FINAL Report

Energy Assurance Plan

Commonwealth of Virginia
Virginia Department of Mines, Minerals, and Energy

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Introduction

This Energy Assurance Plan (EAP) provides the Commonwealth of Virginia Department of Mines, Minerals & Energy (DMME) with guidance to prepare for, monitor and mitigate energy deficiencies and disruptions. Its focus is on energy-related events, which primarily include electricity, natural gas, and petroleum. The information contained in this EAP expedites the Commonwealth's response processes by laying out key information that is necessary to address the safety, health, and economic viability of its constituents.

The objective of this work is to create a document that strengthens and expands Virginia's energy assurance planning and resiliency efforts by identifying response actions for disruptions to new and existing energy portfolios. Toward the same purpose, this EAP explores the possible impact of smart grid applications on energy reliability. It is expected that this effort will also help create sustainable jobs and build in-house Virginia and local government energy assurance expertise. The ultimate goal is to improve regional energy assurance capabilities, allowing Virginia to coordinate more effectively on energy security, reliability, and emergency response issues, both within the Commonwealth and with other states.

To support this work, SAIC has been engaged as a consultant and partner with various Commonwealth of Virginia agencies, local governments, private companies, and other states to develop an EAP that will meet the requirements of this initiative. This EAP reflects a scope of work that accomplishes the Project Management Plan, dated October 9, 2009.

Key elements of the EAP are summarized below.

Guide to Energy Emergency Response in Virginia

One of the most important aspects of accomplishing energy assurance planning is to understand the critical phases of response and the levels of energy shortages. Section 2 (Guide to Energy Emergency Response in Virginia) discusses specific actions that may be taken during and in preparation for each phase. The four phases of energy emergency response, as established by National Association of Energy Officials (NASEO), are:

- Monitor Energy Markets and Alert Stakeholders
- Assess Vulnerability and Determine Action
- Recommend Measures, Take Action, Monitor Results, and Provide Feedback
- Review Lessons Learned and Modify as Appropriate.

Energy in Virginia

Energy broadly affects the health, safety and well-being of all of Virginia's constituents. As a backdrop to understanding energy assurance planning, Section 3 (Energy in Virginia) contains a discussion of the importance of energy in Virginia with the goal of providing a balanced understanding of resiliency. Four primary areas are examined; electricity, natural gas, petroleum products, and coal. This Section also serves as an energy primer for readers not expert in the field. It assists State energy staff in communicating and coordinating with stakeholders in the event of an energy emergency and provides important background information for pre-event monitoring.

Authorities

The roles and response of Federal, State and county governments to an energy emergency are guided by numerous existing statutes. Section 4 (Authorities) provides an understanding of how localities, the State of Virginia and Federal agencies are expected to respond, including references to pertinent statutory and regulatory authorities that underlie this EAP. Section 4 also describes the purpose, scope, duties, and responsibilities of the individuals and agencies that monitor, initiate action, and disseminate information in the event of an energy emergency.

Principal Stakeholders

In conjunction with understanding the roles and responsibilities of government that are presented in Section 4 (Authorities), Section 5 (Principal Stakeholders) identifies the principal stakeholders that would be involved in Virginia's response to an energy emergency. It discusses the specific State departments and agencies, suppliers and distributors of energy, and the various organizations that work to ensure the reliability of supply in Virginia.

Energy Sectors

Virginia's energy landscape is complex and comprised of numerous infrastructure elements that are critical to the reliability of supply. Section 6 (Energy Sectors) provides State energy officials with a more detailed understanding of Virginia's energy market and infrastructure issues, as they pertain to the electricity, natural gas, and petroleum sectors. The objective is to make key energy-related data immediately available to the DMME when responding to shortages or disruptions in supply. Updating and maintaining this information on a regular, scheduled basis is critical to energy assurance monitoring and analysis.

Asset Inventory

The critical energy assets, which are noted in Section 6 (Energy Sectors) and aggregated in Section 7 (Asset Inventory), simplifies the data mining processes that may be required by DMME and other State agencies. This Section focuses on the major energy assets that directly impact the reliability of energy supply.

Vulnerability and Risk Analysis

Section 8 (Vulnerability and Risk Analysis) builds upon prior sections by assessing the vulnerability of the broad spectrum of energy infrastructure with the purpose of winnowing it down to a short-list of the most critical infrastructure. A methodology for vulnerability assessment is presented and the interrelationships between energy sectors are presented.

Emerging Options

Prior EAP sections paint a generally pessimistic image of energy reliability by focusing on vulnerabilities and, essentially, what could go wrong. Section 9 (Emerging Options) takes an alternative perspective by addressing options and specific steps that are taking place in Virginia to improve the reliability of supply. Specifically, Smart Grid, energy efficiency, and renewable generation are described in terms of their relationship to improvements in reliability and implications to Energy Assurance.

Section 1
INTRODUCTION AND PURPOSE

This Energy Assurance Plan (EAP) provides a practical and effective tool that will enhance State government energy assurance capabilities. The EAP is to be used by State energy officials as a tool for communicating and coordinating with energy stakeholders on energy disruptions, and for preparing for potential disturbances. Under the EAP, energy suppliers retain the role of executing remediation strategies in response to energy disruptions; the EAP functions as a mechanism to ensure that the aggregate efforts are complete and communicated accordingly.

1.1 Energy Assurance Plan

This EAP builds upon ongoing efforts at the federal, State and local levels to enhance energy resiliency in Virginia. It is based on guidelines from the National Association of State Energy Officials (NASEO), and borrows from the numerous reference documents made available by the United States (U.S.) Department of Energy (DOE)'s Office of Electricity Delivery & Energy Reliability (OE).

The EAP provides energy stakeholders with a guide to understanding major energy deficiencies and disruptions, and to communicating and coordinating response activities. It provides an overview of major energy sectors, interdependencies, vulnerabilities, and the consequences of disruptions. It also summarizes information about how energy stakeholders address energy disruptions and shortages. Furthermore, it suggests mitigation measures that Virginia might apply to various types and levels of shortages. The EAP also discusses smart grid resiliency.

1.2 Organization of the Document

This document is organized as follows:

1. **Virginia Action Steps:** An overview of how Virginia emergency response officials might approach an energy emergency; provides links to more detailed sections of this EAP as well as external sources.
2. **Energy in Virginia:** An aggregate perspective of what energy is and why it is relevant in Virginia.
3. **Authorities:** The legal background that frames energy assurance responsibilities and accountabilities.
4. **Principal Stakeholders:** A detailed discussion of the different stakeholders participating in Virginia's energy sector and their accountabilities.

5. **Energy Sectors:** A comprehensive account of each of the energy sectors (electricity, natural gas, petroleum, and renewables[1]). This Section provides a perspective on each sector and an understanding of the disruption plans designed to address specific vulnerabilities. It also addresses emerging options (such as smart grid and energy efficiency) and vulnerabilities (such as cybersecurity).
6. **Asset Inventory:** A description of the energy assets in Virginia, with a special emphasis on specific assets that are large and significant.
7. **Vulnerability and Risk Analysis:** This Section builds on the energy asset inventory identifying and assessing those assets that are critical to the State. The term critical is understood to apply to assets that would significantly constrain energy resiliency if they were to be disrupted.
8. **Emerging Options:** An exploration of the innovations and developments likely to affect Virginia's energy assurance planning in the near future. Topics include smart grid, cybersecurity, energy efficiency, and renewable generation.
9. **Corporate Governance:** Outlines the specific methods, objectives, definitions, and limits used to implement the risk management strategy of the Virginia EAP.

1.3 Limitations

The information in this EAP was collected from reputable sources, and to the extent possible, the data presented herein have been reviewed and validated to ensure accuracy.

[1] "Renewable energy" means energy derived from sunlight, wind, falling water, sustainable biomass, energy from waste, wave motion, tides, and geothermal power, and does not include energy derived from coal, oil, natural gas or nuclear power, Virginia Code regarding Renewable Portfolio Standard, CHAPTER 933, [S 1416], Approved April 4, 2007.

Section 2
GUIDE TO ENERGY EMERGENCY RESPONSE IN VIRGINIA

This Section describes the critical phases of energy emergency response as well as the specific actions that may be taken prior to and during each phase. It is important to understand these critical phases, because effective response is not just a matter of reacting to individual events as they occur. Rather, it involves an on-going cycle of preparation, monitoring, communication, assessment, recovery, re-assessment, and the incorporation of lessons learned into preparation for future events. To illustrate how these elements pertain specifically to energy emergency response in Virginia, this Section covers:

- The four phases of energy emergency response, as identified by NASEO
- An overview of energy assurance tasks, as well as suggestions on which State or private sector stakeholders might be most appropriate for assuming responsibility for each task
- An outline of the different levels of energy shortage, including conditions and probable impacts observed by responding agencies, along with suggested stakeholder response steps that are specifically appropriate to each level of energy shortage
- Case studies of real world energy supply disruptions that have taken place in Virginia in recent years, the steps taken to respond to these disruptions, and lessons learned
- A guide to the various State emergency management procedures in place in Virginia
- Public Information and Communication Protocols and associated steps to be taken by various agencies during an energy emergency

The goal of this Section is to highlight the specific energy emergency response measures that the Commonwealth of Virginia may take, with an emphasis on matching the appropriate responses to different conditions.

2.1 Four Phases of Energy Emergency Response

The NASEO Energy Assurance Guidelines describe four basic elements of an energy emergency response. Figure 2-1 and the discussion of the four-phase approach are designed to help stakeholders gain a larger perspective before responding to a problem. They are a basic guide to action, and if followed, will provide a sense of direction that enables energy emergency responders to move forward in an orderly manner.

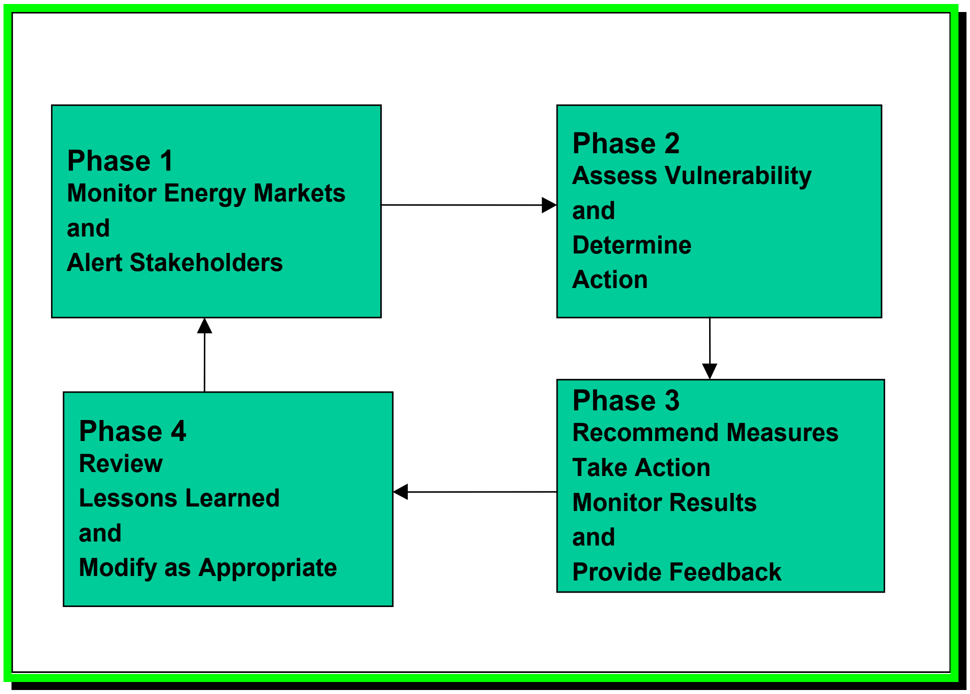

Figure 2-1. Four Phases of Energy Emergency Response

2.1.1 Phase 1:

Questions relating to monitoring markets and alerting stakeholders:

1. Are there unusual patterns in demand, pricing or stocks that may presage a problem?
2. What is the nature/cause of the problem?
3. How extensive is the problem?
4. What is the estimated duration of the problem?
5. Who is affected, where, and how?
6. Who needs to be informed?
7. How to link to energy stakeholders for ready answers.

For example:

- Electric or Natural Gas problem: State Corporation Commission (SCC) or affected utilities.
- Petroleum liquid products problem: Virginia Petroleum, Convenience and Grocery Association (VPCGA)
- For questions 3 and 4, ask SCC or VPCGA representatives to provide information and follow up as needed.
- Providing information to others is a judgment call. It is suggested that if the problem is minor, the cognizant State agency responding (often DMME) should

monitor. If the situation worsens, consider informing VDEM and others, such as local jurisdictions, adjacent utilities, and energy stakeholder associations, as appropriate. If the situation appears to so warrant, consult with VDEM about informing the Governor's office.

2.1.2 Phase 2:

Mechanisms relating to assessing vulnerability and determining action:

- Discuss depth of issue with stakeholders as appropriate.
- Determine whether or not the energy issue is likely to:
  - Be contained quickly
  - Spread
  - Affect which end-users
- Identify possible impacts:
  - Assess what impact may (will) fall on end-users
  - Ascertain from utilities what degree of impact to expect, ranging from "inconvenience" to "danger to life and property"
  - Crosscheck other energy sectors and critical systems (e.g., fresh water, food supply, and telecommunications) to ascertain potential interactive impacts

Determine what, if any, actions are appropriate and who undertakes them. Examples include:

- Energy industry level action such as response and repair crews
- Behind-the-scenes action such as mutual aid agreements and assistance via SCC
- Public level actions that may be advisable (public information and requests for conservation) or required (public assistance, emergency medical, congregant care, energy rationing measures)

2.1.3 Phase 3:

Questions and suggestions for recommending and taking action:

- Working with stakeholders referenced above, determine:
  - How quickly can actions be implemented?
  - How effective are actions taken?
  - What is the appropriate legal authority?
  - What are the limitations in the legal authority?
- What voluntary actions can be taken first?
- If mandatory actions are required, how quickly must they be phased in?

  - Which mandatory actions are to be phased in first? (Least to greatest is recommended.)
  - Check suggested Virginia voluntary and mandatory measures and coordinate with VEDM and other agencies as noted in the suggestions.
- Ask whether the best action may be no action at all.

2.1.4 Phase 4:

Review the following in coordination with VDEM and affected energy companies:

- Status of pre-emergency information.
- Rapidity and accuracy of assessment.
- Appropriateness of recommended actions.
- Effectiveness of actions taken.
- Were the actions relevant or did the problem solve itself?
- Were essential stakeholders left out of the loop?
- Did the stakeholders appreciate what was done?
- How did the public react?
- What should be changed, eliminated, improved?

2.2 Overarching Energy Assurance Tasks and Resources

Table 2-1 provides a quick reference for various levels of energy assurance activity. These are broken down into mitigation, preparedness, response, recovery, and resources. The table also suggests agency and stakeholder responsibilities for each set of tasks.

Table 2-1
Mitigation, Preparedness, Response, Recovery, and Resources

TASK	RESOURCE Primary ▪ Secondary
Mitigation	
Identify areas where public education programs detailing energy-related issues are needed.	SCC DMME
Assist VDEM (and energy companies if mutually acceptable) with public information regarding energy supplies.	Public Information SCC and DMME
Provide guidance in regard to energy supply, demand, and conservation information.	SCC DMME Utilities PJM VPCGA/

TASK	RESOURCE Primary ▪ Secondary
	Virginia Propane Gas Association (VAPGA)
Preparedness	
Assist in determination of State and Federal energy regulations.	SCC DMME VDEM
Discuss and agree upon procedures for notifying Investor-owned Utilities (IOU), Rural Electric Cooperatives and Municipal Utilities in case of disrupted energy services.	Virginia, Maryland & Delaware Association of Electric Cooperatives (VMDAEC) Municipal Utilities
All Virginia energy public sector stakeholders are advised to learn about utility procedures for restoring power and natural gas, which is the responsibility of a primary energy provider (natural gas and petroleum supply pipeline; electric generators are dispatched under the ISO, PJM rules) to providers in affected area(s).	SCC Utility preparedness plans ▪ In coordination with State officials as appropriate
Establish and maintain a link to coordinate with non-regulated power generators to ensure activities and operations are synchronized during emergencies.	SCC ▪ Industry control area operators
Assist in developing and maintaining a list of critical bulk fuels and energy infrastructure facilities affecting Virginia. The list may include facilities outside Virginia but that serve customers in the Commonwealth. (this includes facilities outside Virginia). (The list should include pipelines, refineries, terminals, liquid product trucking companies, and water related terminals.).	DMME VPCGA VAPGA ▪ State Energy Assurance Plan ▪ Seek assistance of Virginia Department of Taxation ▪ VDEM
Develop list of bulk fuel providers and transporters to facilitate acquisition of fuel in the event of infrastructure outage or closure.	DMME VPCGA VAPGA ▪ State Energy Assurance Plan ▪ Coordinate with Petroleum Industry ▪ VDEM
Understand existing Emergency Support Function (ESF) ESF-12 procedures for energy providers to contact VDEM (and Virginia Emergency Operations Center (VEOC)) if a significant energy service disruption occurs (e.g., a loss of 10% service).	SCC VDEM DMME Utilities, VMDAEC, Munis PJM

TASK	RESOURCE Primary ▪ Secondary
Response	
Work with VDEM to provide updates of energy situation impacts to the Governor and citizens. Assess scope, magnitude, and extent of energy impact.	VDEM SCC Utilities, VMDAEC, Munis PJM ▪ Petroleum companies ▪ Various associations
In case of disruptions in the communications system, coordinate with Virginia ESF-15 – External Communications, to establish backup communication system as required.	VDEM SCC Utilities, VMDAEC, Munis PJM ▪ Petroleum companies ▪ Various associations
Determine whether waivers are needed for normally prohibited discharges, when energy resources are necessary for a time-critical action, and acceptable sources are unavailable in necessary amounts.	SCC DMME to coordinate with Virginia Department of Environmental Quality
Consult utility emergency response plans for priorities in the re-establishment of energy to affected areas, based on emergency response and hazard mitigation needs. Work with petroleum sector associations to advise State about priorities and with propane association on issues concerning propane delivery.	SCC ▪ Utilities Emergency Operating Plans DMME ▪ Work with VPCGA, VAPGA
Provide guidance in regard to energy supply, demand and conservation information.	SCC DMME Utilities, VMDAEC, Munis ▪ Petroleum Companies ▪ VPCGA, VAPGA
Assess energy situations through communication with officials in other regions and States.	SCC DMME VDEM Maryland Energy Administration, District of Columbia Department of The Environment, Delaware Department of Natural Resources and Environmental Control – Delaware Energy Office
Recovery	
Assist VDEM as needed in the determination of State and Federal energy regulations.	SCC DMME ▪ State Energy Assurance Plan

TASK	RESOURCE Primary ▪ Secondary
Utilize SCC data, U.S. Energy Information Administration (EIA) data and Virginia energy stakeholder data as available to provide guidance in regard to energy supply, demand and conservation information.	SCC DMME EIA Utilities, VMDAEC, Munis VDEM Public Relations VPCGA, VAPGA
Coordinate with SCC on monitoring procedures for restoring electricity and natural gas. Coordinate with petroleum associations on the progress of the petroleum supply and distribution companies on procedures of liquid and gas providers in affected area(s).	SCC DMME Utilities, VMDAEC, Munis PJM ▪ Emergency Operating Plans, State Energy Assurance Plan ▪ Petroleum companies ▪ VPCGA, VAPGA

2.3 Four Shortage Levels and Suggested Responses

Just as energy emergency response can be organized into phases, energy emergencies themselves can be further divided into different levels of severity ranging from normal conditions to severe shortage. What follows provides a quick reference for assessing an energy shortage. Such shortages could include electricity outages, natural gas supply reductions, or unavailability of petroleum and related products. The spectrum of shortages covered ranges from threats that call for monitoring, to mild shortage conditions, to the most severe levels.

The possible conditions, impacts, reactions, and responses discussed here with respect to each of the four levels of energy emergencies are meant to be suggestive or approximations rather than absolutes. Action steps are suggested, with the understanding that actual circumstances faced by responders must be considered against the conditions and impacts described in the following tables. Furthermore, the intensity of an energy emergency within the Commonwealth may vary by energy sector, by area, and by fuel. For example, natural gas delivery may be interrupted while petroleum product sales remain normal; Richmond may experience a problem while Norfolk enjoys business as usual. Successful management of an energy emergency often rests as much on art as science.

Shortage Level 1 – Monitor and Alert

Conditions are normal, there is no discernible shortage in the State, but shortages are possible elsewhere. No specific level is identified. External conditions such as weather, conflicts abroad, or reports of increased demand in foreign and domestic markets may alert officials to increase monitoring.

Table 2-2
Level 1 – Monitor and Alert

Conditions (one or more may apply)	Probable Impacts Observed
Severe cold weather in any region affecting Virginia may cause local supply problems.	Gasoline, propane (and heating oil) prices may increase; natural gas prices may also rise either in parallel with petroleum products or separately should extreme cold disrupt gas transmission lines or transfer points.
Reports of shortages in other parts of the United States, or reports of natural disasters, terror or political disruptions in oil producing countries, may affect petroleum and petroleum product prices on the New York Mercantile Exchange (NYMEX).	State wholesale marketing companies and retailers may experience temporary supply difficulties evidenced by increased waiting time at terminal supply racks.
Local prices may move up rapidly in response to spot market prices or speculation on commodity markets.	Some gasoline stations, if queried (especially during the summer driving season), will report greater than normal buying as motorists attempt to secure the current lowest price and "top-off" their tank.

Expected Response Steps

Monitor and alert is ordinarily an on-going activity, and creates a baseline for normal operations against which shortage can be measured.

Table 2-3
Level 1 Response Steps

State Agencies	Energy Stakeholders
Monitor supply and demand. ▪ SCC monitors regulated electric and natural gas utilities. ▪ Municipal utility and VMDAEC governing agencies/boards/associations monitor respective utilities and cooperatives. ▪ DMME monitors winter petroleum heating fuel costs through the State Heating Oil and Propane Program (SHOPP) and annual data collection and report. ▪ Petroleum associations monitor activity – often on anecdotal basis.	Monitor supply and demand and report any incidents to designated authority: ▪ Electric: PJM and North American Electric Reliability Corporation (NERC) report, as they deem appropriate. ▪ Natural gas: LDC and municipal gas report as appropriate. ▪ Petroleum: No reporting expected. Some jobbers and dealers will contact State associations. State officials in DMME are most likely to learn about petroleum shortages early from VPCGA and VAPGA and then would contact SCC and VDEM.

Electric and natural gas providers monitor supply and demand in real-time through electronic means. However, most small electric and natural gas outages are not reported in real-time. The SCC monitors electricity and natural gas (as it affects electric generation) on a regular basis, including reports from regulated electric and natural gas providers, while rural cooperatives report to their governing boards. Municipal utilities keep their city and town leaders informed. PJM also monitors power generation and transmission in Virginia, along with the rest of its multi-state territory. Both can detect the impact of even minor problems, outages or shifts in power use on a real-time basis. They are prepared to react and advise in the event of lost generation. Petroleum marketers manage short-term spot shortages by finding alternate terminals for supply. DMME depends on weekly and monthly information provided through EIA, and monitors State agencies, professional associations, and others for State data.

Shortage Level 2 – Mild Shortage

Although mild shortages may be part of the normal on-going and fluctuating nature of an often-volatile energy market, it is critical at this stage for State officials to be on guard and ready to advise the Governor in the event that a mild shortage matures to the moderate level.

NASEO suggests that a mild shortage would be observed when there is a 5 to 10 percent reduction in petroleum supply for a week or more, or a 5 to 10 percent reduction in natural gas nominations for interstate pipelines for up to two weeks. The key to discerning the true level of shortage is in predicting how long any shortage will continue. A supply interruption may indeed be dramatic, but energy providers may be able to fix the problem quickly or find alternatives. Similar situations can occur in the electricity sector where the sudden loss of a transmission or local distribution line is quickly remedied.

It is unlikely that a shortage at this level would result in an emergency declaration in Virginia unless accompanied by strong evidence that the State will soon experience serious problems. It may also be difficult to react to a mild shortage unless energy stakeholders ask for help.

Timing is critical when trying to forecast the depth and duration of a shortage. A determination that would require any level of emergency mobilization would have to be preceded by an examination of the State's supply and demand outlook for the short- and long-term. For example, a mild shortage in heating fuel at the end of winter or in early spring may be managed expeditiously because warm weather is anticipated. On the other hand, a mild shortage of gasoline in the spring may trigger additional monitoring and calls for voluntary conservation in anticipation of summer driving. Foreign petroleum fuel markets would also be monitored for clues to future demand.

A number of proprietary information services can aid this process. In addition, NASEO and the National Council of State Legislators coordinate with the Department of Energy, Office of Electricity Delivery and Energy Reliability (DOE/OE) sponsoring semi-annual fuel outlook conferences each spring and fall. Information about these meetings can be found at the NASEO web site by clicking on the link above.

Table 2-4
Level 2 – Mild Shortage

Conditions (in addition to previous phase; one or more may apply)	Probable Impacts Observed	Media/Public Reaction
DOE, the American Petroleum Institute, or other sources report a decrease in the availability of product (e.g., from Middle East, South America, Canada, domestic refineries). The VPCGA & VAPGA learn from members that rack waiting time has increased.	Some jobbers report supply and delivery problems or related issues (e.g., extended rack wait time). Deliveries may be temporarily extended beyond routine hours. Tighter market conditions indicated by upward pressure on prices or price volatility.	National news may report events indicating that particular energy supplies will be delivered short of expected volume. Stories about energy may be featured in the media. Media may institute "gasoline watch" features on regular news segments.
Spot prices increase rapidly. National and regional oil companies (prime suppliers) may begin to hold jobbers to contract allocation versus buy-as-needed. (Check with VPCGA.)	Some retail dealers are uncertain about product availability and question information received from prime suppliers.	Media may feature reports about higher prices.
Strong draw on natural gas supply may occur. LDCs may begin to seek additional supply sources. (Check with SCC.)	Gas distribution companies may curtail interruptible contract customers. Natural gas prices increase.	Media reaction is minimal. Articles may appear in the business section about higher natural gas prices.
Sharp demand increase outside the State may cause PJM to increase electricity exports from Virginia generators. A local generating plant has to be shut down temporarily. Electric lines may be out of service due to localized damage.	Electric utilities may institute peak hour load management steps. (Check with SCC and IOUs.) Wholesale electricity prices rise due to temporary imbalances between supply and demand.	A few news reports are likely, most in newspaper business sections.
Some problems with energy delivery systems are observed such as refinery outages, transportation problems or sudden increases to tertiary (consumer level) storage.	Government assistance in removing retail driver hour limitations may be sought. (Verify with petroleum and propane associations: VPCGA & VAPGA.)	News stories, mainly features, are likely.
Petroleum dealers report increased pressure on their ability to deliver fuel.	Some customers call dealers to top off home storage tanks. Dealers complain to associations about increased cost of rack waiting time or other shortage-related delays.	News stories, mainly features, possible. Some inquiries may be received by government and non-profit agencies.

Expected Response Steps

During this phase, Virginia officials and energy providers may take some or all of the following steps:

Table 2-5
Level 2 Response Steps

State Agencies	Energy Stakeholders
Jurisdictional authorities receive information from the IOUs and PJM if an electric capacity deficiency emergency is anticipated.	PJM may identify areas in need and request load management or start-up of alternate power sources from PJM members.
VDEM, as lead ESF-12 agency, may discuss with SCC and DMME whether or not the situation warrants a public information campaign designed to refresh consumer knowledge about ways to reduce energy demand.	LDC may warn authorities of potential supply problems. Ordinarily, gas providers, just like electric and petroleum suppliers, will seek alternative supply sources and the public will be unaware of any disturbance. If local distribution companies believe a shortage may worsen, they will contact appropriate authorities. Ordinarily, utilities and petroleum dealers will provide seamless work-around for mild shortages so that the public does not notice them.
Public authorities may be asked to assist energy suppliers in explaining temporary shortage conditions to consumers.	As a supplement to the Federal EIA-782C reporting form, petroleum prime suppliers may be contacted to obtain advance information about distribution issues, prices, and supply.
If the Governor chooses to declare an emergency, additional monitoring will be implemented as specified energy providers (excluding electricity, natural gas or wood) are required to disclose information on a proprietary basis.	As a supplement to the Federal EIA-782C reporting form, prime suppliers may be contacted to obtain advance information about distribution issues, prices, and supply.

Shortage Level 3 – Moderate Shortage

The suggested level of deficiency for identifying a moderate shortage is a 10 to 15 percent reduction in petroleum products for three weeks or more, or a 10 to 15 percent reduction in natural gas supply nominations for interstate pipelines is observed. Other conditions may include storm damage to electric transmission/distribution infrastructure or a loss of electric power that will affect a large numbers of customers for at least 72 hours. An emergency involving natural gas could result in an expansion of curtailment beyond interruptible customers to include firm commercial and even residential customers. Petroleum emergencies could include a major disruption of the pipelines serving the State, major outages at refineries, or even a long-term product loss from foreign crude and off-shore refined product suppliers. Monitoring and analytical precautions for this step are the same as noted for a Level 2 – Mild Shortage.

Table 2-6
Level 3 – Moderate Shortage

Conditions (in addition to previous phase; one or more may apply)	Probable Impacts Observed	Media/Public Reaction
Petroleum product imports to the State or region drop 10 to 15 percent below base period (e.g., previous year or specified period; check EIA weekly *This Week in Petroleum*). Contract allocations for a growing number of petroleum retailers are reduced.	Jobbers report difficulty in obtaining or delivering enough supply to satisfy customers in spite of travel to distant terminals. Queuing at wholesale loading racks increases significantly beyond occasional market anomalies.	News reports about shortage appear on regional and national broadcasts. Federal and state officials are interviewed.
Local weather or storms in other regions result in problems that lead to temporary curtailment of electricity in Virginia (check National Weather Service or local area reports on media).	Wholesale prices jump as many transportation companies add a "fuel charge" to their usual price.	DOE or other federal agencies and energy companies publicly confirm shortage.
Oil product prices rise steadily and level off temporarily before rising again. Prices for key fuels rise at a rate of 15+ percent or more per week (see EIA *This Week in Petroleum*, above or DOE SHOPP program during winter season).	Spot-supplied retail dealers have difficulty meeting contract obligations. Driver hours increase as terminals increasingly distant from the State are tapped for product. State driver hours are extended and jobbers may seek waivers from federal rules.	Energy shortage in affected area is highlighted on national news. Media fuel-watch programming occurs. News media begin to use the words "energy crisis." Accusations about price gouging are possible.
Natural gas supplies fall below State demand for firm customers (check with SCC). Heavy draw on storage is projected; alternate supply sources are tapped; pipeline company may "pack" lines to increase throughput. If the shortage is due to a natural gas pipeline disruption, consumers will lose service until the appropriate repairs are made and the LDC re-ignites pilot lights.	Industrial and commercial interruptible gas customers experience extended curtailment. This in turn places growing demand on heating oil and propane.	News media increase the number of feature stories about shortage. Fuel companies and others advise consumers to reduce demand and may seek voluntary temperature controls for business and industry.
Interstate generation capacity is severely strained by wide spread severe weather (cold, heat, flooding, or windstorms), transmission loss, or other disruption.	Utilities curtail load leading to brownouts and threat of blackouts or rolling blackouts. High energy prices may force some small businesses to close.	Public begins losing patience with mild inconvenience. Some reports of economic impact published, mainly regarding retail commerce.
Growing numbers of low-income customers have difficulty paying for fuel.	Requests for Federal Low-Income Home Energy Assistance Program (check with Virginia LIHEAP) assistance increase and government agencies receive calls from individual households for help.	News media begin to cover energy problems several times a week. Low-income advocates demand help. Volunteer programs accelerate.

Expected Response Steps

In the course of a Level 3 emergency, before a Level 4 emergency is reached, officials will know that the entire State is highly vulnerable and the risk of economic loss is high. There will also be a strong likelihood of consequential harm to the health and welfare of people living in the State. The political risk of taking action may be lower than it would be in a mild shortage situation, but decisions will be no less difficult. During this phase, Virginia officials and energy providers may take all or some of the steps detailed in Table 2-7.

Table 2-7
Level 3 Response Steps

State Agencies	Energy Stakeholders
Authorities continue to receive information from IOUs and PJM. Utilities and petroleum dealers find it increasingly difficult to provide seamless work-around.	Electric utilities and LDC effect restoration of infrastructure as needed. ▪ Municipals and Electric Membership Cooperatives institute mutual aid agreements as appropriate. ▪ PJM may strongly encourage a reduction in electricity demand.
If an emergency is declared as noted above (Mild Shortage), then informational requirements as noted above take effect.	If PJM is unable to divert sufficient regional supplies of electricity to the State (e.g., due to an increase in regional demand or a failure within the distribution system), area utilities may request SCC and VDEM's help in calling for voluntary conservation measures.
DMME will continue to analyze energy supply (especially petroleum products) and evaluate appropriate alternative courses of action.	LDC natural gas customers with interruptible service contracts will be cut off and told to switch to their alternate fuel source. Electric utilities may institute voltage reductions if demand cannot be met with existing supply.
SCC, in consultation with others, acting through VDEM may ask the public to implement voluntary conservation measures in order to reduce demand for affected energy sources. The Governor may also call for reduction in energy use.	If PJM determines that rolling blackouts are necessary, Virginia electric utility members would respond. There may not be time to warn customers, although the industry generally tries to provide advance warning.
Others (e.g., local government) may make recommendations to the Governor, in coordination with VDEM and in consultation with DMME, about implementing mandatory conservation measures.	If a pipeline loss occurs, LDC will shut off the gas lines to affected areas until repairs are completed. Upon completion of repairs, gas companies must relight the pilot light for each suspended customer.
If energy customers require assistance in locating alternate fuels, SCC/VDEM may request DMME assistance in working with energy stakeholders to locate such alternatives.	Local natural gas companies may do one or more of the following: ▪ Request emergency gas from unaffected pipeline suppliers. ▪ Increase spot market purchases. ▪ Curtail service to interruptible customers. ▪ Augment supplies with liquefied natural gas (LNG) and propane. ▪ Request non-interruptible contract customers that have fuel switching capabilities to use their alternate fuel source. ▪ Request customer conservation. ▪ Adjust gas pressures as needed. ▪ Shut off distribution pipeline sections, remaining as sensitive as possible to the needs of critical facilities.

State Agencies	Energy Stakeholders
Petroleum problems may be compounded if the moderate shortage is due to a sustained increase in demand from other areas of the country or international markets. If there is a shortage of crude oil, the federal government could release crude oil from the Strategic Petroleum Reserve (SPR). This is unlikely to happen unless States request it and requests for crude oil from the SPR are typically made directly by affected refineries.	State petroleum distribution companies will seek fuel from terminals outside of the State as necessary. In-state companies can self-declare driver hour waivers. If increasing out-of-State travel is required, they may seek State assistance in petitioning Federal Motor Carrier Safety Administration regulators.
SPR relief is not immediate because it takes some time for bids to be processed and crude to move to and through refineries. However, anticipated relief of SPR crude may dampen market speculation.	Propane (and heating oil) dealers may deliver partial loads to their customers rather than top off tanks.
The State Emergency Operation Center may be activated. VEOC in appropriate county and municipal jurisdictions may also be activated.	Retail motor gasoline stations may curtail hours of operation.

Shortage Level 4 – Severe Shortage

The suggested level of loss for severe shortage is in the range of 20 to 30 percent and above in petroleum products, natural gas, or electricity for more than two weeks. Events observed might include severe reductions in announced plans for natural gas shipments, widespread electricity outages extending for several weeks, and the inability of the petroleum industry to re-supply local distributors. Hence, DMME and SCC, as ESF-12 agencies (DMME, as the agency monitoring petroleum conditions and SCC monitoring utilities), would be expected to consult on a continuing basis together with emergency managers at VDEM and industry representatives, in order to determine when to recommend that the Governor declare an energy emergency. The determination may be based on the suggested levels of loss as recommended in this Plan or by other indications such as requests from various sectors of the energy industry including electric utilities, LDCs, petroleum product associations and representatives of various economic sectors of the State. Officials should keep in mind that if a severe shortage develops suddenly (as opposed to being the result of a steady progression through levels of loss), events may move rapidly.

Table 2-8
Level 4 – Severe Shortage

Conditions (in addition to previous phase; one or more may apply)	Probable Impacts Observed	Media/Public Reaction
Regional and state fuel dislocation is brought on by large-scale storms; extended, widespread winter cold; embargo or terrorist acts.	During peak driving seasons, gasoline stations curtail operating hours and motorists may queue to purchase available fuel regardless of price. Lack of courtesy in queues may produce altercations.	State government may be criticized for not acting (or not acting quickly enough). Public safety agencies such as the Virginia State Police, or local jurisdiction police, may be called upon to protect energy suppliers such as motor gasoline outlets.
Retail energy prices do not level off but continue to rise.	Customers (including government agencies) that obtain spot-market-based fuel may not be able to buy product. During winter months, non-contract distillate customers have serious difficulty locating oil regardless of price.	Fuel issues are reported regularly by the media; rumors are abundant. Media attention may turn from price to the extent of shortage. Accusations of price gouging are likely.
Local product storage levels are extremely low or exhausted. Energy product deliveries through the Port of Norfolk may be interrupted or overseas shipments are curtailed, held-up, diverted or otherwise reduced.	Petroleum fuel hoarding is observed.	Officials from regulated and non-regulated energy companies are called upon to explain the shortage.
Retail motor fuel (and heating oil dealers) receive an accelerating lower percentage of their normal contract allocation and have difficulty maintaining contract delivery	Suppliers sharply reduce allocations to dealers and dealers are "swamped" managing customer inquiries. Non-contract service stations may receive no allocation and will have extreme difficulty locating spot market motor fuel. This may lead to curtailing hours of operation or closing. Jobbers must travel about one working day, one-way, to find terminal supply. Interstate driver hour limits must be addressed.	Some consumption is reduced as users turn to alternatives or go without. The public and media may misunderstand the reduction of hours or closure of non-contract service stations and assume that the region is "out of fuel."
Shortages are generally regional in scope, but possibly broader.	State agencies are called on to provide relief through VEDM. State government may hasten efforts to coordinate interstate mitigation activity.	The public is willing to tolerate mandatory intervention measures such as odd/even gasoline purchase days. Citizens will respond to calls for voluntary conservation such as car-pooling or reliance on mass transit and may modify their consumption habits for the duration of the short fall.

Conditions (in addition to previous phase; one or more may apply)	Probable Impacts Observed	Media/Public Reaction
Firm natural gas contract supplies fall well below normal.	Industrial customers face ongoing higher fuel cost. Commercial customer activity may be curtailed. More small businesses close. Some residential customers are displaced from homes in cold weather.	Increasing economic impact is noted. Media covers the issue daily. The public may demand mandatory temperature control measures for commercial and government facilities. Energy companies may be criticized by public authorities.
Loss of electricity can lead to pump failure in energy pipelines, water and sewage treatment facilities as well as loss of retail pumps for motor gasoline.	If the disruption occurs during the winter heating months, governments may need to open heated shelters and take other measures to protect public health, welfare, and safety.	Media will follow events and critical editorials and op-ed columns can be expected.
Taxi and mass transit fares may increase to cover the rising fuel costs.	Tourism and discretionary shopping suffers.	Negative impact on economy is noted in the media.
Long-term power problems due to weather, fuel prices or lack of fuel, or infrastructure failure result.	Rolling brown and blackouts occur.	Media attention is constant. Economic impact is widespread.
Significant assistance may not be enough to help low-income families obtain fuel.	Economic dislocation occurs.	The danger to vulnerable citizens is featured in the media.

Expected Response Steps

Table 2-9
Level 4 Response Steps

State Agencies	Energy Stakeholders
If the Governor declares an energy emergency, VDEM will most likely activate the VEOC. Local jurisdiction EOC may also be activated.	All affected energy providers will continue to seek alternate sources from pipelines, distant terminals, through PJM, and spot markets as appropriate.
SCC together with DMME will continue to analyze energy supply and may evaluate appropriate alternative courses of action including voluntary and mandatory measures.	If PJM is unable to divert sufficient regional electricity capacity (e.g., due to increased demand or a distribution system failure), area utilities may request government assistance calling for additional voluntary conservation measures as well as mandatory measures.
Health care institutions (check with the Virginia Hospital & Healthcare Association (VHHA)), industry and some commercial operations may need to switch to standby generators. Home-based generators may also be activated.	Rolling blackouts, especially during peak demand periods, are likely. Rolling blackouts may occur without warning and affect significant regions. Rolling blackouts, if instituted, are likely to last for up to two hours in affected geographic areas.

State Agencies	Energy Stakeholders
Individuals using electric powered home medical devices may be affected. ▪ The Virginia Department of Health (VDH) may wish to release seasonal advisories urging such users to secure power backup or alternate sources of energy. ▪ State, county, and municipal offices of aging, human services, social services and low-income heating programs should be prepared to receive and process multiple requests for assistance.	Electricity and natural gas customers may be asked to manage thermostat settings appropriate for the season. Consumers may be asked to reduce hot water temperatures and use. Utilities may seek government assistance in promulgating conservation requests.
Residential, commercial, industrial and government sectors can expect to be actively involved in energy conservation measures.	Commercial and industrial users might also decide to limit operating hours. ▪ Limiting hours of operation will make it difficult to meet customers, schedules and deadlines, which in turn may decrease revenue. ▪ Enterprises might decide to restrict their use of electric lighting for advertising, which could decrease business.
Depending upon the estimated duration of an emergency, government may decide to reduce operating hours and suspend some activities until energy supplies are restored.	Energy providers may be required to: ▪ Activate industry-recognized contingency measures. ▪ Maintain close contact with VDEM/VEOC. ▪ Submit information and reports to VDEM/VEOC.
Mandatory measures may be imposed by government if increasing prices do not "clear" the market (balance supply and demand). These include response measures suggested in the EAP. Examples are: odd/even motor fuel purchase rules, prohibition against vehicle tank topping or other measures meant to control queues and prevent contention at retail outlets.	Energy providers may be required to: ▪ Carry out and monitor government-imposed contingency measures. ▪ Place personnel at the VEOC. ▪ Submit information and reports to VDEM - VEOC.
SCC in coordination with VDEM and DMME may: ▪ Submit proposed executive actions to the Governor. ▪ Assist in the implementation of gubernatorial actions. ▪ Notify neighboring State governments. ▪ Coordinate activities with PJM, other State governments, DOE/OE and other agencies.	All energy providers will continue to monitor and repair infrastructure as necessary.
Other State agencies may be required to assist as requested.	

2.4 Case Studies: Virginia Supply Interruptions and Response Actions

Electricity Supply Disruptions

2009 Snow & Ice Storms

Conditions:

Near the end of 2009, a major snowstorm blanketed much of the Commonwealth with over two feet of snow, causing widespread power outages. Responding to the blizzard of December 18 and 19, Governor Tim Kaine declared a state of emergency focusing attention on the southwestern portion of Virginia. The cities of Roanoke, Blacksburg, Lynchburg, and Bluefield all recorded snow accumulations well over one foot.

Impact:

The heavy snow caused electric transmission and distribution lines to fail, and exacerbating that problem were lines severed by fallen trees weakened by a period of severe drought. Major electricity supply disruptions resulted, primarily in the service territories of Appalachian Power Company (APCo), Kentucky Utilities Company/Old Dominion Power Company (ODP), and Powell Valley Electric Cooperative (PVEC). At the disruption's peak, more than 43,000 APCo customers lost power; in total nearly 100,000 APCo customers went without power at some point, some for up to 18 days. APCo alone replaced 587 utility poles, and restrung over 100 miles of lines. Approximately 99.6 percent (29,817) of ODP's customers in Virginia were affected.

Response Taken:

The affected utilities began work immediately using standard restoration plans, with priority protocols for key public facilities followed by power restoration to the greatest number of customers per line mile or with the largest distribution circuits.

A second powerful storm interrupted restoration efforts battering previously affected areas on December 25. This caused utilities to reset their restoration plans, returning to key facilities and then the largest number of customers per circuit.

Many rural customers, where customers per line mile are fewer than in urban areas, remained without power during the holiday season.

Aftermath:

Numerous requests were made for the Virginia SCC to investigate the utilities' performance prior to and after the storm. As standard practice, the SCC staff performs a post-storm analysis following each major storm. A review of this incident and an analysis of the decisions made by utilities afterwards were completed by the SCC staff in August 2010. The report acknowledged mistakes but noted that the utilities handled the vast scale of the disruption well. [1]

[1] http://www.scc.virginia.gov/comm/reports/2009_Snow.pdf.

Utilities have worked with local governments to establish direct lines of communication to mitigate similar issues in the future. The SCC report concluded that the severe nature of the storm, the problem of trees interfering with transmission lines, the isolated and rugged nature of the rural areas affected, and the widespread extent of the storm all contributed to the major disruption.

Oil and Petroleum Products

Conditions:

In September 2008, two hurricanes struck the Gulf Coast and the resulting damage and disruption to crude oil supplies affected the entire Southeast. The hurricanes struck within 11 days of each other: Hurricane Gustav on September 1 and Hurricane Ike on September 13. The storms impacted nearly 100 percent of operational capacity of crude oil production, and up to 51 percent of refining capacity in the Gulf Coast region[2]. In particular, the Colonial Pipeline, which serves Virginia, was impacted. The Colonial pipeline services the Commonwealth's major metropolitan areas: Richmond, Roanoke, Norfolk/Virginia Beach, and the Washington D.C. suburbs, along with Dulles Airport.

Impact:

All but one of the 30 refineries supplying the Colonial Pipeline was affected, resulting in shortages of all petroleum products. As local stocks of petroleum products ran low, lines at service stations grew longer as did consumer frustration. The media published multiple stories about this shortage. In Virginia, rural areas that have mostly small, independent, petroleum product suppliers suffered from slow replenishment. Because of the shortages, the State activated anti-price-gouging measures.

Response Taken:

The situation gradually improved as Gulf Coast refineries resumed operation, and petroleum products were once again shipped along the pipeline. A 2009 DOE workshop suggested several areas for improving the response in similar situations. High on the list was the suggestion that companies work closely with official agencies to enhance information on restoration priorities.

Aftermath:

In 2010, the 66,300 barrel-per-day refinery at Yorktown ended operations as Virginia's lone refinery. Virginia is now even more dependent on petroleum products delivered via the Colonial Pipeline system, the Plantation Pipeline, and shipments from refineries in Philadelphia and New Jersey. Major pipeline interruption is relatively rare; most pipeline incidents involve minor ruptures, spills, and/or fires, such as an April 2006 incident involving the Plantation Pipeline. The pipeline ruptured in a Richmond suburban area, spilling as much as 30,000 gallons of jet fuel.

[2] EIA data.

The pipeline was immediately shut down, the spill cleaned, and the pipeline repaired and back in service two days later.[3]

Natural Gas

No significant recent natural gas incidents were recorded for Virginia.

2.5 State Emergency Operations

In the event that an energy problem requires operating the State Emergency Operations Center, the State would follow established emergency management procedures. These include:

- Commonwealth of Virginia Emergency Operation Plan (COVEOP): This Plan describes the State's approach to all-hazards response and the concepts of response and recovery operations. VDEM and other State agencies with emergency management duties and responsibilities maintain the basic plan and annexes.
- Emergency Support Function 5 (ESF-5): Supports overall activities of the Commonwealth of Virginia for incident management. This function provides the core management and administrative functions supporting the VEOC and associated field operations.
- Emergency Support Function 7 (ESF-7): Manages resources in support of State and local governments prior to, during, and/or after an incident, in coordination with other ESFs in the VEOC and the Joint Field Office (JFO).
- Emergency Support Function 12 (ESF-12): Coordinates the restoration of damaged energy systems and components during an emergency incident.
- Emergency Support Function 15 (ESF-15): Coordinates the gathering and dissemination of information to interested parties and the public, primarily through the auspices of VDEM.
- Continuity of Operations (COOP) Planning Toolkit: Provides guidance and assistance to State agencies and local governments in developing and maintaining COOP capabilities and plans at the local, State, and federal levels.

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3 Sources: U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability: "Southeast Petroleum Disruption and After-Action Workshop Report," January 14-15, 2009 http://www.google.com/url?sa=t&source=web&cd=1&ved=0CB0QFjAA&url=http%3A%2F%2Fsoutheastpetroleum.govtools.us%2Fdocuments%2FSoutheastPetroleumDisruption_Report.pdf&ei=R6jBTcT1HNCjtgeO062lBQ&usg=AFQjCNEdwZt-r_RdaOgTlVk7TKpiOYa7jQ.

New York Times: "Frustration in the South as a Gasoline Shortage Drags On," September 29, 2008 http://www.nytimes.com/2008/09/30/us/30gas.html.

Energy Assurance Daily Archive Queried May 2011 and March 2012 on the OE site of the DOE http://www.oe.netl.doe.gov/ead.aspx:

2.6 Public Information – Communication Protocols

The steps outlined in Table 2-10 may be helpful in the event that DMME assists the State with public information related to an energy outage or disruption. If an energy outage were to continue for an extended time, the State may wish to consider potential energy emergency mitigation measures listed in the EAP.

Table 2-10
Potential Public Information Steps for State Government

Phase	Suggested Response (may be undertaken by DMME or others)
Monitoring	▪ Review and reinforce communications within the State and ascertain that all interested parties or responders understand their role, what can and cannot be said, and by whom. ▪ Inform VDEM and SCC if DMME is aware of cross-cutting shortage impacts such as gasoline fuel pump or natural gas pipeline pump failure due to electricity outage. ▪ Work with SCC and VDEM and inform the Governor's office. ▪ Keep Governor's staff and legislative offices informed. ▪ Review/prepare energy market presentations and other materials to explain consumption patterns and anomalies paying special attention to graphic displays. ▪ Provide public relations officers with regular updates approved by SCC. ▪ Coordinate with the SCC and VDEM on media contacts in order to help reporters (especially newly assigned) understand basic energy facts and issues. ▪ Review weather forecasts.
Interruptions or Loss Affecting a Limited Number of Communities	▪ Maintain information actions per above. ▪ Coordinate with VDEM, and EDC (Electric Distribution Companies) to draft energy conservation recommendations if shortage/disruption is predicted to increase. ▪ For heating issues, work in coordination with SCC and electric utilities to provide media advisories on setting back thermostats, using cooking fuel wisely, checking heating equipment, and conserving hot water. ▪ Consider public meetings and use of the Internet as appropriate. ▪ Share State energy data with distribution associations, other States, NASEO, and DOE/OE as needed. ▪ Coordinate with SCC to estimate the probability and timing of greater shortage/disruption. ▪ Prepare briefings on possible supply and demand restraint measures, should the shortage/disruption intensify.
Statewide Disruption	▪ Maintain information actions per above. ▪ Assist SCC and VDEM with media briefings (sometimes in conjunction with energy stakeholder representatives). ▪ Develop follow-up messages from Governor to assure public and to maintain compliance. ▪ SCC and VDEM (in coordination/conjunction with the Governor's office or others) announces enforcement actions if any.

Section 3
ENERGY IN VIRGINIA

This Section provides the background for understanding what energy means for the Commonwealth of Virginia. It:

- Details the importance of energy in Virginia.
- Serves as an energy primer for readers who are not experts in the field.
- Builds upon common knowledge to help State energy staff communicate and coordinate with stakeholders in the event of an energy emergency.
- Provides useful information for pre-event monitoring.

The goal is to provide a balanced understanding of energy as it relates to the resiliency issues presented in this EAP. The term energy as used here is generic, and includes electricity, natural gas, petroleum products, and coal.

3.1 Relevant State Plans

State Energy Plan

Drafted in 2007[1] and updated in 2010,[2] Virginia's Energy Plan is a comprehensive 10-year plan geared to achieving the Commonwealth's energy policy goals. These goals include: ensuring energy availability of reliability at reasonable cost; managing consumption of existing energy resources in relation to economic growth; establishing necessary infrastructure to maintain reliable energy availability in the event of a disruption; using energy resources more efficiently; facilitate conservation; optimizing intrastate and interstate use of energy supply and delivery; increased use of less polluting sources of energy; promoting research to reduce, avoid, or sequester emissions of greenhouse gases. See also Virginia's Emergency Services and Disaster Laws, 2008 Edition.[3]

Commonwealth of Virginia Emergency Operation Plan (COVEOP) [4]

The COVEOP describes the State's approach to all-hazards response and the concepts of response and recovery operations. VDEM and other State agencies with emergency management duties and responsibilities maintain the basic plan and annexes. The COVEOP relies on a number of resources, including the following:

- **Emergency Support Function 5 (ESF-5)**: Supports overall activities of the Commonwealth of Virginia for incident management. This function provides the

[1] http://www.dmme.virginia.gov/DE/VAEnergyPlan/VEP-2010.shtml
[2] http://www.dmme.virginia.gov/DE/VAEnergyPlan/2010-VEP/VEP-2010.pdf.
[3] http://www.vaemergency.com/library/VA_Emergency_Services_08_Edition.pdf.
[4] http://www.vaemergency.com/em-community/plans/coveop

core management and administrative functions supporting the VEOC and associated field operations.

- **Emergency Support Function 7 (ESF-7)**: Manages resources in support of State and local governments prior to, during, and/or after an incident, in coordination with other ESFs in the VEOC and the JFO.
- **Emergency Support Function 12 (ESF-12)**: Coordinates the restoration of damaged energy systems and components during an emergency incident.
- **Emergency Support Function 15 (ESF-15)**: Coordinates the gathering and dissemination of information to interested parties and the public, primarily through the auspices of VDEM.
- **Continuity of Operations Planning (COOP) Toolkit**:[5] Provides guidance and assistance to State agencies and local governments in developing and maintaining COOP capabilities and plans at the local, state, and federal levels.
- **State Energy Profiles**:[6] The EIA provides updated individual State profiles that present key facts and statistics about energy markets and industries. Many of the statistics in the profiles are updated simultaneously with data updates on the EIA web site.
- **U.S. Department of Energy's (DOE) Office of Electricity Delivery & Energy Reliability (OE)**:[7] Applies DOE's technical expertise to ensure the security, resiliency, and survivability of key energy assets and critical energy infrastructure at home and abroad.
- **The U.S. Department of Homeland Security's (DHS) Energy Sector: Critical Infrastructure and Key Resources**:[8] Gathers reports and real-time information associated with DHS' involvement with the energy sector, plus links to other useful agencies.
- **Virginia's Department of Mines, Minerals and Energy (DMME)**:[9] Serves a large and varied group of people and organizations to enhance the development and conservation of energy and mineral resources in a safe and environmentally sound manner to support a productive economy in Virginia.
- **Virginia's Department of Emergency Management (VDEM)**:[10] Works under the broad authority of the Commonwealth of Virginia Emergency Services and Disaster Law of 2000 to protect the lives and property of Virginia citizens from emergencies and disasters by coordinating the State's emergency preparedness, mitigation, response, and recovery efforts.

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5 http://www.vaemergency.gov/em-community/plans/coop
6 http://www.eia.gov/state/.
7 http://energy.gov/oe/office-electricity-delivery-and-energy-reliability
8 http://www.dhs.gov/files/programs/gc_1189013411585.shtm.
9 http://www.dmme.virginia.gov/.
10 http://www.vaemergency.com/.

- **State Corporation Commission (SCC or Commission)**:[11] Strives to apply law and regulation to balance the interests of citizens, businesses, and customers in regulating Virginia's business and economic concerns; works continually to improve the regulatory and administrative processes.
- **Division of Energy Regulation**:[12] Assists the SCC's three commissioners in regulating Virginia's investor-owned electric, natural gas, water, and sewer utilities, and member-owned electric cooperatives. Its chief function is to support the SCC in its goal to ensure that Virginia consumers receive adequate utility services at just and reasonable rates.

3.2 State Energy Profile

Virginia is a net importer of energy with some 55 percent of total energy needs coming from out-of-state. Energy demand distribution is fairly even among the sectors of the economy. Although Virginia has essentially no production of oil and relatively minor reserves of coal, two of Virginia's coal bed methane fields are among the top 100 natural gas fields in the country. With the shutdown of the Yorktown oil refinery, the State no longer has active refining capacity. Virginia receives the majority of its natural gas deliveries from the Gulf Coast region via major interstate pipelines. Over 80 percent of the natural gas entering Virginia moves on into Maryland and the District of Columbia (DC) en route to other markets in the Northeast. Significant wind power potential exists off of Virginia's Atlantic coast and in the Chesapeake Bay. Virginia's two nuclear power plants (North Anna and Surry) provide about one-third of the electricity generated in the State.[13]

Consumption Overview

Fossil fuels, particularly gasoline, diesel, coal, and natural gas, dominate Virginia's energy consumption profile both in terms of transportation and electricity generation. Nuclear energy has played an increasingly significant role as a baseload supply source for the generation of electricity, surpassing coal in 2009. The State possesses considerable renewable energy assets, particularly wind and biomass (primarily wood and waste). According to the latest data available, renewables comprised 5.6 percent of the total energy consumption in Virginia.

What follows are data and figures that outline the essential components of energy consumption within the Commonwealth of Virginia. This information provides a relative point of view because the actual data are always in flux. As shown in the map (Figure 3-1) the bulk of the State's energy assets are located along the Interstate 95 corridor (I-95). This concentration has implications for infrastructure security as well as a work around and back-up for possible shortage or outage events.

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[11] http://www.scc.virginia.gov.

[12] http://www.scc.virginia.gov/pue/index.aspx.

[13] Excerpts from EIA's State Energy Profile, http://www.eia.gov/state/state_energy_profiles.cfm?sid=VA.

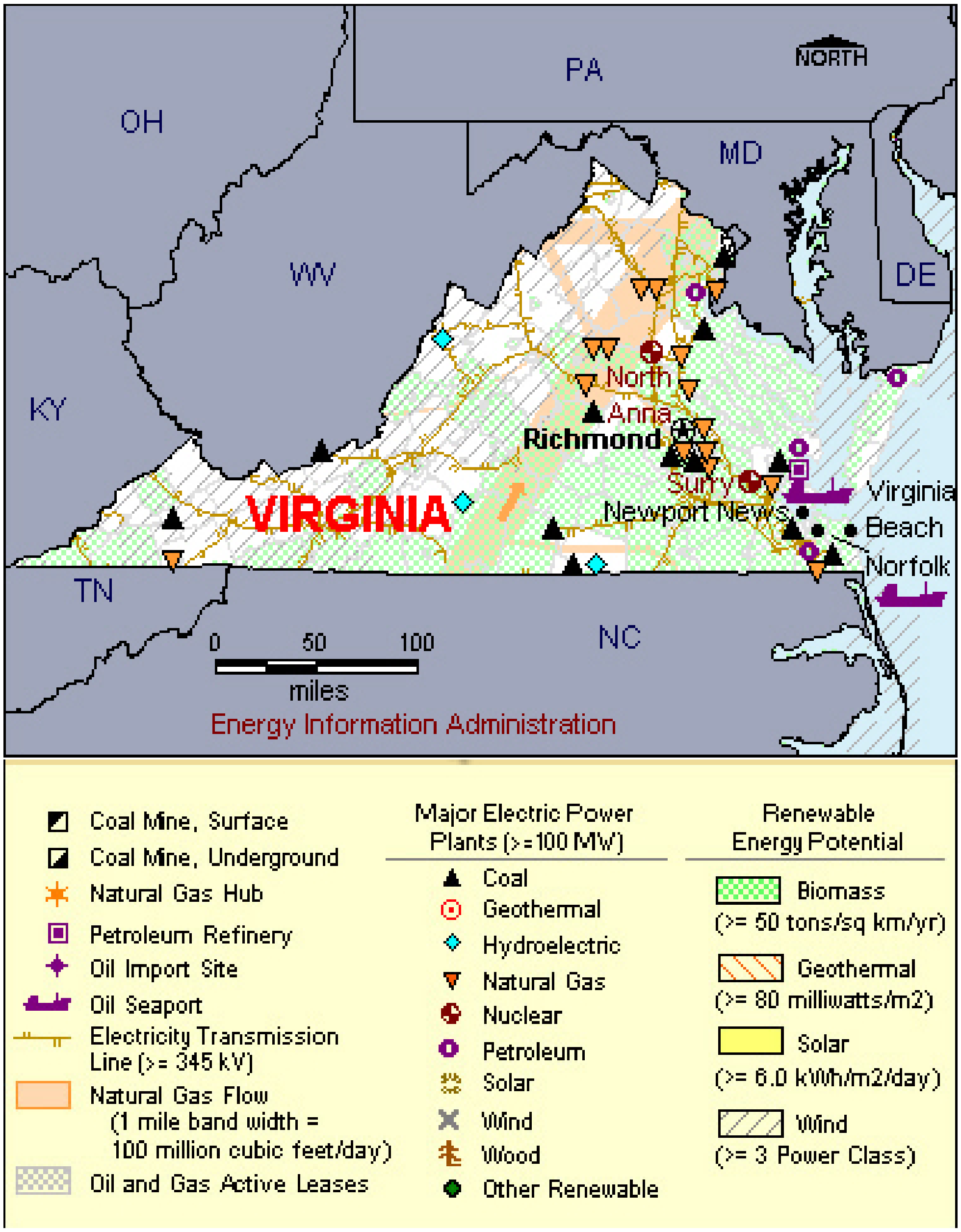
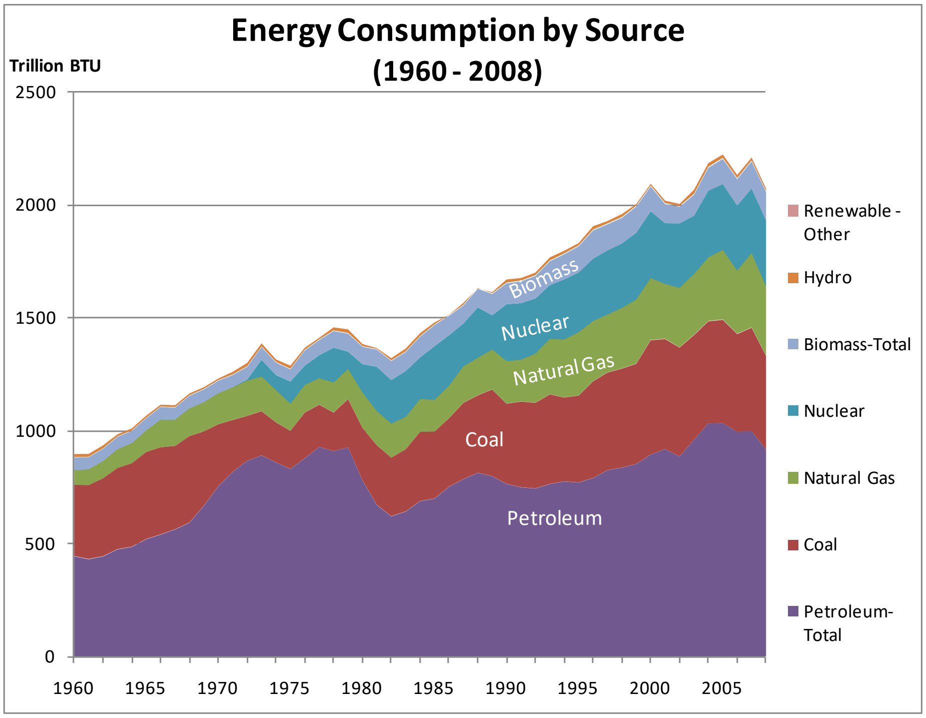


Figure 3-1. EIA Map of Principal Energy Resources in Virginia



Source: R. W. Beck, Inc., using data from EIA

Figure 3-2. Energy Consumption by Source

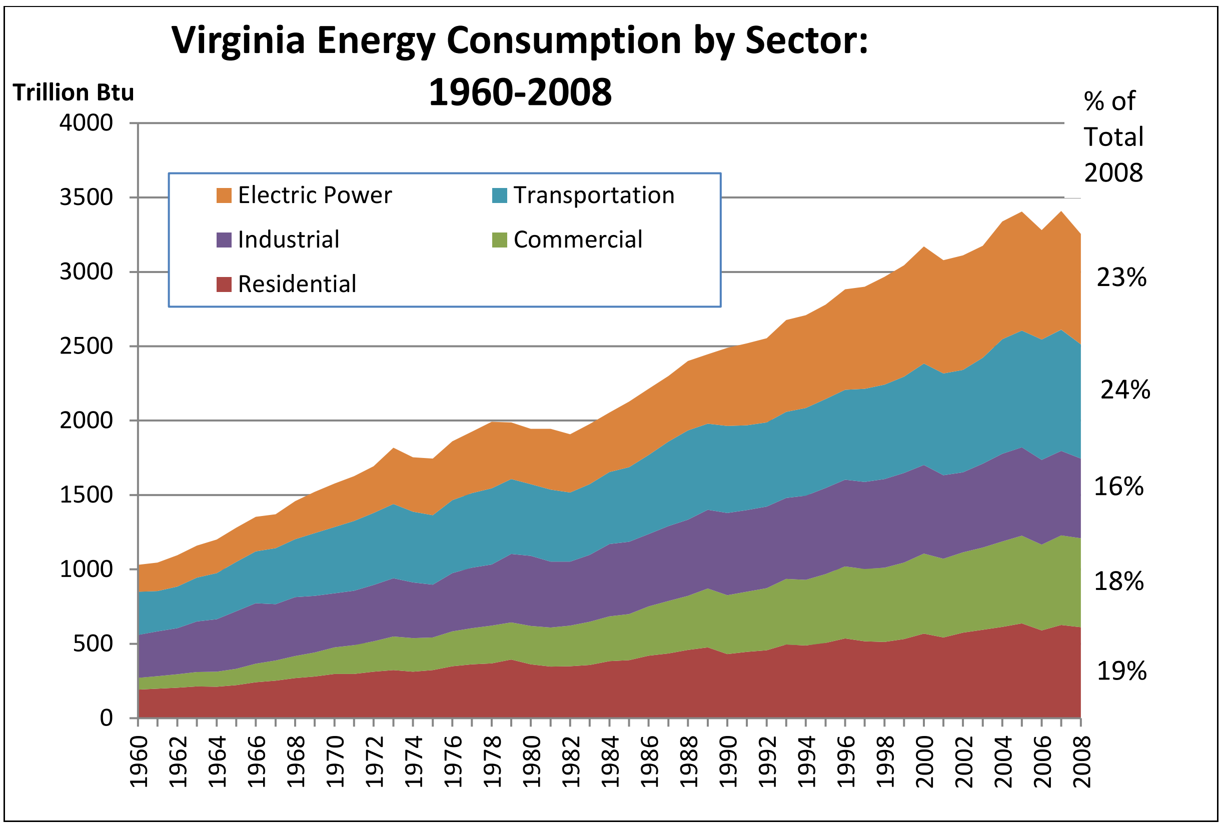
Figure 3-2 illustrates energy consumption by energy source from 1960 through 2008. During that time, total energy use in the Commonwealth more than doubled, growing from 851.1 Trillion British thermal units (Btu) to 2,496.9 Trillion Btu. In addition to the significant growth in energy consumption, there have been significant changes in the energy mix in Virginia. Table 3.1 highlights some of the changes such as a smaller share for petroleum, a larger share for natural gas, and the introduction of nuclear and renewables.

Table 3-1
Changes in Shares of Total Energy Consumption in Virginia 1960 - 2008

Changes in Shares of Total Energy Consumption in Virginia 1960 – 2008		
Year	1960	2008
Petroleum (Total)	49.3%	44.2%
Coal	35.3%	20.0%
Natural Gas	7.6%	15.0%
Nuclear	na	14.1%
Biomass (Total)	6.3%	6.1%
Hydro	1.5%	0.5%
Renewable (Other)	na	0.1%

Source: R. W. Beck, Inc., using data from the EIA

Figure 3-3shows energy consumption by major energy sector from 1960 through 2008. In Virginia, energy is consumed by sector in relatively equal proportions. In 2008, the industrial sector accounted for the smallest portion of total energy consumed with 16 percent, while the transportation sector reported the most at 23 percent. Interrelationships between and among some of the sectors have implications that pertain to energy assurance. For example, petroleum and transportation are closely allied and, consequently, a shortage of petroleum products could affect mobility, perhaps significantly. In addition, a shortage of petroleum products could impact the commercial and industrial sectors if heating oil or bunker fuel deliveries were interrupted. There are also energy assurance implications with respect to the types of energy being supplied. Although currently the bulk of electricity is produced by nuclear power, coal, and natural gas, with hydroelectricity and other renewables contributing a small proportion, Virginia has a voluntary renewable energy goal that could account for up to 12 percent of the State's electricity needs by 2022. However, from the perspective of energy reliability, the Renewable energy Portfolio Standards (RPS) goals cannot be factored in as a secure source of future energy.



Source*:* R. W. Beck, Inc., using data from the EIA

Figure 3-3. 1960 – 2008 Virginia Energy Consumption by Sector

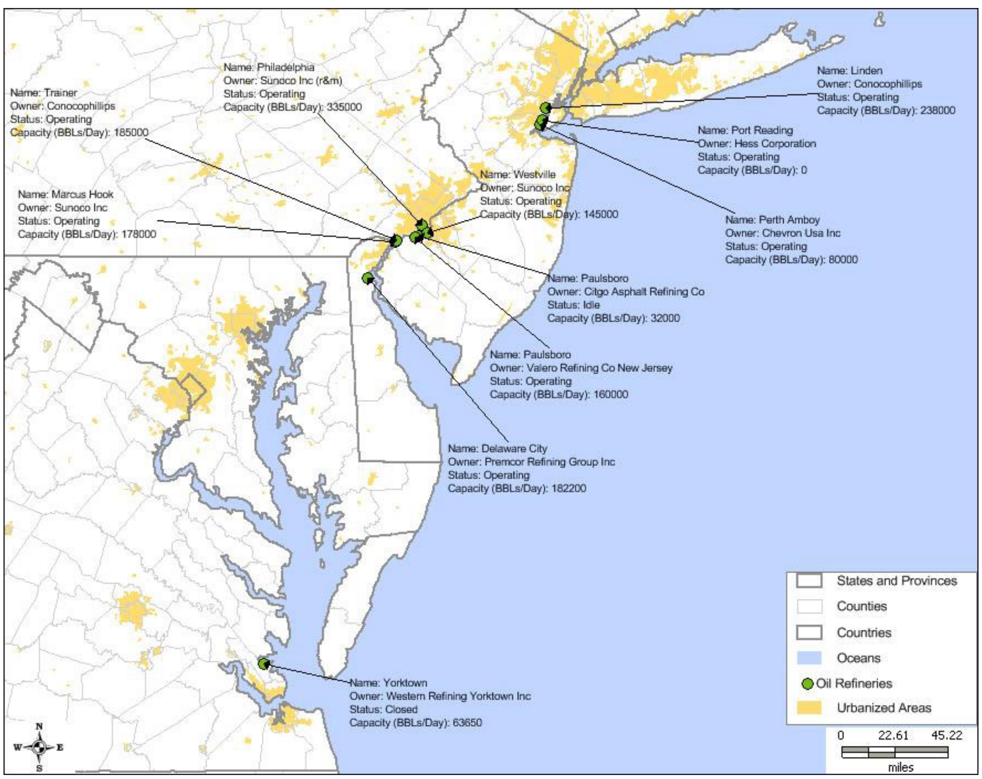
3.3 Primary State Energy Sources in Brief

This Section discusses the primary energy sources used in the State: petroleum, natural gas, and electricity. It also provides basic facts on Virginia's reserves of coal and natural gas. A more in-depth analysis of these topics is contained in Section 6, Energy Sectors.

Petroleum

Transportation accounts for most of the petroleum consumed in Virginia, with motor gasoline accounting for 52 percent, and aviation fuel accounting for 10 percent. Distillates, which include transportation fuels, as well as other uses, such as home heating, represent an additional 26 percent of consumption. Propane plays a minor role, comprising only two percent of total petroleum consumption. Residual fuel oil accounts for three percent and other miscellaneous petroleum products make up the remaining seven percent.

With the closure of the Yorktown refinery in 2010, petroleum is no longer refined in Virginia[14]; hence, the entire 640,000 barrels per day (bbl/d) consumed in the State must be brought in from outside the Virginia. The Colonial and Plantation Pipelines are the primary carriers of petroleum products in the region, delivering refined products from the Gulf Coast to a number of terminals in Virginia.



Source: R. W. Beck, Inc., using data from the ABB's Ventyx®

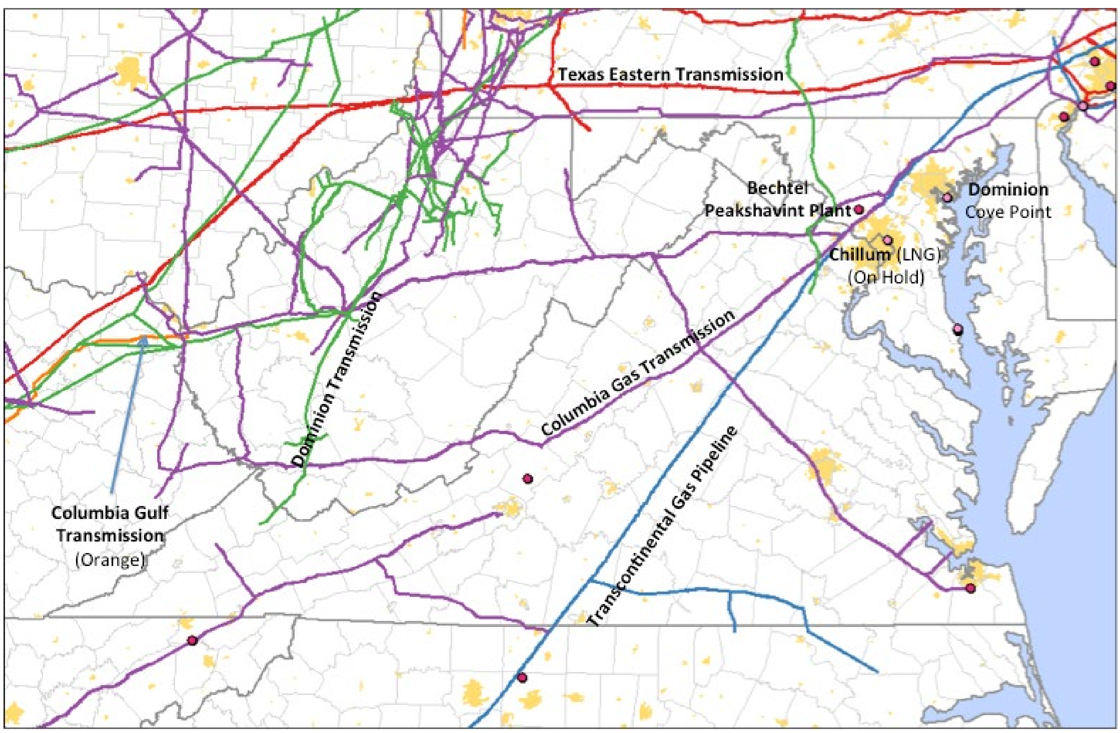
Figure 3-4. Petroleum Refining Near Virginia

[14] The former Yorktown refinery will likely continue in use as a terminal.

The closure of the only refinery in Virginia means increased reliance on the supplies coming through the Colonial and Plantation Pipelines, shipments into the Port of Norfolk, and the availability of supply from refineries in the Mid-Atlantic. Note: Virginia's total consumption of reformulated motor gasoline is above the national average both in terms of per capita and total usage. Figure 3-4 illustrates petroleum refining near Virginia. Factors relating to any of these supply sources may exert considerable influence on prices and supply available in the Commonwealth.

Natural Gas

Natural gas production in Virginia is relatively minor but is sufficient to supply about one-third of the State's demand. Virginia produces both conventional natural gas and coal bed methane in the central Appalachian Basin, which covers the State's western panhandle. Most of Virginia's natural gas production (approximately 80 percent) comes from coal bed methane fields, two of which are among the 100 largest natural gas fields in the U.S. As natural gas is produced, it is collected in low-pressure pipelines and sent to processing facilities where it is cleaned and compressed then injected into the high-pressure transmission pipelines. Most of the natural gas consumed in Virginia is delivered from the Gulf Coast region. The gas is shipped through several major interstate natural gas pipelines that serve Virginia and other states along the East Coast. Figure 3-5 illustrates pipeline locations within Virginia.



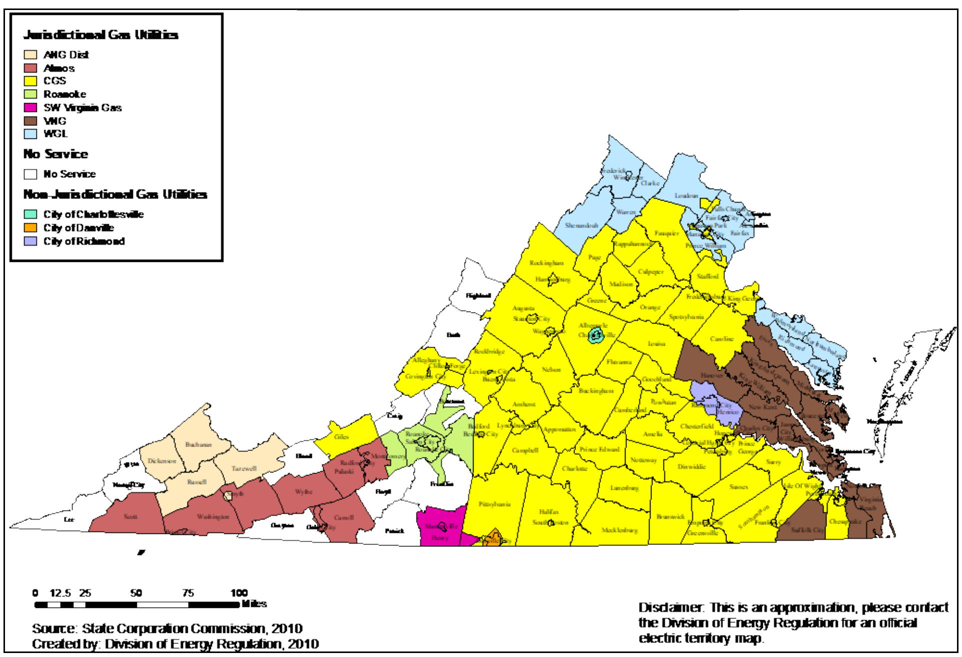
Source: R. W. Beck, Inc., using data from the ABB's Ventyx®

Figure 3-5. Natural Gas Interstate Pipelines

The potential for significantly greater natural gas production exists in Virginia because of recent and pending expansion of natural gas production from shale formations. Foremost among these projects is the Marcellus Shale gas reservoir located throughout the Allegheny Plateau region of the northern Appalachian Basin, including portions of Virginia. Estimates for the recoverable gas from the Marcellus Shale vary significantly, but Marcellus and other unconventional sources of natural gas have already had a strong impact on gas markets throughout the country and their impact will continue well into the future.

One uncertainty with respect to near-term expansion of Marcellus and related shale gas extraction is the concern regarding environmental issues relating to the use of hydraulic fracturing. Hydraulic fracturing or fracking is an extraction process that uses high-pressure injection of water, sand, and chemicals to release the trapped gas. A number of studies are currently underway to determine the impact on ground water and other issues in states including Maryland and New York.[15]

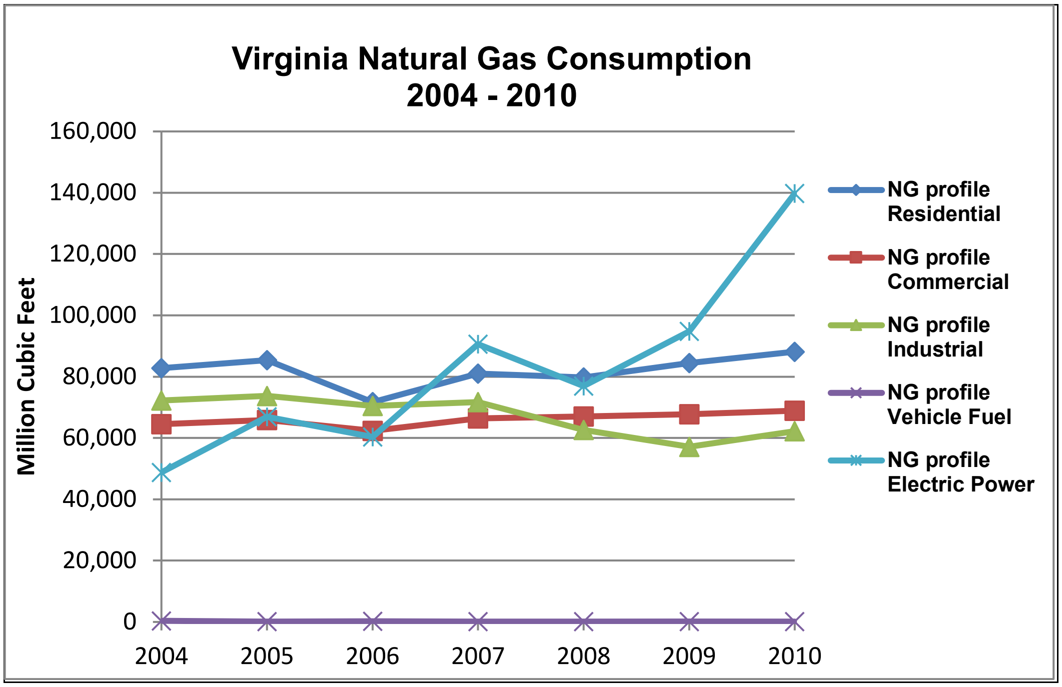
In 2009, 319 billion cubic feet (Bcf) of natural gas, or approximately 1.8 percent of total U.S. of natural gas was delivered to consumers in Virginia.[16] Consumption in the Commonwealth has grown an average of two percent annually over the last decade. The most noteworthy growth occurred in the use of natural gas for electric power generation. Robust growth in this sector is expected to continue, driven in large measure by the investments announced by Dominion Virginia Power (six new gas-fired plants through 2020). In addition, non-utility producers may also construct new gas-fired plants to serve Dominion and other electricity markets. Finally, some additional growth potential exists in the transportation sector for natural gas vehicles, for both private and public transportation.



Source: http://www.scc.virginia.gov/pue/gas/gas_map.pdf

Figure 3-6. Natural Gas Service Territories

[15] http://www.wbaltv.com/politics/26809897/detail.html; http://www.dec.ny.gov/energy/
[16] http://www.eia.gov/dnav/ng/ng_cons_pns_a_EPG0_VRP_pct_a.htm



Source: http://www.eia.gov/dnav/ng/ng_cons_sum_dcu_sva_a.htm.

Figure 3-7. Natural Gas Uses

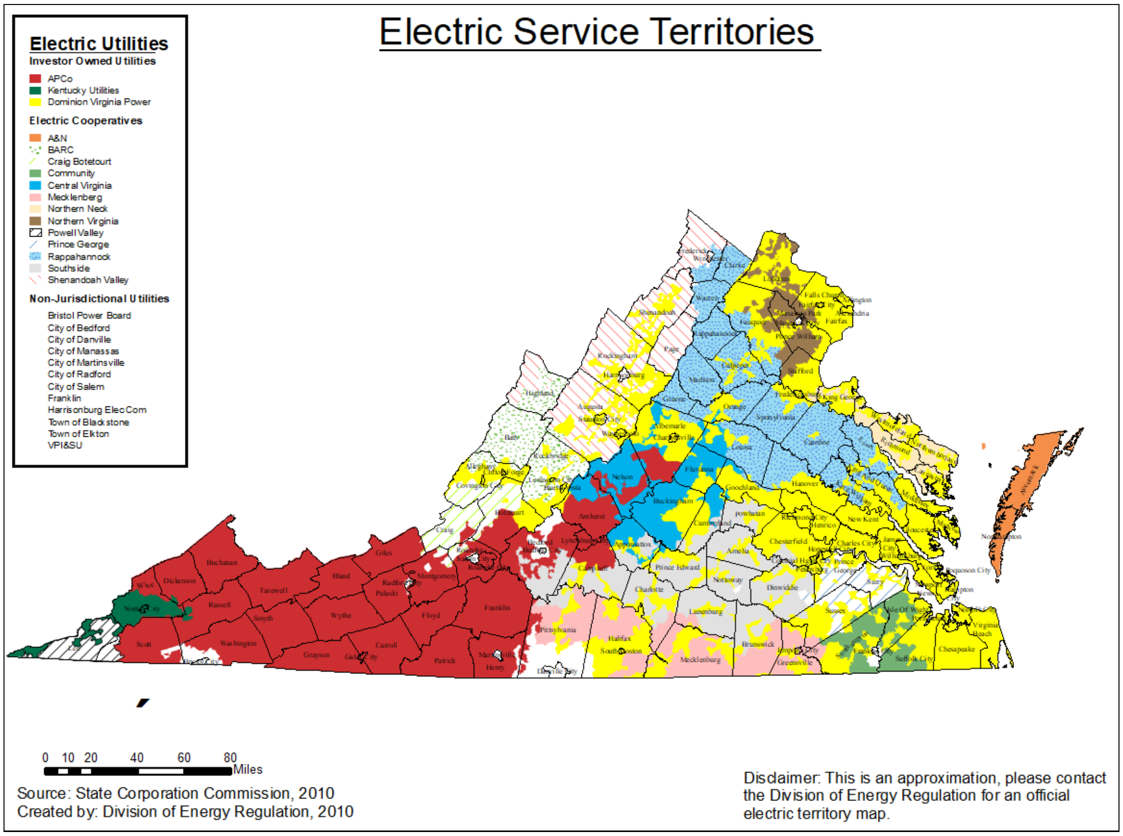
In 2009, natural gas provided approximately 15 percent of the total State energy supply.[17] As seen in Figure 3-7, natural gas consumption for generating electric power nearly tripled from 2004 to 2010. As noted earlier, as the price of natural gas becomes more favorable due to the use of Marcellus and other unconventional sources of natural gas, its use for electricity generation is likely to continue.

Virginia's industrial natural gas consumption held relatively steady, growing slightly from 2007 to 2010. The most prominent uses of natural gas within the Commonwealth are for residential heat and fueling electric generation.

Electricity

Virginia's electricity demand grew at a rate of about three percent annually over the past 10 years. Two-thirds of this growth is attributable to new customers, while the remainder is due to growth in use per customer. Electricity load growth is concentrated in the areas of Northern Virginia, Hampton Roads, and Richmond.

[17] State Energy Data, for Virginia, Table S1, Energy Consumption Estimates by Source and End-Use Sector – 2008.



Source: http://www.scc.virginia.gov/pue/elec/map.aspx.

Figure 3-8. Electricity Service Territories

In terms of electrical generation capacity, natural gas has the largest share with 33 percent of the State's capacity total; followed by coal (24 percent), nuclear (15 percent), hydro (15 percent) with residual and distillate fuel oils (7 percent each). However, actual electricity production by fuel type varies considerably from the capacity by fuel type. In 2009, nuclear held the largest share of net generation at 44.4 percent, with coal coming in second at 32.8 percent, then natural gas (11.4 percent), hydro (7.3 percent), residual fuel oil (3.6 percent) and finally wood/wood waste solids with 0.7 percent.[18]

The following types of entities provide service to retail electric consumers: three Investor-Owned Utilities (IOUs) (84 percent), 13 electric cooperatives (11 percent), and eight municipal utilities (5 percent). The IOUs are Dominion Virginia Power, Appalachian Power, and Old Dominion Power. Figure 3-8 illustrates the service territories of these utilities.

In-State Natural Resource Reserves – Coal and Natural Gas

Virginia has minor natural gas and coal reserves. Nearly all of its coal reserves are in the Central Appalachian Basin in the southwestern part of the State, where production occurs at surface and underground mines. Virginia coal production comprises more than five percent of total U.S. coal production east of the Mississippi River. Large

[18] EIA, State Level Data, Net Electricity Generation, December 2010.

volumes of coal traverse Virginia by rail, including production from Kentucky and West Virginia. Although nearly half of the states in the nation receive coal from Virginia, the primary recipients are Georgia and Tennessee. Most coal consumption is for electricity generation.

Coal-fueled electric generators produced about 36.5 percent of the State's electricity in 2009. A quarter of the coal comes from in-State sources, while a substantial tonnage comes from Kentucky (38 percent) and West Virginia (16 percent). In 2008, the average delivered cost was $0.277 per million Btu (MMBtu) or approximately $3.03 per megawatt hour (MWh), based on an average heat rate of 12,492 Btu per pound.[19]

Reserves of natural gas in Virginia are relatively small, accounting for just over one percent of total U.S. reserves according to data from EIA. Nonetheless, as the result of additions from coal bed methane associated with the vast expanse of the Marcellus shale the proved reserves of natural gas in Virginia over the past decade have increased by some 81 percent, up from 1,704 Bcf in 2000 to 3,091 Bcf in 2009[20]. Of the coal bed methane gas fields in Virginia, two are among the 100 largest natural gas fields in the U.S. The reserves of natural gas and coal bed methane are located in the Central Appalachian Basin, which covers the State's western panhandle.

Virginia's natural gas production is relatively minor but is able to meet about one-third of the State's demand. The number of natural gas wells in the State has increased dramatically reflecting the interest in gas from the Marcellus Shale. The number of natural gas wells in Virginia rose from 3,051 in 2000 to 7,303 in 2009[21].

[19] Information obtained from EIA, Virginia Electricity Profile, Table 6. Electric Power Delivered Fuel Prices and Quality for Coal, Petroleum, Natural Gas, 1990 Through 2008 and Section 3, Virginia Energy Plan 2008.
[20] EIA, State Level Data, Dry Natural Gas Reserves, December 2009.
[21] EIA State Level Data, Natural Gas Number of Gas and Gas Condensate Wells, 2/29/2012.

Section 4
AUTHORITIES

Virginia's energy assurance (EA) authority derives primarily from the Virginia Emergency Services and Disaster Laws of 2000, 2008 Edition. This section of the Virginia Code sets out the basic emergency management organization that authorizes the COVEOP. Within the COVEOP, the ESF-12, lists the agencies responsible for planning and supporting State EA efforts. This Section of the EAP describes the primary authority provided by the Virginia Code, and such additional laws and regulations that directly or indirectly affect EA planning and operation.

4.1 Primary Powers and Authority

Title 44, Military and Emergency Laws, contains the authority by which the Governor is responsible for the Commonwealth's emergency management structure, including fuel emergencies. The following summarizes the power and duties of the Governor, including primary legal titles and chapters.

Power and Duties of the Governor

§ 44-146.17 Powers and Duties of Governor — The Governor shall be Director of Emergency Management. He shall take such action from time to time as necessary for the adequate promotion and coordination of State and local emergency services relating to the safety and welfare of the Commonwealth in time of disasters.

Application of Power to Energy (Fuels)

§ 44-146.17(1) To proclaim and publish such rules and regulations and to issue such orders as may, in his judgment, be necessary to accomplish the purposes of this chapter including, but not limited to, such measures as are in his judgment required to control, restrict, allocate or regulate the use, sale, production and distribution of food, fuel, clothing and other commodities, materials, goods, services, and resources under any State or Federal emergency services programs.

Commonwealth of Virginia Emergency Operations Plan

§ 44-146.17 The Governor may adopt and implement COVEOP, which provides for State-level emergency operations in response to any type of disaster or large-scale emergency affecting Virginia, and provides the necessary framework enabling State agencies, local governments, and other organizations to develop and maintain more detailed emergency plans and procedures.

Powers Related to Energy Emergencies – Political Subdivisions

In addition to the Governor's direct powers, if the Governor declares an emergency, then according to § 44-146.19(C), Powers and Duties of Political Subdivisions include the following:

Each political subdivision within the disaster area may, under the supervision and direction of the Governor or his designated representative, control, restrict, allocate or regulate the use, sale, production and distribution of food, fuel, clothing and other commodities, materials, goods, services and resource systems that fall only within the boundaries of that jurisdiction and that do not impact systems affecting adjoining or other political subdivisions, enter into contracts and incur obligations necessary to combat such threatened or actual disaster, protect the health and safety of persons and property, and provide emergency assistance to the victims of such disaster.

Local Emergency Declaration

The Code also provides for EA authority following the declaration of a local emergency. Under § 44-146.21(C) (C1) Declaration of Local Emergency:

The director of emergency management of each political subdivision or any member of the governing body in the absence of the director, if so authorized by the governing body, may control, restrict, allocate or regulate the use, sale, production and distribution of food, fuel, clothing and other commodities, materials, goods, services and resource systems that fall only within the boundaries of that jurisdiction and that do not impact systems affecting adjoining or other political subdivisions.

Emergency Management Assistance Compact (EMAC)

The EMAC was established in 1996 as a mutual aid agreement and partnership between member states to address emergencies that should arise ranging from hurricanes to earthquakes, wildfires to toxic waste spills, and terrorist attacks to biological and chemical incidents. The Virginia Code includes this interstate compact, which provides an additional basis for authorizing action to plan for, mitigate, and respond to EA issues. Article III (A)(5) states that each party to the compact has the responsibility to: "Protect and assure uninterrupted delivery of services, medicines, water, food, energy and fuel, search and rescue, and critical lifeline equipment, services, and resources, both human and material."

4.2 Federal Reference

Virginia also cites Federal law referring in several EA-related plans to U.S. Public Law 94-163 of 1974, Section 362. As amended in 2000, Section 362 covers the guidelines for energy conservation plans. According to 42 U.S.C. § 6322 (c) (1 - 6), to be eligible for Federal energy conservation assistance these plans must include the following mandatory features:

- Mandatory lighting efficiency standards for public buildings
- Programs to promote the availability and use of carpools, vanpools, and public transportation
- Mandatory energy efficiency (EE) procurement practice standards and policies relating to states and political subdivisions

- Mandatory thermal efficiency standards and insulation requirements for new and renovated buildings
- A right-turn-on-red law
- Procedures ensuring effective coordination among various local, state, and federal energy conservation programs within the state

While all of the above features could mitigate the severity and duration of an energy emergency, the mandatory measures refer to standards, not EA response measures. The Act lists the following measures as options under 42 U.S.C. § 6322 (d) (1-2):

- Restrictions governing the hours and conditions of operation of public buildings
- Restrictions on the use of decorative or nonessential lighting

The remainder of Section 362 refers to various energy conservation, efficiency, and renewable energy programs that eligible Federal assistance could fund. None of these programs could be considered emergency response measures.

4.3 Regulated Energy Sources

Virginia Code Chapter 10, Heat, Light, Power, Water and Other Utility Companies

Chapter 10, Title 56 of the Virginia Code lists other requirements pertaining to all related utilities, including telephone and water. For the purpose of this Section of the EAP, only those related to electricity and natural gas are highlighted in Table 4-1. The ESF-12 references the relevant sections of Chapter 10; the table below notes and describes them.

Table 4-1
Summary of Chapter 10 Sections Noted in ESF-12 re: Electricity and Natural Gas

Sections Identified in ESF-12 Pertaining to Energy Mitigation and Restoration	
Section Number	Summarized Description
§ 56-234	Duty to furnish adequate service at reasonable and uniform rates
§ 56-236	Public utilities required to file rate schedules, charges, rules and regulations
§ 56-237	How changes in rates effected; notice required; changes to be indicated on schedules
§ 56-249	Reports by utilities
§ 56-249.1	Commission may require transfer of gas, water or electricity from one utility to another
§ 56-250	Commission may authorize action by public utility in time of emergency or shortage
§ 56-257	Manner of installing underground utility lines
§ 56-257.2	Gas pipeline safety
§ 56-265	Certain sections not to limit Commission's powers
Other Sections that Could Apply to EA Issues	
Section Number	Summarized Description
§ 56-245.1:1	Customers to be notified about nuclear emergency evacuation plans

Section 56-249.1 is of special interest because the ESF-12 uses the authority conferred by this section for both natural gas and electricity shortages.

> § 56-249.1. Commission may require transfer of gas, water or electricity by one utility to another; compensation. The Commission may require a public utility to transfer to another public utility of like business, gas, water or electricity, whenever the public health, welfare or safety shall be found to so require; provided, however, that the transferring public utility shall be compensated, at a rate fixed by the Commission, for all such deliveries by the receiving public utility.

Section 56-265 provides broad generalized authorization for emergency actions:

> § 56-265. Certain sections are not to limit Commission's powers. "Nothing in § 56-261 or §§ 56-262 through 56-264 shall be construed so as to limit or curtail the existing powers of the Commission to require of all public service corporations in all cases the rendition of adequate service to the public at reasonable rates nor the existing right of municipalities or individuals to apply to the Commission for the enforcement of such duties, the purpose of such sections being to extend and not to limit the powers of the Commission."

State Regulation of Natural Gas

The SCC or Commission retains the powers granting authority over natural gas, especially with regard to the award of a certificate of convenience and necessity. Chapter 10, § 56-257.2 (A), Gas Pipeline Safety states, "the Commission shall have the authority to regulate the safety of master-metered gas systems," as well as landfill gas systems. The SCC is also authorized under subsection § (C) "to conduct safety inspections pursuant to the Federal pipeline safety laws", 49 U.S.C. § 60101 *et seq*.

Among the provisions of Chapter 10.1, Utilities Facilities Act is § 56-265.1 requires that SCC approval is necessary for the construction of "gas pipelines and related facilities." In addition, Chapter 10.1, § 56-265.2, Certificate of Convenience and Necessity Required for Acquisition of New Facilities, requires all utilities to obtain SCC permission after public hearings and due notice. Further, the transfer authority noted under § 56-249.1 applies to ESF-12. Other provisions in the basic emergency sections also apply. The role of the SCC is clearly delineated in Chapters 10 and 10.1 of Virginia Code.

4.4 Ancillary Laws Pertaining to Energy Emergencies; Non-Regulated Energy

State Regulation of Electricity: Chapter 23, Electric Service Provider

Chapter 23 of the Code contains specific sections pertaining to emergencies. § 56-586, Emergency Service Provider, states that "if any supplier fails to fulfill an obligation, resulting in the failure of retail electric energy to be delivered into the control area serving the supplier's retail customer," the local energy supplier (or the regional transmission entity or other entity the SCC designates) may charge the "defaulting" supplier the full cost of replacement energy. If circumstances justify, SCC may revoke a supplier's license in Virginia according to § 56-287.

The Code also defines an Electric Energy Emergency under § 56-586-1. Table 4-2 summarizes this extensive section.

Table 4-2
Summary of Provisions – Electric Energy Emergency

Section	Provisions
§ 56-586-1 (A)	An electric supply emergency is defined as an: unplanned interruption in the generation or transmission of electricity resulting from a hurricane, ice storm, windstorm, earthquake or similar natural phenomena, or from a criminal act affecting such generation or transmission, act of war or act of terrorism, which interruption is (i) of such severity that minimum levels of reliable service cannot be maintained using resources practicably obtainable from the market and (ii) so imminently and substantially threatening to the health, safety or welfare of residents of this Commonwealth that immediate action of State government is necessary to prevent loss of life, protect the public health or safety, and prevent unnecessary or avoidable damage to property.
(B)	Upon finding that an electric emergency exists, the Governor can, declare an electric energy emergency by filing a written declaration with the Secretary of the Commonwealth. The declaration must state the counties and cities or utility service areas of the Commonwealth in which the declaration is applicable, or its statewide application. The declaration is limited to 30 days unless extended in another declaration by the Governor or rescinded by joint resolution of the General Assembly (sub§ F).
(C)	The Governor may: require any generator or any municipal electric utility that is capable of generating but (i) is not generating or (ii) is not generating at its full potential during such declared electric emergency, to generate, dispatch or sell electricity from a facility that it operates within the Commonwealth, to the Commonwealth for distribution within the areas of the Commonwealth designated in the declaration.
(D)	The Governor may use the "services, equipment, supplies, and facilities" of all State agencies "to the maximum extent practicable and necessary to meet the electric energy emergency."
(E)	The Governor is authorized to request the Secretary of the U.S. Department of Energy to invoke section 202(C) of the Federal Power Act, 16 U.S.C. §824(a). (This is essentially an order for temporary connections of facilities, during times of war or other emergency, for the generation or transmission of electric energy and such generation, delivery, interchange, or transmission of electric energy as is requested.)
(F)	See (B) above.
(G)	VDEM is charged with coordinating and establishing guidelines pertaining to the protection of public health, safety, avoidance of property damage so as to minimize any economic disruption to the electricity supply industry.
(G1)	VDEM defines levels of electric emergency and specifies appropriate mitigation measures to protect public health, safety and property damage.
(G2)	VDEM prescribes appropriate response (immediate actions required) measures.
(G3)	VDEM assures the distribution of benefits for such measures equitably among affected users.

Section	Provisions
(H)	The Attorney General may seek prompt compliance. Courts may issue ex parte temporary orders without notice.
(I)	No intentional violations are permitted during a declared emergency.

Petroleum Dealer Supplier Relationship

The petroleum and coal industries are not regulated *per se* in Virginia. However, State laws govern trade practices. Foremost among these State laws is Chapter 2.2, Virginia Petroleum Products Franchise Act, under Title 59.1, Trade and Commerce. The impact of this chapter on managing petroleum shortage issues is indirect. While this chapter contains no specific provisions regulating the petroleum industry's response to shortage or disruption, the law's provisions protecting retail dealers within the State petroleum market do affect the local distribution system's reliability. These provisions aid local dealers to operate profitably. The economic viability of the dealers helps maintain the ready supply of retail petroleum products. These supplier-retail dealer provisions may also impact pricing, although pricing, *per se*, is not generally considered a direct emergency supply issue. Table 4-3 summarizes the legislation that affects the petroleum sector.

Table 4-3
Virginia Trade and Commerce: Virginia Petroleum Product Franchise

Virginia Code Title 59.1	Summary of Provisions
Chapter 2.2,§ 59.1-21.11	Required provisions pertaining to agreements between refiners and dealers: ▪ Protects dealers from potential supply requirements for excessive (over 16) operating hours per day ▪ Protects dealers from other trade practices that are seen as harmful to their operation, e.g., waiver of legal rights, premium participation, assignment of franchise, term of agreement ▪ Certain fees dealers may be required to pay defined and managed ▪ Passing franchise to heirs ▪ Fees on transfer of franchise ▪ Allowable percent of profit fees charged by supplier ▪ No waiver of dealer legal rights
Chapter 2.2,§ 59.1-21.13	Obligation of refiner to repurchase upon termination, etc., of agreement: ▪ Good faith effort on part of refiner must be made to repurchase merchantable products "upon termination" of franchise
Chapter 2.2,§ 59.1-21.14	Producer or refiner not to terminate agreement without notice and reasonable cause : ▪ Notice of termination required ▪ Reasons for termination by refiner defined

4.5 Responsibilities of Primary Energy Cognizant Agencies

The State agencies having primary responsibility for energy matters are: DMME, SCC, and VDEM. DMME and the SCC have the primary legal responsibility for energy matters, while the VDEM has the principal authority for energy emergency response under the Governor. DMME has the responsibility of overseeing all of the State's mineral resource production, including oil, coal, and natural gas. In addition, it has the responsibility of promoting, educating the public about, and managing programs for EE and renewable energy.

DMME manages a myriad of EE and renewable energy programs that apply to all energy sectors, and monitors data and market activity related to the use of petroleum. In the event of a declared petroleum emergency, DMME would coordinate with VDEM to set out and manage emergency measures mandated by the Governor designed to mitigate and respond to a severe shortage.

While the DMME has primary emergency response oversight with regard to the coal and petroleum industries in the Commonwealth, it shares responsibility for planning and managing EA issues with the SCC.

The SCC has the regulatory oversight of regulated electricity and natural gas utilities in the Commonwealth. The range of regulation stretches from initial applications to provide electricity or natural gas service to the emergency plans for response measures, restoration of service, mitigation, and priorities of customers such service assists.

The SCC fulfills its role through a combination of extensive rules and requirements to assure that regulated energy providers meet federal and state standards, follow prescribed operation procedures, and maintain the financial capability to operate with safety and efficiency.

VDEM has primary emergency response authority under the Governor. VDEM coordinates the activities of all responders in accordance with the COVEOP. The scope of the VDEM allows it to focus on an energy disturbance alone, or consider the energy implications of other incidents, such as severe weather or man-made interruptions.

In terms of energy security and reliability, both the DMME and the SCC have key roles in assuring the continuity and reliability of energy delivery in Virginia.

Emergency Support Function 12 (ESF-12)

The ESF-12 is the Commonwealth's central operating protocol for managing energy emergencies. The Virginia ESF-12 divides operational oversight between DMME and the SCC, with DMME overseeing emergency response related to petroleum products and SCC overseeing emergency response pertaining to electricity and natural gas.

Purpose, Scope and Mission of the ESF-12

Figure 4-1 summarizes the basic mission and policy of the ESF-12. The ESF-12 provides Statewide coverage and assistance across defined systemic needs. The ESF-12 is not intended to prescribe an absolute hierarchy. Rather, the ESF-12 is designed to promote a cooperative arrangement. Under the leadership of VDEM (the Primary Agency), three State agencies, DMME, SCC, and the Virginia Information Technologies Agency (VITA) are the designated Commonwealth Support Agencies. Two energy industry organizations are also included in the category as Support Organizations: Dominion Virginia Power Company and Virginia Electric Cooperatives. The general Concept of Operations enjoins all ESF-12 entities to respond to the VEOC and "collectively serve as the focal point within the Commonwealth for receipt of information on actual or potential damage to energy supply and distribution systems."

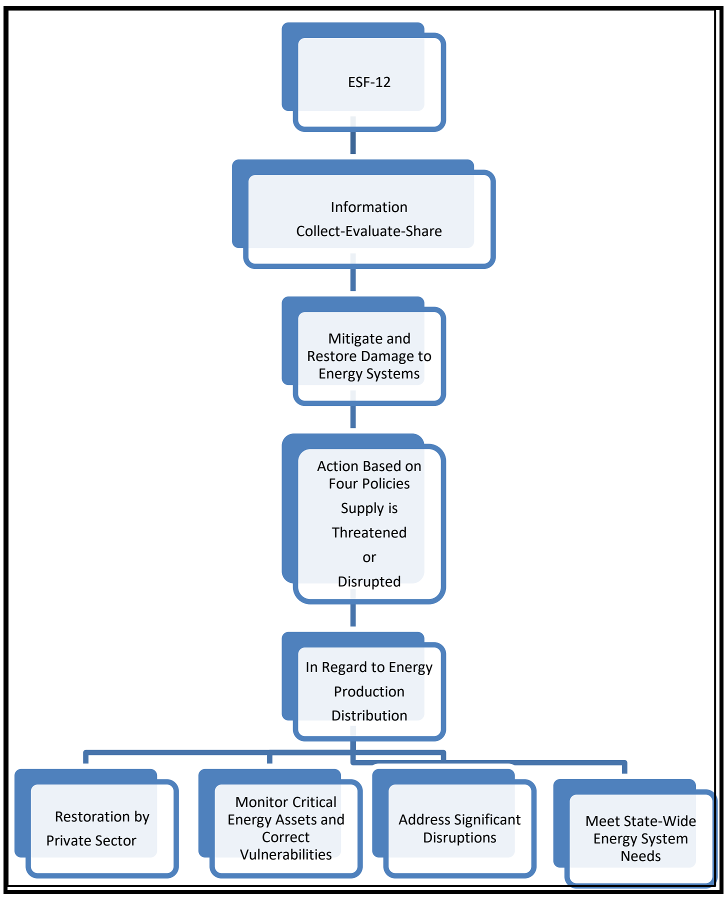


Figure 4-1. Purpose, Scope, Mission, Policy of ESF-12

The ESF-12 agencies begin managing an energy emergency by monitoring the situation. These agencies enhance energy reliability, take steps to mitigate energy disruptions, and assist the energy industry with restoration. However, energy industry owners and operators retain primary responsibility for restoration.

The following are specific steps relating to individual energy forms. However, these steps also require coordination as a part of the ESF-12 in its entirety. These areas include a list of five major actions and nine State level assets. Figure 4-2 and Figure 4-3 summarize these actions and assets.

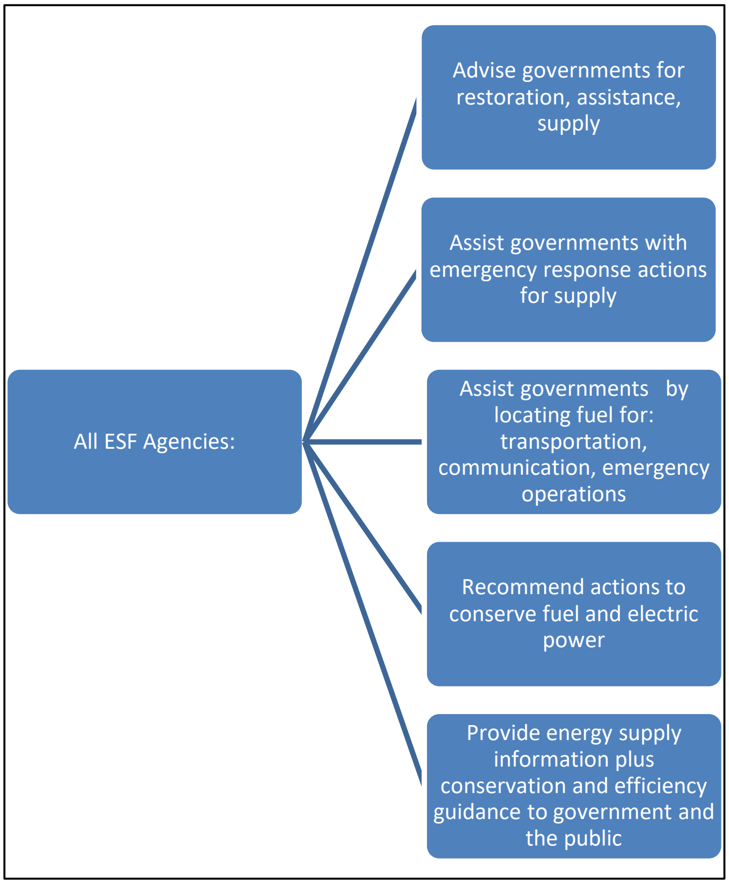


Figure 4-2. Major ESF-12 Duties

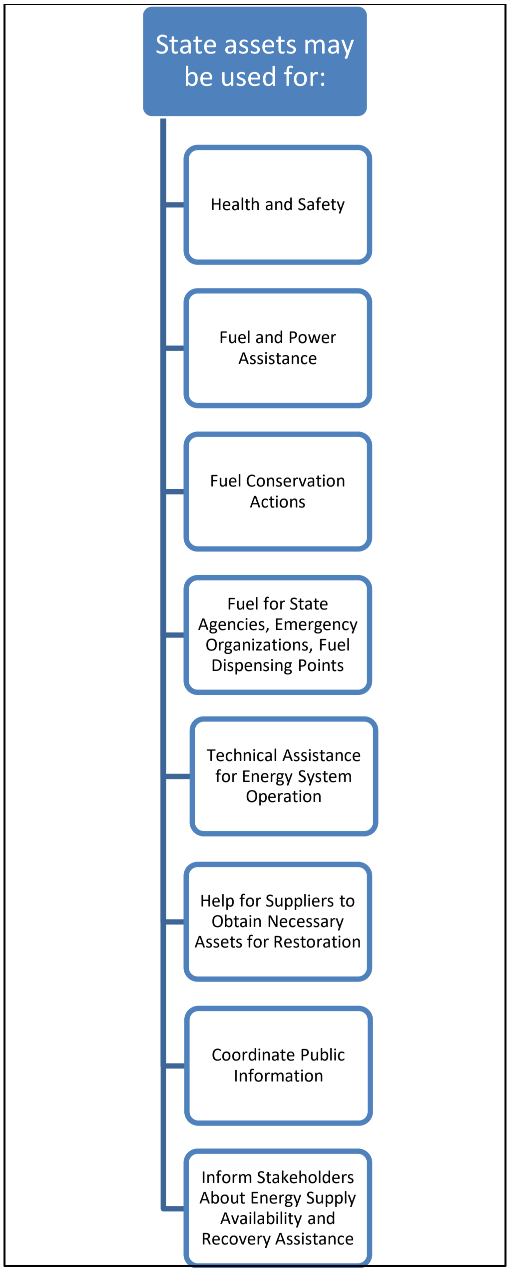


Figure 4-3. State Assets Available for Use under ESF-12

The ESF-12 outlines general requirements and specific operations related to the four major energy/fuel forms that supply Virginia: natural gas, electricity, petroleum liquids, and coal. The ESF-12 cites appropriate legal sources and allows the federal government to oversee interstate activities. For example, under Natural Gas, the ESF-12 notes that Federal Energy Regulatory Commission (FERC) policy is to adjust natural gas curtailments to ensure "the protection of deliveries for the residential and small-volume consumers who cannot be curtailed on a daily basis, and to require instead reduction in deliveries for large-volume interruptible sales."

The ESF-12 also states that DOE is responsible for managing "all interstate aspects of an energy crisis."

ESF-12 Section 1 – Natural Gas

DMME Duties and Responsibilities

The ESF-12 gives DMME the responsibility to "implement information gathering systems to monitor and forecast national and local natural gas demands and available supplies." DMME will coordinate with the SCC, in accordance with the overall coordination framework outlined by the general Concept of Operations of the ESF-12.

Special SCC Responsibilities Noted Within Concept of Operation

The ESF-12 lists two major responsibilities. For reference purposes, these items parallel the "Response Capabilities" subsection under "Electric Power," below. These responsibilities include:

- SCC's authority to allocate supplies between distribution companies as described in reference to § 56-249.1.
- SCC's "Natural Gas Priorities and Rules," found in Virginia Administrative Code (VAC), Agency 5, State Corporation Commission, 20VAC5-300-110. The subsection Natural Gas under, "Energy Sectors," of this EAP addresses natural gas priorities and rules.

SCC Duties and Responsibilities

- Monitor natural gas supplies; establish alert points where increased emergency preparedness would be taken.
- Provide liaison with federal agencies and the natural gas industry to provide the earliest possible warning of shortages.
- Develop and maintain priorities and rules for curtailment and allocation procedures.
- Develop and maintain priorities and rules for voluntary and mandatory conservation procedures.
- Develop and maintain procedures for special hardship appeals of curtailment and conservation procedures.
- Assist with the legal interpretations of all orders as the VEOC requests.
- Assist natural gas users in obtaining alternate supplies.
- Provide guidance to the VDEM as to the extent of shortages, as a basis of recommending to the Department of Environmental Quality the need to temporarily waive air pollution control regulations to allow industrial boilers and furnaces to switch to less clean, heavy oil products.
- Be prepared to request cooperation from railroads in expediting movement of propane cars, both empty and loaded.
- Keep the public fully informed on all matters pertaining to a natural gas shortage.

These duties are straightforward. Item No. 1 overlaps the duties of the DMME, further illustrating the intention that agencies coordinate activities. Although as shown in Item No. 9, the ESF-12 treats propane as a gas. However, propane is also classified as a petroleum liquid since it is derived from both from refinery production and natural gas processing, which strips liquids and volatile organic compounds from natural gas before allowing it to enter the commercial pipeline system. This EAP examines and cross-references propane with natural gas in the "Petroleum" subsection under "Energy Sectors."

Local Government Duties and Responsibilities

- Include measures dealing with a natural gas shortage in the local resource plan.
- Notify the Department of Social Services (DSS) when local citizens are unable to purchase natural gas because of a lack of funds.
- Request from the SCC any assistance relating to natural gas supplies.
- Request from VDEM all other assistance relating to problems caused by natural gas shortages.

The duties assigned to local government essentially broaden the "eyes and ears" of emergency responders, as local government reports the listed observations to VDEM. Local gas distribution companies are also required to report shortages of natural gas or other disruptions to SCC.

ESF-12, Section 2 – Electric Power

This section covers many of the operational issues associated with the production and consumption of electricity. The "Electricity," subsection in "Energy Sectors" of this EAP provides additional details.

Response Capabilities

Response Capabilities – a category that is special to electric power under ESF-12, relates to industry response as opposed to State or local response. The term refers to shortage response through power transfers and curtailment. These items parallel the steps found in the electric utility response plans filed with the SCC. The "Electricity" subsection in "Energy Sectors" of this EAP covers these capabilities in greater depth.

Included among the major steps outlined by the ESF-12 are:

- Transfer of electric power to meet unusual demands.
- Load shedding carried out by the generating company to reduce demand by both voluntary and (failing that) mandatory actions using "predetermined selective load shedding." Affected facilities may include:
  - Places of amusement
  - Non-essential public places
  - Schools not being used for sheltering
  - Commercial wholesale

- Retail establishments and office buildings not engaged in public safety and welfare

If utility actions fail to address the need to reduce power during a severe emergency, the Governor may "allocate or regulate the sale, distribution, and use of all electricity available within the State. Mandatory conservation measures for residential, governmental, commercial, and industrial users may also be instituted as needed."

SCC Duties and Responsibilities

- Monitor utility fuel supplies and reserves, and establish alert points where increased emergency preparations would be taken.
- Provide liaison with federal agencies and the electric power industry to provide the earliest possible warning of shortages.
- Monitor power supply and demand during critical periods.
- Develop and maintain priorities and rules for curtailment procedures.
- Work with utilities to implement a restoration strategy in situations where widespread system infrastructure damage occurs.
- Develop and maintain voluntary and mandatory conservation procedures to be implemented during a shortage.
- Develop and maintain procedures for special hardship appeals of curtailment and conservation orders.
- Assist with the legal interpretations of all orders as the VEOC requests.
- Keep the public fully informed on all matters pertaining to an electric power shortage.

Local Government Duties and Responsibilities

- Include measures dealing with an electricity shortage in the local resource plans.
- Notify the State DSS when local citizens lack funds to purchase electricity and local assistance resources have been expended.
- Request all other assistance relating to an electricity shortage from the State Department of Emergency Management.
- Coordinate the implementation of State voluntary and mandatory programs within local jurisdictions.

ESF-12 Section 3 – Petroleum

Concept of Operation

The DMME is assigned primary responsibility regarding petroleum. The agency both gathers information and remains in contact with stakeholders in the petroleum industry. In the event of a petroleum shortage or other incident, DMME is expected to work with both DOE and VDEM. Industry representatives may also serve as advisors to VEOC. The ESF-12 requires DMME to "coordinate with a network of contacts between industry and government to ensure an efficient State response." The ESF-12 reinforces this requirement in subsection C of the Petroleum Products section, stating: "This plan relies on the cooperative partnership between government agencies and the private sector." DMME is assigned the task of coordinating this partnership.

As with electricity (and to some extent, natural gas), the "Petroleum" subsection in "Energy Sectors" of this EAP covers the ESF-12 market-related information.

Federal Role

The ESF 12 notes the DOE policy allowing the petroleum marketplace to manage the initial response to shortage as well as to implement various response measures. The law to which the ESF-12 refers (Public Law 94-163, 1975, Section 3620) does discuss certain potential response measures; however, this law does not appear to authorize them. This law also notes the role of the U.S. SPR, which the "Petroleum," subsection in "Energy Sectors" of this EAP discusses.

Information and Conservation

The ESF-12 takes note of DMME's obligation to maintain product supply, distribution, and price information for both petroleum and coal. As with electric power, several conservation measures apply in Virginia. These measures include:

- Appeals for voluntary conservation
- The possibility of a State declaration of emergency
- Coordination with the DOE and neighboring states and jurisdictions
- Invocation of mandatory conservation measures for all users in accordance with the Commonwealth of Virginia Emergency Services Disaster Law of 2000 (See §§ 44-146-17 (1); 19(C); 21(C1)).
- As a last resort, the use of the Virginia Set-Aside Program that:
  - Applies to major oil companies
  - Could reserve from one to three percent of total volume imported into the State for reallocation of motor gasoline and distillate (kerosene, No. 2 heating oil, and diesel)
  - May be activated in the event of a supply reduction of 10 percent or more in either an affected area or the entire Commonwealth

DMME Duties and Responsibilities

In the event of a shortage, DMME would do the following:

- Receive requests from fuel oil suppliers, transporters or trade associations to implement vehicle weight and driver hours of service (HOS) waivers.
- Communicate these requests to VDEM.[1]
- Coordinate with trade associations to share information and prepare needs assessments.

[1] The HOS waiver process will be examined further in EAP Section 6 Energy Sectors, Petroleum.

- Maintain current contact information with the petroleum product and propane distribution and delivery industry.
- Provide data regarding supplies and use of petroleum products obtained from:
  - DOE, EIA
  - Virginia Energy Patterns and Trends web site
  - Other sources as necessary
- Coordinate regional contacts. Renew key contacts annually or more often as needed. Listed are:
  - Neighboring Jurisdictions - District of Columbia, Maryland, West Virginia, Kentucky, Tennessee, and North Carolina2
  - Metropolitan District of Columbia Council of Governments
- Maintain ready-to-go guidance materials to assist State government facility managers responding to a petroleum products energy emergency.
- Be prepared to advise the Governor during an energy emergency. The Governor will direct conservation measures and other actions, usually as recommended by federal guidance,[3] through DMME or, in the event of a state of emergency, through VEOC.
- Develop and maintain the Petroleum Products and Coal Energy Emergency Handbook to include key contacts in government and industry, ready-to-go press releases, and other guidance materials for implementing voluntary and mandatory conservation measures.
- Assist and provide technical expertise as needed to the Office of the Secretary of Commerce and Trade and to VEOC during an energy emergency.

<u>VDEM Duties and Responsibilities</u>

- Implement voluntary and mandatory energy conservation measures once the Governor has declared a state of emergency.
- Assist with the driver HOS and other waiver requests as noted under DMME Duties and Responsibilities above.[4]

<u>SCC Duties and Responsibilities</u>

- Acting as the interstate pipeline agent, SCC will coordinate with pipeline companies, other states, and federal/state emergency agencies regarding product disruptions resulting from pipeline distribution and/or system failures.

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[2] The actual ESF-12 lists a DOE office that no longer exists. Hence, that reference is omitted here.
[3] While the DOE offers general energy conservation advice, State EAPs contain such measures for recommendation to the Governor. DOE offices may suggest measures, but these are not considered mandates or authorizations.
[4] This duty is contained under DMME in the ESF-12; hence, it is moved under VDEM here for clarity.

- SCC is the clearinghouse on communications with pipeline company officials and emergency response agencies regarding the status of the emergency and current condition of the pipeline.

Local Government Duties and Responsibilities

- Include measures dealing with a petroleum product shortage in the local energy plan.
- Notify DMME and VEOC when local citizens are unable to obtain petroleum products from local dealers.
- Request all other assistance relating to petroleum product shortages through VEOC.
- Be prepared to provide mass care in heated buildings for citizens who are temporarily without home heating fuels.
- Coordinate the implementation of State voluntary and mandatory conservation and emergency management programs within local jurisdictions.

ESF-12 Section 4 – Solid Fuels (Coal)

Concept of Operation

The ESF-12 identifies coal as essential to the production of electricity as well as some industrial processes.

DMME Duties and Responsibilities

- Receive and review reports from SCC, major industries that use coal, coal dealers, and local governments, regarding impending coal shortages and potential consequences of continued reductions in supply.
- Inform VEOC and State agencies as necessary regarding the status of coal when potential or actual shortages exist.
- Keep information resources available so the public may be fully informed on matters pertaining to a coal shortage.

VDEM Duties and Responsibilities

- Implement conservation measures, emergency rationing or allocation of coal supplies, or other control measures as necessary in the event of a coal shortage.
- Coordinate with DMME to maintain the solid fuel (coal) part of the ESF-12.

SCC Duties and Responsibilities

- Inform DMME and VEOC regarding the status of coal supplies of electric utilities serving the State.
- Implement measures under the Virginia Energy Emergency Plan for Electricity that affect coal consumption at electrical power plants.
- Coordinate actions affecting coal with DMME and VEOC.

Local Governments Duties and Responsibilities

- Include measures dealing with a coal shortage in the local energy plan.
- Notify DMME and VEOC when local citizens are unable to obtain coal from local dealers
- Notify the local DSS when citizens are unable to obtain coal from local dealers for heating or cooking purposes.
- Request all other assistance relating to coal shortages through the VEOC.
- Be prepared to provide mass care in heated buildings for citizens who are temporarily without home heating fuels.
- Coordinate the implementation of State voluntary and mandatory conservation and emergency management programs within local jurisdictions.

Department of Rail and Public Transit Duties and Responsibilities

- Contact rail carriers to identify causes of the transportation problems
- Implement plans to provide necessary supplies to critical coal-burning facilities, such as utility and non-utility electric generating plants when rail shipments of coal are disrupted.

Section 5
PRINCIPAL STAKEHOLDERS

This Section identifies and explains the roles of the principal stakeholders involved in the Commonwealth of Virginia's EA activity. The three categories of principal stakeholders are government, energy industry (including suppliers and distributors), and associated organizations.

5.1 Principal Governmental Stakeholders

Three State agencies are most closely associated with EA planning and activities – DMME, SCC, and VDEM. The EA roles of these agencies are described separately and in relation to the emergency management plan contained in the State's ESF-12.

5.1.1 Virginia Department of Mines, Minerals, and Energy

DMME is organized under the Commonwealth Secretary for Commerce and Trade. The department has six divisions covering the production, licensing, and advancement of "sustainable energy practices and behaviors." DMME enforces regulations pertaining to mineral production within the Commonwealth. As such, DMME has direct oversight over natural gas, oil, and coal production. Unlike SCC, this agency does not regulate the markets for these energy fuels. Figure 5-1 illustrates DMME organization.

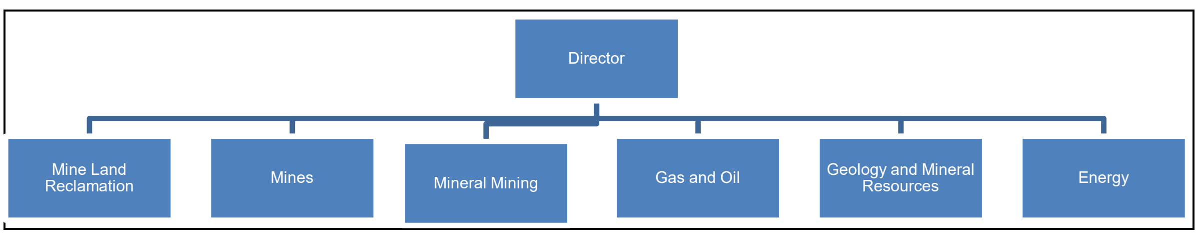


Figure 5-1. Organization of DMME

Duties and Responsibilities

Within DMME, the Division of Energy has primary responsibility for EA planning and oversight. The division fulfills this responsibility with a variety of programs, including energy conservation and efficiency; emerging and sustainable energy industries; and infrastructure, technology, partnerships and public education. Its role in EA stems primarily from the traditional roles of State energy offices under various Federal energy programs, especially the Energy Policy and Conservation Acts that authorized the national State energy conservation and efficiency programs.

If DMME reports to the VEOC, the department's representative is mostly likely to come from the Division of Energy.

5.1.2 Virginia State Corporation Commission

According to the SCC web site:

- The State Corporation Commission is vested with regulatory authority over many varied business and economic interests in Virginia. The State constitution and State law delineate the SCC's powers, and its authority ranges from setting rates charged by large IOUs to serving as the central filing agency for corporations in Virginia.
- Organized as an independent department of government, the SCC's structure is unique containing administrative, legislative and judicial powers. Decisions of the SCC can be appealed only to the Virginia Supreme Court.

The SCC is organized to fulfill multiple responsibilities, as Figure 5-2 illustrates.

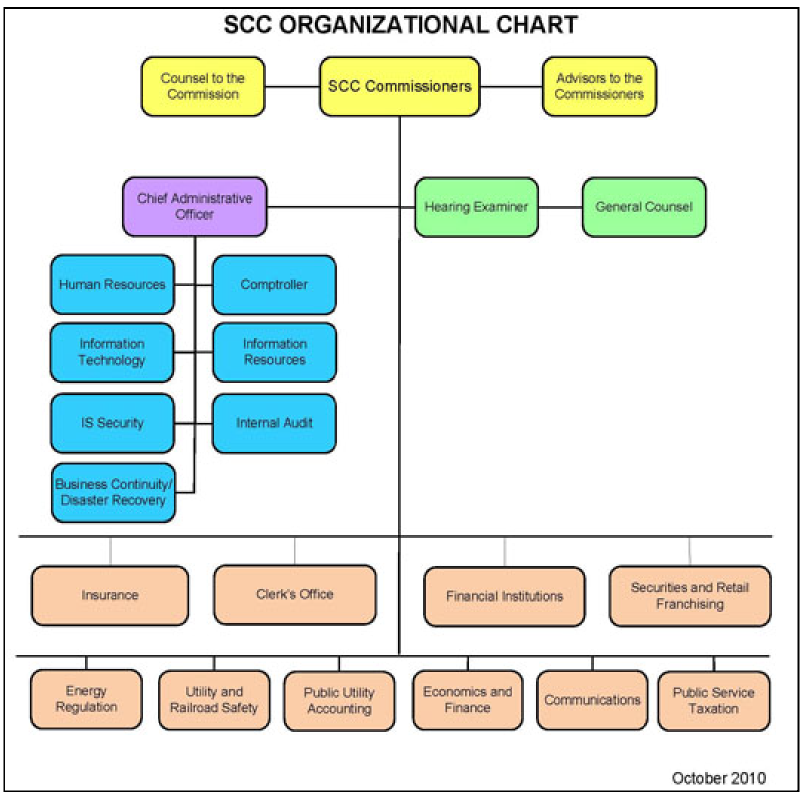


Figure 5-2. SCC Organizational Chart

The SCC's three commissioners are elected by the General Assembly for six-year terms. The SCC's authority encompasses utilities, insurance, state-chartered financial institutions, securities, retail franchising, and railroads. It is the State's central filing office for corporations, limited partnerships, limited liability companies, business trusts, Uniform Commercial Code financing statements, and federal tax liens.

Within the Commission, the staff of the Division of Energy Regulation provides the technical expertise to assist the commissioners: "in regulating Virginia's investor-owned electric, natural gas, water and sewer utilities, and member-owned electric cooperatives. Its chief function is supporting the Commission's goal to ensure Virginia consumers receive adequate utility services at just and reasonable rates."

Actions That Parallel ESF-12

According to SCC web site, the Division of Energy Regulation:

- Reviews rate applications filed by IOUs and member-owned cooperatives, and prepares testimony for rate cases before the Commission.
- Monitors utility construction projects and reviews applications for construction of transmission lines exceeding 138 kilovolts (kV), electric generating units, and intra-state natural gas pipelines.
- Monitors distribution system performance of electric utilities.
- Investigates consumer complaints regarding electric, natural gas, and water and sewer utilities under the SCC's jurisdiction.
- Provides expert technical assistance and public policy recommendations relative to the Virginia Electric Utility Regulation Act.

While these responsibilities do not specifically address EA *per se*, each has a direct impact on the assurance of reliable electricity and natural gas distribution within the Commonwealth. The ESF-12 recognizes this by making the SCC a major part of the State's energy emergency response team.

Pipeline Safety

Another major EA role of the SCC is pipeline safety. The Division of Utility and Railroad Safety assists the Commission with administering safety programs involving underground utility damage prevention, jurisdictional natural gas and hazardous liquid pipeline facilities, and railroads. The Pipeline Safety Division manages the safety of pipelines. The Damage Prevention Section oversees underground utility transmission. The Division of Utility and Railroad Safety manages railway safety, which relates to EA because of rail shipments of both propane and coal.

All of the EA participating units of the SCC have a direct role in assuring energy reliability as well as mitigation. Regulations assure that covered utilities have the material, financial, and personnel capability to maintain high levels of performance, to monitor EA activity, and to require, assist and encourage measures that will mitigate the impact of any shortage or disruption of electric or natural gas service.

5.1.3 Virginia Department of Emergency Management (VDEM)

VDEM is the Commonwealth's primary agency for emergency response. The Department reports directly to the Secretary of Public Safety. As described in the section on Authorities, this agency is responsible for planning and supervising the ESF-12. While that plan is a key to response, the ESF-12 also includes mitigation through information gathering, training, and preparedness. The Department has six operational divisions, as is illustrated in Figure 5-3.

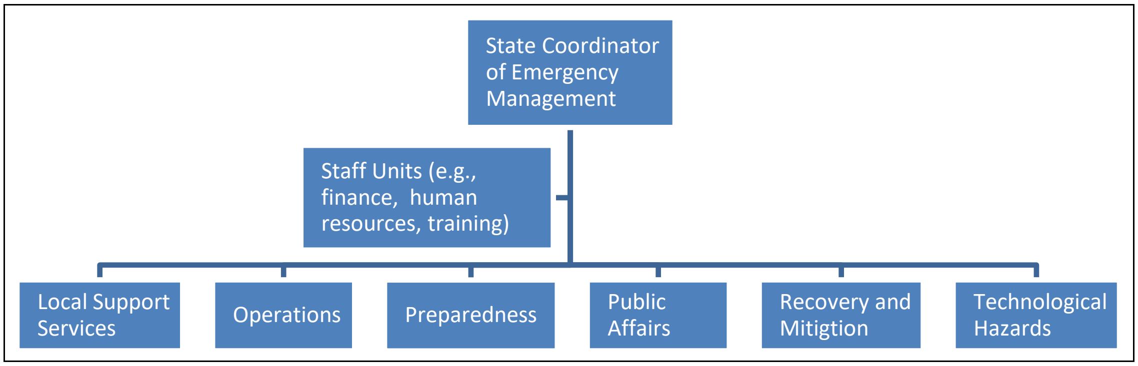


Figure 5-3. Major Divisions of VDEM

ESF-12

As discussed in the section on Authorities, the ESF-12 is the organizing and management component of the Virginia Emergency Response Plan, within which the energy support function is located. The ESF-12 "team" reports to the VEOC by staffing the Center in a declared emergency, or by remaining in contact with designated VEOC personnel if the VEOC is not activated. The VDEM Operations Division maintains and administers the VEOC.

Virginia Emergency Operations Center (VEOC)

The center of action in any emergency is VEOC. The Center is located at the Virginia State Police headquarters in Richmond and is staffed every day of the year around the clock. The Center is equipped with modern communications systems and back-up electric generation. It provides rapid access to critical stakeholders during an emergency through electronic communications. Members of the Virginia Emergency Response Team (VERT) are assembled as needed, depending on the nature and intensity of the emergency or other incident.

Regional Coordination

In addition to the Department's headquarters and VEOC, VDEM maintains a network of seven regional field offices to provide rapid access to, and on-site communications with, local jurisdictional agencies and emergency responders. Figure 5-4 illustrates these locations.

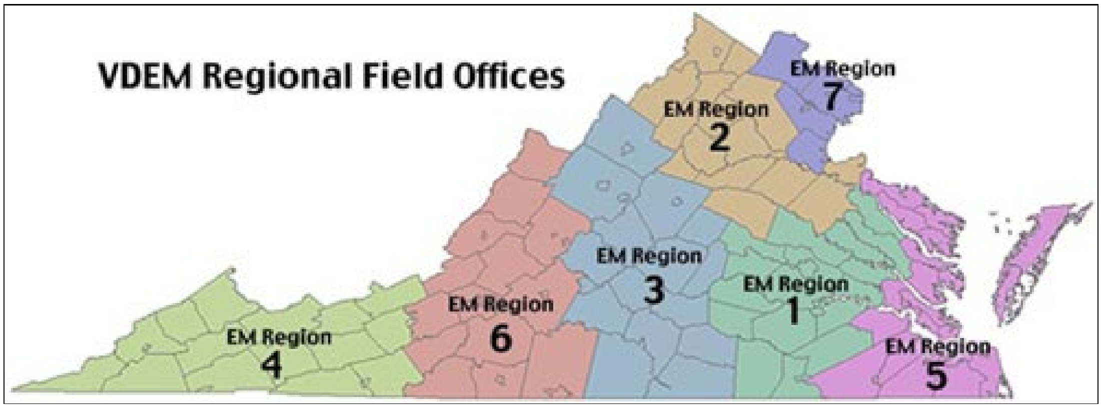


Figure 5-4. Regional Offices

Operation Division Duties Vis a Vis ESF-12

Other duties assigned to the Operations Division have parallels with EA planning, mitigation, and response. Table 5-1 summarizes the EA-related duties of the VDEM Operations Division.

Table 5-1
VDEM Operations Division Activities

Preparedness	**Crossover to ESF-12**
Prepare advanced planning	▪ DMME EAP ▪ Utility Response Plans
Perform stakeholder coordination	DMME & SCC maintain contacts with energy providers.
Prepare and maintain advanced communications	Communications protocols checked regularly.
Maintain readiness and capacity ▪ Stakeholder communications and planning ▪ Training exercises ▪ Ongoing evaluation of potential events	DMME coordinates with SCC, works with VDEM to incorporate energy components into regular VDEM exercises.
Return to preparedness mode upon completion of incident. Utilize lessons-learned for ongoing planning and preparedness.	VDEM takes lead in coordination with DMME and SCC. Energy industry reports are solicited.
Emergency	**Crossover to ESF-12**
Coordinate multiple components.	Work through VEOC to check and cross-reference stakeholder lists.
Assemble key stakeholders ▪ State, local, Federal agencies ▪ Private sector entities ▪ Affected industry ▪ Volunteer organizations ▪ ESF-12 agencies	DMME & SCC advise VDEM on incident-related stakeholders to call/assemble.
Receive and analyze situational information.	DMME & SCC maintain and share respective informational contacts with energy industry and send reports.

Emergency	Crossover to ESF-12 (continued)
Act to protect life and reduce property damage.	DMME & SCC respond as required. Energy industry invokes response mechanisms and mutual aid as needed.
Convene at VEOC as necessary.	DMME & SCC send representatives as needed.
Effect timely communications to public	DMME & SCC coordinate public relations with VDEM and communications protocols. Energy industry may also make announcements.
Transmit hazard and situation warnings to localities and stakeholders (e.g., weather information).	DMME & SCC inform VDEM rapidly about pending and actual incidents.
Operate redundant communication systems.	VDEM takes lead.
Act as primary “entry point” for State-level crisis/event information.	VDEM receives information for DMME, SCC and energy industry stakeholders.
Coordinate acquisition of disaster resources.	VDEM/VEOC takes lead.
Assist recovery teams with resources as needed.	VDEM/VEOC takes lead, coordinates, receive reports from energy industry, DMME, and SCC.
Assist with or initiate as necessary situation/damage assessments.	VDEM takes lead in coordination with DMME, SCC and energy industry.
Assign and track assistance.	VDEM takes lead.
Maintain communications to key people such as: ▪ Governor’s office ▪ Legislature ▪ Local Government ▪ Communities ▪ Affected industry/commerce ▪ Public ▪ Intergovernmental liaison ▪ Volunteers	VDEM takes lead and taps all necessary resources. DMME and SCC assist in accordance with communications protocols.
Maintain communications equipment, systems, and infrastructure.	VDEM takes lead.
Utilize emergency alert system as needed.	VDEM takes lead.
Reports and after-action evaluation,	VDEM takes lead in coordination with DMME and SCC. Energy industry reports are solicited.

5.2 Principal Energy Industry Stakeholders

Virginia possesses the *Virginia Energy Sector-Specific Infrastructure Protection and Resiliency Plan* (May 4, 2009), which provides basic information about the protection and management of the Commonwealth’s energy infrastructure. This document is incorporated into this EAP by reference. Table 5-2 outlines the basic industry assets from which the EAP derives central stakeholders. Not all the assets identified are included in this EAP, especially in relation to production. The EAP focuses more on energy consumption assets and how the Commonwealth interacts with them in the face of pending or actual supply shortage.

Table 5-2
Virginia Energy Infrastructure per Virginia Energy Plan

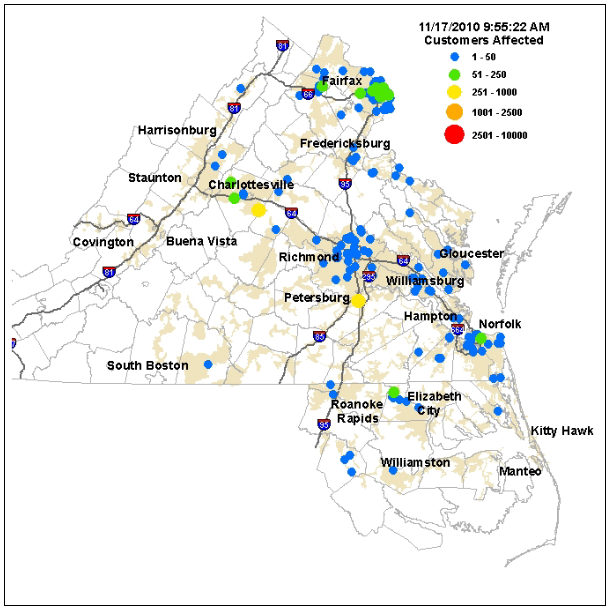
Electricity	Coal	Petroleum	Natural Gas
Generation	Production	Crude Oil	Production
Fossil fuel power plants	Mines	Oil fields	Gas fields
Coal		Terminals	
Natural gas	Processing	Transport (pipelines)*	Processing
Petroleum		Storage	
Nuclear power plants*	Transport		Transport (pipelines)*
Hydroelectric dams*	Railroads*	Processing Facilities	
Renewable energy		Refineries	Distribution (pipelines)*
	Export terminals*	Terminals	
Transmission		Transport (product pipelines)*	Storage
Substations			
Power lines		Storage	Liquefied Natural Gas Facilities
Control centers			
		Control Systems	Terminals
Distribution			Processing
Substations			Trucking
Power Lines			
Control centers			Control Systems
Control Systems			Gas Markets
Electric Markets			
*Assets covered by other sectors			

5.2.1 Investor-Owned Utilities – Electricity

Three regulated investor-owned electric power companies serve Virginia Dominion Virginia Power, Appalachian Power, and Kentucky Utilities/Old Dominion Power.

Dominion Virginia Power

Dominion Virginia Power is the largest electricity stakeholder in the Commonwealth. The parent company operates in several states where it sells both electricity and natural gas, and owns extensive critical energy assets. System-wide, these assets include 5,000 miles of electricity transmission lines; 12,000 miles of natural gas transmission, storage, and gathering pipelines; and 925 Bcf of natural gas storage capacity. Within Virginia, the company serves 2.4 million electricity customers principally in the eastern half of the State: 42 percent residential, 34 percent commercial, 11 percent governmental, and 8 percent industrial. Figure 5-5 shows a typical outage map that also encompasses Dominion's service territory in the Commonwealth. The map also includes the company's service area in North Carolina.



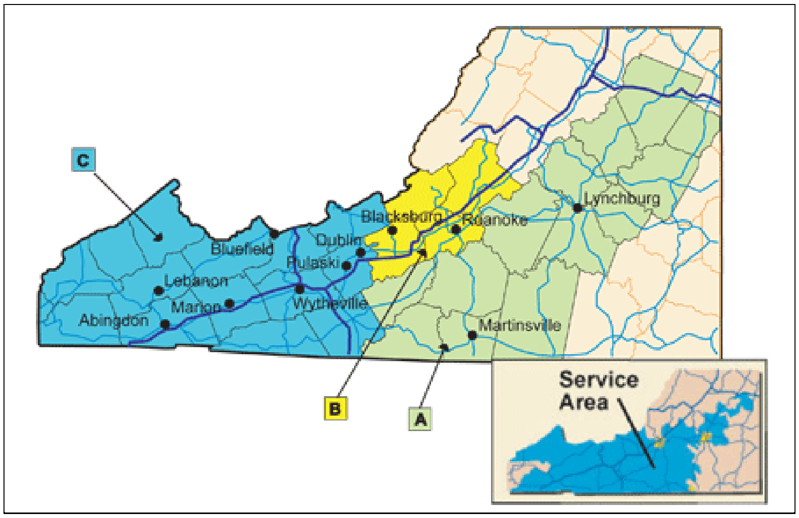
Source: Dominion, http://www.dom.com/storm-center/dominion-electric-outage-map.jsp.

Figure 5-5. Dominion Virginia Power Service Territory

Dominion Virginia Power has 29 electric power generating plants representing 61 percent of total generation capacity within Virginia. Two of the generating plants are nuclear plants, eleven burn coal, ten burn natural gas, five burn oil, and one is pumped storage hydroelectric. Details on the plants are shown in Appendix B, Electric Utilities. .

American Electric Power

AEP is a large, multi-State electric power generator that owns the nation's largest electricity transmission system. Appalachian Power a subsidiary of AEP serves about one million customers in its three-state operating area that includes Virginia, West Virginia, and Tennessee. The utility's rated generation capacity is 8,018 MW, within Virginia AEP owns nearly seven percent of Virginia's total generation capacity and over 2,000 miles of electric transmission lines. The company serves Virginia customers west of a line that runs approximately from Lynchburg to Martinsville. Figure 5-6 depicts the service territory and the location of external affairs offices in Virginia.

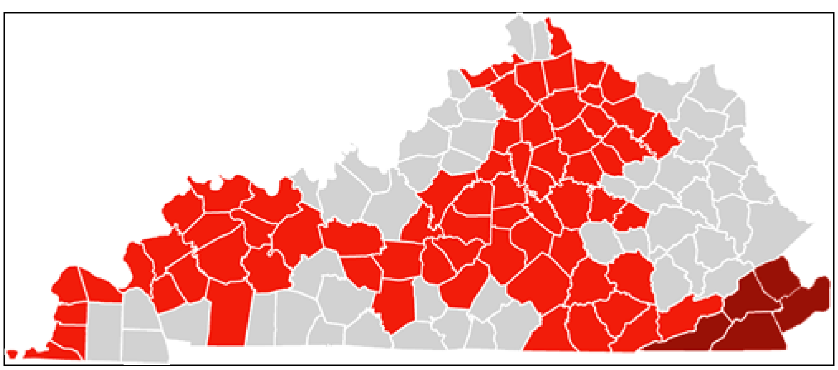


Source: Appalachian Power, External Affairs, https://www.appalachianpower.com/info/community/externalAffairs/VA.aspx.

Figure 5-6. Appalachian Power Territory and External Affairs Offices

Kentucky Utilities

Kentucky Utilities, headquartered in Lexington, Kentucky, is known in Virginia as Old Dominion Power. In 2010, Kentucky Utilities was acquired by PPL Corporation of Allentown, Pennsylvania. It has a total generation capacity of 4,570 MW. All four of its generating plants are located in Kentucky: Ghent in Carroll County, Tyrone in Woodford County, E.W. Brown in Mercer County, and Green River in Muhlenberg County. Kentucky Utilities serves five counties and 29,000 customers in the south western tip of Virginia. Figure 5-7 depicts the utility's entire service area, which is mostly in Kentucky; the darker-shaded region on the lower right side of the map includes the southwestern tip of Virginia served by Old Dominion Power.



Source: LGE/KU Service Territories, http:// www.lge-ku.com/service_territory.asp.

Figure 5-7. Kentucky/Old Dominion Service Territory

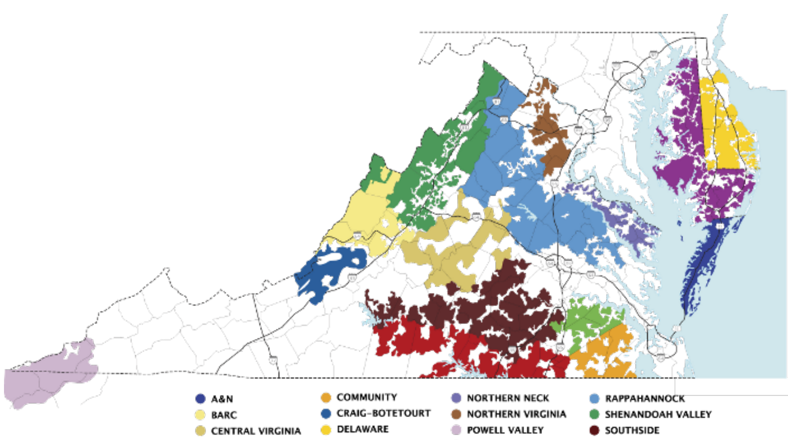
5.2.2 Cooperative Utilities

The SCC regulates 13 distribution electric cooperatives; all are members of the VMDAEC, an association of 16 member cooperatives in Virginia, Maryland and Delaware. The Virginia cooperatives serve over 600,000 retail customers. The Virginia cooperatives are listed here with URL linkage:

A&N Electric Cooperative
B-A-R-C Electric Cooperative
Central Virginia Electric Cooperative
Community Electric Cooperative
Craig-Botetourt Electric Cooperative
Mecklenburg Electric Cooperative
Northern Neck Electric Cooperative
Northern Virginia Electric Cooperative
Prince George Electric Cooperative
Rappahannock Electric Cooperative
Shenandoah Valley Electric Cooperative
Southside Electric Cooperative
Powell Valley Electric Cooperative

The VMDAEC assists the Commonwealth and member cooperatives with mitigation of electricity problems and restoration of service. In addition to monitoring federal and State policy issues, the Association has training programs that help workers at member cooperatives maintain and upgrade their professional skills and the members ensure compliance with applicable federal and state safety regulations.

The Association takes an active role during outages by coordinating and routing power restoration crews as necessary, and facilitating mutual aid among utilities, as provided by mutual aid agreements that cover companies in Virginia, Maryland, Delaware, North Carolina and Pennsylvania. VMDAEC is a member of the National Rural Electric Cooperative Association (NRECA), and coordinates mutual aid agreements with that body as well. The association is also in contact with VDEM during energy incidents affecting customer power. Figure 5-8 shows the service territories for all of the VMDAEC members, including those in neighboring States.



Legend (VA only)
Reading left to right on map:

Light purple	Powell Valley
Blue	Craig Botetourt
Light yellow	BARC
Light blue	Southside
Rust	Mecklenberg
Tan	Central VA
Green	Shenandoah
Light blue	Rappahannock
Brown	Northern Virginia
Light green	Prince George
Mustard	Community
Light purple	Northern Neck
Dark blue	A&N

Source: VMDAEC, About the Association, VMDAEC Members, http://vmdaec.com/MemberCoops.aspx

Figure 5-8. VMDAEC Service Territories

Old Dominion Electric Cooperative

Old Dominion Electric Cooperative (ODEC), headquartered in Glen Allen, Virginia, is a generation and transmission cooperative that serves wholesale and retail electricity customers in Virginia, Delaware, Maryland and North Carolina. The nine Virginia member cooperatives are A&N, BARC, Community, Mecklenburg, Northern Neck, Prince George, Rappahannock, Shenandoah, and Southside.

ODEC generates power from five power plants in Virginia and one in Maryland. ODEC has purchased undivided shares in:

- North Anna nuclear plant, Louisa County – 11.6 percent of 1,800 MW
- Clover Power Station (coal-fired), Halifax County – 50 percent of 850 MW
- Three combustion turbine peaking plants:
  - Marsh Run Station, near Remington in Fauquier County
  - Louisa Power Station, near Gordonsville, Virginia
  - Rock Springs in Cecil County, Maryland

In 2010, ODEC acquired interests in hydro, land-fill gas and wind power facilities. In addition, ODEC owns transmission lines and delivers electricity via power lines that Dominion Virginia and Appalachian Power and Delmarva Power operate in Delaware and Allegheny Power Company in Maryland, respectively.

Four other Virginia cooperatives purchase power via bilateral contracts with various providers, such as IOUs or non-utility generators.

5.2.3 Municipal Utilities

There are 16 municipal electric utilities serving approximately 161,000 retail customers Virginia customers. The Municipal Electric Power Association of Virginia (MEPAV) represents them.

MEPAV's president, vice president, and three other individuals constitute an executive committee. MEPAV does not have a separate office or executive director; however, MEPAV retains a legislative consultant who monitors electricity policy matters on behalf of the membership. When the need arises, MEPAV can be contacted through the Virginia Municipal League or by contacting any of the member municipalities for the contact information.

The members of MEPAV are:

- City of Bedford
- Town of Blackstone
- City of Bristol
- Town of Culpeper
- City of Danville
- Town of Elkton

- City of Franklin
- Town of Front Royal
- Harrisonburg Electric Commission
- City of Manassas
- City of Martinsville
- City of Radford
- Town of Richlands
- City of Salem
- Virginia Polytechnic Institute & State University
- Town of Wakefield

5.2.4 PJM Interconnection

PJM is an independent service operator (ISO); as such it has been designated by the FERC as a regional transmission organization that manages the interstate high voltage electric delivery system, as well as coordinating and creating a forward pricing market for electric power within its region. PJM has grown over the last 20 years from its original roots in Pennsylvania, New Jersey, and Maryland, to cover 13 states including Virginia.

Two of the most important EA considerations for an ISO are the protocols pertaining to power acquisition, transmission, and sales affecting companies that serve its territory, and the ability to monitor and react to any sudden loss of power generation within its system. PJM works closely with other ISOs, such as the Midwest, New York, and New England ISOs to provide enhanced reliability for the electricity transmission system in the entire mid-Atlantic and northeastern United States.

PJM also sets market rules related to the purchase of wholesale power, and has emergency management protocols and capacity retention tools. Some of the rules and protocols are discussed elsewhere in this EAP as they affect assurance and reliability.

5.2.5 Regulated Local Distribution Companies – Natural Gas

There are eight regulated LDCs in Virginia. They are:

- Appalachian Natural Gas Distribution Company
- Atmos Energy
- Columbia Gas of Virginia, Inc.
- Roanoke Gas Company
- Shenandoah Gas Division of Washington Gas & Light
- Southwestern Virginia Gas Company

- Virginia Natural Gas, Inc.
- Washington Gas & Light Company

Figure 5-9 depicts the service territories of the Commonwealth's LDCs.

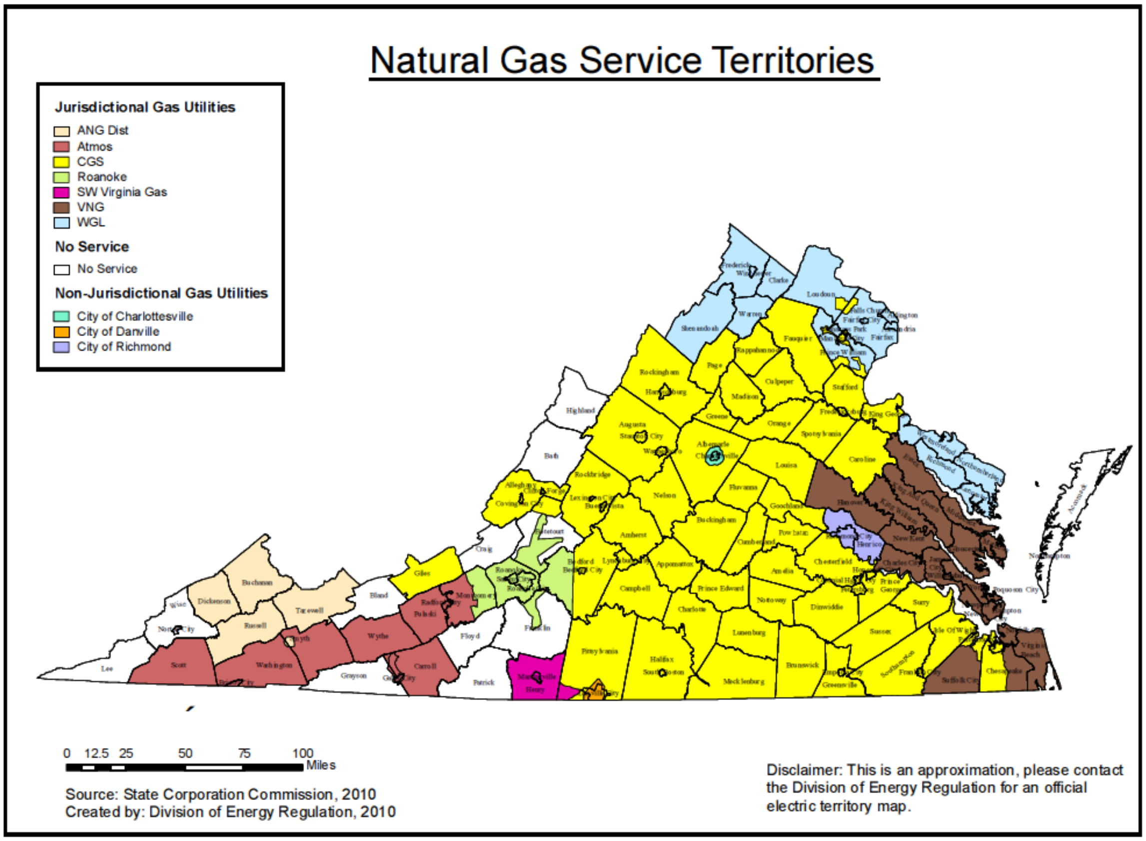


Figure 5-9. Virginia LDC Service Territories

Appalachian Natural Gas Distribution Company

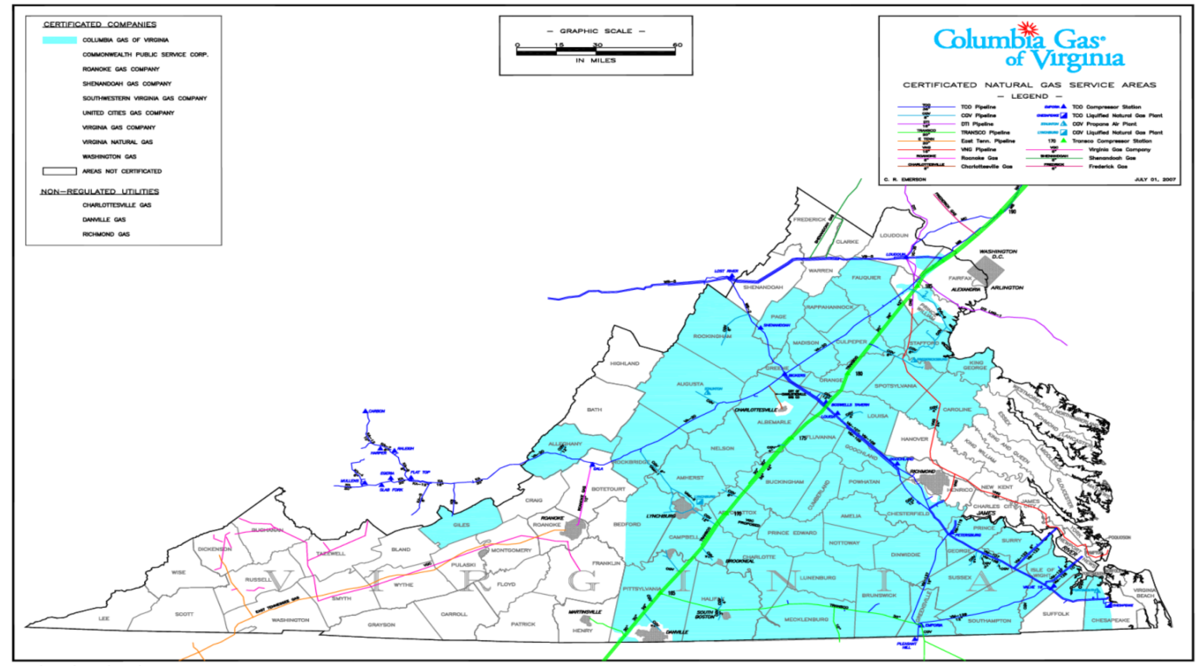
This LDC, headquartered in Abington, Virginia, serves customers in southwest Virginia with natural gas that includes gas produced within the Commonwealth. Virginia counties served include Buchanan, Dickenson, Russell, and Tazewell.

Atmos Energy

Atmos Energy Corporation, headquartered in Dallas, Texas, is a natural gas distributor, serving customers in 12 states. The company serves consumers in western Virginia, (to the south of the West Virginia border) with its 650 miles of distribution pipelines. Atmos also has extensive non-utility operations related to natural gas.

Columbia Gas of Virginia

Columbia Gas of Virginia is a NiSource company. NiSource headquartered in Merrillville, Indiana is multi-state gas transmission and distribution company, with operations stretching from New England to Texas, and west to Oklahoma, Missouri, Illinois, and Michigan. CGV headquartered in Chester, Virginia serves 240,000 customers in the Commonwealth, with nearly 5,000 miles of distribution and 61 miles of transmission pipelines. The LDC provides natural gas to 81 communities in Chesapeake, Chesterfield County, Fairfax County, Fredericksburg, Harrisonburg, Lexington, Lynchburg, Petersburg, Portsmouth, Prince William County, and Staunton. Figure 5-10 shows CGV's service area.

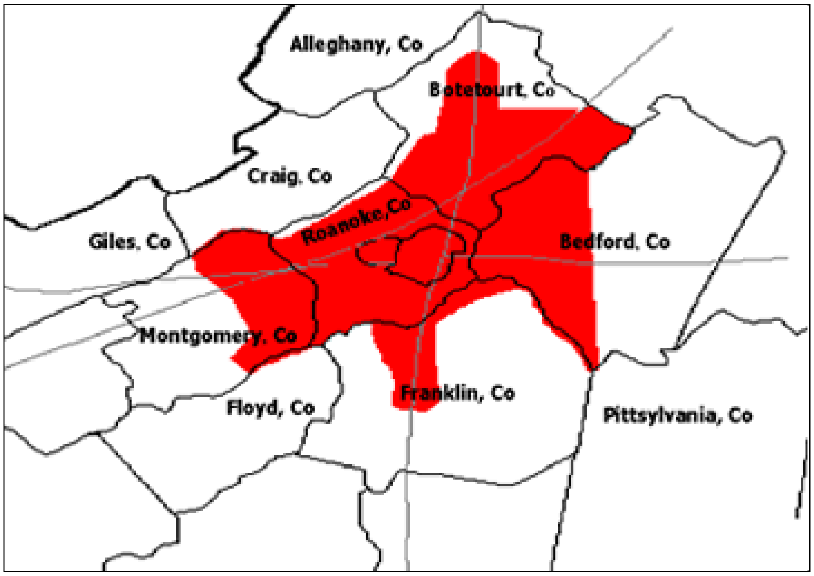


Source: Columbia Gas of Virginia, <http://www.columbiagasva.com/en/about-us.aspx>.

Figure 5-10. CGS Service Area

Roanoke Gas Company

A holding company, RGC Resources, owns Roanoke Gas. The company services over 51,000 accounts in its five county metropolitan service area with over 1,000 miles of distribution and 66 miles of transmission pipelines. Figure 5-11 depicts this company's service area.



Source: RGC Resources, http://www.roanokegas.com/aboutus/servicearea.html

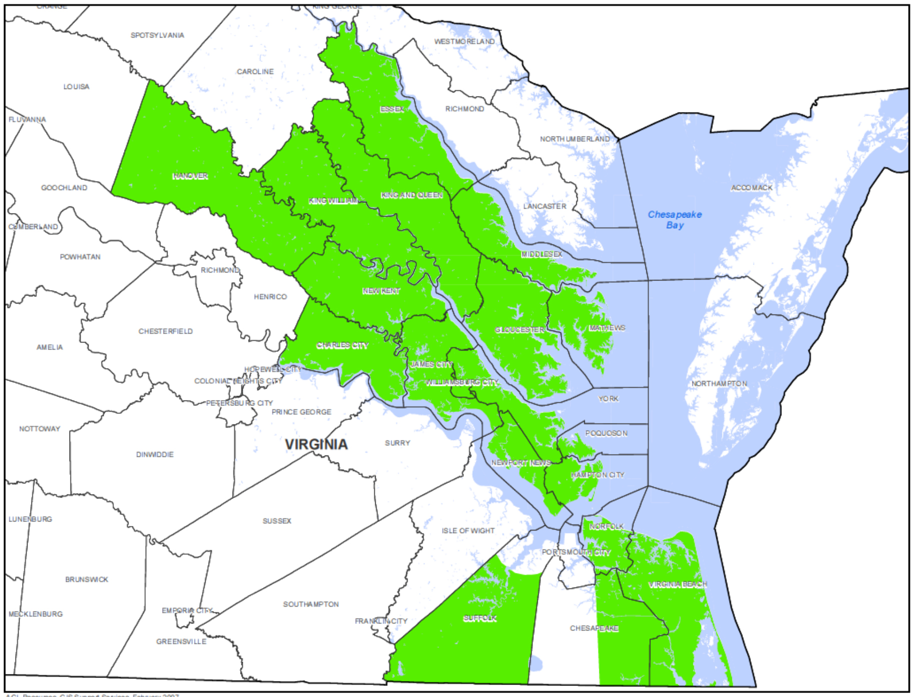
Figure 5-11. Roanoke Gas Service Area

Southwestern Virginia Gas Company

Southwestern Virginia Gas Company is located in Martinsville, Virginia, and serves 4,600 accounts. The company's customers reside in Henry County and parts of Pittsylvania County.

Virginia Natural Gas

Virginia Natural Gas (VNG) is located in Norfolk, Virginia. VNG is a subsidiary of AGL Resources, headquartered in Atlanta, Georgia. AGL covers nine southeastern States. VNG serves over 264,000 customers in southeastern Virginia with over 5,000 miles of distribution and 156 miles of transmission pipelines. Figure 5-12 shows the company's service territory in detail.

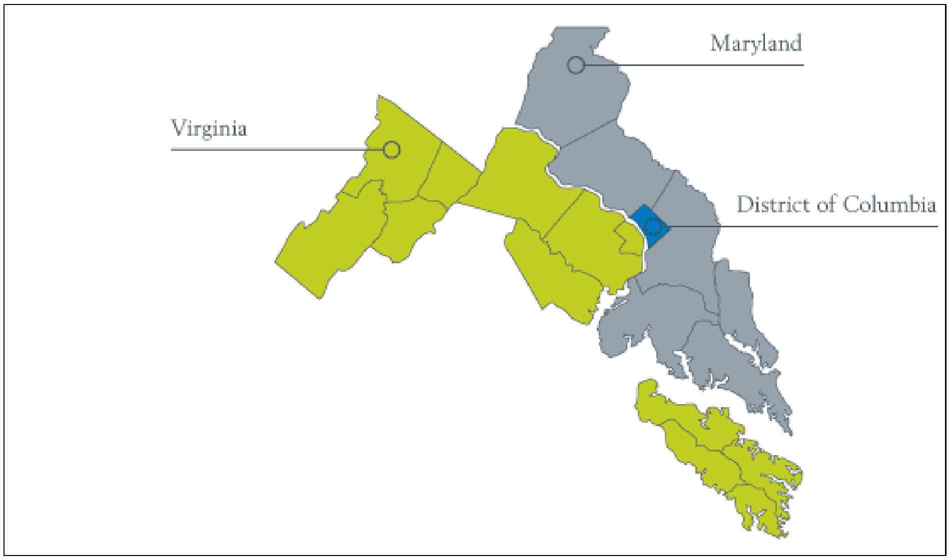


Source: Virginia Natural Gas, About Us, Areas We Serve, http://www.virginianaturalgas.com/Universal/AboutUs.aspx.

Figure 5-12. VNG Service Territory

Washington Gas Light (Including Shenandoah Division)

Washington Gas Light or Washington Gas headquartered in Washington, DC serves customers in the Washington Metropolitan Council of Governments (WMCOG) area. The service territory includes southern areas of Maryland, DC, Northern Virginia, and the Shenandoah area. The Shenandoah division is located in Winchester, Virginia, and the Washington Gas & Light division is located in Herndon, Virginia. Utilizing its 5,500 miles of distribution and 81 miles of transmission pipeline, the company serves over one million customers throughout its service territory with approximately 480,000 end-users in Virginia. Figure 5-13 illustrates the company's service areas.



Source: WGL Holdings, About WGL Holdings, Service Territory, http://www.wglholdings.com/territory.cfm.

Figure 5-13. WGL Service Territory

5.2.6 Non-Regulated Municipal Natural Gas Utilities

In Virginia, three municipal natural gas utilities are governed by their local jurisdictions as authorized by Virginia Code. The three utilities are Charlottesville Gas, Danville Utilities, and Richmond City Gas.

Charlottesville Gas

The City of Charlottesville operates its municipal gas distribution as Charlottesville Gas, within the city Department of Public Works, Public Utilities Division. The city serves 18,300 gas customers, purchasing and reselling wholesale natural gas through a variety of rate schedules, including firm and interruptible tariffs. The service area for Charlottesville Gas includes the city of Charlottesville and parts of Albemarle County.

Danville Utilities

Danville provides electricity and natural gas to its city residents, serving some 16,500 customers. The city purchases gas on a firm contract from the Transcontinental Gas Pipeline Corporation (TRANSCO) as well as other major producers.

Richmond City Gas Utility

The City of Richmond Department of Public Utilities (DPU) operates five utilities including natural gas. The DPU serves more than 500,000 residential and commercial customers in Richmond and the surrounding metropolitan region including Chesterfield and Henrico counties.

5.2.7 Petroleum Product Infrastructure – Supply: Pipelines and Ports

This subsection covers the major petroleum infrastructure stakeholders that are important to the Commonwealth. Market issues are not addressed here, but are covered in the Petroleum subsection in "Energy Sectors," of this EAP. That Section examines the market role of the principal sources of petroleum products delivered to Virginia.

Pipeline companies are critical for the Commonwealth's petroleum product supply, but their role as stakeholders would normally be limited to the maintenance of infrastructure and State regulations concerning pipelines, location and operation within the State.

The Colonial Pipeline

The Colonial Pipeline (Colonial) headquartered in Avenel, New Jersey, operates an office in Fairfax, Virginia. Colonial is a major supplier for the Commonwealth and surrounding states delivering refined petroleum products from the Gulf Coast, as far north as New Jersey. The liquid products Colonial carries vary seasonally and according to demand, but included among the most important are: distillates such as diesel, home heating oil, and jet fuel and motor gasoline. Colonial ships product in batches and then offloads the product at terminals for sale to end-users. Since the mix of products in the line could vary significantly at any given time, a problem with one type of fuel could affect many batches of other fuels en route, or scheduled for delivery in Virginia or other destinations further along the system. The Colonial Pipeline system is shown in Figure 5-14.

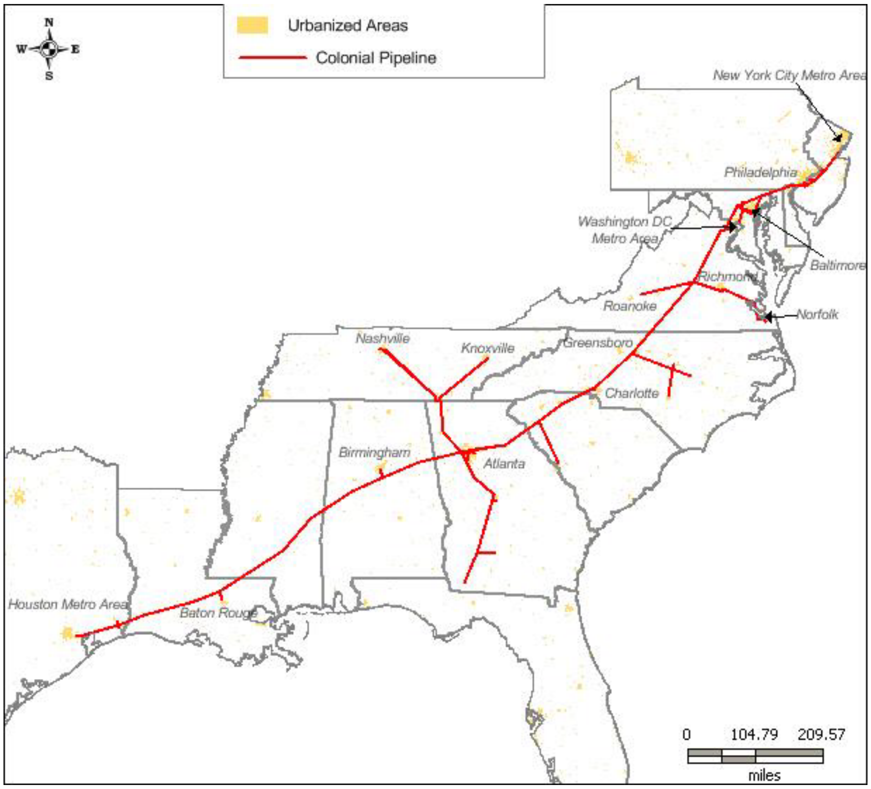
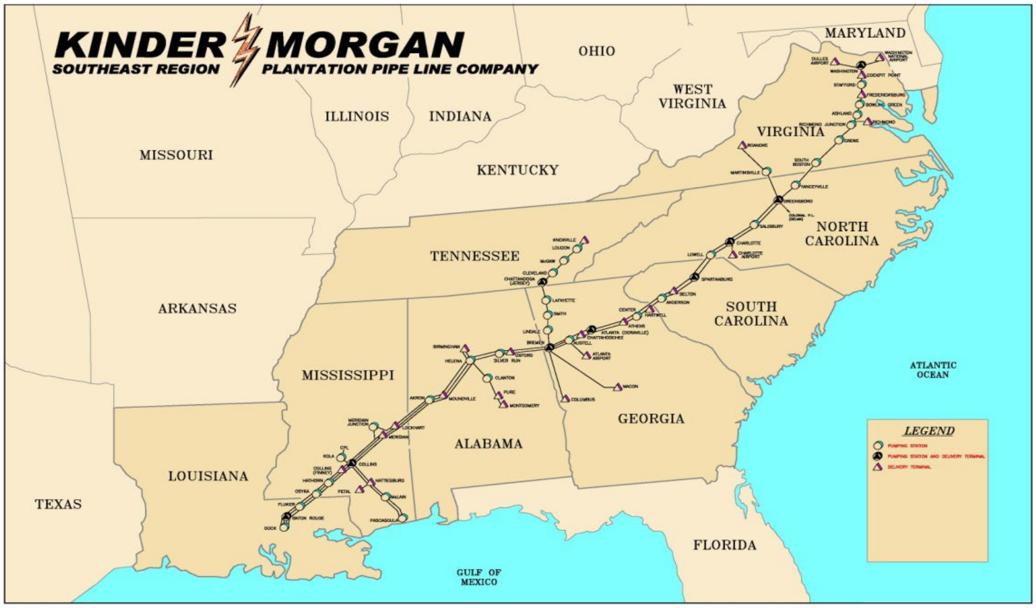


Figure 5-14. The Colonial Pipeline system.

Plantation Pipeline

Kinder Morgan, a major natural gas and petroleum pipeline and energy storage company in the U.S., owns the Plantation Pipeline. Like the Colonial Pipeline, the Plantation Pipeline delivers petroleum products from the Gulf Coast area along the Eastern Seaboard. The pipeline terminates in Washington, DC. Industry sources informally estimate that a batch of product requires approximately 20 days to reach the DC and Virginia area. The Plantation Pipeline is shown in Figure 5-15.



Source: Kinder Morgan, http://www.kindermorgan.com/business/products_pipelines/PPL_System_Map.pdf.

Figure 5-15. Plantation Pipeline Owned by Kinder Morgan

Dixie Pipeline and Chesapeake Port/Terminal

The Dixie Pipeline does not enter Virginia. However, it is a major source of propane for the Commonwealth. Dixie is a subsidiary of Enterprise Products Partners, L.P. of Houston, Texas. LPG is trucked from the Apex Terminal near the intersection of U.S. Route 1 and Route 55 in Apex, North Carolina, to bulk distributing retailers in Virginia. Enterprise also offloads LPG from vessels to a terminal at the Port of Norfolk, located in Chesapeake, Virginia.

Port of Norfolk

The Port of Norfolk both receives and ships petroleum products. The port classifies petroleum products as "mineral fuel, oil, etc." This classification constituted the largest cargo shipments in 2009, with 27,938,900 short tons exported and 4,590,070 imported.[1] The percentage of fuel and oil comprising these volumes (versus minerals and coal) is unclear.

5.2.8 Petroleum Product Infrastructure – Distribution: Terminals and State Associations

Terminals

Terminals are the major infrastructure elements between supply from pipeline or port and distribution to service stations and end-use customers. Refined products received at Virginia terminals are offloaded to large (8,000 or 16,000 gallon) tanker trucks owned and operated by local distribution companies or wholesale marketers (or

[1] Virginia Port Authority, *Comprehensive Annual Financial Report*, June 30, 2019, pp 79.

jobbers) for delivery to local retail locations. Motor gasoline and diesel fuel are delivered to service stations in this way. Heating oil and propane are picked up by local wholesaler/retailers and transferred to smaller trucks for delivery to the tanks of individual customers (usually 250 to 500 gallon). As of September 2010, there were 45 petroleum terminals in Virginia. These 45 terminals are operated by 23 companies. The companies with multiple terminals are:

- Kinder Morgan: 7
- TransMontaigne: 7
- Motvia: 4
- BP: 3
- CITGO: 2
- Magellan: 2
- NuStar: 2
- Quarles: 2
- Richmond: 2

A complete list of Virginia petroleum terminals is found in Appendix E.

5.3 Principal Association Stakeholders

5.3.1 Virginia Petroleum, Convenience, and Grocery Association

The VPCGA has 650 member retail dealers who operate over 4,500 locations throughout the Commonwealth. These retail dealers sell motor gasoline, diesel, and/or heating oil. VPCGA provides liaison with governmental policy makers and offers training on safety and business practices for its members. The VPCGA headquarters is located in Richmond, Virginia.

5.3.2 Virginia Petroleum Council

The Virginia Petroleum Council represents the interests of the major petroleum suppliers that do business in the Commonwealth. The Council is a division of the American Petroleum Institute (API), and is located in Richmond.

5.3.3 Virginia Propane Gas Association

VAPGA represents the business interests of member companies in the Commonwealth. Its basic operations are similar to VPCGA, representing member interests before governmental bodies and offering training for member employees. VAPGA is headquartered in Charlottesville, Virginia.

Section 6
ENERGY SECTORS

The following discussion of electricity, natural gas, and petroleum addresses the market aspects of each energy source as they affect energy reliability. In this examination, information regarding certain critical assets is discussed in greater depth than that found in the introductory sections of the EAP. This type of information should be gathered and discussed as part of everyday energy assurance monitoring and analysis. It should be updated and maintained on a regular on-going basis. Although not meant to be a guide to emergency response *per se*, energy officials should become familiar with this material so they will have an added advantage when responding to shortage and related energy emergency issues.

6.1 Electricity

Electricity is fundamental to Virginia energy assurance. 6-1 shows that according to EIA data, the residential and commercial sectors consume most of the electricity in Virginia, accounting for nearly 85 percent of total electricity demand in 2009. What this table does not show is how significantly electricity underpins all forms of energy supply from providing the power to operate the pumps that move petroleum products and natural gas to consumers to the various monitoring devices, and controls that allow all forms of energy to reach customers safely, expeditiously, and efficiently.

Table 6-1
Virginia Electric Energy Consumption in 2009

Sector	Consumption (million kilowatt hours)	% Share
Residential	44,763	41.27
Commercial	46,828	43.17
Industrial	16,678	15.38
Transportation	193	0.18
Total	108,462	

Source*:* EIA, State Electricity Profiles 2009.

6.1.1 The Virginia Electricity Supply Market

The State's electric supply system comprises generation (and its fuel supply), high voltage (100's of kV) transmission over long distances, and local distribution at lower voltage (10's of kV) to transformers, where higher voltage is reduced to lower levels (e.g., 240 volts (V), 120 V) in order to serve typical end-use customers.

Virginia electricity infrastructure operates as part of a major integrated regional transmission organization (RTO), the PJM Interconnection. Because Virginia repealed deregulation of electricity in 2007, the Virginia SCC regulates the generation and transmission components of this system. However, the SCC does not regulate independent power producers[1] or municipal utilities.

6.1.2 Power Generation Supply Sources

Table 6-2 shows the monthly net generation in Virginia in MWh produced by the fuels used. Understanding the relative impact of each fuel on net generation helps responders evaluate risk, should a fuel source be curtailed or lost. The table also shows that potential risks from a loss of nuclear, coal, or natural gas (in that order).

Table 6-2
Virginia Net Electric Generation (2009)

2009 Net Generation by Fuel	MWh	Share of Total
Total Electric Industry	**70,082,066**	**100%**
Nuclear	28,212,252	40.3%
Coal	25,599,288	36.5%
Natural Gas	12,201,384	17.4%
Other Renewables	2,417,519	3.4%
Hydroelectric	1,478,630	2.1%
Petroleum	1,087,660	1.6%
Other	420,042	0.6%
Pumped Storage	-1,334,709	-1.9%
Other Gases2	-	-

Source: http://www.eia.gov/cneaf/electricity/st_profiles/sept05va.xls

DOE has asked that states consider the implications of a loss in renewable energy. In Virginia's case, as of 2009, such a loss would be relatively minor in comparison to the total amount of electricity generated, but not trivial and, if lost, other resources would have to compensate. State-level data reveal that sources such as municipal solid waste, landfill gas, and wood generate the bulk of the Commonwealth's renewable power. Most of the renewable generation provides power to municipal government facilities and industry. Hence, loss of renewable generation would most affect those sectors. In April 2011, Dominion announced plans to convert three coal-fired power plants to biomass by 2013. The three plants would represent 150 MW of additional biomass capacity and could help power 37,500 homes[2].

6.1.3 Electric Utilities

According to the VEP, Virginia has three IOUs, 13 electric cooperatives, and 16 municipal utilities, plus independent merchant plants and Combined Heat and Power (CHP) systems. The SCC regulates IOUs, and the independent providers manage the power they sell, PJM supervises and directs all of the dispatched power.

[1] Independent power producers also referred to as exempt wholesale generators produce and sell electricity on the wholesale market at market-based rates, and do not have franchised service territories. Source: http://www.eia.gov/cneaf/electricity/page/prim2/toc2.html

[2] Source: http://dom.mediaroom.com/index.php?s=43&item=976)

Table 6-3
2009 Bundled Electricity Sales (MWh)

Electricity Provider	Residential	Commercial	Industrial	Transportation	Total	% of Total
Virginia Electric & Power Co	28340232	38043902	7147238	193414	73724786	67.97%
Appalachian Power Co	6477879	4113983	5125745	0	15717607	14.49%
Northern Virginia Electric Coop	1938853	1087755	269437	0	3296045	3.04%
Potomac Edison Co (The)	1298890	749801	888980	0	2937671	2.71%
Rappahannock Electric Coop	1455905	139822	911360	0	2507087	2.31%
Danville Power & Light Dept	478692	324503	172165	0	975360	0.90%
Kentucky Utilities Co	429111	283819	197805	0	910735	0.84%
Southside Electric Coop Inc	687612	78934	71795	0	838341	0.77%
Shenandoah Valley Electric Coop	448721	106845	237261	0	792827	0.73%
Manassas VA (City of)	168988	208616	375309	0	752913	0.69%
Harrisonburg VA (City of)	185325	382543	126489	0	694357	0.64%
Central Virginia Electric Coop	484174	98966	59134	0	642274	0.59%
A & N Electric Coop	312866	156320	169740	0	638926	0.59%
Mecklenburg Electric Coop	339074	77396	129707	0	546177	0.50%
Bristol Virginia Utilities Board	203434	45906	285748	0	535088	0.49%
Salem VA (City of)	130365	105538	138251	0	374154	0.34%
Virginia Tech Electric Service	53514	263591	12441	0	329546	0.30%
Prince George Electric Coop	162212	47301	81638	0	291151	0.27%
Northern Neck Electric Coop Inc	213455	37830	0	0	251285	0.23%
Bedford County Public Service Authority	82270	45488	83373	0	211131	0.19%
Radford VA (City of)	73436	31419	93073	0	197928	0.18%
Community Electric Coop	157600	25146	3297	0	186043	0.17%
Martinsville VA (City of)	79483	81954	15862	0	177299	0.16%
Barc Electric Coop Inc	117547	47009	0	0	164556	0.15%
Front Royal Electric Dept	86591	72225	0	0	158816	0.15%
Powell Valley Electric Coop	93131	23109	37723	0	153963	0.14%
Franklin Electric Dept	75605	50966	19788	0	146359	0.13%
Culpeper VA (Town of)	41312	32110	21319	0	94741	0.09%
Craig Botetourt Electric Coop	72645	11167	0	0	83812	0.08%
Richlands VA (Town of)	32533	31864	0	0	64397	0.06%
Blackstone VA (Town of)	20179	12750	2827	0	35756	0.03%
Elkton VA (Town of)	10161	7684	423	0	18268	0.02%
Wakefield VA (Town of)	10358	1830	0	0	12188	0.01%

Source: SAIC using ABB's Ventyx

Virginia Electric Power (Dominion Virginia Power) holds a majority (61 percent) of electric generating capacity as well as over 60 percent of electricity sales within Virginia. AEP's Virginia subsidiary, Appalachian Power, is second with close to 15 percent of electricity sales and 7 percent of generating capacity. The difference between capacity and sales results from the fact that AEP imports most of the electricity sold in its Virginia service territory from nearby states. The rest of electricity sales and generation capacity ownership are widely dispersed among a number of electricity market participants.[3]

[3] Note: The terms megawatt (MW) and megawatt hours (MWh) may be confusing. Generally, generation is cited in MWh and capacity is cited in MW.

Table 6-4
Nameplate Capacity by Holding Company

Holding Company	Capacity MW	% of Total
Dominion Resources Inc	15589.41	61%
American Electric Power Co Inc	1758.4	7%
Old Dominion Electric Coop	1702.39	7%
Tenaska Inc	1231.1	5%
Allegheny Energy Inc	1152.8	4%
NextEra Energy Inc	939	4%
GenOn Energy Inc	514	2%
ITOCHU Corp	402.5	2%
GDF SUEZ SA	399	2%
Goldman Sachs Group Inc (The)	344.4	1%
U S Army Corps of Engineers	294.8	1%
General Electric Co	258.3	1%
Covanta Holding Corp	153	1%
Smurfit Stone Container Corp	148.6	1%
Others	779.189	3%

Source: EIA and various data analyzed by SAIC ABB's Ventyx.

Physical management of Virginia power plants is the responsibility of owners and operators. All Virginia power plant owners and operators, whether regulated, or independent of either IOU or municipal electric systems, are required to provide reliable electrical power.

The reliability requirements for electric service originate with NERC, which Federal law empowered to ensure electric system reliability. Virginia falls under the jurisdiction of two NERC regional entities, the Reliability First Corporation (RFC) and the Southeastern Electric Reliability Corporation (SERC). The general guideline for generation reliability is one outage occurrence every 10 years resulting from generation insufficiency. Electric Distribution Companies (EDCs) are required to purchase or maintain sufficient generation to meet this standard. Assuming the proper maintenance and operation of each independently owned and licensed generation company, the most important generation issue for the EDCs is the marketplace where they buy electricity, because that is where availability and price combine to affect supply.

The details provided in Table 6-5 on plant names, location, nameplate capacity, primary fuel type, and owner and operators along with the maps in Figure 6-1, drawn from the VEP, show the location of those plants using petroleum fuels and various alternative or renewable fuels and, thus, provide reference points for emergency responders and EA planners.

Table 6-5
Virginia Power Plants

Plant Name	Sum of Nameplate Capacity	County	Primary Fuel	Owner	Operating Company
Bath County	2772	Bath	Water	Allegheny Generating Co (The)	Virginia Electric & Power Co
North Anna	2035.4	Louisa	Nuclear	Old Dominion Electric Coop	Virginia Electric & Power Co
Possum Point	1943.9	Prince William	Natural Gas	Virginia Electric & Power Co	Virginia Electric & Power Co
Chesterfield	1799.5	Chesterfield	Bituminous Coal	Virginia Electric & Power Co	Virginia Electric & Power Co
Surry	1695	Surry	Nuclear	Virginia Electric & Power Co	Virginia Electric & Power Co
Yorktown	1257	York	Bituminous Coal	Virginia Electric & Power Co	Virginia Electric & Power Co
Tenaska Virginia Generating	946.1	Fluvanna	Natural Gas	Tenaska V Inc	Tenaska Virginia Partners LP
Doswell Combined Cycle	939	Hanover	Natural Gas	Doswell LP	Doswell LP
Ladysmith	892.5	Caroline	Natural Gas	Virginia Electric & Power Co	Virginia Electric & Power Co
Clover	848	Halifax	Bituminous Coal	Old Dominion Electric Coop	Virginia Electric & Power Co
Chesapeake	812.1	Chesapeake City	Distillate Fuel Oil	Virginia Electric & Power Co	Virginia Electric & Power Co
Clinch River	712.5	Russell	Bituminous Coal	Appalachian Power Co	Appalachian Power Co
Remington	705.5	Fauquier	Natural Gas	Virginia Electric & Power Co	Virginia Electric & Power Co
Smith Mountain	547.5	Franklin	Water	Appalachian Power Co	Appalachian Power Co
Potomac River	514	Alexandria City	Bituminous Coal	GenOn Potomac River LLC	GenOn Potomac River LLC
Marsh Run Generating	513.3	Fauquier	Natural Gas	Old Dominion Electric Coop	Pic Energy Services
Louisa Generating	509.1	Louisa	Natural Gas	Old Dominion Electric Coop	Pic Energy Services
Gravel Neck	407.7	Surry	Distillate Fuel Oil	Virginia Electric & Power Co	Virginia Electric & Power Co
Commonwealth Chesapeake	402.5	Accomack	Distillate Fuel Oil	Commonwealth Chesapeake Co LLC	Commonwealth Chesapeake Co LLC
Hopewell Cogeneration	399	Hopewell City	Natural Gas	Suez Energy Generation NA Inc	Suez Energy Generation NA Inc
Elizabeth River Station	388.8	Chesapeake City	Natural Gas	Virginia Electric & Power Co	Virginia Electric & Power Co
Darbytown	368.4	Henrico	Natural Gas	Virginia Electric & Power Co	Virginia Electric & Power Co
Glen Lyn	337.5	Giles	Bituminous Coal	Appalachian Power Co	Appalachian Power Co
Bellmeade	330	Richmond City	Natural Gas	Virginia Electric & Power Co	Virginia Electric & Power Co
Gordonsville Energy LP	300.4	Louisa	Natural Gas	Virginia Electric & Power Co	Westmoreland Coal Co
Wolf Hills Energy	285	Washington	Natural Gas	Wolf Hills Energy LLC (Tenaska)	Wolf Hills Energy LLC (Tenaska)
John H Kerr	280.8	Mecklenburg	Water	USACE Wilmington District	USACE Wilmington District
Birchwood Power Facility	258.3	King George	Bituminous Coal	Birchwood Power Partners LP	Birchwood Power Partners LP
Bremo Bluff	254.2	Fluvanna	Bituminous Coal	Virginia Electric & Power Co	Virginia Electric & Power Co
Cogentrix of Richmond Inc	229.6	Richmond City	Bituminous Coal	Spruance Genco LLC	Spruance Genco LLC
Mecklenburg Cogen	139.8	Mecklenburg	Bituminous Coal	Virginia Electric & Power Co	Virginia Electric & Power Co
I 95 Energy Resource Recovery	124	Fairfax	Municipal Solid Wast	Covanta Fairfax Inc	Covanta Fairfax Inc
Cogentrix Hopewell	114.8	Hopewell City	Bituminous Coal	James River Cogeneration Co	James River Cogeneration Co
Portsmouth Cogen	114.8	Portsmouth City	Bituminous Coal	Cogentrix Virginia Leasing Corp	Cogentrix Virginia Leasing Corp
West Point Mill	101	King William	Black Liquor	Smurfit Stone Container Corp	Smurfit Stone Container Corp
Covington	99.5	Covington City	Black Liquor	Westvaco Corp	Westvaco Corp
Pittsylvania Power Station	90	Pittsylvania	Wood/Wood Waste S	Virginia Electric & Power Co	Virginia Electric & Power Co
Buchanan County Generating	88	Buchanan	Natural Gas	Allegheny Energy Supply Co LLC	Allegheny Energy Supply Co LLC
Low Moor	82.8	Alleghany	Distillate Fuel Oil	Virginia Electric & Power Co	Virginia Electric & Power Co
Northern Neck	82.8	Richmond	Distillate Fuel Oil	Virginia Electric & Power Co	Virginia Electric & Power Co
Claytor	74.8	Pulaski	Water	Appalachian Power Co	Appalachian Power Co
Hopewell	71.1	Hopewell City	Bituminous Coal	Virginia Electric & Power Co	Westmoreland Coal Co
Southampton	71.1	Southampton	Bituminous Coal	Virginia Electric & Power Co	Westmoreland Coal Co
SPSA WTE	60	Portsmouth City	Municipal Solid Wast	Wheelabrator Portsmouth Inc	Wheelabrator Portsmouth Inc
Hopewell Mill	47.6	Hopewell City	Black Liquor	Stone Container Corp	Stone Container Corp
Leesville	40	Campbell	Water	Appalachian Power Co	Appalachian Power Co
Covanta Alexandria/Arlington	29	Alexandria City	Municipal Solid Wast	Covanta Alexandria/Arlington Inc	Covanta Alexandria/Arlington Inc
Narrows (VA)	27.2	Giles	Bituminous Coal	Narrows LLC	Narrows LLC
Tasley	27	Accomack	Distillate Fuel Oil	Calpine Mid Atlantic Generation LLC	Calpine Mid Atlantic Generation LLC
Radford Army Ammunition	24	Montgomery	Bituminous Coal	U S Army Radford	U S Army Radford
Byllesby 2	21.6	Carroll	Water	Appalachian Power Co	Appalachian Power Co
Pleasant Valley	20.5	Rockingham	Distillate Fuel Oil	Harrisonburg VA (City of)	Harrisonburg VA (City of)
Mount Clinton	20	Rockingham	Distillate Fuel Oil	Harrisonburg VA (City of)	Harrisonburg VA (City of)
Dominion/Lo Mar Generating	19.2	Prince William	Distillate Fuel Oil	Manassas VA (City of)	Manassas VA (City of)
Park 500 Philip Morris USA	19.1	Chesterfield	Bituminous Coal	Park 500 Philip Morris USA	Park 500 Philip Morris USA
Amelia (Maplewood) Landfill	14.4	Amelia	Landfill Gas	INGENCO	INGENCO
Charles City Landfill	14.4	Charles City	Landfill Gas	INGENCO	INGENCO
Ingenco Shoosmith Facility	14.4	Chesterfield	Landfill Gas	INGENCO	INGENCO
Philpott Lake	14	Henry	Water	USACE Wilmington District	USACE Wilmington District
VMEA 1 Credit Generating	13.201	Prince William	Distillate Fuel Oil	Blackstone VA (Town of)	Manassas VA (City of)
Reusens	12.5	Lynchburg City	Water	Appalachian Power Co	Appalachian Power Co
Bayview	12	Northampton	Distillate Fuel Oil	Calpine Mid Atlantic Generation LLC	Calpine Mid Atlantic Generation LLC
Diesel Group 1	12	Accomack	Distillate Fuel Oil	Old Dominion Electric Coop	Old Dominion Electric Coop
Big Island	11.2	Bedford	Water	Georgia Pacific Corp	Georgia Pacific Corp
Brunswick Facility	10.8	Brunswick	Landfill Gas	INGENCO	INGENCO
King & Queen County Landfill	10.8	King & Queen	Landfill Gas	INGENCO	INGENCO
Rockville 1 & 2	10.8	Hanover	Distillate Fuel Oil	INGENCO	INGENCO
Virginia Beach Landfill	10.8	Virginia Beach City	Landfill Gas	INGENCO	INGENCO
Boydton Plank Road Cogen	10.2	Dinwiddie	Waste Oil and Other	Dinwiddie Power Inc	Dinwiddie Power Inc

Source: EIA and various data analyzed by SAIC ABB's Ventyx.

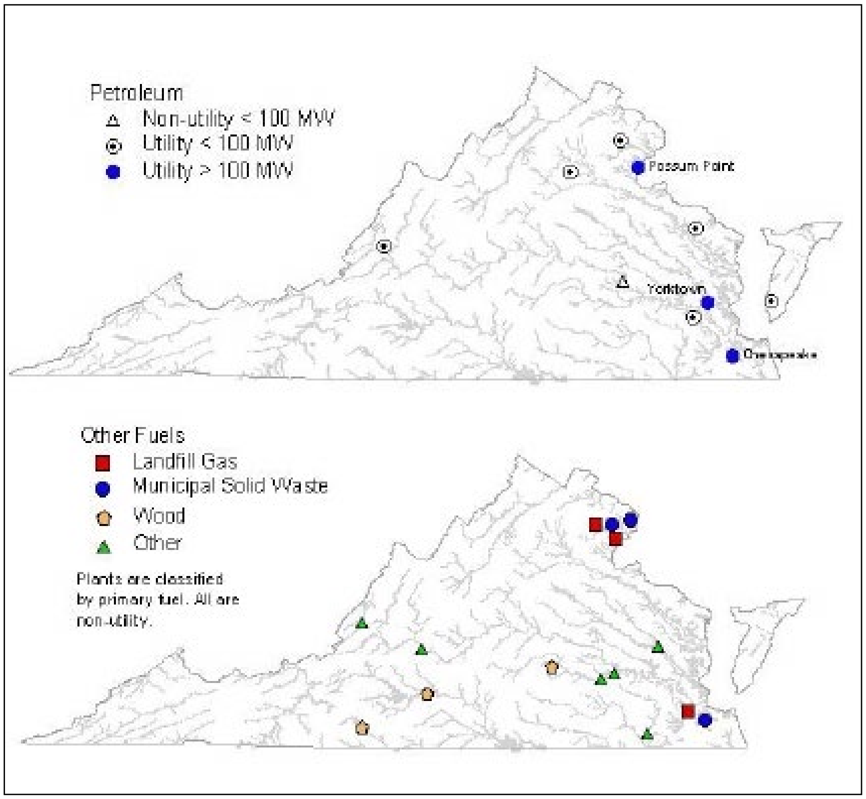
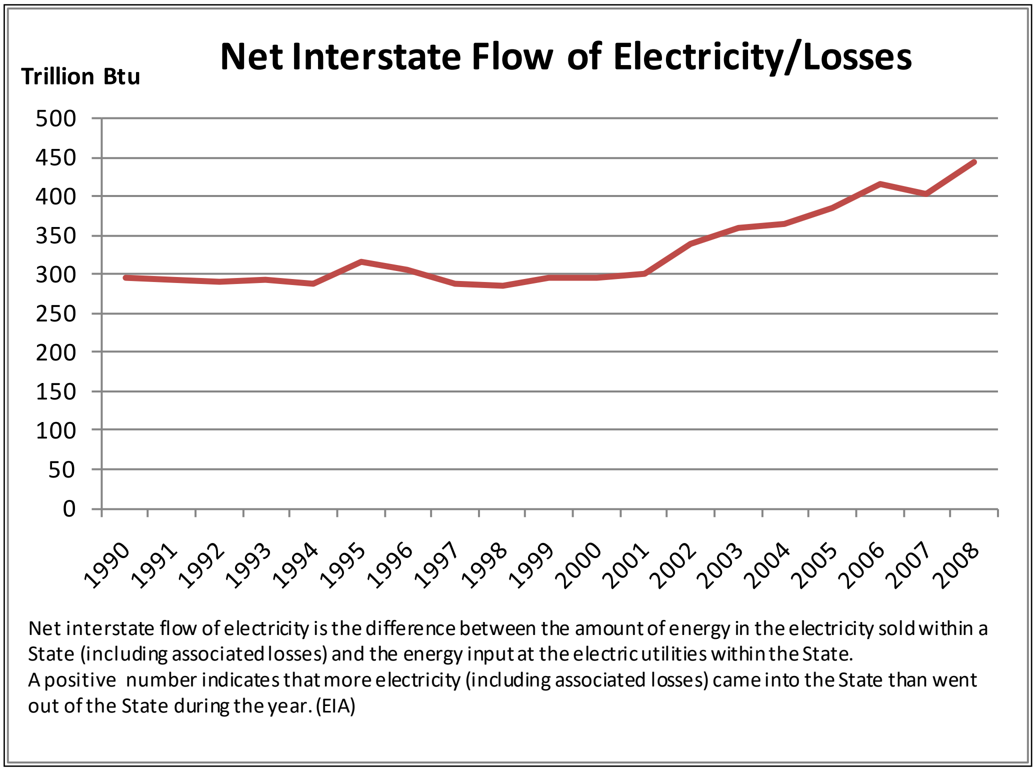


Figure 6-1. Virginia Power Plants Using Petroleum and Alternative Fuels

6.1.4 Imported Power

Virginia EDCs must also import power to meet demand. Although re-regulated, the cost of generated power is market-driven and continues to be a major factor in determining what power a utility may purchase or use at any given time. According to the VEP, the Commonwealth imported about 34 percent of its power in 2009. Figure 6-2 illustrates that imported power is a growing factor in meeting State demand.



Source: EIA. State Electric Profiles, Virginia

Figure 6-2. Net Electricity Imports, 1990 to 2009

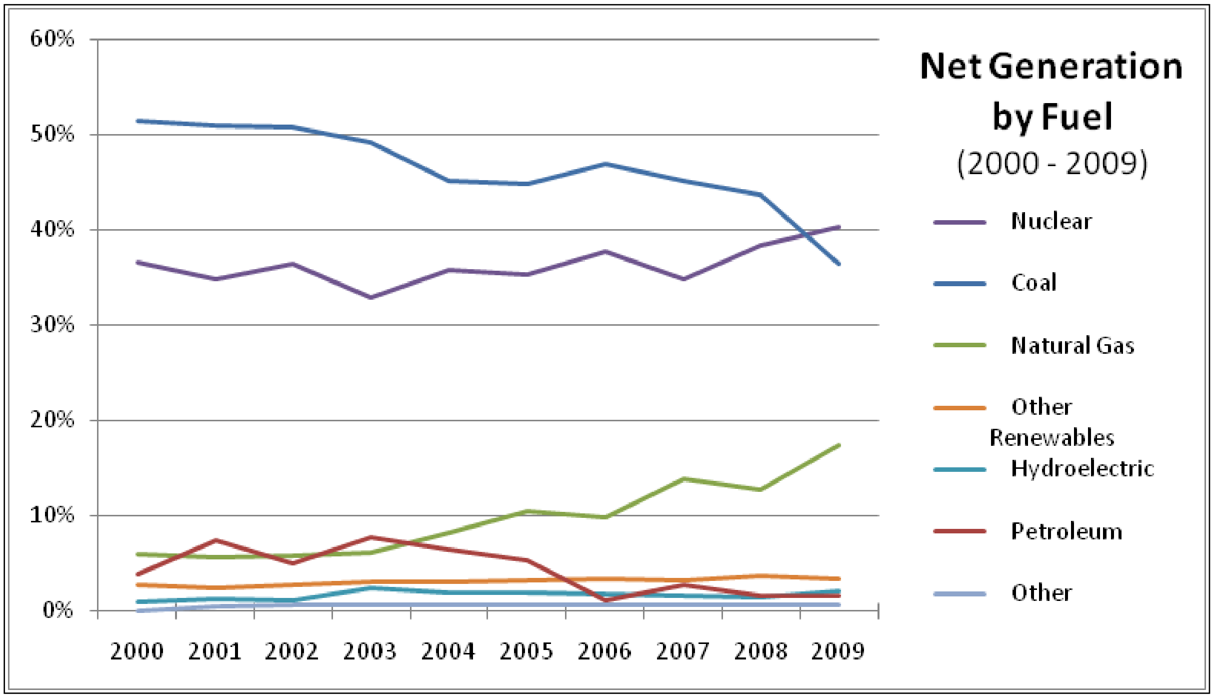
The VEP indicates that the primary sources of imported power are:

- The Mount Storm plant in West Virginia, which Dominion owns
- Dedicated AEP plants
- Dedicated Kentucky Utility plants
- PJM interconnected plants

The role of PJM is also extremely important for electric supply to Virginia. One of the major roles of any RTO, or ISO, is to dispatch power throughout its system. This role joins with the ISO's role in creating the regional pricing market and managing regional transmission. PJM hosts competitive bidding among its utilities for day-ahead and other power needs. Power is dispatched on a cost basis with lower cost power sent first, with increasingly higher-cost power following. This ability to dispatch generated power is also a tool used for mitigating shortage and outage problems. PJM monitors power generation continuously and dispatches power as necessary, or supplies power instantaneously, to maintain load where existing generation has experienced sudden interruption.

6.1.5 Fuel for Power Generation

The VEP contains a thorough analysis of the Commonwealth's coal industry, which this EAP includes by reference. This Section highlights those aspects of Virginia coal and uranium that bear directly on the production of power and influence energy reliability. Figure 6-3 shows net generation by fuel.



Source: http://www.eia.gov/cneaf/electricity/st_profiles/sept05va.xls.

Figure 6-3. Net Generation by Fuel (2000-2009)

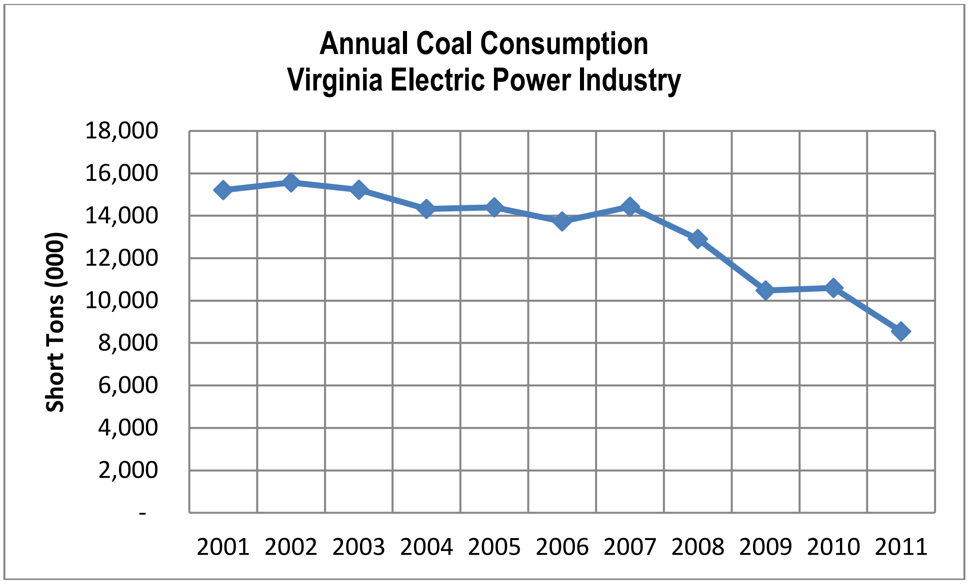
As concerns over pollution and climate change has grown, and natural gas prices decreased, coal (37 percent) has been losing its net generation share to nuclear (40 percent) and natural gas (17 percent). Nuclear is now the most common fuel for electricity generation in Virginia, surpassing coal in 2009. Beyond the increase of nuclear power, coal's decline is also due to the rise of natural gas, which has risen steadily since 2003, growing from 6 percent to 17 percent of net generation in six years. Petroleum fueled electric generation has also fallen with the growth of natural gas, slipping from seven percent in 2003 to a mere two percent in the same time period.

Coal

Coal production within the State has declined by almost half since 1987.[4] A new 585-MW coal-fired plant is scheduled to open in Virginia City, Wise County. Although this facility will increase capacity, other factors may offset any mid- or long-term use of coal. One factor is the announced plans for new natural gas-fired generation facilities; another factor is the possibility of lower fuel prices from shale-produced natural gas; other factors, such as carbon sequestration taxes, and related environmental mitigation costs could also play a role.

[4] Virginia Energy Plan, Figure 3-4, pp. 3-8.

Coal consumption by the electric power industry within Virginia has been declining since 2001. Overall, from 2001 to 2011 annual coal consumption dropped by more than 6.4 million short tons or 44 percent. The steepest drop took place from 2007 to 2009, when coal consumption fell nearly four million short tons, or to 27 percent. Figure 6-4 shows this decline.



Source: http://www.eia.gov/cneaf/electricity/epa/epa_sprdshts_monthly.html.

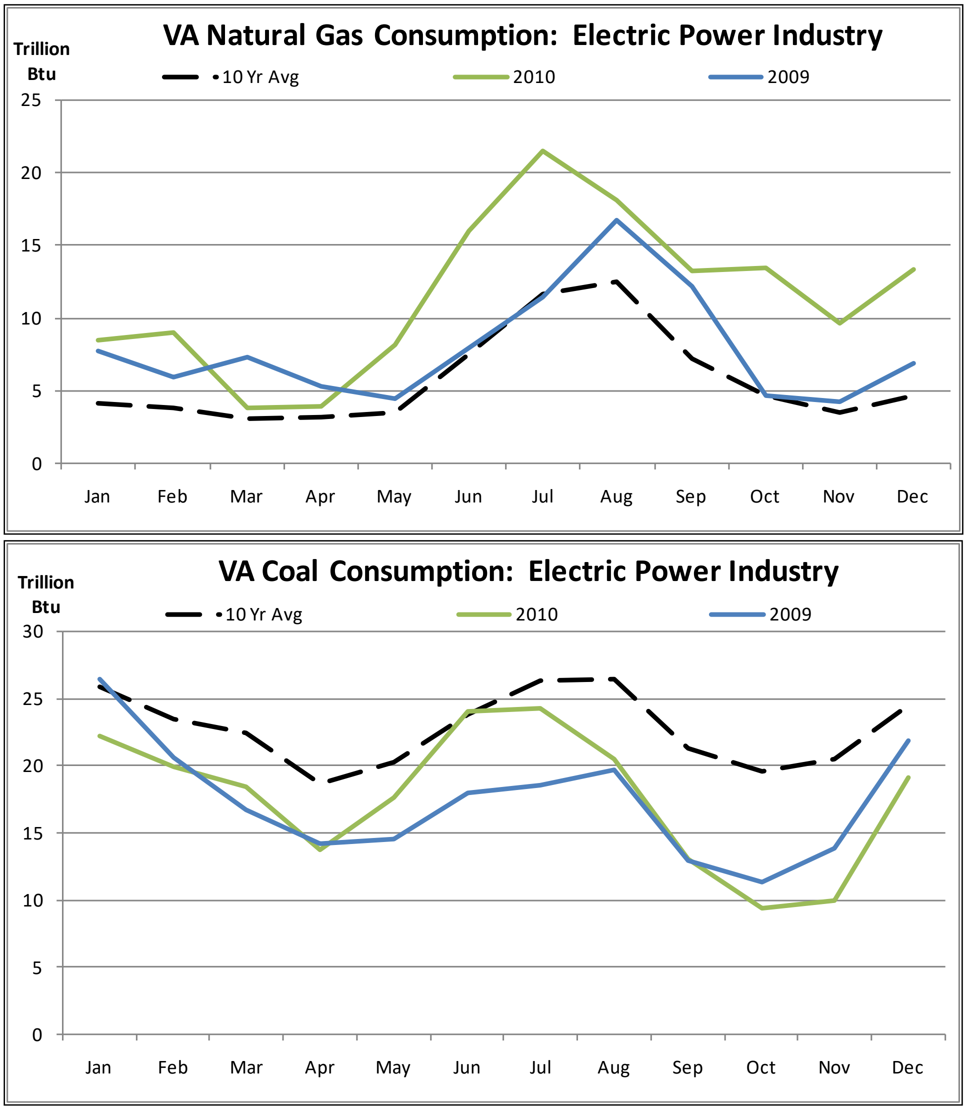
Figure 6-4. Annual Coal Consumption in Virginia's Electric Power Industry (2001-2011)

Despite the drop in the use of coal to fuel electric generation, there is no substitute for coal as a baseload fuel. Consequently, the VEP projections retain coal as an important component of electric power generation well into the future.

As an important commodity moved by rail, coal plays a significant role in supporting the State's rail infrastructure. For that reason, a loss of coal would also create economic issues in addition to its value as a fuel.

Natural Gas

In addition to the relative growth of nuclear power, natural gas use has also displaced coal as a fuel for electric generation. As abundant new sources of domestic natural gas move into the market and low U.S. natural gas prices prevail, more power producers are burning natural gas in baseload plants, moving beyond the role of "peak-shaving" and, thus, reducing coal-fired baseload generation. Consumption levels from 2009 to 2011 were well above the 10-year average and during off months for peak-shaving (September, October, November, and December). During the same period, coal consumption by the Virginia electric power industry declined below the 10-year average, as shown in the following figure.



Source: http://www.eia.gov/cneaf/electricity/epa/epa_sprdshts_monthly.html

Figure 6-5. Natural Gas versus Coal for Consumption in the Electric Power Industry

Nuclear

In addition to coal, Virginia also has significant resources of uranium. With an estimated resource of approximately 119 million pounds of uranium oxide in Pittsylvania County, the State estimates indicate that should the current moratorium on uranium extraction be lifted, there are sufficient resources to allow mining operations through at least 2070 at a production rate of around two million pounds per year.

Table 6-6
Average Capacity Factor

Average Capacity Factor %	2006	2007	2008	2009	4 Year Avg
Nuclear	91.6	91.6	93.5	94.5	92.8
Wood/Wood Waste Solids	64.8	60.4	67.0	59.1	62.8
Bituminous Coal	66.4	66.5	54.3	39.2	55.8
Water	33.8	27.6	20.5	28.6	27.7
Natural Gas	9.5	15.2	13.4	19.2	14.3
Residual Fuel Oil	12.8	17.6	13.7	11.4	13.9
Distillate Fuel Oil	0.2	0.2	0.1	0.1	0.1

Source: SAIC using ABB's Ventyx

Virginia Electric Power operates four nuclear power units at two plant sites. These units ran approximately 95 percent of the time in 2009 (also called a 95 percent capacity factor), the highest of any power sources in Virginia. With a growing share of Virginia's net generation and an average 93 percent power factor during the past four years, these units have become critical to Virginia's electricity supply. Table 6-7 summarizes the basic information pertaining to these plants.

Table 6-7
Virginia Nuclear Facilities

Plant Site/Unit	Owner & Percent	License Ends:
Surry County		
Surry Unit 1	Dominion 100%	2032
Surry Unit 2		2033
Louisa County		
North Anna Unit 1	Dominion 88.4 % Old Dominion Electric Cooperative 11.6%	2038
North Anna Unit 2		2040

6.1.6 Virginia Electricity Transmission

The Basic State Electric Transmission System

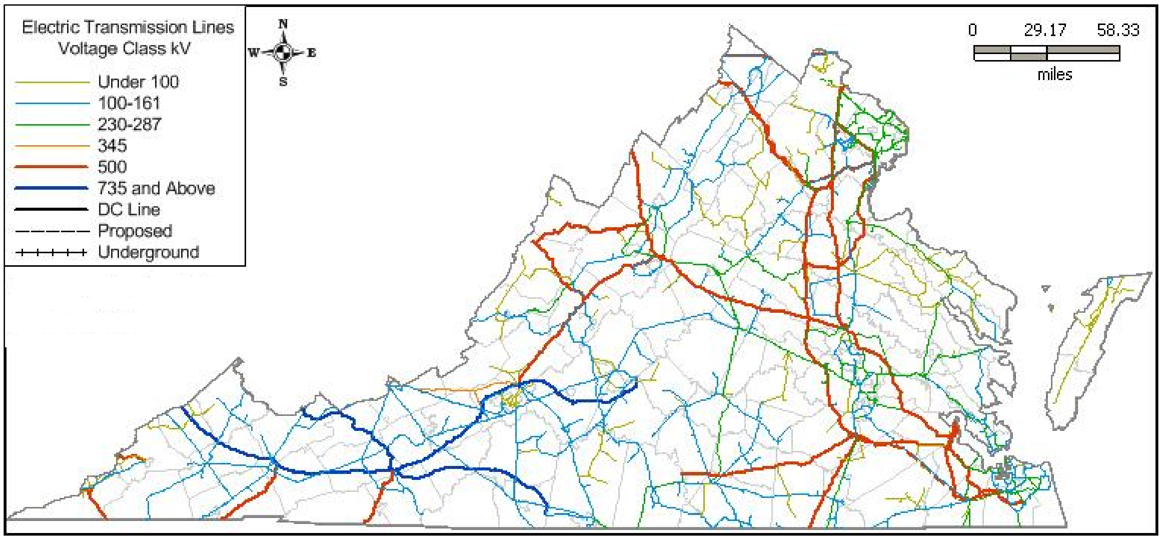
Several entities manage the electric power transmission system: EDC, SCC, and PJM.

Dominion, Appalachian Power, Delmarva Power, and Allegheny Power transmit power into and throughout the Commonwealth via 230-, 500-, and 765-kV power lines. SCC oversees the dockets concerning the need for new power lines.

PJM derives the authority to manage regional transmission from the FERC Order 888, the open access tariff, a key component of the U.S. Energy Policy Act of 1992. The order includes a Regional Transmission Expansion Plan (RTEP) through which PJM identifies necessary transmission additions.

As mentioned earlier, State utilities must meet required electricity operation standards set out by NERC. Participation in NERC was designed to enhance EA for transmission of power. FERC Regulations, Section 39.11 (b) states "the ERO (Electric Reliability Organization) shall conduct periodic assessments of the reliability and adequacy of the Bulk-Power System and report its findings to the Commission, the Secretary of Energy, Regional Entities, and any Regional Advisory Bodies annually, or more frequently if directed by the Commission [i.e. FERC]."

As of June 18, 2007, the FERC granted NERC the legal authority to enforce reliability standards with all users, owners, and operators of the bulk power system in the U.S., and made compliance with those standards mandatory and enforceable. Virginia participates in two regions of NERC: SERC and RFC. Within Virginia, the former covers the Dominion region and the latter covers the Appalachian Power region. Figure 6-6 illustrates the electric transmission system in Virginia.



Source: SAIC using ABB's Ventyx.

Figure 6-6. Map of Virginia Electricity Transmission System

Proposed Transmission Expansion

According to the VEP, the 2009 RTEP supported by PJM includes four potential projects. These include:

- Allegheny and Dominion's 500-kV Trans Allegheny Interstate Line (TrAIL) from the 502 Junction in western Pennsylvania to Loudoun County
- Dominion's 500-kV Carson-to-Suffolk line
- Allegheny and Appalachian Power's 765-kV Potomac-Appalachian Transmission Highline (PATH) from Atmos, West Virginia, to Kempstown, Maryland
- Pepco's 500-kV Mid-Atlantic Power Pathway (MAPP) from Possum Point in Virginia to Indian River, Maryland

SCC has approved two of the lines – TrAIL and Carson-Suffolk. The other two projects have experienced delays in light of reduced electricity demand from 2009 to 2010.

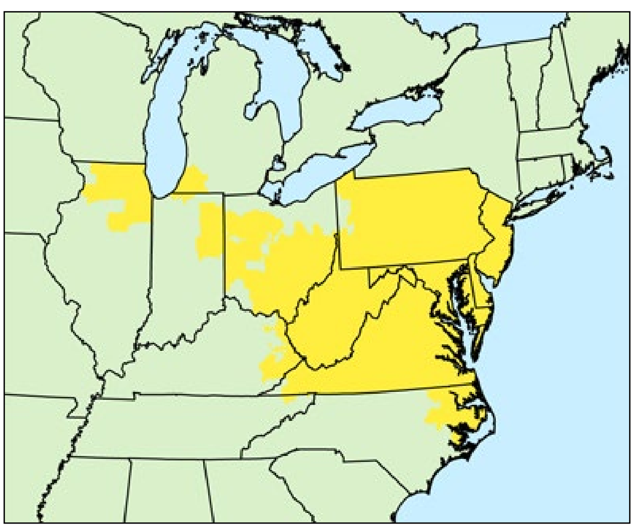
The statewide transmission system connects all the utilities in Virginia. Each utility also owns and maintains its own local area distribution system. Generally, consumers interact with a utility at the local distribution level, so these systems are the most visible to customers and disruptions to them are most likely to generate complaints.

PJM

PJM is an ISO and the primary entity that manages electric transmission in Virginia. As an ISO, PJM acts in large measure to lower wholesale electricity prices, and thus retail electricity costs by increasing the efficiency of the transfer of electric power. In practice, to achieve this goal, ISOs do much more. As moving power longer distances became necessary to meet local demand, many power line owners imposed fees for use of their transmission property. Over time, complex contracting and administration led to increased system costs. Further, a complex system of electron transfer components reduced flexibility as well as the ability to move power when demand was high thus stressing the system and increasing vulnerability. ISOs were designed to reduce barriers, simplify fee structures, and develop common rules, rates, and service requirements. The resulting "Open Access Transmission Tariff" system reduces transmission constraints that evolved both with the growth of the electric power industry and the concomitant regulations designed to prevent monopoly practices. For example, one-on-one power acquisition meant utilities had to increase generation reserves to assure sufficient capacity to meet obligations. Hence, the efficiency gained through a power pool improved EA by increasing system resiliency and reliability. Now, an Energy Imbalance Service (EIS) market, with a central, independent operator, efficiently and quickly locates and schedules needed power, reduces some of the need for additional expensive generation, lowers market transfer costs, and improves regional system reliability, reducing risk.

The Role of PJM

Figure 6-7 depicts the ISO's territory.



Source: PJM, http://www.pjm.com/about-pjm/how-we-operate/territory-served.aspx.

Figure 6-7. PJM Service Territory and Basic Facts

The PJM Interconnection coordinates the movement of electricity through all or parts of the following 13 states and DC: Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and DC. The PJM region covers an area of 168,500 square miles, with a population of about 51 million and a peak demand of 144,644 MW[5]. PJM provides eight primary services to its broad territory of states and utilities:

- Energy Market
- Financial Transmission Rights
- Market Settlements
- Compliance
- Reliability Pricing Model
- Demand Response
- Financial Credit
- Transmission Services

The following discussion focuses on those aspects of PJM activity that relate primarily to EA and reliability.

Market Mechanisms for Reliability

PJM describes its market as "the continuous buying, selling, and delivery of wholesale electricity." Protocols that support reliability and the mitigation of potentially damaging events are a part of this balancing process in an open access market. The primary wholesale markets PJM operates that affect reliability are the Energy Market, the Reliability Pricing Model capacity market, and the Ancillary Services Market.

Energy Market

Market participants wishing to buy and sell energy in PJM have multiple options. Load serving entities (LSEs) decide whether to meet their energy needs through self-supply bilateral purchases from generation owners, or market intermediaries, and through the day-ahead and real time energy markets PJM manages. Generation owners can use generation to meet their own loads, sell into the spot market, or sell bilaterally, and they can sell their output to entities within or outside PJM. Market participants in PJM include power generators, transmission owners, electricity distributors, power marketers, and some large consumers.

The PJM Energy Market operates much like any commodity market, with buyers and sellers establishing a price by matching supply and demand. Generating resources in PJM that do not submit self-schedules or are not assigned to bilateral transactions are required to submit energy bids into the day-ahead energy market. PJM uses the energy price bids to perform a day-ahead, least-cost security constrained economic dispatch (SCED) of the entire PJM system, from which projected loads, net of self-schedules, for the following day are modeled to be served at the lowest possible bid cost of generation, while maintaining adequate transmission system reliability and operating reserves.

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[5] Source: PJM, http://www.pjm.com/about-pjm/how-we-operate/territory-served.aspx.

Figure

Reliability Pricing Model

Entities serving load in PJM are required to maintain adequate capacity resources to serve their peak demand and reserves as the Reliability Assurance Agreements for each reliability region in PJM. These entities may acquire capacity through several means, including bilateral transactions, long-term self-scheduling, and/or participation in the Reliability Pricing Model (RPM) capacity market. PJM developed the RPM to reduce price volatility and secure this region's growing electricity needs with long-term voluntary investments in building capacity, local generation security, and grid improvements. The model is based on an algorithm that optimizes reliability and minimizes the cost of the needed capacity given generation possibilities and the current conditions of the grid. Underlying the RPM is the concept that paying higher prices for capacity in areas with little excess capacity will help create incentives either to build generation in these areas or to improve transmission.

RPM rules require generating resources in the energy market to be bid into the capacity market, and load is required to purchase capacity from the market (or secure capacity rights through other means, such as bilateral transactions) for three years into the future. The RPM is designed to produce bid prices that reflect the annual fixed carrying costs of new capacity entering the market, less PJM-administered assessments for energy and ancillary services revenues.

Ancillary Services

PJM offers Regulation, Synchronized Reserves, and Day-Ahead Scheduling Reserves through bid-based markets. Regulation is a service that allows PJM to balance supply and demand in real time by working with generators having telecommunications control and response capability to increase or decrease output in response to signals sent by PJM.

Resources that can react to meet larger supply/demand imbalances within a response time of 10 minutes provide Synchronized Reserves. Generators that are synchronized to the grid but are operating at less than full load, or demand resources that can reduce load within the specified time, can also provide this service.

Day-Ahead Scheduling Reserves are supplemental power from 30-minute reserves on the system. According to PJM: "The market is intended to provide a pricing method and price signals that can encourage generation and demand resources to provide day-ahead scheduling reserves, and to encourage new resources to be deployed that have the capability to provide such reserves."[6]

In other words, this pricing tool encourages utilities to avoid last minute load needs by planning correctly in advance of anticipated demand. Advanced planning adds reliability to the entire electricity system by reducing last minute demand when generators might not be available, or fuel that is more expensive must be consumed to produce power.

[6] *Day-Ahead Scheduling Reserve Market*, http://www.pjm.com/markets-and-operations/energy/day-ahead-sched.aspx.

PJM manages other ancillary and transmission services on a tariff basis. These ancillary services include black start, and reactive and voltage control. Firm and non-firm transmission service is managed through the PJM open access transmission tariff and operation of its Open Access Same Time Information System (OASIS).

Demand Response

Demand Response measures are at the heart of EA and emergency response to market and capacity incidents. PJM has a number of demand response and capacity-related tools available to enhance electricity reliability. These are listed in terms of increasing complexity:

- **End-User Reductions**: End user reductions entail load management by conserving power and scheduling activity to non-peak hours of the day. Customers are encouraged to adopt increasingly efficient procedures and equipment and otherwise initiate load reduction on their own. Their motivation might be to avoid high prices (e.g., locational marginal prices where newer increments of power are increasingly expensive) or perhaps react to an emergency or anticipated severe weather conditions. Essentially, these initiatives are a non-fuel resource that substitutes for more costly fueled generation. This market attracts members of PJM known as curtailment service providers (CSPs), who reach out to end-users and aggregate (encourage) end-user reductions that "save" capacity.
- **Demand Response Capacity Market:** Demand response resources are eligible to participate in the RPM market described above.
- **Full Emergency Load Response:** A technique used by PJM to secure reserve capacity to meet an unplanned outage. Unused demand capacity is committed for three months before a delivery year begins. The submitting entity is rewarded with offset capacity payments. Both load-serving entities and CPSs can register aggregated demand resources for this purpose. This mechanism is another price advantage tool through which non-fuel capacity is made available to provide reliable service for the market.

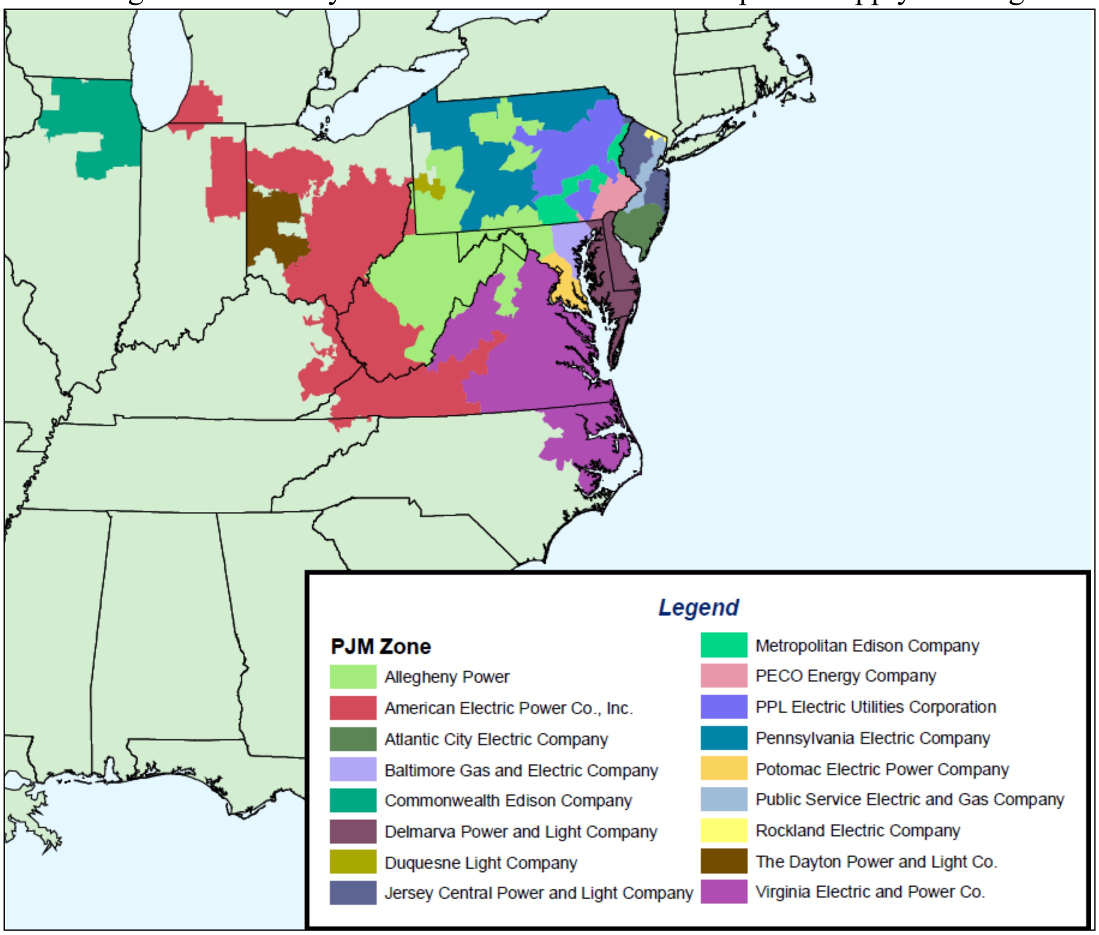
Synchronized Reserve Market

Demand response resources also are eligible to contribute to the Synchronized Reserve Market. Entities that participate in this synchronized system must be able to deliver power within a 10-minute window. Such entities must have metering that provides for readings at no less than a one-minute scan rate to verify that such capacity is indeed available on short notice. This type of power acquisition is expensive, but is critical in the event of a sudden power loss. PJM does not utilize this mechanism lightly: "While demand response resources must install infrastructure to allow them to curtail their consumption of electricity within 10 minutes, they will be requested to curtail only when system conditions require the 10-minute response." Other requirements for this critical resource include operator training.[7]

[7] Demand Response Synchronized Reserve Market, http://www.pjm.com/markets-and-operations/demand-response/dr-synchro-reserve-mkt.aspx.

Transmission

PJM provides two basic transmission service options to its customers, point-to-point transmission service and network transmission service. PJM offers these service options under Open Access Transmission Tariff and OASIS. Figure 6-8 illustrates the various regional electricity transmission zones that affect power supply for Virginia.



Source: PJM.

Figure 6-8. PJM Transmission Zones

Point-to-Point Transmission Service

There are three aspects to this service:

- The service is offered for the transmission of both capacity and actual energy "between a point of receipt and point of delivery."
- The service may be offered as "firm service," meaning that this service receives delivery priority by "reservation."
- The service may be offered as "non-firm service" meaning that this service receives "available" power and capacity and may receive a pro-rated amount or nothing depending on system conditions.

Firm transmission is a concept well understood in the utility market. Satisfying "firm" customers always carries a price premium. Hence, if a utility wishes to assure that customers without any other means of power are protected, the utility will acquire the higher priced, “reserved” power to assure that power flows without interruption. The system is similar to buying a reserved seat on an airplane or taking a chance that a seat will be available at a lower fare when it is needed.

Network Transmission Service

This type of transmission essentially covers in-network customers of PJM. According to PJM, “Network transmission service enables network customers to use their generation resources to serve their network loads located in PJM.” To accomplish this, “PJM works with transmission owners to plan and coordinate the operation, maintenance and expansion of PJM transmission facilities in order to provide all network and point-to-point customers with transmission service.”

This service also allows for economic planning and power delivery. PJM’s Transmission Service Request Manual and OASIS cover these complex efforts. Responders do not necessarily need to be able to duplicate these services; understanding that they are available and help provide stability and reliability to the Commonwealth’s electricity market is useful.

Compliance

PJM complies with NERC regional reliability standards working closely with the North American Energy Standards Board (NAESB) and the regional entities, RFC and SERC.

Training

PJM provides an extensive array of training to support the many reliability functions and standards for such activities as balancing, interchange management, planning and reliability coordination, resource planning, and various transmission services.

Corporate Compliance

The PJM Regulatory Oversight and Compliance Committee, along with associated internal departments attending to compliance training efforts, and other issues, further supports reliability.

Emergency Operation Procedures

PJM has published a table of its standard emergency procedures. This Section, as well as information found in Appendix F, summarizes information found in PJM’s standard emergency procedures table.

Based on a series of phased notifications, PJM emergency procedures include

- Alerts
- Warnings
- Actions

Each step is intended to alert generators, utilities, and others connected to the electricity system infrastructure about impending incidents. At each level, PJM provides a detailed description that informs participants of PJM actions and details how participants (such as transmission and generation operators, dispatchers and others) should proceed. Hence, PJM works to inform all participants in the PJM electricity network about the nature and management of an issue. Such notifications may be sufficient to mitigate a problem. According to PJM, "However, in certain situations the implementation order of these levels may change. Sometimes PJM must omit a warning or alert and immediately implement an emergency procedure. Certain emergency situations do not have an alert, warning or action level."[8]

Examples of reasons or actions for notification include:

- Weather issues, events
- Curtailment
- Emergency energy request
- Heavy load voltage warning
- Load issues, events
- Voltage issues, events
- Generation issues, events
- Reserve warnings
- Solar magnetic disturbance
- Transmission issues, events

6.1.7 Virginia Electricity Distribution

As discussed in the Authorities section, EDCs are subject to the requirements established by statutes and regulated by the SCC, and FERC rulings and in addition, NERC standards are in effect.

Although distribution companies must meet FERC and NERC requirements, the primary regulatory agency at the distribution level is the SCC. State officials at the SCC continually work with the State's regulated EDCs to enhance distribution system efficiency and maintenance to ensure the continuity of reliable service.

Figure 6-9 illustrates a typical electric distribution system. Although the distribution system is deceptively simple from the customer's perspective, it nonetheless provides the basic data required to plan for capacity. Behind the wall, switch, and meter are wires carrying several levels of power as substation transformers step down power from high-voltage, long-range transmission to voltage levels for various local distribution lines. Working from the point of generation, complex transformers step up power for long-range transmission as power leaves the generation plant and moves into the transmission system for eventual delivery into a distribution system. The

[8] *PJM Emergency Procedures,* PJMDOCS-#379119-v11-Emergency_Procedures_-_Message_Definitions.DOC, pp.1 of 9.

local distribution system is a complex web of infrastructure, from substations and transformers to poles and junction boxes and finally to the wires and meters at the end-user's location. Utilities must also operate complex communication networks for routine and emergency operations; control rooms to monitor network activity, maintenance and repair shops, equipment, and trained personnel; and an accounting and billing operation to assure electrons are accounted for when purchased.

Another feature of Figure 6-9 illustrates an additional level of complexity that helps stakeholders, unfamiliar with the electricity system; understand potential issues regarding electricity distribution. Some industrial users receive power directly from high-voltage transmission lines and may maintain their own end-use off grid equipment. The diagram also illustrates two additional levels: small industry and commercial/institutional users. These customers may obtain favorable bulk rates depending on size and demand.

At the end of the distribution system are residential customers. The restoration of electrical outage affecting them may convey the appearance of discrimination and favoritism because of repair protocols. Utilities have found that first restoring both larger users, whose distribution infrastructure has the ability to accept higher kV power, and distribution lines that carry the greatest number of users per line segment, is expeditious. This strategy results in customers on a heavily used line generally experiencing a restoration of power before others.

Finally, Figure 6-9 can also be viewed as a summary, illustrating the restoration of power. Companies generally restore power after a loss or interruption based on system created priorities. This strategy relates to EA as the restoration of the larger (i.e., serving more accounts or customers) circuits occurs first, with smaller sub-systems that serve diminishing groups of users following.

EDCs assess outage location and extent after any disruption or incident. Incidents that occur in only a smaller sub-system typically result in more rapid restoration than incidents that occur at or near the bulk power level. This more rapid restoration in smaller sub-systems occurs because the repair of complex large-scale components that must be restored before local distribution needs can be addressed may require more time.

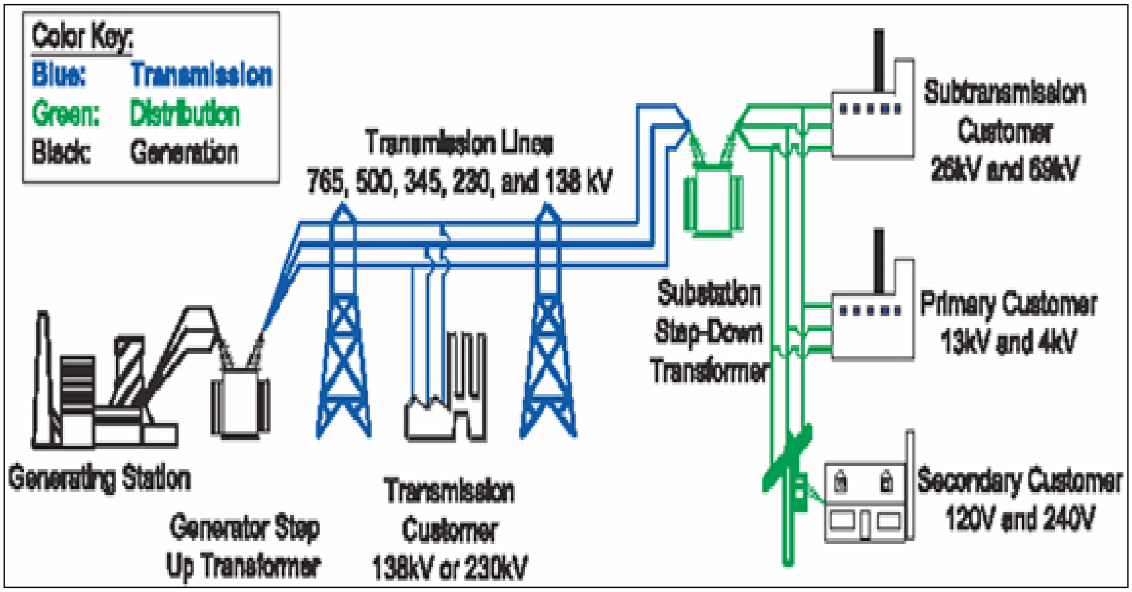


Figure 6-9. Electricity 101 - Electric System Diagram

Resource Planning for Distribution and Mitigation

All utilities have plans to mitigate energy interruptions and distribution problems. Regulated utilities report to the SCC; municipal utilities report to their boards of directors and local jurisdiction authorities. Mitigation involves identifying potential problems in light of future demand and reducing risk associated with resource acquisition, markets, physical incidents, and any other factors that may lead to a loss of power.

A principal instrument in this process is an integrated resource plan (IRP). The SCC requires IOUs to submit a 15-year IRP every two years. Guidelines contained in Title 56, SCC, § 56-599 require attention to:

- Enter into short-term and long-term electric power purchase contracts.
- Own and operate electric power generation facilities.
- Build new generation facilities.
- Rely on purchases from the short-term or spot markets.
- Make investments in demand-side resources, including energy efficiency and demand-side management services.
- Take such other actions, as the Commission may approve, to diversify its generation supply portfolio and ensure that the electric utility is able to implement an approved plan.
- Identify the methods by which the electric utility proposes to acquire the supply and demand resources in its proposed integrated resource plan.

Section 56-599 required the first submission of these plans by September 1, 2009, so the process is relatively new. These planning efforts will coincide with utility activity within PJM's market planning systems, the State's renewable energy portfolio standards, and potential future system changes, such as smart grid, that, if adopted, could provide an interface between distribution customers and the entire utility system. A smart grid has the potential to be automated all the way from the EDC to a customer's appliance. Such systems are being promoted by some as a means for utility companies to monitor consumption remotely in real time and, eventually, to encourage and monitor conservation at the point of sale. They might also have the potential to speed dispatch and repair without need for customers to inform their utility.

Examples of the IRP Process

The VEP notes examples of IRP planning:[9]

Virginia Electric Power
Virginia Electric Power's preferred IRP includes adding 7,900 MW of generation capacity, nearly 950 MW from demand side management programs, and market purchases.[10] Projected new generation capacity would come from the Virginia City coal-biomass hybrid plant under construction and new plants including six natural gas-fired combined cycle, four natural gas-fired combustion turbines, a third North Anna nuclear unit, two biomass units, and four wind facilities.

Appalachian Power
Appalachian Power's IRP (East Zone) includes adding 4,168 MW of generation capacity and 1,346 MW from demand side management. This addition will be offset by planned unit retirements and retrofits lowering capacity by 5,093 MW for a net capacity addition of 422 MW.[11] Projected new generation capacity would come from completion of the Dresden plant under construction in Ohio; capacity uprates at the Cook nuclear plant in Michigan; and construction of four new fossil fuel plants, biomass co firing, and two new biomass plants, as well as purchases or additions of wind and solar capacity.

Old Dominion Cooperative
The Old Dominion Electric Cooperative (which provides wholesale power to its member retail electric cooperatives) is proposing constructing a new coal-fired power plant near Cyprus Creek in Surry County. The facility would have a capacity between 750 and 1,500 MW, and could be in service as early as 2018.

Reliability Requirements

Virginia's utilities must comply with reliability standards in PJM as well as operating within SERC and RFC guidelines. The SCC works with utilities to assure fair and reasonable rates of return because EDCs must make a profit in order to provide the

[9] Virginia Energy Plan, pp. 2-16-to 2-17.
[10] Virginia Electric and Power Company Integrated Resource Plan filed with the Virginia SCC on September 15, 2009.
[11] Appalachian Power Company's Integrated Resource Plan filed with the Virginia SCC on September 1, 2009.

service that certificates of public convenience and necessity (CPCN) require. At the same time, the SCC must also oversee reliability as a condition of a utility's obligation to serve.

Virginia utilities collect annual data pertaining to electricity reliability. Following major incidents such as storms, the SCC staff performs both informal and formal analyses to determine if EDCs used adequately prepared and appropriate processes, mutual aid, and resources to mitigate and restore power efficiently and expeditiously. Reports or even formal docket hearings may follow such analyses. The SCC maintains liaison with each utility to assure the flow of information and to handle special requests. The SCC also maintains liaison with PJM, which also does extensive contingency planning.

6.1.8 Summary of Utility Emergency Response Activity

State Emergency Response Supervision

SCC staff has established contacts with electric utilities to obtain outage information in the event of any service interruption. ESF-12 of the COVEOP identifies roles and responsibilities of entities participating in State emergency response, including the VDEM. In coordination with the ESF-12, the SCC works closely with other State agencies to respond to electricity emergencies and the section on Authorities describes this process.

Examples of IOU Response Activities

The following addresses the general concept of incident management: what a typical EDC does to both prepare for, and react to an incident that may, or has caused, a loss of electricity. Commonwealth and local jurisdiction responders may wish to use the guide below to explain an outage to the public. The SCC also addresses detailed utility response plans as necessary when assessing State options during an incident.

Incident Management

Table 6-8 summarizes the basic action any EDC may pursue to mitigate and restore power in the event of a storm or other problem affecting the delivery of electricity.

Table 6-8
Typical EDC Incident Mitigation and Response

Action	Explanation
Pre-Incident Preparation and Mitigation	
Planning, building, purchasing	▪ Continually assess electric capacity needs as customer base changes over time. ▪ Obtain generation capacity through building or purchase. ▪ Create and exercise protocols, working with regional entities (i.e., PJM, SERC, RFC), for emergency power acquisition. ▪ Acquire or identify sources of large and difficult-to-obtain equipment for rapid deployment in the event of component failure.
Training	▪ Maintain staff readiness through ongoing training and instruction.
Protection	▪ Assure infrastructure integrity. ▪ Build to and maintain NERC, SERC, and RFC industry standards for quality and operation. ▪ Maintain and repair equipment, poles, and lines regularly. ▪ Create, maintain, and exercise computer and electronic controls for system operation. ▪ Instruct and encourage customers on the efficient use of power. ▪ Maintain right-of-away (e.g. vegetation control). ▪ Create and sustain mutual aid agreements among all utilities including municipal retail entities that purchase wholesale power for local distribution. ▪ Maintain financial integrity in order to sustain the company's responsibility to deliver power in compliance with State tariffs and rules. ▪ Ask customers with critical medical needs to notify the company.
Awareness	▪ Monitor for conditions that may create shortage, interruptions, or other incidents. ▪ Analyze system needs and capacity in relation to potential problem, threat, or other potential cause of power loss.
Mobilize	▪ Pre-position repair and technical personnel in advance of known threat, such as a weather emergency. ▪ Prepare in advance for post-incident logistic support.
Post-Incident Actions	
Incident	▪ Assess damage and impact of incident, especially: ▪ Backbone feeders ▪ Major trunk lines ▪ Critical users with immediate public health and welfare responsibilities ▪ Medical needs as known ▪ Adequacy of rapid response capability ▪ Needs (e.g., personnel, repair equipment, replacement parts) for response support in terms of incident response time to completion ▪ Perform range of response steps relating to the incident such as public appeal, onsite and in-company responder adequacy vs. need to call for mutual aid assistance. ▪ Coordinate and collaborate with other utilities or operational entities, local and State government, and consuming public.

Action	Explanation
	▪ Begin action steps as appropriate (may occur prior to assessment). ▪ Monitor progress of action taken and make necessary adjustments. ▪ Report action and restoration progress to SCC and VDEM as appropriate. ▪ Sustain efforts with logistics support to completion.
Evaluation	▪ Review all aspects of performance in relation to pre-event planning and training. ▪ Review incident response in relation to frequency and location of incidents. ▪ Collaborate with other stakeholders to enhance future response capability. ▪ Make changes to plans and preparatory steps as indicated.

Source: EDC web sites and various response plans

Restoration Priorities

The electricity delivery infrastructure and the location of a problem within each EDC system dictate power restoration. Table 6-9 shows this information for a typical utility.

Table 6-9
Typical Electricity Restoration Priorities

Curtailment Due to a Fuel Shortage	
Burn Days (days of fuel remaining)	**Action to Take**
45	▪ Request industrial and commercial customers voluntarily curtail non-essential power use. ▪ Request consuming public conserve. ▪ Request wholesale electric systems (municipals, cooperatives) implement conservation and curtailment plans.
30	▪ Reduce distribution system voltage up to 5%. ▪ Request emergency allocation. ▪ Request industrial and commercial customers substantially reduce power.
25	▪ Buy emergency power.
20	▪ Request emergency natural gas.
15	▪ Open selected circuits for short periods. ▪ Implement rolling curtailment as necessary for non-critical customer circuits.

Curtailment because of a capacity shortage typically defined as the loss of generation capacity or when bulk transmission demand exceeds the supply available from operating units or for purchase (or both). See Table 6-10 for curtailment actions.

Table 6-10
Typical Electricity Curtailment Actions

Curtailment Due to Capacity Shortage	
Step	**Action taken in order listed**
1	▪ Reduce power manually at all company facilities.
2	▪ Request wholesale power customers to run all available generation and reduce company power use.
3	▪ Request public conservation.
4	▪ Request municipal and other dependent systems implement conservation and curtailment plans.
5	▪ Reduce distribution system voltages up to 5%.
6	▪ Ask industrial and commercial companies to reduce non-essential power.
7	▪ Implement controlled load tariff load reduction.
8	▪ Request industrial and commercial customers substantially reduce power.
9	▪ Open selected circuits for short periods. ▪ Implement rolling curtailment as necessary for non-critical customer circuits.

Actions for Dynamic Emergencies

This type of action is taken in response to sudden loss of major infrastructure resulting in the immediate loss of power whenever the system cannot maintain an electric frequency of 60 hertz to satisfy load demand. Steps are illustrated in Table 6-11.

Table 6-11
Typical Dynamic Emergency Steps – Electricity

Dynamic Emergency	
Number	**Action**
1	▪ Switch off interruptible load and controlled loads per tariff.
2	▪ Reduce distribution system voltages up to 5%.
3	▪ Open selected circuits for short periods. ▪ Implement rolling curtailment as necessary for non-critical customer circuits.
4	▪ Selected under frequency relays are tripped. ▪ If load tripping is anticipated to last “for a substantial period of time,” implement company load shedding procedures.
5	▪ Totally discontinue service during the emergency to any customer who refuses to comply with procedures outlined in company load shedding procedures list.

Upon the conclusion of any emergency, the company initiates full system restoration and reports to SCC and FERC.

6.1.9 Risk, Vulnerability, and EDC Response

While the primary State agency working with utilities is the SCC, this EAP is designed to illustrate to all potential responders how the electric utilities and related entities manage emergency issues. Risk in an electricity system consists of two elements – supply and distribution. Each operates in reference to the other, but this division is a useful way to examine risk and describe how various components of the electric industry prevent, mitigate, or recover from power problems. Virginia EDCs and others address capacity and interstate marketplace issues on the supply side while being prepared to maintain and restore power on the distribution side.

Major Issues and Electric Utility Industry Response

To understand electric utility emergency response activity in Virginia, a review of SCC procedures as they pertain to both mitigation (pre-emergency preparedness and measures) and incident response is useful.

Resource Planning (Mitigation)

As a part of its fundamental responsibilities, the SCC regulates the jurisdictional electric utilities to ensure safe and reliable service at reasonable rates. The SCC has established quality of service standards and resource planning guidelines to ensure that electric utilities have sufficient resources and facilities for safe and reliable operation. Further, as part of its standards, guidelines, and regulations, the SCC ensures that electric utilities prepare for prompt restoration of service in the event of an outage, regardless of the cause.

Specific resource planning guidelines ensure adequate supplies of capacity and energy necessary to serve each utility's load. In the development and evaluation of resource plans, utilities and the SCC consider a number of factors, including but not limited to load forecasts, generation and transmission capacity forecasts, peak usage, and weather data.

SCC staff ascertains whether equipment is adequate to meet the load. Although new generation may appear to be necessary initially, the SCC may find that there is only a need for balancing and "hardening" of existing equipment. SCC staff has observed that utilities appreciate operational improvements that promote cost-effective electric delivery.

Table 6-12 summarizes problems not covered in the previous discussion. The table also illustrates how utilities and related stakeholders may respond.

Table 6-12
Power System Risk and Representative Mitigation and Response

Issue	Stakeholder and Actions
Adequate Generation Capacity Note: Adequate Generation Capacity means balance for routine supply and demand with sufficient reserve/capability to satisfy peak period needs	PJM ▪ Locate alternate supply. ▪ Assure reliability of existing plants through market participation requirements. ▪ Encourage and facilitate new construction. ▪ Maintain wholesale system integrity. ▪ Use automatic and manual monitoring. ▪ Maintain PJM operation facility and infrastructure to highest standards. ▪ Train personnel. ▪ Coordinate with supply and distribution stakeholders. ▪ Inform/Coordinate with SCC. Distribution Utilities ▪ Plan for seasonal capacity needs. ▪ Build or buy into expanded capacity as forecasted and planned. ▪ Exercise energy trading and risk management market tools where applicable. ▪ Improve distribution efficiency. ▪ Encourage consumer energy use efficiency. ▪ Coordinate with PJM, utilities and government to expand generation options. ▪ Inform/coordinate with SCC.
Adequate Transmission Capacity	PJM ▪ Study and recommend additions as identified and needed. ▪ Support capital acquisition by utilities to build additional infrastructure. ▪ Assist/testify before FERC, the SCC, or other authorities as applicable to support infrastructure improvements. ▪ Inform/coordinate with SCC. Utilities ▪ Coordinate with PJM's other utilities. ▪ Plan and coordinate with SCC. ▪ Offer load curtailment programs to appropriate customers.

Critical Infrastructure Protection	SCC
	▪ Issue annual reports on electric distribution system reliability for regulated electric utilities. All utilities and PJM maintain such protection as:
	  ▪ Perimeter protection on major sites.
	  ▪ Guard forces.
	  ▪ Access control.
	  ▪ Back-up command centers.
	  ▪ Professional security assistance.
	  ▪ Electronic monitoring.
	  ▪ Regular physical inspection and maintenance/upkeep.
	▪ Meet National Infrastructure Protection Plan (NIPP) definitions/requirements
	▪ Training

Source: Interviews with SCC and various electricity entities 2010.

Cybersecurity

Cybersecurity is a critical issue facing electric utilities. This issue has received additional attention as EDCs consider the enhanced capability of customer-located monitoring through new systems – particularly those labeled as smart grid. A report DOE and DHS issued in 2006 noted several challenges related to cybersecurity issues.

Subsequently, in 2008, FERC approved eight mandatory cybersecurity standards developed by NERC. These standards extend to all entities connected to the U.S. power grid. The standards govern asset identification, management controls, personnel and training, perimeters, physical security, systems management, incident response and reporting, and disaster recovery. Through these standards, NERC is responsible for assuring that the electric distribution system and control centers are protected from cyber-attack.

Among the 100-plus NERC standards, critical infrastructure protection (CIP) standards concerning potential sabotage have been established. CIP standards No. 2 through No. 9 concern control systems for critical assets. Challenges include consistent metrics within and across energy companies for measuring risk and vulnerabilities to cyber-attack; the need for information sharing on lessons learned; and poorly designed connections between control systems and enterprise networks. Updated standards will feature a risk-based methodology to assess cyber impacts on components of the electric power system such as generation, transmission, distribution, and equipment. Responders will receive training to assess the impact of loss, compromise of information, and misuse of systems.

6.1.10 Other Response Actions that State Authorities May Take

The VDEM is the State agency designated to work with electric utilities in managing energy emergencies. Virginia utilities provide liaison with the VDEM and meet required filing and regulatory mandates. Direct involvement on behalf of DMME in electricity outage emergency management is unlikely. However, the VDEM's designated role in planning for and coordinating among stakeholders during energy emergencies does not rule out this agency's ability to provide perspective as requested on electricity shortage matters. This Section provides background information should such a request be made to the VDEM acting under its leadership for ESF-12.

Public Information – Communication Protocols

In the event that DMME becomes involved in assisting the State with public information related to an electrical outage that continues for an extended time, the State may wish to consider the potential energy emergency mitigation measures listed in Table 6-12.

Table 6-13
Public Information Steps for State Government – Electricity

Phase	Suggested Response
Monitoring	▪ Review and reinforce communications within the State, and ascertain that everyone understands their role, what can and cannot be said, and by whom. ▪ Be aware of cross-cutting shortage impacts such as gasoline fuel pump or natural gas pipeline pump failure due to an electricity outage. ▪ Work with State agencies to keep Governor's staff and legislative offices informed. ▪ Review/prepare energy market presentations and other materials to explain consumption patterns and anomalies with special attention to graphic displays. ▪ Provide public relations officers with regular updates approved by the SCC. ▪ Coordinate with the State agencies on media contacts in order to help reporters (especially newly assigned) understand basic energy facts and issues. ▪ Review weather forecasts.
Interruptions or Loss Affecting a Limited Number of Communities	▪ Maintain information actions per above. ▪ Coordinate with State agencies to draft energy conservation recommendations if shortage/disruption is predicted to increase. ▪ For heating issues, work in coordination with State agencies and electric utilities to provide media advisories on setting back thermostats, using cooking fuel wisely, checking heating equipment and conserving hot water. ▪ Consider public meetings and use of the Internet as appropriate. ▪ Share State energy data with distribution associations, other States, NASEO and DOE as needed. ▪ Estimate the probability and timing of greater shortage/disruption. ▪ Prepare briefings on possible supply and demand restraint measures should shortage/disruption intensify.
Statewide Disruption	▪ Maintain information actions per above. ▪ Assist with media briefings (sometimes in conjunction with energy stakeholder representatives). ▪ Develop follow-up messages from Governor to assure public and to maintain compliance. ▪ Coordinate with the Governor's office or others) to announce enforcement actions if any.

Potential Energy Emergency Response Mitigation Measures

Table 6-14 contains potential emergency contingency measures that the Commonwealth may apply if utility response actions are overwhelmed or otherwise cannot sufficiently protect the public.

Table 6-14
Potential State Mitigation/Response Measures – Electricity

Measure	Voluntary / Mandatory	Timing
Public Information for Energy Conservation	Voluntary	Consider for Early Conditions
What It Does	Promotes voluntary reduction in energy use to aid recovery and restoration efforts, share limited energy supplies equitably and assure sufficient energy for priority customers. Gives the public specific guidance for type of energy shortage and may stimulate the use of alternatives or efficiency measures.	
Target Consumers	All users, general public	
Recommended Steps for State Responders	▪ Use staff knowledge; obtain information from sister States, DOE, NASEO and others to develop conservation guidance. ▪ Coordinate with State natural gas utilities, and work with their media and public relations professionals. ▪ Develop brochures, handouts, video, audio, Internet and other dissemination materials. ▪ Work with media and others to obtain low cost or free airtime or print space. ▪ Hold public meetings for town energy task forces and citizens. ▪ Provide feedback to legislature and local jurisdictions. ▪ Enforcement: Not Applicable.	
Metrics	▪ EDC report lower demand. ▪ Query EDC after incident to see if supply availability improved after public information was provided.	
Measure	**Voluntary / Mandatory**	**Timing**
Telecommuting	Voluntary	Consider for Tightening to Serious Conditions
What It Does	Reduces natural gas consumed in places of employment.	
Target Consumers	Commercial & Government	
Recommended Steps for State Responders	▪ Secure assistance from VEDP (Virginia Economic Development Partnerships), business associations, employee unions and groups. ▪ Encourage all business sectors to participate. ▪ Provide technical assistance. ▪ Seek advice and operating procedure help from national and regional telecommuting organizations. ▪ Publicize and explain. ▪ Design this measure for self-administration. ▪ Consider publicized recognition or awards for participating employers. ▪ Coordinate with affected local jurisdictions. ▪ Provide "success stories" to media. ▪ Enforcement: Not Applicable.	
Metrics	▪ Seek assistance of selected commerce associations (e.g. Chambers of Commerce) to gauge effectiveness. ▪ Query EDC after incident to see if supply availability improved after public information was provided.	
Measure	**Voluntary / Mandatory**	**Timing**
Hot Water Set Back	Voluntary or Mandatory	Consider for Tightening Conditions

Measure	Voluntary / Mandatory	Timing
What It Does	Reduces temperature of hot water at commercial, governmental and industrial facilities. Also recommended as a voluntary measure for residential and institutional users.	
Target Consumers	Commercial, institutional and industrial consumers	
Recommended Steps for State Responders	▪ Recommend a percentage (e.g., 5% or 10%) reduction in temperature and consult with cross-section of user representatives. ▪ Design this measure for building operator self-certification. ▪ Use local inspectors for random verification. ▪ Notify the public. ▪ Use standard testing procedures. ▪ Arrange media coverage. ▪ Enlist support and technical assistance from plumbing professionals. ▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures. ▪ Coordinate with local authorities as appropriate. ▪ Enforcement: Self-enforcement and local code officials. See note above re: Attorney General.	
Metrics	▪ Work with businesses, institutions, and associations to provide regular reporting on reductions implemented. ▪ Use DOE or other standard measurements for reducing hot water costs per size of unit, volume of use or other pre-determined measurement.	
Measure	**Voluntary / Mandatory**	**Timing**
Building Temperature Adjustment	Voluntary or Mandatory	Consider for Serious Conditions
What It Does	Reduces/restricts space conditioning in commercial, institutional and public facilities.	
Target Consumers	Building owners and operators	
Recommended Steps for State Responders	▪ Recommend a +/- 5-percent seasonal temperature adjustment in consultation with commercial, institutional and industry representatives. ▪ Use building operator self-certification (building operator keeps log for review by management) for this measure. ▪ Use local inspectors and town energy task forces for random verification. ▪ Work with VEDP for support. ▪ Notify the public. ▪ Establish self-certification and self-enforcement feedback. ▪ Use standard testing procedures. ▪ Arrange media recognition for participating companies. ▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures. ▪ Coordinate with affected local jurisdictions. ▪ Enforcement: Self-enforcement and local code officials. See note above re: Attorney General.	
Metrics	▪ Work with businesses, institutions, and associations to provide regular reporting on reductions implemented. ▪ Work with local jurisdictions and building owner/operator associations to ascertain compliance and numbers participating.	

Measure	Voluntary / Mandatory	Timing
	▪ Use DOE or other standard measurements for reducing hot water costs per size of unit, volume of use or other pre-determined measurement.	

6.2 Natural Gas and Liquefied Natural Gas

While a mix of regulations ranging from federal transportation to State production, supply, and distribution management govern the Commonwealth's natural gas industry, the industry is also subject to unregulated market dynamics. Natural gas production in Virginia comes from underground resources. Both the federal and state governments regulate aspects of distribution to ensure safety and to prevent unfair pricing and restraint of trade. Under Virginia law, customers may purchase natural gas from any natural gas supplier.

Natural gas is essentially methane, an odorless combustible gas, plus some minor additives, especially mercaptan, which gives natural gas a distinctive odor. Natural gas is relatively abundant worldwide and reaches end-use destinations via interstate and international pipelines. Long distance international shipments of natural gas occur as LNG, a super-cooled highly compressed form of natural gas that facilitates shipment in ocean going tankers.

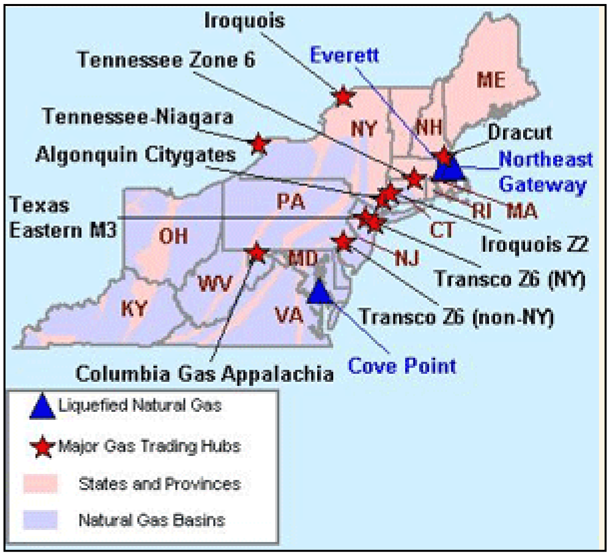
To give energy assurance responders a basic idea of how the natural gas market operates, this Section discusses market components and the principal delivery systems for natural gas. It also notes risks and vulnerabilities affecting the natural gas industry to provide an understanding of how disruptive events may be managed.

6.2.1 Natural Gas Market Description and Issues

National and Regional Infrastructure and Supply for Virginia

FERC places Virginia as the southernmost state in its Northeast natural gas market (See Figure 6-10). Virginia's inclusion in FERC's Northeast region means that issues that affect that region at least in part also affect the Commonwealth. The Northeast, a traditionally region of strong winter peaks in gas consumption, has undergone a change as increased reliance on natural gas-fired generation has tended to even out annual gas use. In addition the growth in the use of gas generating electricity, significant growth in the use of gas in space heating and for gas-fired plants has resulted in greater challenges in the Northeast, compared to other regions, in aligning commercial and operating conditions between the gas and power industries.[12]. However, Virginia's position as the southernmost state in FERC's Northeast region means that Virginia adjoins the Southeast gas market where Virginia's position along the pipelines bringing gas from the Gulf Coast as well as company ties gives the Commonwealth strong ties to the Southeast.

[12] FERC, Natural Gas Markets: Midwest, http://www.ferc.gov/market-oversight/mkt-gas/northeast.asp.



Source: http://www.ferc.gov/market-oversight/mkt-gas/northeast.asp

Figure 6-10. FERC's Northeastern Natural Gas Region

At times, because of the lack of significant gas, storage in Virginia pipeline companies warn customers to match their scheduled gas volumes with actual volumes available, and this can result in higher basis.[13] LNG and pipeline related infrastructure improvements, however, have augmented regional supply diversification and altered traditional basis relationships. Over 6 billion cubic feet per day (Bcf/d) of pipeline capacity was added between 2008 and first quarter 2009 to better link shale gas and Texas and Oklahoma production with premium Southeast markets.[14]

Gas Supply Sources

Virginia has modest indigenous natural gas resources. According to the EIA, natural gas production from 7,303 wells totaled 140.7 Bcf in 2009. This total comprised 44 percent of natural gas consumption in the Commonwealth in that year.

In 2010, coal bed methane comprised about 80 percent of Virginia's natural gas production. As the State is located at the southern end of the Appalachian natural gas region, Virginia can expect to participate in production from the Marcellus Shale, one of the major shale gas fields contributing to expectations that U.S. natural gas production will increase. See Appendix G for a 2009 map of potential shale gas growth in the United States.

The VEP notes that pipeline-gathering systems that include low-pressure pipelines from wells to gas processing facilities collect Virginia's natural gas production. At these processing facilities, the gas receives relatively minimal post-production

[13] Basis refers to "basis differential," or the difference in the value of a commodity based upon different market factors such as time-of-year, physical location and related transport charges or other factors that may influence the cost of the commodity. Basis is generally traded in the market as a form of commodity exchange, or swaps. Swapping the price of a commodity with one basis for the price of another with a different basis allows market participants, such as LDCs buying gas, to benefit from a favorable basis differential.

[14] FERC, Natural Gas Markets, Southeast, http://www.ferc.gov/market-oversight/mkt-gas/southeast.asp.

processing including removing the often associated gas liquids such as butane and propane. Although the gas liquids are valuable commodities, they are nonetheless considered impurities, and removed from the gas stream. With processing complete, the gas then enters the interstate transmission system and is sold to customers in southwest Virginia and elsewhere, including Tennessee and northeastern states. Although Virginia's natural gas production remains relatively small, it has doubled since 2000, increasing by approximately 106 percent from 2000 to 2010.

According to EIA, the Gulf Coast region supplies the bulk of Virginia's natural gas deliveries via Columbia Gas Transmission Corporation, Dominion Transmission Company, East Tennessee Natural Gas Company, and Transcontinental Gas Pipeline Company. LNG receipts at Cove Point LNG, located in Lusby, Maryland, on the Chesapeake Bay, also contribute to the State's natural gas deliveries.

Figure 6-11 (from the VEP) illustrates the interstate pipelines supplying gas to the Commonwealth.

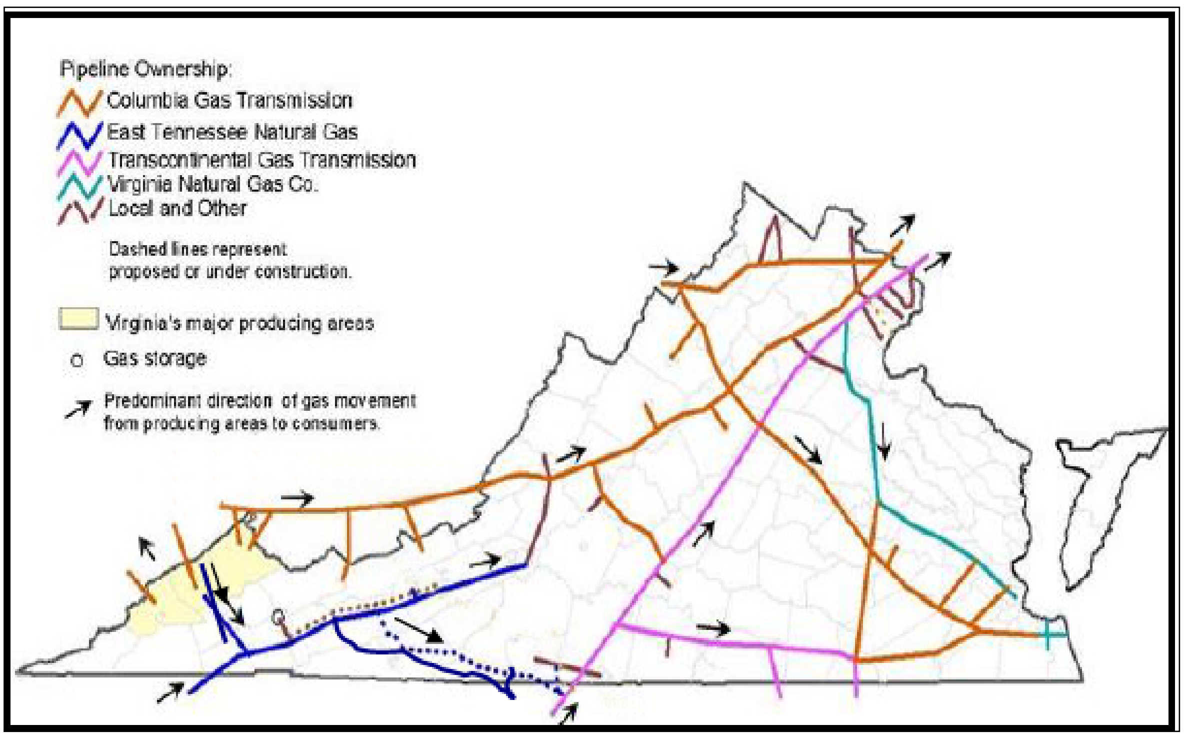


Figure 6-11. Major Natural Gas Pipelines in Virginia

Table 6-15 lists these gas transmission companies. Appendix G contains the contact information for these companies.

Table 6-15
Virginia Natural Gas Pipelines

Pipeline Company	Principal Supply	System Configuration (primary/secondary)	Enters Virginia	Exits or Terminates
Columbia Gas Transmission Co.	Southwest & Appalachia	Grid with spurs southwest to northeast and north central to southeast and adjacent to northern border	West Virginia	District of Columbia & Maryland
Dominion Transmission Corp/Virginia Natural Gas (includes gas from Cove Point)	Southwest & Appalachia	Grid & Trunk	North to southeastern part of the State	Chesapeake
East Tennessee Natural Gas Co.	Interstate system	Trunk & Grid	Tennessee border	Roanoke & spur to Martinsville
Transcontinental Gas Pipeline Co. (TRANSCO)	Southwest	Trunk	Mid-south near Danville	North to District of Columbia and Maryland and spur southeast

Source*:* EIA About U.S. Natural Gas Pipelines – Transporting Natural Gas – Natural Gas Pipelines in the Northeast Region. http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/northeast.html.

Storage and Consumption Patterns

According to the VEP, Spectra, the parent company of the East Tennessee Natural Gas, owns two large underground storage facilities located in Saltville field, Washington County, and Early Grove field, Scott County. EIA does not list the latter facility in Table 6-16. Nearby storage is located in Maryland, Ohio, Pennsylvania, and West Virginia. Virginia natural gas companies also operate compressed and LNG tanks for local needs.

Table 6-16
Major Natural Gas Storage as of November 2010

Company	Field	County	Total Capacity in Bcf[15] (data rounded up)	Working Gas Capacity in Bcf (data rounded up)
Virginia				
Saltville Gas Storage Company	Saltville	Smyth, Washington	9.5	5.4
Saltville Gas Storage Company	Early Grove	Scott	Not listed	Not listed
Neighboring States				
Extensive natural gas storage is contained in Maryland, Ohio, Pennsylvania and West Virginia; hence, this storage is listed by company total capacity (with some exceptions) instead of individual facilities. (As of March 2010)				

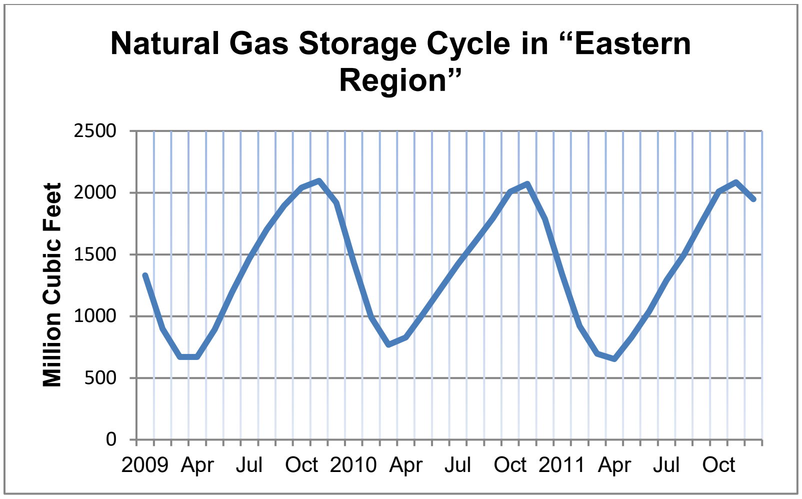
[15] Total capacity refers to the physical measurement of how much gas a storage facility could hold. Working capacity is what is typically stored, which the owner/operator typically determines. In reality, acquiring and storing natural gas that seasonal storage history reveals to be unnecessary is generally too expensive.

Company	Field	County	Total Capacity in Bcf[15] (data rounded up)	Working Gas Capacity in Bcf (data rounded up)
Maryland				
Texas Eastern Transmission	Accident	Garrett	64	17.3
Ohio				
Columbia Gas Transmission	Various	Various	389.2	157.1
NGO	Various	Various	5.87	2.6
Pennsylvania				
Columbia Gas Transmission	Various	Various	64.7	50.2
Dominion Transmission, Inc.	Various	Various	452	357
Equitrans, LP	Various	Various	29	16.1
National Fuel Gas Supply Corp	Various	Various	99.9	48.7
Tennessee Gas Pipeline Co.	Hebron	Potter	29	17.3
Steckman	Steckman Ridge	Bedford	Not listed	Not listed
West Virginia				
Columbia Gas Transmission	Various	Various	229.1	90.2
Dominion Transmission, Inc.	Various	Various	181.7	96
Equitrans, LP	Various	Various	19	12.7

Source*:* EIA: Jurisdictional Storage Fields in the United States by Location, March 2010.

Figure 6-12 shows natural gas storage for the storage region that includes Virginia[16]. The figure also shows that the natural gas supply for the region is seasonally driven. Eventually this curve could change if enough gas-fired electric power plants were built to sustain a steady, year-round demand profile. Natural gas-fired power plants provide great flexibility in electric generation, and they pollute less than coal- or oil-fired plants. Because of cost, natural gas for power generation primarily satisfies peak electricity demand. An increase in the consumption of shale gas could alter this trend, making the fuel more attractive for wider use.

[16] The U.S. is divided into three gas storage areas: the Producing Area (essentially the Gulf Coast) the Consuming West and Consuming East. The Eastern region is comprised of states from Florida to Maine as well as the upper Midwest and Nebraska, Iowa and Missouri.



Source: http://www.eia.gov/dnav/ng/ng_stor_wkly_s1_w.htm

Figure 6-12. Natural Gas Storage Cycle "Eastern Region"

Shale Gas

The supply of natural gas in Virginia became more robust during the past decade with the development of Appalachian shale gas. In particular, natural gas from the Marcellus Shale formation may provide supplies for many decades. Virginia planners noted the potential for long-range expansion of gas production from this source in the VEP.

Shale gas does raise some concerns that could affect its market penetration. The extraction process used to liberate shale gas – hydraulic fracturing – requires the pressurized injection of liquids and chemicals into a shale formation. Questions remain regarding the potential for post-drilling surface subsidence and the possible contamination of aquifers. Areas with significant populations are more likely to raise these concerns. Rural and remote areas in Appalachia may avoid the community and political controversies that often arise with the introduction of new energy facilities.

Factors Relating to the Reliability of the Virginia Natural Gas Market

High-pressure pipelines deliver natural gas to the City Gate, where a reduction in pressure occurs as the gas enters the LDC or municipal gas company system. Following this delivery, gas is sold in several consumption sectors.

Consumption Sectors

Residential consumption is the largest portion of total consumption. Until recently, the consumption of gas for the production of electric power surpassed residential consumption in 2007 and then again in 2009 and 2010. Commercial consumption has remained more or less steady, while industrial consumption declined during this period. Natural gas use as a vehicle fuel is too small to be shown on the graph declined from a peak of 368 million cubic feet (MMcf) in 2004 to 157 MMcf in 2010.

The industrial sector includes gas for feedstock and manufacturing, while residential and commercial sectors use gas primarily for space heating. These numbers give energy assurance responders perspective on the relative vulnerability to shortage among end-use sectors. A severe loss of natural gas would have the greatest impact on the residential sector in terms of number of customers and consumption volume.

Design Day

Natural gas companies generally gauge supply needs sufficient to meet demand for a specified peak, or design day, lessening the risks associated with natural gas consumption.[17] This practice includes supply to customers who arrange for their own supply with transport through the distribution system, as well as reserves for demand contingencies and anomalies in the volume of demand (e.g., weather events that extend beyond a moving average or "normal" pattern). Virginia LDCs use different design days based on specific criteria for the area they serve. In addition, seasonal, "swing" gas contracts are in place to supplement gas supply for winter use. The use of, and settings for, a design day are at the discretion of the gas utilities in Virginia. Notably, Virginia does not require LDCs to file an integrated resource plan.

Inter-fuel Awareness

The use of natural gas to fuel electricity generation creates inter-fuel awareness in Virginia. LDCs generally purchase natural gas from third parties and deliver to electricity generators. Transportation is sold as a "firm commitment" (an industry term for a supply contract). The gas supply is contracted between the generating plant and the third party supplier. According to EIA, natural gas used for generating electricity increased from 48,784 MMcf in 2004 to 94,829 MMcf in 2009, with 2007 being the previous record high year at 90,573 MMcf[18]. The use of natural gas to generate electricity should not negatively impact the space conditioning market if shale gas production volumes increase.

An additional inter-fuel element of interest to Virginia emergency responders is the role of electric power for natural gas pipeline compressors. A loss of electricity for any length of time may jeopardize the flow of natural gas. Loss of pressure on any one of the major lines in Virginia would only reduce delivery capability by a few percentage points, minimizing pumping loss. As Figure 6-11, illustrates, the State enjoys a robust multi-directional pipeline system with the potential for diversity in routes in the event of pipeline failure. The risk of interruption to more than one line is minimal, but if such an event occurred, the extensive grid lines supplementing major trunk lines would tend to minimize the impact in most cases.

Interruptible Service

Delivery of gas sold to firm customers, typically residential and commercial users, is an extremely high priority for LDCs. Industrial customers who possess, or have access to, an alternate fuel source can obtain more favorable rates than residential and commercial customers can by subscribing to an interruptible gas delivery tariff. As a

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[17] Design day is the difference between the average ambient temperature and a base point of 65 degrees Fahrenheit.

[18] http://www.eia.gov/dnav/ng/ng_cons_sum_dcu_sva_a.htm

result, they may experience an interruption in service when necessary.[19] This "interruptible service" may occur when demand exceeds (or the company expects demand to exceed) capacity – primarily because of weather. Though there is no precise temperature or standard at which a service interruption may occur, LDCs are most likely to invoke interruptible service in sub-zero (Fahrenheit) weather. An interruption applies to all interruptible customer uses, including process, manufacturing, or space conditioning.

6.2.2 Regulation

State Regulation

Virginia customers may purchase natural gas from any natural gas vendor; hence, the State does not regulate natural gas prices. Virginia regulators work to balance fuel reliability issues with consumer prices. While the SCC requires LDCs to maintain reliable service in exchange for their CPCN and regularly provides dockets on regulated fuel issues, the Commonwealth focuses on LDC responsibility for sound decisions concerning system reliability. The State focuses on a variety of incentive programs to which LDCs may subscribe to encourage and enhance reliability. The VEP lists these programs and governing rules.

Virginia's Natural Gas Utility Regulatory Structure

Retail Supply Choice

The Commonwealth offers two programs for the purchase of natural gas. One is the continuance of "traditional rate regulation," the other is a program called "retail supply choice."

As of 2010, two of the State's LDCs, Washington Gas and Columbia Gas, participated in the retail supply choice program that allows customers to shop for natural gas service from natural gas suppliers. In 2008, 7.9 percent of residential natural gas customers and 22.5 percent of commercial users participated in this program.[20]

Performance-Based Ratemaking

To enhance the natural gas distribution structure of the Commonwealth, the SCC also allows LDCs to participate in a performance-based ratemaking (PBR) Program that provides higher rates of return for LDCs meeting or exceeding performance standards. These standards were designed to improve service and mitigate potential distribution problems. As of 2010, Columbia Gas, Virginia Natural Gas, and Washington Gas have filed and secured approval for PBR plans.

Conservation and Ratemaking Efficiency

[19] The tariff is not available if no back-up system is in place. LDCs survey such customers annually to see that back-up is maintained; but LDCs do not "act as policemen." The company enjoying the tariff bears the risk. In some shortages, service may be retained for a very high rate cost. In other situations, there may be no choice but shut down if back-up was not arranged.

[20] EIA, Retail Unbundling Virginia, http://www.eia.doe.gov/oil_gas/natural_gas/restructure/state/va.html. May 16, 2010.

The Virginia General Assembly enacted the Natural Gas Conservation and Ratemaking Efficiency Act in 2008. This act authorizes LDCs to create Conservation and Ratemaking Efficiency (CARE) programs that decouple earnings from gas sales volume. Participation requires SCC approval of any program that invests in conservation and efficiency for customers. Virginia Natural Gas, Columbia Gas, and Washington Gas have proposed CARE plans.[21] Plans for Virginia Natural and Columbia Gas were operational in mid-2010.

The proper implementation of conservation measures can also mitigate the impact of shortage and energy emergency. The Commonwealth uses various tests to determine whether proposed conservation programs are cost-effective. According to the SCC, tests through the end of 2009 were inconclusive concerning cost-effectiveness. Whether or not such programs also reduce the impact of a shortage is even more difficult to measure. The State was able to meet winter demand during 2009-2010, and these programs may or may not have contributed to lower customer risk.

Steps to Advance Energy Plan

Virginia enacted the Steps to Advance Virginia's Energy (SAVE) Program in 2010 to provide timely cost recovery for large-scale replacement of aging local distribution and pipeline infrastructure. The act provides LDCs opportunities to mitigate potential supply and distribution problems by offering stepped-up cost recovery for vital infrastructure improvements and upgrades. However, the act does not reward construction of infrastructure designed to increase a company's acquisition of new customers or simply increase income. As of 2010, there was insufficient data to measure the success of this legislation.

Federal Regulation

Federal Agencies

Federal law changed interstate natural gas pipelines from company-controlled assets to price regulated common carriers in 1992. Two federal agencies, the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), Office of Pipeline Safety (OPS) and FERC, have a central role in U.S. and Virginia pipeline safety regulations. These regulations pertain to critical infrastructure components of the natural gas system, as well as many other issues affecting price, location, construction, and related matters.

U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), Office of Pipeline Safety (OPS)

Public Law 90-481, the Natural Gas Pipeline Safety Act of 1968, forms the basis for Federal pipeline safety rules. According to the Federal OPS official web site:

> The U.S. Department of Transportation's (DOT) PHMSA acting through OPS, administers the Department's national regulatory program to assure the safe transportation of natural gas, petroleum, and other hazardous materials by

[21] State Corporation Commission, Report: Implementation of The Natural Gas Conservation and Ratemaking Efficiency Act, December 1, 2009. pp. ii – iv.

pipeline. OPS develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Since 1986, a user fee assessed on a per mile basis on each pipeline operator OPS regulates has funded the entire pipeline safety program.

As noted in the Stakeholders Section, the SCC Division of Utility and Railroad Safety inspects and oversees pipeline safety within the Commonwealth, acting on behalf of PHMSA as well as Virginia.

Federal Energy Regulatory Commission

FERC Order 636 radically changed the national natural gas market in April 1992. Interstate natural gas pipelines became common carriers transporting natural gas; they no longer bought and sold the gas. In the process of enforcing this Order, FERC governs several areas of the national natural gas market and, thus, directly affects distribution and sales in Virginia. Examples of FERC oversight include[22]:

- Determining rate-setting methods for interstate gas pipelines
- Developing rules for pipeline company business practices
- Approving or disapproving the siting, construction, and operations of interstate gas pipelines
- Coordinating gas pipeline projects with applicable federal agencies
- Effecting environmental, endangered species, and historic preservation reviews
- Cooperating with OPS
- Examining pipeline mergers and acquisitions in coordination with other federal agencies and state authorities

Even when FERC grants certification of an interstate pipeline, storage, or LNG facility over which the Commission has jurisdiction, the applicant must still obtain certain approvals from the affected state(s) pursuant to the Clean Water Act, Coastal Zone Management Act, and Clean Air Act. If a state finds a proposed project is inconsistent with its Federally approved coastal management program and rejects the project, the applicant may appeal the state's decision to the U.S. Secretary of Commerce. Through this process, the state maintains a role in the building of new natural gas infrastructure.

When FERC approves a pipeline project pursuant to the Natural Gas Act, the Act grants the right of eminent domain to the applicant. Therefore, if the applicant is unable to obtain necessary property and rights-of-way through agreement with affected property owners, the Natural Gas Act provides a mechanism for reaching a solution.

The Restructuring Rule

[22] FERC has no jurisdiction over pipeline safety or security; however, FERC works to ensure that the pipelines certified by the Commission comply with standards of the Department of Transportation and other agencies responsible for safety and security issues.

FERC Order 636 did more than make the pipelines common carriers, it also mandated the unbundling of sales services from transportation services, providing natural gas customers with a choice of providers, and opening gas markets to competition. FERC intended the unbundling requirement to ensure that the gas of other suppliers would receive the same quality of transportation services as the pipeline company's own gas, thereby increasing competition among gas sellers and diminishing the market power of pipeline companies.

6.2.3 Risk and Vulnerability – Mitigation and Recovery

For the purpose of this analysis, the risk associated with supplying natural gas to the State can be divided into supply and distribution. Pipelines bring natural gas into the State, where LDCs distribute the gas to consumers and manage all of the consumer-related financial activity. Sales at the consumer level ultimately dictate the volume acquired from natural gas producers, many of which also drill for and produce crude oil.

In this subsection, describing what natural gas providers do to mitigate or recover from gas supply problems assesses risk and vulnerability. This subsection also discusses how Virginia LDCs address local needs and capacity on the supply side while being prepared to maintain infrastructure, repair damage, and restore gas on the distribution side.

Mitigation

The Commonwealth has taken steps to reward LDCs for programs and measures that reduce risk from loss of natural gas supply. In particular, the PBR, CARE, and SAVE Programs have the potential to reduce consumption and improve infrastructure, thus reducing risk.

Pipeline Inspection

The SCC has been designated the appropriate State agency for the Commonwealth to prescribe and enforce compliance with safety standards for jurisdictional gas and hazardous liquid companies. The Commission adopted Parts 191, 192, 193, 195, and 199 of Title 49 of the Code of Federal Regulations to serve as minimum pipeline safety standards in Virginia.

The Commission has safety jurisdiction for more than 16,100 miles of intrastate pipelines that transport natural gas and hazardous liquid through the Commonwealth. In addition, the Commission has safety jurisdiction over approximately 200 natural gas master meter systems, two liquid natural gas, and two natural gas storage facilities. The Division of Utility and Railroad Safety's trained engineers inspect facilities and construction, review records, and investigate incidents to ensure the safe operation of the jurisdictional pipeline facilities.[23]

[23] SCC, Division of Utility and Pipeline Safety, Pipeline Safety, http://www.scc.virginia.gov/urs/pipe/index.aspx.

The provisions of the Federal and State pipeline codes ensure that jurisdictional natural gas utilities and operators construct, operate, and maintain their facilities to ensure safe and reliable service and consequently avoid outages and interruptions of service.

Restoration of Distribution

Each jurisdictional natural gas utility has established procedures to restore service in the event of an outage, regardless of its cause. Specific provisions address restoration of service in the event of an outage. The jurisdictional natural gas utilities have executed those procedures on numerous occasions.

SCC staff has established contacts with natural gas utilities to obtain outage information in the event of any service interruption. The SCC has priority of service rules and communicates with affected gas utilities during incidents to coordinate and abet mutual assistance among responding LDCs. ESF-12 of the State emergency plan identifies interaction with State and emergency officials, including VDEM, to share information. SCC also interacts with individual customers to provide information and resolve questions during emergencies or outages.

Table 6-17 summarizes Commonwealth LDC and SCC oversight activities to mitigate and restore natural gas supply when threatened or lost.

Table 6-17
System Risk and Representative Response – Natural Gas

Issues	Stakeholder Responses
Inadequate Transportation Capacity	LDCs ▪ Monitor and maintain communications. ▪ Coordinate with SCC and other LDCs. ▪ Review capacity expansion plans. SCC ▪ May develop dockets for review of capacity plans. ▪ Work closely with LDCs to monitor potential and imminent capacity issues. ▪ Review LDC expansion plans
Weather-Related Shortage (including natural disasters)	Utilities ▪ Assess, monitor situation. ▪ Increase draw from storage, as needed. ▪ Purchase gas from other regions. ▪ Coordinate with SCC and other LDCs. ▪ Communicate with pipelines as needed. ▪ Increase line pack[24] and pump more gas. ▪ Curtail interruptible tariff customers. ▪ Invoke Curtailment Plan steps if condition persists. ▪ Post information on web site and inform media. SCC ▪ Monitor, communicate, advise.

[24] Line pack is the ability to add more natural gas into a line by increasing the pressure of gas in the line. Usually line pack is a form of storage prior to a period of anticipated high demand, such as winter.

Issues	Stakeholder Responses
Sudden Supply Loss (load curtailment, facility failure) Local pipeline break Transport system pipeline break Potential outage types Local contractor ruptures feeder lines Automatic shut-down due to intrusion to electronic controls Ground movement occurs (earthquake, large equipment or structure failure near gas line) Pipeline pumps fail for lack of electricity Process plant/ storage facility, explosion/fire Other natural cause or human-induced interruption	Utilities ▪ Assess, monitor situation. ▪ Send local crews to repair. ▪ Control ignition source, if applicable. ▪ Control leak, as applicable. ▪ Isolate and shut off supply. ▪ Report to SCC. ▪ Inform locality/citizens. ▪ Coordinate with individual jurisdictions. ▪ Seek assistance/coordinate with local fire departments. ▪ Post information. ▪ Send liaison to VEOC if needed. ▪ Seek mutual aid if required. ▪ Invoke re-lighting procedures if shut-off was required. ▪ Curtail as necessary during time of repair. ▪ Transmission pipeline system break. ▪ Assess, monitor. ▪ Invoke same steps as during severe weather outage. ▪ Offer mutual aid crews as local outage or transport system event requires. ▪ Work closely with all authorities for large-scale burner tip re-lights.

Critical Infrastructure Protection	Utilities
	▪ Maintain such protection as:
	  ▪ Perimeter protection on major sites
	  ▪ Guard forces
	  ▪ Access control
	  ▪ Back-up command centers
	▪ Maintain and monitor supervisory control and data acquisition (SCADA) systems.
	▪ Professional security assistance.
	▪ Electronic monitoring.
	▪ Regular inspection and maintenance.
	▪ Meet NIPP definitions/requirements.
	▪ Training.

Cybersecurity	Utilities ▪ Support as part of monitoring and control networks (e.g., SCADA). ▪ Employ alarm systems for abnormalities in system flow. ▪ Use manual mode if system hacked or shut down. ▪ Employs fail safe devices to prevent gas flow if intrusion occurs. ▪ Follow disaster recovery plan to re-start. ▪ Maintain alternate control facilities.

6.2.4 Typical Gas Utility Emergency Plans and Priorities

The jurisdictional LDCs file emergency response plans with the SCC. These plans are a part of the State's overall energy preparedness portfolio that also encompasses this EAP. Duplicating the detailed LDC response plans is unnecessary here; however, these plans are summarized below to provide insight into the process:

Federal and State regulations require that each natural gas operator develop written procedures "to minimize the hazard resulting from a gas pipeline emergency."[25] The following provisions outline a typical LDC restoration response.

Typical Issues Addressed in LDC Plans

- Identification of events requiring immediate attention
- Communication with all necessary stakeholders
- Prompt and effective response mechanisms for:
  - Gas leaks affecting pipeline infrastructure
  - Fire
  - Explosion, per above
  - Natural disaster
- Maintenance of resources such as people, equipment, tools, and materials
- Training to deploy response actions
- Training for emergency shutdown and pressure reduction use by pipeline section
- Definition and assurance of contingent area safety
- Notification of public authorities and emergency responders
- Initiation and completion of the restoration process
- Distribution of action plan to responders
- Post event review and evaluation

Other Typical Considerations Found in LDC Emergency Plans

LDC emergency plans typically have certain parameters by which they define different levels of emergency. For example, an emergency deemed as moderate *might* involve:

- Explosions or fires in which gas facilities are involved, and that result in damage less than $50,000
- Service interruptions involving more than 50 customers
- Release of gas from a distribution system that results in:
  - Ignited gas
  - Coverage by media
  - Outage of health care facilities or other sensitive premises
- Events, such as odorant spills or noisy gas leaks that may be expected to result in a sudden, heavy influx of calls to the dispatch or customer services center

[25] Title 49: Transportation Part 192—Transportation Of Natural And Other Gas By Pipeline: Minimum Federal Safety Standards , Subpart L—Operations ,§ 192.615 Emergency plans (a)

- Any leak or non-leak damage, including coating damage, to a distribution line with a pressure greater than, for example, 200 pounds-force per square inch gauge (PSIG)

A situation might be classified as minor by the LDC emergency plan if it involves, for example:

- Explosions or fires in buildings that are served by or near gas facilities, but where gas is not suspected as being involved
- Evacuation of more than a single family residence
- Carbon monoxide calls resulting in occupants being taken for emergency health care
- Irate customer complaints
- Other:
  - Service interruptions involving less than, for example, 50 customers
  - Evacuation of a single family residence
  - Class 1 gas leaks
  - Other hazards to the public or private property that require immediate response
  - Environmental spills

Such a plan would also detail procedures and responsibilities for personnel, from management to field, for staffing repair situations, securing a safe result, and informing stakeholders.

Natural Gas Curtailment Priority

For the purposes of State responders, one of the most important parts of an LDC's emergency plan is the priority for curtailing customer usage during a shortage.

Table 6-18 summarizes typical priorities, illustrating how potential variations between two companies may occur, but lead to similar results.

Table 6-18
Typical Natural Gas Curtailment Priority List

Priority Number	Group 1	Group 2
1	Interruptible customers	Interruptible customers
2	Large company customers	Media request for customers to reduce usage
3	Public appeal to reduce consumption	Large company customers (especially where previous use on interruptible tariff indicated alternate fuel source back-up)
4	Isolation and supply shut-off of affected sections at the city gate	Shut off affected communities at the city gate

Source: Company emergency plans and discussion with LDC representatives, 2011.

6.2.5 Cybersecurity

Cybersecurity for natural gas pipelines and LNG storage falls under the oversight of DOT PHMSA OPS. In general, LDCs are aware of cybersecurity, but believe that the electric/mechanical safeguards they employ in their systems accomplish the necessary protection.

Supervisory Control and Data Acquisition (SCADA) systems for natural gas provide monitoring data and some limited ability to change settings of control valves. However, mechanical means with electronic communications involved only in data acquisition and changes to the set points of the mechanical controls essentially control the gas system. The mechanical controls have limits on adjustability, which prevent electronic signals from causing problems. If the natural gas SCADA system failed or suffered an attack, utilities would lose electronic monitoring and revert to mechanical recordings for system monitoring.

Concern over cybersecurity throughout the United States has grown with the increasing threat of terrorist activity. The Commonwealth and natural gas utilities will undoubtedly be involved in assessing and developing protocols for improving cybersecurity as national efforts to reduce risk and vulnerability in this area continue.

6.2.6 Response Actions that May Be Taken by State Authorities

The SCC is the primary State agency designated to work with the State's regulated natural gas utilities in energy emergency management. Virginia utilities provide liaison with the SCC to meet required filing and regulatory mandates, and work with VDEM and local jurisdictions, as emergencies require. DMME may become involved in a natural gas supply emergency because of its responsibility to coordinate stakeholders during an energy shortage. DMME's coordination and broad interest in many energy areas also can help the agency provide perspective on natural gas issues.

Communications Process

Energy shortages and emergencies require public explanations. In the event that the State is called upon to respond to an energy outage or an emergency, the first suggested response measure after monitoring is public information. Small events may not be reported in the media. However, any event can come to the media's attention regardless of how many customers are affected or the time it takes to restore the system. For example, a small event in Richmond may be reported while a similar event elsewhere might be ignored. People will turn to the media for answers and the media may query both company and State officials.

The public will expect energy companies and government to provide accurate information. Most citizens can cope with short-term outages and will be patient. Over the years, most energy companies and government agencies have learned the value of being forthright when discussing energy interruptions. Lack of candor can turn public opinion against energy providers and government, thus diminishing cooperation during restoration.

Media Preparation

The keys to successful media relations are planning, preparation, and training. Maintaining updated information on normal energy consumption patterns is the first step toward accurate reporting. When a natural gas shortage occurs, DMME may first contact affected energy-provider trade associations in order to learn the cause and assess the situation. If an energy shortage develops slowly, State officials will have time to prepare and check facts. Such preparation permits government responders to interpret what is learned from energy companies and trade associations, which enhance government's perspective and ability to assist as, needed.

Regular staff training that includes practice in media relations is valuable. This involves gathering data under pressure, analyzing rapidly, and conveying complex information effectively.

Coordinating Information

DMME will work with VDEM and others to brief senior State officials in response to questions from the media. DMME would not directly contact the media. Energy providers and associations will also respond to the media. The Governor may choose to meet the media as well. VDEM is prepared to coordinate in order to avoid contradictory and confusing statements.

Preparing and coordinating public relations materials and protocols for a natural gas shortage are the same for other energy forms as well. DMME should anticipate that not all stakeholders would be equally prepared or sufficiently knowledgeable to speak about or provide advice on energy matters. It is always prudent to coordinate and cooperate in order to provide a timely and consistent message for the Governor, to the public, and neighboring states.

Emergency Alert System

The Emergency Alert System (EAS) enables state and local government officials, with the voluntary cooperation of area broadcasters, to advise the public directly in the event of life threatening emergencies.

If a natural gas emergency occurs, DMME could become involved, either through the coordination efforts of the SCC or VDEM, or by the Governor's directive because of the declaration of a fuel and energy state of emergency. In the event that DMME should become involved in assisting the Governor with public information related to natural gas shortage or interruption, suggested guidelines are contained in Table 6-19.

Table 6-19
Public Information Steps for State Government – Natural Gas

Phase	Suggested Response
Early Warning	▪ Review and reinforce communications within the State and ascertain that everyone understands his role, what can and cannot be said, and by whom. ▪ Work with State agencies to keep the Governor's office apprised. ▪ Keep Governor's staff and legislative offices informed. ▪ Review/prepare graphic energy market presentations and other materials to explain consumption patterns and anomalies. ▪ Work with State agencies to provide helpful conservation and mitigation advice to the public. ▪ Continue to acquire supply and demand data. ▪ Coordinate with State agencies on media contacts in order to help reporters (especially newly assigned) understand basic energy facts and issues. ▪ Review weather forecasts often.
Pre-Emergency Declaration	▪ Maintain information actions per above. ▪ Coordinate with State agencies to draft energy conservation recommendations if shortage is predicted to increase. ▪ Work with natural gas utilities on heating issues to provide media advisories on setting back thermostats, using cooking fuel wisely, checking heating equipment and conserving hot water. ▪ Consider public meetings and use of the Internet as appropriate. ▪ Share State energy data with other States, National Association of State Energy Officials (NASEO) and DOE, as needed. ▪ Assist the Governor in making follow-up announcements to assure the public and to encourage continued cooperation and compliance. ▪ Estimate the probability and timing of greater shortage. ▪ Prepare briefings on possible supply and demand restraint measures should shortage intensify.
Emergency Declared	▪ Maintain information actions per above. ▪ Assist State agencies with media briefings (sometimes in conjunction with energy stakeholder representatives). ▪ Develop follow-up messages from the Governor to assure the public and to maintain compliance. ▪ Work with the SCC and VDEM (in coordination/conjunction with the Governor's office or others) to announce enforcement actions, if any.

Potential State-Initiated Emergency Mitigation Measures

If a natural gas shortage were to continue for an extended time, the State may wish to invoke energy emergency mitigation measures.

Table 6-20 does not suggest a measure for reducing possible natural gas use in vehicles since this consumption is relatively minor compared to space heating and industrial uses.

Table 6-20
Potential Public Information Steps for State Government

Phase	Suggested Response
Early Warning	▪ Work with State agencies to inform the Governor's office. ▪ Keep Governor's staff and legislative offices informed. ▪ Review/prepare graphic energy market presentations and other materials to explain consumption patterns and anomalies. ▪ Work with State agencies to provide helpful conservation and mitigation advice to the public. ▪ Continue to acquire supply and demand data. ▪ Coordinate with State agencies on media contacts in order to help reporters (especially newly assigned) understand basic energy facts and issues. ▪ Review weather forecasts often.
Pre-Emergency Declaration	▪ Maintain information actions per above. ▪ Coordinate with State agencies and LDCs to draft energy conservation recommendations if shortage is predicted to increase. ▪ Work with natural gas utilities on heating issues to provide media advisories on setting back thermostats, using cooking fuel wisely, checking heating equipment and conserving hot water. ▪ Consider public meetings and use of the Internet as appropriate. ▪ Share State energy data with other States, NASEO and DOE, as needed. ▪ The Governor may make follow-up announcements to assure the public and to encourage continued cooperation and compliance. ▪ Estimate the probability and timing of greater shortage. ▪ Prepare briefings on possible supply and demand restraint measures should shortage intensify.
Emergency Declared	▪ Maintain information actions per above. ▪ Assist State agencies with media briefings (sometimes in conjunction with energy stakeholder representatives). ▪ Develop follow-up messages from Governor to assure public and to maintain compliance. ▪ State agencies (in coordination/conjunction with the Governor's office or others) announce enforcement actions, if any.

Table 6-21 suggests other potential government-initiated measures.

Table 6-21
Potential State Mitigation/Response Measures – Natural Gas

Measure	Voluntary / Mandatory	Timing
Public Information for Energy Conservation	Voluntary	Consider for Early Conditions
What It Does	Promotes voluntary reduction in energy use to aid recovery and restoration efforts, share limited energy supplies equitably and assure sufficient energy for priority customers. Gives the public specific guidance for type of energy shortage and may stimulate the use of alternatives or efficiency measures.	
Target Consumers	All users, general public	
Recommended Steps for State Responders	▪ Use staff knowledge from State agencies; obtain information from sister States, DOE, NASEO and others to develop conservation guidance. ▪ Coordinate with State natural gas utilities, and with State agencies working with their media and public relations professionals.	

Measure	Voluntary / Mandatory	Timing
	▪ Develop brochures, handouts, video, audio, Internet and other dissemination materials. ▪ Work with media and others to obtain low cost or free airtime or print space. ▪ Hold public meetings for town energy task forces and concerned citizens. ▪ Provide feedback to legislature and local jurisdictions ▪ Enforcement: Not Applicable.	
Metrics	▪ LDC report lower demand ▪ State agencies query LDC after incident to see if supply availability improved after public information was provided.	
Measure	**Voluntary / Mandatory**	**Timing**
Compressed Work Week	Voluntary	Consider for Tightening to Serious Conditions
What It Does	▪ This is a form of flexible time management. It could reduce hours of operation for buildings and thus the volume of natural gas required. ▪ Many Federal agencies already support a 10-hour, 4-day/week schedule for employees.	
Target Consumers	Commercial, institutional, industrial consumers	
Recommended Steps for State Responders	▪ Requires State and local government leadership. ▪ Participation of major employers is highly desirable. ▪ Certain businesses and agencies cannot participate due to the nature of their work. ▪ State agencies work with State personnel management and private employers to enlist support. ▪ Work with unions and other employee organizations to obtain support. ▪ Ask affected local jurisdictions to help solicit participants. ▪ Coordinate with State agencies. ▪ Determine which businesses/agencies are capable of participating. ▪ If mandatory, develop list of exemptions. ▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures. ▪ Assist participants in coordinating with out-of-State entities if necessary. ▪ Ascertain equity issues (including overtime pay) if measure is mandatory. ▪ Coordinate with affected local jurisdictions. ▪ Enforcement: Not Applicable	
Metrics	▪ Seek assistance of selected commerce associations (e.g. Chambers of Commerce) to gauge effectiveness. ▪ State agencies query LDC after incident to see if supply availability improved after public information was provided.	
Measure	**Voluntary / Mandatory**	**Timing**
Telecommuting	Voluntary	Consider for Tightening to Serious Conditions
What It Does	Reduces natural gas consumed in places of employment.	
Target Consumers	Commercial & Government	
Recommended Steps for State Responders	▪ Obtain assistance from State agencies, business associations, employee unions and groups. ▪ Encourage all business sectors to participate. ▪ Provide technical assistance. ▪ Seek advice and operating procedure help from national and regional telecommuting organizations.	

Measure	Voluntary / Mandatory	Timing
	▪ Publicize and explain. ▪ Design this measure for self-administration. ▪ Consider publicized recognition or awards for participating employers. ▪ Coordinate with affected local jurisdictions. ▪ Provide “success stories” to media. ▪ Enforcement: Not Applicable	
Metrics	▪ Seek assistance of selected commerce associations (e.g. Chambers of Commerce) to gauge effectiveness. ▪ State agencies query LDC after incident to see if supply availability improved after public information was provided.	
Measure	**Voluntary / Mandatory**	**Timing**
Reducing Government Agency Hours of Operation	Voluntary or Mandatory	Consider for Tightening Conditions
What It Does	Creates a short workweek for State and local government in order to provide limited natural gas for high priority use by critical care and residential consumers.	
Target Consumers	Government (State and local)	
Recommended Steps for State Responders	▪ Chief elected official, cognizant agencies and other authorities or leaders as needed. ▪ Approval and coordination required. ▪ Develop criteria to identify agencies/buildings to reduce hours or close. ▪ Develop criteria for return to normal operations. ▪ Coordinate with employee unions, if applicable. ▪ Attend to employee issues such as criteria for any wage/salary changes, and impact on benefits, such as sick leave/vacation time. ▪ Provide timely notice to employees. ▪ Enforcement: Applicable Public Authority	
Metrics	▪ Measure average computer, lighting and elevator use during non-emergency periods to create “typical” worker cost per defined period of time. ▪ State agencies to conduct survey of State government to determine number of employees participating. Estimate savings based on pre-determined “typical” cost basis, per above.* ▪ *Consider same pre-determined measurement for commerce and work with commercial sector associations to achieve. Publicize participants and compliment in public.	
Measure	**Voluntary / Mandatory**	**Timing**
Hot Water Set Back	Voluntary or Mandatory	Consider for Tightening Conditions
What It Does	Reduces temperature of hot water at commercial, governmental and industrial facilities. Also recommended as a voluntary measure for residential and institutional users.	
Target Consumers	Commercial, institutional and industrial consumers	
Recommended Steps for State Responders	▪ Recommend a percentage (e.g., 5% or 10%) reduction in temperature and consult with cross-section of user representatives. ▪ Design this measure for building operator self-certification. ▪ Use local inspectors for random verification. ▪ Notify the public. ▪ Use standard testing procedures. ▪ Arrange media coverage. ▪ Enlist support and technical assistance from plumbing professionals.	

Measure	Voluntary / Mandatory	Timing
	▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures. ▪ Coordinate with local authorities as appropriate. ▪ Enforcement: Self-enforcement and local code officials; See note above re: Attorney General.	
Metrics	▪ Work with business and institutional entities and associations to provide regular reporting on reductions implemented. ▪ Use DOE or other standard measurements for reducing hot water costs per size of unit, volume of use or other pre-determined measurement.	

Measure	Voluntary / Mandatory	Timing
Building Temperature Adjustment	Voluntary or Mandatory	Consider for Serious Conditions
What It Does	Reduces/restricts space conditioning in commercial, institutional and public facilities.	
Target Consumers	Building owners and operators	
Recommended Steps for State Responders	▪ Recommend a +/- 5 percent seasonal temperature adjustment in consultation with commercial, institutional and industry representatives. ▪ Use building operator self-certification (building operator keeps log for review by management) for this measure. ▪ Use local inspectors and town energy task forces for random verification. ▪ Work with State agencies for support. In addition, notify the public. ▪ Establish self-certification and self-enforcement feedback. ▪ Use standard testing procedures. ▪ Arrange media recognition for participating companies. ▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures. ▪ Coordinate with affected local jurisdictions. ▪ Enforcement: Self-enforcement and local code officials; see note above re: Attorney General.	
Metrics	▪ Work with business and institutional entities and associations to provide regular reporting on reductions implemented. ▪ Work with local jurisdictions and building owner/operator associations to ascertain compliance and numbers participating. ▪ Use DOE or other standard measurements for reducing hot water costs per size of unit, volume of use or other pre-determined measurement.	

6.3 Petroleum

The third energy sector addressed in this Section is petroleum, with a specific focus on three fuel types since they are the most widely used in Virginia: motor gasoline, distillate, and propane (one form of LPG). Distillates including diesel, kerosene, jet fuel, heating oil, and residual fuel oil is also used in Virginia. Most of the Commonwealth's petroleum consumption is for ground transportation in the form of motor gasoline. However, kerosene and heating oil account for 20 percent, and aviation fuels account for another eight percent.

This discussion also includes propane, even though it differs from motor gasoline and distillate. Propane enters the market as either a product of petroleum refining or a liquid by-product of natural gas. The propane distribution system is similar to that for other liquid petroleum products, and it is generally regarded as part of the petroleum sector.

Unlike electricity and natural gas, the liquid fuels market does not consist of regulated utilities. Instead, the market consists of entities ranging from large-scale integrated major companies that may do business in global markets, to regional independents and wholesalers, to independent businesses operating on a local basis with perhaps only a single location.

To explain how petroleum and propane market components affect EA, the discussion identifies the principal petroleum liquid market delivery systems. In order to address the management of disruptive energy events, this text also describes industry issues and supply disruption, mitigation, and response, as well as energy shortage identification. Finally, this discussion identifies certain agency response activities and suggested crisis response measures.

6.3.1 International and National Petroleum Market Description and Issues

International and National Market Factors

The NASEO/NARUC State Energy Assurance Guidelines discuss the petroleum market and EA.[26] While the details of this discussion should be examined carefully, this EAP summarizes many of the issues discussed in the Guidelines.

International Commodity

Petroleum is a global commodity. While there are domestic laws pertaining to the integrity and safety of petroleum shipping and pipelines, as well as certain trade practices prohibited in the United States, crude oil and its refined petroleum products are bought and sold in an unregulated international marketplace. The economic principles of supply and demand generally govern petroleum markets. However, essential elements of this marketplace can be obscure. In other words, both sides of the supply and demand equation can be, and often are, adjusted to affect market pricing.

Some of the factors that affect pricing, and thus create uncertainty, are the ability of producers to increase or decrease extraction, of refiners to expand or contract refinery output and product production ratios, and of end-users to reduce consumption. For example, speculation in oil futures from participants who do not take actual (wet) barrels affects price. This speculation in turn may send market signals that result in an inaccurate representation of physical market. Components of this market may be more or less vulnerable, depending on the apparent need for petroleum products at any given moment and the ability of the market to clear. In other words, supply is expected to satisfy demand at a price that facilitates (even if reluctantly proffered) this exchange. If supply does not satisfy demand at the given price, there may be risk of shortage.

[26] State Energy Assurance Guidelines, v. 3.1, NASEO/NARUC, September 2009, www.naseo.org.

Essential Market Systems

There are several essential systems affecting petroleum: exploration/production of crude oil, pipeline and shipping transportation, refining, reserves, and the State petroleum market. Each system has its own supply and demand structure. These system structures further complicate the availability and price of petroleum products sold for consumption.

Exploration/Production

At the international and national levels, a complex system of factors affect oil exploration and production: demand for crude oil (and natural gas because production wells often produce both); the cost of exploration, including location and discovery of the resource; infrastructure; supplies; insurance; time; personnel; national and local laws and regulations; and, to be frank, luck.

Transportation

Many factors affect the transportation of crude oil. Some of these include shipping rates, vessel availability and location, alternative transport such as secure pipelines, insurance, personnel, weather, and international and national shipping and transportation rules and practices. In the U.S., and for product from neighboring countries, crude oil can move from production to refinery via international and interstate pipelines, thus reducing risk and cost to the U.S. domestic market. However, with over 60 percent of U.S. oil imports coming from outside North America, ocean shipping is also an important component of the supply equation.

Perhaps the two most important points concerning shipping are that 1) the U.S. petroleum market would collapse without shipping, and 2) shipping is an essential pathway linking the United States to world prices with all of the implications for domestic price and supply risk. Although Virginia receives the bulk of its petroleum products via pipeline from the Gulf Coast region, those products may have begun their journey in any of several states where much of the oil is produced, offshore in the Gulf of Mexico or be imported from South America, the Middle East or Africa or even Europe. Consequently, the Commonwealth's consumers pay market prices that world shipping makes possible.

National Refining

History

In the 1970s, the Organization of Petroleum Exporting Countries (OPEC) embargo of oil to the United States signaled the growing ability of economically emerging nations to affect the price and other market fundamentals of oil supply as foreign countries nationalized assets and began to dictate crude oil prices. Major oil companies also witnessed a growing spot (prompt) market that supplied a burgeoning off brand retail sector. To increase economic efficiency and profits, major suppliers drastically reduced wholesale and retail oil product storage, creating the "just-in-time" oil market in the United States. The reduction of storage also reinforced profits for refineries, where petroleum products are manufactured.

Even the so-called Seven Sisters, the seven largest international oil companies, could not compete effectively in a growing multi-national climate with diminishing U.S. domestic crude oil production. Furthermore, transparent electronic based pricing eventually replaced monopolistic pricing mechanisms like the Texas Railway Commission. Exploration, production, supply, refining, and retail marketing became more fluid. A number of the major oil companies merged; others shed components to concentrate on one or a few aspects of their formerly vertically integrated companies. Independent local oil product distribution companies were closely tied to one major supplier into the 1970s. By the beginning of the twenty first century, many of those same independent distributors had become major regional suppliers of distillate, motor gasoline, and even propane, to a variety of branded and unbranded retail outlets.

Refinery Closures

Domestic and foreign consumption dropped during the U.S. economic recession that began in 2008. Until then, analysts had noted the risk to EA resulting from the difficulty of expanding the refining industry. During this recession, refining profitability contracted, several refineries shut down temporarily or simply closed, and few refiners pursued major expansion programs. A sustained reduction of the size of this industry segment could increase price volatility when demand increases, thus accelerating supply risk along with price and economic vulnerability for consumers.

Although refinery capacity abroad has expanded in such developing countries as China, India, and Saudi Arabia, the trend in the United States and Europe is a reduction in refinery capacity. This trend may add risk for consumers in Virginia where the only instate refinery, located in Yorktown, closed in September 2010. With the closure of the Yorktown refinery, while some petroleum products will likely come from neighboring states or be processed through the port, this will also put additional pressure on refineries in the Gulf Coast area that serve the State as well as potentially drawing on supplies from nearby refineries in the Mid-Atlantic. The shut-in of older, more distant facilities appears to have had a minimal effect on the Commonwealth. Table 6-22 illustrates this recent trend. On January 1, 2010, the United States had 148 refineries with an operable capacity of just under 17.6 million Bbl/d, or 87,760 fewer barrels than on January 1, 2009.

Table 6-22
Recent Out-of-State Refinery Capacity Changes

Company	Refinery	State	Type of Change	Announced Date of Change	Refinery Capacity Report Status 2010	Capacity Change (Mbbl/d)
Flying J	Big West, Bakersfield	CA	Idled Indefinitely	Jan 2009	Idled	-66
Valero	Delaware City	DE	Permanently Closed	Nov 2009	Shut down 01/01/2010	-182
Sunoco	Eagle Point, Westville	NJ	Idled Indefinitely	Oct 2009	N/A	--
			Permanently Closed	Feb 2010	Shut down 01/01/2010	-145
Western	Bloomfield	NM	Idled Indefinitely	Nov 2009	Idled	-17
Marathon	Garyville	LA	Expansion	Jan 2010	Expansion 01/01/2010	+180

Notes: NA= not applicable. MMb/d = million barrels per day. A barrel of oil yields about 42 gallons of product.
Sources: News releases and information on company websites. *This Week in Petroleum*, Recent Changes to U.S. Refinery Capacity, Released March 31, 2010.

EIA has emphasized one additional factor contributing to the reduction in refinery capacity. EIA estimated that ethanol use from March through June 2010 would increase by about 400,000 Bbl/d over the same period in 2007. The increase in ethanol use combined with lower consumption suggests that 640,000 Bbl/d less gasoline will be necessary from refiners and importers during this same period. EIA estimated that the overall effect of ethanol blending has reduced U.S. refinery utilization rates to about 83 percent at the end of 2009, or about nine percent less than their peak in early 2007.

Refinery Products

The global integration of petroleum markets resulted in a sharp increase of exports of petroleum products from the U.S. Driven primarily by finished motor gasoline and distillate fuel oil, which are increasingly exported to Latin America U.S. exports doubled since 2007. Despite the recent growth, exports of petroleum products represent only a very small portion of total U.S. consumption. Between 2000 and 2009, gasoline exports were typically about one to two percent of gasoline demand while distillates were near 10 percent. Since 2009, gasoline exports have accounted for close to four percent and distillates exports rose to more than 10 percent of product supplied.

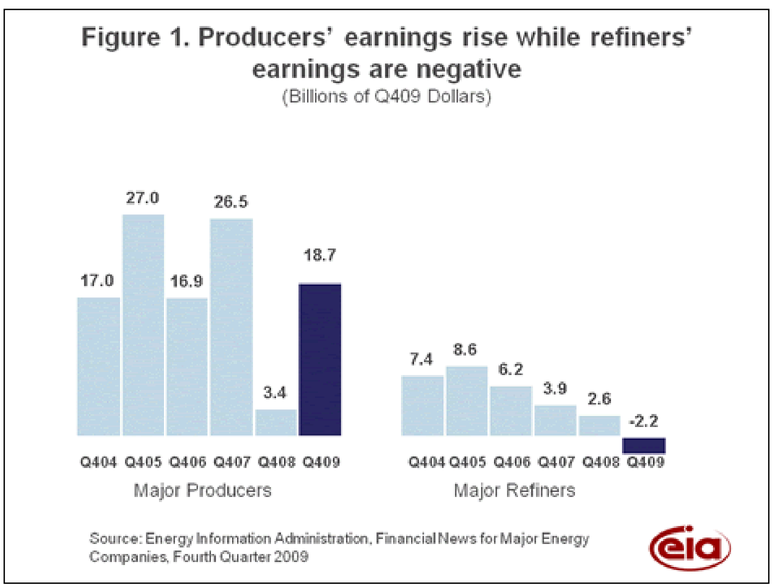
In the past, seasonal refinery production adjustments typically caused a variation in the percentage of motor gasoline versus distillate (e.g., diesel and other distillates) refined from crude oil. Gasoline production increased before the summer driving season and distillate production increased before the winter heating season. However, refining has always been more complicated than simple seasonal variations.

For example, the United States not only imports crude oil, it imports refined petroleum products such as gasoline and gasoline components, distillates and other products including propane. These imports are reflected in product pricing along with the output of domestic oil refineries. It is easy to overlook the pricing mix of imported and domestic finished products because basic supply, demand, and price-to-clear equations eventually resolve into one price point at any given location. Keeping track of price trends in the refining sector may be daunting, but attention to such figures can provide advanced warning of potential supply problems. At the very least, they may alert state energy managers to increase monitoring of state supply and demand metrics.

Other Factors Influencing Refinery Operation

The availability of crude oil at a profitable price can no longer be assumed. Some refinery operators have found that the purchase of crude oil has made comfortable refinery margins difficult to attain. Some reasons for these unfavorable margins are related to the prices set by foreign producers, including OPEC, or prices resulting from commodity speculation. Other reasons include domestic and international economies experiencing rapid growth in demand; cost of infrastructure creation; and availability and cost of raw materials, including chemical components, technology, safety, insurance, trained personnel, heightened security, environmental rules, taxes, and community opposition to expansion.

Figure 6-13 illustrates the disparity between the cost of production (exploration and extraction of oil from wells) and refining products. This profit squeeze is yet another factor in the closure of refineries.



Note: The table refers to Q409, or the fourth quarter of 2009.

Figure 6-13. Producer and Refiner Earnings

National Storage and Reserves

Petroleum supply stakeholders make the claim that price is the best way to manage (or clear) a shortage. When product is short, jobbers will seek supply from outside of their usual area to re-supply. The higher prices they charge cover the costs of bringing in the product. Market fundamentals demonstrate that upward pressure on prices also attracts newer volumes of product that should help satisfy and moderate retail demand, thus reducing the impact of supply shortage. Over time, supply and demand tend to balance. This theory works well enough, but is subject to variance attributable to permanent changes in the market. For example, a significant factor in the U.S. market is the creation of a relatively new reduced storage supply chain. While this new supply chain increases the efficiency of the market from the seller's viewpoint, it also reduces market flexibility from the perspective of the buyer. This just-in-time delivery mechanism has caused permanent change, reflecting a newer (higher-priced) balancing point.

Although just-in-time product delivery strategy tends to reduce product storage speculation on the New York Mercantile Exchange it may increase volatility, as speculators trade petroleum commodities based on real-time risk attributable to refinery status, national oil politics, and political turmoil in some oil-producing counties.

At one time, locally stored petroleum products helped to moderate price volatility. As costs to retain such storage increased (e.g., Environmental Protection Agency (EPA) pollution rules, insurance and capital to replace aging infrastructure), reduced local storage raised the economic risk for consumers in tight supply markets. Aside from rhetoric, the federal government has one tool to manage price volatility during supply shortage, the SPR. A 2011 Presidential decision to release a limited amount of crude oil for purchase by refineries illustrated a moderate reduction of price volatility. However, this release for economic (versus significant shortage) reasons created considerable political debate.[27]

Petroleum Reserve

The SPR is located in Louisiana and Texas near the Gulf Coast. The SPR's total capacity is 727 million barrels (MMbbl) of crude oil; no petroleum products are stored in the U.S. SPR. It was intended that the SPR should contain as much oil as the nation imports in 90 days. The President can order the SPR to solicit bids from U.S. refineries for its crude oil to mitigate a severe shortage. SPR management completed the current fill program at the end of 2009.[28] The reserve held approximately 750 MMbbl in early 2011. As of May 2011, the SPR contained 726.5 MMbbl, which at a rate of consumption of 21 MMbbl per day would last about 34 days. The potential draw of 30 MMbbl from the SPR authorized in June 2011 would result in approximately 33 days of supply.

6.3.2 The Virginia Petroleum Market

Virginia Petroleum Liquids and Propane Gas Supply Systems

The distribution of petroleum products in Virginia begins with major oil company suppliers. Depending on price and availability of supply, major petroleum companies may deliver oil and propane products to Virginia. Major national product trading

[27] *CNN Money*, http://money.cnn.com/2011/06/30/markets/oil_prices/index.htm
[28] U.S. EIA, Strategic Petroleum Reserve, *Quick Facts and Frequently Asked Questions,* August 2010.

firms that buy from many suppliers also sell petroleum in Virginia. The major companies, or independent petroleum marketers, also known as jobbers, also directly supply motor gasoline. Most of the distillate and propane passes though jobbers as well. Virginia consumers purchase distillate and propane mostly through independent retailers.

Primary Petroleum Supply

External Supply

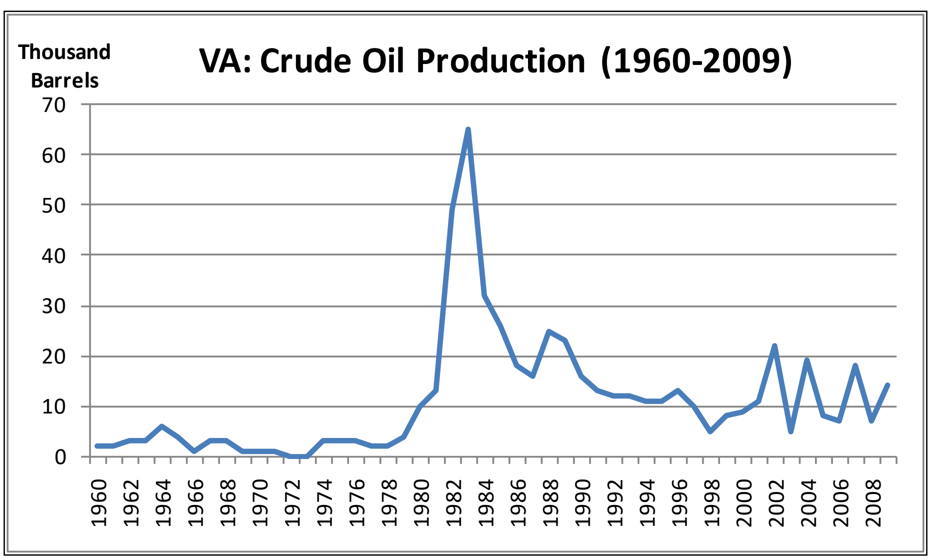
The Commonwealth is clearly dependent on the continuity of the interstate pipeline network for supply. Both the Colonial and Plantation Pipelines serve Virginia; these two are also the major petroleum liquids pipelines serving the East Coast from the Gulf and Texas coasts through Mississippi, Alabama, Georgia, South and North Carolina, and into Virginia (See Figure 5-14 and Figure 5-15 in Stakeholders).

The State also receives some petroleum products via the Port of Norfolk. In the future, offshore oil could provide an estimated 165 MMbbl from the coastal waters of the Commonwealth.[29]

Instate Production

Oil production is present but diminishing in Virginia.

Figure 6-14, derived from Figure 7-6 in the VEP, illustrates this trend. According to this Plan, stripper wells were the source of 15,712 bbl of oil production in 2008. EIA data pointed toward about 12,000 bbl in 2010.



Source: http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm.

Figure 6-14. Petroleum Production in Virginia, 1960-2008

[29] See Figure 7-7, Mid-Atlantic OCS Proposed Lease Area, The Virginia Energy Plan, July 1, 2010.

Terminals Serving Virginia

Petroleum product terminals are a key component of the State supply system. Terminals delineate between supply entering the Commonwealth and distribution of products to consumers inside the State. Appendix E., Petroleum Stakeholders, contains a list of State terminals.

Instate Supply Market

Terminals and Product Distribution Markets

Major terminal companies often serve liquid petroleum product markets throughout the United States. For example, both Kinder Morgan and Magellan are terminal companies acting as national product intermediaries and each operate two terminals in Virginia. Such companies buy petroleum products at all levels, including acquisition of non-contract product from refineries, in essence creating and maintaining the spot market for excess petroleum products. They balance the cost of their market involvement with efficiencies in purchasing so their market presence is transparent to the end-user. They could also be called national jobbers.

The petroleum market in Virginia has changed over the past two decades. Consolidation has taken place at the national, regional, and local level. Although the basic distribution structure remains the same, fewer companies supply the same volume of liquid petroleum products. Regional offices of supply companies have consolidated as well, reducing the number of competitive contacts that State responders could reach in the event of a shortage. However, the impact on supply is transparent.

Liquid Petroleum Fuel Acquisition – Prices/Contracts

The most important factor in jobber product acquisition is price. Jobbers will seek the lowest cost per gallon of fuel their customers require and send trucks to terminals (within a reasonable distance their own calculations determined)[30] to supply their retail outlets. For example, the Kinder Morgan terminal in Richmond may post a different price on any given day than the Kinder Morgan terminal in Roanoke.

Consumer contracts are another important element of fuel acquisition. Contract secured accounts generally receive service; non-contract (so-called unbranded) customers follow. Many of the State's unbranded dealers are affiliated with convenience, or "C" stores supplied by spot market product. Over 90 percent of the C-stores in Virginia sell fuel obtained in the spot market.

Ordering Product

Retail dealers signal their jobbers in two ways. Either they send a regular (daily) posting to their jobber (supplier) indicating how much product they anticipate selling, or the jobber obtains this information automatically via electronic sensors in the retailer's underground tanks. In the latter case, an automatic tank gauge (ATG) sends

[30] Weather affects price spread variations. In general, most jobbers will not drive farther than 100-135 miles out of their area for fuel. As a rule of thumb, they will not make such an out-of-area pick-up unless there is a 10-cent or greater price spread.

a morning reading and the jobber's tanker is dispatched. Under this system, a retailer may never know if there is a shortage as long as sales proceed at a normal pace. However, if a shortage worsens or if the public perceives a shortage, the jobber is likely to inform the retailer because there is a chance that supply could run short before the end of the day. This type of automation is still under development for other end-users.

Storage

Another link in the fuel acquisition chain is storage. Local storage diminished significantly in Virginia as major suppliers moved to just-in-time delivery. The cost of implementing environmental management requirements and the soaring cost of tank insurance have also reduced storage. Currently, there are less than 100 bulk facilities remaining in Virginia.

Motor Gasoline, Distillate and Propane Fuel Curtailment

Commercial, institutional (including governments), and industrial end-users may purchase fuel with long-term supply contracts. However, the sale of most motor fuel (diesel and motor gasoline) occurs through contracts with general retail outlets that in turn sell to end-users. Alterations to contractual arrangements may occur during a significant supply shortage.

If crude oil supply is less than refiners anticipate, prices increase as refiners compete to obtain the lower number of barrels available for sale. This price increase causes the refiners' profit margins to decrease, unless they raise the cost of the petroleum products they sell. This chain of events describes the impact of the OPEC embargo in the 1970s. A similar pattern occurred when Venezuela crude shipments diminished from 2002 to 2003 during a workers' strike in that country.

When petroleum consumption is flat or shrinking because of weak market conditions, refiners avoid "competing with themselves" by reducing production. This reduction prevents supply from exceeding demand and helps maintains refinery margins (i.e., prices). Another way to explain this strategy is that a common response of the petroleum product industry to a decrease in consumption is to reduce production to balance supply and demand. This method may not prevent lower prices, but does soften the impact on profits.

If refinery production decreases enough, product marketers may receive notice (which may not be formal; sometimes jobbers must recognize a decrease in volume on their own) of a reduction in (or curtailment of) the previously calculated volume for contract fulfillment. Because Federal trade practice laws prevent discrimination in choosing or favoring buyers, jobbers reduce the amount of contract specified available to all of their retail dealers. In such cases, the retail dealer is "put on allocation." Retail dealers may experience a curtailment up to "100 percent-of-contract." Curtailment reduces jobbers' flexibility in serving non-contract customers.

Local propane systems can manage a temporary supply reduction because the contracted customer base is filled in cycles; hence, most customers will have enough fuel on hand until normal supply is restored. If supply remains low or diminishes further, customers become increasingly vulnerable to fuel shortage risk.

Experienced dealers know they must be aware of market conditions and check their tank volume gauges frequently. If supply is short, they may adjust their hours of operation. However, they may not reduce purchased volume at the point of sale without authorization from a public authority. For this reason, some of the petroleum emergency mitigation measures in

Table 6-29 may help to soften the impact of severe shortage. The least obtrusive of the suggested mandatory measures provide substitutes for rationing (e.g., tank topping prevention or odd even day purchases). The most stringent measure, the Petroleum Set-aside, transfers the assignment of a percentage of products from private suppliers to the state government (the actual sale remains with the private sector seller but the set-aside customers are assigned to them by the state. No money passes to the state through such transactions).

From 2006 to 2008, lower supplies of refined motor gasoline and other fuels resulted in increasingly high retail prices.[31] This trend indicates that for most petroleum product shortages, the market price will clear, or balance, the market.

Implications of Price and Shortage

The economic burden of price as the mediator of energy shortage is that the consumer must reduce travel or pay more. Businesses with insufficient cash flow, weak market position, or other disadvantages are vulnerable. Institutions without alternative sources are also vulnerable. Homeowners may conserve up to a point beyond which their jobs, health, or other needs demand fuel-or-food decisions.

The problem for EA responders is that these anticipated outcomes vary significantly. According to the Congressional Budget Office (CBO), consumers did not alter driving behavior very much from 2003 to 2006. However, CBO postulated that as prices reached $3.00 per gallon, weekday drivers in California with access to rail would reduce driving by four percent.[32] Higher prices appeared to have no effect on weekend motoring. Anecdotal experience from 2007 to 2008 indicates that around $4.00 per gallon, driver behavior began to change, especially for discretionary driving and highway speed. However, this reaction coincided with an economic recession, to which many market issues, excluding fuel prices, contributed.

As prices dropped in response to the recession of 2008 through 2010, sales volumes remained low, and anecdotal experience indicates that drivers resumed former highway speeds. Increases in the sale of hybrid vehicles may reflect consumer concern for high fuel prices; however, broader economic issues continue to shroud driving habits in relation to fuel prices, so the metrics are murky at best.

6.3.3 Propane Delivery Profile

Approximately 220 million gallons of propane is delivered to Virginia customers each year. These deliveries flow through the Dixie Pipeline to the Apex Terminal located

[31] High crude oil prices and speculation added to the cost.
[32] Congressional Budget Office, Gasoline Prices and Driving Behavior, http://www.cbo.gov/ftdocs/88xx/doc8893/Chapter1.5.1.shtml.

in Apex, North Carolina, and from the Port of Norfolk to a terminal in Chesapeake, Virginia. Propane is then trucked from the North Carolina and Chesapeake terminals to wholesale and retail bulk plants in Virginia. Smaller retail delivery (bobtail) trucks deliver the propane from these plants to end-users.

Processing plants obtain propane, or LPG, by stripping it from natural gas or as a by-product during the refining of crude oil. Most of the LPG sold in Virginia is purchased on contract and delivered to consumer tanks owned by a delivery company. Dealers generally contract with a propane gas transport company to deliver contracted product to their local bulk plant.

Occasionally a combination of high product demand and weather may prevent a dealer from filling a customer's tank in a timely manner. Potential liability issues make dealers reluctant to cross-fill another dealer's customer. Some states require cross-filling during a shortage, thus reducing liability. Dealers may also manage this issue by acquiring supply from another dealer, replenish his customer, and settle purchase arrangements later.

Other Propane Issues

Knowledge about the Market

An understanding of seasonal supply and customer consumption behavior is important for retail LPG dealers because liquid propane is ordered each spring for winter storage and shipment. If an order is inaccurate, customers may be vulnerable to insufficient supply and volatile prices. Local retailers work to maintain sufficient bulk plant storage to meet short-term demand. This risk combined with economic efficiency considerations is why most propane retailers insist on contracted, automated fuel delivery for space conditioning customers. With a known customer base and a record of usage rates, a knowledgeable LPG dealer can determine how much storage remains in customers' tanks versus demand requirements.

Generally, State propane dealers will learn about an impending shortage from the terminal operators. If major suppliers invoke allocations reducing available fuel for sale, word spreads quickly. Servicing customers, plus excess time spent waiting at terminal racks, can cause delivery and tanker driver hours to exceed Federal standards. Virginia propane and petroleum industry officials consider relief from Federal HOS regulations for supply and distribution drivers a vital tool for mitigating shortage while it is still manageable.

In the event that the LPG terminals supplying State propane retailers cannot deliver sufficient fuel, local retail dealers are prepared to drive to distant terminals. This additional transport increases the cost of the fuel; a rule of thumb used by dealers is to try, if possible, to avoid adding more than 30 to 35 cents per gallon in long-range transport and personnel time costs. Such long-haul efforts almost inevitably entail requests for exemption from Federal HOS regulations. A reduction in supply or shut down of either of the two principal sources from which Virginia obtains LPG during the winter season would create major supply issues. The contract nature of LPG sales provides some margin of safety, because at any time about two thirds of the State's propane customers will have sufficient supply in their tanks to sustain them until normal supply can resume. Customers who do not contract for supply are the most vulnerable to shortage.

6.3.4 Petroleum Product Risk and Vulnerability

This subsection focuses on two types of risk that are specific to the petroleum market. The first type of risk is fuel loss at the major supplier level, before consumers feel the shortage. The second risk includes vulnerabilities when loss of fuel threatens or affects end-use sectors within Virginia. These risks tend to overlap. Major international and national events, such as the OPEC oil embargoes, the oil spill in Prince William Sound, Alaska (commonly referred to as the Exxon Valdez oil spill), massive hurricanes, the burning and collapse of the British Petroleum (BP) offshore platform, damage to an interstate pipeline, and major refinery outages represent the worst sort of risks petroleum companies must manage. Lesser risks include the impact of refinery equipment failure or maintenance shutdown or an occasional pipeline pump failure. Other localized risks include closed service stations or the temporary failure of an energy retailer to deliver product during a period of high demand.

Hazardous Materials

Another aspect of the petroleum risk spectrum is the daily management of hazardous materials. Hazard events may not cause a shortage, but do draw significant attention and raise supply related questions. Virginia officials may or may not visit VEOC in response to geographically distant petroleum risk events. However, monitoring increases after reports of an accident or other hazard related emergency affecting the production and distribution of petroleum. If a petroleum hazard occurs inside the State, the need for hands-on activity is greater. State officials will undoubtedly respond robustly to safety and health issues that expose people, animals, and property to hazardous materials.

Risk and Response Addressed by Petroleum Industry Stakeholders

Many issues threaten or interrupt routine petroleum operations and threaten supply. These issues can occur at any point, from the exploration and production stages to distribution. In all cases, when State officials receive notice of an interruption, actively monitoring the situation is important to detect whether the problem increases energy risk for Virginia customers.

Repair and Restoration

The petroleum industry's disclosure of details regarding specific infrastructure damage, assessments, or repair is uncommon. Because of competitive concerns, most petroleum companies are careful about discussing specific damage. There are federal rules pertaining to safety and effective hazard management, but as the 2010 BP oil spill in the Gulf of Mexico demonstrates, both federal and state governments lack the expertise and tools for thorough monitoring, repair, and restoration. Furthermore, media and the public will focus on the dramatic portions of supply interruption. For example, a refinery explosion or fire garners attention; the long, tedious job of repair and restoration – far more salient for returning supply to normal – is usually reported with less intensity.[33]

Risk Associated with Commodities

The sale of vertically integrated petroleum company components shifted much of the marketing of crude oil and finished products from intracompany to intercompany. This transition increased economic risk because single companies no longer control as much of the entire supply purchase chain. In-house commodities staff as well as contractors selling Energy Tracking and Risk Management (ETRM) systems that manage commodity risk make risk management easier for large companies. The commodity futures market adds to price volatility, as traders on the NYMEX invest in petroleum futures contracts. Disparity between the purchases of barrels for actual use versus buying futures complicates and may exacerbate risk. Also, additional financial marketing elements compound supply risk, such as the availability of credit, growing competition for commodities from economically emerging nations and the overall economic health of national and international economic systems.

Sources for Information about Supply Disruptions or Other Distribution Problems

In most cases, State responders obtain details about supply issues and infrastructure problems more easily from local jobbers and distributors than from major petroleum suppliers. For example, if there is an upstream problem with petroleum products and the VPCGA learns about it, VPCGA is more likely than the supply company to inform DMME. State officials first should contact VPCGA, the VAPGA, and the Virginia Petroleum Council (VPC) to obtain further information.

Derivation of Response Activities

Common sense provides the rationale for some of the response activities detailed in the following tables, but observation provides the basis for most of the measures. For example, petroleum product distributors request HOS waivers during cold snaps. Suppliers impose fuel allocations in response to supply/demand imbalance. Companies re-route crude oil and petroleum products around major pipeline breaks where infrastructure permits. In addition, railroad or tanker truck capacity is purchased following pipeline interruption, especially if demand is sufficient to pay for higher transportation costs. Potential response measures taken by petroleum companies are listed in Table 6-23.

[33] The 2010 BP disaster appears to be an exception given the extensive on-going media coverage of that event.

Table 6-23
Sample Supply Issues Affecting the Petroleum Industry

Issue	Petroleum Industry Response
Weather forecast Temperature extremes Wind conditions Rain/flood conditions Ocean storms Snow/Ice	▪ Allocate contract supply; reduce release to spot market. ▪ Add distribution capacity as price increases. ▪ Prepare/protect distribution infrastructure. ▪ Seek alternative routes and delivery means. ▪ Reroute ships, seek alternative supply market ▪ Equip local delivery vehicles. Request HOS waivers.
Geologic events Earthquake	▪ Allocate contract supply; reduce release to spot market. ▪ Assess damage to infrastructure (pipelines and tank farms), send repair crews as required, reroute deliveries as needed.
Electromagnetic events Solar flares	▪ Electronic and computer systems may be vulnerable. It is unlikely that efforts to reduce this threat will be reported or discussed with State officials.
Supply system issues Embargo Production field exhaustion Environmental hazard Equipment failure Refinery fire or other outage Pipeline flow issues Storage tank failure Regulations Tank integrity Bottoms (shipping) Tankers not available Jones Act restrictions Ocean storms	▪ Allocate contract supply; reduce release to spot market. ▪ Seek assistance from Federal authorities. ▪ Explore and produce new locations – an ongoing activity. ▪ Reduce hazard and adjust prices to cover cost or close facilities. ▪ Assess, repair, replace or shutdown as economics indicate. ▪ Assess, repair, replace, reroute, allocate. ▪ Meet safety obligations as required, adjust prices to cover costs. ▪ Maintain, assess, repair, replace or shutdown. ▪ Seek new ships as market permits. ▪ Work with Federal government to modify, eliminate.
Regional Transportation Issues Highway interruption Port and river issues Weather conditions Insufficient trucking available Terminal queuing Railroad Issues (related in particular to ethanol)	▪ Seek assistance of Virginia Department of Transportation (VDOT), operate State and local EOCs, reroute. ▪ Participate with port authorities, constantly assess and inform. ▪ Pre-fill customers, maintain large contract customer base; locate alternate supply sources. ▪ Seek HOS waivers if conditions warrant. ▪ Same as above.
Human Instigated Issues Worker strikes Lack of experienced workforce Terrorism Cyber-attack (IT risk) Workplace mistakes Training Commodities	▪ Work with unions, have back-up contractors to replace, allocate. ▪ Expand and train as economics permit. ▪ Harden infrastructure, supply information to DHS. ▪ Assess, turn to IT and security professionals. ▪ Train personnel, monitor, prepare media response ▪ Results are best barometer, and seen at supply level. Refinery workers are highly trained and drilled regularly. Distributor organizations provide and encourage employee training. ▪ Companies use a variety of in-house and ETRM consultants to evaluate and manage the sale and purchase of crude oil and petroleum products.

6.3.5 Risk and Vulnerability at the Distribution Level – Virginia Petroleum Industry

At the State level, risk shifts from supply to distribution. Distribution occurs between a terminal and the consumer. The development of the issue/response list in Table 6-24 occurred in conversation with representatives of the petroleum industry. Not all participating companies heed every suggestion in this list. However, the list in Table 6-24 provides a useful starting point for State responders inquiring about petroleum supply and distribution issues related to petroleum industry response.

Table 6-24
Summary of Issues and Potential Responses Taken by the Petroleum Industry

Issue	Potential Risk/Response
Spot-market purchase increase as major suppliers/refiners reduce direct retail ownership (i.e., "branded" outlets).	▪ Branded outlets are less vulnerable than spot-market fuel stations due to supply contracts reducing risk during shortage. ▪ Spot-market outlets enjoy price advantage while supply is abundant. ▪ The petroleum industry anticipates that higher prices will "clear" or re-balance the market.
Reduction in storage for all petroleum fuels is related primarily to economics.	▪ Reduced local storage increases customer risk when supply is tight. ▪ Major petroleum suppliers approve of storage reduction in order to manage demand signals and prices efficiently. ▪ State propane dealers see reduced secondary storage as a disadvantage.
Federal law requires electronic and manual (every 30 days) tank integrity monitoring.	▪ Some dealers complain, but all seem to understand safety implications. ▪ Attention to safety reduces insurance risk and potential legal exposure.
Some gasoline retailers and large users increase automatic fill ordering via electronic equipment on tanks.	▪ Many retail dealers continue to enter orders into the system manually.
The petroleum industry employs many contract protocols and cost plans that are reflected in retail pricing rather than reliability risk. An example would be zone pricing (in which an area is priced as a unit to maximize profit).	▪ A dealer's ability to remain in business is a market/private sector decision. ▪ Overall, the loss of a dealer is quickly compensated by a purchase or expansion by another. ▪ Reliability does not appear to diminish.
Product allocation applies to contract or branded outlets but affects spot-market outlets as well.	▪ When supply diminishes, excess product supplying unbranded sellers is reduced. ▪ When supply is tight, spot buyers bid up the price to acquire fuel in a tight market.
Major propane delivery is by truck from out-of-State. If HOS waivers are needed, relief from Federal rules is required.	▪ If HOS waivers are necessary, interstate coordination with neighboring North Carolina propane representatives and the North Carolina State energy office are a given.
HOS waivers are granted by state and federal officials based on verification by product distribution associations	▪ Associations ask many questions and work with retail dealers to find alternatives for HOS waivers requests
Dealer consolidation is occurring in the retail propane industry.	▪ Interstate companies hold increasing market share. ▪ Reliability does not appear to diminish.

Sources: Interviews with petroleum distribution association and industry representatives, 2010.

Risk and Responsibility Addressed by State Stakeholders

Loss of Fuel and Associated Vulnerability

Table 6-25 provides a guide for State and local government EA responders encountering distribution risk. Inevitably, new risks and attendant vulnerabilities will appear. Authorities will want to be alert for additional events not listed in Table 6-25 that also threaten the reliability of fuel shipments into the State.

Table 6-25
State Loss-of-Fuel – Risk and Vulnerability Table – Petroleum

Consumption Sector	Risk Due to Petroleum Product Issues	Economic and Related Vulnerability
Residential	▪ Price volatility adversely affects many users—especially low income. ▪ Price escalates rapidly when supply is short, thus reducing consumption and lowering fuel risk. ▪ Federal, State and local safety regulations mitigate risk. ▪ Industry record of accomplishment for instate distribution is good, easing risk to State. ▪ Oil industry record on major external events is uneven. Risk is situation dependent. ▪ Loss of fuel due to refinery closure increases risk to all liquid fuel-consuming segments. ▪ Port-related issues such as dredging may increase risk.	▪ Loss of propane increases vulnerability of rural and suburban heating customers. ▪ Loss due to price escalation increases vulnerability for low income and those burdened by recession. ▪ Some reduction in vulnerability if high price reduces consumption, thus providing system self-correction. ▪ Economically vulnerable citizens may have to make choice of fuel or foods. ▪ Sales of other goods and services may suffer increasing economic vulnerability. ▪ Insufficient propane for space heating increases vulnerability to disease and illness and consequent loss of productivity. ▪ Loss of propane in winter is more dangerous to residents than loss of motor gasoline during peak driving season.
Commercial	▪ Price volatility affects some users, especially business and institutions weakened by recession. ▪ Price escalates rapidly when supply is short, thus reducing consumption and lowering fuel risk. ▪ Industry record of accomplishment for instate distribution is good, thus easing risk to State. ▪ Oil industry record on major external events is uneven. Risk is situation-dependent. ▪ Loss of fuel due to refinery closure increases risk to all liquid fuel-consuming segments. Resulting high motor fuel costs increase risk for retail merchants. ▪ Port-related issues such as dredging increase risk for all sectors.	▪ Price volatility is absorbed by most commerce. ▪ Financially at-risk enterprises suffer more than others do, especially small establishments. ▪ High prices increase risk for all retail (commercial) areas in which shortage occurs because customer purchasing may decline and sales profitability may suffer. ▪ Theoretically, higher price leads to lower consumption, providing self-correction and lowering risk. ▪ Some commercial entities may not have sufficient cash or capital to endure a low consumption period. ▪ Higher fuel costs for institutions may lower services to clients, especially increasing vulnerability for challenged populations. ▪ Higher fuel costs for government institutions may result in tax increase.
Industrial	▪ Loss of oil is a concern for industrial process. ▪ Loss of petroleum in this sector appears to affect industrial process much more than space conditioning, lighting or fueling vehicles.	▪ Industrial process-related fuel or feedstock losses increase economic vulnerability. ▪ Price volatility in petroleum markets increases vulnerability as industrial, on-hand, process inventory drops. ▪ Industry generally is less vulnerable in non-process fuel use if energy alternatives are on site. ▪ Industry may reduce vulnerability with certain alternative energy systems, especially CHP systems.

Consumption Sector	Risk Due to Petroleum Product Issues	Economic and Related Vulnerability
Transportation	▪ Ability of the oil industry to obtain supply from alternate (e.g., out-of-State) terminals reduces risk. ▪ Ever-increasing demand for motor gasoline increases risk in any loss. ▪ Any major disruption of the Colonial or Plantation pipelines increases risk. ▪ Distillate market usually parallels motor gasoline market. ▪ Shutdown or out-of-State refineries may increase risk. ▪ Delivery of motor gasoline in Virginia appears basically stable over time, thereby lowering risk. ▪ Any issue affecting the Port at Norfolk could create risk for certain delivery areas.	▪ Price volatility increases economic vulnerability. ▪ Increasing price of petroleum may slow demand, thus lowering vulnerability. ▪ Price inelasticity shifts economic vulnerability to goods and services as discretionary dollars move from other sectors to petroleum. ▪ 2008 anecdotal data suggests at $4.00/gal, fuel price may be more elastic than previously thought. ▪ Very high crude oil costs appear to affect overall economic growth. ▪ Serious volumetric loss could produce rationing by major suppliers, thus increasing economic vulnerability.
Agriculture	▪ Diesel is the dominant petroleum fuel in this sector. ▪ Loss of distillate would hinder operation of major farm machinery operating on diesel fuel. ▪ Degree of risk depends on crop growth and harvest cycles. ▪ Loss of propane would affect space heating for livestock increasing risk for farmers and consumers. ▪ Farms can store fuel supply on site; this moderates risk.	▪ Greatest economic risk related to diesel is to crop harvesting when time management is critical. ▪ Vulnerability is seasonally dependent. ▪ Loss of propane would create greater economic vulnerability for livestock (especially poultry) than crops. ▪ Loss of motor gasoline may create spot burdens but can be managed with relatively small amounts of onsite storage

6.3.6 Identifying Problems

As supply risk shifts from the international/national petroleum industry to local jobbers and retail dealers, the State's role in reacting to shortage increases. The Authorities section of this EAP outlines the responsibilities of essential State stakeholders and agency roles.

Identifying Supply Shortage Problems

The Energy Supply and Data Tracking Plan, developed in coordination with this EAP, helps responders understand when to begin data tracking efforts related to a potential or actual shortage.

Table 6-26 expands the examination of disruption by focusing on some of the conditions that responders may observe before and during a fuel shortage. This list is not exhaustive; responders should rely also on their own training and experience. Attention to seasonal conditions, regular monitoring of supply and consumption, contact with industry and government representatives, and open communications are essential to preparedness.

Table 6-26
Petroleum Shortage Conditions and Probable Impacts to Observe

I. Early Conditions (One or more may apply)	Probable Impacts Observed
Severe cold weather in any region affecting Virginia may cause local supply problems.	▪ Gasoline, propane prices may increase. ▪ Natural gas prices may also rise in parallel with petroleum products.
Reports of shortages in other parts of the United States or reports of natural disasters, terror or political difficulties in oil producing countries may affect petroleum and petroleum product prices on the NYMEX.	▪ State jobbers and retailers may experience temporary supply difficulties evidenced by increased waiting time at terminal supply racks.
Local prices may move up rapidly in response to spot market prices or speculation on commodity markets.	▪ If queried (especially during the summer driving season), some gasoline outlets will report greater than normal buying as motorists attempt to secure the current lowest price.[34]

II. Tightening Conditions (In addition to previous phase, one or more may apply)	Probable Impacts Observed
DOE, NYMEX, American Petroleum Institute (API), Oil Price Information Service (OPIS) reports reflect a decrease in the availability of product (e.g., from Middle East, South America, domestic refineries). Petroleum and propane associations hear from members that rack-waiting time has increased.	▪ Some jobbers report supply and delivery problems or related issues (e.g. extended rack wait time). ▪ Deliveries may be temporarily extended beyond routine hours. ▪ Tighter market conditions indicated by upward pressure on prices or price volatility.
Spot prices increase. National and regional oil companies may begin to hold jobbers to contract allocation versus replenish-as-needed.	▪ Some retail dealers are uncertain about product availability and question information received from prime suppliers.
Problems with energy delivery systems are observed, including refinery outages, transportation interruptions (including waterways), or rapid increases in consumer level storage.	▪ State government assistance in suspending commercial driver HOS rules may be sought. ▪ Virginia Port Authority assistance may be required with marine and river issues.
Petroleum dealers report increased pressure on their ability to deliver fuel.	▪ Some customers call dealers to top off home storage tanks. ▪ Dealers complain to associations about increased cost of rack waiting time or other shortage-related delay.

III. Serious to Severe Conditions (In addition to previous phase, one or more may apply)	Probable Impacts Observed
Regional and State fuel dislocation is brought on by large-scale storms; extended, widespread, winter cold; embargo; infrastructure failure or damage; accidents or other human initiated acts.	▪ During peak driving seasons, gasoline stations may curtail operating hours and motorists may queue to purchase available fuel regardless of price. ▪ Lack of courtesy in queues may produce altercations at service stations.
Retail energy prices do not level off but continue to rise. Some vendors may not be able to buy wholesale product regardless of price.	▪ Customers (including government agencies) who contract with vendors for spot-market fuel may not be able to obtain product. ▪ During winter months, will-call heating oil and propane customers may have difficulty locating fuel regardless of price.
Local product storage is extremely low or exhausted.	▪ Petroleum fuel hoarding may be observed.

[34] The term for this condition is "Cantango," meaning forward prices are moving higher. The opposite price movement is called "Backwardation."

III. Serious to Severe Conditions (In addition to previous phase, one or more may apply)	Probable Impacts Observed
Major petroleum suppliers sharply reduce allocations to jobbers. Spot-market fuel "dries up."	▪ Retail dealers are overwhelmed managing customer inquiries. ▪ Retail dealers may curtail hours of operation or close to conserve fuel. ▪ Jobbers may travel long distances to buy from terminals with supply. ▪ Interstate driver HOS rule suspensions become routine.
Shortages are generally regional in scope but possibly broader.	▪ Requests for government assistance and relief increase rapidly. ▪ State governments may speed efforts to coordinate interstate mitigation measures.
Taxi and mass transit fares, and vehicle rental fees may increase to cover the rising fuel costs. Existing assistance programs may be insufficient to help low-income families in distress.	▪ If mass transit is available, ridership increases significantly. ▪ Tourism and discretionary shopping suffers. ▪ Economic dislocation occurs, especially for income challenged consumers.

6.3.7 State Initiated Response Measures

While petroleum industry and federal government officials usually cooperate in responding to an energy emergency, State government may wish to take additional steps. Table 6-27 summarizes initial actions that the various sectors may pursue when a shortage or other problem surfaces. With the identification of a petroleum problem, public relations and communications may provide market price signals as well as allow industry recovery efforts the time needed to reduce or manage demand. Table 6-28 summarizes these public information related suggestions. When supply is tight, the petroleum industry will often call for HOS waivers.

Table 6-27
Response Guidance Table – Petroleum

Response Initiation					
Response Sector	**Energy Sector**	**Local Sector**	**State Sector (DMME)**	**Federal Sectors**	**Observations**
Condition	**Potential Steps to Take**				
I. Early Conditions	Monitor. Inform State agencies. Check status of preparedness plans.	Monitor. Communicate with energy sector.	Monitor. Notify State agencies. Communicate with State petroleum associations.	Monitor on request from State.	
II. Tightening Conditions	All of the above. Prepare repair crews as needed. Activate repair & restoration actions as needed. Assess delivery issues. Expand supply acquisition if possible.	All of the above. Provide local repair & recovery assistance as requested.	All of the above. Consider public information about conservation and EE management. Discuss potential mandatory measures with State agencies according to time of year and general conditions. Evaluate HOS needs as requested.	All of the above. Provide technical assistance as requested from DOE – Office of Electricity Delivery & Energy Reliability (OE).	Begin to develop contingency options including use of EOC. Energy industry asks out-of-area energy entities for assistance.

Response Initiation					
Response Sector	**Energy Sector**	**Local Sector**	**State Sector (DMME)**	**Federal Sectors**	**Observations**
Condition	**Potential Steps to Take**				
			Initiate Public Information Actions.		
III. Serious to Severe Conditions	All of above. Repair and restore. Accelerated supply acquisition effort. Seek government assistance with HOS waivers. Seek government assistance with supply and equipment enhancement.	All of the above. Assist State at EOC, and regional level and provide responders as needed.	All of the above. Evaluate/Approve HOS Waivers. Activate EOC as needed. Work with other States to enhance supply as possible. Initiate response measures from voluntary to mandatory depending upon success of successive measures	All of the above.	Local government response capacity exceeded. Energy industry can no longer effect relief by itself.
IV.	All sectors review actions and plans in order to evaluate lessons-learned and improve response capabilities				

Communications Protocols - Public Relations and Coordination

An introduction to Communications Protocols is found under Energy Sectors – Natural Gas. The same information applies to Petroleum as well. Table 6-28 addresses issues and organizations specific to petroleum.

Table 6-28
Public Information Steps for State Government – Petroleum

Phase	Suggested Actions
Early	▪ Review and reinforce communications within the State and ascertain that everyone understands his role, what can and cannot be said, and by whom. ▪ Work with appropriate State agencies and inform the Governor's office. ▪ Keep Governor's staff and legislative offices informed. ▪ Review/prepare graphic energy market presentations and other materials to explain consumption patterns and anomalies. ▪ Provide State agencies public relations officer with regular approved updates. ▪ Continue to acquire supply and demand data. ▪ Coordinate with the State agencies on media contacts in order to help reporters (especially newly assigned) understand basic energy facts and issues. ▪ Review news and weather forecasts often. ▪ Counsel local governments to arrange credit with oil companies (especially major suppliers) well in advance of an anticipated shortfall, because companies may not approve such credit expeditiously.

Phase	Suggested Actions
Tightening	▪ Maintain information actions per above. ▪ Coordinate with State agencies, and distribution industry associations to draft energy conservation recommendations if shortage is predicted to increase. ▪ For propane issues, work with VPCGA or VAPGA to provide media advisories on setting back thermostats, using cooking fuel wisely, checking heating equipment and conserving hot water. ▪ For vehicle issues, provide driving tips in coordination with appropriate State agencies and Virginia petroleum industry organizations including: VPCGA, VAPGA and VPC. ▪ Consider public meetings and use of the Internet as appropriate. ▪ Share State energy data with distribution industry associations, other States, NASEO and DOE as needed. ▪ The Governor may make announcements to assure the public and to encourage continued cooperation and compliance. ▪ Estimate the probability and timing of a greater shortage. ▪ Prepare briefings on possible supply and demand restraint measures should shortage intensify.
Serious	▪ Maintain information actions per above. ▪ Assist State agencies with media briefings (sometimes in conjunction with energy stakeholder representatives). ▪ Develop follow-up messages for the Governor to assure public and to maintain compliance. ▪ State agencies (in coordination/conjunction with the governor's office or others) announces enforcement actions if any.

Hours of Service Waivers

Propane distribution companies often request HOS waivers from federal driver safety rules[35] before an actual shortage, when supplies are tight. This reduction in supply occurs when propane dealers encounter extraordinary demand during the coldest periods of winter. The basic premise of HOS waivers is to permit professionally trained drivers to remain at the wheel longer than highway safety regulations allow. Because tanker trucks transport much of Virginia's propane from the Apex LPG terminal in North Carolina, interstate coordination with North Carolina propane dealers and the North Carolina energy office are essential.

Suggested Energy Emergency Mitigation Measures

Table 6-29 provides some of the mitigation measures contained in earlier Virginia plans, which are similar to those suggested by the NASEO/NARUC Energy Assurance Guidelines. The measures suggest a progression from voluntary actions to mandatory rationing. The table suggests appropriate timing for each measure along with implementation steps and other agencies or groups that may be involved. Measures such as the Virginia Petroleum Set-Aside require a formal Declaration of Emergency. The table includes these measures so that responders can consider a range of options as events unfold. For most events, only the least stringent voluntary measures will be necessary. Mandatory measures involve process and political decision that may be unrelated to EA. Selecting appropriate measures is a matter of judgment.

[35] Virginia abides by the Federal HOS regulations: Federal Motor Carrier Safety Administration (FMCSA) Regulations (49 CFR 395) and FMCSA (49 CFR 390.23).

Table 6-29
Potential State Mitigation/Response Measures – Petroleum

Measure	Energy Source	Voluntary / Mandatory	Timing
Public Information for Energy Conservation	Applies to All Petroleum Fuels	Voluntary	Consider for Pre-Emergency Declaration
What It Does	Promotes voluntary reduction in energy use to aid recovery and restoration efforts, share limited energy supplies equitably and assure sufficient energy for priority customers. Gives the public specific guidance for type of energy shortage and may stimulate the use of alternatives.		
Target Consumers	Can apply to all fuel consumer groups according to the nature of the shortage: heating oil and propane; transportation.		
Recommended Steps for State Responders	▪ Utilize extensive store of State agencies staff knowledge; obtain information from sister States, DOE, NASEO and others to develop conservation guidance. ▪ Coordinate with State fuel distribution associations working with their media and public relations professionals. ▪ Develop brochures, handouts, video, audio, Internet and other dissemination materials. ▪ Work with media and others to obtain low- cost or free airtime or print space. ▪ Hold public meetings for concerned citizens. ▪ Provide feedback to legislature and local jurisdictions. ▪ Enforcement: Not Applicable.		
Metrics	Heating Oil and Propane ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance of VPCGA and VAPGA to survey jobbers and retail dealers to determine if customer emergency calls and complaints have dropped. Motor Gasoline/Diesel Fuel ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance from VPCGA to survey service stations for observation of “closer to normal” fuel purchase activity.		

Measure	Energy Source	Voluntary / Mandatory	Timing
Compressed Work Week	Motor Gasoline and Diesel Fuel	Voluntary	Consider for Tightening to Serious Conditions
What It Does	This is a form of flexible time management. It could reduce vehicle miles traveled (VMT) for workforce, but runs risk of increasing leisure driving instead. (Many Federal agencies already support a 10-hour, 4-day/week schedule for employees.)		
Target Consumers	Commuters using motor vehicles		
Recommended Steps for State Responders	▪ Requires State and local government leadership. ▪ Participation of major employers is highly desirable. ▪ Certain businesses and agencies cannot participate due to the nature of their work. ▪ Work with State personnel management and private employers to enlist support. ▪ Work with unions and other employee organizations to obtain support. ▪ Ask affected local jurisdictions to help solicit participants. Coordinate with Virginia Economic Development Partnership (VEDP), and State agencies. ▪ Determine which businesses/agencies are capable of participating. ▪ If mandatory, develop list of exemptions. ▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures. ▪ Assist participants in coordinating with out-of-State entities, if necessary. ▪ Ascertain equity issues (including overtime pay) if measure is mandatory. ▪ Coordinate with affected local jurisdictions. ▪ Enforcement: Not Applicable.		
Metrics	Motor Gasoline/Diesel Fuel ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance from VPCGA to survey service stations for observation of “closer to normal” fuel purchase activity.		

Measure	Energy Source	Voluntary / Mandatory	Timing
Variable Work Hours	Motor Gasoline and Diesel Fuel	Voluntary	Consider for Tightening to Serious Conditions
What It Does	Reduces traffic congestion, fuel lost in idling and stop-and-go driving. May also encourage greater use of mass transit and carpooling among known associates.		
Target Consumers	Commuters using motor vehicles		
Recommended Steps for State Responders	▪ Solicit business sectors to participate. ▪ Publicize and explain. ▪ Coordinate with and obtain assistance from relevant State agencies ▪ Seek active help of business associations, employee unions and groups. ▪ Provide technical assistance to participants. ▪ Encourage self-administration by participants. ▪ Coordinate feedback with affected local jurisdictions. ▪ Provide “success stories” to media. ▪ Enforcement: Not Applicable.		
Metrics	Motor Gasoline/Diesel Fuel ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance from VPCGA to survey service stations for observation of “closer to normal” fuel purchase activity.		

Measure	Energy Source	Voluntary / Mandatory	Timing
Reducing Government Agency Hours of Operation	Heating Oil and Propane (Can also apply to other space conditioning energy sources such as natural gas and electricity)	Voluntary or Mandatory	Consider for Tightening conditions
What It Does	Creates a short workweek for State and local government in order to divert tight fuel supplies to critical and residential consumers.		
Target Consumers	Government (institutional type) users		
Recommended Steps for State Responders	▪ Chief elected official, cognizant agencies and other bodies as needed; approval and coordination required. ▪ Develop criteria to identify agencies/buildings to reduce hours or close. ▪ Develop criteria for return to normal operations. ▪ Coordinate with employee unions, if applicable. ▪ Attend to employee issues, such as criteria for any wage/salary changes, impact on benefits, such as sick leave and vacation time. ▪ Provide timely notice to employees. ▪ Enforcement: Not Applicable.		
Metrics	Heating Oil and Propane ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance of VPCGA and/or VAPGA to survey jobbers and retail dealers to determine if customer emergency calls and complaints have dropped.		

Measure	Energy Source	Voluntary / Mandatory	Timing
School System Fuel Conservation	Motor Gasoline and Diesel Fuel	Voluntary or Mandatory	Consider for Serious Conditions
What It Does	Reduce VMT and motor gasoline consumption in the education sector. This is similar to other ride sharing measures.		
Target Consumers	Students using motor gasoline and diesel fuel vehicles		
Recommended Steps for State Responders	▪ Requires approval and cooperation of local government and school boards. ▪ State agencies coordinate to lay groundwork. ▪ Consult with local government and school boards through appropriate associations and local school systems. ▪ Assist school districts with planning as needed. ▪ School officials to address scheduling, services, meals, extra-curricular activities and post-school day use of facilities. ▪ School officials to coordinate with parent-teacher & related associations, if any and as appropriate. ▪ School officials to determine rules for high school students who drive motor vehicles to school, such as minimum number per auto. ▪ Provide technical support on vehicle use, alternative fuels and related issues. ▪ State agencies coordinate and monitor school-related programs. ▪ Enforcement: School District officials and local public safety agencies coordinate enforcement at local level.		
Metrics	Motor Gasoline/Diesel Fuel ▪ Transport trucks spend less time at terminal racks.		

Measure	Energy Source	Voluntary / Mandatory	Timing
Employer-Based Travel Assistance	Motor Gasoline and Diesel Fuel	Voluntary or Mandatory	Consider for Serious Conditions
What It Does	Reduces consumption of motor gasoline by increasing average vehicle occupancy. Also reduces VMT and queuing. This measure could be used in conjunction with high occupancy vehicle (HOV) lanes. May be coordinated with telecommuting measure		
Target Consumers	Commuters using motor vehicles		

Recommended Steps for State Responders	▪ Requires cooperation of participating companies.
	▪ Company-based plan is essential whether a voluntary or mandatory measure.
	▪ Recruit State agencies and companies over predetermined size (e.g., 100 employees).
	▪ Coordinate with State planners and companies to set up employee car, vanpool or busing arrangements, including schedules and access locations.
	▪ Employers determine applicability of staggered or flexible work hours, guaranteed ride home feature, preferred parking, company rewards, subsidy or other inducements.
	▪ Employers handle insurance questions and State agencies assist in obtaining information on government safety requirements.
	▪ State agencies monitor in coordination with business associations.
	▪ Coordinate with affected local jurisdictions.
	▪ Encourage self-enforcement in cooperation with associations.
	▪ If mandatory, work with Attorney General to set up enforcement and appeals procedures.
	▪ Enforcement:
	  ▪ Promote rewards and competitive compliance achievement in the business community.
	  ▪ Provide favorable media coverage for compliance.
	  ▪ Monitoring for compliance would require assistance from the Attorney General, additional paper work and personnel effort.		

Metrics	Motor Gasoline/Diesel Fuel ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance from VPCGA to survey service stations for observation of “closer to normal” fuel purchase activity.		

<table>
<tr><th>Measure</th><th>Energy Source</th><th>Voluntary / Mandatory</th><th>Timing</th></tr>
<tr><td>Modified Fuel Purchase Times</td><td>Motor Gasoline and Diesel Fuel</td><td>Mandatory</td><td>Consider for Serious Conditions</td></tr>
<tr><td>What It Does</td><td colspan="3">Aids in the equitable distribution of motor gasoline and is designed to alleviate long lines at retail gasoline stations. This measure may be used in conjunction with the odd/even measures.</td></tr>
<tr><td>Target Consumers</td><td colspan="3">All motor vehicle consumers</td></tr>
<tr><td>Recommended Steps for State Responders</td><td colspan="3">▪ Cooperation of VPCGA and service stations is vital.
▪ Depends on retail gasoline outlets selling product in a prudent manner while pacing sales to avoid depleting supply until resupply occurs.
▪ Encourage retail outlets within the same area to stagger hours in coordination with their associations.
▪ Set retail outlet weekend operations with distribution association agreement (e.g., 1st or last digit of tax number designates day).
▪ Coordinate with VPCGA and VPC to obtain agreement among participant organizations and dealers.
▪ Attorney General's assistance is required to work outside of State and Federal anti-trust laws.
▪ Attorney General needs to obtain Federal permission to allow its representatives to monitor and keep discussions focused on measure management.
▪ Obtain agreement about number of hours retail outlets will remain open (e.g., 4 to 6/day).
▪ Determine if flag or other identification system is useful.
▪ If not self-enforcing, work with Attorney General to set up appeal procedures.
▪ Work with distribution industry associations to monitor.
▪ Coordinate with affected local jurisdictions.
▪ Enforcement:
  ▪ Local police departments to ensure that retail outlets adhere to hours.
  ▪ Attorney General works with local law enforcement officials on enforcement details.</td></tr>
<tr><td>Metrics</td><td colspan="3">Motor Gasoline/Diesel Fuel
▪ Transport trucks spend less time at terminal racks.</td></tr>
</table>

Measure	Energy Source	Voluntary / Mandatory	Timing
Enhanced Speed Limit Enforcement	Motor Gasoline and Diesel Fuel	Mandatory	Consider for Serious Conditions
What It Does	Achieves maximum energy savings through increased compliance with existing speed limits to reduce motor gasoline/diesel fuel consumption.		
Target Consumers	All vehicle drivers		
Recommended Steps for State Responders	▪ Requires approval by the State and local government law enforcement. ▪ Political approval is essential. ▪ Law enforcement could undertake this measure independently; however, coordination with all stakeholders is crucial for success. ▪ State agencies may work with law enforcement agencies to develop public education and information campaign. ▪ Enhanced enforcement may require increased appropriations for labor needs. ▪ State agencies work with law enforcement to monitor effectiveness of measure. ▪ Enforcement: by DSP and local police departments.		
Metrics	Motor Gasoline/Diesel ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance from VPCGA to survey service stations for observation of "closer to normal" fuel purchase activity.		
Measure	**Energy Source**	**Voluntary / Mandatory**	**Timing**
Prevention of Tank Topping	Heating Oil and Propane	Mandatory	Consider for Serious Conditions
What It Does	Prevents panic buying by heating oil and propane customers. This measure is similar to minimum and maximum purchase measure (see odd/even).		
Target Consumers	Heating oil and propane customers		

Recommended Steps for State Responders	▪ Requires active cooperation of jobbers, heating oil and propane dealers.
	▪ Needs VPCGA promotion and oversight for success.
	▪ Consult with VPC.
	▪ Coordinate with jobbers and dealers to set procedures.
	▪ State agencies and associations prepare media material to inform the public.
	▪ Attorney General needed to set up enforcement and appeals procedures.
	▪ Coordinate with local jurisdictions and law enforcement.
	▪ Enforcement:
	  ▪ Oil and Propane dealers keep record of customer fill and refuse to make top-off deliveries.
	  ▪ Retail outlets screen will-call and make determination.
	  ▪ Consider sharing a list of abusers with VPCGA and VAPGA to identify panic purchasers.		

Metrics	Heating Oil and Propane ▪ Transport trucks spend less time at terminal racks. ▪ Seek assistance of VPCGA a VAPGA to survey jobbers and retail dealers to determine if customer emergency calls and complaints have dropped.		

<table>
<tr><th>Measure</th><th>Energy Source</th><th>Voluntary / Mandatory</th><th>Timing</th></tr>
<tr><td>Odd/Even, Carless Day & Minimum/Maximum Purchase</td><td>Motor Gasoline and possibly Diesel Fuel</td><td>Mandatory</td><td>Consider for Serious Conditions</td></tr>
<tr><td>What It Does</td><td colspan="3">Discourages panic fuel purchases and risk of increasing local shortage due to topping off motor fuel tanks.</td></tr>
<tr><td>Target Consumers</td><td colspan="3">Motoring public</td></tr>
<tr><td>Recommended Steps for State Responders</td><td colspan="3">▪ Requires support from VPC, VPCGA and petroleum retail outlets plus coordination with local government.
▪ Public acceptance is crucial.
▪ Develop detailed implementation plan in coordination with retail outlets and petroleum associations.
▪ Determine minimum/maximum purchase levels if minimum/maximum option is added.
▪ Set license plate or other protocol for identifying status of vehicles.
▪ Determine days of operation (e.g., workweek only, set number of days, rotating weekend control).
▪ Prepare reference materials for use by retail outlets and for State agency staff when answering inquires.
▪ Set up extra telephone or computer response banks to answer questions.
▪ Secure emergency funding for staff time, if necessary.
▪ Coordinate with law enforcement for random checks and follow-up.
▪ Determine exemptions such as:
  ▪ Agriculture vehicles
  ▪ Common carriers
  ▪ Energy company vehicles
  ▪ Medical emergency
  ▪ Personal vehicles (motorcycles, mopeds, etc.)
  ▪ Public safety vehicles
  ▪ Rental vehicles
  ▪ Sanitation vehicles
  ▪ Telecommunications vehicles
▪ Carefully weigh potential rules for dealing with motorists identifying other motorists as violators.
▪ Work with Attorney General to set up appeals procedures.
▪ Notify the public; explain to the media.
▪ Monitor and follow up.
▪ Coordinate with affected local jurisdictions.
▪ Seek continuing media coverage to encourage public cooperation.
▪ Provide data to the public illustrating fuel savings.
▪ Retail outlets may not have sufficient, capable, or trained personnel to enforce. If local law enforcement does not enforce, measure should not be considered.
▪ Attorney General's assistance is required to work outside of State and Federal anti-trust laws.
▪ Attorney General needs to obtain Federal permission to its representatives to monitor and keep discussions focused on measure management.
▪ Enforcement: Local law enforcement departments.</td></tr>
<tr><td>Metrics</td><td colspan="3">Motor Gasoline/Diesel Fuel
▪ Transport trucks spend less time at terminal racks.
▪ Seek assistance from VPCGA to survey service stations for observation of "closer to normal" fuel purchase activity.</td></tr>
</table>

<table>
<tr><th>Measure</th><th>Energy Source</th><th>Voluntary / Mandatory</th><th>Timing</th></tr>
<tr><td>State Petroleum Fuel Set-Aside</td><td>All Petroleum Fuels</td><td>Mandatory</td><td>Consider for shortage beyond serious only when public would accept full scale vehicle (or other) fuel rationing</td></tr>
<tr><td>What It Does</td><td colspan="3">Assists petroleum product suppliers in providing product to designated priority end-users in circumvention of Federal non-discriminatory marketing rules and assure that priority end-users have fuel available for vital public services.
This measure also can be used to establish fueling priorities for guiding retail dealers in selling fuel to specified users.
Note: Both Natural Gas and Electric curtailment procedures approved by the Virginia State Corporation Commission contain priority lists for restoration of service.</td></tr>
<tr><td>Target Consumers</td><td colspan="3">All petroleum customers</td></tr>
<tr><td>Recommended Steps for State Responders</td><td colspan="3">Designed to provide hardship assistance based on the availability, not price, of product.
Transportation fuel sectors of heaviest impact would be imported motor gasoline, diesel, and perhaps aviation fuels.
Could also apply to propane, heating oil and kerosene depending on season.
Maximum percentage of incoming product set aside by major suppliers, and reallocated to priority users, to be determined by Governor in coordination with petroleum industry.
Suggested monthly set aside levels could be:
Motor gasoline: 5%
Middle distillate (diesel & heating oil): 4%
Propane: 3%
Aviation gasoline: 5%
Kerosene: 2%
Reasons for using Set-Aside include refiners’ inability to supply accounts adequately for sustained period of time & price not clearing the market.
Governor may designate certain geographic areas as suffering from supply imbalance and redirect product as needed.
Applicants include jobbers for sale to direct customers and resale to retail dealers and their end-users.
Suggested priority users’ order to be determined at time Set-Aside is recommended:
Agricultural production; aviation ground support; cargo, freight & mail; emergency services; energy production; health care; passenger transportation; sanitation; and telecommunications
Administration:
Notify major petroleum companies.
Provide EOC or work to develop alternate site if EOC is not available.
VDEM and DMME coordinate with petroleum stakeholders to generate information for media including press releases.
Determine where applications can be picked up (e.g., local government offices or via the Internet).
Determine how application is returned for investigation, verification and evaluation (e.g., facsimile, E-mail, hand delivery, regular mail).
Provide access and operation information to potential applicants using services of distribution associations, media and Internet.</td></tr>
</table>

Measure	Energy Source	Voluntary / Mandatory	Timing

	▪ Establish processing order (e.g., first come, first served).
	▪ Establish protocol for releasing remaining set aside volumes if conditions dictate/permit.
	▪ Maintain coordination and communications with petroleum stakeholders, VDOT, VEDP, law enforcement and participating local jurisdictions.
	▪ Attorney General's assistance is required to work outside of State and Federal anti-trust laws.
	▪ Attorney General needs to obtain Federal permission to allow its representatives to monitor and keep discussions focused on measure management.
	▪ Monitor imported fuel supply using State, Federal and private sector data.
	▪ Obtain prototype forms from NASEO. Ascertain geographic area(s) of operations.
	▪ NASEO can arrange for guidance if the State wishes to employ this measure.
	▪ Enforcement:
	  ▪ Attorney General when false information has been provided to obtain set-aside fuel.
	  ▪ May require additional enforcement personnel at retail outlets if motor gasoline is allocated to filling stations to meet critical need groups (e.g. medical personnel at a nearby hospital).
	▪ Enforcement: Local law enforcement departments.		

Metrics	▪ This not a fuel savings measure. It is designed to assure that critical users can obtain fuel to serve critical needs of the public. ▪ It may be possible to survey critical end users to determine if their needs are being met.		

Section 7
ASSET INVENTORY

The Asset Inventory is the prequel to Section 8, Vulnerability and Risk Analysis, and provides a detailed inventory of major energy assets within the State. The focus is on the major energy assets whose loss could cause significant disruptions to critical systems. The goal is to identify the location, size, and type of energy asset, the energy flows through the assets, and the inter-relationships between the different types of energy assets.

Energy assets include a broad array of facilities for production, transport, storage, and final delivery of retail energy to industrial, commercial, and residential customers. These assets can be disaggregated for the purpose of inventory and analysis. However, they actually represent an integrated web of supply chains that include power plants, high voltage transmission lines, interstate gas pipelines, LNG terminals, petroleum pipelines, storage, barges, ships, and trucks. In total, these linkages provide the basis for both the strength and vulnerability of the State's energy system.

This information provides State responders with metrics for defining a baseline of use for estimating the impact of system failure at any given time and for any given asset. For example, understanding the ongoing normal operation and seasonal parameters of natural gas flow from an interstate pipeline to a city gate, or transfer point from supply to distribution, can enable responders to assess the risk associated with a sudden reduction in supply. Flow data for electricity and petroleum products provides similar opportunities to define a baseline of what constitutes normal when estimating the risk associated with a particular event.

There are associated industries that fall within or feed these three primary industries. These vital ancillary energy resources include coal, propane, LNG, and renewable energy. The transportation infrastructure within the State supports the delivery of some or all of these energy products to the critical assets and general population.

7.1 Sources of Information

The electricity and natural gas industries are well organized. There is significant centralized data in both commercial and government sources, and they will be indexed for this study. By contrast, the petroleum products industry is relatively disaggregated and unregulated. Accordingly, data must be acquired piecemeal from a variety of commercial and public resources, and from the archives of the State Energy Office (or equivalent). The methodology for identifying energy assets in the State included the following:

- Querying the major commercial and public databases.
- Leveraging existing knowledge, data and contacts.
- Interfacing with other State agencies.

- Independently researching focused data sources (not directly related to the energy sector).

The electricity industry is the most organized and centralized in terms of both asset information and real-world operations. The ISO operates the bulk electricity grid in real time, and has detailed procedures that respond to all types of contingencies in the bulk generation and transmission markets. The ISO also produces a wide variety of reports, databases, studies, and forecasts that describe the electric generation and transmission infrastructure.

EIA collects extensive data on the electricity sector related to assets and the industry operations. EIA databases were queried for consumption data on a customer class basis, and Energy Velocity, a commercial database by Ventyx®, provided asset data as well as proprietary research for regional operations. Additionally, and contingent on their willingness to reference their data, other sources of information include the following: FERC, DOT, and LNG terminal data from Energy Velocity. Natural gas flow rates were obtained through Energy Velocity and EIA-provided natural gas consumption data.

Detailed information on critical energy assets by energy type is provided in Appendix J. These data include the following Virginia-specific information:

- Electric generating stations
- Electric transmission lines
- Electric substations
- Petroleum pipelines
- Petroleum storage facilities
- Natural gas pipelines
- Natural gas compressor stations
- Natural gas delivery points

Section 8
VULNERABILITY AND RISK ANALYSIS

This Vulnerability and Risk Analysis is a key step of the EAP initiative, and provides the foundation for identifying critical infrastructures. Thus, the Vulnerability and Risk Analysis is based on how energy affects the State's transportation, communications, finance, and government infrastructures. For example, coal shipments are highly dependent on rail, while supply of petroleum products depends on petroleum refineries and pipeline pumping stations, which themselves depend on a reliable crude oil supply and backup generation. This Vulnerability and Risk Analysis explores these relationships and identifies those assets that are critical as stand-alone elements, or that form a critical link in the supply chain.

Effective public-private partnerships are essential for effective vulnerability and risk analysis. Earnest participation with ample opportunities for a wide array of input and validation from stakeholders will yield the greatest benefit. Many owners and operators, government emergency managers, and first-responders have already developed strategies, plans, policies, and procedures to prepare for, mitigate, respond to, and recover from a variety of natural and manmade incidents. Therefore, this Vulnerability and Risk Analysis does not re-create or replace those efforts; rather, this analysis simply serves as an instrument for understanding the existing efforts that support a timely response and rapid recovery from an energy emergency.

This Section defines the criteria used to categorize assets; it then identifies the assets, and assesses their degree of vulnerability. This approach differs from the DHS *National Infrastructure Protection Plan, 2009* (NIPP) in that the EAP applies to the State, not the federal effort. This approach, nevertheless, forms the basis for continuing work with DHS and other federal agencies and initiatives. It also borrows from the logic presented by the NIPP to ensure continuity and synergy across federal and state levels.

The focal point of this analysis is awareness, monitoring, and consequence assessment. This analysis differs from a strict vulnerability analysis in that its focus is primarily on consequences – such as the possible outcomes of an energy emergency that could occur – as opposed to estimating the probability of the occurrence of vulnerabilities.

To improve energy system resiliency, this Vulnerability and Risk Analysis will clearly identify assets and scenarios of distinct vulnerability, and in doing so, it may also to some degree reduce vulnerability. For each of the assets it identifies as critical, this Section rates asset vulnerability based on the known/potential consequences, existing mitigation capability, and frequency of disruption occurrence. The scores of the vulnerability are normalized to a five-point scale: 1 = Rare, 2 = Low, 3 = Moderate, 4 = High, and 5 = Catastrophic.

8.1 Summary

The purpose of the Vulnerability and Risk Analysis (VRA) is to identify critical assets, highlight why they are critical, and describe their specific vulnerabilities. This Section provides the criteria for identifying the critical assets and vulnerabilities up-front in a summary format. For the purposes of the EAP, Table 8-1 outlines the basic distinctions between critical assets, vulnerability, and consequences.

Table 8-1
Vulnerability, Critical Asset and Consequence: Definitions

Concept	Description
Vulnerability	The energy disruption itself; a distinct event
Critical Asset	The object upon which the consequence is measured; the location of the vulnerability
Consequence	The result of the event; the measurable impact of the energy disruption on the asset.

These concepts are pivotal elements of the analysis. Thus, energy disruptions are examined in terms of the nature and magnitude of their effects on certain assets. Using this semantic construct, a critical asset is facility where a particular energy disruption (the vulnerability) has an impact that clearly restricts the efficiency of energy resiliency in the State.

Table 8-2
What Qualifies as a Critical Asset: Criteria?

Criteria	Description
Consequence	The measure of the impact that vulnerability has on an asset.
Redundancy	A resiliency strategy that uses known alternatives to correct, attenuate or adapt to the consequence of an energy disruption. For the purpose of this study, redundancy can be measured in many different ways, including, alternative supply sources/routes, or multiplicity of transmission paths.
Frequency	The repetitive nature of the event, if the consequence is expressed in more than one period or is reflective of the possibility of occurrence in the future.

Section 9
EMERGING OPTIONS

9.1 Smart Grid

Increased dependence on electricity supply – in combination with long-term, continuing declines in the cost of automation, concerns about reliability, terrorism, efficiency, and the environment – have combined to promote interest in Smart Grid. Smart Grid consists of a cluster of new developments in the electric supply system with the potential to bring about a number of benefits, some of which bear directly on EA.

Creating a Smart Grid – or automating the existing electric supply system – may facilitate certain goals, including improvements such as:

- Reliability and availability of electric service
- Resilience in the face of challenges, such as solar flares and seismic events, equipment failures, accidents, and sabotage
- Utilization of deployed assets, thus improving economic value
- Quality and diversity of energy services, such as prepayment service, time-dependent rates, and rates that allow customers to minimize their energy costs
- Supply system capacity to receive power from renewable and variable sources
- Diversity and distribution of power sources of all kinds, including distributed and renewable generation
- Utility resources for managing supply to sustain critical facilities and resources
- Facilitate diversity of supply by developing systems to cope with the sudden swings that can occur in availability of wind generation

Smart Grid may have the potential to be a productive long-term resource for EA. The most significant element of Smart Grid now being deployed is advanced metering infrastructure (AMI). Once installed, AMI facilitates rapid discovery and management of power outages, as well as supporting a rate schedule that enables timely demand management practices in response to dynamic changes in electric markets and grid operating conditions.

Deployment of hardware and operating software could enable some immediate progress toward these goals. Systems integration is a key element and prerequisite to achieving additional benefits. However, full integration of the many Smart Grid systems requires additional time, perhaps as much as five years. Aside from the complexities in developing a Smart Grid, some of the capabilities inherent in the technologies such as privacy concerns relating to interoperable communication systems, raise policy and operating issues that necessitate examination and discussion in order to realize potential benefits.

9.1.1 What is Smart Grid?

The idea behind Smart Grid is that integrating modern sensing, communication, and automation technologies with the existing electric grid might make possible new capabilities and features. Proponents of Smart Grid point to a number of widely publicized benefits stemming from the system including:

- increased reliability (fewer and shorter service outages)
- greater resilience in the face of challenges
- increased efficiency
- ability to accommodate substantial amounts of renewable and distributed generation, lower electric losses
- higher power quality ("cleaner" power)
- lower environmental impact ("greener" power)
- benefits to and for consumers

Revenue meters, voltage sensors, current sensors, and a wide range of other devices can serve as sensors. Radio, power line, optical fiber, and other methods can enable two-way communication. Automation can encompass the full range of implementation, now and in the future, using computers distributed throughout the electric grid.

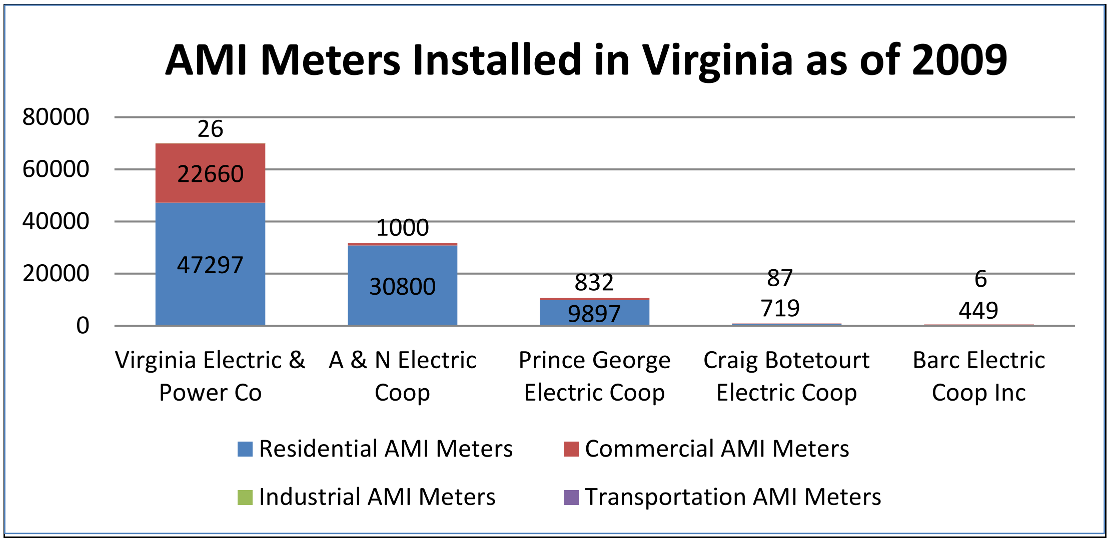
Today's Grid

The present electric grid[1] is a vast, highly complex and sophisticated system consisting of generating facilities, transformers, transmission lines, substations and numerous other components involved in delivering the electricity to the consumer. The grid currently has relatively few components capable of providing information regarding transmission and distribution systems. As a result, operators of the various components must rely almost entirely on information gathered from a limited number of locations (mostly substations), communications between ISOs, NERC regions, as well as complaints from customers when a service outage occurs.

Sensing, communication, and automation equipment exist today in some substations and select distribution devices, such as switches and capacitors. However, these devices typically control a single function (a switch or capacitor for example) and are not integrated into larger systems enabling grid management. In some cases, automation can improve individual functions enough to compensate for its cost. The greatest benefits of automation arise from the integration of disparate elements at a high level to coordinate an entire system, such as the electric system.

Figure 9-1 illustrates an important technical issue pertaining to Smart Grid, being the installation of AMI meters.

[1] The transmission network is configured as a grid. Distribution networks generally are branching tree networks, rather than grids. The popular vernacular now uses "grid" to refer to both and we will use that convention.



Source: SAIC using ABB's VENTYX

Figure 9-1. AMI Meters Installed in Virginia as of 2009

Smart Grid Serving Today's Functions

Information, communication, and automation sensors may enable utilities to plan more accurately and operate the grid more effectively and efficiently. Examples include lower capital costs, deferred expansion of distribution capacity (due to more accurate planning and managed load), reduced electric losses, and improved service.

With automation of some currently manual function, problems could be detected before they result in outages, swifter restoration could be achieved in some cases, and could be possible to manage voltage and current at all times to minimize technical losses.

Smart Grid Serving New Functions

Smart Grid may allow the electric system to include a wider diversity of supplies and loads, both large and small, and enhance the ability of operators to maintain both stability and supply. Areas with potential Smart Grid involvement are discussed below.

Transmission Networks

Transmission networks currently operate within limits defined by the worst case of what could happen. The worst case is a calculated condition governing the amount of power a line can safely carry. New sensors, called synchrophasors, now in large-scale trials nationwide in DOE-funded programs, and are being integrating into operating systems. When in general service throughout the transmission network over the course of the next decades, they will significantly expand the capacity of the existing transmission network by allowing operators to know actual conditions in the grid. Utilities will then be able to operate the transmission network up to its actual limit, rather than being constrained by the theoretical limits of conditions that might occur but are not actually occurring.

Renewable Supply

Some renewable generation technologies, notably solar and wind are subject to uncontrollable variations in output. Stability of the grid requires that supply and load remain equal. For example, if an appreciable fraction of the present load is served by solar generation,[2] and clouds suddenly cover the sun, the grid may become unstable if other supplies are not engaged immediately or load is not reduced to match the reduced supply. System instability risks large-scale damage and destruction of electric assets, including customer equipment. Thus, utilities generally will incur brownouts or blackouts rather than allow instability.

Presently, the balance of generation and load is managed dynamically. Conventional generation can take 5 to 15 minutes to come online to meet new load requirements. However, the sun can block a large solar array (or many smaller ones) in much less than five minutes, and then instability looms.

If renewable supply is suddenly diminished, Smart Grid would allow utilities to respond more dynamically (and rapidly) than is currently possible. Certain Smart Grid applications such as stored supplies, enabled by batteries or parked electric vehicles (EVs) could also help to control customer loads and stabilize the grid when a sudden drop in renewable sources occurs. Typically these actions could operate for just a short time, perhaps 15 minutes, but used in combination with peaking plants, pumped storage and other existing prompt start facilities these renewable resources could make the critical difference, until traditional supplies are ramped up to serve the load.

Smart Grid may also help consumers, or utilities, to reduce load by abetting the selection of end-use priorities thus turning off non-critical consumption first. Examples might be water heaters, pool pumps, and air conditioners.

Emergency Response

Another aspect of a projected Smart Grid system includes service switches in all residential (and many small business) meters. Such switches could permit a utility to remotely connect or disconnect any or all residential services as needed to protect system integrity. However, policy constraints may limit this particular action.

In current utility practice, the most immediate and obvious use of a remote service switch might be reduction of field labor associated with disconnecting and re-connecting seasonal and delinquent accounts. This too could be a controversial use of Smart Grid. However, having a switch at every service location could also enable entirely new applications that enhance system reliability through more efficient load management and emergency load shedding as discussed above.

If electric demand approaches or exceeds available supply, utilities may ask consumers to voluntarily reduce use. Utilities may also enlist government support for

[2] If a small fraction (say, less than two percent) of load is served by solar, and the sun is suddenly covered by a cloud, system voltage will drop, but not enough to compromise stability.

such a request. Failing that, they currently have few options other than to interrupt service. Called a "rolling blackout," this is generally implemented by opening distribution substation switches to selected feeders. If a feeder serves a hospital, police station, or individual life/safety customer that does not have an assured backup supply, utilities endeavor to maintain the entire circuit. In the event this is not possible, then such circuits could also lose power. Smart Grid systems may greatly reduce consumer risk during such outages.

Notwithstanding many new applications potentially enabled by Smart Grid, there are unresolved policy issues raised about such systems. These are addressed further on in the discussion.

Electric Vehicles

Numerous analyses indicate that plug-in EVs will have lower overall environmental impact, and may even cost less than fossil-fueled vehicles. However, charging EVs will be a substantial challenge for the electric grid. Charging an EV may be comparable to supporting an entire household. If a sudden upsurge in the population of EVs occurs, the residential electric load could exceed the capacity of an existing grid. Substantially increasing the capacity of distribution systems to accommodate the EVs would be both time-intensive and costly, perhaps making EVs economically unattractive.

A Smart Grid system could provide the sensing and communication needed for the electric system to know when and where EV charging load is to be served, and could manage both the financial transaction and the charging load to produce an economical and efficient result, minimizing the peak load. Such load management capability could enable the present grid to serve the EV charging load with relatively modest capacity expansions. In addition, those same EVs could provide intervals of supply to support the grid during temporary lapses of renewable supplies.

Load and Demand Management

For half a century, direct load control[3] has provided utilities with a predictable and reliable method for managing system load and minimizing or delaying the need for expanded generation. However, the amount of load that can be managed directly is limited. Involving customers in the process at the time of the need may greatly expand the rapidity of load reduction and load shift. This seems straightforward, but involving consumers in load reduction and shifting may have financial considerations as well.

Direct load control can operate with very simple monthly metering and no customer action beyond agreeing to participate in the program. However, directly involving customers in actively optimizing the load served, or demand response, requires more sophisticated metering and a way to exchange with customers on such issues as prices,

[3] Direct load control is control exerted unilaterally by the serving utility without customer interaction at the time of control. This is in contrast with Demand Response, which involves a decision by the customer (or the customer's agent or automation) at the time of control. In both program types, customers must be actively involved in the decision to accept the program and its terms at the time they enroll in it.

event notices, and opt-in/out choices. The current generation of AMI is fully capable of providing the necessary metering and much of the customer communication. Future residential internet services may enable the addition of a number of useful tools to the utility-customer interaction. In any case, studies have demonstrated that at least some customers, including many with major loads, will participate in demand response programs that benefit them directly and others indirectly as well.

9.1.2 What Would Smart Grid Look Like?

Smart Grid would mean an expansion of the automation that is already underway in electric operations. Much of Smart Grid will consist of small and medium-sized weatherproof boxes that house sensors and electronics, located on poles, on transmission and distribution line devices, and in substations. The two-way communications by radio waves and power lines would be transparent to consumers with the computers, servers and other data management resources of the utility in secure data centers. As the Smart Grid develops, interoperable communications among utilities will become increasingly important.

The creation of a Smart Grid involves the design, deployment, and integration of sensing, communications, and automation equipment and systems. The "smart" part of Smart Grid will comprise many devices coupled with pervasive information technology (IT) integration. Gaining its full benefit will require extensive evolution of utility business and operating practices.

Some component parts of Smart Grid already integrated into the grid include Intellirupter™ switches, SCADAMate™ switches, various meter automation systems, and the new communicating faulted circuit indicators. Such contemporary components are monolithic systems. However, once fully integrated into utility operations along with the other devices and systems, the current grid would become the Smart Grid. This grid would be a "system of systems," both fostering and relying on a new and still-growing engineering discipline for defining, creating, and sustaining complex aggregations of automated systems.

Specific examples of devices that are the "smart" part of Smart Grid are examined below.

Customer Automation

Automated revenue meters that sense and report customer energy usage any time may report other valuable parameters, such as voltage, outage times and durations, and meter tampering events. These could include customer-owned devices that communicate with the end-user's meter or other utility resources in order to capture and respond to operating conditions. Examples include Heating, Ventilation & Air Conditioning (HVAC) thermostats, major load controllers (water heat, pool pump, air compressors), and home and business automation systems. Such devices may be integrated into a home computer system, automated appliances, dedicated control devices such as smart wall switches and outlet receptacles, or other innovative home devices. Customer-owned EVs or other storage, and small-scale solar or wind generation could also be part of such systems.

When deployed, connecting such devices to AMI meters and "smart" coordination and protection devices protect both the host site and the surrounding grid from synchronization and back feed hazard issues.

Distribution Automation

Switch monitoring and control electronics that sense local operating conditions and respond to commands based on conditions elsewhere in the grid include:

- Faulted circuit indicators that detect and report large line current surges
- Transformer monitors that detect and report temperature and oil contamination
- Pole-top boxes with radios and computers that receive and store data, and process some of these data to determine immediate conditions and control needs

Transmission Automation

Synchrophasors can detect and report critical voltage, current and phase data.

Supply Automation

Small-and large-scale wind and solar supplies—AMI-metered—can communicate with utility resources to coordinate operation. Other distributed generation elements, such as small hydro and local backup supply, are able to similarly communicate and coordinate. These distributed sources would make possible the operation of "islands" within the distribution system that may be cut off from central electric supply. Other applications could include automated load management systems and devices that track customer load behavior and shed load briefly when local renewable supplies are temporarily compromised.

System Resources

Comprehensive security software and practices will affect every device in the grid.

9.1.3 How Might Smart Grid Support Energy Assurance?

Short Term

Synchrophasors

The installation of synchrophasors in transmission lines will begin soon, giving regional electric grid operators insight into operating conditions. Any spillover from one region's infrastructure event into connecting regions would be immediately apparent, allowing operators to act quickly to protect neighboring areas from compromise. Although the installation of synchrophasors in the majority of major transmission lines would be time-intensive, these devices have the potential to become important operating and EA resources upon deployment.

Advanced Metering Infrastructure (AMI)

Some utilities currently use limited grid automation. In the last five years, the deployment of some large-scale Smart Grid subsystems has occurred. The most substantial of these components is AMI, which currently serves between 5 and 10 percent of U.S. accounts, and is expanding rapidly. The following sections discuss AMI applications that directly support EA. Other AMI applications improve overall service and efficiency and as well as providing benefits such as remote monitoring.

Outage Management

AMI represents a significant enhancement to utilities' ability to quickly assess and respond to service outages. Individual AMI meters report loss of power, typically in a "last gasp" message to the utility as the supply voltage drops to zero. As such an event develops, the utility would receive outage messages; identify the scale and locations of the outage enabling the utility to take action within minutes. Installation of remotely operable switches also enables the utility to redirect power flow, potentially speeding up restoration and track the progress of service restoration efforts.

Even without remote switch control or automation, these devices can improve service restoration by giving the dispatchers information about the problem they are addressing, enabling service restoration of critical facilities to occur more rapidly.

Demand Management

Demand Management allows energy consumers to mitigate demand peaks and simultaneously control their own energy costs, all in response to signals from the utility. The ability to manage demand facilitates the role of the utility in maintaining service in the presence of supply interruptions to a much greater degree than is now commonly practical.

The infrastructure necessary for effective demand management consists primarily of AMI plus a suitable rate structure. An additional major pre-requisite is customer education. Utilities can help educate consumers by providing secure web access and basic applications to obtain and understand consumption information. For example, Pacific Gas & Electric has deployed over one million smart meters and now offers customers considerable support.[4]

AMI deployment is occurring at an accelerating rate. Utilities are now exploring rate designs that correctly balance incentives to customers with utility revenue and demand needs. In this context, a "correct" rate results in significant demand reduction but still brings in revenue sufficient to cover the costs of serving customers.

As AMI deployment continues, identifying the appropriate processes and implementing new rates, constitute the primary obstacles to achieving demand response in the near future. Demand response is widely expected to soon be a productive demand management tool at times of power system stress, for EA, and for other (e.g., economic) purposes. To achieve this result, demand response must be

[4] See http://www.pge.com/myhome/myaccount/usage/ and http://www.pge.com/myhome/customerservice/smartmeter/energyalerts/.

accompanied by clearly defined and presented customer education programs, As AMI and suitable rates become common, a large commercial industry will emerge[5] that will supply automation devices to consumers and educate them on how to benefit from them, further improving demand response.

Service Switches

In principle, using service switches in advanced meters for system-wide emergency load management could be possible shortly after deployment. Because numerous feeders supply critical loads, rolling blackouts are less productive than opening the service switches on all non-critical residential and small business services. Once defined in the AMI software, the utility would be able to manage those customer groups. Functionally, this mechanism is very similar to existing direct load control programs.

However, the underlying policy development supporting such actions could be more time-intensive. Questions that might be raised include:

- What are the limits of the utility's uses of this capability?
- What, exactly, defines a critical account that will not be interrupted in an emergency?
- What will happen if utility power is interrupted in a neighborhood where a customer has local generation (e.g., a solar panel or backup generator) that is producing power?
- What if that account is interrupted?
- What if it is not interrupted and continues to supply the local grid?

Before full attainment of the advantages of Smart Grid, a number of major technical and policy issues related to back feeding, frequency synchronization, protection coordination, and personnel/human safety must be fully aired and resolved. Many of these issues are largely without precedent, and thus require thorough explanation and vetting through public processes. The creation and integration of new kinds of records into operations must occur, such as the locations and attributes of local generation. These issues are an important focus of EA planning related to Smart Grid.

Sectionalizing Switches

Sectionalizing switches are not currently in widespread use, but many have already been installed. They allow the utility to isolate distribution problems and minimize the number of affected customers. Some of these switches have communications capabilities that make them remotely operable, a feature that will expand quickly with the deployment of AMI and other communication infrastructures. Automated and remotely operable sectionalizing switches would be a valuable tool for grid operators to use to isolate problems to the grid in small areas.

[5] This claim is made with confidence because this trend is already happening. Players like Google and Microsoft are jockeying for position, along with dozens of small companies.

Long Term

In addition to the short-term Smart Grid functions, Smart Grid has the potential to provide long-term value for EA in many ways. Discussion and examples follow.

Leveraging Distributed Generation

Many utilities already have agreements with large customers (such as data centers and hospitals) who have backup generation that allows the utility to dispatch the customers' generation in times of need. Where the amount of such generation makes a significant contribution to meeting the utility's requirement, it reduces the need for Smart Grid. However, automating the process expands the available capacity by allowing utilities to employ a much larger number of smaller capacity generators that customers own/operate. For other new operating functions, automating dispatch of customer-owned generation will require resolution of major technical and policy issues.

The utility would similarly be able to control other distributed generation using the sensing, communication, and automation features of Smart Grid. Again, this control will require resolution in advance of numerous issues related to system protection (against over-current or back feed hazards), rights of control, and other technical and policy matters. These technical and policy issues are appropriate early entries on the EA planning agenda.

"Default Automation" Leads to Smart Grid

Passive devices populate the existing electric grid, including switches, reclosers, breakers, fuses, capacitors, voltage regulators, etc. Some include processing, but no communications. Many of these devices are decades old and are no longer supported or supportable and gradually as they fail they are replaced. For new devices, the incremental cost to include communication and automation already is small compared to the hardware cost of the device itself. Therefore, the ideal default choice could be to install a "smart" replacement device when the existing unit fails. This default expansion of grid automation is happening now, and will continue as the relative cost of communication and automation continues to fall.

Each of the three near-term resources described above, synchrophasors, AMI, and sectionalizing switches, has the potential to be productive for EA in the immediate future. Their value may increase with the deployment of more automated devices. Automation will be employed first where its economic value is highest – for example, to support large commercial centers, industrial parks, or critical facilities such as hospitals and public safety locations.

Eventually, as default automation spreads feeder by feeder, the grid will reach a critical juncture where the value of replacing all remaining passive devices is greater than the cost. Then a fully automated grid may then rapidly result.

No one can say with certainty when that point will occur. However, it is widely believed that it will come before all presently in-service passive devices have failed. If the remaining life of the newest of such devices is 30 years, then the Smart Grid could have substantial penetration in less than 20 years.

9.1.4 Smart Grid Implementation Progress in Virginia

The Commonwealth of Virginia has approximately 3.6 million electric accounts: 40 percent residential, 43 percent commercial, and 17 percent industrial.

Smart Grid Investment Grants

In addition to several EA grants, Virginia received ARRA grants currently implementing Smart Grid now.

- **Rappahannock Electric Cooperative, Fredericksburg $15.7 million:** The Rappahannock Electric Cooperative received $15.7 million for the Smart Grid Investment Grant Program (EISA 1306) to implement advanced meters, cybersecurity equipment, and digital automation of meters.
- **Northern Virginia Electric Cooperative, Manassas - $5 million:** The NVEC received $5 million for the Smart Grid Investment Grant Program (EISA 1306) to replace older equipment with Smart Grid technology. NVEC estimates a savings of $600,000 annually in power costs.

Energy Efficiency Grants

Virginia received several grants to implement EE programs. Although these programs limit electric demand growth, they do not actively contribute to EA when an urgent need exists. Nonetheless, these programs assist in the essential effort to promote public awareness regarding energy consumption habits and their impact on energy efficiency and EA. One of the most significant obstacles to implementation of demand response programs is the pervasive lack of engagement of the citizenry in the energy dialog. These EE programs will continue enhancing the public's awareness of energy uses, their timing, and value. As a result of such increased awareness, the public should be more responsive in the future when time-dependent rates are more common and with the implementation of demand response programs times of electric system stress.

9.1.5 Supply Resources

In discussing Smart Grid, NASEO suggests considering the following steps:

- Describe the current status of Smart Grid implementation:
  - Purpose(s) and drivers for Smart Grid projects
  - Energy assurance aspects; emergency response, resiliency and risk mitigation
  - Business case developed by utilities and others
  - Other expected benefits
  - Overall plan for Smart Grid implementation; technologies installed and planned
  - Degree to which Smart Grid implementation has enabled or will enable:
    - Improvements in security, reliability and resiliency

  - More rapid recovery from power outages
  - Demand management and energy efficiency programs
  - Integration of distributed generation and renewable energy
  - Integration of plug-in electric hybrid vehicles
- Use of Smart Grid distribution automation
- Plans for evaluating performance and benefits, and comparing to initial estimates
- Digital meters (also known as smart meters and AMI)
- Overview of meter investment plan, objectives, drivers
- Relation to energy assurance plans
- A description of the meter functional capabilities (the type of meter deployed may vary among utilities)
- Number and location of AMI/smart meters installed
- Implementation of meter data management systems to support the large volume of data and make it available to other utility processes
- Customer web portal for customers to access and view their own usage from as recent as prior day
- Two-way communications through the AMI and related head-end management systems to provide services to customers, such as demand response and pre-pay services
- Determination of whether the systems being deployed are proprietary or open-source based systems
- Distribution system
- Overview of distribution system investment plan, objectives, drivers
- Automated and remotely controlled capacitor banks for VAR (reactive power) and power factor control, to maintain voltage on feeders at optimum levels to save end-use energy and to reduce losses
- Supervisory-controlled reclosers to speed restoration for faults that clear themselves, avoiding manual fuse replacements
- Automated fault isolation and feeder reconfiguration equipment
- Mobile workforce management systems that dispatch crews already in the field to new work assignments, such as outage repairs, in a timely and effective manner
- Outage management systems that integrate smart meter “last gasp” outage information for better and more rapid identification of the number of customers affected (and their location) to speed restoration of power

    - Distribution management systems that incorporate seamless interface for operators and provide for fault location to speed crews to precise locations of outages
    - Transmission system
    - Overview of transmission system investment plan, objectives, drivers
    - Relation to energy assurance plans
    - Phasor measurement units (PMUs) at key grid nodes
    - Dynamic line rating tools and methods for system operators
    - Condition monitoring of major transformers to allow operation at maximum safe loadings and detect emerging equipment problems
- Describe utility and other State and private sector plans for future Smart Grid deployment, including pilot and demonstration programs.
- Describe both future projects, including near term and the longer term. The description should include the level of investment and other factors driving deployment, such as laws and regulatory requirements, reliability, security and operational efficiency:
    - The level and source of investments, including those funded by grants, stockholders, and those already approved by the State utility commission for inclusion in rates.
    - Are there future investments that are pending approval?
    - Any non-utility Smart Grid related investments that may integrate into the Smart Grid. For example, this could include storage for renewable projects such as compressed air, battery, pumped hydro, etc.
- Identify any State public utility commission orders or administrative rules addressing Smart Grid, and any special conditions that may have been set by the commission.
- Identify any pending cases that address Smart Grid completely or in part.
- Identify any future anticipated cases that may address Smart Grid investment.
- Identify any projects that funded by other sources that may support Smart Grid, including the State Energy Program or the Energy Efficiency Conservation Block grants to local communities.

9.2 Cybersecurity

Cybersecurity for the energy sector is a national concern. This concern is growing as the energy system becomes increasingly complex and reliant on information technology and communications infrastructures. This reliance has seen a corresponding increase in the energy system's vulnerability to cyber-attack. The incorporation of cybersecurity in the EAP is an important means of documenting and building a greater understanding of associated technologies and their implications.

Cybersecurity is critical to responding to an energy related emergency affecting Virginia's energy infrastructure composed primarily of assets and systems in the electric power, petroleum, and natural gas sector. These energy resources are protects from threats both physical and cyber by a number of federal agencies and industry organizations and working groups.

Modern energy systems have become increasingly complex and their day-to-day and emergency operations are highly dependent upon web-enabled communications. This makes such systems vulnerable to "hacking", where intrusions occur with the intent to cause harm. The risk of such events has grown to the point where the role of protecting critical infrastructure from cyber related attacks is central to Virginia's Energy Assurance Planning efforts.

Cybersecurity's principle role in energy systems is to identify, measure, and adequately manage the risks associated with digital systems, including their physical protections. This Section provides an introduction of cybersecurity, a survey of the digital systems that accompany State energy portfolios, and a discussion of risks, issues, resources, and risk management approaches available to Virginia's Energy Assurance planners.

Part-1 of this Section provides an introduction to the fundamental concepts of cybersecurity in order to provide a basis for application to the energy industry. Part-2 provides an overview of the major trends and themes of evolving digital energy portfolios. Part-3 outlines areas of focus and challenge in securing these new and evolving energy infrastructures. Part-4 defines resources that are generally available to Virginia. Finally, Part-5 of this Section outlines areas of focus that Virginia should engage in to ensure that risk to energy infrastructures are properly understood and managed.

An Introduction to Cybersecurity for State Energy Offices

Cybersecurity is often associated with technical jargon, which can make it feel inaccessible to a great many participants in the energy discussion, but in fact, it is a core principle that needs to be considered by everyone involved in energy assurance planning. At its best, cybersecurity is a shared understanding of the value systems and technology provide the consequence that could result from failure or compromise, and the value of actions that may be taken to manage against those consequences.

What cybersecurity is and what it is not.

- Cybersecurity involves technology however it cannot be described in those limited terms only. Cybersecurity is principally about risk management, not individual technologies, and it will be described in those terms in this section.
- Cybersecurity is not procured, it is integrated and engineered. Cybersecurity involves a wealth of people, processes, and tools across current and sometimes future investments. There simply is no such thing as buying it off the shelf.
- Cybersecurity is not a mystery but a defined process. Effective cybersecurity has well defined procedures and lifecycles that help guide the identification,

measurement, and mitigation of risk. Critically, a well-defined cybersecurity plan and process can help manage against the impact of both known and well-understood risks, as well as unknown and potentially poorly understood risk.

- Cybersecurity often over-focuses on building and constructing solutions during the design and build phases of projects. Maintenance and assurance of the efficacy of investment over the lifecycle of the investment are often not part of the focus.
- Cybersecurity is at its root, a process of risk management related to the digital infrastructures that underpin modern enterprises. These can include pipeline control systems, banking systems, and modern communications systems to name a few.

In the energy assurance domain, the role of cybersecurity is principally one of identifying and managing the risks and consequences associated with the vast digital infrastructure, which underpins modern energy delivery systems. This Section discusses the process and lexicon of identifying risk, security controls used to manage against risk, and the role that Virginia can play in assuring that risk management through cybersecurity is suitably encouraged and delivered throughout the energy portfolio.

Cybersecurity Fundamentals for Energy Assurance

There are three principal goals of cybersecurity that are core to all cybersecurity discussions, including Energy Assurance: Availability, Integrity, and Confidentiality (including Privacy). The purpose of cybersecurity is to maintain suitable levels of these qualitative attributes throughout the services and functions that support Energy Assurance. It is the risk of the failure of one of these attributes that drives investment and focus in security controls that can manage and militate against failure, either malicious or accidental. Modern energy systems cover vast areas of physical space, and a comprehensive deployment of all potential controls across all assets in all locations can be significantly cost prohibitive, so ensuring that the right controls are deployed to manage the right risks is a key success criteria for energy systems. Source: NIST SP 800-60 Security Objectives Definitions provides an overview of how the three principal goals of cybersecurity are commonly defined.

Table 9-1
Cybersecurity Objectives and Definitions

Security Objectives	FISMA Definition [44 U.S.C., Sec. 3542]	FIPS 199 Definition
Confidentiality	"Preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information…"	A loss of confidentiality is the unauthorized disclosure of information.
Integrity	"Guarding against improper information modification or destruction, and includes ensuring information non-repudiation and authenticity…"	A loss of integrity is the unauthorized modification or destruction of information.
Availability	"Ensuring timely and reliable access to and use of information…"	A loss of availability is the disruption of access to or use of information or an information system.

Source: NIST SP 800-60 Security Objectives Definitions

Confidentiality is the loss of data or information control that could affect the ability to suitably operate or maintain the operations of energy systems. The loss of data confidentiality could have system-level impacts such as the disclosure of information related to the location of critical assets and their implemented access controls. The loss of data confidentiality could take the form of critical system status, such as the level of a reservoir or oil tank. While the disclosure of such information is not in and of itself a risk, this type of information disclosure could be used to manipulate or otherwise influence the operational state of the energy infrastructure.

The loss of data confidentiality could also have individual-level impacts such as the disclosure of energy consumption data for an individual consumer. In this example, the loss of data confidentiality has an impact on individual privacy, and could result in criminals understanding when a consumer seldom uses energy, access to customer data and thus may not be home to stop a robbery. In addition, as the popularity of automatic bill payments grows, electric utilities' customer databases are increasingly including bank and credit card information.

Integrity is the loss of faith or control of data and systems within the environment. In digital control systems, remote status events in SCADA systems move operators and controllers to respond with associated change.

- If an electric utility's Smart Grid system was maliciously accessed to suddenly curtail customer loads, aggregate generation could significantly exceed demand and the utility would enter into an over-frequency condition. Most utilities have automatic relays in place that take generating units off-line, thereby compounding the problem.
- If an electric utility's SCADA system was maliciously accessed to operate high-voltage circuit breakers, then widespread blackouts could occur
- If a reservoir is too full, they may stop pumps to fill it. If it is too low, they may start pumps to fill it.

Availability is the loss of access to systems or data in the digital infrastructure that enable modern energy delivery systems. Availability is a principle concern in Energy Assurance because loss of availability can be tantamount to failure. Were a digital control system to become unavailable during an event, a plant control system might be unable to shut down operations, a breached pipeline could be left open, or a power grid could be left in a persistent fault condition.

Different digital infrastructure domains and interests can have different perspectives on which of the main goals of cybersecurity are most appropriate. A corporation may view confidentiality as a key goal for their enterprise systems, even if it impacts the availability of their systems from time to time. Grid operators may view availability as paramount, even if the integrity of the data could potentially be suspect. These different perspectives represent an important difference between "enterprise cybersecurity" and "critical infrastructure cybersecurity." The definition of success in one domain may represent the definition of failure in another.

It is for this reason that we describe cybersecurity not by the technologies and controls that may be applied, but by the risks, we are able to identify, measure, and manage. Once the systems under consideration are understood and defined, and the risks and consequences of failure are clearly understood, a meaningful cybersecurity risk management plan can be put in place.

Risk and Risk Management in Energy Assurance

When discussing risks to energy infrastructure availability, integrity, and confidentiality goals, it is important to understand the two core concepts associated with risk: impact and probability. Risk impact represents the consequence of an event's occurrence, with no consideration of the likelihood of occurrence. The purpose of impact analysis is to ensure a clear understanding of the consequence of failure, as it relates to the energy infrastructure, and its availability, integrity, and confidentiality. Separate from the impact of a risk, risk probability represents the likelihood of a risk becoming an issue (transforming from a potential to an actual event). The purpose of probability analysis is to understand how likely the risk is to become an actual issue.

The combination of impact and probability inform the cybersecurity risk profile and help set priorities. If a risk has high impact and high probability, it is considered a high risk and likely requires mitigation in order to manage risk to the energy portfolio. An important dimension of impact is its static nature. High impact events generally cannot be easily made into low impact events. For example, the long-term loss of the availability of a SCADA system in the bulk electric system is a high impact event. No amount of cybersecurity will transform the impact of that event from high to low. Conversely, probability is a non-static and manageable dimension. Investment in cybersecurity controls can reduce the probability of an event, and thus reduce the overall risk of the event. Similarly, the omission of security investment and vigilance can increase probability, and thus increase the risk of an unacceptable event.

As a result, cybersecurity risk management in the context of energy assurance needs to follow a process of identifying risks, and the impacts of those risks, to the current and future digital infrastructure underpinning energy portfolios. Once risk and impact are understood in association with availability, confidentiality, and privacy, risk probability can be determined, and reviewed to determine if the overall risk is acceptable or unacceptable.

Finally, risk management cannot be separated from investment cost. The costs and constraints of attempting to deliver complete security everywhere represent an inefficient and unattainable level of investment. Legacy investments cannot necessarily bear the cost of transformation to current perspectives on cybersecurity, and new investments may represent negative business cases and ROIs if burdened with every conceivable security control.

As discussed in previous sections, cybersecurity is not one static definition; it is a creative exercise where impacts of failure need to be considered across complex interdependencies and constantly changing externalities. Likewise, across an energy portfolio, constant change creates new dependencies, impacts, and risks.

In short, there is no clear, consistent, and universal definition of success in cybersecurity. Some amount of risk will always exist, and the goal of cybersecurity should be to understand and manage it in an ongoing and consistent fashion, not to try to eradicate it.

Compliance versus Security in Energy Assurance

Another important theme in cybersecurity is the difference between “compliance” and “security.” Compliance is an adherence to a defined set of controls or standards. A third party defines them and compliance to them means an organization has conformed to them. NERC CIP is a good example of a compliance mandate. NERC has defined a set of operational standards for cybersecurity that bulk-electric organizations must comply. The issue with compliance is that firms and organizations tend to make legal conformance to the standard the goal, instead of cybersecurity risk management. The focus may be shifted to the avoidance of financial penalties and not risk mitigation of digital infrastructures. One of the major issues with compliance is the perception of externalizing risk definition and management. Often with a mandate for compliance comes an attitude of, “you made me do this, so that is what I will do, and that is it.”

Separate from compliance is the concept of security. Security comes from understanding the scope, risk, assets, interfaces, and context of the digital infrastructure, and the mission it serves. Each organization in the critical infrastructure and energy domain has a unique set of scope, history, infrastructure, and mission. Standardizing risk management is virtually impossible across such a heterogeneous domain. Virginia’s goal should be to ensure that energy organizations manage risk, not simply comply with a one size fits all standard. In the security world, professionals are fond of saying, “Security may well lead to compliance, but compliance will seldom lead to security.”

When it comes to cybersecurity in support of energy assurance, neither a strict compliance mandate nor an industry driven risk management program have proven to be sufficient to manage risk. Cybersecurity compliance approaches have tried to standardize too much of the risk management process which is ultimately an intimate organizational challenge. Alternatively, depending on commercial firms to internalize and complete the cybersecurity risk management process to mutually agreeable standards has accomplished too little mitigation, and left too much residual risk. These residual risks could have significant impacts on state energy assurance. Going forward, State Energy Offices should look to a mixed approach in order to assure energy supplies. That approach should include compliance mandates to ensure minimum cybersecurity standards, as well as state pressure on firms to identify, measure, communicate, and manage risk in order to assure state energy portfolios and maintain suitable energy supplies for the population.

Security Controls and Control Catalogs

No discussion of cybersecurity in energy assurance would be complete without a discussion of security controls and controls catalogs. Security controls are the detailed guidance around security challenges and challenge responses. An example of a security control would be an access-control that limits access to a system, resource, or set of data. Security control catalogs, such as NIST SP 800-53, represent comprehensive security control collections that address the breadth of security concepts and concerns. The appropriate application of a security control catalog can manage the risks to confidentiality, integrity, and availability by reducing the probability of a compromise occurring.

Once a digital system has been decomposed and understood in terms of risks, impact, and probability, security engineers and project teams can work to integrate security controls into the system in order to help manage risk and reduce probability of risks becoming issues. Where risk analysis is considered the "top-down" perspective that ties mission and scope to security and impacts, control catalogs are considered the "bottom-up" perspective that tie cybersecurity technologies and strategies to assets and missions. Together, along with other dimensions like threat profiles and threat vectors, they represent the ways in which risk and risk probability are managed.

As an example, an advanced metering infrastructure (AMI) within electric distribution systems requires two fundamental steps in order to suitably be secured. The first is a "top-down" analysis that defines the functions the AMI system will provide to the utility owner. These functions can vary dramatically and could include: remote-meter reading, remote-connect and disconnect, tamper-alerting, voltage monitoring, distribution system monitoring and control, etc. The functions or services provided define the value of the system and inform the consequence of failure. The second step is the "bottom-up" application of security control catalog controls and best practices. Together, the controls can be aligned and prioritized in order to match the mission and functions of the system.

There are a number of control catalogs available and used across the general information technology space, as well as applied specifically to energy and energy systems. A few notable control catalogs include the following.

Table 9-2
Summary of Control Catalogs

Control Catalog	Description
NIST SP 800-53 and 800-82	National Institute of Standards catalog of controls and control application. 800-53 is the foundation for many other security catalogs. 800-82 applies 800-53 specifically to industrial control systems and their specific missions.
NISTIR-7628	National Institute of Standards' guidance on the application of standard control catalogs specifically to the domains of Smart Grid.
ISO 27001/27002	International standard for information security management, and associated best practices.
COBIT	The Control Objectives for Information and related Technology provides an IT security framework often used in support of the Sarbanes-Oxley Act of 2002.
DHS Catalog of Controls	Guidelines and best practices developed by the US Dept. of Homeland Security National Cybersecurity Division.

Most control catalogs cover similar materials in terms of scope, and most maintain traceability to other control catalogs. A great many control catalogs maintain traceability to NIST SP 800-53, and that is the lexicon used in this document.

Within the NIST SP 800-53 control catalog, there are three general classes of security controls: management, operational, and technical. Simply put, management controls establish policies and govern the scope of security within an organization or organizational component. Operational controls, such as configuration management or security event management, represent the people, processes, and tools required to manage the security of assets, components, and systems. Technical controls, such as encryption and access control, represent the technologies and system capabilities required to secure the infrastructure assets, interfaces, and data flows. A capable and effective security plan must include components of all three if it is to be successful. No amount of technology can maintain security without attention and vigilance. No amount of policy can achieve security without people, process, and tools to execute it. In addition, no amount of process can suitably secure insecure technologies. Table 9-3 identifies the key domains covered in the NIST 800-53 control catalog.

Table 9-3
NIST Control Catalog

Identifier	Family	Class
AC	Access Control	Technical
AT	Awareness and Training	Operational
AU	Audit and Accountability	Technical
CA	Security Assessment and Authorization	Management
CM	Configuration Management	Operational
CP	Contingency Planning	Operational
IA	Identification and Authentication	Technical
IR	Incident response	Operational
MA	Maintenance	Operational
MP	Media Protection	Operational
PE	Physical and Environmental Protection	Operational
PL	Planning	Management
PS	Personnel Security	Operational
RA	Risk Assessment	Management
SA	System and Services Acquisition	Management
SC	System and Communication Protection	Technical
SI	System and Information Integrity	Operational
PM	Program Management	Management

Source: NIST SP 800-53 Security Control Classes, Families, and Identifiers

Cybersecurity Landscape and Trends in Energy Portfolios

Virginia's energy landscape has a number of potential cyber-related relationships. The most prevalent are the critical digital infrastructure support systems and the enterprise systems run by the organizations and corporations involved in managing the energy infrastructure. This Section will address where these industrial control, as well as enterprise systems, and cybersecurity create meaningful dependencies for energy assurance.

Industrial Control Systems and the Smart Grid

Industrial control systems (ICS) underpin the management and operation of nearly all modern distributed energy systems. ICS are described in NIST SP 800-82 as follows:

> *ICS, which include supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other control system configurations such as skid-mounted Programmable Logic Controllers (PLC), are often found in the industrial control sectors. ICS are typically used in industries such as electric, water and wastewater, oil and natural gas, transportation, chemical, pharmaceutical, pulp and paper, food and beverage, and discrete manufacturing (e.g., automotive, aerospace, and durable goods.)*

Virtually every energy sector leverages ICS platforms to command and control all manner of generation, storage, and delivery infrastructure. In ICS systems, availability and integrity are generally the driving factors in cybersecurity. Table 9-4 describes ICS platforms across the energy sector.

Table 9-4
Energy Domain Industrial Control Systems

Energy Domain	ICS Examples	Context
Electric Power Generation	Distributed Control Systems (DCS)	Controls plant safety, generation, and market reaction.
Electric Power Transmission and Distribution	Supervisory Control and Data Acquisition (SCADA), Energy Management Systems (EMS)	Situational awareness and control over wide geographies
Electric Power Consumer Interaction	Advanced Metering Infrastructure, Automated Load Control	Metering, remote service point, and in-home consumption control
Oil and Gas Refineries	Supervisory Control and Data Acquisition (SCADA), Energy Management Systems (EMS)	Situational awareness and control over wide geographies
Pipelines & Terminals	Supervisory Control and Data Acquisition (SCADA), Energy Management Systems (EMS)	Situational awareness and control over wide geographies

Historically, ICS systems were designed based on closed-loop proprietary systems where access was fundamentally constrained to “physical” means. The only control point was in the control room, and there were no connections beyond the system. It was a highly specialized system with no connection to the outside world. In order to compromise it, physical access was required. As ICS systems have matured and proliferated, systems have come to be built on standard commercial platforms (like Microsoft Windows), and interconnections have been made with regulatory and enterprise systems in order to share control system metrics, alerts, and data. While these advances have enabled more visibility and capability, they have also connected legacy ICS domains to threats and issues they were not designed to handle.

Another facet of ICS systems are their 24x7 operating cycle. Many ICS systems are used all day, every day. There is no good time for maintenance or upgrades, as they are performing their duties constantly. As a result, software patches and potential upgrades end up being delayed or deferred for long periods, leaving Commercial off the Shelf (COTS) platforms open to known vulnerabilities and threats. In extreme cases, ICS platforms can remain for lifecycles beyond their support horizons. This creates a situation where ICS platforms may be running on legacy OS platforms (Microsoft Windows NT or 95) that cannot be secured and are ripe for attack. Lastly, what works for the enterprise often does not work for ICS platforms. Whereas enterprise systems may maintain a goal of confidentiality above all else, ICS systems generally maintain an availability goal. Too much security is tantamount to a compromise, as the system may become non-functional.

ICS systems leverage non-standard components as compared to their enterprise systems counterparts. Remote Terminal Units (RTUs), Programmable Logic Controllers (PLCs), and Integrated Electronic Devices (IEDs) are all actors and participate in the command and control mission of ICS platforms. These devices tend to be designed for very specific missions, and do not traditionally come with mature or elaborate cybersecurity capabilities.

These characteristics, such as legacy infrastructures, challenging change control, and specialized equipment, make securing ICS systems a very specific challenge. Often remediating legacy infrastructure lacks a business case without a clear and present danger as a catalyst. Within the ICS domain, there are a number of more recent systems that are being introduced under the umbrella of “Smart Grid.” Smart Grid represents a vast domain of new capabilities to measure energy systems, collect and analyze the data, and leverage that analysis for real-time or future command and control operations. Smart Grid ICS systems are focused on the electric power domain of the energy infrastructure, and generally focus on the transmission, distribution, and consumer interaction aspects of electric power. Examples of Smart Grid systems include Advanced Metering Infrastructure (AMI), Distribution Automation (DA), Demand Response (DR), Substation Automation (SA), and many others.

The key aspect Smart Grid brings to the table as compared to traditional legacy ICS systems is their security maturity and capabilities. Legacy ICS systems were designed and built in a conceptual vacuum and were never intended to require comprehensive cybersecurity capabilities. Smart Grid systems are largely “net new” and most are being designed with significantly higher levels of security technical control capabilities. A key aspect of Smart Grid, as well as other new digital energy infrastructures, is the adoption, deployment, and effective operations of these new security capabilities. As discussed in the security overview section, technology alone will not achieve effective risk management. The integration of those capabilities into a mature security operations and management capability is what will provide lasting security investments.

Enterprise Systems

In addition to the ICS infrastructures, most critical infrastructure organizations maintain separate enterprise systems, which are much more focused on business and back-office functions than their ICS counterparts are. In enterprise systems, confidentiality is often a principle driver, even if it has an effect on availability.

Modern energy organizations are finding that the demands for regulatory compliance, leadership understanding, and collaboration are driving the interconnection of ICS and enterprise systems. This allows for a great many benefits in terms of real-time monitoring and reporting, regulatory oversight, and others. However many of the ICS systems in question were designed and architected to a different set of assumptions and goals. Many legacy systems were designed to operate in an "off-line" world, and thus are challenging to secure when connected to enterprise systems.

Cybersecurity Risks and Challenges to Consider in Energy Assurance

Across Virginia's energy infrastructures, and within the ICS and enterprise systems that support them, there are a number of issues that challenge our ability to identify risk, measure risk, and effectively manage risk. State energy assurance plans should identify these challenges and understand where they apply, who are the key stakeholders are, and how they can best be managed through risk management and emergency response planning.

- **Traditional Risk Profiles and Digital Assets:** As energy control systems evolve and mature, more and more historically "unintelligent" assets are being replaced or augmented with assets that maintain digital profiles, configurations, and remote control capabilities. These changes bring a wealth of new capabilities to measure and monitor systems. However, they also transform the risk profile. Legacy infrastructure had a decidedly physical security model. An attacker needed physical access to create an impact. Intelligent and connected devices no longer require that physical proximity, which requires organizations that manage these assets to rethink how they manage and protect their critical infrastructure.
- **Legacy and Aging Infrastructure Risks:** Aging infrastructure used in support of energy management often was not designed or intended to be part of an interconnected set of modern systems. As we demand more situational awareness out of legacy systems, we are required to connect older systems to newer capabilities, and the ability to deploy technical controls to manage the risk of interconnection between the systems is limited. As cybersecurity threats, risks, and best practices evolve, the challenge to uniformly secure heterogeneous systems will increase.
- **Service Lifecycles and Budgets:** In the traditional enterprise world, users get new computers, laptops and smart-phones every three to five years. As the platform lifecycle continues, extended capabilities, speed, and maturity are constantly introduced which allow advancing security controls to be implemented. ICS systems often have 15-20 year lifecycles, restricting how these systems can adopt newer security technologies to respond to evolving threats and risks. As service and support moves on, these ICS systems are left vulnerable and at increased risk of attack (while impact may be consistent, probability increases).
- **Maturing Operational Capabilities:** Security conversations tend to be dominated by technical discussions of threats, attack vectors, and complex technological responses. In legacy ICS systems, these advanced technical discussions can often leave out the most meaningful dimension of managing risk, the ability to monitor and manage security throughout the operational lifecycle. Many legacy ICS systems lack the capacity to deploy advanced security technologies, but almost all of them can be actively monitored for attacks, penetrations, unapproved

configuration changes, etc. A key metric for success beyond our ability to design secure solutions on day one, is our ability to manage the efficacy of that security throughout the long (sometimes 20 years) service lifecycle.

- **Sharing Risk and Situational Awareness information:** Critical infrastructure management organizations tend to be wary of sharing risk and impact information, and often for good reason. Without assurance that the custody of this information will be protected, there can become a real risk that the information is leaked and may serve as a blueprint for attack. For these reasons, DHS and the FBI are more likely to receive the information than state offices. However, there is no substitute for a clear understanding of the issue being faced by operators, and the impacts inaction may present. State energy assurance efforts should work across a protected public/private partnership to identify risk, protect the disclosure of that risk, and plan disaster planning accordingly.
- **Making Security a Bolt-on Instead of a System Lifecycle:** Many energy system operators have long been focused on large and complex operational assets: plants, pipes, towers, platforms, etc. Many do not think of cybersecurity as a risk management practice, but as a capital expenditure. "How much will security cost, and when will it be done?" Energy infrastructure operators need to focus on engaging and delivering ongoing risk management that includes cybersecurity technical, operational, and management controls throughout the design, build, and operate project lifecycle phases. A key area where State energy offices can add value is to encourage operators in adopting security development lifecycles that integrate across their projects.
- **Risk vs. Cost and Perspectives on Value:** Managing risk to ICS and critical infrastructures is widely accepted as a priority, but as with all risk, a subjective perspective on probability and impact, and differing perspectives on the value and ownership of investment can make consensus difficult. Operators may see little or no business value or return on investment from replacing or updating control systems. State planning officials may have a different view of acceptable risk than operators. Risk management, especially in cybersecurity, can be a highly subjective process, where reasonable people can disagree. This underscores the need for an open dialogue and relationships between stakeholders.
- **Buying Security vs. Integrating Security:** Many energy firms believe that security is something that "comes with" new solutions. Smart Grid or SCADA system procurement often includes language about security controls and technical capabilities. These are important steps in integrating security into infrastructure programs, but they are not the whole story. No off-the-shelf product can identify operational impact or consequences, and no asset or technology can monitor the ongoing efficacy of security controls and protections. A wider perspective on risk and security operations are required to create real and lasting critical infrastructure security, which will never be "procured" from a vendor.
- **Avoiding Standards Traps (Compliance vs. Security):** Security and interoperability standards often serve important roles. They help drive focus and often action critical first steps in securing systems and investments. The challenge

with standards, especially security standards, is that they attempt to create one version of risk management. Given the different organizations involved in Virginia's energy portfolios, their different roles, histories, scope, assets, and impacts, it is hard to imagine ever standardizing on what "acceptable risk" looks like. In the face of standards, there are often two simultaneous responses: the standard goes too far, and the standard does not go far enough. Both are right. No formalized structure will achieve a universal view of risk correctly, and manage it appropriately. Standards can play an important role, but are no substitute for risk identification, measurement, and management.

Resources

Critical infrastructure and energy cybersecurity have recently come to the forefront of many security discussions as a major area of concern, investment, discussion, and action. There is a wealth of organizations and resources available to help guide both the decomposition of risk and lead the best practices of security control application to manage those risks. The following represent a survey of major resources State energy assurance efforts may leverage for context and guidance.

Standard Cybersecurity References and Resources

- **NIST SP 800-53: Recommended Security Controls for Federal Information Systems and Organizations:** NIST SP 800-53 is the definitive control catalog for information systems and can be thought of as the "landscape" against which security is measured and considered. It can also be considered as the "list of questions" one might ask of an energy digital infrastructure system. Caution should be taken, as no system would necessarily adhere to all guidance in NIST 800-53. It merely represents a reasonably complete list of areas to investigate in terms of technical, operational, and management security controls.
- **NIST SP 800-82: Guide to Industrial Control Systems (ICS) Security:** NIST SP 800-82 applies the concepts within NIST SP 800-53 specifically to industrial control systems such as those deployed in support of state energy portfolios. This document contains applied guidance, specific ICS challenges, and best practices. This document should also be considered as guidance, not a formal set of requirements.
- **NIST SP 800-30: Risk Management Guide for Information Technology Systems:** NIST SP 800-30 provides a methodology for describing systems, such as ICS systems, and describing vulnerabilities, risks, and impacts. Many energy sector firms may reference NIST 800-30 as a tool for identifying and measuring risk.
- **NIST SP 800-60: Guide for Mapping Types of Information and Information Systems to Security Categories:** NIST SP 800-60 defines a risk management framework and methodology for integrating security into system development lifecycles and "integrating" security into programs. It is used by programs and program managers to make security a part of the overall project and program delivery lifecycle.

- **DHS Catalog of Control Systems Security:** The DHS catalog of controls for control systems is similar to NIST 800-53, but with specific focus on what areas need to be addressed, or at least considered, in identifying, measuring, and managing risk to control systems.

Electricity and Smart Grid References and Resources

- **NERC - Standards CIP-002 through CIP-009:** NERC has defined a set of security standards around assuring critical assets and critical cyber assets as they relate to bulk electric power reliability. The NERC standards generally only apply to 100kV systems and above, which usually limit applicability to electric transmission systems, not distribution and metering systems.
- **Section 1305 of EISA 2007:** Section 1305 defines the roles of both Federal Energy Regulatory Commission (FERC) and NIST as they relate to the development and adoption of smart grid standards. Subsection 1305(d) defines the Commission's role. This subsection reads as follows: "At any time after the Institute's work has led to sufficient consensus in the Commission's judgment, the Commission shall institute a rulemaking proceeding to adopt such standards and protocols as may be necessary to insure smart-grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets."
- **NISTIR 7628 Guidelines for Smart Grid Cybersecurity, Introduction and Volumes 1-3:** Under the direction of EISA 2007, NIST was made the standards organization for Smart Grid interoperability and security. Under that mandate, NIST's cybersecurity coordination task group (CSCTG) developed significant guidance on Smart Grid and Smart Grid security best practices across multiple electric sectors including metering, Home Area Network (HAN), distribution and transmission. The NISTIR guidelines represent a wealth of information on how to approach securing Smart Grid investments, and aggregate a number of earlier efforts as well.
- **NESCO/NESCOR**: Over the next three years, the National Electric Sector Cybersecurity Organization (NESCO) will be working with the National Electric Sector Cybersecurity Organization Resources (NESCOR) to lead a broad-based, public-private partnership to improve electric sector energy systems cybersecurity. NESCO will work with federal agencies to improve electric sector cybersecurity, identify and disseminate cybersecurity best practices to the sector, and develop a dissemination system for threat and vulnerability information.

Oil and Gas References and Resources

- **American Petroleum Institute (API) Standard 1164:** The API 1164 standard on SCADA security provides guidance to the operators of oil and gas liquid pipeline systems for managing SCADA system integrity and security. The document can be viewed as a listing of best practices to be employed when reviewing and developing standards for SCADA systems, and is targeted at small to medium pipeline operators with limited Information Technology security resources.

- **AGA Report No. 12:** Cryptographic Protection of SCADA Communications: AGA 12 is the first of an expected series of documents recommending practices designed to protect SCADA communications against cyber-attacks. It is the product of a cooperative effort by AGA and the Gas Technology Institute in coordination with associations representing the gas, water, and electric industries; manufacturers; SCADA operators; U.S. Government Agencies (National Institute of Standards and Technology and Department of Transportation); and security experts. The intent of the recommended practices is "to provide confidential SCADA communications that are known to be unaltered by potential attackers and that can be authenticated as having originated from valid authorized users."

Areas of Focus for Virginia

In order to help identify, measure, and manage cyber risks to Virginia's energy portfolios, energy assurance efforts should focus on three principle areas.

1. **Define the Problem.** Engage with energy operators in the state and work to understand what ICS platforms are in place, and what the consequence of failure is. There is no substitute for clarity around scope, function, and impact when identifying and managing risk. Without this step, energy assurance efforts and risk mitigation will never get out of the individual details discussion.
2. **Assess the Current State of Security.** What existing systems have had cybersecurity audits performed recently? What were the findings? What new projects are on the horizon? How are the firms running them integrating risk management and security controls into the entire lifecycle? How are they applying technical, operational, and management controls according to best practices (see resources)?
3. **Engage in an ongoing Dialogue.** Develop an ongoing discussion and interaction with the energy operators in the State to continue to discuss enabling technology that supports energy, the state of security, the evolving risks, impacts, and probabilities, and the disaster response plan were an unlikely risk to become an issue.

By engaging in these three activities, Virginia energy assurance efforts can:

- Gain an understanding of the critical infrastructure the Commonwealth depends on
- Understand the risks and impacts that could accompany the compromise of availability, integrity, or confidentiality/privacy
- Understand the current risk and impact posture of the infrastructure, and its consequence for the state
- Identify emergency preparedness and response plans where the State can help manage the risk and impact from a compromise to enabling energy infrastructure
- Identify and understand the particular risks associated with the presence of such key national facilities as the Pentagon and the proximity to Washington, DC have on key energy infrastructure in Virginia

9.2.1 Development of the Cybersecurity Capability

Table 9-5 outlines the general structure of the cybersecurity discussion.

Table 9-5
Outline of Cybersecurity

Introduction to Cybersecurity Concepts	How Cybersecurity Can Impact Energy Assurance at the State and Local Levels
Integrity and energy	Natural gas: current status, trends and Risks
Traditional Risk Profiles	Natural Gas Storage
Trends and challenges with mandated regulatory compliance	T&D and SCADA Controls
Unacceptable outcomes and impacts	Propane: Current Status, Trends and Risks
Local Distribution Companies	Cyber-security in Pipeline Operations
Generation	Risks
Petroleum Products: Current Status, Trends and Risks	Common Approaches to Identifying and Managing cybersecurity Risk in support of energy assurance programs
Refineries	Approaches
Pipelines	Monitoring and Reporting
Trends	Energy applicability
Future view and considerations	Operators
Standards	Consequence and worst-case-scenario planning
Benchmarking	Petroleum Products
Natural Gas	Cybersecurity risk and areas of attention
Cybersecurity risk and areas of attention	Operators
Operators	Consequence and worst-case-scenario planning
Infrastructure	Understand [and envision] future standards and guidelines currently under discussion and development, and how they may affect utilities' plans for Smart Grid development
Propane	Confidentiality
Cybersecurity risk and areas of attention	Risk and Risk Management
Understand the current cybersecurity requirements for the energy sector	Developing a balanced approach
Consider and address the human element of cybersecurity.	Fundamental risks and issues
The CIA Triad [6]	Interstate Pipelines
Availability and Energy	Electric Systems: Current Status, Trends and Risks
Digital Energy Risk profiles	Renewable Energy
The difference between security and compliance	Pipelines, Petroleum Terminals

[6] Continuity, Integration and Availability

9.3 Energy Efficiency

9.3.1 Overview

Generically, EE is understood as those activities associated with enabling more effective energy consumption by improving or increasing the efficiency of the production, process and delivery of energy, and/or improving the production alignment of energy consumption. Efficiency measures such as insulation help retain heat or cooling while buying time for infrastructure repair, replacement or enhancement. Energy efficient motors also reduce the load on grids faced with potential overload and failure. To a certain extent, the variety of measures employed to increase EE can be viewed as forms of alternative energy. Such alternatives typically reduce consumption at the margins and depending on when, where, and how a shortage occurs provide response teams more time to complete repairs or draw upon other sources to alleviate a short supply situation.

EE measures create a smaller energy usage footprint for facilities, processes, and services. This reduced footprint equates to reduced energy demand during normal usage and during partial or total energy supply disruptions. EE is the most cost effective strategy for hardening critical facilities, processes, and services to ensure their maximum availability to the public.

EE and renewable energy can also help diversify and improve the resiliency of supply by better allocating energy resources, and by making consumption more responsive to system constraints and market price signals. State energy offices should continue to promote these resources, recognizing the importance of their role in emergency preparedness and response.

EE can enhance EA through:

- Assured continuity of critical public services.
- Reduced operating costs during normal supply operations.
- Reduced environmental emissions.
- Increased national security through the reduction in dependence in non-U.S. energy supplies.
- Expansion of employment opportunities for U.S. workers.

DOE defines energy security as having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs. Toward that end, DOE directs facilities to:

- Address energy security while simultaneously enhancing mission assurance.
- Conduct a coordinated energy assessment to prioritize critical assets.
- Promote investments in EE.

- Ensure that critical assets are prepared for prolonged outages: natural disasters, accidents, attacks.
- Consider that: Energy Reliability, Security, Sufficiency = EA

9.3.2 Added Value of Local Jurisdiction Participation

Local officials and first responders are essential to EA and security. Local officials can readily identify infrastructure interdependencies thus avoiding potential interference with EA and provide State officials with valuable, real-time information during energy supply disruptions. For example, local officials can report on the operational status of motor vehicle fuel outlets and thereby assist State emergency management personnel to direct emergency vehicles to functioning outlets. It is important to realize that because energy supply disruptions ultimately affect localities EA relies largely on local municipal governments. In addition, local citizens also have a strong interest in comprehensive, integrated EA planning designed to mitigate and enable timely response to the interactive consequences of energy supply disruption. EA – as opposed to energy emergency response – is increasingly recognized not only as an important component of the Nation’s energy emergency planning, but also a more comprehensive and preemptive approach intended to:

- Reduce the likelihood of energy emergencies
- Reduce the potential severity and duration of energy emergencies
- Increase the reliability of access to the energy that underlies every aspect of our lives and economy

Types and examples of energy alternatives are found in Table 9-6.

Table 9-6
Types and Examples of Energy Alternatives that May Lower
EA Risk from Conventional Energy Sources

TYPES AND EXAMPLES OF ENERGY ALTERNATIVES THAT MAY LOWER ENERGY ASSURANCE RISK FROM CONVENTIONAL ENERGY SOURCES DEMAND SIDE CROSSOVER RESOURCES	
Energy Efficient Programs	
ADVANTAGES	DISADVANTAGES
▪ Most effective non-fuel means for providing energy assurance ▪ Well developed and has track record of reducing power consumption ▪ Technological advances have secured constant yielding benefit	▪ Much of the advantage gained from efficiency has been mitigated by demand growth ▪ Human equation can reduce value of efficiency and conservation ▪ Major industries (e.g., automobile) have resisted maximizing energy efficient technology
Renewable Energy Portfolio Standards	
ADVANTAGES	DISADVANTAGES
▪ May encourage large fuel consumers to reduce purchase of carbon-based fuels through combination of regulations and credits	▪ Long-term benefits are still to be measured ▪ Cannot be scheduled or dispatched in the same manner as conventional resources
Demand Response Management ***Smart Grid – Time-of-Day Pricing – Remote Switching***	
ADVANTAGES	DISADVANTAGES
▪ Offers advantage of creating wide-spread efficiency gains thus reducing risk ▪ Participating consumers can see money saving results rapidly ▪ Time-of-day pricing is generally accepted by many industrial, commercial and institutional users ▪ Major federal support has been obtained from some Federal Energy Regulatory Commission members ▪ Pilot programs show promising results for risk mitigation	▪ Any form of external (especially centralized) control raises issues of privacy ▪ Smart grid technology may have serious technological challenges in scaling up from demonstration and pilot programs to large-scale use ▪ Utilities can be expected to weigh capital costs of implementation versus profitability ▪ Long-range benefits are still being debated
Energy Codes	
ADVANTAGES	DISADVANTAGES
▪ Can create common responsibility ("level the playing field") among classes of consumers for costly energy consumption reduction strategies ▪ Once in place, and properly monitored, codes can create permanent technological solutions for energy assurance ▪ Properly administered energy codes enhance environmental benefit as well as energy assurance	▪ Code development is a complex political process involving debate about energy efficiency benefits versus project costs and supplier profit ▪ Local code enforcement officials often resist any state initiatives perceived to challenge local political responsibility ▪ Industries that must incur capital costs can be expected to resist code development

9.3.3 Complementary Local and Federal Efficiency Initiatives

- Federal ENERGY STAR
- State Rebate Programs
- Utility Rebate Programs

Federal ENERGY STAR

ENERGY STAR is a voluntary labeling and recognition program sponsored by the EPA and DOE with the goal of accelerating the adoption of clean and efficient domestic energy technologies. Meeting or exceeding the ENERGY STAR efficiency requirements is typically the requirement for customers to receive financial incentives or other benefits from participation in EE programs. The program provides an opportunity to combine financial resources at the State and federal level to increase energy consumers' awareness regarding the availability specific EE products and services. In Virginia, DMME and other EE program administrators promote ENERGY STAR-qualifying products and services in their various initiatives.

Federal Tax Incentives

During the past few years, available Federal tax incentives have included the following:

- The Emergency Economic Stabilization Act of 2008 (EESA) extends tax credits related to EE measures for both consumers and builders of residential or commercial buildings. Under provisions of EESA, consumers are eligible to receive tax credits for energy-efficient home improvements, such as window or door replacement, roof insulation, and HVAC or non-solar water heater replacements, made during 2009.
- Homebuilders are eligible for a $2,000 tax credit per new home that achieves 50 percent energy savings for heating and cooling over the 2004 International Energy Conservation Code (IECC).[7] In addition, EESA provides a $1,000 tax credit to homebuilders for each manufactured home that achieves 30 percent energy savings for heating and cooling over the 2004 IECC[8] and supplements or meets EPA's requirements under the ENERGY STAR program. EESA also provides owners or developers of new or existing commercial buildings, under certain conditions, with the opportunity to receive a tax deduction for buildings that save at least 50 percent of the heating and cooling energy of a building. A partial tax deduction is available for building efficiency measures including improvements to the building envelope, lighting, or heating and cooling systems.
- In addition, ARRA included Federal tax credits for EE.[9] Consumer tax credits were available at 30 percent of the cost, up to $1,500, in 2009 and 2010 for existing homes, including windows and doors, insulation, metal and asphalt roofs, HVAC, non-solar water heaters, and biomass stoves. Additional tax credits are available at 30 percent of the cost, with no upper limit through 2016, for existing homes and new construction; these include geothermal heat pumps, solar panels, solar water heaters, small wind energy systems, and fuel cells.

[7] One-fifth of the efficiency savings must stem from building envelope improvements.
[8] One-third of the savings must come from building envelope improvements.
[9] ENERGY STAR. Federal Tax Credits for EE. 2009. http://energystar.gov/taxcredits.

9.4 Renewable Generation

Renewable energy is defined as generation that uses a naturally replenished, inexhaustible fuel source. In the electricity industry, this includes generation powered by wind, bio-energy, water, geothermal, or solar energy. In 2010, Virginia's renewable energy resources consisted of, 820 MW of hydropower, and 668 MW of other renewable resources such as biomass.

In addition to existing renewable supplies, Virginia has a voluntary renewable energy portfolio goal to obtain 15 percent of base year 2007 sales, excluding supply from nuclear power plants, from renewable resources by 2025. The voluntary goal offers participating investor-owned utilities cost recovery for meeting the RPS goals, as well as an increased rate of return for each RPS goal attained. Eligible renewable energy sources are solar, wind, geothermal, hydropower, wave, tidal, and biomass energy.

9.4.1 Renewable Generation in Virginia

Renewable generation in Virginia is integrated into the grid operated by the PJM. PJM operates the world's largest centrally dispatched electric grid, and manages the region's generation and transmission expansion planning process. PJM monitors the status of the power grid for a region that includes 1,271 generating facilities connected by more than 56,000 miles of transmission lines. The primary responsibility of PJM is the continuous monitoring and control of the reliable operation of the transmission grid serving the PJM area.

Renewable energy sources are subject to not only the same operational limitations, restrictions, and vulnerabilities as the rest of the power grid. Renewable energy plants must also confront specific risks, particularly the intermittent nature of solar and wind energy.

Section 10
ACRONYMS

AEP	American Electric Power
AMI	Advanced metering infrastructure
APCo	Appalachian Power Company
API	American Petroleum Institute
ARRA	American Recovery and Reinvestment Act of 2009
ATG	Automatic tank gauge
bbl/d	Barrels per day
Bcf	Billion cubic feet
Bcf/d	Billion cubic feet per day
BP	British Petroleum
Btu	Common energy units
CARE	Conservation and Ratemaking Efficiency
CBO	Congressional Budget Office
cf	Cubic feet
CGS	Columbia Gas of Virginia
CHP	Combined heat and power
CIA Triad	Confidentiality, Integrity and Availability
CIP	Critical infrastructure protection
Colonial	Colonial Pipeline
Commission or SCC	Virginia State Corporation Commission
COOP	Continuity of Operations
COTS	Commercial off the Shelf
COVEOP	Commonwealth of Virginia Emergency Operations Plan
CPCN	Certificates of public convenience and necessity
CSP	Curtailment service provider
DC	District of Columbia
DHS	U.S. Department of Homeland Security
DMME	Virginia Department of Mines, Minerals and Energy
DMV	Department of Motor Vehicles
DOE	U.S. Department of Energy
DOLI	Department of Labor and Industry
DOT	U.S. Department of Transportation
DSP	Virginia Department of State Police
DSS	Department of Social Services
EA	Energy Assurance
EAP	Energy Assurance Plan

EAS	Emergency Alert System
EDC	Electric distribution companies
EE	Energy efficiency
EESA	Emergency Economic Stabilization Act of 2008
EIA	U.S. Energy Information Administration
EII	Energy Intensity Index
EIS	Energy Imbalance Service
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
ERO	Electric Reliability Organization
ESF-12	Emergency Support Function 12 (ESF-12) - Energy
ETRM	Energy Tracking and Risk Management
EV	Electric vehicle
FERC	Federal Energy Regulatory Commission
FMCSA	Federal Motor Carrier Safety Administration
GDP	Gross domestic product
HAN	Home Area Network
HOS	Hours of service
HOV	High occupancy vehicle
HVAC	Heating, Ventilation & Air Conditioning
IECC	2004 International Energy Conservation Code
IOU	Investor-owned utility
IRP	Integrated resource plan
ISO	Independent system operator
IT	Information technology
IT risk	Cyber attack
JFO	Joint Field Office
JIC	Joint Information Center
kV	Kilovolt
kWh	Kilowatt hour
LDC	Local distribution company
LIHEAP	Low-Income Home energy Assistance Program
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
LSE	Load serving entity
MAPP	Mid-Atlantic Power Pathway
Mcf	Thousand cubic feet
MEPAV	Municipal Electric Power Association of Virginia
MMbbl	Million barrels
MMbbl/d	Million barrels per day

MMBtu	Million Btu
MMcf	Million cubic feet
MW	Megawatt
MWh	Megawatt hour
NAESB	North American Energy Standards Board
NARUC	National Association of Regulatory Utility Commissioners
NASEO	National Association of State Energy Officials
NERC	North American Electric Reliability Council
NIPP	National Infrastructure Protection Plan
NRECA	National Rural Electric Cooperative Association
NVEC	Northern Virginia Electric Cooperative
NYMEX	New York Mercantile Exchange
OASIS	Open Access Same-Time Information System
ODEC	Old Dominion Electric Cooperative
ODP	Kentucky Utilities Company/Old Dominion Power
OE	Office of Electricity Delivery & Energy Reliability
OPEC	Organization of Petroleum Exporting Countries
OPIS	Oil Price Information Service
OPS	Office of Pipeline Safety
PATH	Potomac-Appalachian Transmission Highline
PBR	Performance-based ratemaking
PHMSA	U.S. Pipeline and Hazardous Materials Safety Administration
PMU	Phasor measurement unit
PSIG	Per square inch gauge
PVEC	Powell Valley Electric Cooperative
RFC	Reliability First Corporation
RPM	Reliability Pricing Model
RPS	Renewable energy portfolio standards
RTEP	Regional Transmission Expansion Plan
RTO	Regional transmission organization
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAVE	Steps to Advance Virginia's Energy
SCADA	Supervisory control and data acquisition
SCC or Commission	Virginia State Corporation Commission
SCED	Security constrained economic dispatch
SERC	Southeastern Electric Reliability Council
SHOPP	State Heating Oil and Propane Program
SPR	Strategic Petroleum Reserve

State	Commonwealth of Virginia
T&D	Transmission and Distribution
Tcf	Trillion cubic feet
TrAIL	Trans Allegheny Interstate Line
TRANSCO	Transcontinental Gas Pipeline Company
U.S.	United States of America
V	Volt
VAC	Virginia Administrative Code
VAPGA	Virginia Propane Gas Association
VDEM	Virginia Department of Emergency Management
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation
VEDP	Virginia Economic Development Partnership
VEOC	Virginia Emergency Operations Center
VEP	Virginia Energy Plan
VERT	Virginia Emergency Response Team
VHHA	Virginia Hospital & Healthcare Association
VITA	Virginia Information Technologies Agency
VMDAEC	Virginia, Maryland and Delaware Association of Electric Cooperatives
VNG	Virginia Natural Gas
VPC	Virginia Petroleum Council
VPCGA	Virginia Petroleum, Convenience, and Grocery Association
VRA	Vulnerability and Risk Assessment
WMCOG	Washington Metropolitan Council of Governments