presentation**

## *Part 1:*

# *NGK Insulators, Ltd. NAS Battery Technology, Status & Applications*

# ***NGK Insulators, Ltd.***

## Outline of NGK

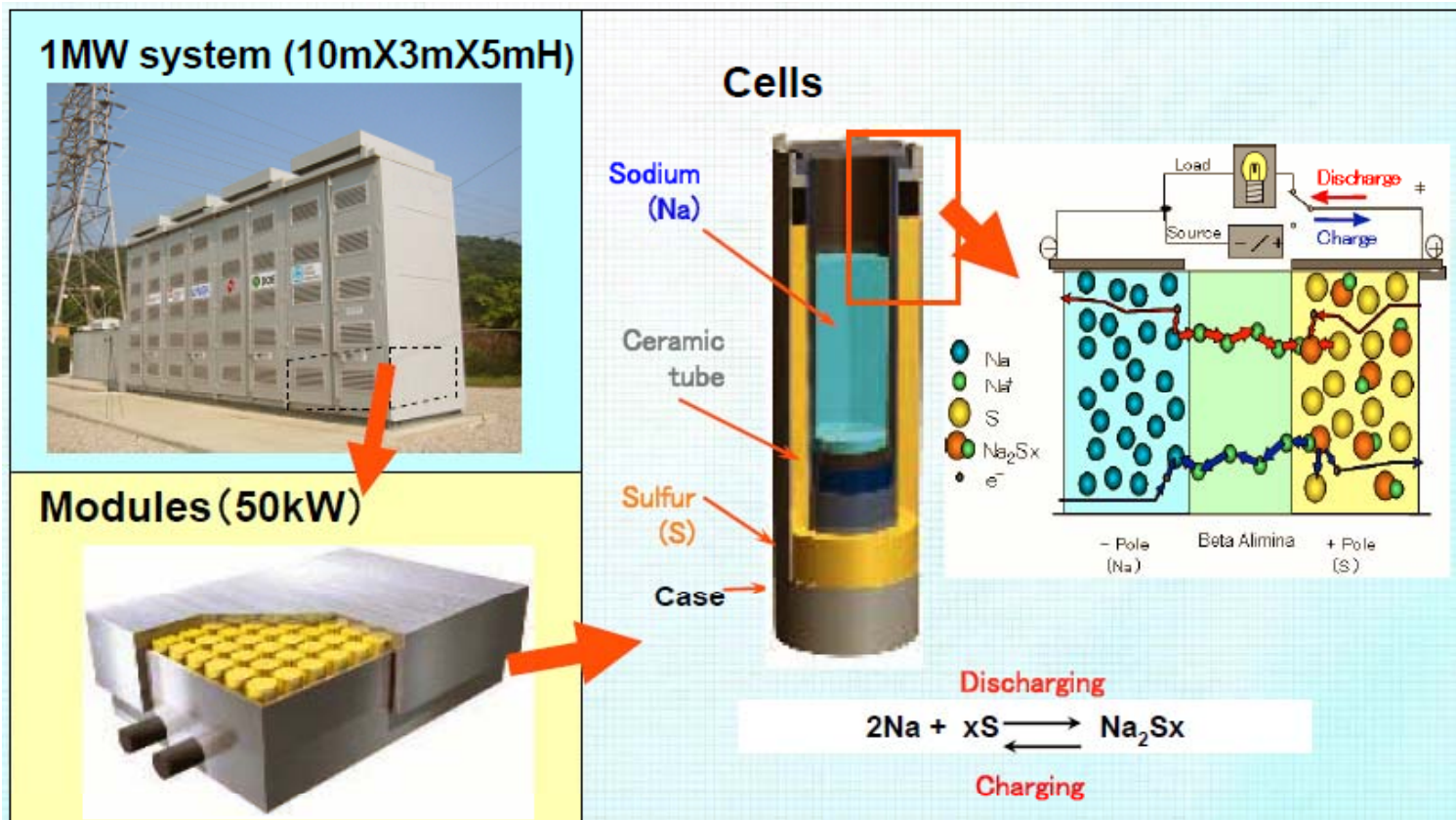


Company Name	NGK INSULATORS, LTD.
Date of Establishment	May 5, 1919
Paid-in Capital	69,849 Million Yen
Representative Directors	Shun Matsushita (President and CEO) Tsurayuki Okamoto (Senior Vice President)
Number of Employees	3,356 (non-consolidated) 10,342 (consolidated)
Consolidated Subsidiaries	52 companies

As of March, 2007

# The "Na" + "S" → "NAS" Battery

Unit Rating: 1 MW, 6 MWh/cycle, 300 cycles/yr, 15 years



## ***NAS Battery Development Highlights***

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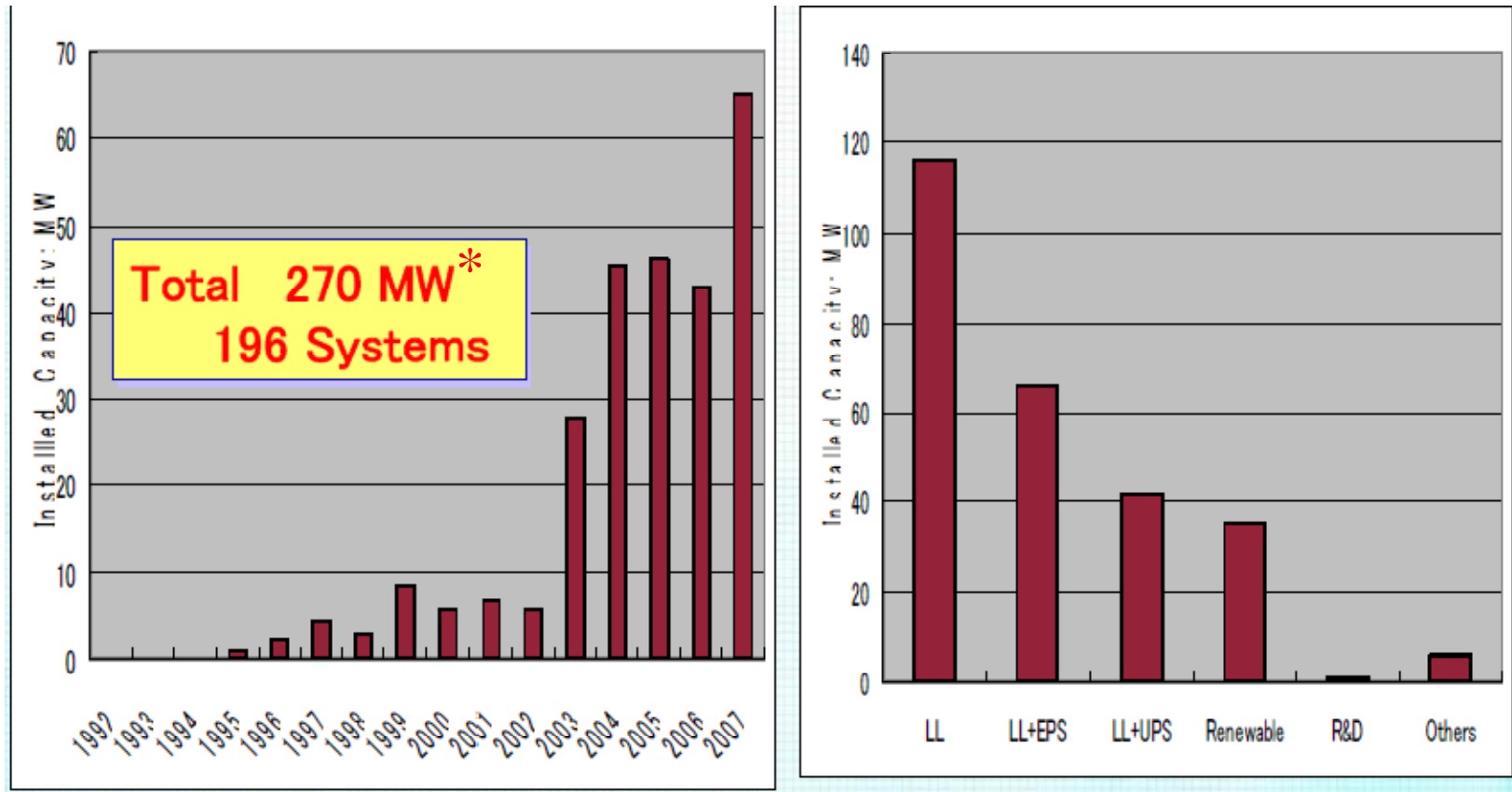
- Joint Development by **NGK** and **Tokyo Electric Power Company (TEPCO)**
- Initial Target: **Utility-Scale (Multi-MW, Multi-Hour) Distributed Energy Storage (DES)**
  - 1984 ~ Technology – Beta Alumina Ceramic Electrolyte
  - 1989 ~ Cell and Battery Module Development
  - 1997 ~ **Field Tests at Substations (6 MW, Tsunashima, JPN)**
  - 2000 ~ Field Tests at Customer Sites
  - 2002 ~ Commercialization in Japan
  - 2006 ~ **First US Utility-Scale Installation at AEP (1 MW)**
  - 2008 ~ Largest to Date: 34 MW, Wind Stabilization, JPN

## ***NAS Battery Manufacturing***

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- **2003 – Commercial-scale manufacturing plant commissioned**
- **2005 – 48 MW/yr production (960 modules)**
- **2008 – 90 MW/yr (1800 modules)**
- **2010 – 150 MW/yr (expansion in-progress)**

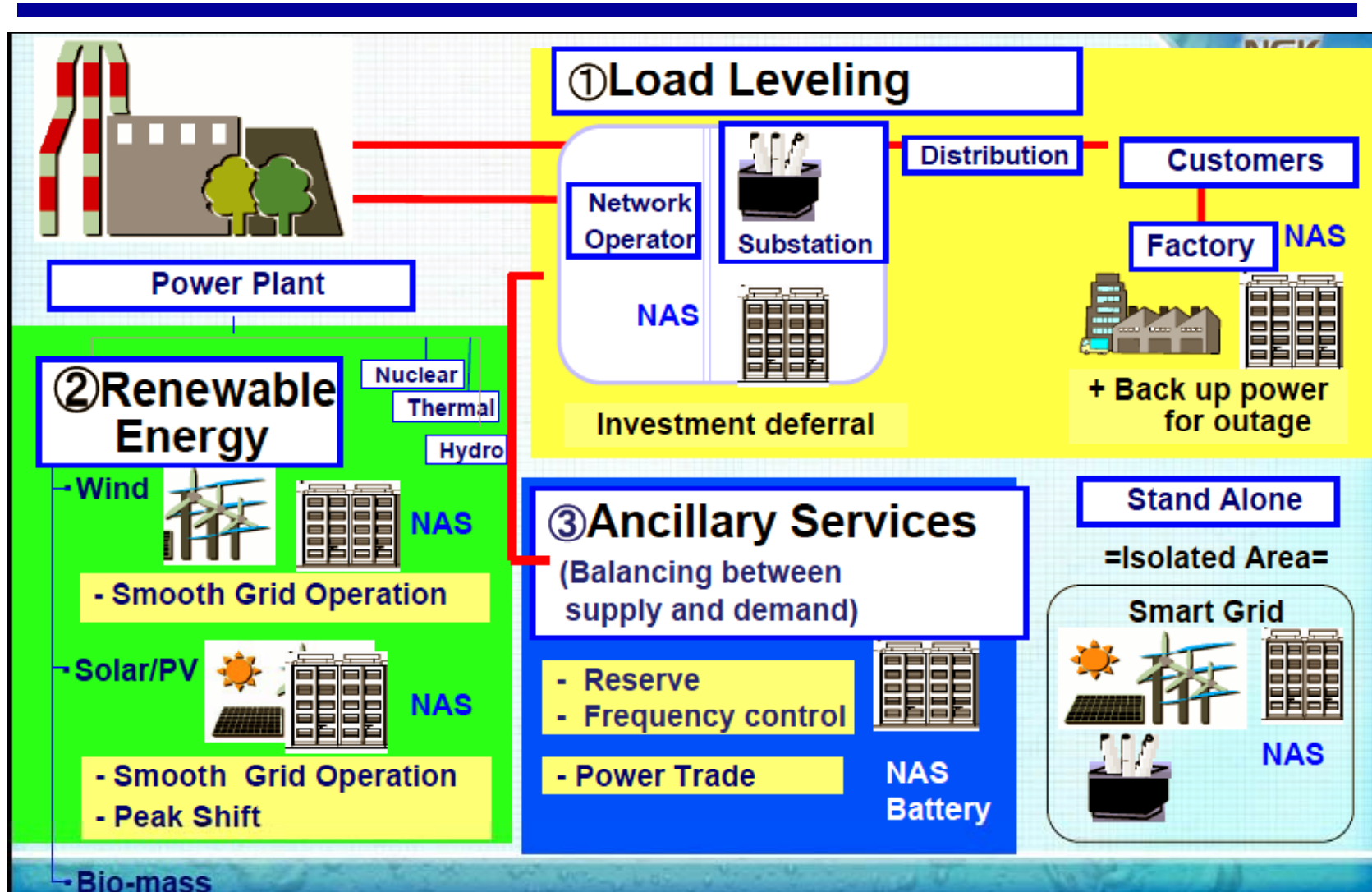
# NAS Deployment History



**\* Includes 160 MW NAS Distributed Energy Storage within Tokyo**



# NAS Battery Applications



## *Part 2*

# *Barriers & Issues Encountered in US Deployment*

## *The Regulatory “Ownership” Issue*

**Ownership regulations have obstructed NAS owners from accruing the combined benefits of both MARKET SERVICES and GRID SERVICES**

### Organized (ISO) Markets (competitive, unregulated)

- **Market Services**
  - Energy Trading, e.g., time-shift wind
  - Ancillary Services, e.g., frequency regulation

### Grid Infrastructure (rate-based, regulated)

- **Grid Services**
  - Reliability Enhancement
  - Upgrade deferral

### • **This issue –**

- Creates owner uncertainty on investment recovery
- Applies to all DES technologies like NAS (multi-MW, Hrs)
- Presents a barrier to DES contribution to CA RPS goals

- **Case 1: 6 MW DES (NAS) Project delayed ~ 1 year**
  - Owned by a California Investor Owned Utility, Transmission Company (abbreviated, CA-IOU(T))
- **Case 2: 4 MW DES Project approval delayed ~ 6 months**
  - Customer is a Texas Investor Owned Utility, Transmission and Distribution Company (abbreviated, TX-IOU(T&D))
- **Case 3: Multi-MW DES Proposal to CA-IOU – combined benefits were NOT considered**
  - Proposed by a California Independent Storage Developer (abbreviated, CA-ISD)

## Case 1: CA-IOU(T)\* 6 MW DES Project Delay

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- **In Feb 08, CA-IOU(T) purchased 6 MW DES to provide:**
  - Reliability enhancement [a grid service]
  - Renewables generation support (time-shift wind) [a CAISO market service]
  - Ancillary services - regulation control, VAR support [CAISO market services]
- **In May 08, the vendor was advised that**
  - “CA-IOU(T) is facing the challenge of establishing the precedent for Battery Energy Storage Systems (BESS) as a Transmission Asset recoverable in the Transmission Access Charge (TAC).”
- **The vendor’s understanding is that**
  - The CA-IOU(T)’s challenge to qualifying BESS as a Transmission asset is due to a FERC ruling on the rigid separation of Generation and Transmission.
    - . . . “[asset] may not be operated and/or managed by the California Independent System Operator Corporation or functionalized as transmission for rate recovery purposes,”
  - The CA-IOU(T) considered the ruling to place the cost recovery of energy storage assets at risk
  - No FERC or CPUC rulings have been obtained

\* California Investor Owned Utility, Transmission Company

## **Case 2:** ***TX-IOU(T&D)\* 4 MW DES Project Delay***

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- **In July 08, TX-IOU(T&D) received ERCOT approval of 4 MW DES for reliability enhancement**
  - No ISO market services (energy trading, ancillary services) planned
- **In Aug 08, two Market Participants (TX-MPs) filed objections**
  - *“ . . . it is not clear [to TX-MP] that the storage device should be owned and operated by the TX-IOU(T&D), causing the TX-IOU(T&D) to effectively take ownership of the energy while it is stored in the battery. “*  
*“ . . . TX-MP believes that the intent of the Legislature was to distinctly separate generation, transmission and retail functions.”*
- **ERCOT tabled the issue**
  - *“ . . . until the PUCT issues a decision in the proceeding relating to the ownership issue (PUCT Docket No. 35994).”*
- **In Feb 09, PUCT expressed approval for TX-IOU(T&D) to proceed**

**\*Texas Investor Owned Utility, Transmission and Distribution Company**

## **Case 3:** **CA-ISD\* Multi-MW DES Proposal to CA-IOU**

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- **During 2008, CA-ISD submitted a proposal based on networked multiple DES systems in response to CA-IOU RFO.**
- **CA-ISD projected value based on combining both**
  - CAISO market services (e.g., frequency regulation, energy) and
  - Grid services (e.g., upgrade deferral, feeder reliability)
- **The vendor's understanding is that**
  - CA-IOU proposal evaluators were not equipped to consider the combined benefits of market and grid services, i.e.,
    - *DES only credited for MARKET SERVICES (as though DES were a generator)*
    - *DES benefits for GRID SERVICES ignored.*

**\*California Independent Storage Developer, (Storage counterpart to IPP)**

## Case Summaries

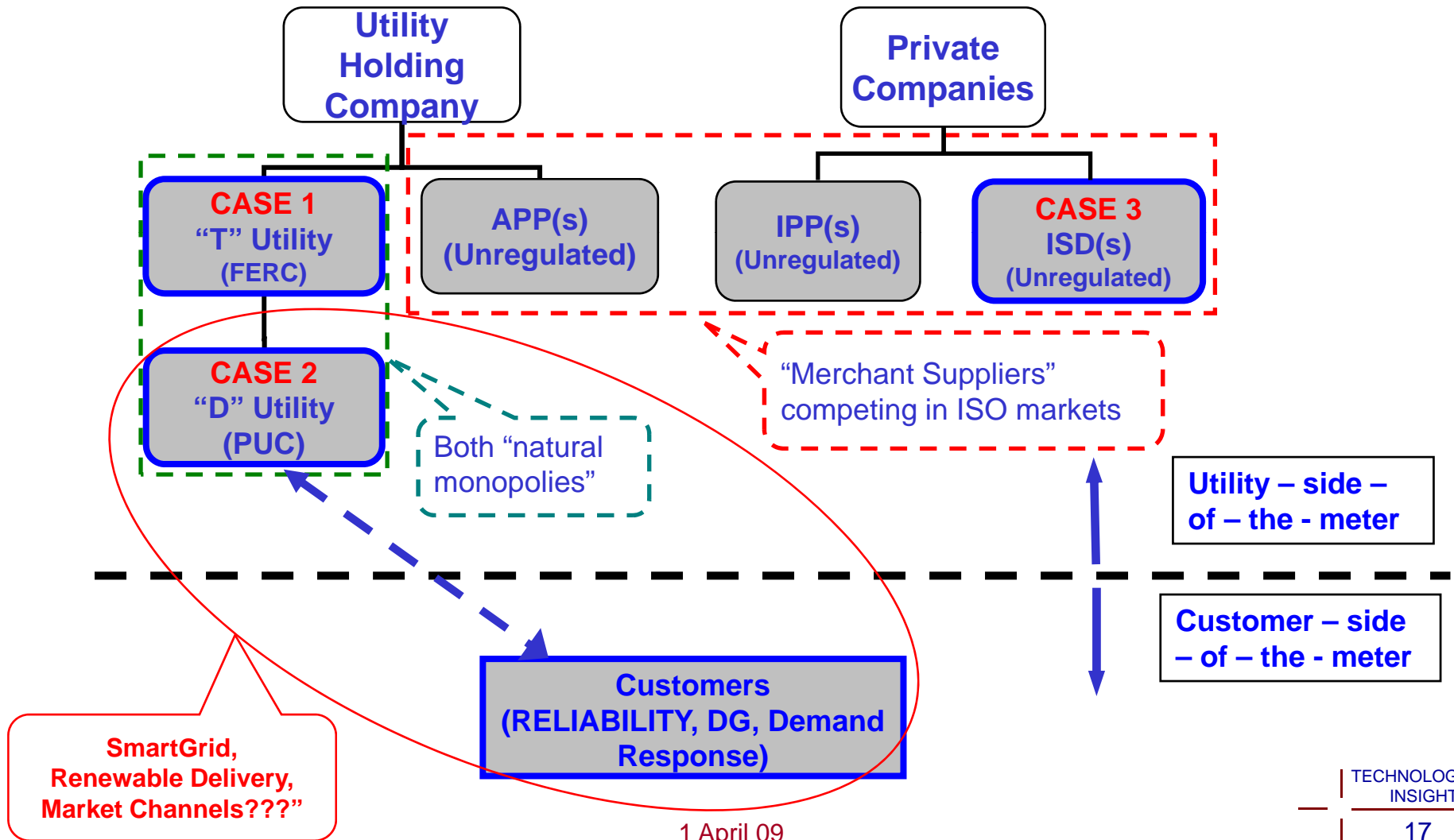
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- **Case 1: CA-IOU(T) Owner - 6 MW DES Project Delay**
  - FERC ruling appears to deny BOTH market and grid services
- **Case 2: TX-IOU(T&D) Owner - 4 MW DES Project Delay**
  - Market participants (TX-MP) objected to storage for grid services
    - *PUCT has recently approved project*
  - The use of storage for market services was not addressed
- **Case 3: CA-ISD Owner - Multi-MW DES Proposal to CA-IOU**
  - Storage valued by CA-IOU for ONLY market services
  - Value of proposed grid benefits denied



# Vendor Perspective of US Market Structure

Shaded denote candidate energy storage owners, i.e., MARKET CHANNELS

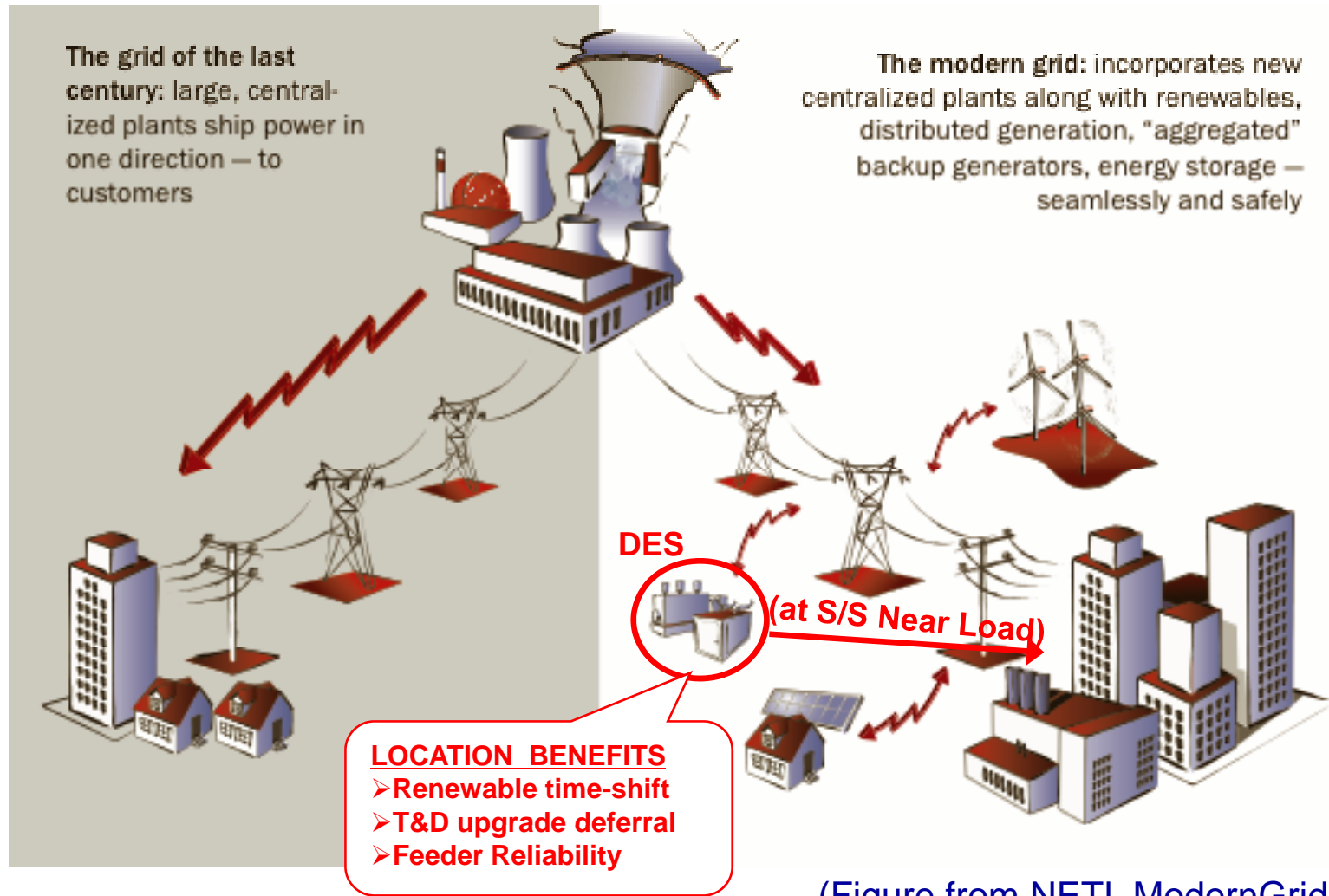


## ***Alternative Rules for Owners of Distributed Energy Storage (DES)***

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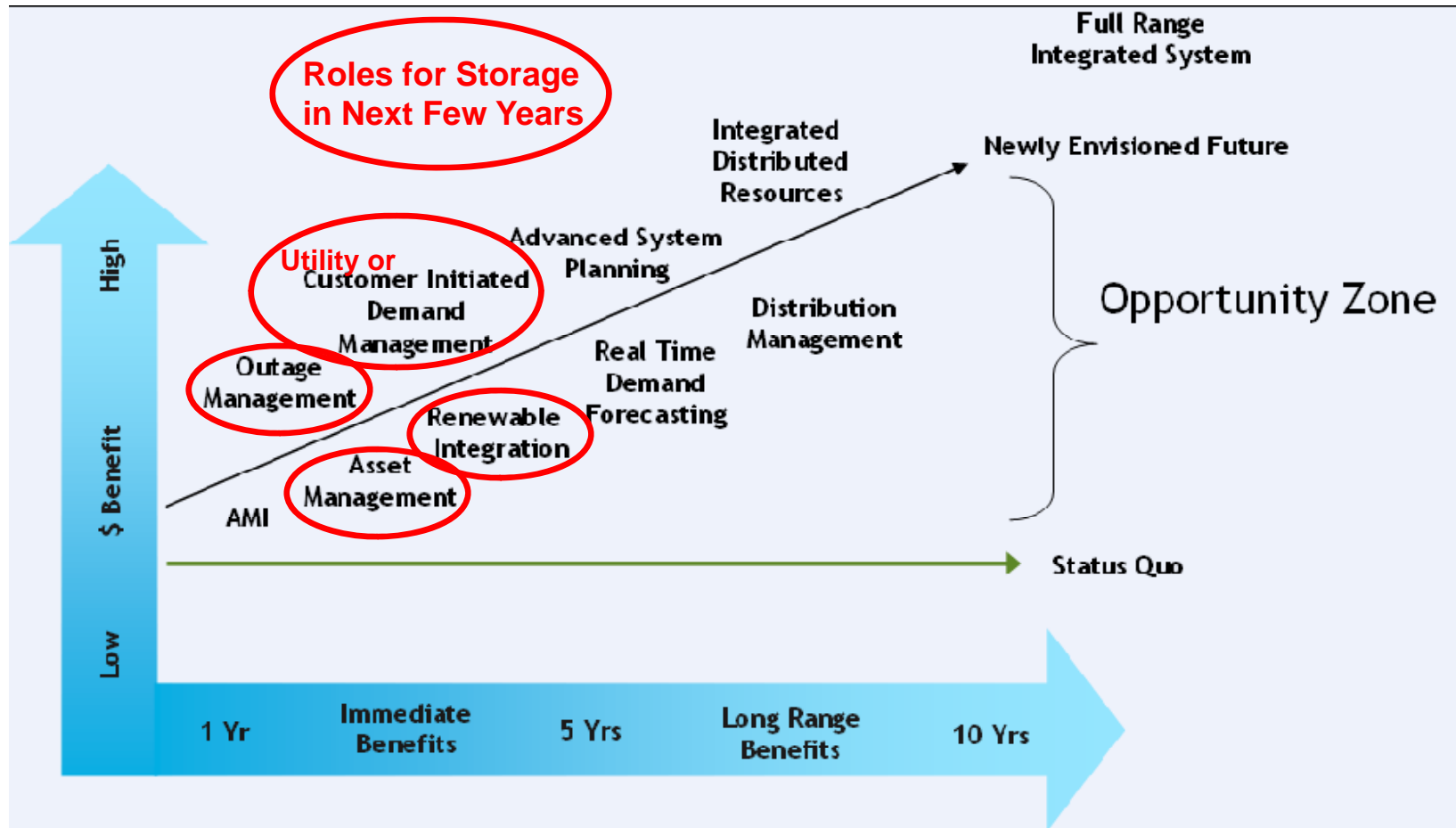
- **DES technologies are “new tools” in “new markets”**
  - Existing rules appear to stem from “deregulation” of generation assets, and strict separation generation and T&D functions
  - “Storage” is being treated “generation”
- **Alternative rules for DES ownership should allow owners to accrue benefits from COMBINED market and grid services. Options include:**
  - Interim Rule-Making/Flexibility – while experience is gained with DES technologies, e.g.,
    - *Allow “T&D” utilities to place storage in rate-base for grid services and return market revenues to rate payers*
  - New Rule-Making – to recognize “energy storage” as a regulatory category separate from generation and T&D

# Networked DES Located Near Load in SmartGrid



(Figure from NETL ModernGrid) | TECHNOLOGY INSIGHTS

# Networked DES in SmartGrid Deployment



(Figure from Energy Pulse)

## *Contact Information*

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