**UNITED STATES OF AMERICA**
**BEFORE THE**
**FEDERAL ENERGY REGULATORY COMMISSION**

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| **Grid Reliability and Resilience Pricing** | **)** | **Docket No. RM18-1-000** |
| **NOPR of the Office of the Secretary of Energy** | **)** | |

**REPLY COMMENTS OF THE FOUNDATION FOR RESILIENT SOCIETIES**

Submitted to FERC on November 7, 2017

The Foundation for Resilient Societies, Inc. (or "Resilient Societies") is a 501(c)(3) non-profit organization engaged in scientific research and education to protect technologically-advanced societies from infrequently occurring natural and man-made disasters. Resilient Societies appreciates the opportunity to provide reply comments on "Grid Reliability and Resilience Pricing" in FERC Docket No. RM18-1-000.[1]

On October 23, 2017, Resilient Societies filed comments in the above-captioned rulemaking proceeding established by the Federal Energy Regulatory Commission ("FERC" or the "Commission") to consider, implement, or modify the Grid Resilience Pricing Notice of Proposed Rulemaking ("NOPR") proposed by the Secretary of the Department of Energy (DOE).[2] Recognizing the unprecedented scope of public policy issues and public participation in this docket, Resilient Societies limits its responses to certain comments and issues raised.

# RTO/ISOs Dismiss Risks to America's Economy and Population

RTO/ISO commenters on FERC Docket No. RM18-1-000 narrowly focus on day-to-day reliability issues and put aside DOE's concerns on electric grid resilience to natural and man-made disasters. The RTO/ISOs apparently have trouble seeing the fundamental point of the

[1] Unless otherwise noted, all referenced docket comments are from FERC Docket No. RM18-1-000, "Grid Reliability and Resilience Pricing."
[2] Resilient Societies filed timely Comments on October 23, 2017, and corrected Errata in a secondary filing on October 24, 2017, within the extended filing period authorized by the Commission.

Department of Energy's proposed rule: America is at risk of a long-term blackout that could result in economic catastrophe and hundreds, thousands, or even millions of deaths. Instead, RTO/ISO commenters almost universally discount this threat to our nation.

Midcontinent Independent System Operator (MISO) states:

> *There are no imminent reliability / resilience issues in MISO.*

PJM states:

> *[T]he DOE NOPR offers nothing to show that market regions in general, or the PJM Region in particular, is in any danger of failing to meet reliability or resource adequacy requirements now or in the future. This is not surprising, as the PJM Region unquestionably is reliable…*

CAISO states:

> *Even if the rule were to apply to ISOs and RTOs without capacity markets, the CAISO already has mechanisms in place that ensure the CAISO BAA remains reliable and resilient in the face of unexpected loss of supply resources.*

NYISO states:

> *The NYISO is not aware of any imminent emergency likely to develop on the wholesale electric system that necessitates drastic and immediate action, particularly in the form proposed in the NOPR.*

ISO-New England states:

> *Given the ISO's retirement review process and the development of new resources in the region, as well as existing market and operational tools, the New England power system will remain reliable through at least 2022 barring a significant event at a key facility in the region.*

## Concerned Parties Agree With the Department of Energy

In their docket comments, citizens and technical experts alike agree with DOE's concerns and support its directive to improve electric grid resilience.

Trayce Bradford, President of the Texas Eagle Forum, and 72 other concerned citizens made this comment in the Docket:

> *Having 90-day fuel supplies ready for each power station and grid to get up and operational on their own after natural disaster, cyber, solar, or an EMP event would be an enormous help. It would also be one way to dissuade other nations from war and warlike aggression in this area.*

In his comment, Fred A. Reitman of Houston, Texas states:

> *The directive is particularly timely in light of recent advances by North Korea in nuclear weapon and ICBM development, as well as their recent threats to attack the U.S. via electromagnetic pulse (EMP) using these weapons. Both North Korea and Iran know our grid vulnerability affords them means to an asymmetric attack on us. This is but one reason to expedite rule making as Sec. Perry has directed…The Nov. 2, 2015 letter from 23 members of Congress to Texas Gov. Abbott briefly summarizes threats to the grid and potentially catastrophic consequences of grid shutdown. It cites the estimate that up to 90% of Americans would perish within a year of such a severe grid shutdown.*

William R. Graham, outgoing chairman of the Congressional EMP Commission, states in his comment:

> *I urge you, the [FERC] Commissioners entrusted with the reliability of our electric grid and other energy systems, to respond fully and completely to the Secretary's initiative to make our grid more resilient by ordering that critical, long lead-time elements of our power grids, beginning with nuclear power reactors, large power transformers, and electronic system controls, be modified to survive nuclear EMP. Your bold action is essential to enhance deterrence and if necessary survive EMP attack…The government of North Korea may be the first, but it will not be the last nation to threaten explicitly our*

*survival by targeting our critical infrastructures with high altitude nuclear EMP. The U.S. in general and the FERC in particular would be taking a grave and unjustified risk with the future of our country if you ignored specific North Korean threats.*

In the Exelon comment, the testimony of Dr. Paul Stockton brings forth issues similar to those in the previously submitted docket comment of Resilient Societies:

> ***WHAT SPECIFIC RISKS DO YOU SEE?*** *In addition to the risks specified in the Notice, I would call the Commission's attention to three specific challenges: First, reliance on a single fuel creates the danger of "common mode failures" where a lack of natural gas incapacitates multiple generators at the same time. Second, such failures could help create "black sky" power outages, which would entail outages lasting a month or more over multiple regions of the United States. Third, rising gas-electric interdependencies create dangers of mutually-reinforcing failures…*
>
> ***WHAT WOULD BE THE CONSEQUENCES OF A "BLACK SKY" OUTAGE?*** *A black sky power outage would inflict immense disruption on national security, the U. S. economy, and public health and safety.*

## Fuel Insecurity for Gas-Fired Generators Is Real

In his comment, Michael Moore, an independent consultant to the energy industry and prior Director of Marketing for Falcon Gas Storage, gives critical information on fuel insecurity for gas-fired generators:

> *During the Polar Vortex, the entire gas system operated as hard it could to move in gas needed to meet the extraordinary demand, including tremendously drawing down stored gas…For many months after, a situation of exceptional insecurity and risk persisted…Because of the extraordinary demand noted above, the entire U.S., east of the Rocky Mountains, was very close to a natural gas system-wide shortage event…Had the country experienced another Polar Vortex the following winter, the country would not have been able to sustain electricity supply during that period, because gas supply was still in a depleted state.*

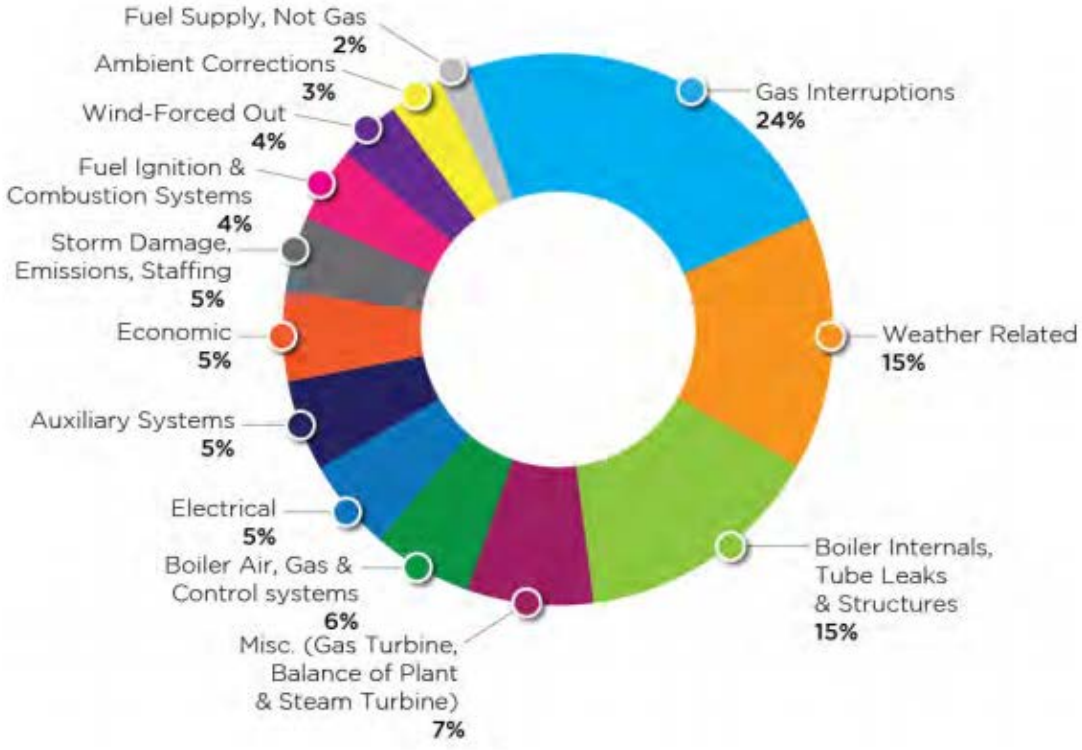
Despite near-blackouts during the 2014 Polar Vortex, numerous commenters still maintain that fuel security for gas-fired generators is a non-issue and therefore the DOE proposal for 90 days of fuel stored at generator sites is unwarranted. Several dozen commenters, including pro-gas trade associations and environmental groups, reference a misleading Rhodium Group study placed on the Docket.[3] This study concludes:

> *We find that between 2012 and 2016, utilities reported roughly 3.4 billion customer hours impacted by major electricity disruptions. 96% of those lost service hours were due to severe weather…Fuel emergencies or deficiencies at power plants resulted in 2,382 customer hours of lost service or 0.00007% of the total.*

By excluding records of gas interruptions and "close calls" where blackouts nearly occurred, the Rhodium Group has ignored a longstanding and well-documented record of fuel insecurity for gas-fired generators, especially in PJM and ISO-New England.

[3] Larsen, John, Marsters, Peter, and Houser, Trevor. "Electric System Reliability: No clear link to coal and nuclear." Comment of John Larsen, Director at the Rhodium Group LLC. under FERC Docket RM18-1-000. Rhodium Group, October 23, 2017.

**Figure 16: Causes of Forced Outages – January 7, 7:00 p.m.**




The above graphic shows that during the January 7, 2014 Polar Vortex, "gas interruptions" accounted for 24% of forced outages in PJM. In fact, gas interruptions were the No. 1 cause of generator outages during this day of the Polar Vortex.[4]

In New England on January 7, 2014, 1,473 MW of natural gas generation was lost due to inability to obtain fuel, leaving a razor-thin capacity margin of only 44 MW out of 23,792 MW total.[5]

[4] PJM. "Analysis of Operational Events and Market Impacts." Report. PJM Interconnection, May 8, 2014. http://www.pjm.com/~/media/library/reports-notices/weather-related/20140509-analysis-of-operational-events-and-market-impacts-during-the-jan-2014-cold-weather-events.ashx

[5] ISO New England. "January 2014 FERC Data Request." ISO New England Inc. System Operations, January 10, 2014 https://www.iso-ne.com/static-assets/documents/pubs/spcl_rpts/2014/iso_ne_response_ferc_data_request_january_2014.pdf

The 2012-2016 time frame for the Rhodium Group study falls just short of including the 2011 Southwest Cold Weather Event that disrupted natural gas operations and electric generation across several states. Since the impacts of fuel insecurity can be more significant than transmission and distribution network outages but occur only infrequently, an appropriate analysis of fuel insecurity should include a longer time horizon.

FERC's own report on the 2011 Southwest Cold Weather Event documents a long record of natural gas interruptions and resulting generation losses from 1989 to 2011.[6] This joint FERC/NERC report provides a reference table of ERCOT generation outages due to natural gas issues during the 2011 Southwest blackouts:[7]

[6] Staffs of FERC and NERC. "Report on Outages and Curtailments During the Southwest Cold Weather Event of February 1-5, 2011." Report. FERC and NERC. August 2011. https://www.ferc.gov/legal/staff-reports/08-16-11-report.pdf

[7] Ibid, p. 153.

## February 2011 Generation Capacity Reductions in ERCOT Due To Fuel Curtailment and Fuel Quality Problems

| Generator | Trip Time | Unit | Gen MW | MW Reduction | Pipeline (s) |
|---|---|---|---|---|---|
| Bosque Power Company | 2/2 9:26 AM | Bosque Power: Unit 1, Unit 2, Unit 3, and Unit 4 | 597 | 154 | Enterprise Texas Pipeline, Markwest Lateral |
| Calpine | 2/4 7:55 AM | Corpus Christi: GT1, GT2, and ST1 | 516 | 174 | South Cross CCNG Transmission |
| City of Austin (Austin Energy) | 2/2 7:30 AM | Decker : Unit 2 | 450 | 100 | Enterprise Texas Pipeline / Atmos Texas Pipeline |
| Power Resources | 2/2 5:14 PM | Cal Energy: Unit 1 | 212 | 7 | ONEOK WesTex Transmission |
| Luminant | 2/1 10:00 AM | Lake Hubbard: Unit 1 | 441 | 174 | Atmos-Texas Pipeline |
| GEUS | 2/1 9:00AM | GEUS Steam Plant | 112 | 112 | Atmos-Texas Pipeline |
| Exelon | 2/1 7:30 PM<br>2/2 11:00 AM<br>2/2 3:00 PM<br>2/2 6:00 PM | Mountain Creek: Unit 6, Unit 7, and Unit 8 | 808 | 476<br>396<br>476<br>396 | Atmos-Texas Pipeline and Energy Transfer Fuel |
| Frontera Generation | 2/2 8:16 AM | Frontera: Unit 1, Unit 2, and Unit 3 | 485 | 85 | Kinder Morgan Tejas |

As further documented in the FERC/NERC report, prior cold snaps in 2003 and 1989 caused gas interruptions to generators, electric grid frequency reductions, and blackouts:

- Between February 24 and 25, 2003, 5,500 MW of gas-fired generation capacity in ERCOT was lost due to curtailments. At 9:08 AM on February 25, 2003 gas curtailment to a power plant in ERCOT caused three units to trip, resulting in the loss of 745 MW of generation. System frequency dropped to 59.81 Hz and could not be restored.[8]
- On Friday, December 22, 1989, ERCOT experienced-high loads and a large number of generating units being forced offline due to gas curtailments. Also, switching from natural gas to fuel oil caused loss of 1,500 MW of generation. At 7:49 AM on Saturday, ERCOT directed the utilities that were generation deficient to shed firm load. Altogether, 1,710 MW of load was shed by three utilities.[9]

The gas interruptions during the 2014 Polar Vortex, as well as the 1989, 2003, and 2011 events in the American Southwest, should serve as warning signs. If the U.S. electric grid were to be hit with a cyberattack, electromagnetic pulse attack, or severe solar storm, natural gas interruptions could be pervasive. [10]

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[8] Ibid, pp. 170-171.

[9] Ibid, p. 174.

[10] The Commission should take notice of the November 20, 2014 public testimony by Admiral Michael Rogers, Director of the National Security Agency and Commander, Cyber Command, before the House Permanent Select Committee on Intelligence, stating that it was not a question of "if" but "when" a cyber attack on U.S. critical infrastructures would occur.

The Commission should also take notice of the February 1, 2017 Report of the Defense Science Board Task Force on Cyber Deterrence, stating: "…major powers (e.g. Russia and China) have a significant and growing ability to hold U.S. critical infrastructure at risk via cyber-attack, and an increasing potential to also use cyber to thwart U.S. military responses to any such attacks. This emerging situation threatens to place the United States in an untenable strategic position…Hardening and increasing the resilience of the most vital critical infrastructure systems -- including electricity, water, and waste water -- is urgently needed to bolster deterrence by denial and by cost imposition." Intro and p. 7.

The Commission should take notice of recent threats by the government of North Korea to employ high altitude electromagnetic pulse (HEMP) thermonuclear weapons, a category of threats addressed in Chapter 2 of the National Critical Infrastructure Report of the EMP Commission, April 2008.

The Commission should also take notice of the risks to the electric grid from severe solar geomagnetic storms, with a probability of occurrence of roughly 10 to 12 percent per decade. See InfraGard Special Interest Group, *Powering through: From Fragile Infrastructures to Community Resilience*, Version 1.0 (InfraGard, 2016), at p. 3 and footnote 9.

## "Ghost Capacity" Can Disappear During Emergencies

We commend DOE for initiating this rulemaking, because the docket process has exposed important information that might otherwise be withheld from the public. From docket comments, we find out that ratepayers are being unjustly charged for "ghost capacity"—electric generation capacity that lacks fuel stored on-site and therefore can disappear during emergencies, when it is needed the most.

In his comment, energy industry insider Michael Moore reveals that natural gas-fired generators do not provide reliable capacity unless there are firm supplies of gas stored nearby:

> *Natural gas units do not have the assurance of fuel on site, and cannot approximate matching such security unless there is a natural gas storage facility within a close radius, operating within its operating parameters, with a set-aside buffer of working gas available to the facility (i.e., mandatory firm storage coupled to physical gas in storage), with firm delivery contracts that provide for delivery in the contingency of pipeline disruption, and priority of delivery over other customers.*

In their comment, the Interstate Natural Gas Association of America discloses many generators in RTO/ISO imprudently rely on interruptible gas, instead of firm supplies:

> *[I]t must be noted that many generators in ISO and RTO markets choose to rely upon interruptible or secondary firm transportation service, instead of primary firm transportation service. Natural gas and pipeline transportation are extremely reliable, as proven by the industry's record. However, there are regions and periods where pipeline capacity is constrained and primary firm gas transportation may be required for a generator to have fuel security.*

The Algonquin Gas Transmission comment confirms that 96% of its gas-fired generation in New England relies on non-firm gas—a potentially fatal flaw when half of electricity consumed in New England is gas-fired:

> *Remarkably, of the 60% of natural gas-fired generation in New England that is directly connected to Algonquin and its affiliate systems, only 3.8% is supplied under firm*

*pipeline contracts…On one of the coldest winter days in January 2014, only 3,100 MW of natural gas-fired generation was able to run and the average day ahead energy clearing price in New England was $360/MWH; meanwhile, 70 percent of those power plants that could only run on gas sat idle due to lack of pipeline capacity.*

Encouraged by the comments of Michael Moore, Interstate Natural Gas Association of America, and Algonquin Gas Transmission, we undertook a study of the Forward Capacity Market for ISO-New England. We obtained the generator-by-generator results of the Forward Capacity Auction (FCA) No. 11 from ISO-New England and categorized the cleared capacity for January 2021 by energy source.[11] We made downward adjustments for capacity that is "intermittent," relies on just-in-time fuel supplies, relies on demand response that supplies no real or reactive power during emergencies, or is imported over contingency-prone transmission lines. We also made downward adjustments for generator availability, using Availability Factors from the NERC 2016 Generating Unit Statistical Brochure.[12] We compared our estimate for net available capacity to real peak summer load for 2016.

[11] In the October 23, 2017 Comments of Resilient Societies in this Docket, we develop and display a bar chart showing "Winter Peak-Day Natural Gas Supply and Demand in New England." A single pipeline system, that of Algonquin [Gas Transmission, LLC], is projected to supply 1.91 BCF of natural gas to ISO-New England in year 2018 and 2.10 BCF of natural gas to ISO-New England in year 2025. We estimated that "loss of the Algonquin pipeline in 2018 would result in loss of about half of the fuel supply for gas-fired plants; loss of this pipeline in 2025 might result in loss of about two-thirds of the fuel supply for gas-fired [electric generation] plants."

[12] North American Electric Reliability Corporation. "NERC 2016 Generating Unit Statistical Brochure – Units Reporting Events." NERC, August 17, 2017. http://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx

# "Ghost Capacity" Scenario in ISO-New England under Forward Capacity Auction No. 11

## Megawatts of Capacity

| Energy Source | Jun-Sep 2020 Cleared Capacity | Intermittent | Just-In-Time Fuel | No Real and Reactive Power in Emergencies | Imports | Ghost Capacity | Cleared Capacity Net of Ghost Capacity | Availability Factor | Net Available Capacity |
|---|---|---|---|---|---|---|---|---|---|
| Coal | 917 | 0 | 0 | 0 | 0 | **0** | 917 | 83% | 763 |
| Nuclear | 3,344 | 0 | 0 | 0 | 0 | **0** | 3,344 | 93% | 3,094 |
| | | | | | | | | | |
| Fuel Oil | 4,940 | 0 | 0 | 0 | 0 | **0** | 4,940 | 84% | 4,157 |
| Jet Fuel & Kerosene | 1,043 | 0 | 0 | 0 | 0 | **0** | 1,043 | 91% | 944 |
| | | | | | | | | | |
| Natural Gas-Dual Fuel | 7,600 | 0 | 0 | 0 | 0 | **0** | 7,600 | 82% | 6,239 |
| Natural Gas-Mystic LNG | 1,984 | 0 | 0 | 0 | 0 | **0** | 1,984 | 82% | 1,629 |
| Natural Gas-Single Fuel | 7,301 | 0 | 7,301 | 0 | 0 | **7,301** | 0 | 82% | 0 |
| | | | | | | | | | |
| Hydropower Local | 3,122 | 250 | 0 | 0 | 0 | **250** | 2,872 | 81% | 2,319 |
| Solar | 66 | 66 | 0 | 0 | 0 | **66** | 0 | n/a | 0 |
| Wind | 137 | 137 | 0 | 0 | 0 | **137** | 0 | n/a | 0 |
| Waste, Biomass, Steam | 935 | 441 | 0 | 0 | 0 | **441** | 495 | 82% | 406 |
| | | | | | | | | | |
| Demand Response-Passive | 2,791 | 0 | 0 | 2,791 | 0 | **2,791** | 0 | n/a | 0 |
| Demand Response-Generator | 4 | 0 | 0 | 0 | 0 | **0** | 4 | 100% | 4 |
| Demand Response-Load Shed | 416 | 0 | 0 | 416 | 0 | **416** | 0 | n/a | 0 |
| | | | | | | | | | |
| Hydropower Imports | 896 | 0 | 0 | 0 | 896 | **896** | 0 | n/a | 0 |
| Other Imports | 339 | 0 | 0 | 0 | 339 | **339** | 0 | n/a | 0 |
| Totals | 35,835 | 894 | 7,301 | 3,207 | 1,235 | **12,638** | 23,197 | 84% | 19,555 |
| Percent of Cleared Capacity | 100% | 2% | 20% | 9% | 3% | **35%** | 65% | | 55% |
| Percent of Net Available Capacity | 183% | 5% | 37% | 16% | 6% | **65%** | 119% | | 100% |
| | | | | | | | | | |
| | Net Real Load | Net Available Capacity | | Surplus/Deficit | | | | | |
| August 12, 2016 Summer Peak | **25,596** | **19,555** | | **-6,041** | | | | | |

We found that approximately one third of ISO-New England capacity is "ghost capacity"—capacity that could disappear in a grid emergency. We also found that when further adjustments are made for availability of generators, the available capacity of ISO-New England in 2020 would be significantly below the peak real load experienced during summer 2016.

Importantly, we divided natural gas generation into three subcategories: "Natural Gas-Dual Fuel," "Natural Gas-LNG Nearby," and "Natural Gas-Single Fuel."[1] The "Natural Gas-Dual Fuel" category represents generators that primarily run on natural gas but have backup capability to run on fuel oil.[2] The "Natural Gas-LNG Nearby" category represents units of the Mystic Generating Station that are adjacent to the Distrigas Liquefied Natural Gas (LNG) facility. The "Natural Gas-Single Fuel" represents generators that run only on natural gas—commonly modern, high efficiency Combined Cycle Gas Turbines (CCGT). Because "Natural Gas-Single Fuel" units rely on non-firm gas that can be interrupted by diversion to home-heating and industrial customers, or by common-mode pipeline failure, these units are a primary contributor to "ghost capacity."

Significant insights are available from this analysis. First, the majority of coal and nuclear capacity in New England has already retired; when adjusted for availability, these generators will represent only 20% of Net Available Capacity in 2020. A FERC rule to protect coal and nuclear plants from retirement would have some benefit, but would not itself provide security. Instead, in order to bolster grid resilience, gas must be stored nearby natural gas-fired

[1] To develop our Natural Gas-Dual Fuel category, we matched data from the U.S. Energy Information Administration (EIA) Form EIA-860 on energy sources for individual generators to generator-by-generator cleared capacity for FCA No. 11. Where matching with the EIA data was not possible, we performed our own research on dual-fuel capability at generators using public internet sources. When complete data was not available for individual units at a facility, we assumed that the megawatt capacity of all units is "dual fuel." We also assumed that switching to fuel oil would not down-rate the capacity of generating units.

[2] Natural gas-dual fuel units may have significant capacity reductions when running on fuel oil. Moreover, the duration of fuel stored in on-site tanks may be only a few hours or days. We do not account for these less optimistic limitations in our "ghost capacity" analysis.

generators or, alternatively, the generators must be converted to "dual fuel" with prudent amounts of on-site fuel storage.[3]

We found that 26% of our estimated Net Available Capacity is at generation plants running on fuel oil, jet fuel, and kerosene. According to ISO-New England, 4,289 megawatts of capacity in these categories are at risk of retirement, out of a total of 5,983 megawatts in these categories—a stunning 72% of this resilient capacity is at risk.

Our "ghost capacity" analysis for ISO-New England is necessarily preliminary for multiple reasons, but mostly because we do not have access to detailed engineering data for each plant, nor are we familiar with their operating protocols. For example, when switching to fuel oil, the capacity of some plants may be down-rated. We respectfully suggest that FERC ask each RTO/ISO with a capacity market to perform a "ghost capacity" analysis and to present the results at a publicly-accessible technical conference supporting Docket RM18-1-000.

## Ratepayers Are Unjustly Charged for "Ghost Capacity"

When a detailed examination of the ISO-New England capacity market is performed, it becomes clear that ratepayers are being unreasonably and unjustly charged for "ghost capacity." For example:

- Ratepayers pay the same per kilowatt-month charges for capacity at gas-fired generators that prudently invest in dual fuel capability (or nearby LNG regasification with firm delivery) as ratepayers pay for capacity at generators that use interruptible gas from pipelines.
- Ratepayers are being charged for "passive demand response" capacity—the estimated megawatts saved by efficiency measures such as LED lighting. None of these megawatts

[3] Potomac Economics, which has market monitoring functions for the NYISO and ISO-NE, concludes that "New York and New England…are both more vulnerable to natural gas supply contingencies…Reliance on dual-fuel capability (generally the ability to switch from natural gas to on-site oil) has been the most effective and cost-effective means to address natural gas system contingencies." See Potomac Economics, Ltd. Comments in Docket RM18-1-000, Oct. 20, 2017, at p. 6.

(or "negawatts") can be used for prioritized grid restoration and none have real or reactive power to contribute in emergencies.

- Ratepayers pay the same per kilowatt-month charges for "intermittent" capacity that comes from wind or landfill gas generators as ratepayers pay for dispatchable power from non-intermittent generators. Notably, this intermittent power does not provide the same reliability or resilience benefits.
- Ratepayers pay the same per kilowatt-month charges for imported power (over transmission lines susceptible to outage from cyber-attack, physical attack, severe solar storms and electromagnetic pulse attack) as for power locally generated. [4]

We calculated that New England ratepayers are being charged billions of dollars for "ghost capacity" enabled by phantom fuel, passive demand response, and contingency-prone long-distance transmission. We estimate that one-third of ratepayer charges for capacity markets in New England are for "ghost capacity," or about $100 per ratepayer annually for the most recent capacity auction. [5]

## FERC Actions to Reform Capacity Markets

We note that the Commission has, in January 2007, disallowed double charging for reserve capacity and for emergency energy costs.[6] But more recently, FERC has allowed recovery of

[4] A consistently high source of imports for ISO-New England is the Hydro-Quebec Phase II line, a High Voltage Direct Current (HVDC) link with a history of tripping off.[4] Solar storms caused the Phase II HVDC link to trip off on March 24, 1991 and again on October 28. See Leonard Bolduc, "GIC observations and studies in the Hydro-Quebec power system," *Journal of Atmospheric and Solar-Terrestrial Physics* 64 (2002) p. 1793. Available at: http://www.sciencedirect.com/science/article/pii/S1364682602001281. On December 4, 2014, imports from Canada were interrupted by an airborne terrorist attack on the Hydro-Quebec transmission lines near James Bay, Quebec. See Behr, Peter. "Outage on Quebec power grid traced to airborne attacker." *Energywire*. June 17, 2015. https://www.eenews.net/stories/1060020352

[5] In FCA No. 11 for ISO-New England, the total estimated cost will be $2.3 billion. In its "Key Grid and Market Stats" webpage, ISO-New England discloses there are 7.1 million retail electricity ratepayers in the region.

[6] See Energy Services, Inc. Westar Energy, Inc. Oklahoma Gas & Electric et al., 117 FERC ¶ 61127, Jan. 31, 2007. The Commission determined: "…it would be unjust and unreasonable for [the utility] to recover under ancillary service schedules a contribution towards its overall capacity costs … and also recover those same costs from customers who obtain emergency service…a just and reasonable emergency energy rate should reflect only the actual costs of emergency energy and should not include capacity costs…reserve sharing charges can be based on the higher of

both capital costs and emergency energy costs. These practices are ripe for reform, to reward providers of emergency capacity when it is needed, but not to pay for *faux* capacity that cannot in fact be delivered when needed.

More recently, the Commission has allowed cost recovery for capital assets supposedly available for emergency participation in forward capacity markets, and the Commission has recognized that penalties for non-participation during supply shortages may be inadequate. So FERC has required that penalties be increased for non-availability of reserve capacity under contract in real-time markets.[7] The Commission has addressed inadequacies of "shortage pricing" under the authority of Section 206 of the Federal Power Act.[8] The Commission has also increased "offer caps" in RTO and ISO markets, but these market caps may still "suppress locational marginal prices (LMPs) below the marginal cost of production."[9]

Resilient Societies supports market-based financial incentives for resilient generating capacity and for energy supply and ancillary services during emergencies. We urge the Commission -- in parallel with efforts to strengthen incentives for resilient capacity and for adequate fuel supplies at the times and places needed -- to eliminate compensation for "ghost capacity" and for non-delivered energy during emergencies. Without parallel commitment by the Commission to avert compensation for illusory resilient capacity and illusory energy supplies,

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the incremental costs plus an adder consisted with Commission precedent…for the unit responding to the reserve sharing event."

[7] See *ISO New England Inc. and New England Power Pool*, 153 FERC ¶ 61223, 2015 WL 7345804 (November 19, 2015). The Commission found that payments during Shortage Events "even when those resources are unable to deliver energy or reserves at that time: were unjust and unreasonable because the payment "not only fail[s] to incent resource performance, but also perversely select[s] less reliable resources over more reliable resources." See also FERC Order, 147 FERC ¶ 61,172, May 30, 2015 at p. 26, finding that the rate of unplanned outages in ISO-New England has doubled since year 2007, and the average response rate for generators dispatched following a contingency was only 71 percent.

[8] In Order No. 825, 155 FERC ¶ 61,276, issued on June 16, 2016 in Docket RM15-24-000, the Commission addressed the under-compensation and resulting disincentives to dispatch resources. The Commission ordered RTOs and ISOs to settle energy dispatched in real-time markets at the time interval of actual dispatch and to reform the settlement pricing for operating reserves to also reflect real-time prices.

[9] See FERC Order 831, Offer Caps in Markets Operated by Regional Transmission Organizations and Independent System Operators, 81 *Federal* Register 8770-01, 18 CFR Part 35, December 5, 2016.

electric consumers will pay unjust and unreasonable prices while remaining vulnerable to avoidable cascading outages and resulting long-term blackouts.

High rates for "ghost capacity" should not be considered just and reasonable under FERC tariffs. We respectfully ask that FERC convene a technical conference for Docket RM18-1-000. One panel could have the purpose of determining how much ratepayers are being charged for capacity—both resilient and non-resilient—in PJM, ISO-New England, NYISO, and other markets with capacity market analogs.

# Technology-Neutral, Market-Based Solutions Can Be Devised

Numerous commenters, including utilities, consumers, and non-profit think tanks, advocate for technology-neutral (or "fuel-neutral") solutions. Several commenters further propose market-based solutions.

## NRG Energy

NRG Energy proposes an auction-based "Forward Resiliency Market":

> *One option would be for the Commission to institute a "Forward Resiliency Market," or "FRM" in each of the relevant ISOs and RTOs. The FRM is a quarterly auction-based program designed to ensure that each organized market has sufficient on-site fuel to supply the megawatt hours of production needed to allow the ISO/RTO to operate for the next 90 days. The FRM would specifically define the resiliency product as "a supply-side resource's ability to generate megawatt-hours of electricity using on-site feed stocks." This would ensure that the grid is resilient against catastrophic failures or disruptions of the natural gas supply or coal supply, whether caused by weather events, terrorist incidents, loss of railway and/or road infrastructure, or other unforeseen events. While there are a variety of ways to design such a system, one approach would be that each organized market would identify the total megawatt-hours of electricity that it expects its customers to consume over the upcoming quarter. Any qualified market participant would be allowed to bid in its total ability to supply a share of the market's total needs for the forthcoming quarter, with its maximum contribution limited to the*

*amount that it could generate using on-site fuel supplies, while maintaining compliance with environmental regulations.*

## ClearPath Foundation

ClearPath Foundation likewise proposes an auction-based "Resilient Operation Market":

*To implement the new tariff structure proposed in the NOPR, ClearPath suggests a market-based solution that could be implemented through auctions administered by the RTOs/ISOs -- auctions that operate in a similar fashion to the capacity auctions currently administered by certain RTOs/ISOs. Auctions could set the value of needed resiliency consistent with the current constructs of the organized markets and, thus, promote efficiencies through competition that exist in today's wholesale organized markets. The auction (referred to in these comments as a Resilient Operation Market or "ROM") could provide an additional revenue stream to owners of eligible generators to mitigate the price distortions noted in the NOPR while providing an opportunity for these generators to continue to provide the sufficient grid resiliency that may be required based on the various contingencies that currently threaten the grid.*

## Kentucky Industrial Utility Customers

In its initial comments and November 2 reply comments, Kentucky Industrial Utility Customers proposes a "Separate Descending Clock Capacity Auction For Grid Reliability and Resiliency Resources." Notably, under this proposal, only "merchant coal and nuclear resources" would qualify for the auction:

*The first step of a possible market based solution would be to determine the proper amount of fuel secure generation for optimal grid reliability and resilience based upon engineering and system planning criteria. It would be uneconomic for an RTO or ISO to purchase more resiliency than it needs… The next step would be to competitively procure the requisite merchant coal and nuclear resources. A descending clock auction would be an efficient, simple and potentially least cost way to purchase a set number of fuel secure MW.*

## PJM Interconnection

PJM Interconnection, LLC., while denying that an "emergency" exists, concedes that significant market-based initiatives are underway in that RTO.[10] Moreover, in Appendix B of the PJM Interconnection comments, Professor William J. Hogan supports reforms in price formation that could enhance grid resilience:

> *Importantly, the enhanced price formation PJM intends to propose would be compatible with other reforms that are part of the larger discussion in PJM. For example, the enhanced pricing would be extended in practice to deal with multi-period problems where ramp rates and other flexibilities are important. Furthermore, the enhanced pricing model could accommodate improved scarcity pricing which should play a prominent role in adapting to changing market conditions with increasing supplies of intermittent or distributed resources…Currently PJM's rules for shortage pricing do not accurately value energy and reserves during reserve shortages. Based on the current penalty factors, the value of energy and reserves do not approach the estimated value of lost load (VOLL). Additionally, PJM's demand curves do not articulate the reliability value of reserves to the system. To fully address price formation, reforms are required to PJM's shortage pricing approach as well…"*[11]

In summary, Professor Hogan advocates reforms in pricing of RTO capacity to provide market incentives for both reserve generating capacity and reserve fuels during supply shortages. These incentives should reflect the value of lost load (VOLL). Reforms in market pricing can improve resilience in a fuel-neutral marketplace.

## Resilient Societies

In its initial docket comments, Resilient Societies proposes a technology-neutral, market-based solution:

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[10] See the Section of PJM's Comments entitled, "The DOE NOPR Ignores Efforts Underway to Address Resilience through Markets," October 23, 2017, at pp. 18-20. PJM also supports price formation reforms to strengthen incentives for resilience. See Comments, ibid., at pp. 39-46, and section on "Shortage Pricing" at pp. 47-48.

[11] William W. Hogan, Appendix B to PJM Interconnection Comments, Letter to Stu Bresler, Senior Vice President, Operations and Markets, PJM Interconnection, LLC., October 23, 2017, at pp. 2-3.

*We alternatively propose a technology-neutral solution that will allow all generating capacity with reserve fuel stored on-site (or nearby) to participate, including generating plants with dual-fuel capability. We also suggest a significant modification to the DOE-proposed rule: instead of a requirement for 90 days of on-site fuel at individual generators, we suggest that each RTO/ISO should have a total goal for energy inventory stored on-site at generation plants…A simple compensation system with only one time bucket of energy inventory might unduly advantage generators that routinely store large quantities of fuel on-site, such as coal-fired and nuclear plants, but are unable to convert their fuel into electric energy in the first hours or days after a grid collapse…To allow more prompt grid restoration, greater operational flexibility, and ability for more generation technologies to participate in compensation for energy inventory stored on-site, we further propose three or more time buckets of energy inventory—for example, inventory that can generate electric energy anytime within 1 to 7 days of a grid collapse, energy inventory that can generate electric energy within 8 to 30 days of a grid collapse; and energy inventory at generators that can operate even 31 to 90 days after a grid collapse…As with other RTO/ISO markets, bidders would be paid the highest clearing price. Hence, this auction would be a basis for just and reasonable rates while being technology-neutral.*

## Synthesized Proposal

We put forth a proposal that synthesizes basic elements of technology neutral, market-based solutions:

1. **Generation Resilience Product**: Markets should implement a new ancillary service product for resilient generation, alongside currently existing market mechanisms. The name of this resilience product should signal both resilience and value to ratepayers. We suggest “Secure Electricity Reserves Program” (SERP).
2. **Technology Neutral**: Any generation technology that can fulfill certain attributes defined in the tariff should be able to participate. These technology-neutral attributes

would be explicitly included in price formation for the market. Examples of attributes could include:

   a. Dispatchable capacity available within a certain time bucket after declaration of a grid emergency; for example, 1-8 days, 9-30 days, and 31-90 days.
   b. Energy stored on-site or nearby with firm contractual delivery.
   c. Capable of supplying essential reliability services such as reactive power and primary frequency response.

3. **Administratively Set Quantities for Capacity**: Targets for megawatt capacity reserves should be set for each RTO/ISO, or for load zones within each RTO/ISO, for defined time periods such as quarters or years.
4. **Market-Based Incentives**: Remuneration for generators should be based on auctions of the administratively determined targets for capacity with on-site energy reserves.
5. **Administratively Determined Penalties:** Penalties should not be based on non-performance during rarely-occurring emergency conditions that the society will attempt to prevent—for example, physical attack, cyberattack, electromagnetic pulse attack, or grid collapse following a severe solar storm. Instead, penalties should be based on audits determining non-compliance with tariff terms—for example, requisite quantity of energy is not stored on-site or the generator is unable to start for regular capacity tests.
6. **Additional to Existing Compensation Constructs:** For regions currently lacking energy and/or capacity markets, states should be able to opt into a newly established "Secure Electricity Reserve Program" for their region.

Resilient Societies respectfully suggests that FERC convene a technical conference with appropriate panels to discuss a range of technology neutral, market-based solutions for grid resilience.

## Conclusions

The RTO/ISOs, designers of the currently flawed market constructs, are in apparent denial that inattention to grid resilience is causing grave risk to America's economy and population. Concerned citizens and technical experts know that a solution is urgently needed. When electric grid risks are continually increasing—namely, overreliance on "just-in-time" fuel for generation—the absence of major crises recently is no assurance that catastrophe will not occur someday soon. In multiple RTO/ISOs, ratepayers are unjustly forced to pay for "ghost capacity"—capacity that can disappear in an emergency. Technology-neutral, market-based solutions can be devised, but time is of the essence due to constant threats from foreign adversaries and natural disasters.

We urge the FERC commissioners to act quickly on the DOE proposed rule, to recognize that a resilient capacity emergency does exist, and to provide for secure electricity reserves. FERC should act promptly to establish markets for generation resilience, with pricing to include on-site energy reserves.

Respectfully submitted by:

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## CERTIFICATE OF SERVICE

I hereby certify that I caused a copy of the foregoing document to be served electronically upon each person designated on the official service list compiled by the Secretary of the Federal Energy Regulatory Commission.

Dated at this 7th day of November 2017.

*/s/ William R. Harris*

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