Improving Generator Flexibility

David Sun
ALSTOM Power
Energy Management Business

ALSTOM

Evolution of Generation Scheduling

ALSTOM

Formation

- Ad-hoc advisory
- UC, EconA/B, HTC
- DP, heuristics

Production

- RTO market-clearing
- SCUC
- LR, LP

Extension

- Smart-grid scheduling
- SCUC+ DR + Storage
- MIP, stochastic

1980 1990 2000 2010

Smart Grid Transforming the Energy Industry

Demand - energy, electricity

Environment – conservation, laws

Technology – power, IT

Choices - end-users, operators

Energy drives business model changes

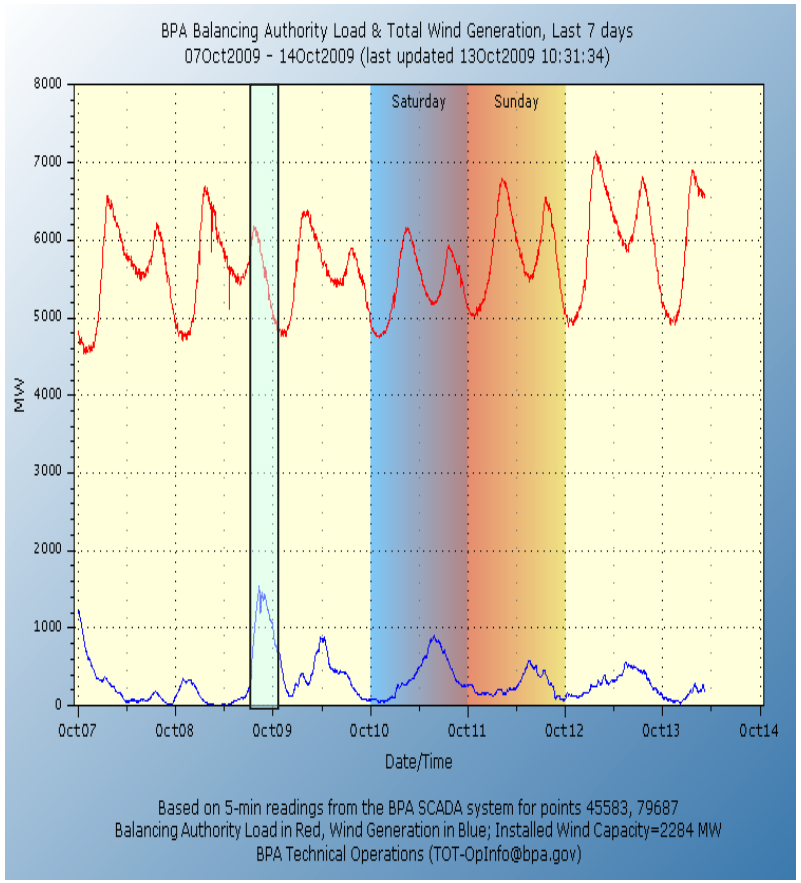
Impacts of Smart Grid Transformation on Energy System Operations

ALSTOM

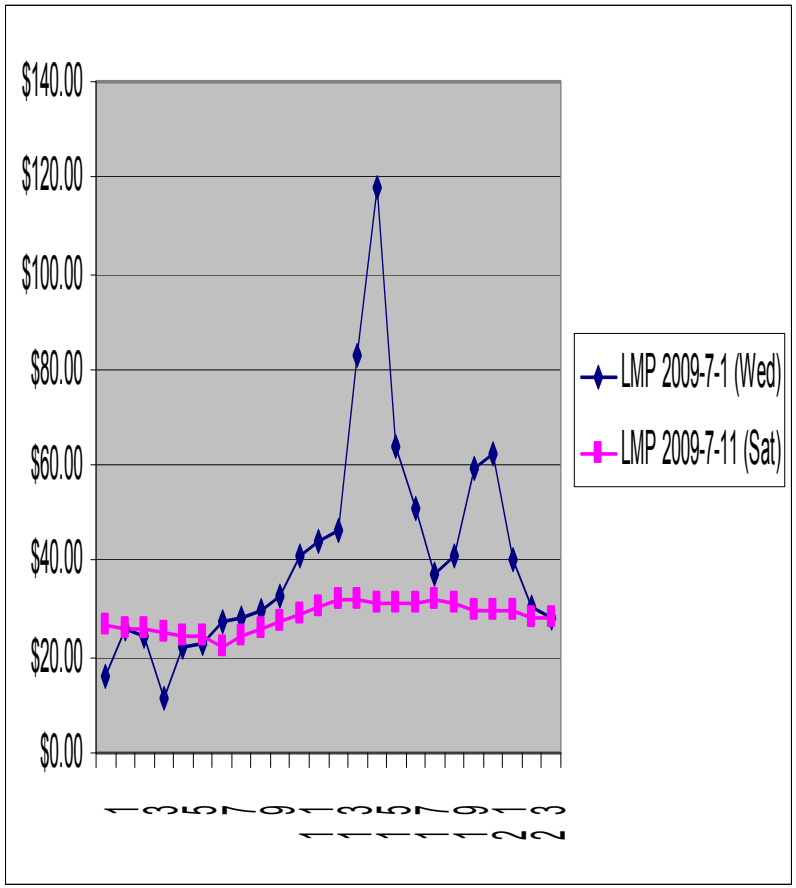
- **Renewable Generation & Demand Response**
  - Intermittent generation with limited forward visibility
  - Implicit, indirect control of stochastic distributed resources
- **Reliability and efficiency mandates**
  - MW & Price volatility
  - Asset portfolio (fleet/plant) optimization
- **Expansion of choices through market mechanisms**
  - Electricity products & services
  - Extending wholesale markets to retail exchanges
- **Asynchronous decisions with distributed intelligence**
  - Challenges in temporal and spatial coordination
  - Business organizational (mis)-alignment

Uncertainty Drives Value for Flexibility

Addressing Uncertainty & Volatility Challenges



Physical (MW)



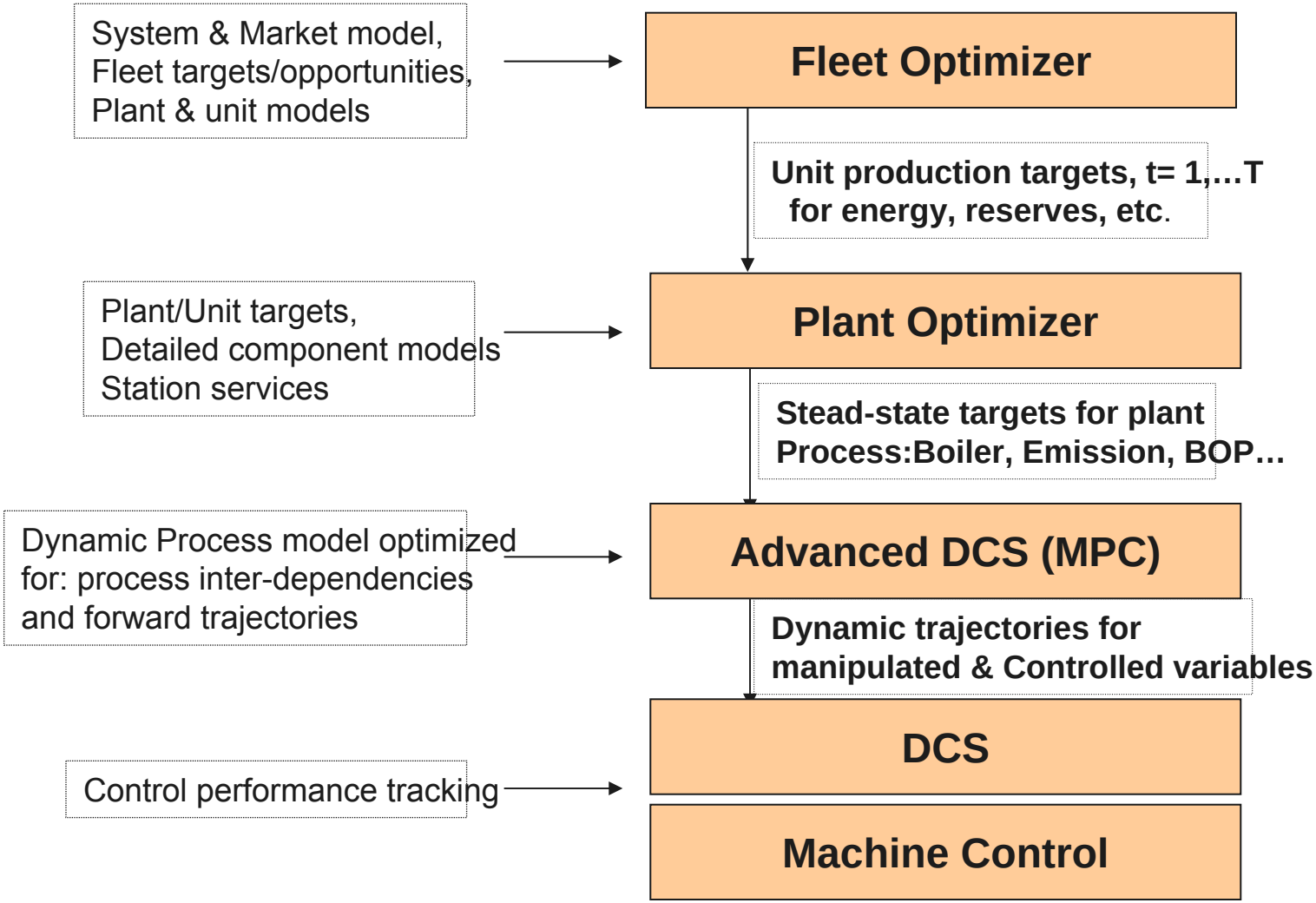
Financial ($)

Resource Flexibility

ALSTOM

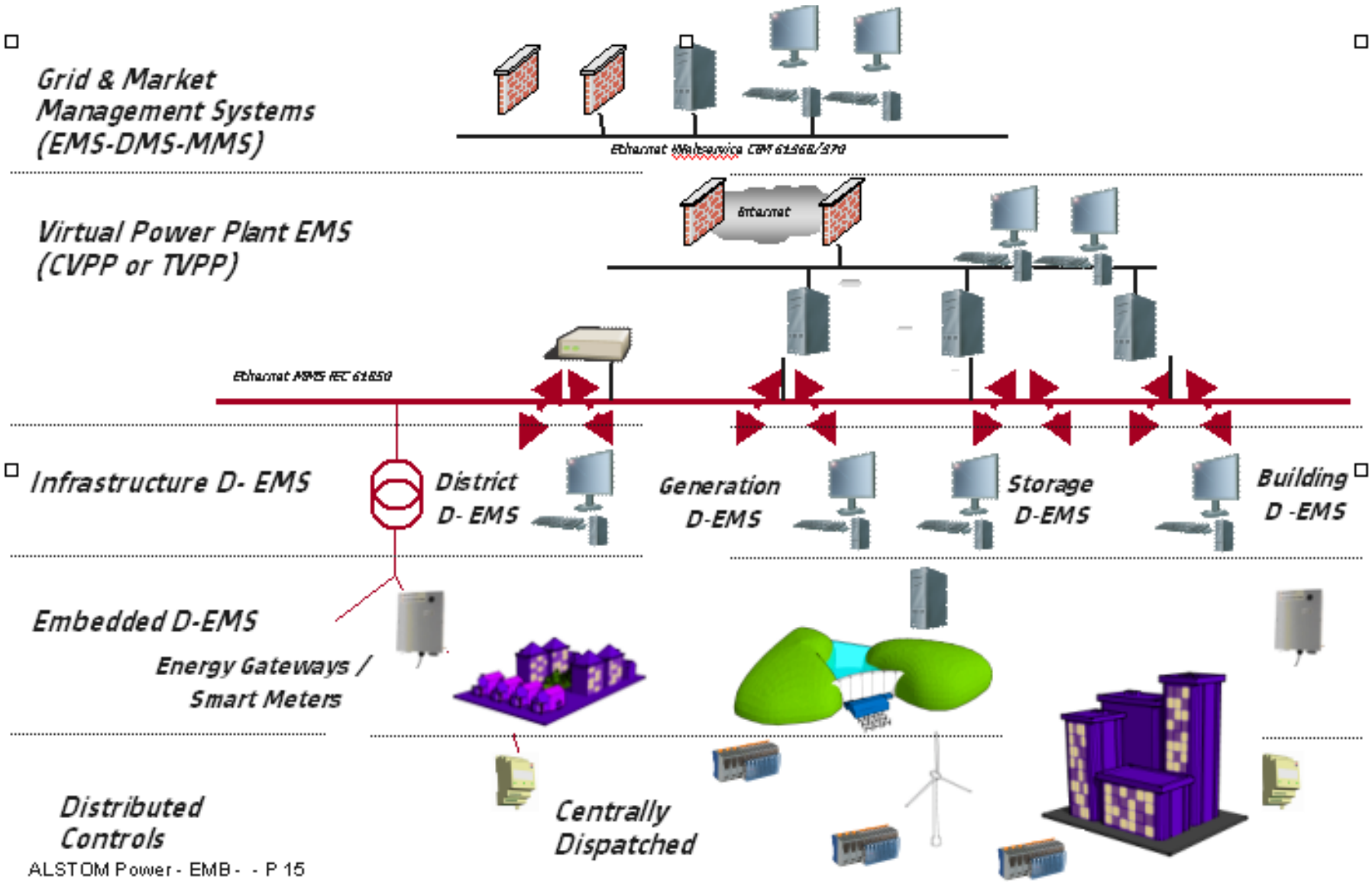
- Model
  - Nominal parameters: notification, commitment, dispatch
  - Life-cycle impact parameters: econ.& physical impacts for exceeding nominal range (e.g. ramping, max/min MW)
- Data
  - Equipment monitoring & diagnostic, performance analysis
  - Life-cycle impact analysis
- Balancing between flexibility and life-cycle impacts
  - Integrated co-optimization
  - Sensitivity information

Multi-Tier Resource Optimization



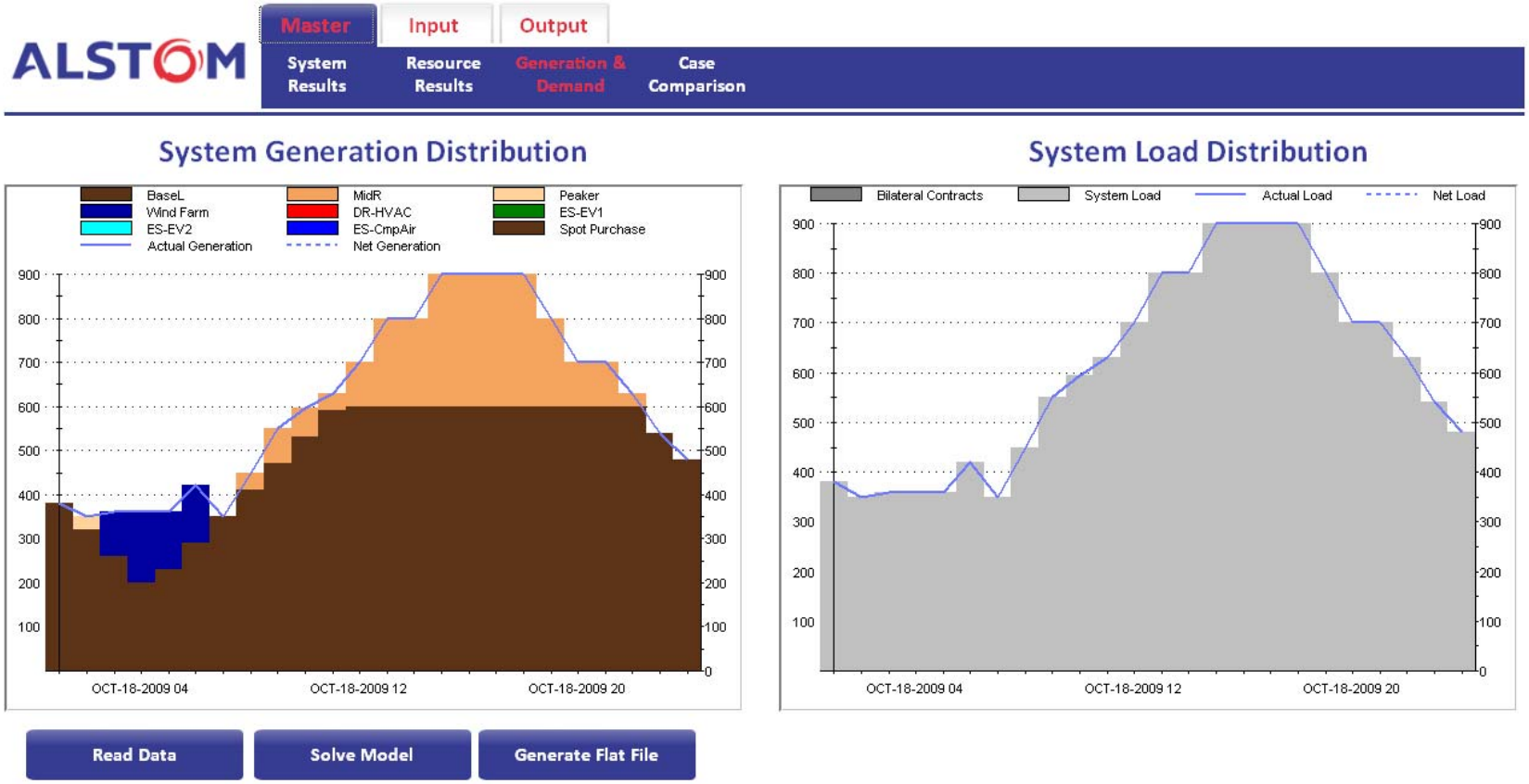
Smart Grid Decision Framework

ALSTOM

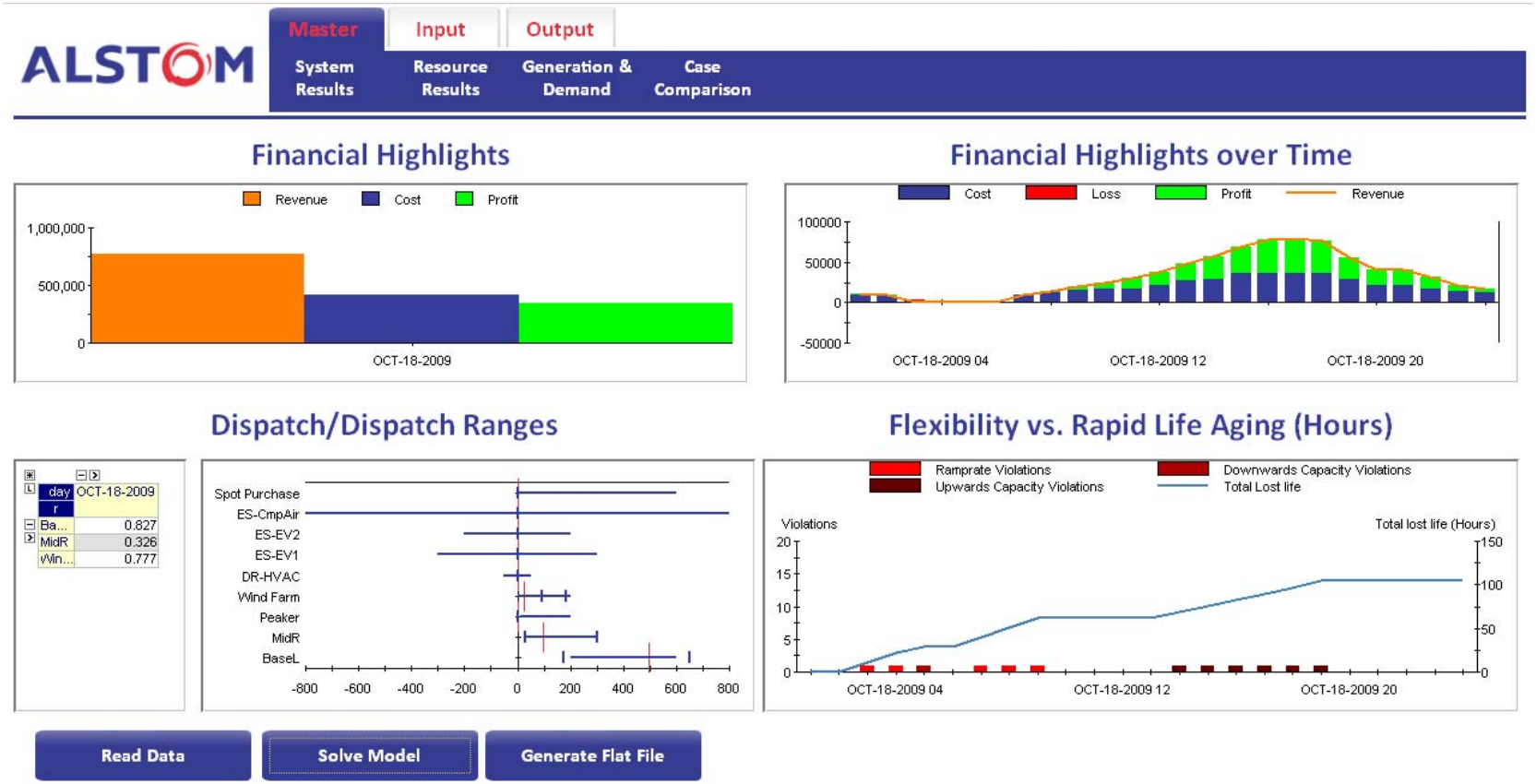


Dashboard –Scenario 1 (Base)

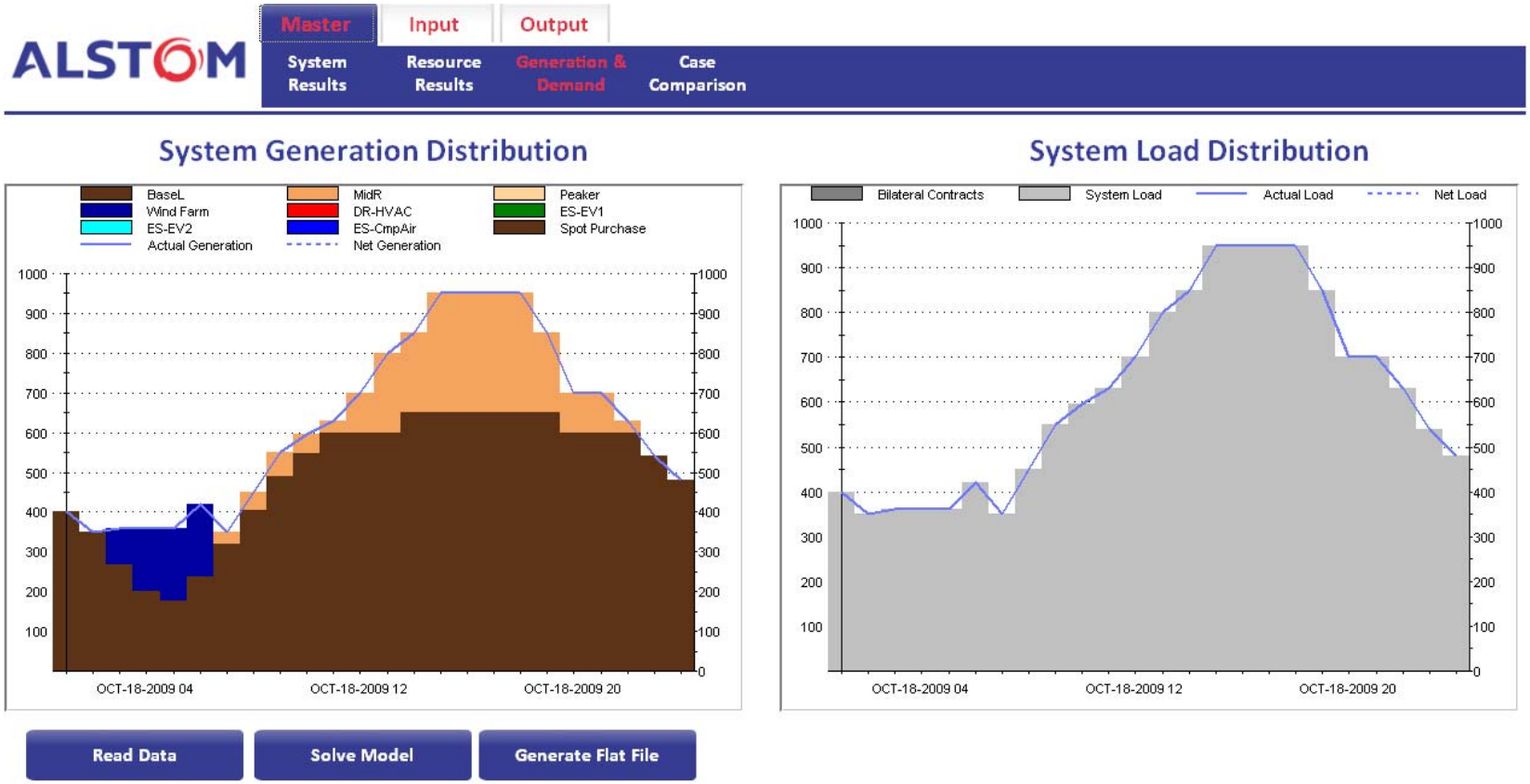
Dashboard –Scenario 1 (Base)

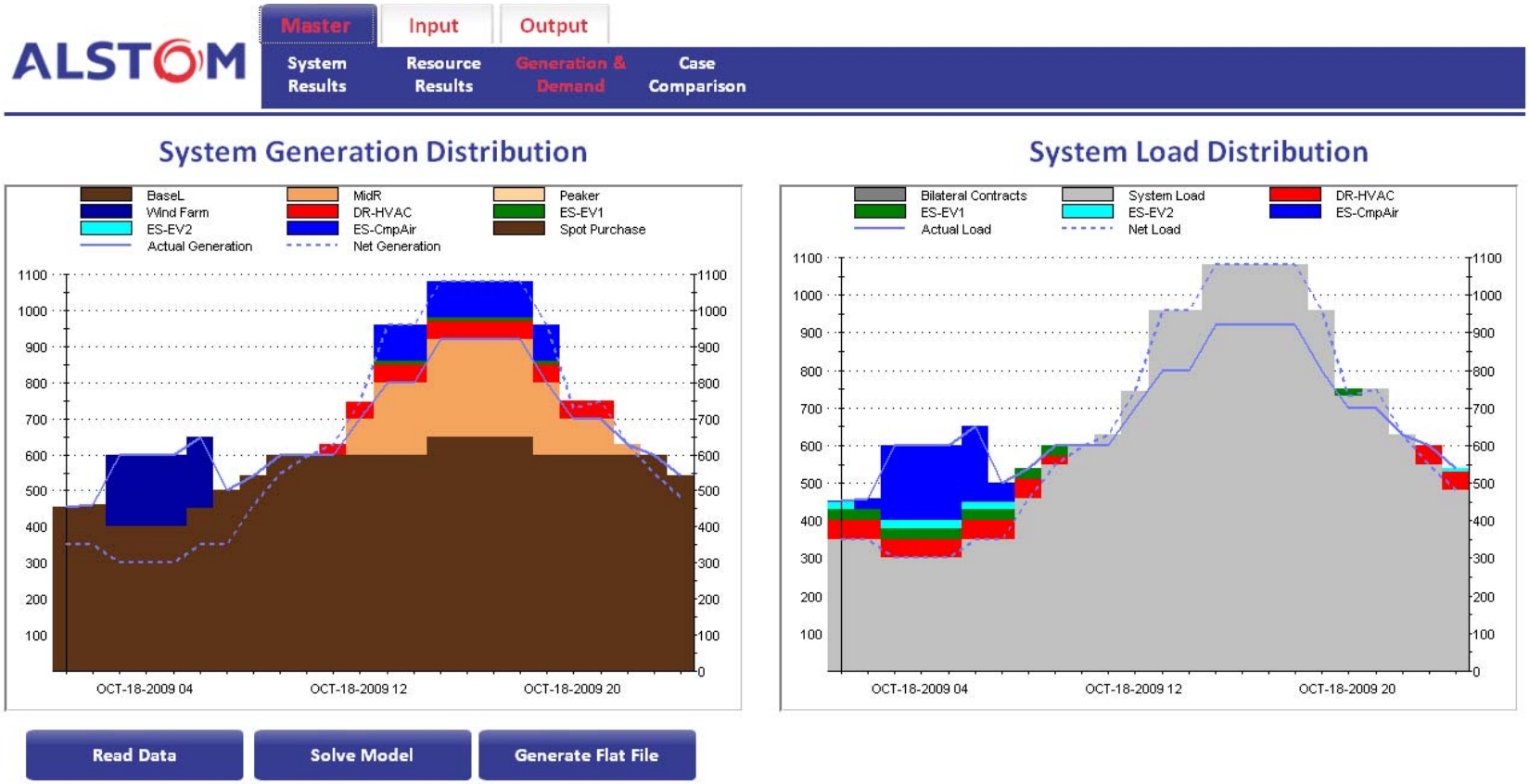


Dashboard –Scenario 1
(Base with flexibility trade-offs)



Dashboard –Scenario 1
(Base with flexibility trade-offs)



Dashboard –Scenario 3 (Base + DR + ES)

Dashboard –Scenario 3 (Base + DR + ES)