

An aerial photograph of the Lawrence Berkeley National Laboratory campus at dusk. The image shows various buildings, including a prominent circular building with a dome, and a parking lot filled with cars. The city lights and the bay are visible in the background under a twilight sky.

Addressing Energy Shortfall through Demand Response: Policies, Technologies and Practices

通过需求响应解决电力短缺: 政策, 技术和实践

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Outline 大纲



- ✓ Demand Response (DR) and its Drivers 需求响应及其动因
- ✓ DR Benefits 需求响应的作用
- ✓ Policies for Facilitating DR 政策的推动
- ✓ Technologies that Enable DR Applications 技术的保障
- ✓ DR Practices in the U.S. 需求响应在美国的实际应用
- ✓ Tapping DR Potential in China 对中国的启示

DR is a reduction in customers' electricity consumption over a given time interval relative to what would otherwise occur in response to a price signal, other financial incentives, or a reliability signal (CEC)

需求响应是指电力用户在一定的时间因响应特定的价格信号、电费奖励补贴、及保障电力可靠性的信号而采取的减少用电的行为。没有这些信号，用户减电的响应可能不会发生。（加州能源委员会）

Demand Response (DR) Drivers

需求响应的动因



- Difficulties in building new power plants make DR an answer to demand shortfall
- High fuel costs and expensive spot market prices make DR a low cost solution
- Regulatory policies push the adoption of DR
- Smart grid technologies enable DR expansion; DR in return helps push the innovation in SG

- 对建新电厂的限制使需求响应成为解决短缺的答案
- 趋高的燃料成本和高昂尖峰段电价使需求响应成为成本优势的手段
- 新的能源政策促使需求响应的实施
- 智能电网的拓展使需求响应有了技术的保障，同时需求响应带动智能电网技术的进步

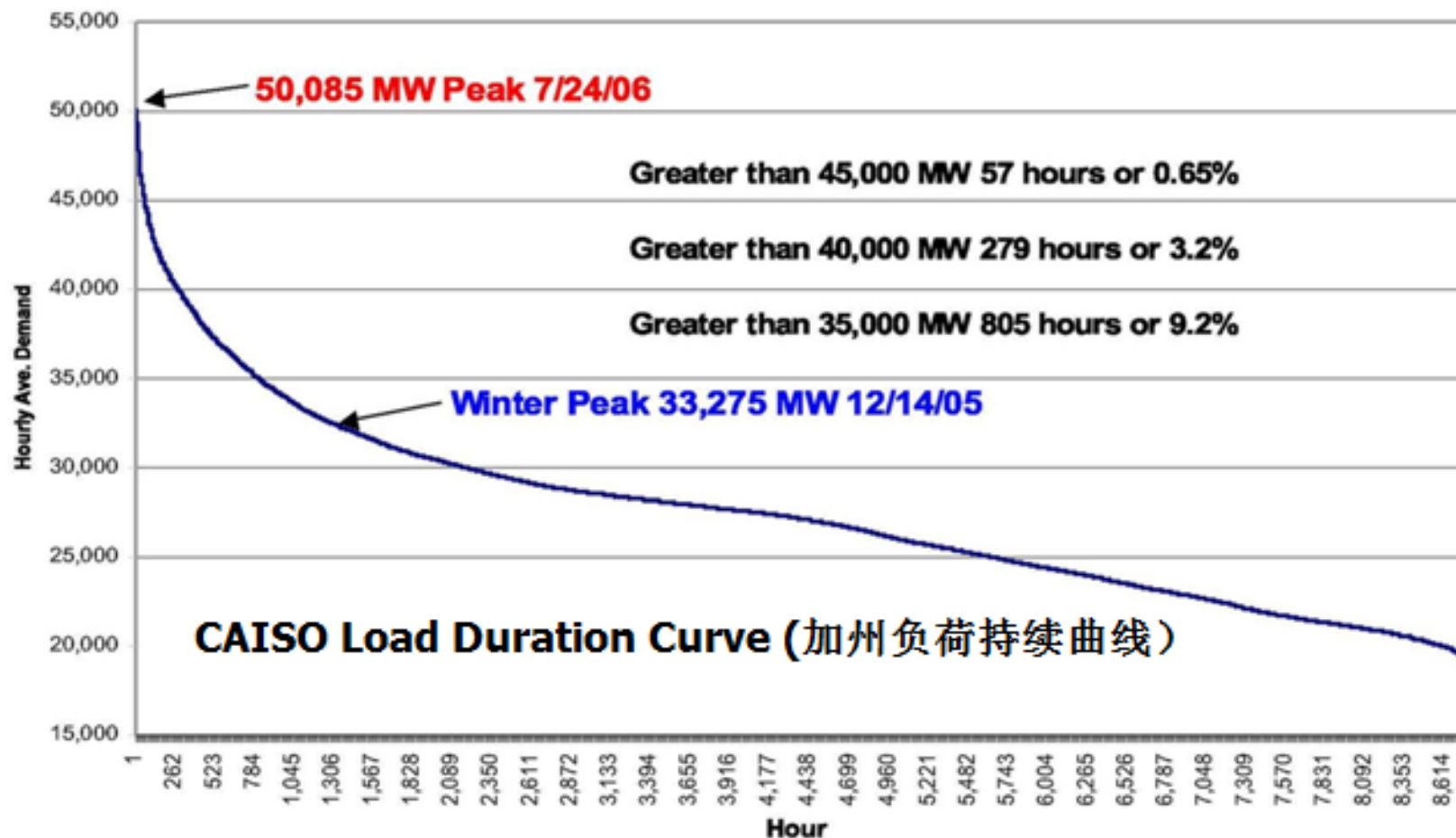
Demand Response (DR) Benefits

需求响应的影响和作用



- An effective way to address financial /structural shortfall
- Avoided new capacity minimizing the lock-in effect of power plant operation
- Reduced capacity use leading to reduced fuels and emissions
- Reduction in line losses, more significant when lines are heavily loaded during the peak
- Flatter load curves improve power generation efficiency
- Makes economic sense: In many systems, 10% of costs incurred to meet demands which occur less than 1% of the time
- Creates a cost-effective resource, alternative to supply options

- 是解决结构性短缺的有效手段
- 无需新设施的建设降低发电厂锁定效应
- 减少的负荷降低燃料的需求和污染的产生
- 减少输变电损失，特别是尖峰线路重载时
- 峰谷平衡提高发电机组效率
- 经济效果：目前10%的成本只用来满足不到1%的时间的需求
- 需求响应可成为有效的能源资源



Integrated DSM Solutions

综合DSM项目



Coordination of DR and EE

需求响应和节能的相互促进



DR and EE could be coordinated at the customer level at least in the following four ways

- Offering combined programs
- Coordinating program marketing and education
- Market-driven coordination services
- Incorporating building codes and appliance standards

需求响应和能效项目至少在四个方面可以相互助力

- 成为整合的DSM项目
- 对两个项目的市场推广和教育宣传进行高度协调
- 市场驱动的服务协调
- 在建筑标准规范和电器标准制定中将两者整合

DR Facilitating Policies

政策的推动



- EPACT 2005 mandates the elimination of barriers to DR participating in the wholesale market
- FERC Order 719 (2008) permits load aggregators to bid DR directly into organized markets
- Order 745 (2011) requires that DR resources are paid the wholesale market price for energy, placing demand side resources on equal footing with generation
- Cost recovery and decoupling
- Loading orders
- Peak demand mandates

- 2005 能源政策法要求消除需求响应进入市场的政策障碍
- FERC719（2008）允许负荷整合服务商参与市场竞标
- FERC745（2011）要求需求响应的价格与传统供能价格相同，需求响应与传统供能得到同等待遇
- 允许成本纳入电价及收入脱钩
- 电力采购的顺序
- 法定尖峰需求消减

DR Enabling Technologies

智能电网技术保障需求响应



Open ADR 开放自动DR

- An open standard-based protocol to communicate price and reliability signals 一个实时传递价格和系统可靠性信息的全开放性的标准化的通讯规范

Auto DR 自动DR

- A platform that provides fully automated signaling from a utility or ISO/RTO to provide automated connectivity to customer control systems preconfigured with load reduction strategies. 一个由电力公司向用户自动传递信号并使之启动用户端预设了控制方案的系统的平台

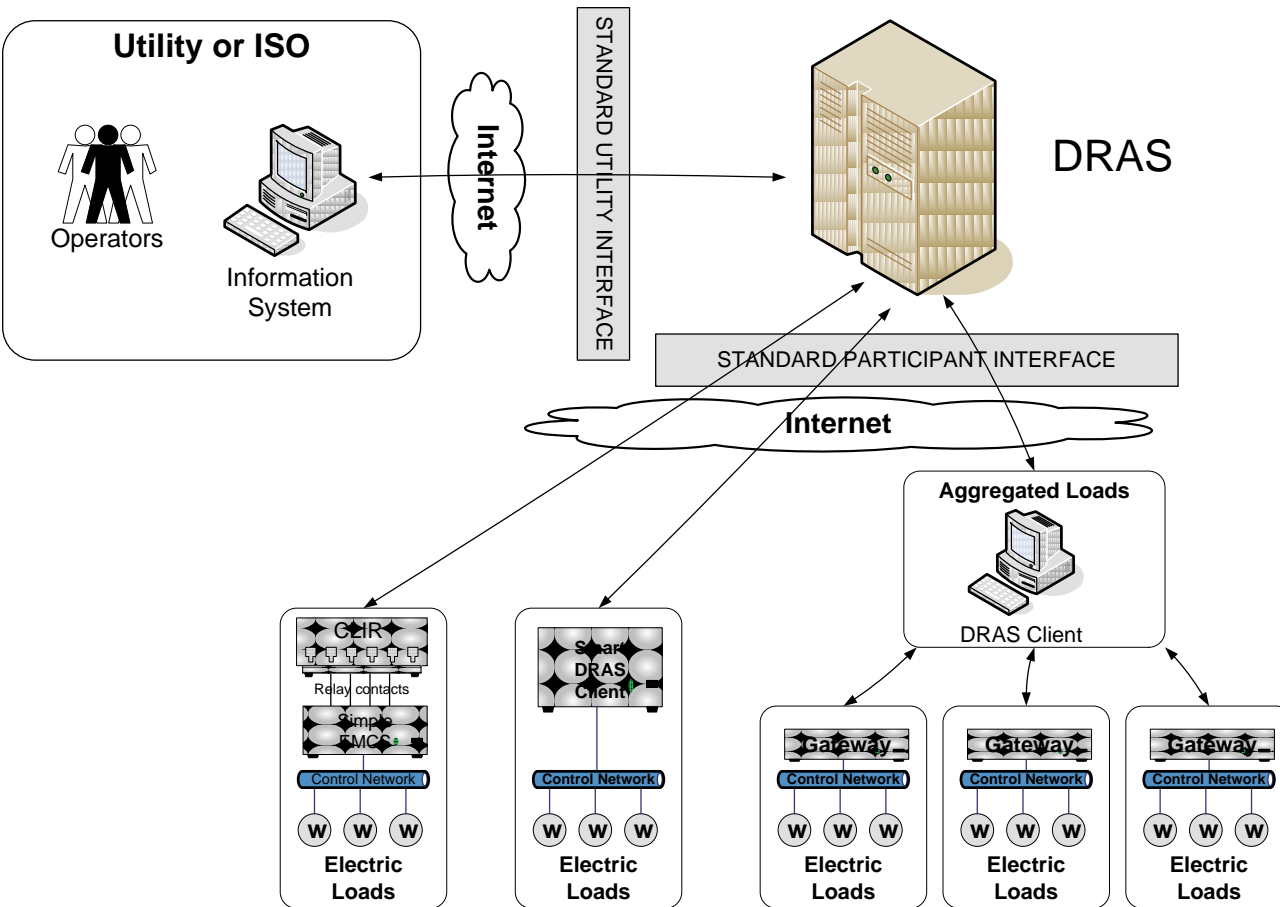
Automated Demand Response

自动需求相应

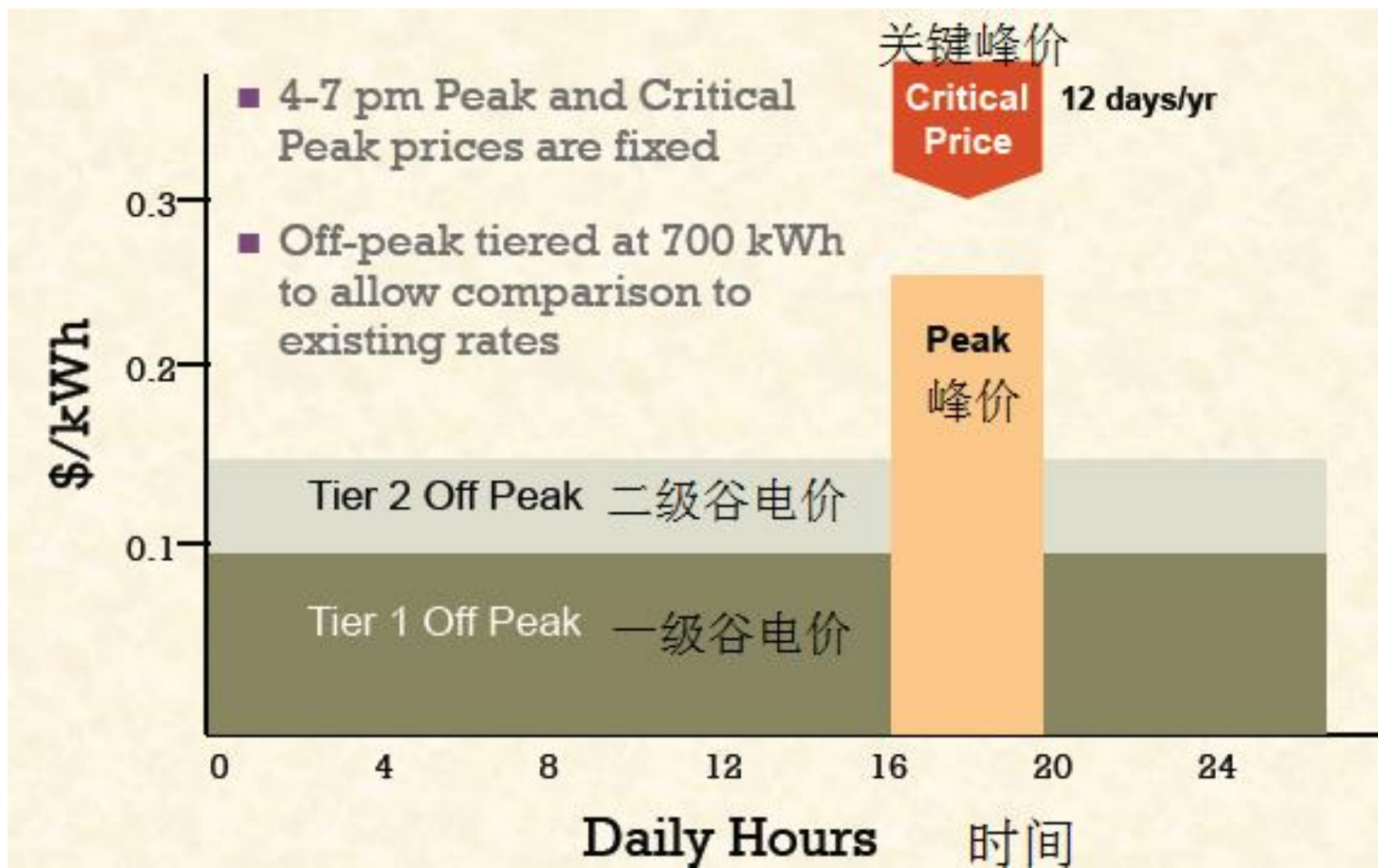
- A DR program that initiates the curtailment strategy without the need for human intervention at the end-user's site. 在用户端无人工参与的需求相应控制方案

DR Enabling Technologies

需求响应技术应用



Pricing Signal 电价信号



Source: Herter Energy

Financial Incentives

奖励补贴



Technology Incentive Specifics by Utility

加州主要电力公司提供的奖励

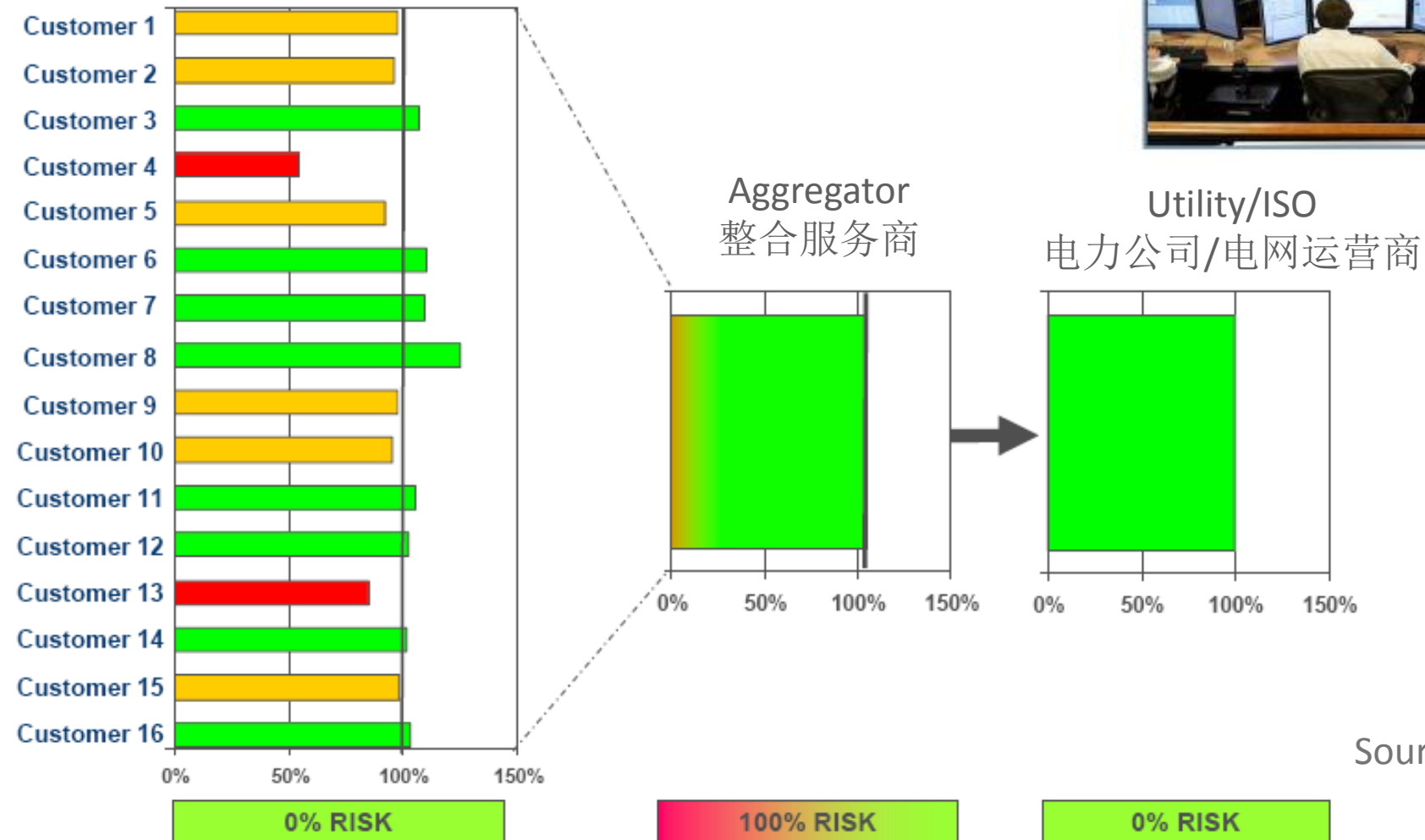
	AutoDR Incentives 需求响应奖励	TA/TI Incentives 技术支持奖励
PG&E	\$250/kW	\$125/kW up to 75% of project costs
SCE	\$300/kW	\$125/kW up to 100% of project costs*
SDG&E	\$300/kW	\$125/kW up to 100% of project costs

DR Aggregation and Aggregators

需求响应打包整合及整合服务商



Match utility/system needs with customer capabilities
调剂余缺使系统的需要和用户的用电达到匹配



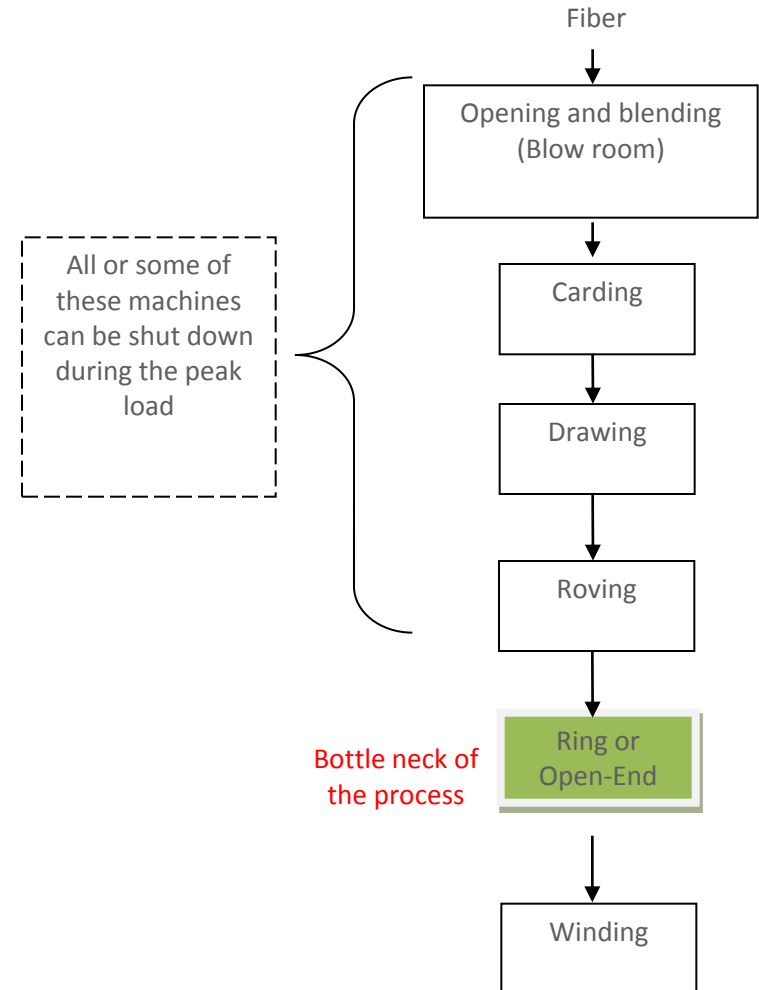
Source: EnerNoc

DR Practices in Industrial Sector

需求响应在工业部门的实践



- Wastewater treatment 污水处理
- Refrigerated warehouse 冷冻
- Food processing 食品加工
- Textile 纺织
- Data center 数据中心



- Capacity Market Programs:
customer load curtailments offered as system capacity to replace conventional resources. Customers typically receive day-of notice of events and face penalties for failure to curtail when called upon.
- Ancillary Services Market Program:
customers bid load curtailments in wholesale markets as operating reserves. If their bids are accepted, they paid the market price for committing to be on standby. If their load curtailments are needed, they are called by operator, and may be paid the spot market energy price.

- 容量市场资源:
用户降低负荷可作为系统容量来与传统供能竞争。若未能按承诺降低负荷将面临罚款
- 辅助服务市场资源:
用户在辅助服务市场将降低负荷作为运行备用容量。一旦其竞标被接受，将做好随时降荷的准备，一旦需要，负荷即刻降下来。参与的用户得到实时电价的支付

Tapping DR Potential in China

对中国的启示及建议



- International experiences show DR could become an effective tool in addressing shortfall
- Proactive DR programs allowing customers to take initiative in response to market signals, spurring customer interests than reactive load curtailment
- Make load control program a strategic, dispatchable resource alternative to traditional supply options
- Policy barriers need to be removed for greater DR opportunities
- DR application should be integrated into the country's smart-grid development
- Use open, standardized protocol like OpenADR to allow interoperability among systems and auto DR to enable utilities/ISO to communicate DR signals directly to customers ensuring seamless and reliable response
- Coordination of EE and DR in the country's DSM programs
- Encourage aggregation to scale-up and mitigate the risk of non-performance
- Enhancing existing orderly use of electricity program through innovation

- 国际经验证明需求响应是应解短缺的有效手段
- 通过市场的手段给用户较大的自主权比被动的以行政手段限电的方法有效
- 需求响应可以成为可调度的资源，补充传统供能的不足
- 需求响应的大力发展需要政策的大力推动
- 需求响应与智能电网的发展紧密结合
- 开发类似Open ADR的开放性标准规范促进系统的兼容性以及Auto DR增加用户响应的可靠性
- DSM项目应将能效和需求响应两者高度协调，以达到最大效果
- 鼓励需求响应项目打包，以扩大市场规模和减少未响应风险
- 有序用电进行创新

谢谢! Thank you!

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