Request for Information

State-Provincial Steering Committee

Western Interstate Energy Board
1600 Broadway, Suite 1700
Denver, Colorado 80202

Western Natural Gas-Electric Assessment

Request for Information: Western Natural Gas-Electric Assessment

Issue Date: February 1, 2013

Closing Date: March 1, 2013

Responses must be submitted to: aginocchio@westgov.org **and** tcarr@westgov.org.

This is a Request for Information (RFI) only. SPSC will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. SPSC may or may not issue a Request for Proposal (RFP) or other Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

State-Provincial Steering Committee (SPSC)

Request for Information: Western Natural Gas-Electric Assessment

Program Manager: Doug Larson, Director, Western Interstate Energy Board

Subject:

This is a Request for Information (RFI) seeking input on how to conduct a study that addresses two questions: (1) Will there be adequate natural gas infrastructure (interstate and intrastate), including storage, to meet the long-term needs of the electric industry in the Western Interconnection? If not, what needs to be done? (2) Will the gas system have adequate short-term operational flexibility to meet electric industry requirements in the Western Interconnection? If not, what needs to be done?

SPSC and the Committee on Regional Electric Power Cooperation (CREPC) formed the Western Gas-Electric Regional Assessment Task Force ("Task Force") to make recommendations on the scope of work (SOW) for the assessment. The Task Force seeks feedback and information on alternative approaches, appropriate project phases, analytical tools, and data to analyze these questions. This information will be used to further develop the scope of work (SOW) for a Request for Proposal (RFP). Information about the Task Force, related documents, and recordings of the meeting webinars are available at: http://www.westgov.org/ngei/index.htm.

Background:

The increased reliance on natural gas as the primary fuel for electricity generation and the challenges it presents to both operations and planning have raised concerns in most regions of the country, including the West. SPSC is currently considering undertaking a natural gas-electric regional assessment throughout the Western Interconnection. The Western Interconnection includes eleven western U.S. states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming); two western Canadian Provinces (Alberta and British Columbia); and the northern part of Baja California, Mexico. A map of the Western Interconnection is appended as ***Attachment #2*****.**

SPSC consists of one representative of the Governor and one representative of the public utility commission from each state in the Western Interconnection plus representatives from Alberta and British Columbia. SPSC provides input into industry interconnection-wide transmission planning, fosters policies to improve the efficiency of the transmission system, and evaluates region-wide actions to minimize the cost of integrating large amounts of renewable energy. Pursuant to a DOE electric transmission planning grant to the Western Governors' Association (WGA), the Western Interstate Energy Board (WIEB) provides staff support to SPSC. CREPC is a joint committee of WIEB and the Western Conference of Public Service Commissioners. CREPC consists of representatives from public utility commissions, energy agencies and facility siting agencies in the U.S. states and Canadian provinces in the Western Interconnection. CREPC works to improve the efficiency of the western electric power system and works in

conjunction with SPSC on a number of projects. Additional information about SPSC and CREPC are available at the WIEB website: http://www.westgov.org/wieb/.

The increased reliance on natural gas as the primary fuel for electricity generation and the challenges it raises have been priority issues for CREPC and SPSC for the last year. At the recent joint meeting of SPSC/CREPC and the Resource Planners' Forum on October 4, 2012, a session consisting of diverse stakeholders in the electric and natural gas sectors explored the need for a regional infrastructure assessment to understand the risks and assess the reliability at the interface of the natural gas and electric systems in the region. The following day SPSC/CREPC passed a motion to form a task force to develop the scope of work for a west-wide gas-electric assessment.

The Western Gas-Electric Regional Assessment Task Force began meeting on November 5, 2012. The Task Force determined that initial efforts would be focused on modeling the electric sector's demand for natural gas and the natural gas sector's ability to meet that demand in the Western Interconnection, conducting peak day/design day analyses, scenario analyses, and contingency analyses. Solutions and mitigation strategies will be integrated if problems or vulnerabilities are identified. A key issue in the West is whether the gas system of pipelines, storage and compressors will be able to respond with enough speed to deliver large amounts of natural gas to gas-fired generators to meet large ramp requirements, especially for the integration of variable energy resources (VER).

The Task Force developed a draft scope of work (SOW) outlining an approach to such an assessment, which is appended to this RFI as ***Attachment #1***, however, ongoing deliberations have raised a number of questions about how to perform the analysis and the feasibility of alternative approaches. Questions in this RFI are framed in part around the draft SOW, however, the draft SOW is a working document and should be viewed as a resource to help frame and describe the project, not as a guidepost instruction on how it can best be executed. In fact, the purpose of the RFI is to inform development of the SOW. The SOW will be revised based on the responses to these questions and further development of the RFP.

Purpose:

SPSC wants a study to examine the ability of the natural gas system to meet the growing needs for natural gas fired electricity generation in the Western Interconnection. SPSC seeks information from responders to inform the development of the SOW for the RFP. It is the intention of SPSC to move the RFP process forward quickly after evaluating the information from the RFI responses, however, SPSC does not offer any assurance that an RFP or other FOA will be issued and reserves the right to discontinue the RFI and RFP process at any time.

A draft SOW for the study has been developed through a Task Force (see Background above), however, questions remain unanswered in the SOW and these questions and others are being addressed to the respondents to the RFI. Specifically, the Task Force seeks more information about analytical approaches, appropriate phases for performance of tasks, methodologies and costs to conduct such an assessment.

This is a Request for Information (RFI) only. SPSC will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. SPSC may or may not issue a Request for Proposal (RFP) or other Funding Opportunity Announcement (FOA) based on consideration of the input received in response to this RFI.

RFI Response Instructions and Guidelines:

Responses to this RFI must be submitted in Microsoft Word (.doc or .docx) or Adobe Acrobat (.pdf) format and emailed to both Alaine Ginocchio (aginocchio@westgov.org) and Thomas Carr (tcarr@westgov.org) **no later than 5:00 p.m. MST on Friday, March 1, 2013.**

The email subject line should read as follows: "**RFI Response: Western Natural Gas-Electric Assessment**."

WIEB will hold an Informational Meeting via webinar-conference call on Friday, February 15, 2013 at 11:30 a.m. MST. The meeting will be a question and answer format where potential respondents can ask questions about the RFI and WIEB will provide answers to those questions. This meeting will also serve as an information gathering session for staff. Access information is as follows: Web link: http://westgov.adobeconnect.com/wgetf/; phone: 1-888-850-4523; passcode: 568900. Participants can sign in as a "guest" to the webinar.

Potential respondents can also submit written questions about the RFI by Wednesday, February 20, 2013, 5:00 p.m. MST. WIEB will respond with answers to the written questions by February 26, 2013 and post these questions and answers on the WIEB website. Written questions should be submitted after the Informational Meeting to Alaine Ginocchio (aginocchio@westgov.org) and Thomas Carr (tcarr@westgov.org).

SPSC is seeking cost information for approaches or methodologies recommended by respondents.

While SPSC will evaluate all conforming RFI submissions, SPSC makes no commitment to any submitter that it will incorporate or otherwise act upon any information provided in response to this RFI or the subsequent RFP. This RFI does not commit SPSC to award a contract, to pay any costs incurred in preparing the response to this request or to procure a contract for services or supplies. SPSC reserves the right to accept or reject any or all responses received as a result of this request. SPSC also reserves the right to discontinue the RFI and RFP process at any time.

No confidential information should be included in RFI submittals, and SPSC shall not be held responsible for disclosure of any information submitted as part of the RFI, even if labeled "confidential" or "proprietary." Although it is not our policy to publish the responses on a publicly accessible website, they will form the basis of future Task Force discussions (Task Force webinar-meetings are recorded and archived) and discussions with SPSC and CREPC.

Content of RFI Responses:

1. **Organization information and expertise:**
   - Name:
   - Organization:
   - Area of Expertise:
   - Mailing Address:
   - Phone:
   - Email Address:
   - Include information about your work, experience or expertise on the following: other similar projects (e.g., gas-electric assessments); the Western region; and evaluating operational flexibility / gas system flexibility.
2. **Answers to RFI questions (see pages 8-9)**

Goals and Objectives of Assessment

The Task Force identified two fundamental questions in the Western Interconnection that we intend to address:

1) Will there be adequate natural gas infrastructure (interstate and intrastate), including storage, to meet the long-term needs of the electric industry in the Western Interconnection? If not, what needs to be done? (Objectives 1-3 below)
2) Will the gas system have adequate short-term operational flexibility to meet electric industry requirements in the Western Interconnection? If not, what needs to be done? (Objective 4 below)

To address these questions, the Task Force has identified four objectives:

Objective 1: Assess the gas-electric system. Analyze and evaluate the electric sector's demand for natural gas and the natural gas sector's ability to meet that demand in the Western Interconnection and its subregions. The methodology for this assessment could be designed to link with existing models and publicly available data that has been vetted by stakeholders. In addition the study methodology should become a tool to build sustainable collaboration among the two industries and stakeholders in assuring coordinated planning that promotes reliability. Included in this objective is the identification and mapping of the key components of the two systems and conducting a market balance analysis for specified peak days/design days and annually.

Objective 2: Conduct scenario analyses. Evaluate the adequacy of the natural gas pipeline system to reliably meet the electric sector's demand for natural gas and other demands for natural gas 10-years into the future under expected conditions and a robust set of plausible futures. Intermediate points of analysis should be examined along the ten-year path where feasible.

Objective 3: Conduct contingency analyses. Evaluate the robustness of the natural gas pipeline system to deliver gas to the electric sector subject to a series of contingencies characterized by infrastructure or equipment failures 10-years into the future. Intermediate points of analysis should be examined along the ten-year path where feasible.

Objective 4: Perform operational assessment with a focus on integrating variable generation. Evaluate the operational flexibility or gas system flexibility. The gas and electric industries plan and operate in different time scales. Understanding the ability of the natural gas system to meet the needs of the electric power system to satisfy peak loads and flexibility requirements is important. A key issue is the adequacy of the natural gas pipeline system to deliver large amounts of natural gas over short periods of time to enable the electric sector gas-fired generator fleet to ramp up or down to integrate high levels of variable generation in the future. It may be appropriate to focus this phase of the work on specific geographic areas where work under Objectives 1-3 points to the need for specific operational analysis.

Alternative approaches considered by the Task Force:

The Task Force initially developed a draft SOW that is based on Alternative #1 described below. Subsequently, the Task Force discussed two other possible approaches to the assessment, also outlined below. Uncertainties around the best approach and capabilities to perform these alternatives prompted the Task Force to issue the RFI. We are looking for the best approach whether it is one of these three options ***or a different methodology*** that would meet the objectives of the project in the most cost effective manner.

(1) **Develop a model.** Initially, the Task Force developed an approach, as outlined in the draft SOW (Attachment #1), for a contractor to develop a functional model that integrates the electricity and natural gas systems. Due to considerations of cost and time, we envisioned linking existing models, such as commercially available software, and using existing data sources to construct the gas-electric model. Questions remain as to the time, cost and general feasibility for this approach. For example, what type of existing natural gas sector models would be available and applicable for this project? Where would data from the gas side come from? How complicated would it be to bring the two models together? What are the estimated start-up and operational costs associated with this approach (e.g., software licensing, staff, data, etc.) In addition, what are the implications of developing a model that analyzes resource adequacy (objectives 1-3) versus one that analyzes operational flexibility (objective 4). See Question 5 below.

(2) Contractor performs the analysis using the contractor's or third party resources. The Task Force has questions about the cost and sophistication of the analytic tools available for the first approach (model development). As an alternative, all or part of the analysis could be performed with contractor-owned resources. Questions remain as to the type of modeling capabilities or analytical tools contractors would use to perform the assessment? What data would be used, especially for the gas delivery side of the analysis? Because transparency is a very important principle for SPSC and for the credibility of the project, how open would the process, tools and data be to public or third party scrutiny? What are the timeframes and

expected costs for this approach? Finally, it is not clear, how this option would develop into a sustainable process.

(3) Natural gas pipeline companies perform hydraulic modeling. Several natural gas transportation companies offered to perform hydraulic modeling of their own pipelines for this assessment. The Task Force is considering the following approach for the assessment:

- Electric industry develops its demand for gas under specified scenarios and conditions
- Gas pipeline industry models delivery of gas under these scenarios
- Contractor coordinates the development of electric industry scenarios and gas industry modeling

A number of questions remain regarding the implementation of this strategy, see ***Attachment #3***. Given the number of issues regarding implementation, questions remain as to the probability of success. One key issue is that the modeling contributions would be limited to 3-4 scenarios or contingencies; this is a substantial contribution by the gas transportation companies, however, the Task Force contemplates a much more extensive analysis. As an alternative, the Task Force is considering a targeted use of this approach. Questions remain as to how to target or efficiently use hydraulic modeling by the natural gas transportation companies.

Scope, timing and other parameters of the assessment:

- SPSC's gas-electric assessment project hopes to build a sustainable collaborative process between the two industries.
- ***We anticipate a 9 month period for contract performance, therefore, responses should be based on work that can be accomplished within 9 months.***
- The geographic scope of the project is the Western Interconnection as a whole, its subregions, and more granular geographic analysis as needed. We consider it possible that the work performed to meet Objectives 1-3 could determine the necessary scope and geography for the operational analysis to meet Objective 4. The geographic footprint of the Western Interconnection is largely composed of the 11 western U.S. states, two western Canadian provinces and the northern region of Baja California, Mexico. A map of the Western Interconnection is appended as ***Attachment #2*****.**
- The study period is 10 years into the future with intermediate points of analysis along the 10 year path if feasible.
- The focus of the supply side of the assessment is on gas delivery as opposed to gas production.
- We seek cost ranges, cost estimates and/or a discussion of the costs associated with each segment of the work.
- Cost efficiency is a key parameter. We are looking for the least cost method to get meaningful results.

RFI Questions

Question 1: Recommendation for the approach to the assessment. We invite you to comment on the three approaches thus far considered by the Task Force (see pages 6-7 above). However, ultimately we would like your recommendation for the best approach to perform the assessment ***which may or may not be one of the alternative approaches considered thus far by the Task Force***; it may also be a combination of approaches. Please provide a detailed description of the recommended approach. Also include cost estimates, comparisons or a discussion of costs. Clearly explain why the results from your approach would be meaningful, including enough detail about the recommended methodology or methodologies so that the Task Force can assess this.

All or some of the remaining questions may be part of the response to Question 1. If so, please indicate this in your responses to those questions.

Question 2: **Phased Implementation.** Should the project be performed in two distinct phases, with Phase 1 addressing infrastructure adequacy questions (fundamental question #1 on page 5 of the RFI and Objectives 1-3 on pages 5-6), followed by an evaluation of Phase 1 results and performance of Phase 2 operational questions (fundamental question #2 on page 5 and Objective 4 on page 6) based on findings of areas of concern identified in Phase 1. As defined here, please address whether a Phase 1 project scope would have stand-alone value without performance of Phase 2? Would the two distinct project phases require different modeling tools and separate participation by pipeline industry representatives? Are there other phased approaches to the project that should be considered?

Question 3: For each objective or segment of work, what time scale is sufficient in the analysis to produce meaningful results; this is especially important for the gas delivery side? For example, should the analysis be weekly, daily, hourly, sub-hourly or other? We are looking for the most cost effective approach, however, the results must be meaningful, that is, reliable enough to provide information about any real risks to the system. Can we get meaningful results for the first fundamental question (objectives 1-3) with a less granular analysis (especially on the gas delivery side) than that which may be required for the second fundamental question (objective 4)? What are our options for objective 4?

Question 4: Data. Identify the data that is available or that you would recommend using, especially on the gas delivery side, and any cost associated with data collection or third party provided data. Provide as much information as possible about the data you recommend, such as sources, whether the information is available to the public, the time series of the data, whether it is geographical (e.g., represented by nodes) and formats of the data. Also, if there are proprietary issues associated with any data necessary for the study include how this would be addressed.

Question 5: Feasibility of model development. It is our preference to have a sustainable process. Would it be feasible to develop a model that addresses all four objectives sufficiently and what are the time and cost implications? Compare this to an approach that includes model development for objectives 1-3 and a different approach for objective 4.

Question 6: Subregions. For the subregional analysis, the draft SOW presumes the use of the WECC study regions. The WECC study regions include: (1) Northwest; (2) California North; (3) California South & CFE (includes northern part of Baja California, Mexico); (4) Basin; (5) Rockies; (6) AZNMNV; (7) British Columbia, Canada; and (8) Alberta, Canada. A map of the study regions is appended as ***Attachment #2*****.** One of the reasons for choosing these subregional footprints is that these are the subregions used by WECC's Transmission Expansion Planning Policy Committee (TEPPC) to model and analyze the Western Interconnection (see Question 8 below). However, given your expertise regarding the natural gas transportation system or the approach you are recommending for the study, would you recommend different geographic footprints for the subregions and why?

Question 7: Top down or bottom up process. How would you propose to conduct the analysis across the geographic scope of the Western Interconnection and the major subregions? Do you recommend starting at the regional level and working towards more granular analyses, or starting at the subregional level and working out geographically?

Question 8: Use of WECC's TEPPC Data. The draft SOW envisions the use of TEPPC 2022 Reference Case data for the gas demand for electricity generation, which is the result of cost production modeling. This data has been publicly vetted and is publicly available. If you recommend a different data set, please explain why. The draft SOW presumes intermediate points of analysis along the ten-year path where feasible. Presuming the use of the TEPPC 2022 data, how would you construct the demand data for intermediate points of analysis?

Question 9: Variable Generation Demand Data. The draft SOW envisions the use of a growing body of work in the electric sector for modeling variable generation and effects on natural gas demand. This includes WECC-E3 modeling for EDT; PUC EIM Group-NREL modeling on a proposed EIM; Northwest Power Pool on a regional EIM; and NREL modeling for Phase 2 of Western Wind and Solar Integration Study. See Attachment #1, draft SOW, p. 4, Objective 4, subpart b. If you recommend a different source for this data explain why.

Attachments:

#1**:** Draft Scope of Work
#2**:** WECC Map of Western Interconnection and Study Subregions
#3**:** Questions re: Hydraulic Modeling Performed by Gas Transport Companies

Draft Scope of Work: Regional Assessment of the Gas-Electric Interface in the West (Dec. 7, 2012)

Project Framework

This project will analyze the challenges at the interface of the natural gas and electric systems in view of the increasing reliance on gas-fired electric generation and the expanding role of variable generation in the Western Interconnection. The purpose is to determine whether the natural gas system can reliably deliver gas to electricity generators in the future. The geographic scope of the project is the Western Interconnection as a whole, its subregions, and more granular geographic analysis as needed. The scope of work covers an analysis of the gas-electric systems balance ten-years into the future including scenario analysis, contingency analysis, and an assessment of the short-run operational challenges posed by the integration of variable generation. Intermediate points of analysis should be examined along the ten-year path where feasible.

A technical review committee will be formed that is representative of industry, regulators, and others engaged in examining the interface of the gas and electric sectors in the Western Interconnection. The technical review committee will review, oversee and manage the contractor in this project.

Guidance on Project Development

Bidders on this RFP shall explain how they will perform their analysis to conform to the following instructions. The project will rely on existing work wherever possible and cooperate with current initiatives underway in the Western Interconnection. The contractor shall perform outreach to subregions to ensure that issues specific to the subregions are reflected in the analysis and work is not duplicated. The analysis should be based on publicly available data and open to stakeholder input and review.

Throughout the study, the contractor shall recommend solutions to address vulnerabilities or problems identified in the gas-electric interface.

If the contractor chooses a different methodology than that proposed in the scope of work the rationale for, and benefits associated with, that course of action should be provided.

Project Objectives

1. Build a functional model that characterizes the interface of the electric sector's demand for natural gas and the natural gas sector's supply of natural gas in the Western Interconnection and its subregions. This interface model could be designed to link with existing models and publicly available data that has been vetted by stakeholders. The interface model should become a tool to build sustainable collaboration among the two industries and stakeholders in assuring coordinated planning that promotes reliability. This objective will be met in the gas-electric market balance scope of work for the project.

2. Evaluate the adequacy of the natural gas pipeline system to reliably meet the electric sector's demand for natural gas and other demands for natural gas 10-years into the future under expected conditions and a robust set of plausible futures. This objective will be met in the scenario analysis scope of work for the project.
3. Evaluate the robustness of the natural gas pipeline system to deliver gas to the electric sector subject to a series of contingencies characterized by infrastructure or equipment failures. This objective will be met in the contingency analysis phase of the project.
4. Evaluate the adequacy of the natural gas pipeline system to deliver large amounts of natural gas over short periods of time to enable the electric sector gas-fired generator fleet to ramp up or down to integrate high levels of variable generation in the future. This objective will be met in the operational assessment phase of the project.

Scope of Analysis to be Performed

1. **Objective 1: Model the Gas-Electric Interface**. Build a functional model that characterizes the interface of the electric sector's demand for natural gas and the natural gas sector's supply of natural gas in the Western Interconnection and its subregions. This gas-electric interface model could be designed to link with existing models and publicly available data that has been vetted by stakeholders. The interface model should become a tool to build sustainable collaboration among the two industries and stakeholders in assuring coordinated planning that promotes reliability. The gas-electric interface model will include, but not be limited to, the following features and characteristics:
    a. Electric system
        i. Rely on existing body of work from WECC's Transmission Expansion Planning Policy Committee (TEPPC) to identify key transmission paths, generation, and load zones.
        ii. Use specific assumptions of TEPPC's 2022 Common Case that looks 10-years in the future and assumes IRP and other utility plans on future generation, utility load forecasts adjusted to meet DSM policies, and the Common Case Transmission Assumptions which are stakeholder vetted transmission additions identified as having a high probability of being built.
        iii. Derive the demand for natural gas by the fleet of natural gas-fired generation in the electric sector under foreseeable future conditions using probabilistic modeling techniques.
    b. Gas system
        i. Identify and map the current 2012 natural gas system to overlay with the 2022 electric system. Characterize the current gas supply and infrastructure including production areas, major pipelines, and storage facilities.
        ii. Identify and calculate the demand-side of the natural gas system that includes LDCs, industrial users, and gas generators.
        iii. Calculate the amount of gas available for gas-fired electric generation.

iv. Add any known pipeline or major infrastructure projects that are expected to be operating by 2022 with a high degree of confidence and confirmed by consensus by participants and observers of the gas industry.
v. Remove any pipelines expected to be retired or converted to another use. Rely on existing data sources that are publicly available and consider regional studies including, but not limited to, the Northwest Gas Association's Outlook with projections through 2021, the California Gas Report, the Northwest Gas Electricity Primer, BPA Whitepaper: The Role of Natural Gas in the Northwest's Electric Power Supply, etc.
vi. If feasible, model should include other important features that impact the availability of gas for gas-fired generation:
    1. Balancing requirements on the pipelines
    2. Curtailment practices and protocols on pipelines
    3. Identifies which pipelines provide hourly service

c. Market interface balance
    i. The model should identify the market equilibrium or gap between the electric sector's demand for gas and the gas sector's supply of gas in subregions of Western Interconnection for the following time periods:
        1. Annual
        2. Winter peak
        3. Summer peak
        4. Fall period when gas is being injected into storage
        5. Spring
    ii. The analysis should address potential impacts under different levels of gas supply and transportation contractual relationships (i.e., firm and nonfirm arrangements).
    iii. If the expected gas infrastructure does not meet future loads in some zones, identify infrastructure of new pipelines and/or storage as potential solutions to constraints in the gas system.
    iv. If an intermediate study period shorter than 10-years is feasible , examine the market equilibrium or gap for such intermediate time period for the Western Interconnection or appropriate subregions.

2. **Objective 2: Scenario Analysis**. Evaluate the adequacy of the natural gas pipeline system to meet the electric sector's demand for natural gas and other demands for natural gas 10-years in the future under expected conditions and a robust set of plausible futures. The contractor will identify key scenarios that should be modeled to identify potential vulnerabilities and risks in the Western Interconnection. The contractor will also identify scenarios most relevant to individual subregions. The contractor will provide the rationale for the scenarios identified including an explanation for how each scenario is key to evaluating system adequacy. Where vulnerabilities are identified, the contractor will provide recommendations for potential solutions.

3. **Objective 3: Contingency Analysis**. Develop a series of contingencies characterized by infrastructure, equipment failures or other major events for the purpose of testing the robustness of the natural gas pipeline system to deliver gas to the electric sector.

Consider multiple stresses in one or more of the contingencies. The contractor will provide the rationale for the contingencies identified for analysis including an explanation for how each is key to evaluating the robustness of the system. Where vulnerabilities are identified, the contractor will provide recommendations for potential solutions.

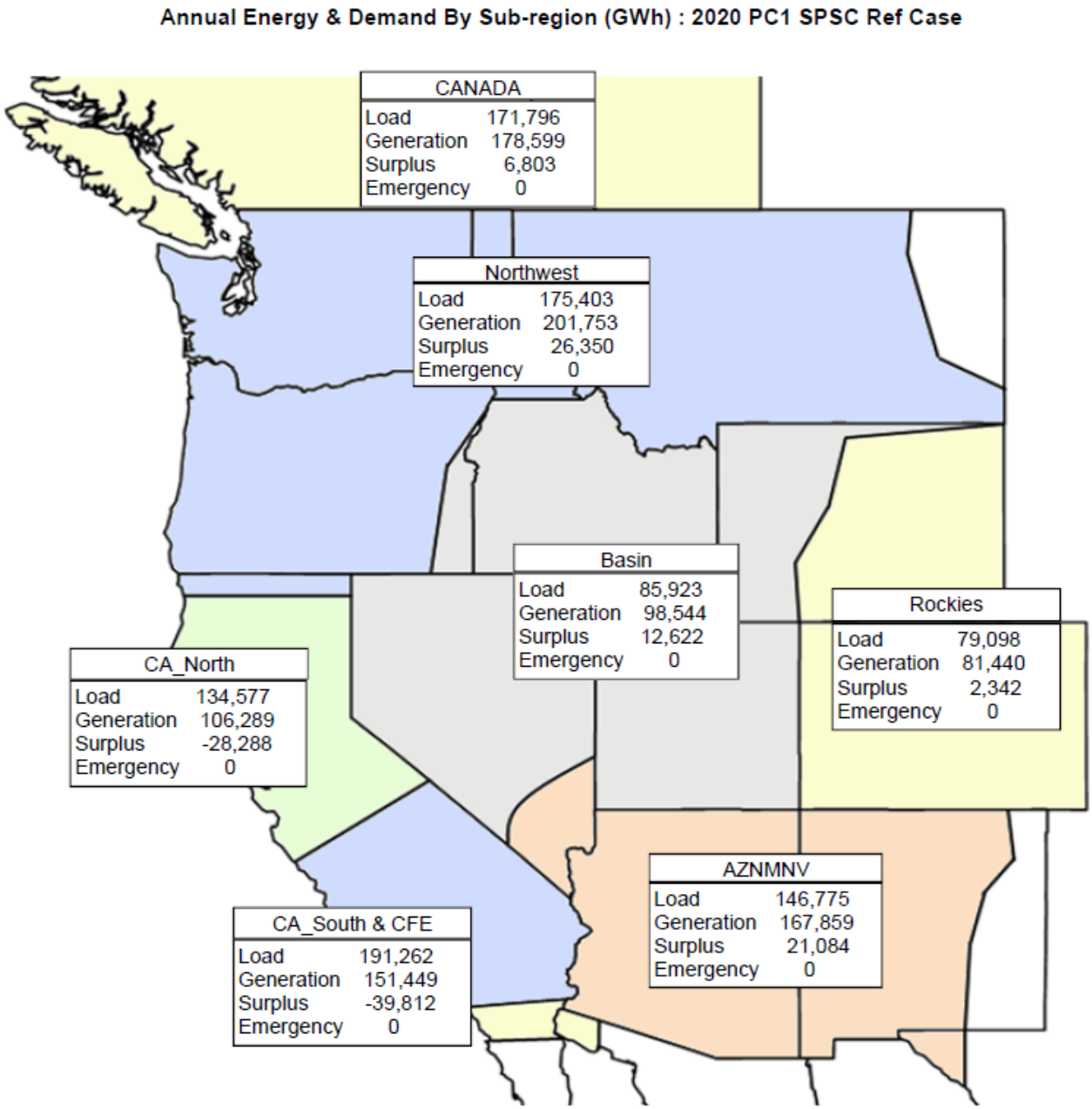
4. **Objective 4: Operational Assessment to Integrate Variable Generation**. Evaluate the adequacy of the natural gas pipeline system to deliver large amounts of natural gas over short periods of time to enable the electric sector gas-fired generator fleet to ramp up or down to integrate high levels of variable generation in the future. This analysis will drill down on short time periods to assess gas deliverability during big gas-fired generation ramps due to changes in wind and solar variable generation. This operational assessment should consider, but not be limited to, the following:

    a. *Geographic Scope*. The stress on the combined systems from changes in variable generation and large ramps on the gas fleet is likely to be a subregional issue in the short term. The impacted subregion may need to rely on imports or exports of neighboring subregion(s) or potential market reforms to balance its system. Therefore, the focus of this type of analysis will start with a narrow geographic scope such as a utility or subregion, and potentially expand as the electric system taps resources in other subregions.

    b. *Electric Sector*. The analysis should rely on a growing body of work in the electric sector using production cost models (WECC-E3 modeling for EDT; PUC EIM Group-NREL modeling on a proposed EIM; Northwest Power Pool on a regional EIM; NREL modeling for Phase 2 of Western Wind and Solar Integration Study). All of these efforts should build upon the TEPPC 2020 Reference Case. The modeling was improved by these different groups by expanding the data set to a sub-hourly time frame and running production costs models (e.g., Plexos) on a 10-minute timeframe. The contractor shall build upon this body of integration studies and incorporate material updated assumptions from the TEPPC 2022 Common Case (e.g., coal plant retirements, OTC retirements and replacements).

    c. *Gas Sector*. The crucial issue is whether the gas system of pipelines, storage and compressors will be able to respond with enough speed to deliver large amounts of natural gas to gas-fired generators in a subregion to meet large ramps. This type of problem is typically addressed using hydraulic modeling. Hydraulic modeling can be a time consuming and expensive process. Potential contractors are encouraged to develop methodologies and tools that would be useful in analyzing the gas system's ability to deliver large amounts of gas to electric generators and meet other customer needs.

WECC Western Interconnection Study Regions



Attachment #3
RFI: Western Natural Gas-Electric Assessment

Questions re: Hydraulic Modeling Performed by Gas Transport Companies

The following are some of the questions raised by the Task Force and staff regarding an approach to the study in which the natural gas transportation companies perform the modeling (hydraulic) for the gas delivery side of the analysis:

- How do we get modeling contributions from all pipelines?
- Will pipelines be willing to model to the extent necessary?
- Pipelines are volunteers, what would we do if circumstances change and commitments need to change?
- With different models and capabilities, will it be possible to bring consistency to the process and results? Can we even model across all systems in a manner that addresses our questions or scenarios?
- Are there issues with the black box modeling approach? Will there be any opportunity for public or 3d party scrutiny of model and/or data?
- Perceived conflict of interest. Will there be push back or will the results be viewed as potentially biased, if they are in part the outcome of a black box model performed by businesses with a financial stake.
- Will this become a sustainable process?[1]

[1] Excerpt from December 21, 2012 Western Gas-Electric Regional Assessment Task Force meeting presentation, slide 14, available at: http://www.westgov.org/ngei/index.htm.