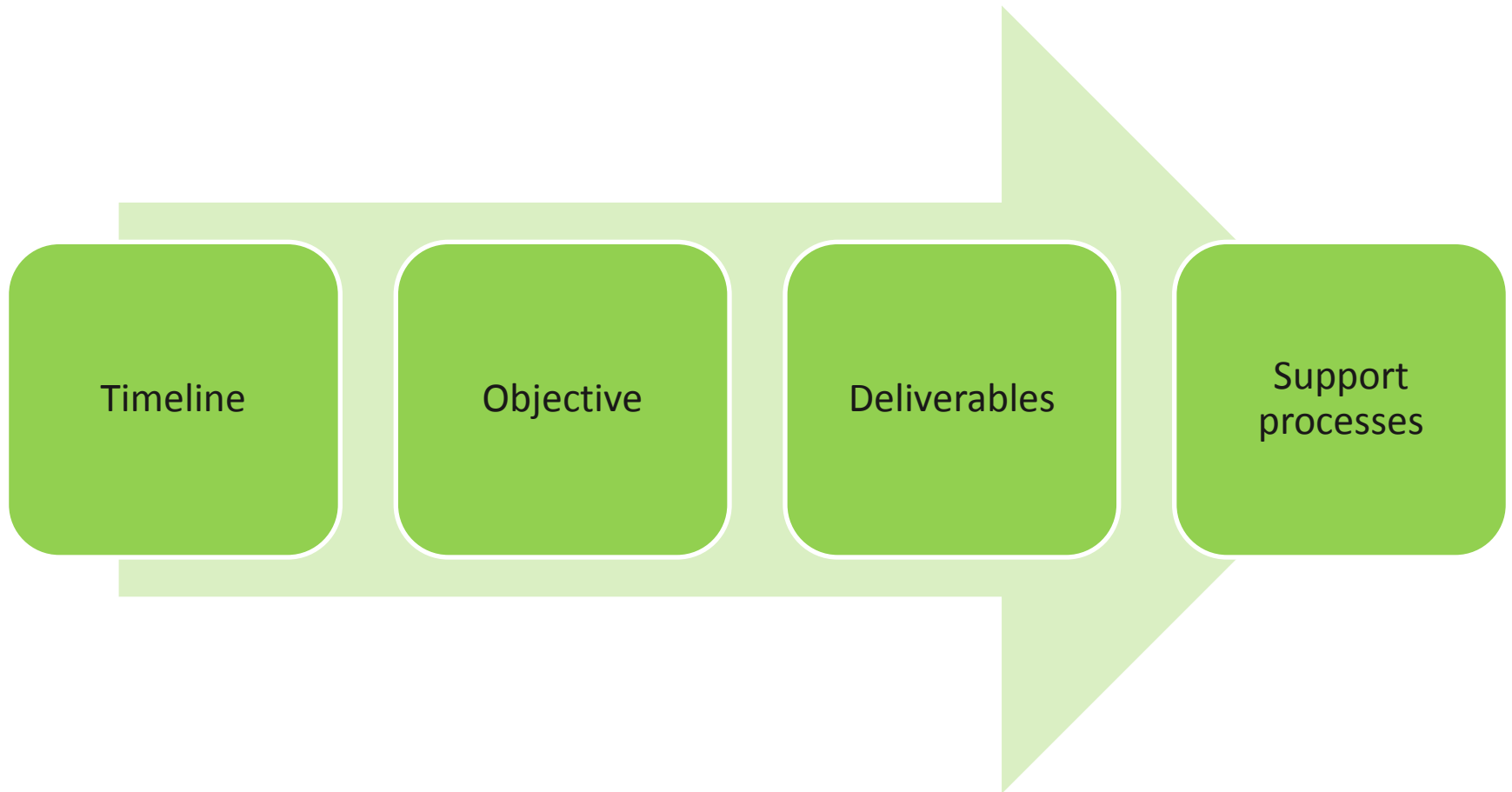


Forecast & Scheduling

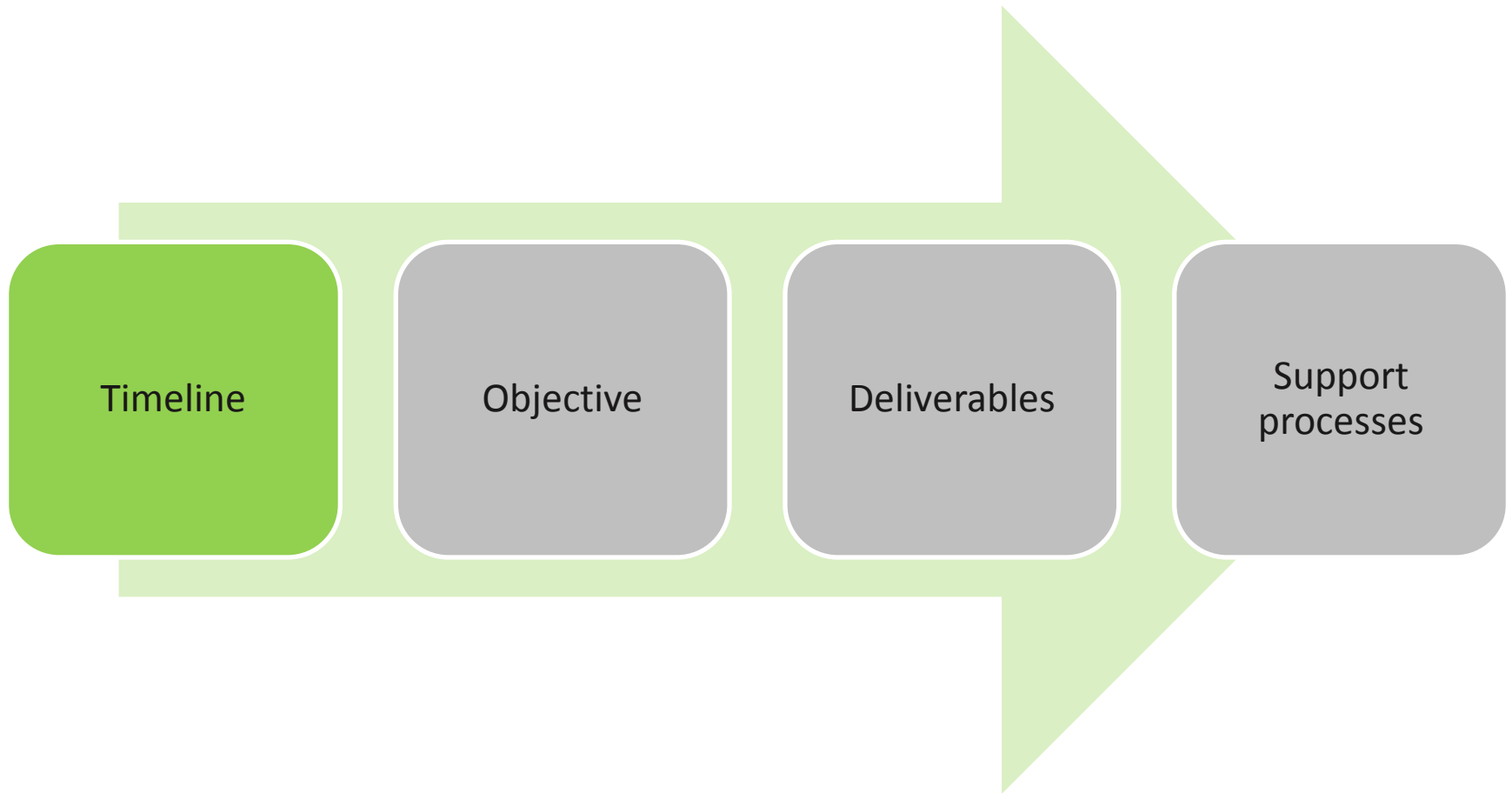
Reserve Adequacy Assessment (RAA)

Tom Dandeneau, Forecaster
Operations

Topics Covered in this Module

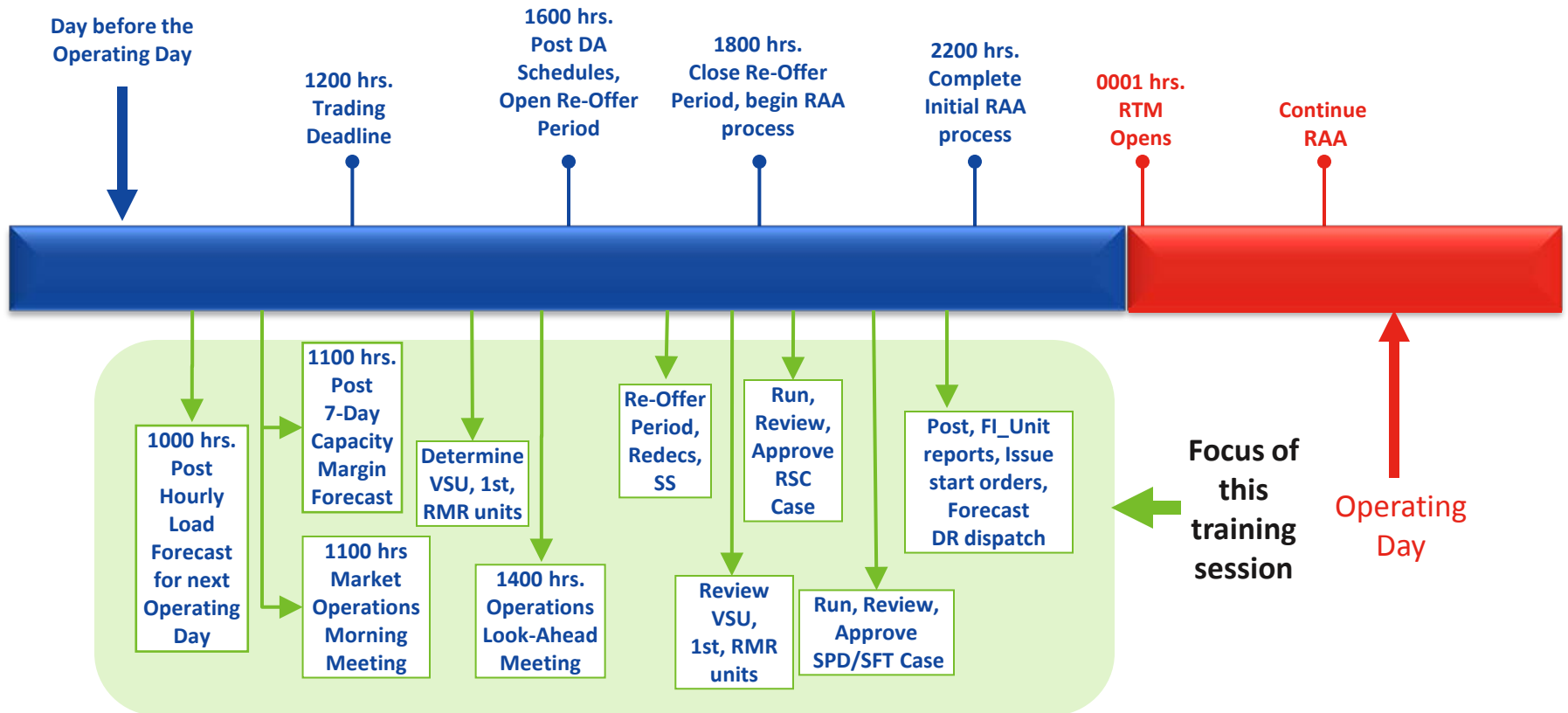


Topics Covered in this Module

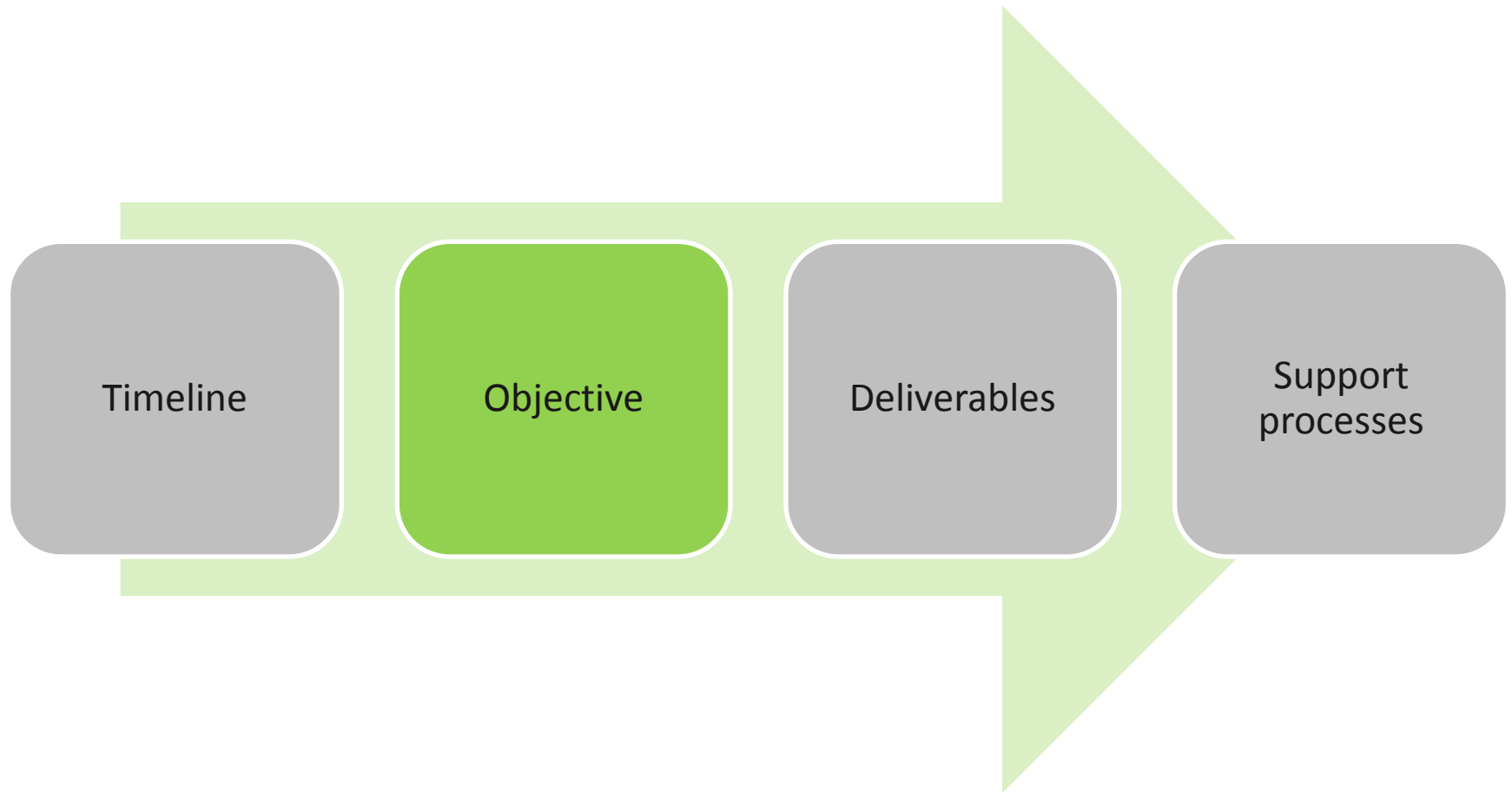


Timeline

Day-Ahead (DA) and Reserve Adequacy Analysis (RAA) Processes



Topics Covered in this Module



Objective



Financial Market



RAA Process

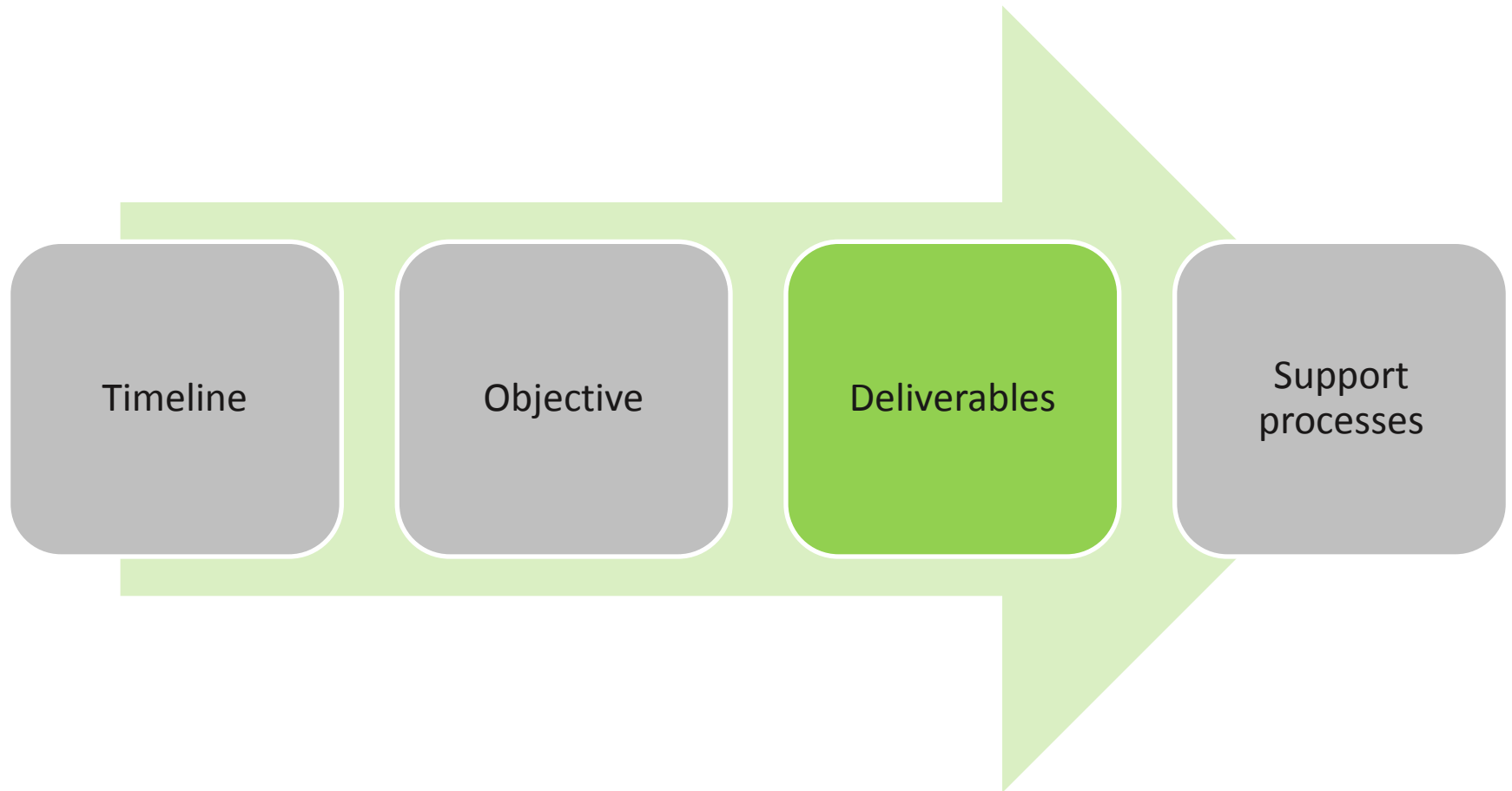


**Reliable Production
of Electricity**

Objective (cont.)

- Ensure sufficient capacity available to meet the ISO-NE Real-Time (RT) demand, reserve requirements, and regulation requirements
 - If sufficient capacity is scheduled in the Day-Ahead Market (DAM), and all system and local area requirements are satisfied, no additional capacity will be scheduled by ISO-NE.
 - If insufficient capacity is scheduled in the DAM, ISO-NE will commit internal generators to meet ISO-NE system and/or local area requirements:
 - The objective is to minimize the cost of bringing the capacity to the Market (Minimize the combined start-up, no load, and energy cost to operate at Eco Min). This could be for one or multiple units.

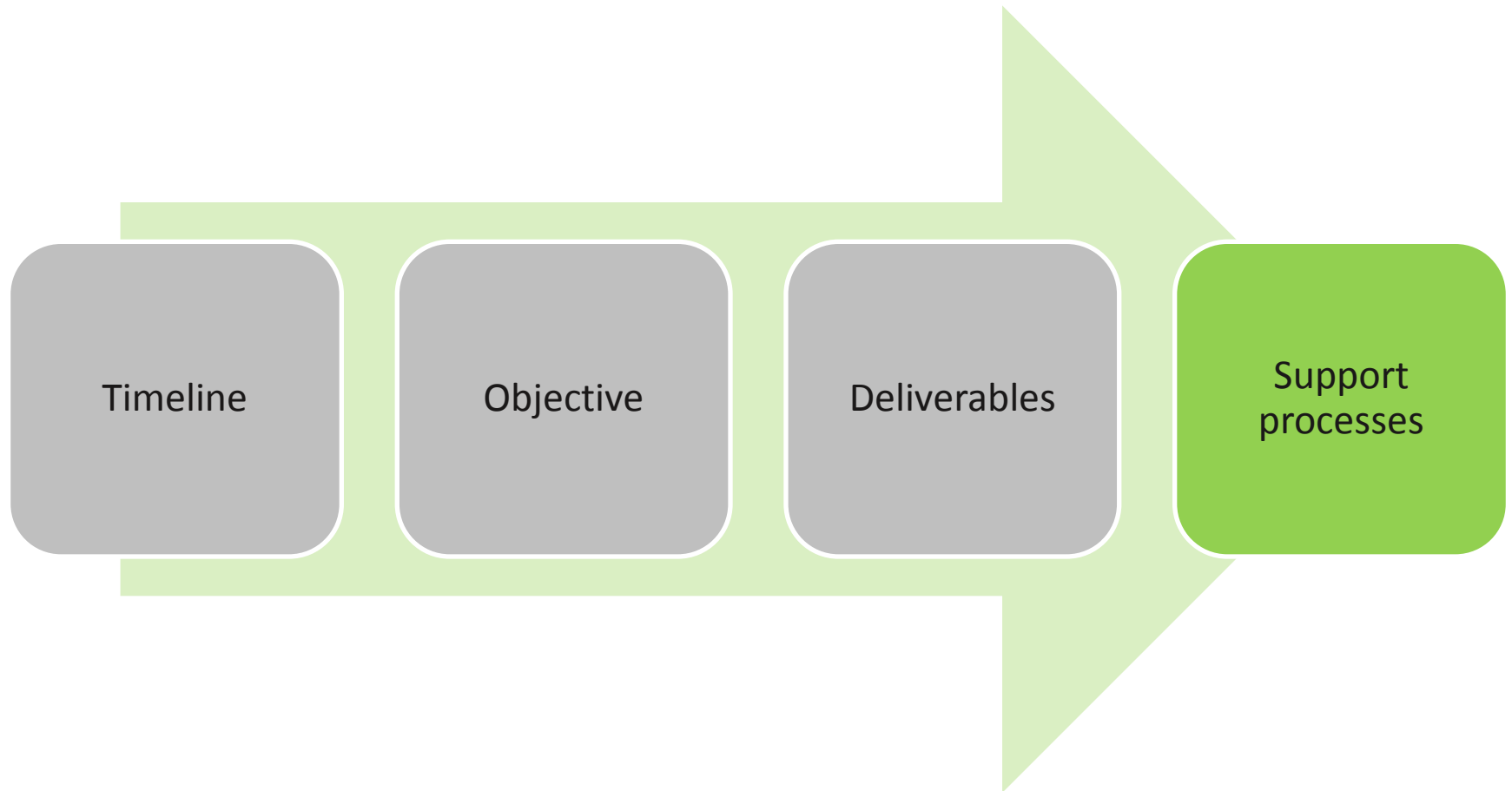
Topics Covered in this Module



Deliverables

- Forecast System Demand of ISO-NE hourly demand for current and next 2 days by 10:00 (ISO-NE.com)
 - Periodic Updates (400 MW deviation threshold)
- Seven Day Forecast of ISO-NE Capacity Margin by 11:00 (ISO-NE.com)
- Forecast Information Reports (FI) – Specific unit reports for non-Fast Start units with each RAA update. Notify long lead time units of start-up times.
 - Initial RAA published by 22:00 for next Operating Day
 - RAA updates of the current operating day are published periodically throughout the operating day (01:00, 05:00, 08:00, 12:00,17:00)

Topics Covered in this Module



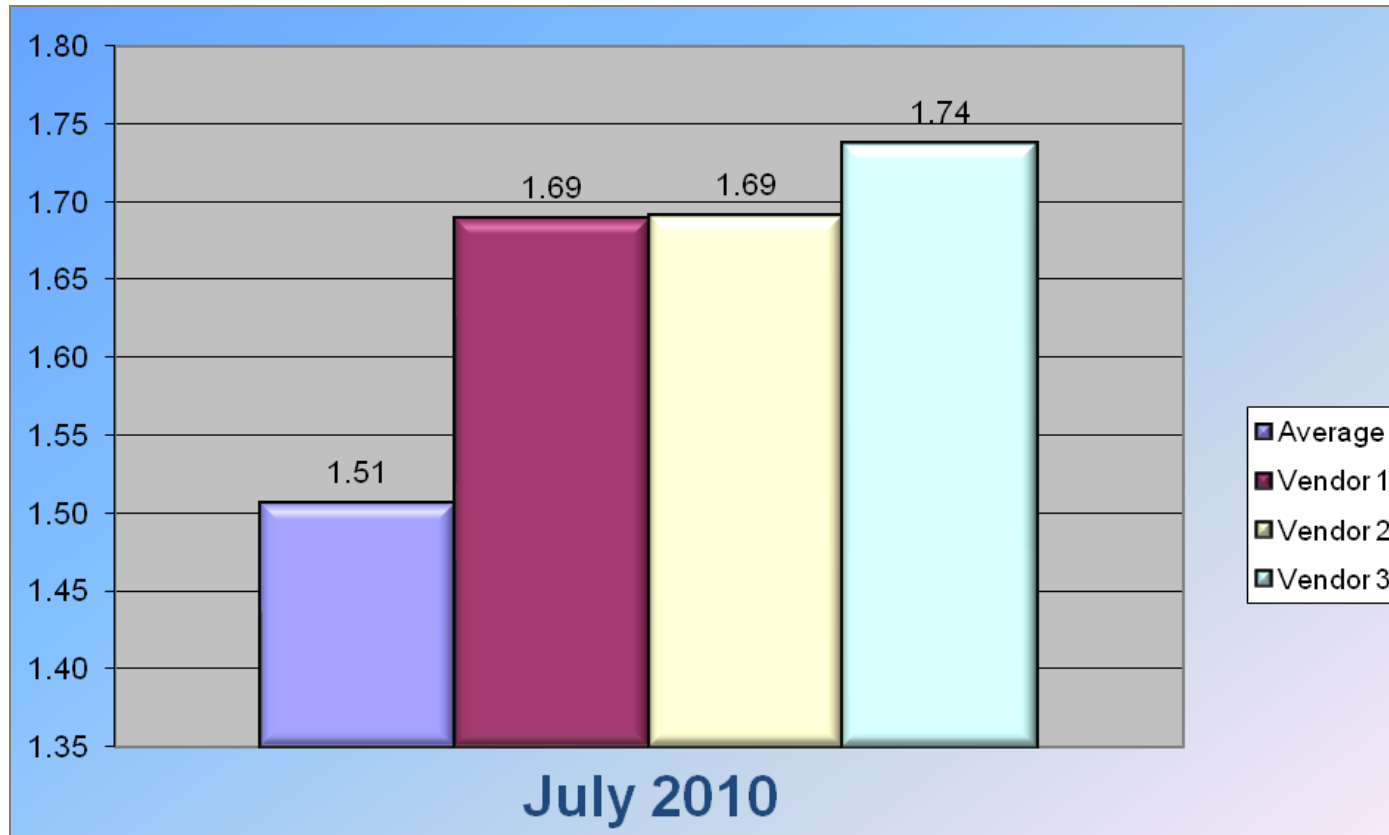
Development of Weather Forecast



- ISO-NE utilizes three weather forecast vendors
- Inputs:
 - Hourly Temperature, Dew Point, Wind Speed & Direction, Cloud Cover, and Precipitation for eight New England cities for the current day and next six days.
 - Boston, Worcester, Hartford, Bridgeport, Concord, Portland, Burlington, and Providence
 - Each vendor's multiple city forecast is aggregated into a New England forecast via fixed city load weights.
 - Multiple vendors' New England forecasts are aggregated into a single ISO-NE forecast via user-entered weights.

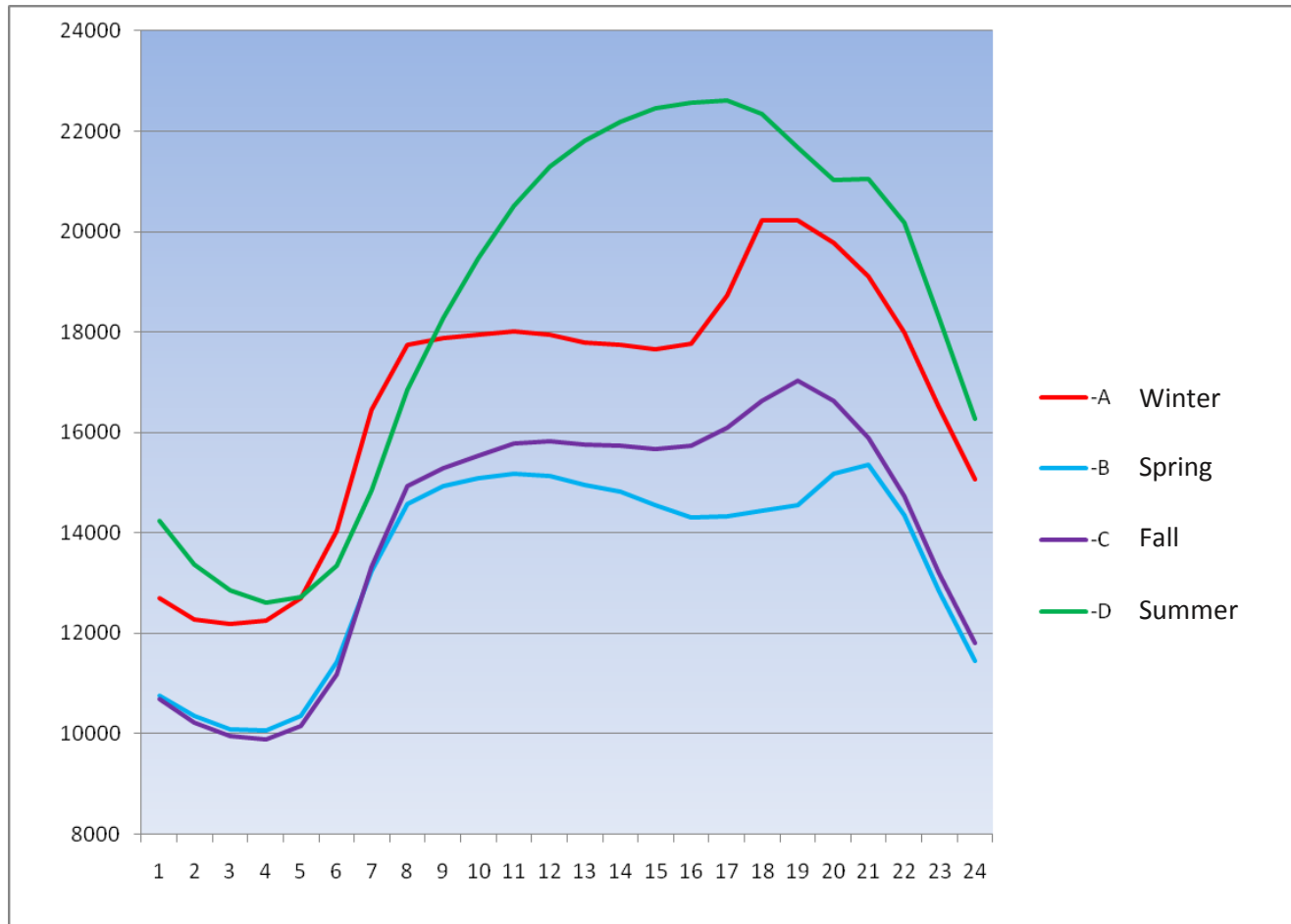
Comparison of Weather Services Errors

Average Forecast Dewpoint Error



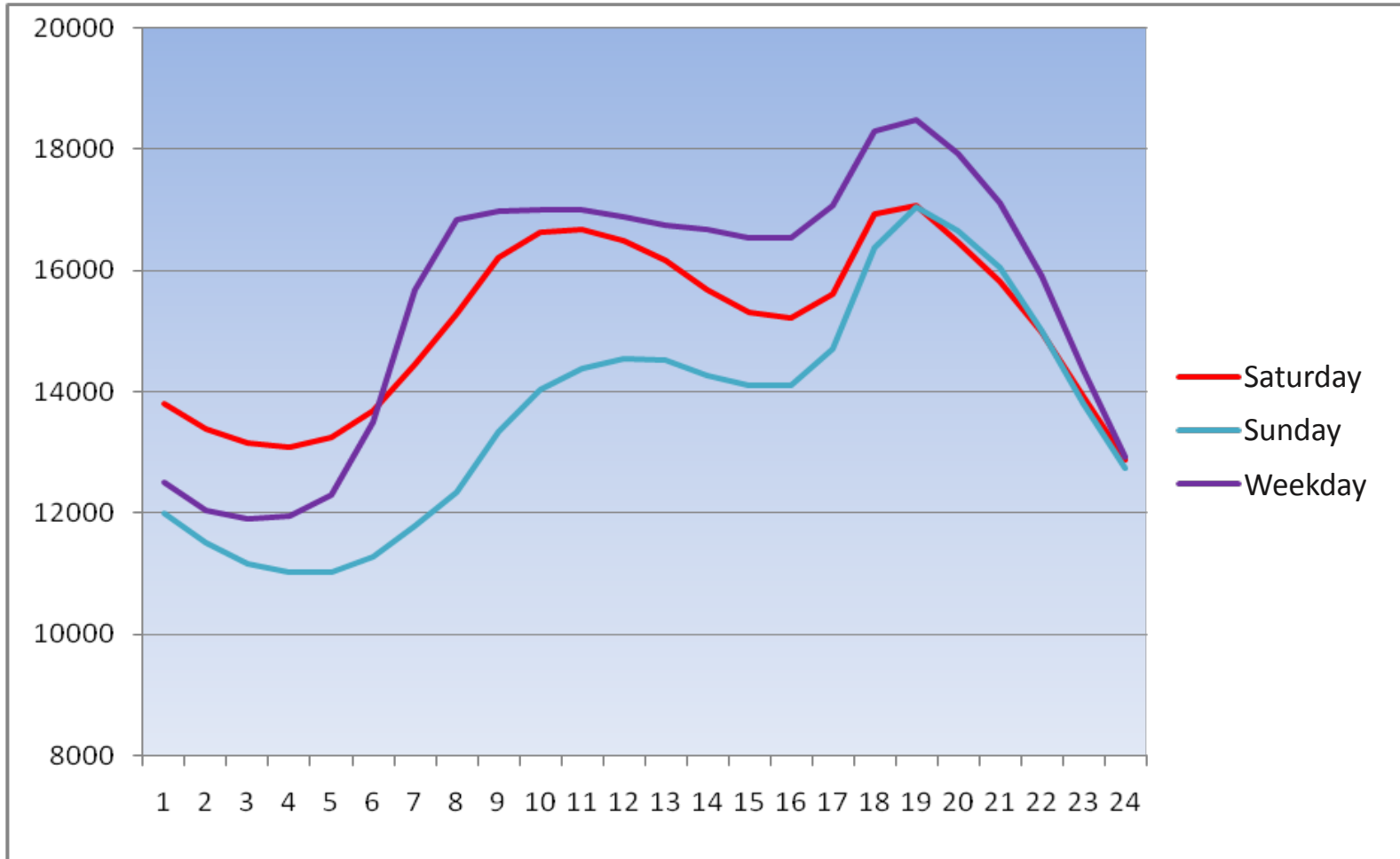
Develop Demand Forecast

Seasonal Load Curves



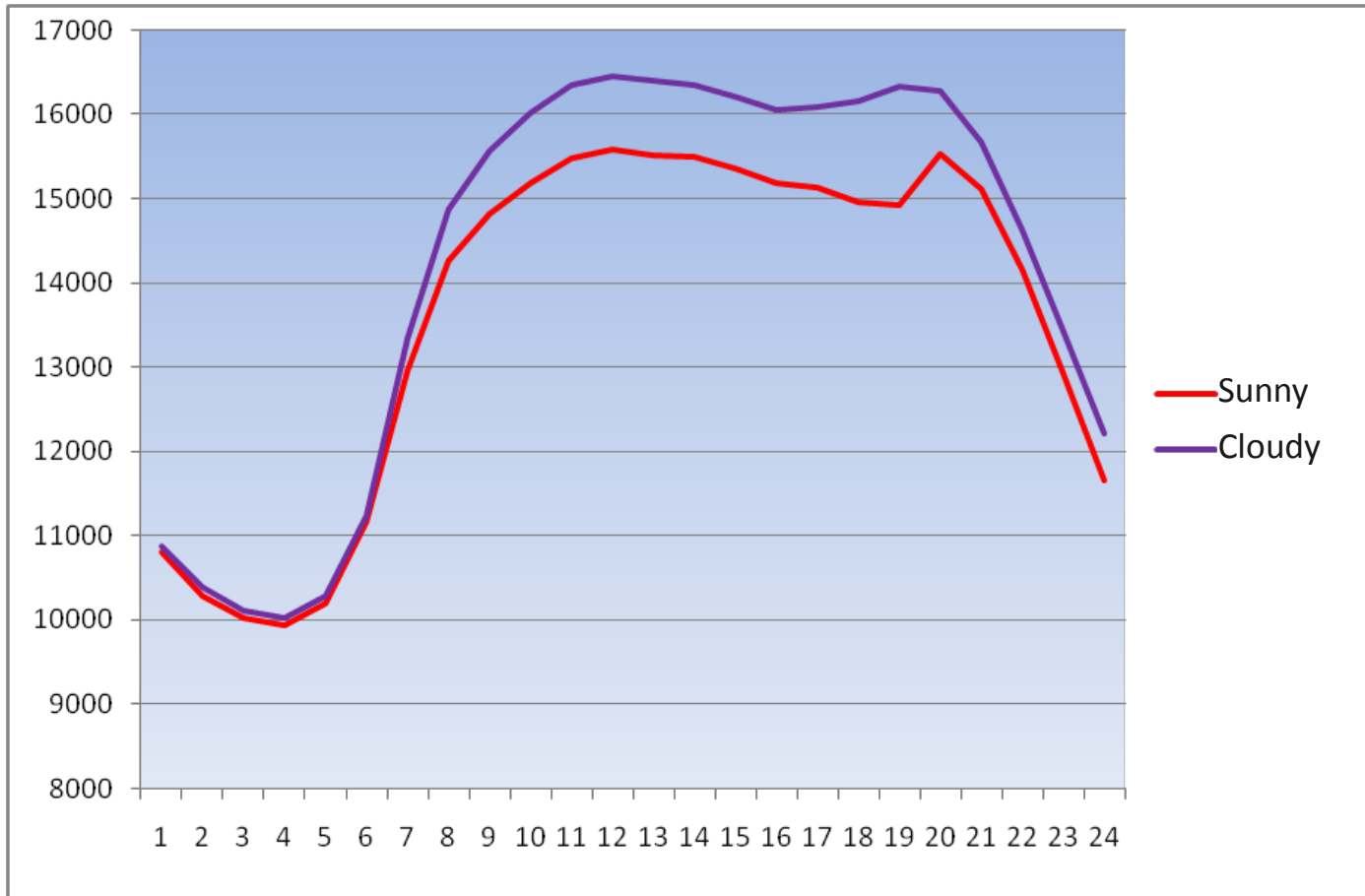
Develop Demand Forecast

Day of the Week Load Curves



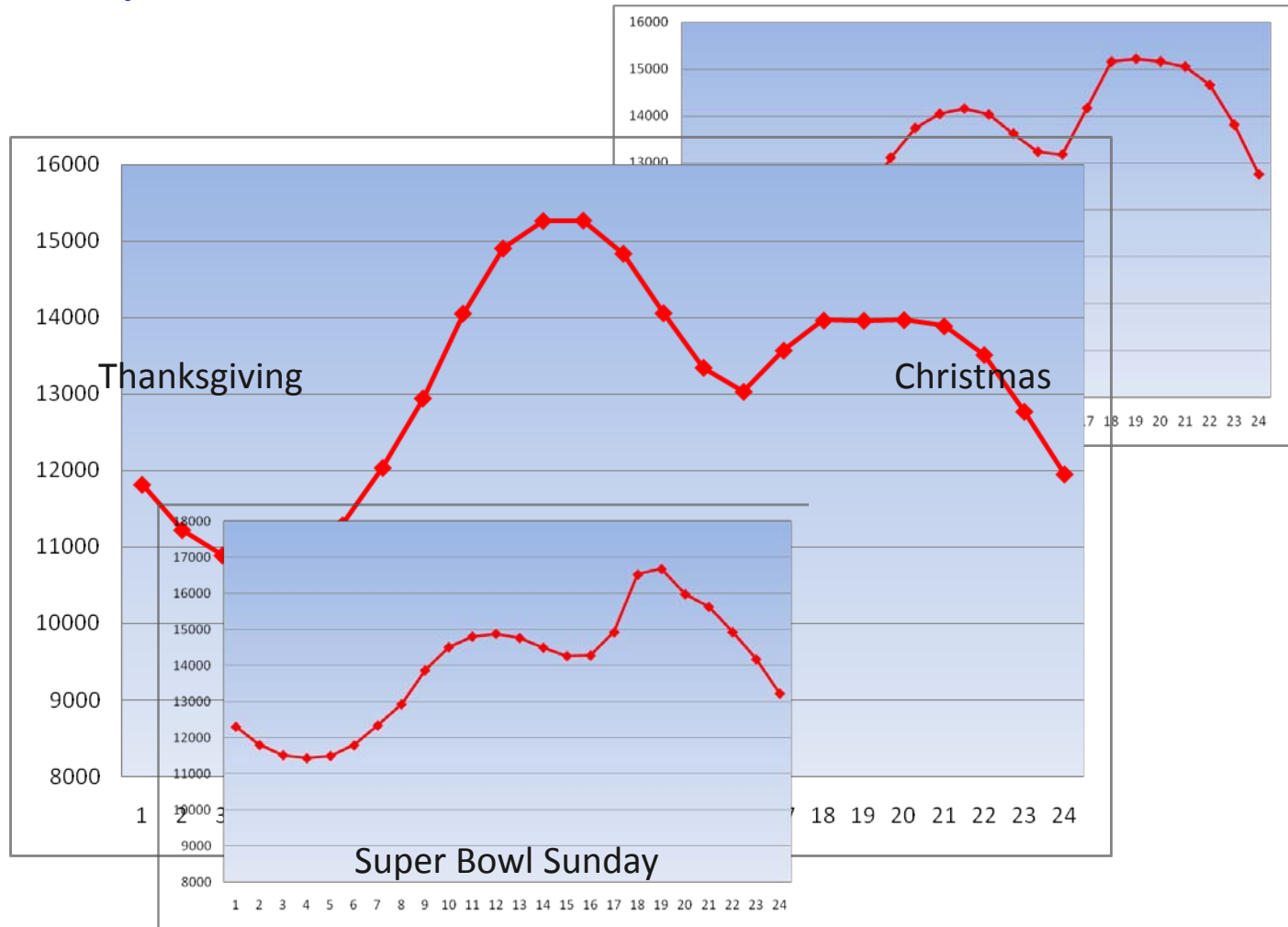
Develop Demand Forecast

Cloud Cover-Winter



Develop Demand Forecast

Special/Holiday Load Curves



Development of Demand Forecast



- ISO-NE utilizes several demand forecasting tools
 - Similar Day
 - Search engine compares weather forecast to historical days and determines which days fit best.
 - Up to five days can be pulled from a database into a spreadsheet application.
 - User adjusts for energy growth (or decrease) and differences between historical and forecast weather (temperature, dew point, cloud cover, and precipitation). FERC has stated there was a 4.2% decrease in electrical consumption for 2009.
 - User aggregates adjusted model days into single similar day forecast via user-entered weights.

Development of Demand Forecast (cont.)

ISO-NE Similar Day Adjustment

Similar Day Adjustment Load Summary for 07/16/2010

Day 1: Day 2: Day 3:

Weight:

Enter weight as a numeric value greater than zero. Enter zero to exclude day.

Hour	07/21/2006	<input checked="" type="checkbox"/>	07/18/2008	<input checked="" type="checkbox"/>	07/09/2010	<input checked="" type="checkbox"/>	Final	Sum Weight
1	15328	<input checked="" type="checkbox"/>	15544	<input checked="" type="checkbox"/>	15061	<input checked="" type="checkbox"/>	15248	4
2	14507	<input checked="" type="checkbox"/>	14665	<input checked="" type="checkbox"/>	14216	<input checked="" type="checkbox"/>	14401	4
3	14036	<input checked="" type="checkbox"/>	14068	<input checked="" type="checkbox"/>	13661	<input checked="" type="checkbox"/>	13856	4
4	13840	<input checked="" type="checkbox"/>	13746	<input checked="" type="checkbox"/>	13376	<input checked="" type="checkbox"/>	13584	4
5	13881	<input checked="" type="checkbox"/>	13786	<input checked="" type="checkbox"/>	13369	<input checked="" type="checkbox"/>	13601	4
6	14665	<input checked="" type="checkbox"/>	14336	<input checked="" type="checkbox"/>	13793	<input checked="" type="checkbox"/>	14147	4
7	16327	<input checked="" type="checkbox"/>	15813	<input checked="" type="checkbox"/>	15295	<input checked="" type="checkbox"/>	15682	4
8	18508	<input checked="" type="checkbox"/>	17821	<input checked="" type="checkbox"/>	17137	<input checked="" type="checkbox"/>	17651	4
9	20044	<input checked="" type="checkbox"/>	19473	<input checked="" type="checkbox"/>	18599	<input checked="" type="checkbox"/>	19179	4
10	21151	<input checked="" type="checkbox"/>	20976	<input checked="" type="checkbox"/>	19987	<input checked="" type="checkbox"/>	20525	4
11	22194	<input checked="" type="checkbox"/>	22291	<input checked="" type="checkbox"/>	21054	<input checked="" type="checkbox"/>	21648	4
12	23191	<input checked="" type="checkbox"/>	23468	<input checked="" type="checkbox"/>	22014	<input checked="" type="checkbox"/>	22672	4
13	23786	<input checked="" type="checkbox"/>	24082	<input checked="" type="checkbox"/>	22475	<input checked="" type="checkbox"/>	23204	4
14	24321	<input checked="" type="checkbox"/>	24654	<input checked="" type="checkbox"/>	22964	<input checked="" type="checkbox"/>	23726	4
15	24602	<input checked="" type="checkbox"/>	24883	<input checked="" type="checkbox"/>	23195	<input checked="" type="checkbox"/>	23969	4
16	24547	<input type="checkbox"/>	25008	<input checked="" type="checkbox"/>	23327	<input checked="" type="checkbox"/>	23887	3
17	23266	<input type="checkbox"/>	24974	<input checked="" type="checkbox"/>	23135	<input checked="" type="checkbox"/>	23748	3
18	22822	<input type="checkbox"/>	24561	<input checked="" type="checkbox"/>	22775	<input checked="" type="checkbox"/>	23370	3
19	21975	<input type="checkbox"/>	23555	<input checked="" type="checkbox"/>	21950	<input checked="" type="checkbox"/>	22485	3
20	21234	<input type="checkbox"/>	22658	<input checked="" type="checkbox"/>	21007	<input checked="" type="checkbox"/>	21557	3
21	21224	<input type="checkbox"/>	22329	<input checked="" type="checkbox"/>	20732	<input checked="" type="checkbox"/>	21264	3
22	21642	<input type="checkbox"/>	21231	<input checked="" type="checkbox"/>	20302	<input checked="" type="checkbox"/>	20612	3
23	19853	<input type="checkbox"/>	19278	<input checked="" type="checkbox"/>	18763	<input checked="" type="checkbox"/>	18935	3
24	18000	<input type="checkbox"/>	17411	<input checked="" type="checkbox"/>	17028	<input checked="" type="checkbox"/>	17156	3

Click on Check Box to select/de-select loads. Hours checked are included in the final load forecast.

Click on the Details button to view detailed weather data for the day.

Actual/Combined Loads for 07/16/2010

Legend: Final (red), 07/21/2006 (green), 07/18/2008 (blue), 07/09/2010 (yellow)

Development of Demand Forecast (cont.)

- Execute two computer models
 1. EPRI Artificial Neural Network (two releases-re-trained annually)
 2. Metrix Next Day regression model (retrained twice monthly)
- Individual demand forecasts, (Similar Days, ANN, and Metrix), are aggregated into a single ISO-NE Demand Forecast using Forecaster-entered weight factors.

Development of Demand Forecast

ISO-NE View Load Forecast
ISO-NE

ISO NEW ENGLAND SEVEN DAY LOAD FORECAST - Starting Thu, Jul 15, 2010

Day 2: Fri, Jul 16, 2010

Print

Number of Copies:

Go To Day 1

Go To Day 3

HR	Prev Fcst	Sim Days	ANN07 Fst	ANN07 Reg	ANN08 Fst	ANN08 Reg	ANN09 Fst	ANN09 Reg	Fcst Adj	Final	HR
1	15520	15248	14855	14885	14932	14850	14915	14866	0	14970	1
2	14660	14400	14014	13972	14072	13967	14057	13980	0	14110	2
3	14120	13857	13510	13422	13561	13441	13547	13455	0	13580	3
4	13880	13584	13307	13151	13326	13157	13314	13176	0	13320	4
5	13980	13601	13434	13242	13420	13252	13408	13272	0	13400	5
6	14600	14147	14005	13862	14009	13864	13995	13885	0	13990	6
7	16010	15682	15477	15351	15552	15341	15532	15363	0	15500	7
8	17850	17650	17262	17337	17399	17281	17387	17302	0	17410	8
9	19270	19179	18670	18949	18807	18843	18806	18868	0	18910	9
10	20660	20525	20176	20352	20233	20217	20221	20238	0	20310	10
11	21950	21648	21432	21598	21471	21467	21453	21481	0	21520	11
12	22970	22672	22450	22539	22479	22467	22462	22475	0	22530	12
13	23710	23205	23292	23165	23386	23157	23368	23160	0	23240	13
14	24310	23726	23909	23784	24120	23793	24098	23787	0	23870	14
15	24600	23969	24172	24158	24468	24126	24444	24115	0	24180	15
16	24610	23888	24116	24259	24577	24259	24555	24248	0	24220	16
17	24500	23747	23841	24188	24519	24277	24495	24271	0	24140	17
18	24090	23370	23359	23779	24069	23900	24042	23903	0	23720	18
19	23190	22484	22586	22929	23266	23064	23247	23071	0	22890	19
20	22570	21557	21931	22302	22527	22452	22508	22464	0	22160	20
21	22320	21264	21796	22051	22238	22142	22225	22166	0	21890	21
22	21570	20613	21264	21457	21736	21455	21726	21483	0	21290	22
23	20060	18934	19820	19951	20223	19880	20210	19905	0	19730	23
24	18310	17155	18115	18145	18505	18049	18493	18070	0	17960	24

2

1

1

1

1

1

1

< Used Weights

Columns shaded in blue can be modified. Press F9 to copy cell above to current cell or F10 to copy cell above to all cells below.

Exit

Load Forecast for 07-16-2010

— Final

— ANN07 Fst

— ANN08 Fst

— ANN09 Fst

— Sim Days

— ANN07 Reg

— ANN08 Reg

— ANN09 Reg

Prepared by: DPEASE

Saved: Jul 15, 2010 09:28

Forecast System Demand Report

(Three Day Load Forecast)

Forecast System Demand

Forecast for 2010-08-10

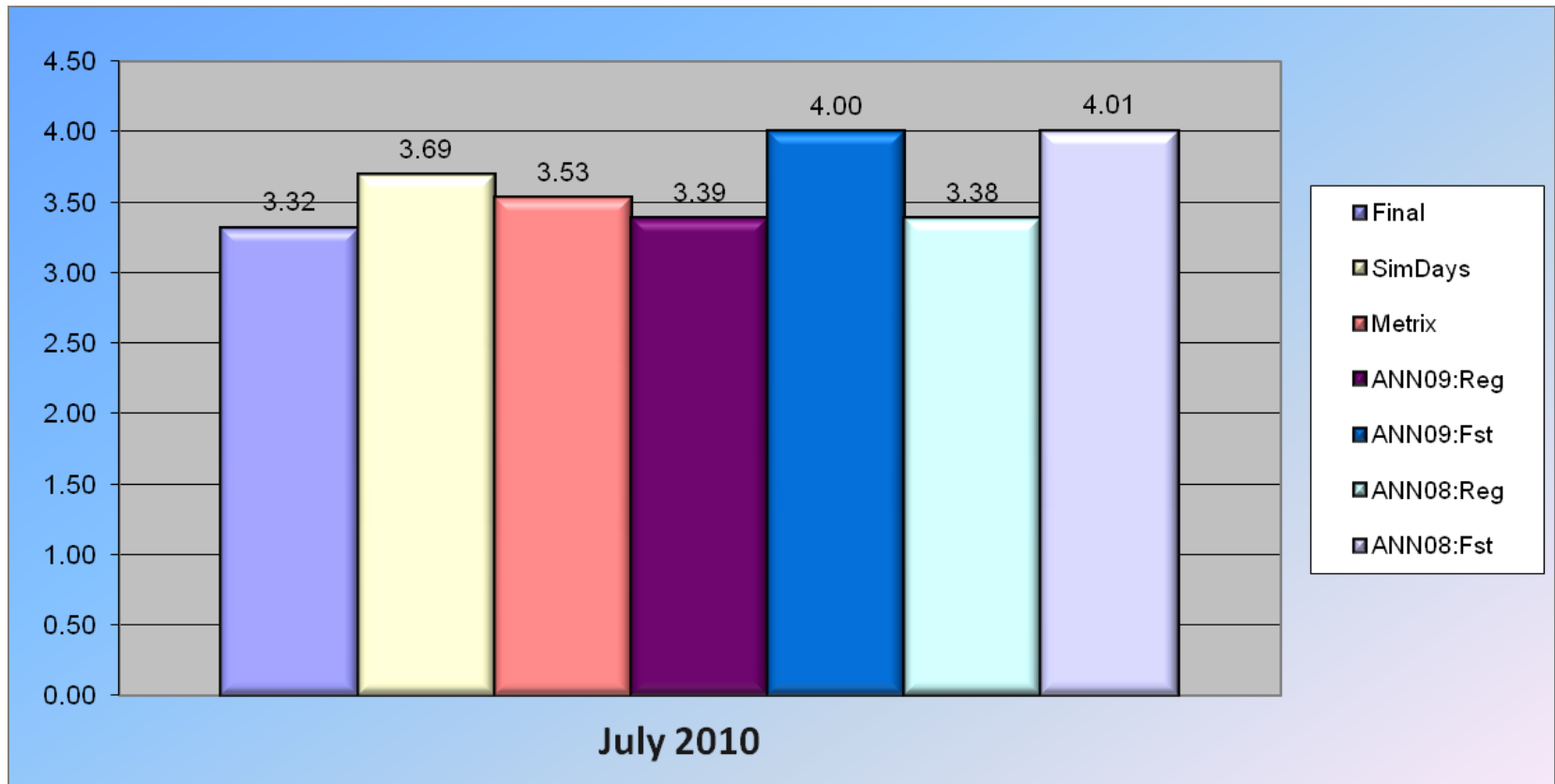
(as of 2010-08-10 09:54:47 EDT)

Trading Interval	Forecasted Demand	Forecasted Demand MWh					
		Total Adj	Adjusted	Day 2	Day 3	Day 2	Day 3
Hour End	Native MWh	MWh	MWh	Hour End	Hour End	Hour End	Hour End
01	15830	0	15830	01	15990	01	14470
02	14950	0	14950	02	15050	02	13580
03	14400	0	14400	03	14440	03	13030
04	14160	0	14160	04	14080	04	12750
05	14270	0	14270	05	14190	05	12980
06	14980	0	14980	06	14840	06	13590
07	16370	0	16370	07	16140	07	14860
08	18200	81	18118	08	17960	08	16540
09	19750	87	19662	09	19330	09	17720
10	21150	87	21062	10	20540	10	18690
11	22640	87	22552	11	21490	11	19400
12	23600	87	23512	12	22270	12	19940

[Home > System Operations > Operations Forecasting > Forecast System Demand](#)

Comparison of Different Model Errors

Average Forecast Error



Seven Day Forecast – ISO-NE Web Site

Seven Day Forecast

 [Download a CSV file of the Seven-Day Forecast.](#)

For today's forecast, please refer to the **Morning Report**.

For an explanation of this report please refer to the **Seven-Day Forecast Explained**.

	Day 2 Wed 08/11/10	Day 3 Thu 08/12/10	Day 4 Fri 08/13/10	Day 5 Sat 08/14/10	Day 6 Sun 08/15/10	Day 7 Mon 08/16/10
Weather						
High Temperature - Boston	94	89	74	78	82	80
Dew Point - Boston	71	59	57	57	62	65
High Temperature - Hartford	91	90	78	82	85	83
Dew Point - Hartford	74	62	59	61	64	67
Generating Capacity Position						
Total Capacity Supply Obligation (CSO)	30,122	30,122	30,122	30,122	30,122	30,122
Anticipated Cold Weather Outages	0	0	0	0	0	0
Other Generation Outages	-3,465	-3,925	-3,504	-3,784	-3,062	-3,273
Anticipated De-List MW Offered	1,456	1,456	1,456	1,456	1,456	1,456
Total Generation Available	28,113	27,653	28,074	27,794	28,516	28,305
Import at Time of Peak	750	750	750	450	450	750
Total Available Generation and Imports	28,863	28,403	28,824	28,244	28,966	29,055
Projected Peak Load	23,480	20,780	19,470	17,690	19,240	22,170
Required Reserve	2,100	2,100	2,100	2,100	2,100	2,100
Total Load plus Required Reserve	25,580	22,880	21,570	19,790	21,340	24,270
Projected Surplus/(Deficiency)	3,283	5,523	7,254	8,454	7,626	4,785
Available Real-Time Demand Response	765	652	652	652	652	652
Available Real-Time Emergency Generation	525	503	503	503	503	503
Load Relief Actions Anticipated						
Power Watch	NO	NO	NO	NO	NO	NO
Power Warning	NO	NO	NO	NO	NO	NO
Cold Weather Watch	NO	NO	NO	NO	NO	NO
Cold Weather Warning	NO	NO	NO	NO	NO	NO
Cold Weather Event	NO	NO	NO	NO	NO	NO
Energy Emergency	NO	NO	NO	NO	NO	NO

Report Generated 08/10/2010 14:07:47 GMT

Seven Day Forecast of ISO-NE Capacity Margin

- Published each day by 11:00 a.m. on ISO-NE Web site
- Utilizes:
 - A. Total Capacity Supply Obligation (CSO) (+)
 - B. Anticipated Cold Weather Outages (-)
 - C. Other generation outages (-)
 - D. Anticipated De-List MW Offered (+)
 - E. Import at time of Peak (+)
 - F. Projected Peak Load (-)
 - G. Required Reserve (-)
 - H. Projected Surplus/(Deficiency)
 - I. Available Real-Time Demand Response (New)
 - J. Available Real Time Emergency Generation (New)

Seven Day Forecast (cont.)

- Purpose of the Seven Day Forecast is to indicate the peak hour capacity margin for days 2-7. (The Morning Report contains the current day capacity margin)
- Also contains a section for 'Load Relief Actions Anticipated', which can be a Power Watch, Power Warning, Cold Weather Watch, Cold Weather Warning, Cold Weather Event, or an Energy Emergency.

[Home > System Operations > Operations Forecasting > Seven Day Forecast](#)

Market Operations Morning Meeting



- Attended at 11:00 by:
 - Market Administrator,
 - Forecaster, Generation Coordinator
 - DA/RT Transmission Specialist
- Discuss all approved transmission maintenance for the next Operating Day and known major generation outages
- Discuss Generation Requirement for Transmission (GRT)

Determine Reliability Requirements

- ISO-NE reliability commitments include:
 - Special Constraint Resource request by LCC, Transmission Owner or Load Serving Entity (SCR flag)
 - Voltage control during light load periods (VSU flag)
 - 1st line contingency for local and import congestion area
 - If voltage limit (VSU flag)
 - If thermal limit (No flag)
 - Local Second Contingency protection to meet 2nd line/generator contingency in an import congestion area (Commitment for Local Reserve Zone Requirement)
 - If voltage limit (VSU & RMR flag)
 - If thermal limit (RMR flag)
 - RMR is now LSCPR (Local Second Contingency Protection Resource)

Operations Daily Look-Ahead Meeting

- Attended at 14:00 by:
 - Forecaster, Generation Coordinator
 - DA/RT Transmission Specialist
 - CR Shift Supervisor
- Forecast weather and demand
- Approved transmission maintenance
- Generator availability (AI, STO, EO, FO)
- Generation Requirement for Transmission (GRT)



Operations Daily Look-Ahead Meeting (cont.)

- Transmission maintenance that requires/limits generator availability
- Anticipated capacity margin
- Other power system reliability issues (extreme heat or cold, hurricane/blizzard, etc.)



Re-Offer Period

- Re-Offer Period (16:00 – 18:00)
 - All Generators can re-offer during the re-offer period
 - Generators not scheduled in DA can waive start and no load prices and can change energy prices for consideration in RAA and RT dispatch.
 - Generators scheduled in DA and Dispatchable Asset Related Demand (DARD) can change only the energy prices for consideration in the RAA and RT dispatch.
 - Intermittent Resources can SS for RT.
 - All Generators and DARD can re-declare operating limits to reflect the station physical capabilities.
 - All Generators and DARD can request self commitment or de-commitment and changes to Self-Schedules (SS)
 - Approved if request does not cause or worsen a reliability constraint
 - Capacity Deficiency, Minimum Generation Emergency, Reserve Zone or local requirement

RAA Process Software (Part 1) RSC

- Resource Scheduling and Commitment (RSC) is the commitment engine of the Market Operations Interface (MOI) software
 - No access to transmission network model
 - Starting point for the RSC software is the Day-Ahead Commitment, and any units input for real time reliability.
 - Uses ISO system-wide Forecasted Load and reserve requirements vs. DA bid in load and reserve requirements
 - Results reviewed to ensure that sufficient capacity is committed to meet system-wide Forecast Demand, Reserves Requirement and Regulation Requirement
 - RSC normally approved once per day, can be approved multiple times

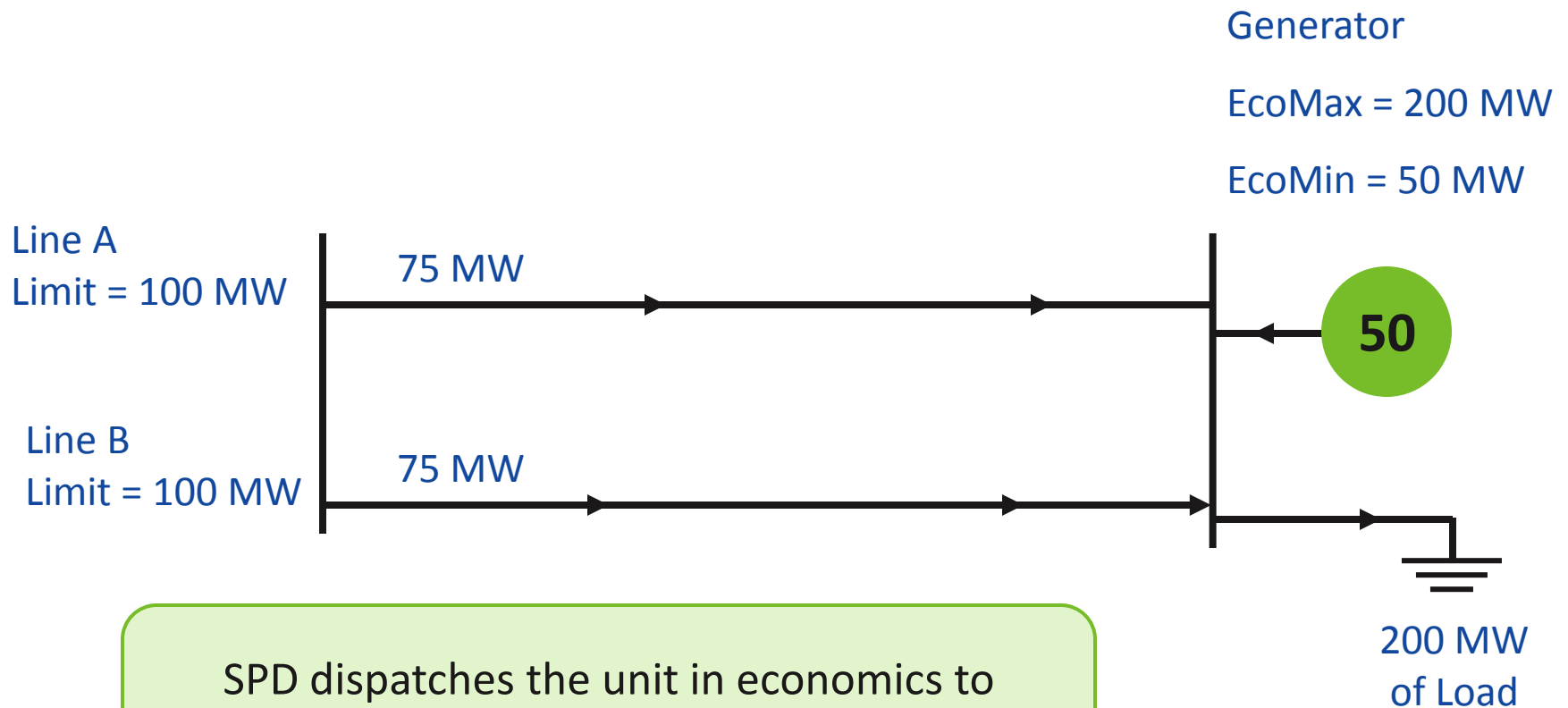
RAA Process Software (Part 2) SPD/SFT

- Scheduling, Pricing and Dispatch (SPD) is the dispatch engine of the MOI software
 - Inputs
 - ISO Forecasted Load
 - Transmission Network Model
 - Unit Commitment from the RSC Case
 - Outputs
 - Produces hourly generator, external transaction, and pumped storage schedules.
 - FI_Unit Reports are produced from the final SPD case.
 - Forecasted LMPs for each node
 - Produces forecasted Real Time Demand Response (RTDR) Schedules.

RAA Process Software (Part 2) SPD/SFT (cont.)

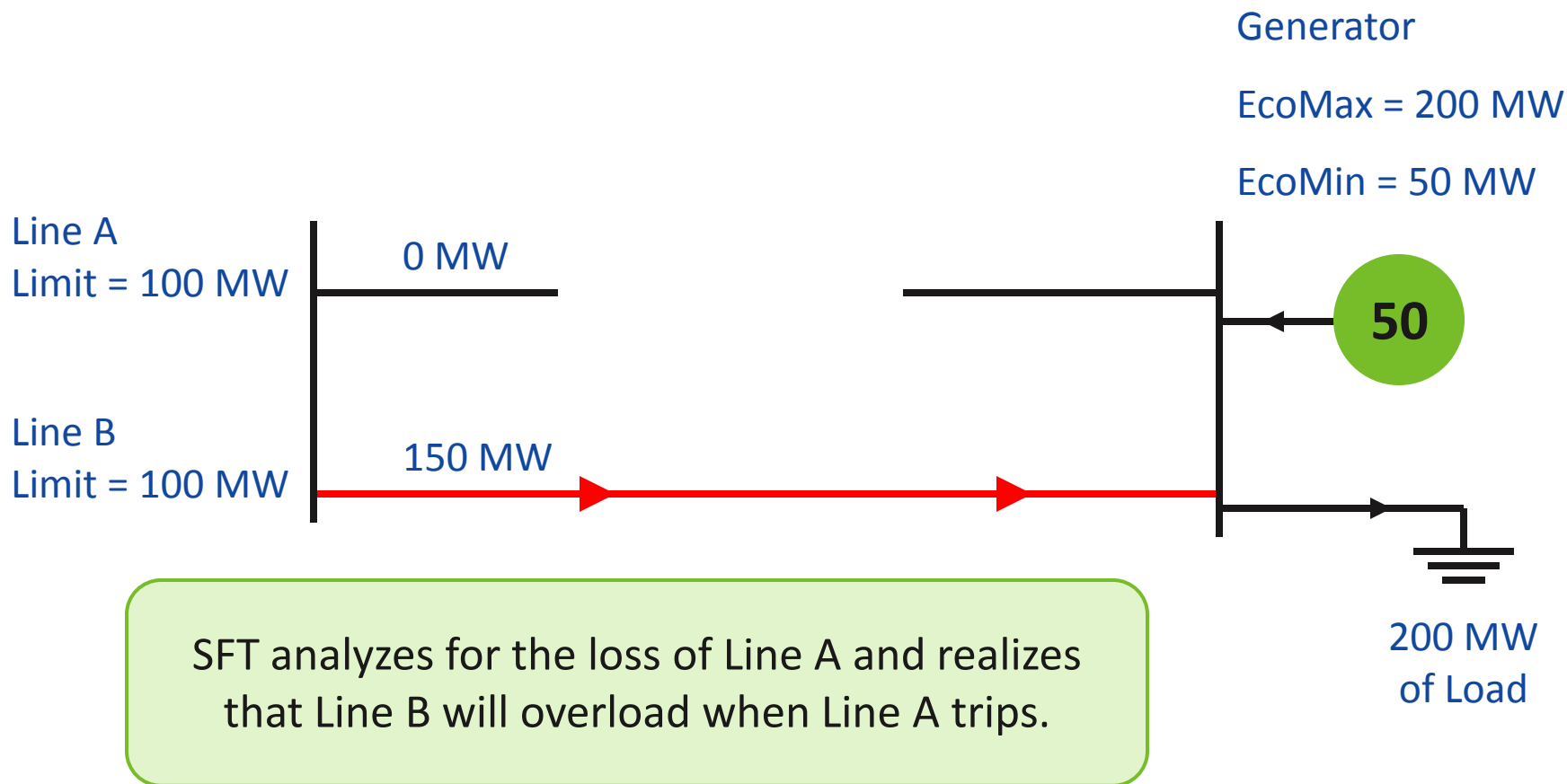
- Simultaneous Feasibility Test (SFT) is a power flow application that performs Contingency Analysis (CA).
 - Uses a pre-defined set of contingencies,
 - Determines post contingency power flows,
 - Returns a set of generator constraints to SPD for re-dispatch
- SPD/SFT iterations are performed for each hour
- This provides a security constrained forecast dispatch for the control room.

What are SPD and SFT Doing?

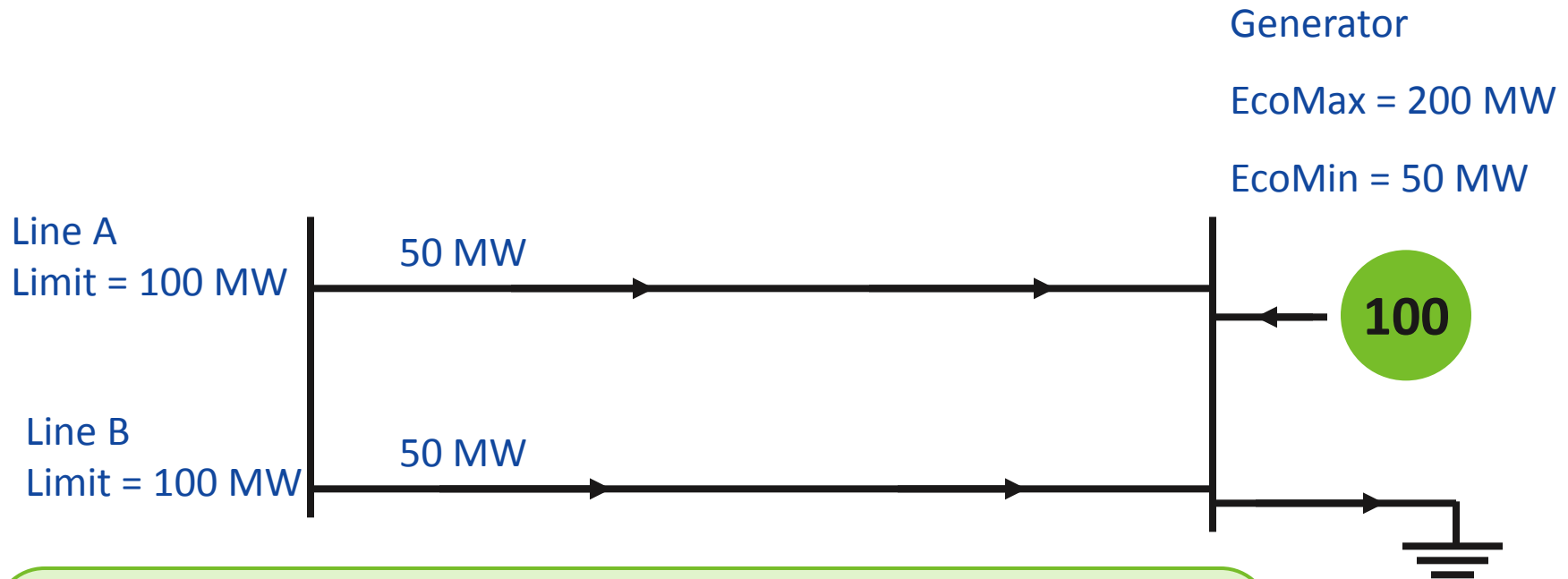


SPD dispatches the unit in economics to satisfy the load and honor normal line limits.

What are SPD and SFT Doing? (cont.)



What are SPD and SFT Doing? (cont.)



SPD re-dispatches generation with the constraint that the generator must be loaded pre-contingent to 100 MW to prevent a violation upon the contingency. It then re-dispatches the rest of the system based on that loading.

Module Review: Topics Covered

