

# What are the contributions of Demand Side Management for balancing power systems?

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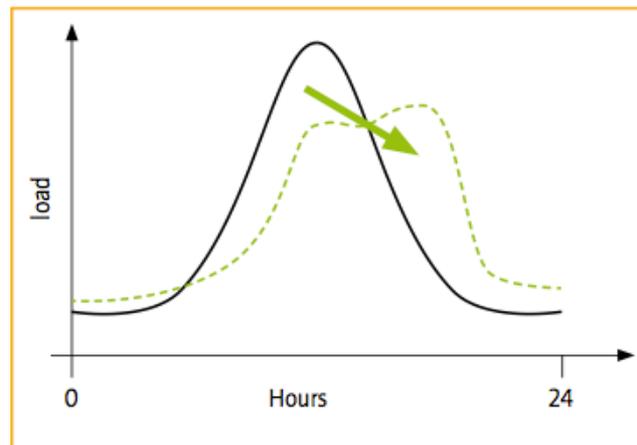
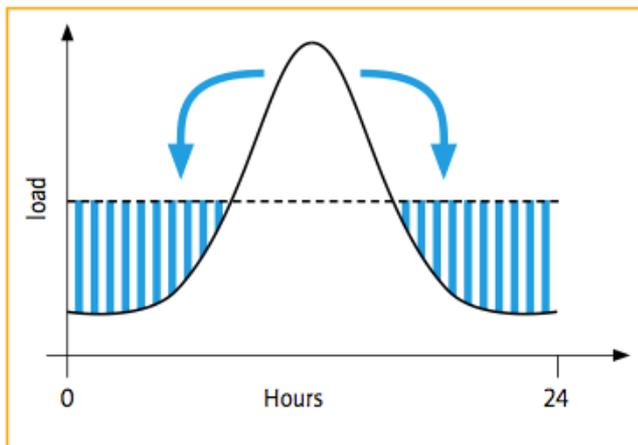


# Introduction

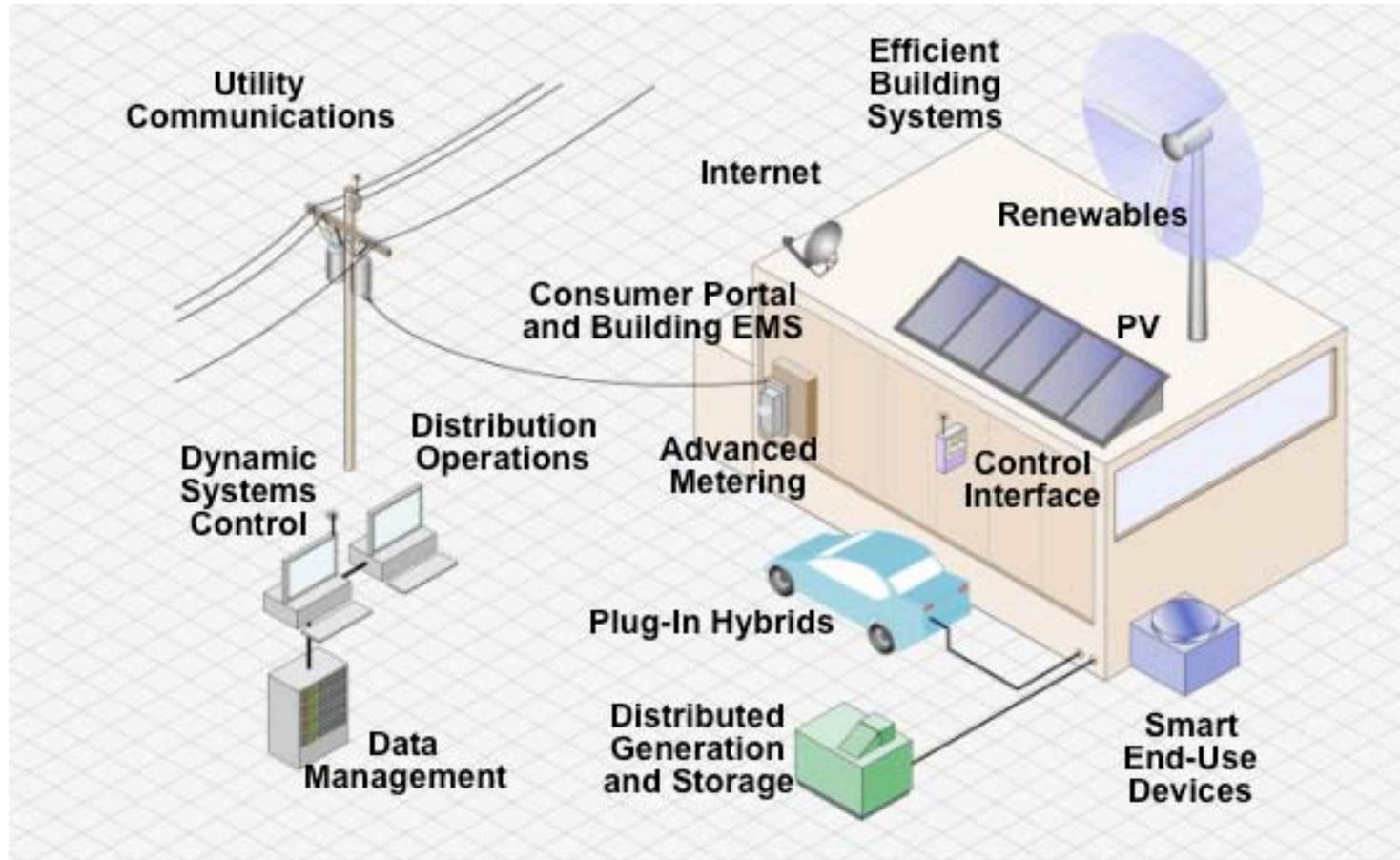
- The interest in Demand Side Management (DSM) has increased in recent years because of:
  - Higher costs in generation and network activities
    - CO2 emissions and fuel costs, social rejection against building new plants and infrastructure “NIMBY”
  - Restructured electricity systems provide adequate price signals for introduction of DSM services
  - DSM potential ability to address challenges related to renewable integration
    - Providing flexibility for responding to intermittency of renewables generation

# Demand Side Management

- Demand would not be static or uncontrollable anymore; rather it is enabled to respond to price signals or to other indicators (frequency control) reflecting the current load on the electricity system
- So far, the response of the demand side has mostly focused on large consumers in the industrial and commercial sector.
- In the domestic sector, the most common measure of controlling demand is to curtail or to shift thermal loads such as electric storage heating systems or electric storage water heaters
- Though, domestic appliances and electric vehicles can also offer a range of options for load-shifting
- There is a new paradigm of flexible electricity demand



# DSM as a part of the new vision



# Questions about DSM

- Despite current interest and research, still many unaddressed questions remain
  - Technical issues
  - Market issues
    1. Which services of DSM can be introduced into power markets?
    2. What will be the market value of DSM services?
  - Regulatory issues

# Aim of this presentation

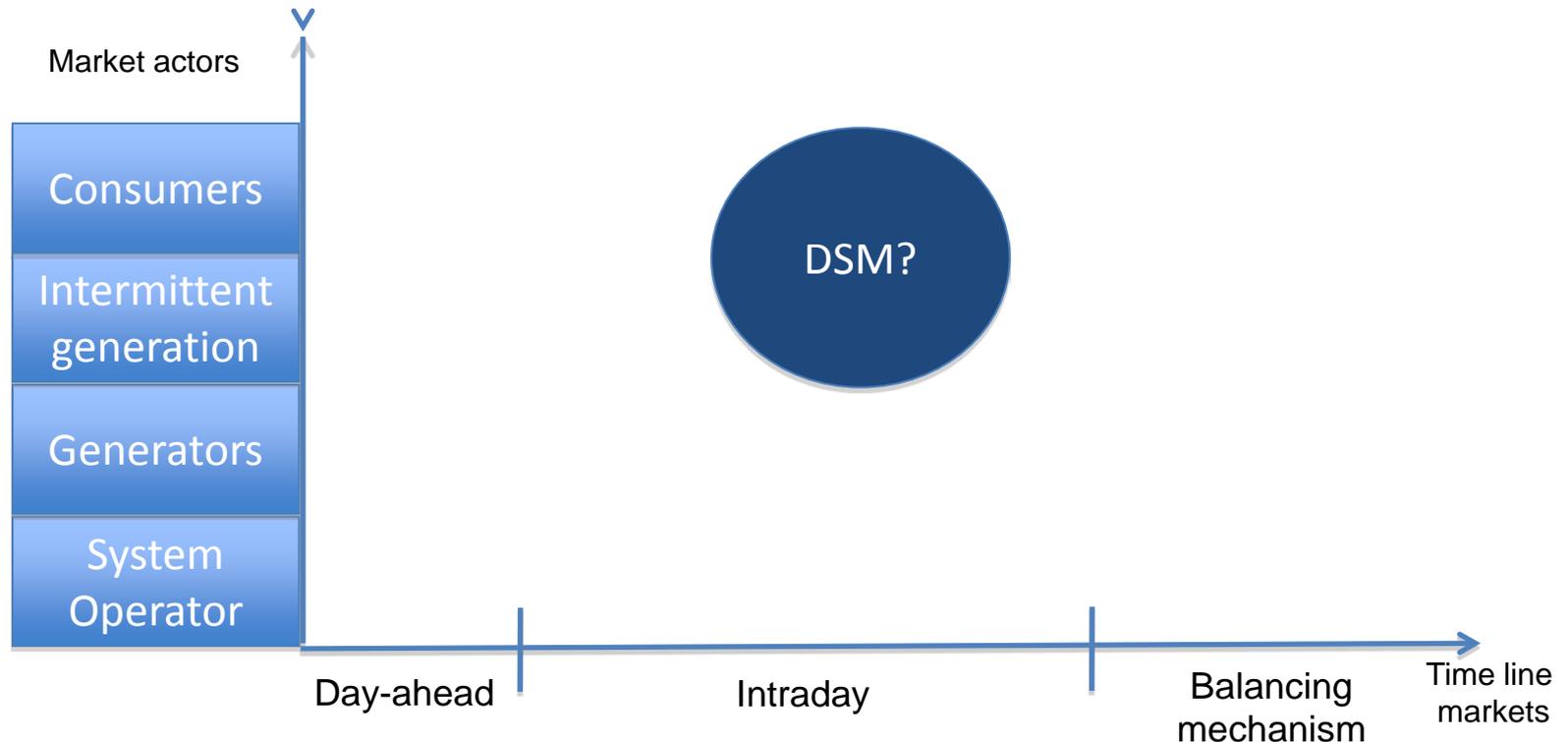
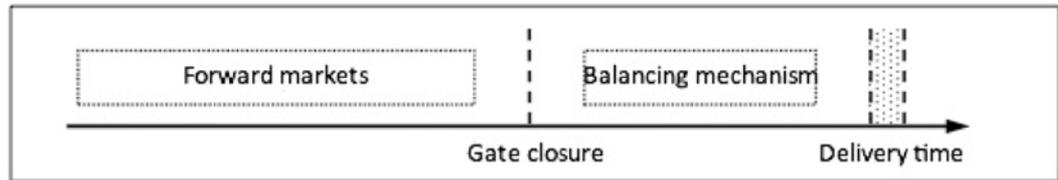
- To present the state of the art of DSM for providing balancing services in power markets
- At the end of this paper, you will have a clear idea of the key points for further research

# Methodology

1. Identification of key points for analysis
2. State of the art of preceding research and evaluation of research holes
  - Little research on DSM providing balancing services, therefore we complement the analysis with related research
3. Discussion of results from step 2

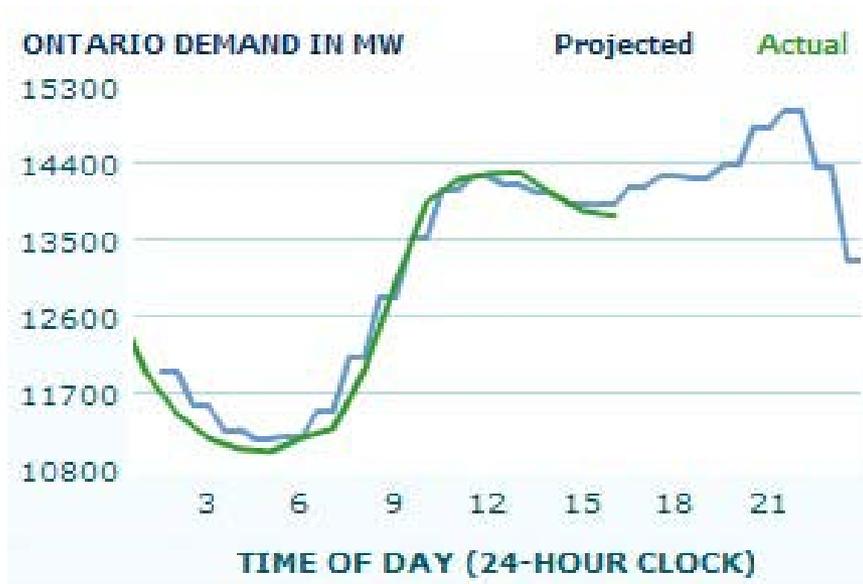
# Market Framework

- DSM market actors: SO, Generators, Intermittent generation, Consumers
- Power market: Modular analysis of power markets
  - Day-ahead
  - Intraday
  - Balancing mechanism
- DSM, when, to whom and at what value?

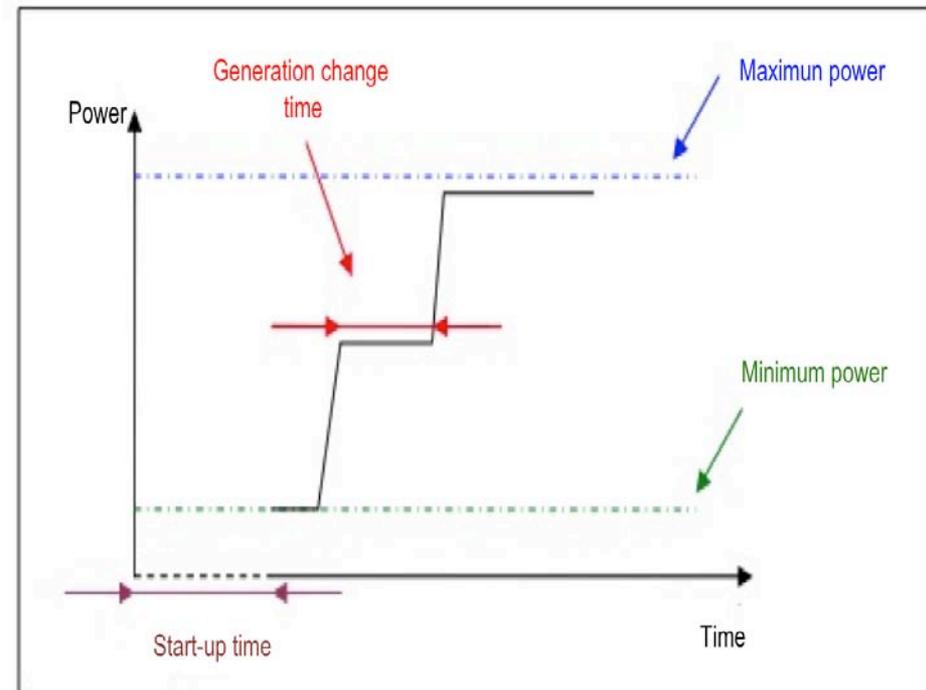


# Physical framework

- Equilibrium between generation and load at all times
- Consumption and Intermittent generation are the net load, which varies and is uncertain
- Conventional generation follows the net load have static and dynamic constraints. Moreover, generators can fail



Example variation and uncertainty net load



Generators constraints

# Analysis Framework Table

Power System													
Physical System						Power market							
Generators		Intermittent Generation		Consumption		Market Actors				Market design			
Static & Dynamic limits	Outages & failures	Variability	Uncertainty	Variability Uncertainty	DSM	SO	G	IG	C	Forward markets		Balancing Mechanism	
										Day-ahead	Intraday	One price	Two prices

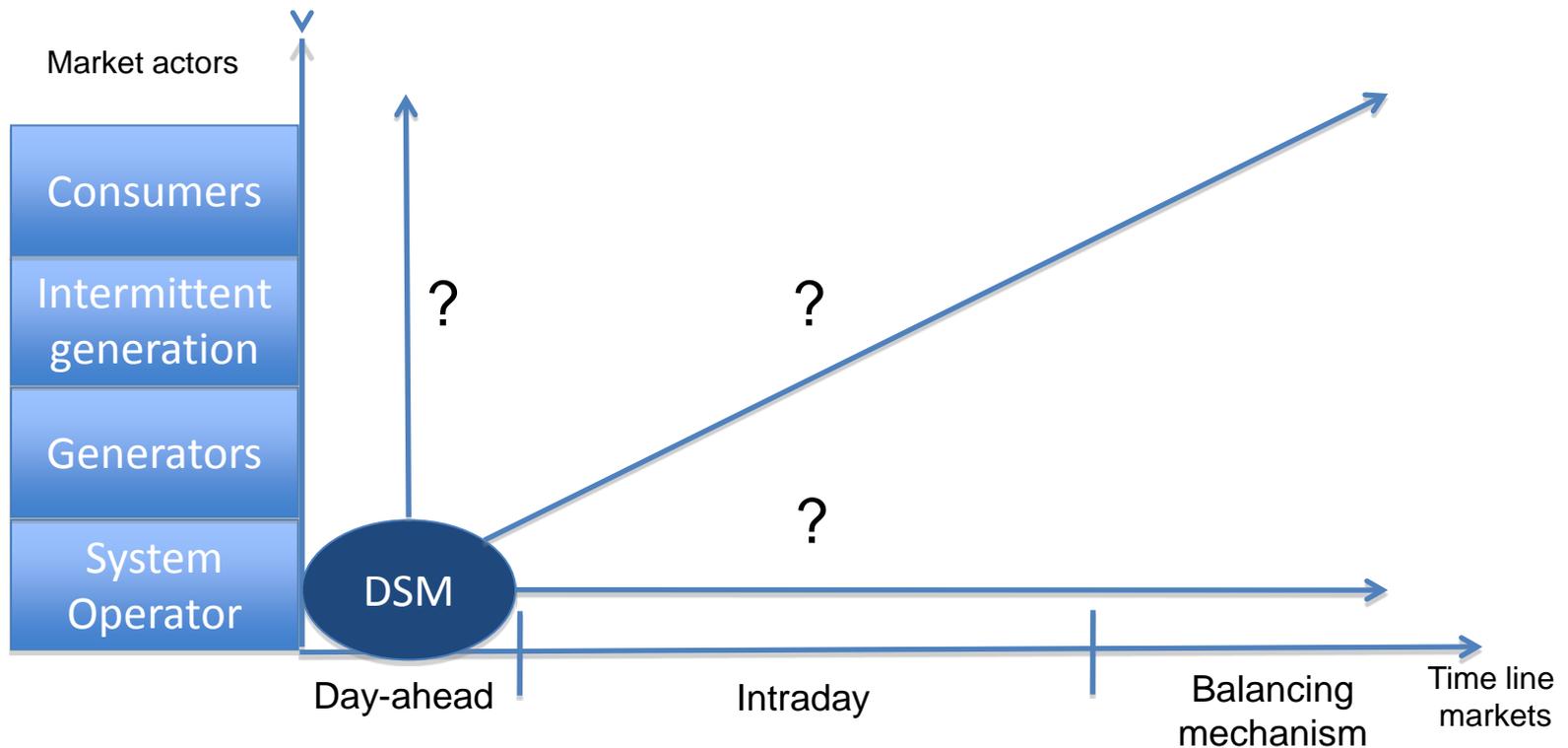
# State of the Art of DSM proving Balancing Services

Studies	Power System									
	Physical System					Power market				
	Generators		Intermittent Generation	Consumption		Market Actors	Market design			
	Static & Dynamic limits	Outages & failures	Variability & Uncertainty	Uncertain variability	DSM		Forward markets		Balancing Mechanism	
							Day-ahead	Intra day	1 price	2 prices
Holttilen (2008)	✘	✘	✘	✘		No	✘			
Saguan (2007)			✘			Yes		✘	✘	✘
Maupas (2007)	✘		✘	✘		Yes		✘	✘	✘
Doherty et al (2005)		✘	✘	✘		No	✘			
Bouffard et al (2008)			✘	✘		No	✘			
Ortega & Kirschen(2009)			✘	✘		No	✘			
Makarov (2010)	✘	✘	✘	✘		No	✘			
Silva (2009)	✘		✘		✘	No	✘			
Berard (2009)					✘	Yes			✘	

# Discussion

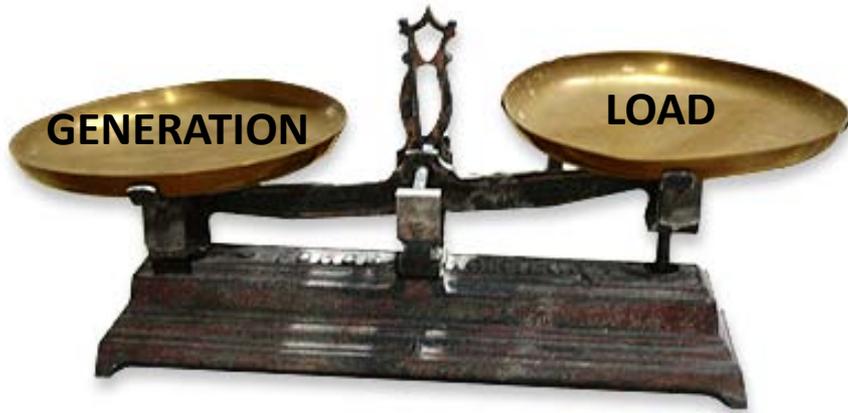
1. No much research considers DSM as a way to balance the system
2. When considered, DSM is dispatched for balancing services at day-ahead time by the system operator
  - If I had the chance in market design...
  - Why would I have to sell my balancing services at day-ahead time?
    - DSM services can be sold in intraday time
  - Why would I have to sell it to the system operator?
    - Other market actors can pay more

# State of the Art of DSM proving Balancing Services: Outcome



# Conclusions

- Our analysis framework points out that preceding research has studied DSM being dispatched for balancing services at day-ahead time by the system operator
- However, DSM should be allowed to provide services to market actors, other than the system operator. Moreover, DSM could take advantage of the time line of markets up to real time
- Therefore, analyzing the provision of DSM services considering the different actors and the market time line in power systems will be the key contributions to subsequent works on this area
- In this sense, the framework developed by Maupas (2007) and Saguan (2007) provides an interesting framework as it considers relations among different actors across the market time line. However, it does not take into consideration DSM



Thank you!  
Questions?

