COVID-19 Bulk System Impacts

Demand Impacts and Operational and Control Center Practices

EPRI Transmission Operations and Planning
March 24, 2020

WORKING DRAFT v2.0 – SUBJECT TO CHANGE

EPRI Response to COVID19

COVID19-GRID-IMPACT@EPRI.COM
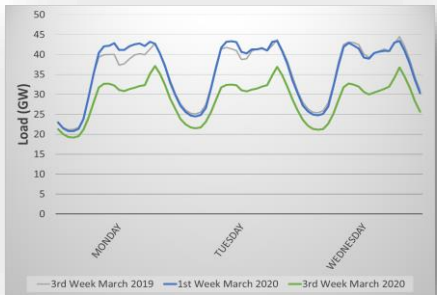
Information Gathering

Key Insights

Technical data analysis

Webcast updates, technical brief reports

Information Sharing

Using global reach to gain insights and share with wider audience

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Upcoming WebEx Meetings This Week

Distribution Operations Practices

Monday, 3/23: 4-6pm EDT
(20:00-22:00 GMT)

- Distribution operation practices, including companies discussing their specific actions to date
- Meeting Link

Bulk System Demand and Operations Impacts and Practices

Tuesday, 3/24: 11am-12:30pm EDT
(15:00-16:30 GMT)

- Transmission control center practices with international companies discussing their specific actions to date, as well as updated demand and operational impacts from several systems across the globe.
- Meeting Link

Distribution Operations Practices
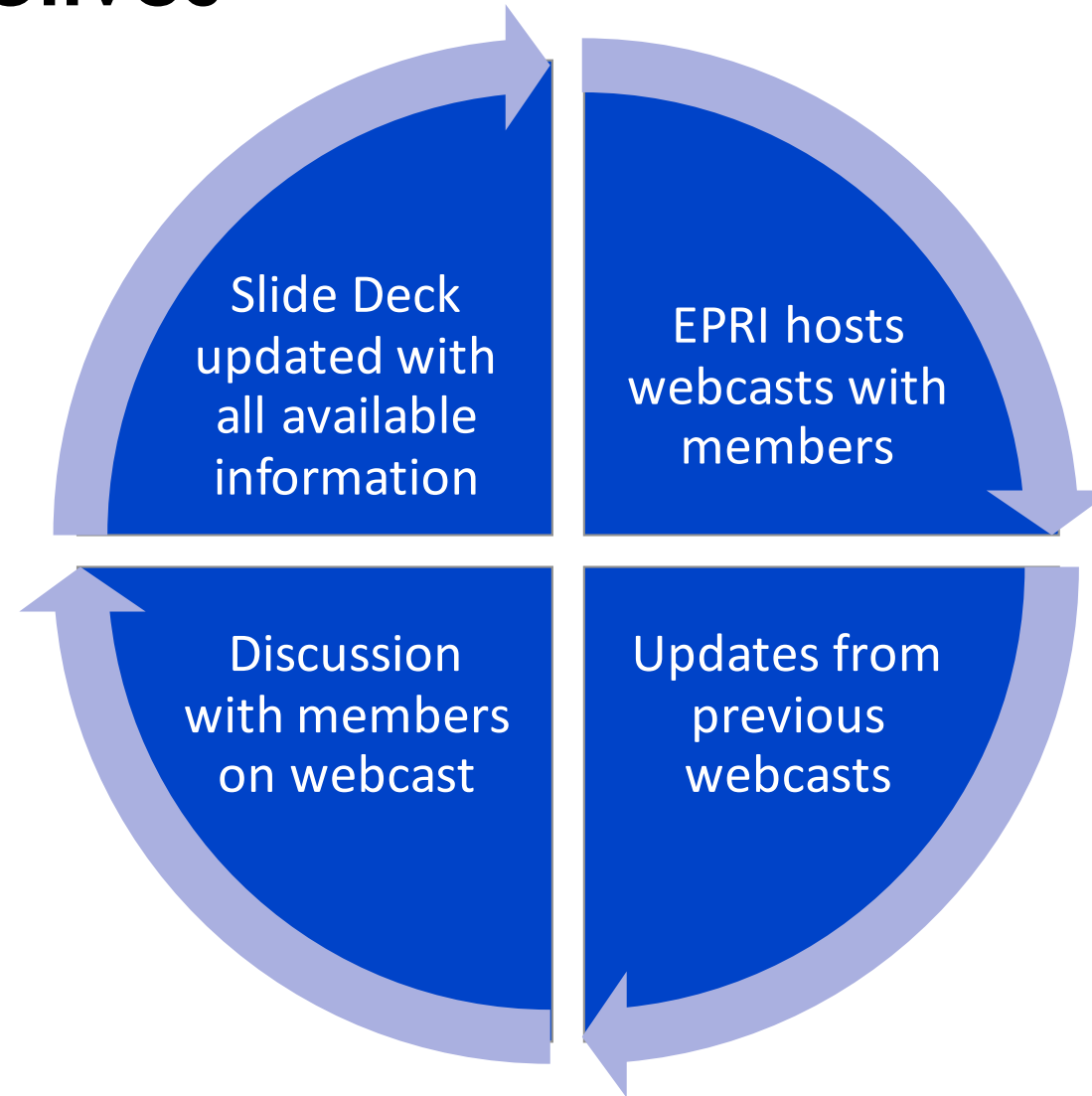
Thursday, 3/26: 9-11AM EDT
(13:00-15:00 GMT)

- 2nd Webex focusing on sharing distribution operation practices, providing summary of information collected throughout the week as well as companies discussing specific actions to date.
- Meeting Link

T&D Operations Leadership Impacts and Practices

Friday, 3/27: 11am-12:30pm EDT
(15:00-16:30 GMT)

- Aggregated insights from international Transmission and Distribution operators from engagements during the week – pandemic practices and demand/operational impacts.
- Meeting Link

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Webcast Objectives

The diagram shows a circular cycle with four quadrants:
- Slide Deck updated with all available information
- EPRI hosts webcasts with members
- Updates from previous webcasts
- Discussion with members on webcast

Fast Evolving Situation. Synthesize important information. Build Body of Knowledge

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Agenda

Update From Webcasts	Impacts of COVID-19 Crisis on Generation Plants	Impacts on Operations and Outage Planning	Summary of COVID-19 Related Operations Actions Taken by Various EPRI Members (Transmission and Distribution)
General Company Response and Notes	Sanitary and Hygiene Basics	Staff Health and Monitoring	Control Center Buildings and Staffing
Emergency Response Planning and Communications	Practices Related to Field Operations	Practices Related to Office Work	Impact on Demand of COVID-19 Shutdown

Aim to keep the webcast and discussion focused on bulk system operations

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Update From Webcasts

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

March 24ᵗʰ Webcast Polls

Is Your Company Cancelling Transmission Outages

- All, 5, 7%
- None, 6, 8%
- Most, 15, 20%
- Some In Confined Areas, 48, 65%

Legend: None · Some In Confined Areas · Most · All
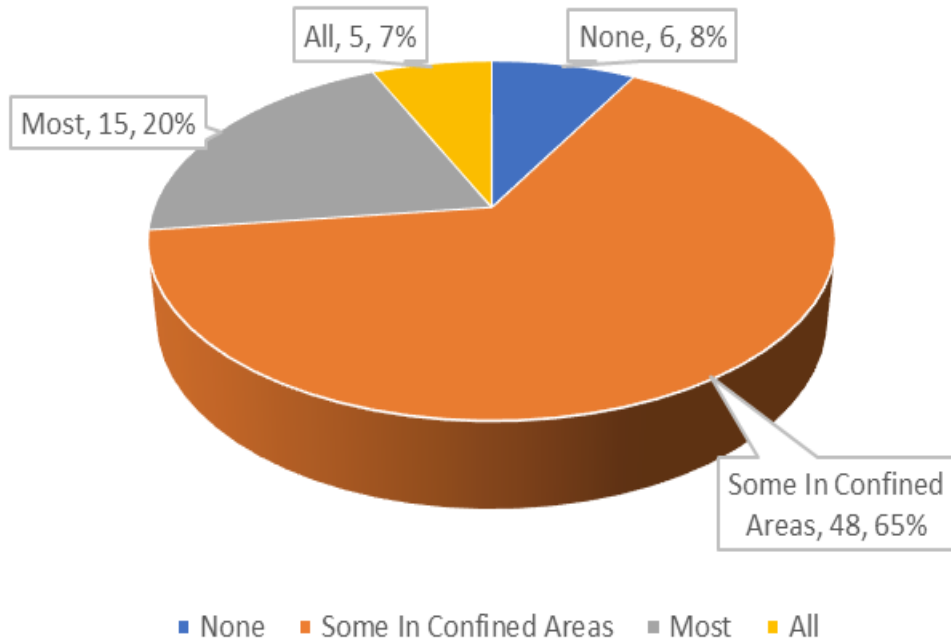
Has Your Company Observed Load Shifts

- No, 18, 10%
- Moderate (<10 %), 59, 34%
- Not sure yet, 90, 51%
- High (>10 %), 9, 5%

Legend: Moderate (<10 %) · High (>10 %) · Not sure yet · No

EPRI | ELECTRIC POWER RESEARCH INSTITUTE
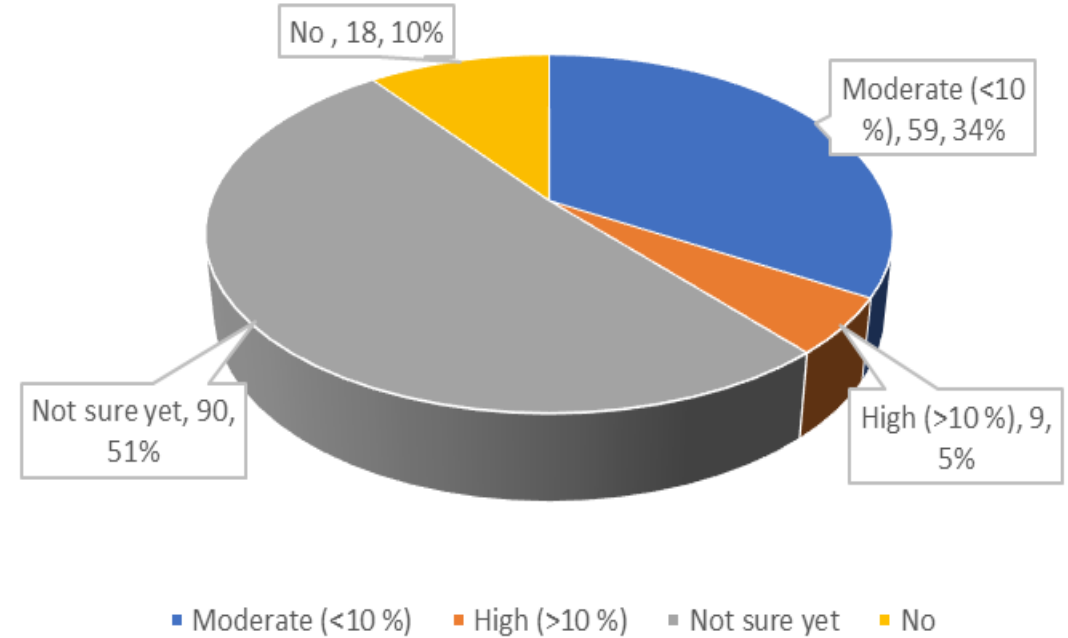
General Update – UPDATE MARCH 24th

- Companies are using scenario planning at least on a 3 month horizon and longer
- Increasing shift to need to define critical operational roles and key staff
- Increasing shift to remote operation strategies and implementation.
- Companies following state/country guidelines for limits to numbers of people in groups (in the UK this is now 2 people)
- Many more utilities asking operators or staff to self monitor and report if they have a temperature or if they have a fever
- Reported uptick in spearfishing and cyber malfeasance
- Need to communicate with state/country emergency response team on key functions and staff
- Some NERC and FERC regulatory, compliance relief granted last week
- We have some reports of general company staff and field crews with COVID-19 who are quarantined.
- No reports of control center staff outbreak anywhere

TSO Core Activities to Ensure Safety of the Grid – UPDATE MARCH 24th

- Incomplete List:
  - Grid Monitoring (operations and market)
  - Asset Management
  - Congestion management
  - Incident Management
  - Operational Planning
  - National and international coordination with operators and authorities
  - Switching
  - Balancing
  - Load – Frequency Control
  - Voltage Control
- Others??

Hygiene and Staff Health – UPDATE MARCH 24th

- Sanitary and Hygiene:
  - Some considering portable hand washing units in control centers. (No reports of implementation).
  - Masks would have to be changed several times daily due to saliva. With restrictions in place, most companies are not opting for using masks.
  - Consider paperless control centers. Documents and paper can be vectors
- Staff Health Monitoring
  - Some looking at infrared tool for forehead temperature measurement without touching.
  - One control center reported operators self monitoring with temperature check before and after each shift.
  - Open question about metrics for return to work for staff member: One utility using 72 hours fever free and without medication.
  - More reports of key staff health dashboards in China, operators required to report on health, travel and contacts twice per day.

Source HENGTONG Group China

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Control Center Building and Staff – UPDATE MARCH 24th

- **Consider IM clients for contact between operators rather than physically talking to operator**

- **Distribution Control Centers:**
  - Some companies staff being sequestered in hotels and some in home self isolation. Cleaning of hotel carried out by utility contracted cleaners.
  - Crews being split into small A, B, C crews with minimal interaction to limit cross-contamination.
- **Sequestering Control Centers and Operations Staff:**
  - Utilities planning for it, one report of DCC that have done so. It is usually at the highest level of a business continuity / pandemic response plan.
  - Postponing vacation: We have heard that leave has been cancelled in Europe, but this is expected. Companies have refunded cost of vacations for operators.
  - Distribution companies are canvassing staff for volunteers for sequestering
- **Control Center Air Quality:**
  - For AC systems in control centers, some utilities investigating the use of UV (ultra violet) or HEPA (high-efficiency particulate air) filters or retro fitting air systems to prevent / limit circulation in air. (More information needed)
- **Training:**
  - Some utilities utilizing web-based video applications (webex) for training
  - Retired staff or staff with lapsed certification being engaged to fill training pipeline. (Note health risk to older cohort)
  - Mutual assistance for grid operators of neighboring system operators. If there is familiarity with the E/DMS system and familiarity with the system operation in the area.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Field Crew Operations Practices – UPDATE MARCH 24th

- Reporting To Work:
  - Some utilities reported crews not reporting to head quarters, instead reporting to remote substations in staggered times.
  - Some being dispatched directly from home
  - Staggering start times, to stop unnecessary congregation at facilities

- Driving:
  - Some limiting to 1 person per vehicle
  - Some 2 per vehicle, 1 driving and the other in back on opposite side
  - Car pooling for operators should stop
  - Some companies allowing field crews use personal vehicles (reimbursing for mileage) to limit staff in trucks/cars.
  - Enhanced cleaning of trucks is required for common surfaces, steering wheel, door handles etc.

- Contractors for field works (non company employees)
  - Company reported that contractors are screened with questions prior to entry
  - Materials stores placed far from offices. Pick up/drop off is pre planned for day ahead.
  - Contractors scheduled to start shifts at different times.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Remote Working for Control Centers – UPDATE MARCH 24th

- In the absence of backup facilities, to decentralize system operations, some utilities have extended and set up operator workstations in IT areas such as communications rooms. (Within secure NERC perimeter to ensure compliance)

- Distribution: Some utilities testing or have implemented remote working for some operations tasks such as GIS modelling, switching plan creation, studies. Some distribution tools have remote capability.

- Customers with no backup power at home. Can implement geographic pairing, one in office and one remote as backup.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Entering Customer Premises – UPDATE MARCH 24th

- Some companies have limited entering customer premises or developing protocols such as:
  - Avoid physical contact with customer
  - Knock then step 3 steps back
  - Use hand sanitizer
- Some are actively reducing or eliminating customer work except emerging and limit to 2/3 person per job. Other actively reviewing customer work and outages.
  - Depending on state of business continuity stage, At highest state (mission critical) some are cancelling planned and capital works and only responding to emerging work.
  - Further investigation need on how this will impact summer network operations

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Emergency Response and Storm Events – UPDATE MARCH 24th

- Some companies establishing minimum staffing levels of on call staff to respond to emergencies and storm.
- If an outbreak occurs and staff levels drop, geographic areas of response can be revised – increases response times, but maintains staff safety

- Storm response:
  - Plans being put in place for remote working for some elements of storm response – transferring control out of DCC and limit control center activity to bulk / feeder events.
  - Plans in place for decentralizing control to local supervisors to control their defined boundaries, if central dispatching is lost.
  - Some reported flexibility on boundary areas, to allow multiple areas respond to storm events.
  - Important that transfer of control authority is clear and documented. Some utilities working on documents to formalize it.

- Additional discussion with EPRI and DOIG are needed to discuss storm and emergency response implementation, mutual assistance, contractors, etc.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Remote Working for Staff – UPDATE MARCH 24th

- Office Equipment variations in practices reported among companies:
  - Some allow employees to take all office equipment, chair etc.
  - Some allow 1 additional monitor
  - Some allow a laptop only
  - Companies increased data plans on cell phones and issued remote Wi-Fi spots.
  - TVs can be used as an extra monitor if needed

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Impacts of COVID-19 Crisis on Generation Plants

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

COVID-19 Generating Plant Impacts to Date (US and Canada)

- Plant outages

  – Reduced and personnel interactions controlled

  – Cancelled

- Plant operations

  – Minimal staff, non-essential work from home

  – Control rooms locked down

  – Personnel entering site are screened using IR

  – Some are sequestering personnel and obtaining backup staffing

  – Turnovers and interactions performed remotely (Skype, Facetime and personnel are being issued their "own" equipment – key boards, mice, headsets, etc.)

Impacts on Operations and Outage Planning

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Day ahead forecast performance
XM Colombia March 15-22, 2020
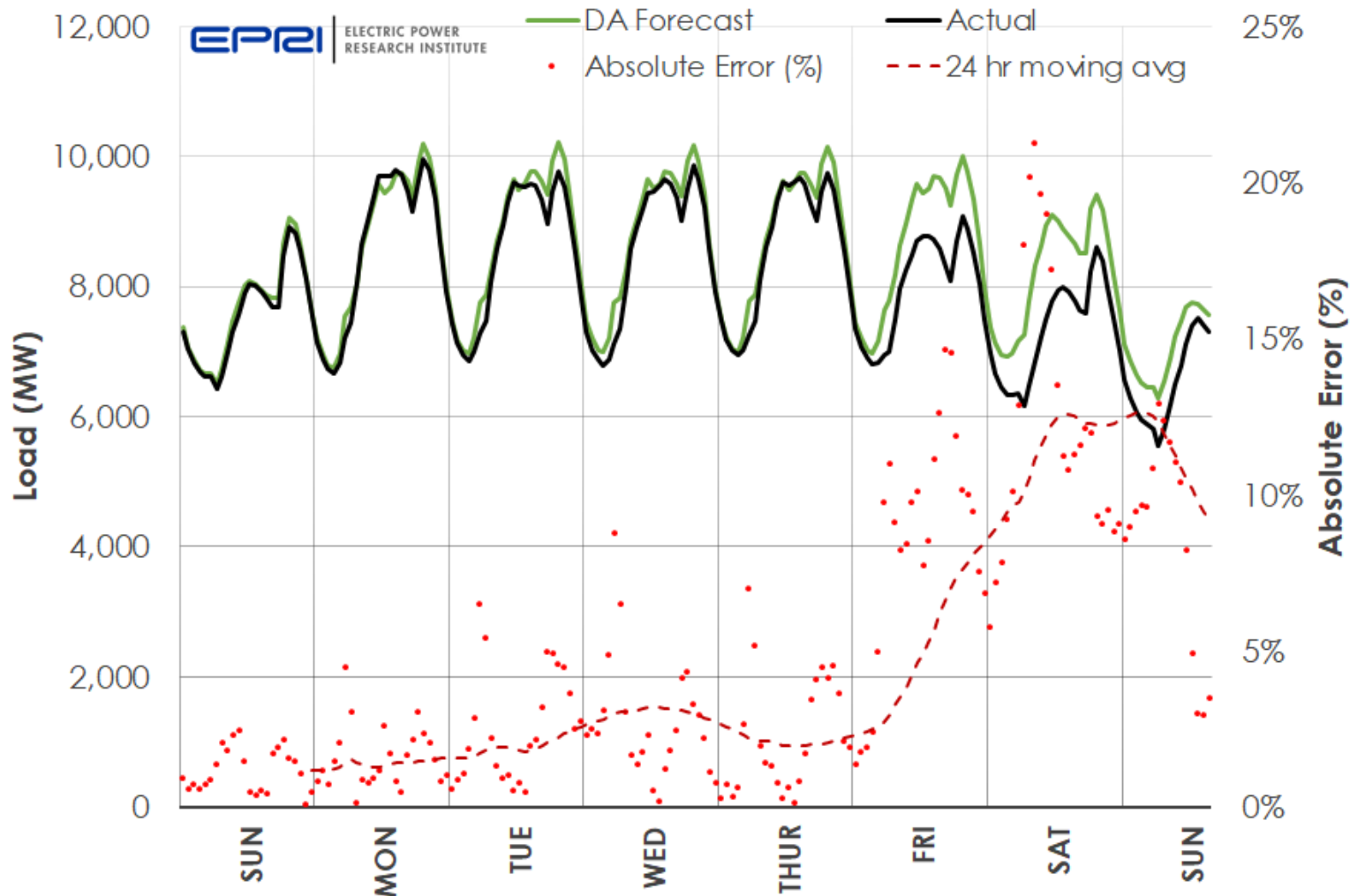
Mean Absolute Error

- **1.2% in previous week**
- **2.1% in the last week through Thu**
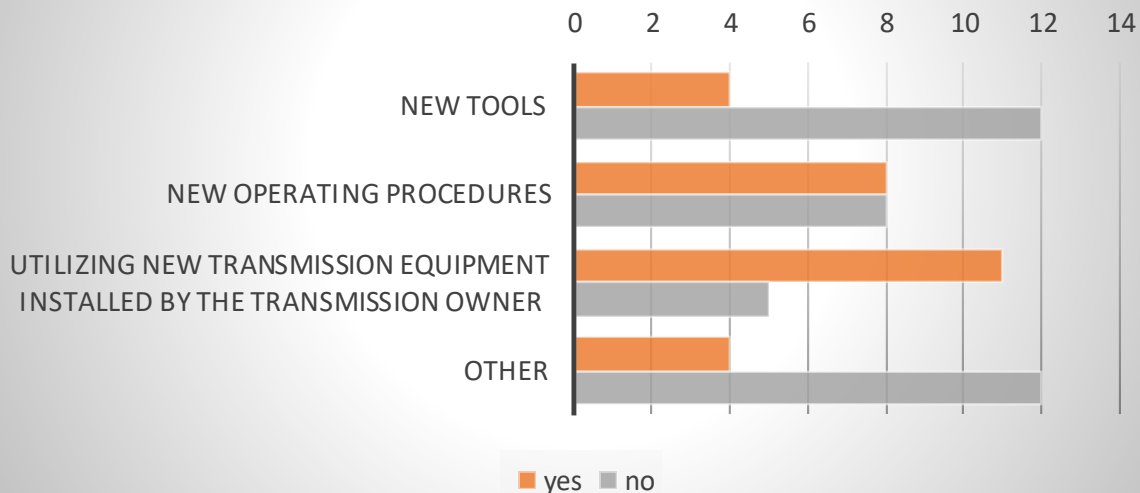- **9.9% first 2 days isolation Fri-Sat**

Day ahead load forecasts degrade immediately after isolation measures, but forecasting algorithms quickly adjust (1-2 days).

Despite forecast error, expected changes in load are predictable → approaches weekend values/shape.

High Voltage Operations Corrective Measures

Corrective Measures Implemented by Operations

- • **Manual actions**
  - ▪ switching shunts and transmission facilities
  - ▪ generator reactive or voltage schedules
  - ▪ committing generation for voltage control
- • **Seasonal transformer tap change, normally opening EHV and HV lines**
- • **Tools:**
  - ▪ Detailed predictive studies
  - ▪ Improved use of EMS and offline study tools
  - ▪ Improved load/renewable forecast

Impact/effectiveness of corrective measures not always studied in detail

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Transmission Protection Impacts of Reverse Power Flow

- **Reduced industrial and urban demand may impacts efficacy of underfrequency, under-voltage load-shedding schemes**

- **Potential Protection Impacts:**
  - Delayed clearance of transmission busbars faults due to DER short circuit current contribution
  - Ground fault overvoltage issues on tapped lines
  - Risk of sustained unintentional islanding of distribution feeders

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Congestion & Ancillary Services

- Operational conditions akin to weekends <u>thus far</u>

- No extraordinary activity noted in balancing or congestion relief markets in Europe – transmission assets managing voltage issues to same extent

- Open question around availability of industrial load to provide ancillary services through demand response

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Outage Coordination

- **Several systems cancelling outages**
  - By asset class
  - Urgent only
  - Regional restrictions

- **Previously cleared outages will have been studied under substantially different conditions to those expected**

- **Consideration to be given to outage coordination should restrictions be kept in place into / through peak load season**

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Summary of COVID-19 Related Operations Actions Taken by Various EPRI Members (Transmission and Distribution)

Disclaimer: The information presented here is based on information gathered from EPRI members. We do not present these as recommended or best practices, but we do present these as potentially useful information for utilities and system operators as they implement their own practices

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Summary of March 19th Webcast

Sanitary and Hygiene

- Limit common equipment usage. Limit direct interactions
- Consider standard issue computer / phone equipment for operators
- Consider clean turnovers
- Cleaning / disinfecting / sterilizing. Regular deep cleaning of CC facilities during the day

Staffing

- Identify key operational staff and some monitoring health
- Some implementing temperature checks at building or control center
- Non essential staff work from home. All face to face meetings (within company and without) cancelled

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Summary of March 19ᵗʰ Webcast

Control Center Strategies

- Split crews and key operational staff into groups
- Most utilizing main and backup CCs, some as active CCs, some keeping backup as a sterile site or have a sterile third control center.
- Shift cycles changing to limit turnover, preparing for extended stays for staff in control centers, with no external access. Pre-plan familial, other aspects.

Communications and Management

- Form managerial level team and exec team to report up to country/state response team. Business continuity plans pandemic response plans.

Planning for infectious outbreak

- Speed up training, quarantine and contact trace sick member, communicate with crisis response team.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Questions we are investigating

- Impact of drop in demand on system voltage / constraints.
  - To date load drop has not being below yearly valley load, continental European systems are summer peaking. Will be system dependent.
- Training and certifying staff?
  - Need to engage wider on this.
- What happens for infected staff?
  - At the moment following expert advise (isolate, contact trace etc)
  - Need to engage wider on how to mitigate and stop spread within office.
- Italy / China specific questions on control centers?
  - We are engaging to see if there are lessons to be learned Italy / China / Korea, but at this point most companies are taking major precautions.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

General Company Response and Notes

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

General Update

- Companies are using scenario planning at least on a 3 month horizon and longer
- Increasing shift to need to define critical operational roles and key staff
- Increasing shift to remote operation strategies and implementation.
- Companies following state/country guidelines for limits to numbers of people in groups (in the UK this is now 2 people)
- Many more utilities asking operators or staff to self monitor and report if they have a temperature or if they have a fever
  - Do not report to work if temperature exceeds a threshold or family member is sick
- Reported uptick in spearfishing and cyber malfeasance
- Need to communicate with state/country emergency response team on key functions and staff
- Some NERC and FERC regulatory, compliance relief granted last week

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Sanitary and Hygiene Basics

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Steps that Control Centers Have Implemented (US/EU)

Sanitary and Hygiene Basics

- **Alcohol sanitizing gels, sprays, wipes** available throughout control center and office
- Regular handwashing and hand sanitation emphasized for all staff, especially operators. **20 seconds per handwash**
- **Limit or restrict use of common equipment** such as phone receiver or mouse, keyboards which are particularly susceptible to germs
- Consider **standard issue equipment** for operators. Each operator responsible for their own equipment:
  - Wireless computer mouse and keyboards
  - Phone headsets
- Personalize stationary in control center (calculators etc.)
- **Wipe all equipment** pre and post shift. Reports of desks being disinfected 3 or more times per day
- Consider **"clean turnovers"** – turnover is given with operators on adjacent desks. When person leaving shift finishes, they wipe down desk and equipment and unplug headset / mouse USB point.
  - Person starting shift begins by wipe down of desk and plug in own headset and mouse
- **Keep at least 1 meter distance** during interactions with essential staff members in TCC and during turnover

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Steps that Control Centers Have Implemented (US/EU)

Sanitary and Hygiene Basics Continued

- Some utilities considering portable hand washing facilities in control center
- Disinfect door knobs, light switches, keyboards, touchscreens and work surfaces, etc. - shift changes
- Disinfect vehicle door handles, steering wheel, shifter, gas pump handles
- Avoid touching faces, and cover coughs and sneeze
- Masks would have to be changed several times daily due to saliva. With restrictions in place, most companies are not opting for using masks.
- Consider paperless control centers. Documents and paper can be vectors
- No eating at control center workstations

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Cleaning / Disinfecting / Sterilizing

Note the subtle difference in terminology:

- **Cleaning** - Removes debris

- **Disinfecting** - Removes most organisms from surfaces

- **Sterilizing** - removes all life including viruses, bacteria, fungi from workspace

➢ Engage external experts on the best solutions for workspaces and control center disinfecting and sterilizing

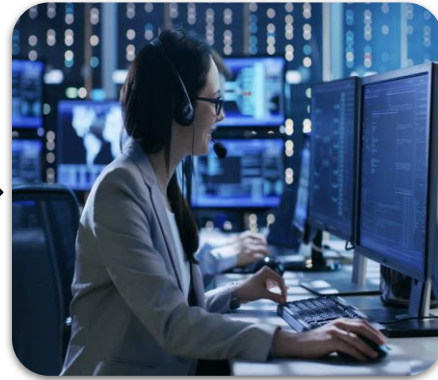The Greek TSO IPTO released this image of their control center

www.epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Staff Health and Monitoring

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Staff Health Monitoring

- Identify key operational staff in the company. All illnesses immediately reported to management for further advise, **no matter how small.** Report of a company implementing a dashboard to track staff sickness.

- Monitor body temperature for fever of every person entering building.

- Some investigating infrared tool for forehead temperature measurement without touching skin.

- One control center reported operators self monitoring with temperature check before and after each shift.

- Open question about temperature threshold for reporting to work or to allow entry into the building.

- Open question about metrics for return to work for staff member: One utility using 72 hours fever free and without medication.

- More reports of key staff health dashboards in China, operators required to report on health, travel and contacts twice per day.
  - Also similar reports at nuclear generation plants

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Control Center Buildings and Staffing

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Staffing in the Control Center – First Approach

Control Center A (main)

- Shift crew A with age and experience diversity
- EMS/IT support A
- Shift Supervisors A
- Key system ops staff A

Control Center B (backup)

- Shift crew B with age and experience diversity
- EMS/IT support B
- Shift Supervisors B
- Key system ops staff B

- Crews are not mixed. Multiple shifts in each site and/or handover to alternate site at end of shift crew cycle.

- Utilizing additional operator workstations in Storm Operations Centers, Backup Control Centers, Mobile Command Centers or regional control centers.

- Some CCs have adjusted the shift pattern to 2 x 12 hour from 3 x 8 to reduce turnovers and lengthen the cycles in each control center 8-15 days depending on staff

- Pre planning for critical staff (such as operators) for extended stays within the CC for up to 2 weeks.
  - Backup stock of food or clear supply line to food in each control center.
  - Plan for familial / child care impacts and mental health aspects of this approach.
  - Some utilities are restricting CC common area access. So this should be carefully managed.

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

Staffing in the Control Center – Second Approach

Control Center A (main)

- Normal operations
- Shift crew
- EMS/IT support
- Shift Supervisors
- Key system ops staff A

Control Center B (backup)

- Sterile site
- Locked down
- If outbreak in center A -> move operations to center B

- Sterile, locked down backup control center and offices if the main center gets infected or a staff member gets sick.

- Maintains continuity in main control center

- Hybrid approach is worth considering if available, two operational centers and a sterile, locked down site.

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Staffing in the Control Center – Third Approach

Daily Changeover

Control Center A (main)

- Shift crew A with age and experience diversity
- EMS/IT support A
- Shift Supervisors A
- Key system ops staff A

Control Center B (backup)

- Shift crew B with age and experience diversity
- EMS/IT support B
- Shift Supervisors B
- Key system ops staff B

- When changeover occurs, the empty site is deep cleaned and disinfected

- Always one clean site if there is an outbreak.

- Increase in facility switchover and risks associated

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Control Center Staff Practices

- Some locations: operations staff asked to stay at home when not on shift, limit contacts to only family and not to use public transportation.

- A few utilities reported checking individuals entering the facility, office or control center.
  - Utilities asking operators to self test themselves prior to coming to work.
  - One utility reporting operators self monitoring pre and post shift with non touch thermometers

- To limit physical distancing operators encouraged to use other communication methods such as text or instant messaging within the control center and between field operators

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Control Center Building and Staff

- **Distribution Control Centers:**
  - Some companies staff being sequestered in hotels and some in home self isolation. Cleaning of hotel carried out by utility contracted cleaners.
  - Crews being split into small A, B, C crews with minimal interaction to limit cross-contamination.
- **Sequestering Control Centers and Operations Staff:**
  - Utilities planning for it, no reports of any that have done so yet. It is usually at the highest level of a business continuity / pandemic response plan.
  - Postponing vacation: We have heard that leave has been cancelled in Europe, but this is expected. Companies have refunded cost of vacations for operators.
  - Distribution companies are canvassing staff for volunteers for sequestering
- **Control Center Air Quality:**
  - For AC systems in control centers, some utilities investigating the use of UV (ultra violet) or HEPA (high-efficiency particulate air) filters or retro fitting air systems to prevent / limit circulation in air. (More information needed)
- **Training:**
  - Some utilities utilizing web-based video applications (webex) for training
  - Retired staff or staff with lapsed certification being engaged to fill training pipeline. (Note health risk to older cohort)
  - Mutual assistance for grid operators of neighboring system operators. If there is familiarity with the E/DMS system and familiarity with the system operation in the area.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Distribution:- Remote Working for Control Centers

- In the absence of backup facilities, to decentralize system operations, some utilities have extended and set up operator workstations in IT areas such as communications rooms. (Within secure NERC perimeter to ensure compliance)

- Distribution: Some utilities testing or have implemented remote working for some operations tasks such as GIS modelling, switching plan creation, studies. Some distribution tools have remote capability.

- Customers with no backup power at home. Can implement geographic pairing, one in office and one remote as backup.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Preparing for an Infectious Outbreak

Pre Planning
- Grid operator new staff pipeline
- Accelerated training programs or certification if this is possible
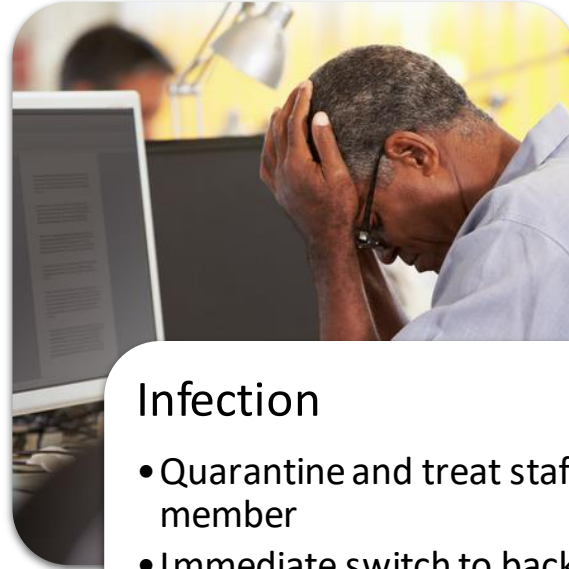
Infection
- Quarantine and treat staff member
- Immediate switch to backup Control Center
- Sterilization of infected control center
- Contact tracing with operations staff who interacted

Post Event
- Continued monitoring of operations staff health
- Communicate to appropriate crisis response agencies if required

Any other plans in place for grid operations in the event of infection? (Enter in Chat)

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Emergency Response Planning and Communications

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Steps that Control Centers Have Implemented (US/EU)

Country / State Crisis Response Team

↑

Operational executive level crisis management team

↓

Operational managerial level crisis management team

↓

Control Center A (main)

Control Center B (backup)

Emergency Response Planning

- Most companies have enacted business continuity plans and/or pandemic response plans, if available.

- Communicate to power stations and advise on emergency response operations. Ensure proper business continuity procedures are in place in critical power stations.

- Test critical station staffing protocols (from blackstart and storm restoration plan)

- Test external communications protocols (from blackstart and storm restoration plan).

- Distribution Operations is adapting storm restoration plans for the potential that Mutual Assistance will be unavailable.

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Other Publicly Available European News and Insights

Many companies proactively engaging the wider public to assure continued electricity operation and contingency planning

- Statnett Norway: only TSO we have monitored to publicly report a case of Covid-19 among one member of staff

- Swissgrid: Publicly state they are monitoring (temperature) of staff for fever.

- RTE France: Launched their official business continuity plan as of Monday 16th March

- National Grid UK ESO have posted a blog post by the Director explaining the response

- Red Eléctrica Spain: very active on LinkedIn with news updates to public; operating across three autonomous control centers, each capable of independently controlling full system; have deployed hygiene teams to work with staff

- AEMO Australia: Implemented full Pandemic Response Plan

We will continue to monitor and update with new information

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

www.epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Practices Related to Field Operations

Field Crew Operations Practices

- Reporting To Work:
  - Some utilities reported crews not reporting to head quarters, instead reporting to remote substations in staggered times.
  - Some being dispatched directly from home
  - Staggering start times, to stop unnecessary congregation at facilities

- Driving:
  - Some limiting to 1 person per vehicle
  - Some 2 per vehicle, 1 driving and the other in back on opposite side
  - Car pooling for operators should stop
  - Some companies allowing field crews use personal vehicles (reimbursing for mileage) to limit staff in trucks/cars.
  - Enhanced cleaning of trucks is required for common surfaces, steering wheel, door handles etc.

- Contractors for field works (non company employees)
  - Company reported that contractors are screened with questions prior to entry
  - Materials stores placed far from offices. Pick up/drop off is pre planned for day ahead.
  - Contractors scheduled to start shifts at different times.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Entering Customer Premises

- Some companies have limited entering customer premises or developing protocols such as:
  - Avoid physical contact with customer
  - Knock then step 3 steps back
  - Use hand sanitizer
- Some are actively reducing or eliminating customer work except emerging and limit to 2/3 person per job. Other actively reviewing customer work and outages.
  - Depending on state of business continuity stage, At highest state (mission critical) some are cancelling planned and capital works and only responding to emerging work.
  - Further investigation need on how this will impact summer network operations

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Emergency Response and Storm Events

- Some companies establishing minimum staffing levels of on call staff to respond to emergencies and storm.
- If an outbreak occurs and staff levels drop, geographic areas of response can be revised – increases response times, but maintains staff safety

- Storm response:
  - Plans being put in place for remote working for some elements of storm response – transferring control out of DCC and limit control center activity to bulk / feeder events.
  - Plans in place for decentralizing control to local supervisors to control their defined boundaries, if central dispatching is lost.
  - Some reported flexibility on boundary areas, to allow multiple areas respond to storm events.
  - Important that transfer of control authority is clear and documented. Some utilities working on documents to formalize it.

- Additional discussion with EPRI and DOIG are needed to discuss storm and emergency response implementation, mutual assistance, contractors, etc.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Practices Related to Office Work

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Practices Related to Office Work

> ## Practices Related to Office Work

- If staff have been **in an affected area** in the past two weeks leave work and **self isolate** for 2 weeks.

- **Managerial briefings given electronically** by company preferred means (email, IM, text, video conference)

- Most companies have:
  - Instructed all **non essential staff to work remotely**
  - Restricted access by **external people to offices**
  - **Restricted access** to floors that Control Centers, IT, market systems are on.
  - **No meetings, no walk throughs** on these floors, unless person's desk is on the floor. Controlled by security personnel. Reduce meetings & interactions generally.

**EPRI | ELECTRIC POWER RESEARCH INSTITUTE**

Remote Working for Staff

- Office Equipment variations in practices reported among companies:
  - Some allow employees to take all office equipment, chair etc.
  - Some allow 1 additional monitor
  - Some allow a laptop only
  - Companies increased data plans on cell phones and issued remote Wi-Fi spots.
  - TVs can be used as an extra monitor if needed

- For staff still in office (key staff) using office conference rooms throughout the building to key separate staff

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Impact on Demand of COVID-19 Shutdown

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

System Impact Classification
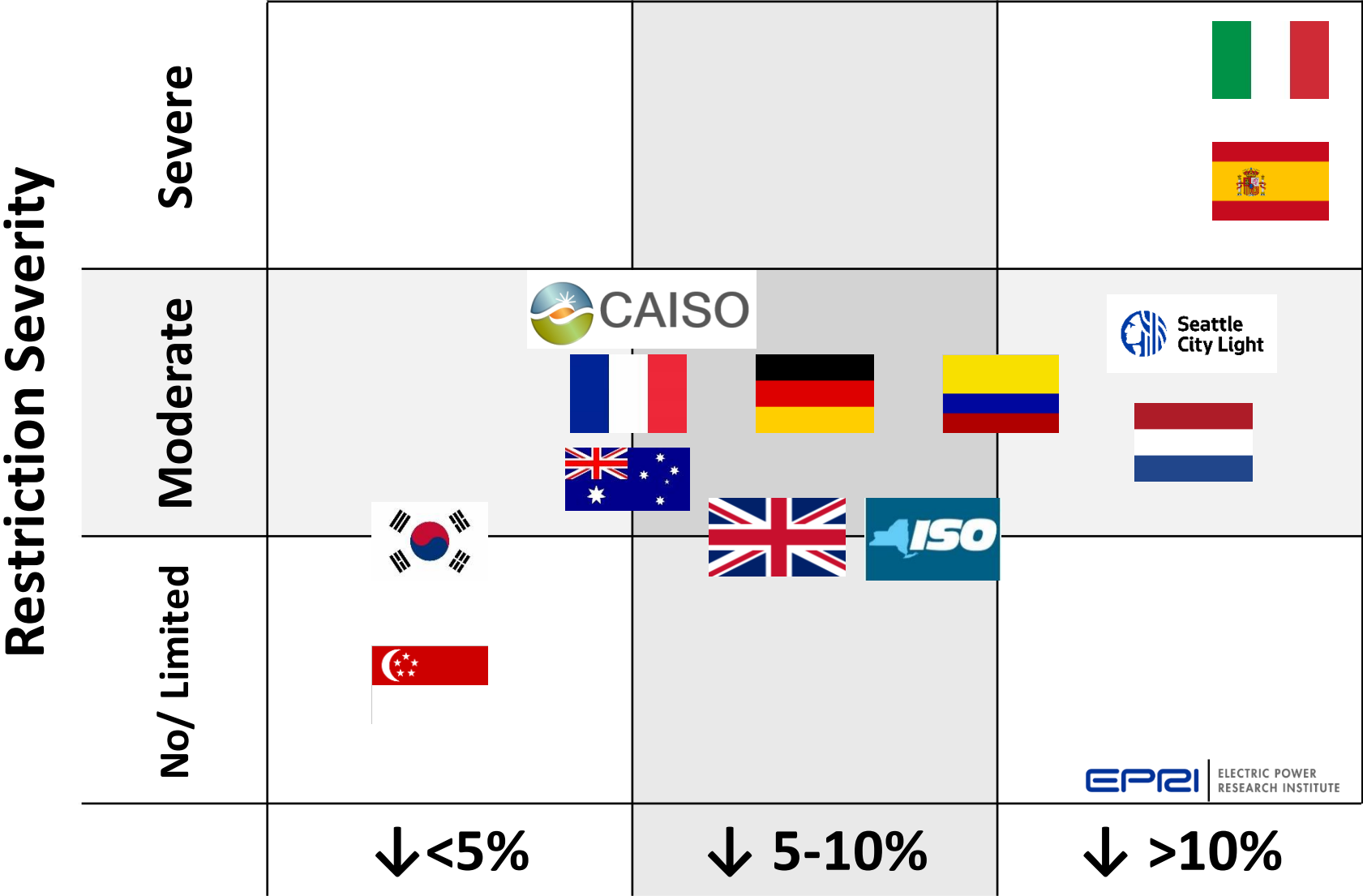
Effective: Mar 23rd
Data Sources: ENTSO-E, RTE, EMC, data.gov.kr, EIA

Key insights from Italy on demand impacts

Italia

PHASE	Partial shutdown	First Days	Weekend	Day 5-10
PEAK REDUCTION	**3%-4%**	**10%-14%**	**6%-10%**	**18%-22%**
NOTES	Only North Italy shut down and people adjusting	Reduction in weekday peak, and energy usage, year-on-year and compared to previous week	Min. demand, energy use reduction. Weekend demand still lower than weekdays	Peak and daily energy usage down year on year compared to same week last year

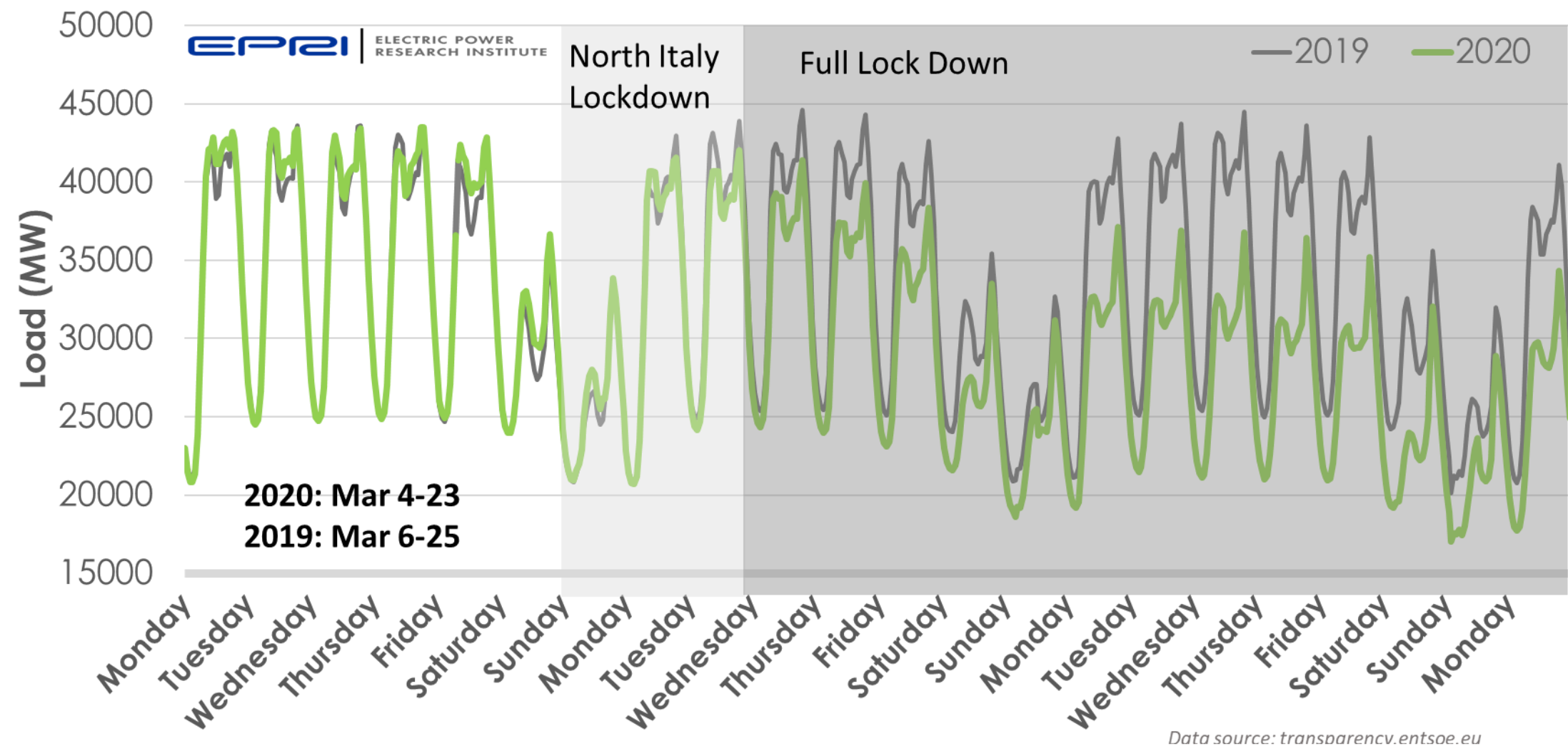## Analysis does not account for weather differences or non-COVID-19 economic factors.

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Key insights from Italy on demand impacts

- **Load shapes stay much the same** with reduction in magnitude, but some indications of lower morning peaks

- Day ahead **forecast mean absolute error 1**% worse first few days seems to be getting better since – back to pre-event

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Italian load in last 3 weeks – 2019 vs 2020

North Italy Lockdown

Full Lock Down

— 2019 — 2020

2020: Mar 4-23
2019: Mar 6-25

Load (MW)

50000
45000
40000
35000
30000
25000
20000
15000

Monday Tuesday Wednesday Thursday Friday Saturday Sunday Monday Tuesday Wednesday Thursday Friday Saturday Sunday Monday Tuesday Wednesday Thursday Friday Saturday Sunday Monday

Data source: transparency.entsoe.eu

Weather and economic growth impacts not considered but clear trend observable

w w w Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

Comparison: Electricity Consumption Mix
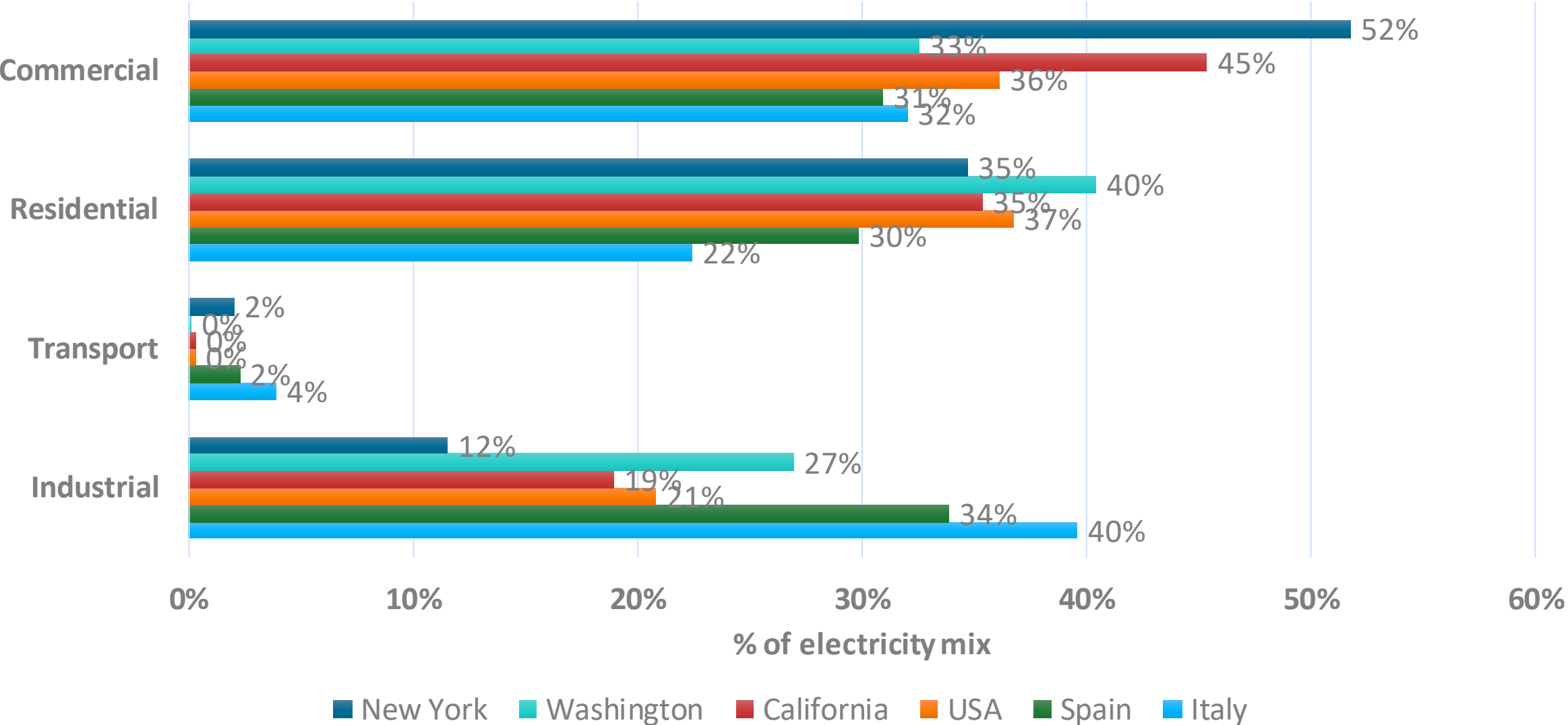
Comparison: Electricity Consumption Mix

- Residential lower in Italy than other countries examined
  → potential increase observed in that sector may be less noticeable than other regions

- Commercial very similar for Italy, Spain and US as a whole, higher in NY and CA
  →may result in greater reductions in commercial load in those regions

- Industry shutting down in Italy may result in even greater impact there than others

- Note: This is annual data, but monthly data for US states shows similar mix (higher industry in CA in summer)

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Key insights from Spain on demand impacts

Espana 🇪🇸

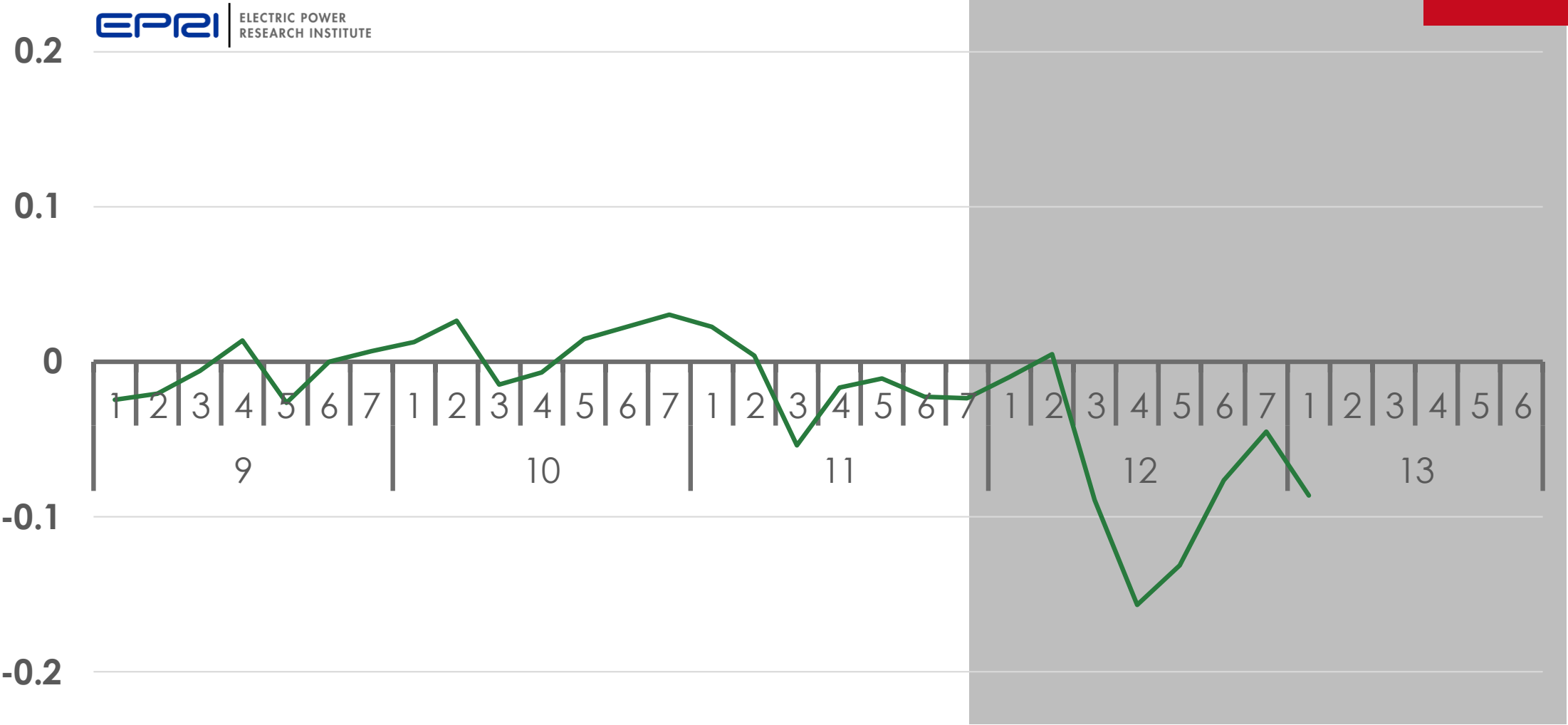| PHASE	First Work Week	First Weekend	Second Week
PEAK REDUCTION	0%-15%	2%-4%	9%
NOTES	Demand holds initially before dropping substantially as industry closes	Within range of normal weekend load	Monday showed signs of following first week with ~10% reductions initially

Analysis does not account for weather differences or non-COVID-19 economic factors.

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com
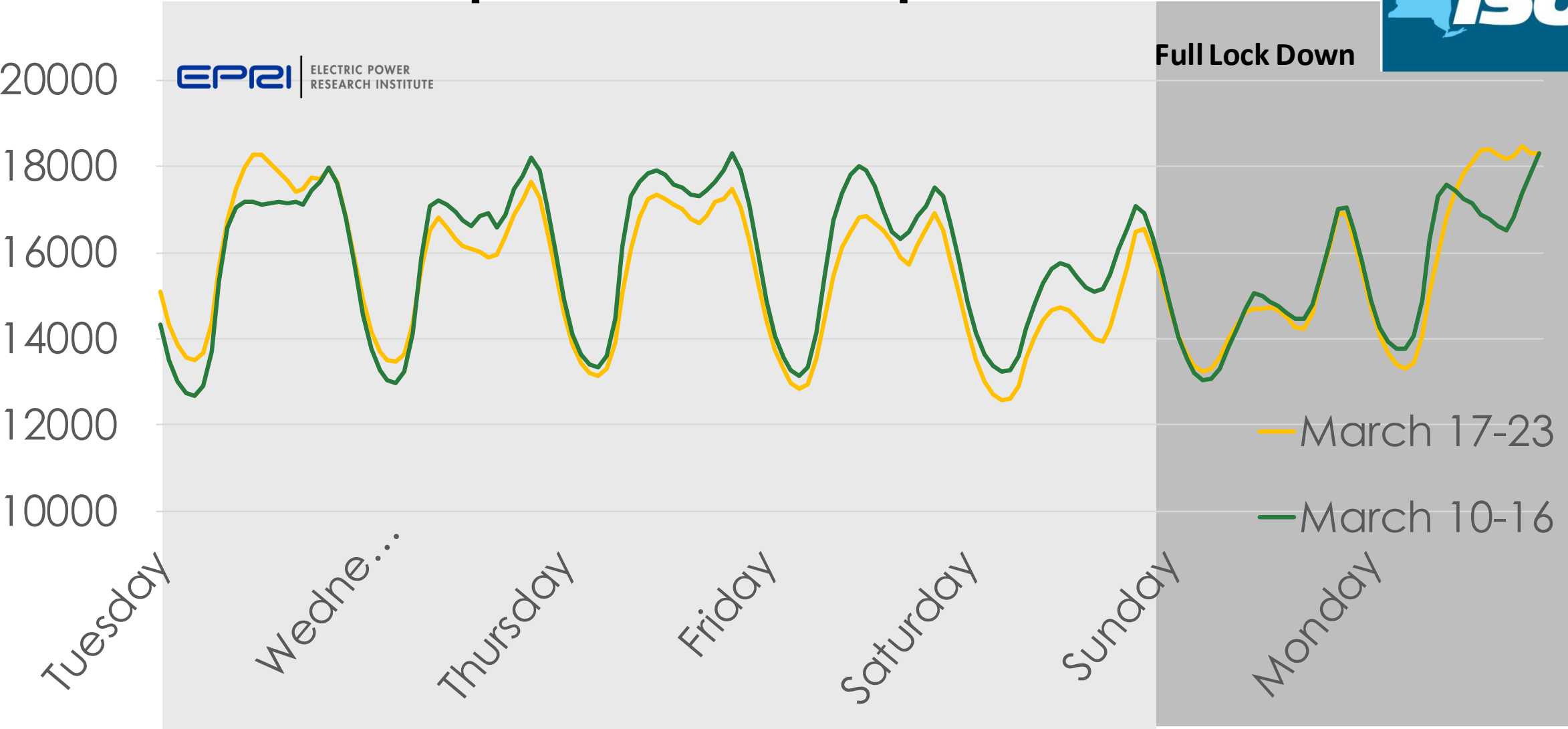
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Daily Peak Demand Spain

Full Lock Down

2019 — 2020

Week No / Day: 9, 10, 11, 12, 13
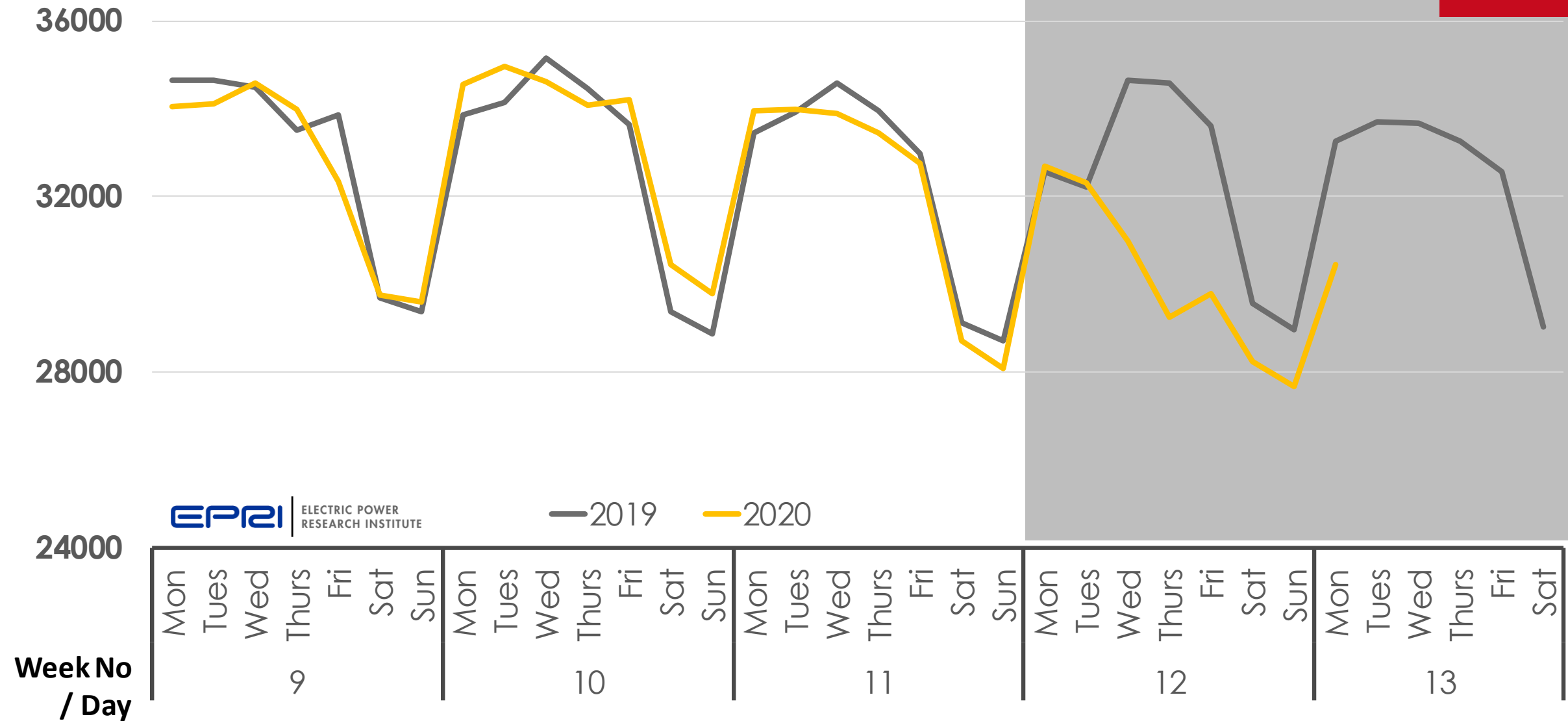
Changes in Daily Demand

NYISO load over past week and previous

Full Lock Down

| March 17-23 |
| March 10-16 |

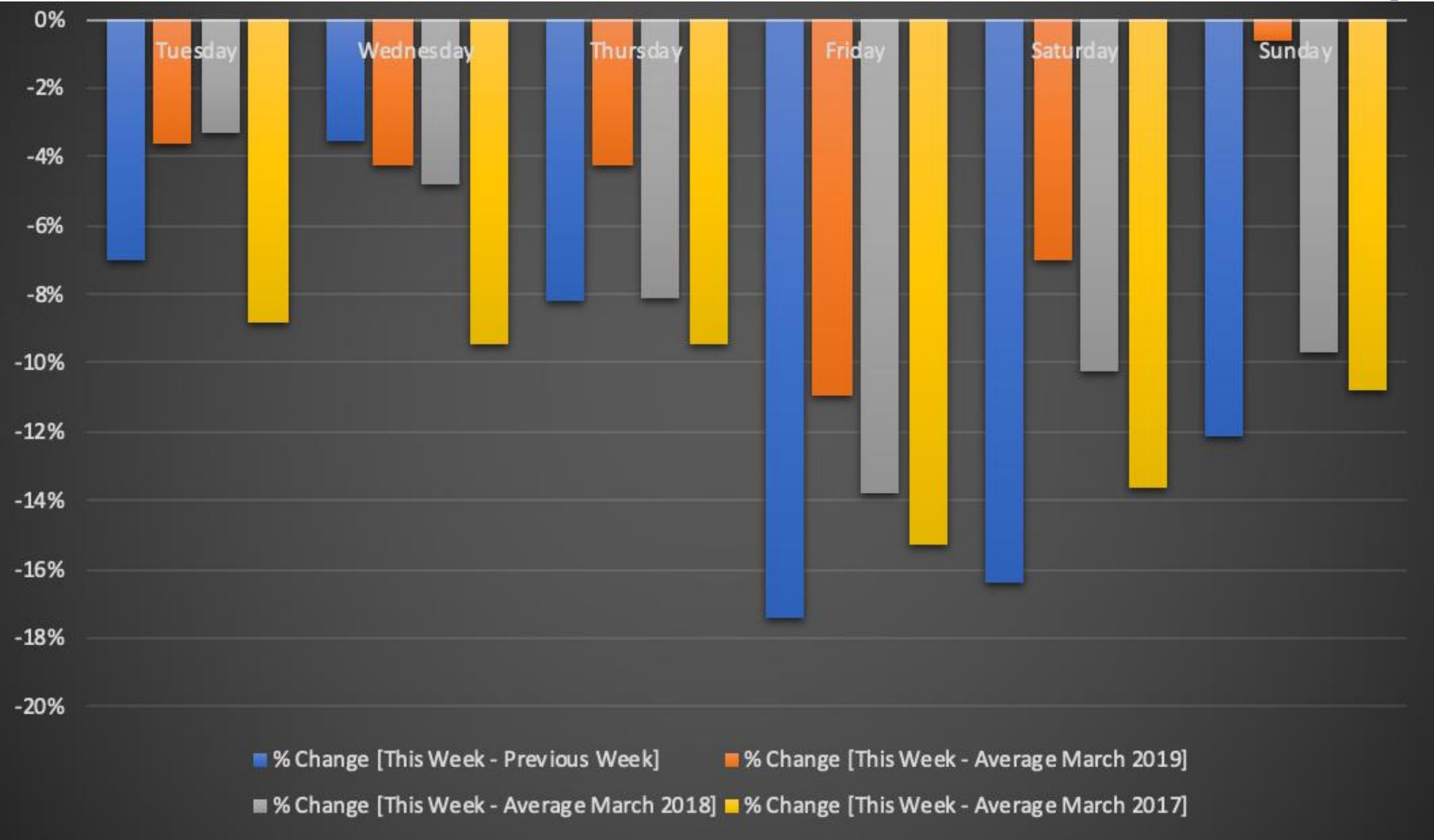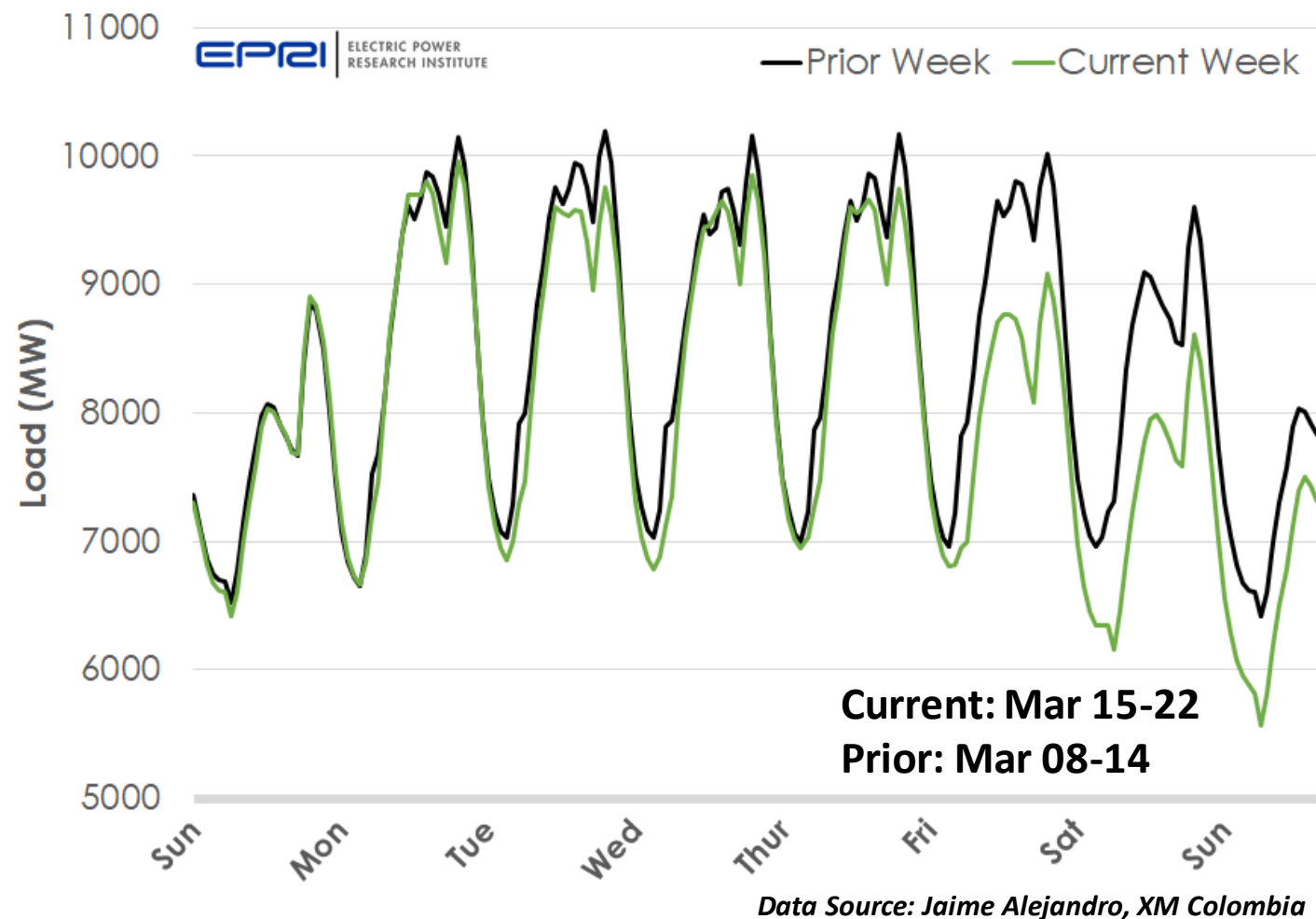**May have some impact on Friday, but very warm in NY (70sF)**

New York ISO – Demand Impacts
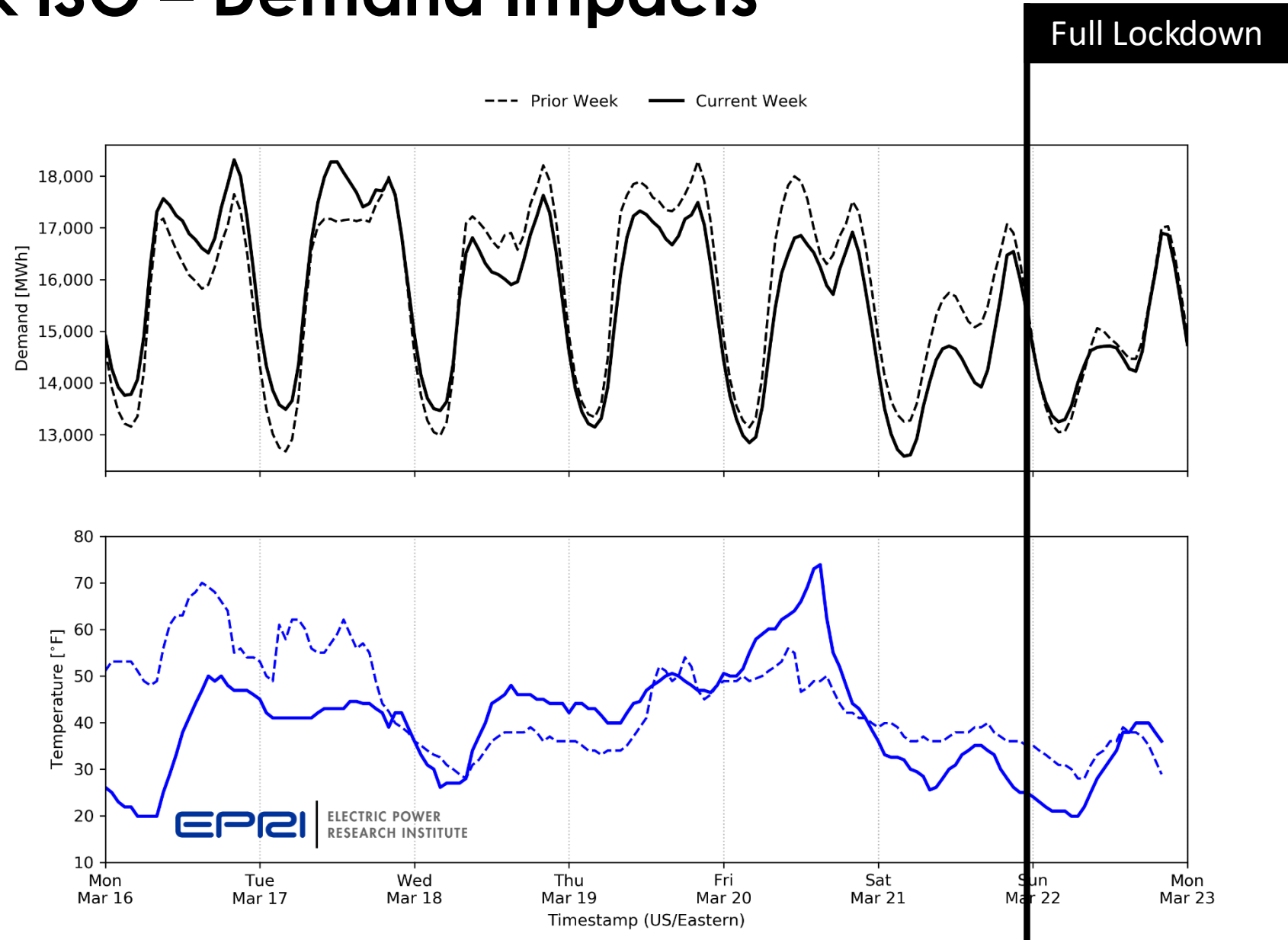
Seattle City Light – Energy Impact

Colombia: Regional shutdowns (Friday, March 20)

Data Source: Jaime Alejandro, XM Colombia

Current: Mar 15-22
Prior: Mar 08-14

Peak Demand
- Weekdays: 10% (Only Fri Mar 20)
- Weekend: 12% (Only Sat Mar 21)

Daily Energy Demand
- Weekdays: 9% (Only Fri Mar 20)
- Weekend: 13% (Only Sat Mar 21)

Min Demand
- Weekdays: 2% (Only Fri Mar 20)
- Weekend: 13% (Only Sat Mar 21)

Preventive isolation in some regions only began Friday, Mar 20.

Email any insights related to COVID-19 on electricity systems to our confidential inbox: covid19-grid-impact@epri.com

Open Questions

- How does this translate into Summer?

- How does duration of lockdown impact demand?

- Do load forecasts catch up quickly?

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Coronavirus COVID-19 in RT Operations

- Email setup for providing information or if you have questions on operations related issues: COVID19-GRID-IMPACT@epri.com

- Looking to setup information sharing microsite

- Open discussion on Coronavirus impacts – please share comments, thoughts or questions for EPRI SMEs or EPRI members on mitigating impacts of virus

Medium term: EPRI planning to develop a set of guidelines for TCC business continuity for a serious health issues or pandemics

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Together…Shaping the Future of Electricity

Prepared by Aidan Tuohy, Adrian Kelly, Brian Deaver, Eamonn Lannoye, Daniel Brooks

EPRI COVID Operations Helpline: COVID19-GRID-IMPACT@epri.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE