

How Do Technology and Pricing Impact Consumer Behavior?

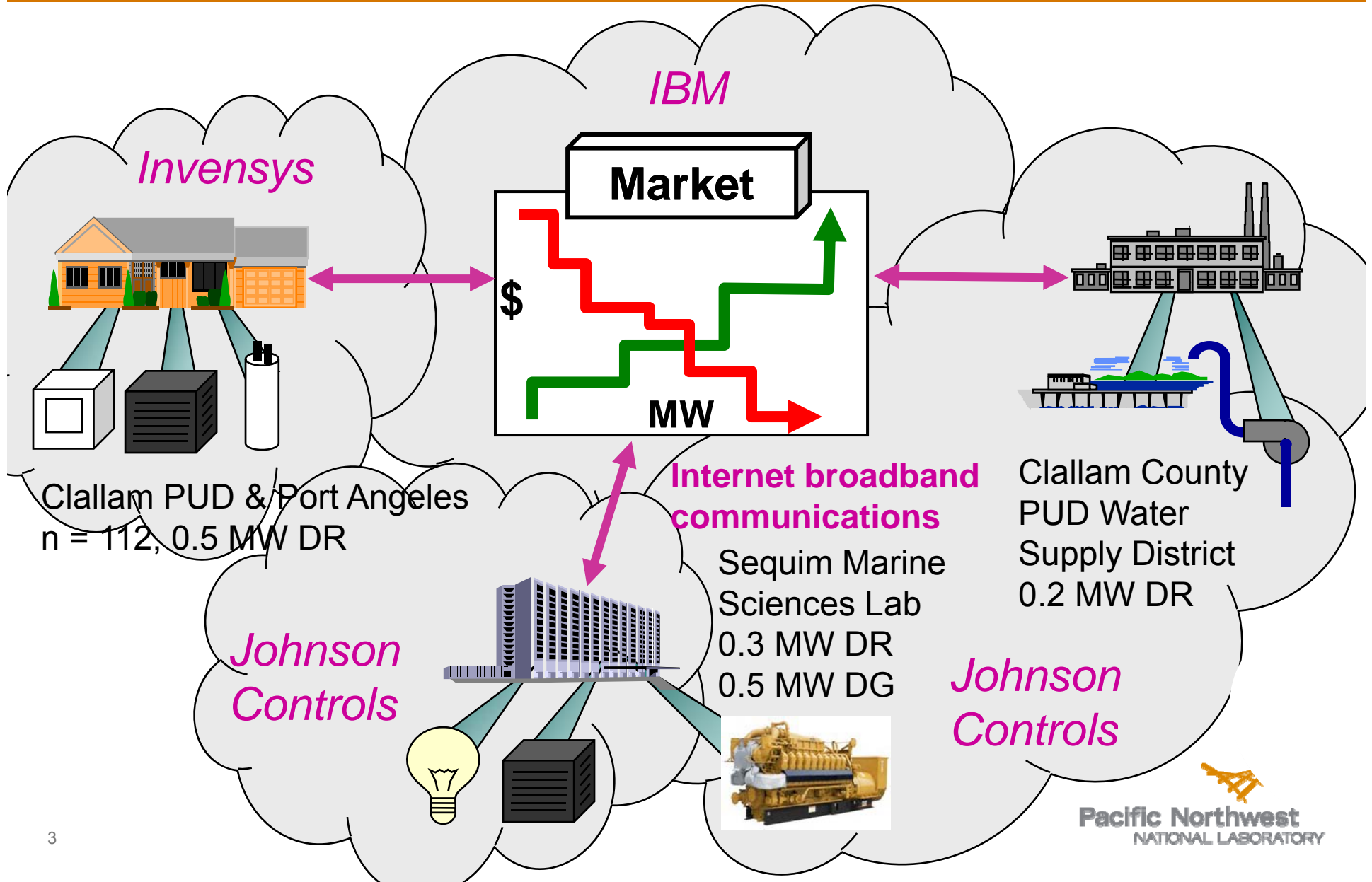
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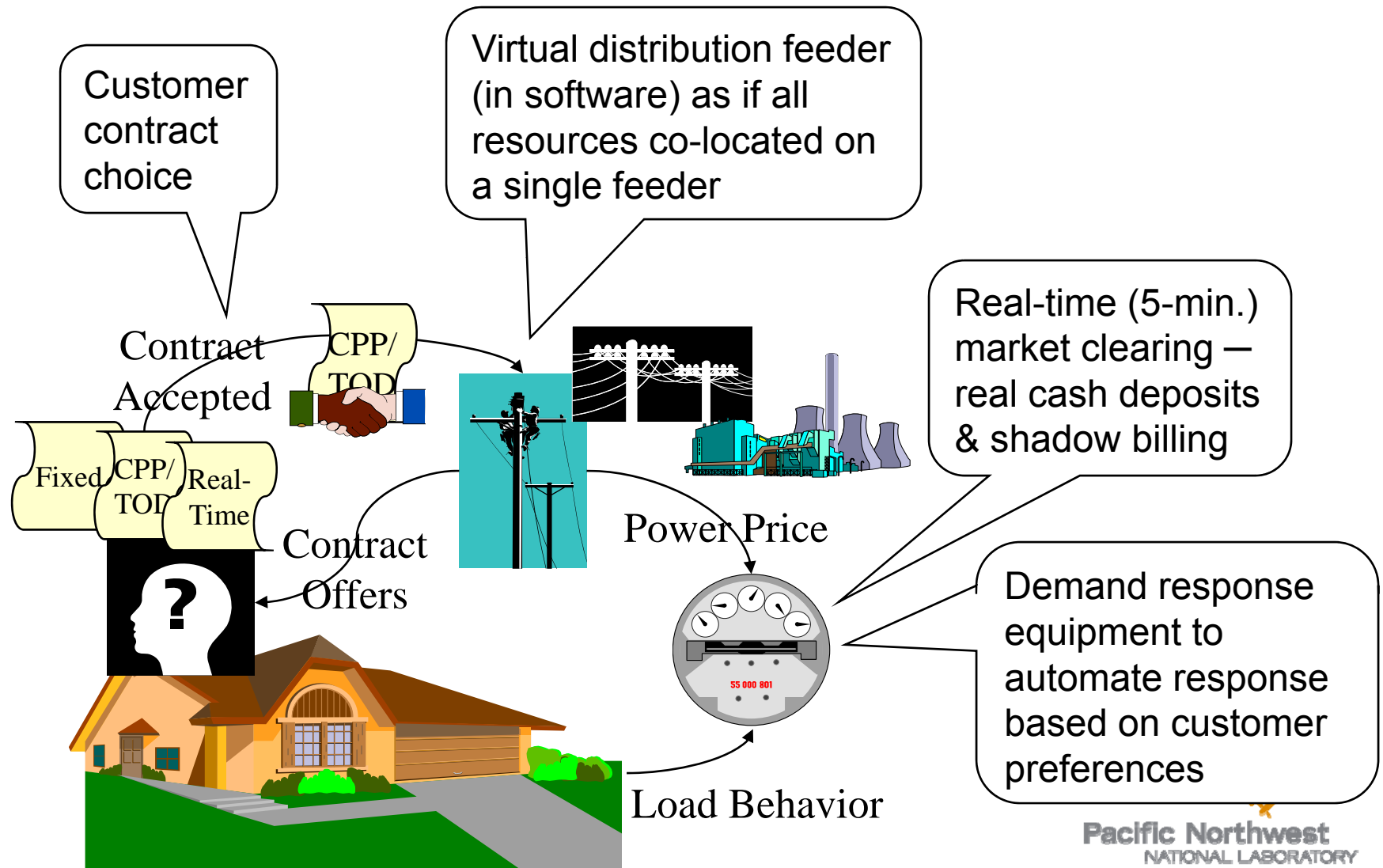
Fully Engaging Demand: What We've Learned from the Olympic Peninsula Demonstration



Olympic Peninsula Demonstration



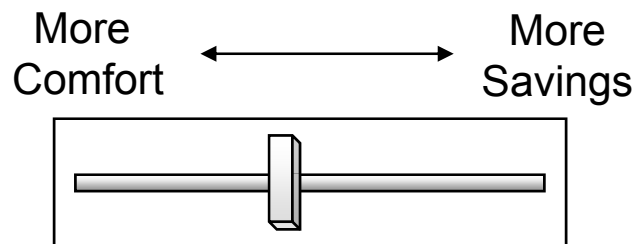
Testing Market-based Customer Incentives



Olympic Peninsula Demo: Key Findings (1)

Customers can be recruited, retained, and will respond to *dynamic pricing* schemes **if they are offered**:

- ▶ Opportunity for significant savings (~10% was suggested)
- ▶ A “no-lose” proposition compared to a fixed rate
- ▶ Control over how much they choose to respond, with which end uses, and a 24-hour override
 - prevents fatigue: reduced participation if called upon too often
- ▶ Technology that automates their desired level of response
- ▶ A simple, intuitive, semantic interface to automate their response



Translates to control parameters:

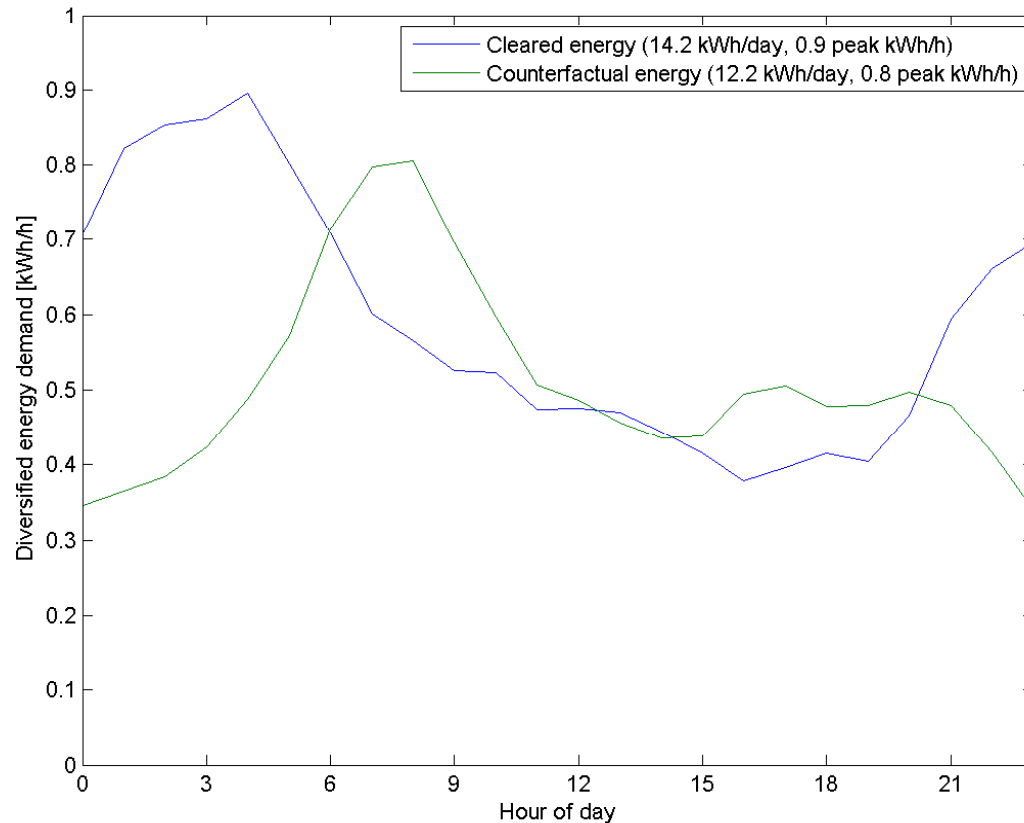
K, T_{max}, T_{min} (see *Virtual Thermostat*)

Olympic Peninsula Demo: Key Findings (2)

Significant demand response was obtained:

- ▶ 15% reduction of peak load
- ▶ Up to 50% reduction in total load for several days in a row during shoulder periods
- ▶ Response to wholesale prices + transmission congestion + distribution congestion
- ▶ Able to cap net demand at an arbitrary level to manage local distribution constraint
- ▶ Short-term response capability could provide regulation, other ancillary services adds significant value at very low impact and low cost)
- ▶ Same signals integrated commercial & institutional loads, distributed resources (backup generators)

Load Shifting Results for RTP Customers



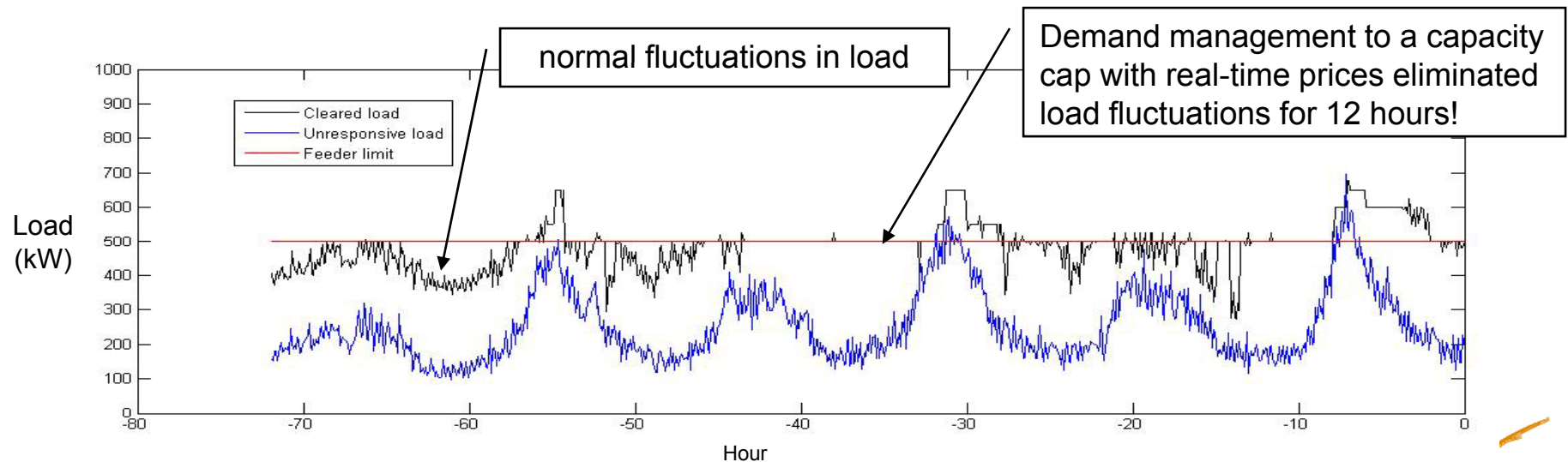
- ▶ Winter peak load shifted by pre-heating
- ▶ Resulting new peak load at 3 AM is non-coincident with system peak at 7 AM
- ▶ Illustrates key finding that a portfolio of contract types may be optimal – i.e., we don't want to just create a new peak

Potential for Demand Response to Help Manage the Large Infusion of Wind Power Implicit in a Carbon Strategy

Regulation: one or more fast-responding power plants continually throttle to match normal fluctuations in load

Highest cost generation in markets (zero energy sales, wear & tear, fuel consumption)

Fluctuations in wind farm output greatly exacerbate need for regulation, reduce cost effectiveness of wind power at high penetrations



How Can We Engage Demand Response in a Fully Regulated Utility Environment?

- ▶ Keep regulated, “flat” rates for small customers
- ▶ Lay the financial “cards” on the table:
 - Determine *actual costs to serve* customers, *by time & by location*
 - *Reveal to customers the marginal value* of reducing their demand
 - *Offer to share* the benefits they create through incentives
 - *Buy them controls to automate* the response & savings they desire
 - *Keep it simple*, transparent, customer in charge of all response
 - Remaining share of benefits to *reduce rates for all customers*
- ▶ Design revenue-neutral, fully-regulated incentives (no windfalls, no risk)
 - Pay-for-curtailment (measurement & analysis intensive to compare actual to “baseline”)
 - Price-based programs* (simple: pay for what you use) debited from a *declining balance incentive account*

* *Note: time-based retail price signals or incentives do not require deregulated wholesale markets*

What is a *Declining Balance* Approach?

How it works from customer perspective:

- ▶ Pay fixed rate bill as usual
- ▶ Receive up-front incentive deposited in internet holding account in customer name—potential to save \$ is explicit
- ▶ Incentive deposit can be designed or adjusted to be revenue neutral for current average customer load shape
- ▶ Debited a TOU/CPP or real-time-price based “shaping charge” against their holding account
- ▶ Periodically receive a check for the unspent balance in their account—clear, tangible reward distinct from bill
- ▶ Account cannot go below zero—ensures “no losers” proposition, lowers risk of trying something new

What are the Advantages of this Approach?

- ▶ Looks like payment for curtailment to customers, regulators
- ▶ Avoids complexity of customer baseline—*none required by pricing schemes*
- ▶ No losers (holding account cannot go negative)—*eliminates risk for customers* (and regulators)
- ▶ Up front payments can be
 - revenue neutral or revenue positive, course corrected over time to maintain targets
 - individually tailored to each customer (e.g., a fraction of previous year's bill, and/or based on AMI data)
- ▶ Engages customers in dynamic pricing, where demand response can be fully employed, all the time, to provide maximum value

Going Beyond the Traditional Benefits of Demand Response is Simply Good Business

- ▶ Obtain the broadly recognized, “traditional” benefits of demand response (DR):
 - Minimize need for new generation & transmission capacity
 - Manage demand on peak days
 - Mitigate wholesale price spikes
- ▶ Maximizing return on the strategic DR investment is simply good business:
 - Utilize demand for ancillary services
 - Defer distribution capital investments
 - Leverage network to obtain & measure efficiency/carbon benefits



Engaging DR continually rather than intermittently brings many additional benefits

Questions/Comments

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