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NVEnergy™

Distributed Generation Study

Presentation to California Energy Commission

IEPR Committee Workshop

June 22, 2011

Navigant identified the maximum amount of DG that can be installed within operating limits and assessed DG impacts, costs and benefits.

NV Energy DG Study

Background

- The Public Utility Commission of Nevada issued an Order to determine how DG can impact NV Energy's energy delivery system performance, reliability and distribution operations, as well as electricity rates.

Project Scope

- What is the maximum amount of DG from renewable energy that can be integrated on the distribution systems of NV Energy within existing operating limits?
- What are the costs and benefits of DG?

Navigant Focus

- Use 80/20 rule; balance micro-level precision, macro-level applicability, and speed of analysis
- DG options are mostly PV, with some wind in rural areas

This study was sponsored by NV Energy and the U.S. Department of Energy (through Sandia National Laboratory)

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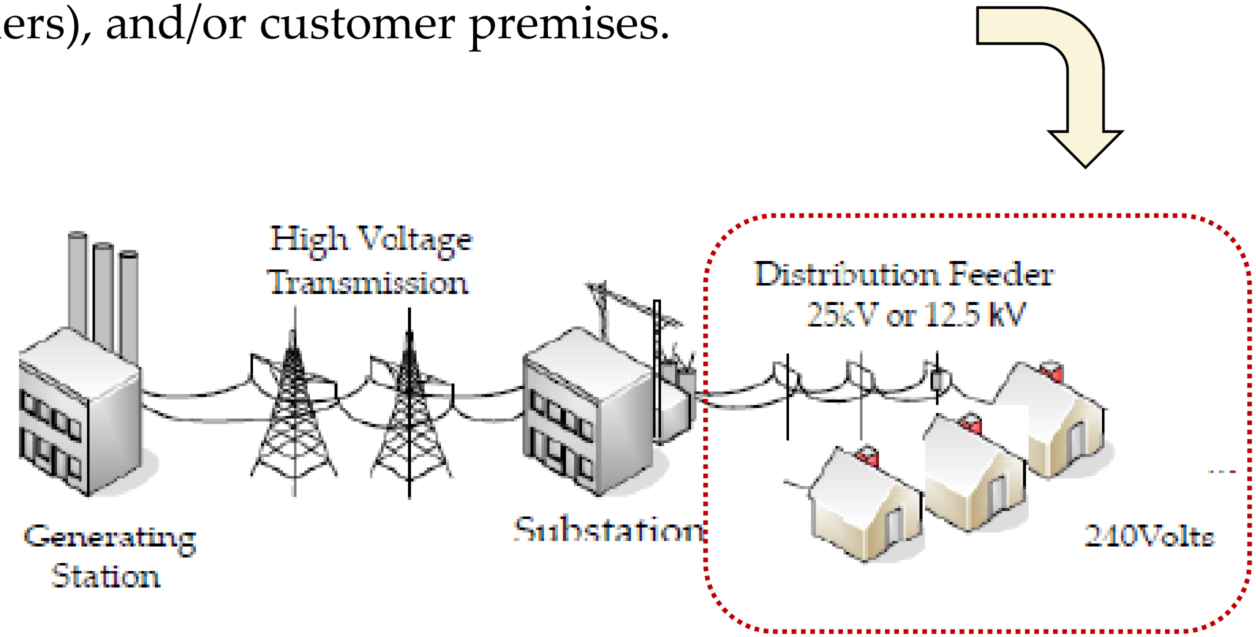
The study analyzed DG from the utility perspective. Specifically, it evaluated the technical and economic impacts of DG on NV Energy's system and ratepayers.

- It did not address the cost, economics or value of DG from the DG owner's perspective.
- The investigation focused on DG installed on NV Energy's distribution lines (feeders), and/or customer premises.



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The following Stakeholders participated in project meetings and provided feedback on assumptions, methods, and interim results.

Name	Organization	Stakeholder Area of Interest
David Hicks	NV Energy	Electric Utility DG Impact
Vladimir Chadliev	NV Energy	Electric Utility DG Impact
Richard Salgo	NV Energy	Electric Utility DG Impact
Herb Goforth	NV Energy	Electric Utility DG Impact
Paul Maguire	Public Service Commission of Nevada	Distributed Generation Policy
Anne-Marie Cuneo	Public Service Commission of Nevada	Distributed Generation Policy
David Chairez	Public Service Commission of Nevada	Distributed Generation Policy
Karen Olesky	Public Service Commission of Nevada	Distributed Generation Policy
Robert Nellis	Nevada State Office of Energy	Economic Development
James Groth	Nevada State Office of Energy	Economic Development
Pete Konesky	Nevada State Office of Energy	Economic Development
Dale Stransky	Bureau of Consumer Protection	Customer Rates
Jennifer DeCesaro	U.S. Department of Energy	Distributed Generation Integration
Lydia Ball	Clean Energy Project	Environmental Advocacy
Rich Hamilton	Clean Energy Center	Distributed Wind Industry
Matt Campbell	SunPower	Distributed Solar Industry
Carl Lenox	SunPower	Distributed Solar Industry

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Study assumptions were reviewed by Stakeholders and applied in the evaluation of DG alternatives. Key assumptions are below.

Study Assumptions

- Varying levels of penetration were analyzed for two renewable DG technologies: solar photovoltaic (PV) and wind
  - Approximately 80% of the DG penetration was PV and 20% wind
  - PV rating: 3-5 kW residential; 250-500kW commercial; Up to 5 MW ground-based
  - Wind rating: 5 kW residential; 25kW commercial
  - 70/30% PV versus wind in the North; 90/10% PV versus wind in the South
- 12 feeders selected to represent NV Energy's distribution system (6 North, 6 South)
  - It includes a mix of residential, commercial, agricultural, and industrial feeders where DG technologies likely would be installed
- Technical studies were completed using comprehensive, industry-accepted simulation models to predict DG impact on system capability and performance
- Economic studies based on load and price forecasts contained in the Mid-Carbon Integrated Resource Plan (IRP) filed with the PUCN for the period 2011 to 2020

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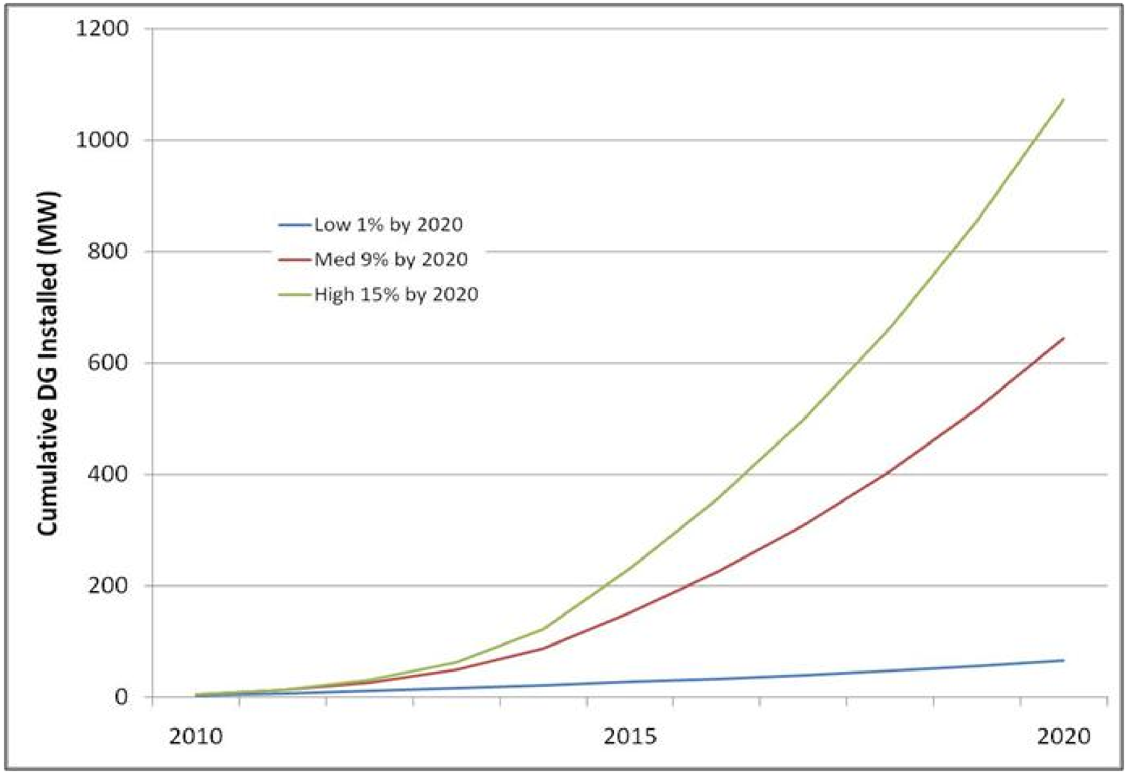
Our analysis focused on three DG penetration scenarios over 10 years, relative to NV Energy's current ~5,600 MW capacity.

Penetration Scenarios

1. 1% of NV Energy's current peak demand (current RPS goal)
2. 9% of NV Energy's current peak demand
3. 15% of NV Energy's current peak demand



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12 feeders were selected to represent the entire NV Energy distribution system. Feeders in the North tend to be longer with low load density.

Northern Feeders						
Feeder Name	**Feeder Description**	**Town**	**Voltage (kV)**	**Length (Miles)**	**Demand (MW)**	**Project Type**
Feeder No.1	Residential, Agricultural	Elko	25	110	.6 ->2	Mixed wind and small PV
Feeder No.2	Residential, Industrial Commercial	Reno	25	31.6	1.6->11.6	Residential PV and large rooftop PV
Feeder No.3	Residential	Carson	12	61	1.5 ->8.3	Residential rooftop PV
Feeder No.4	Residential, Resort/ Commercial	Reno	25	1.8	.4 ->17.6	Large rooftop PV & residential PV
Feeder No.5	Ind. Warehouse, Commercial, Light Manuf.	Reno	25	1.2	1.4 ->11.4	Large rooftop PV
Feeder No. 6	Wind	Elko	25	163	1.6 ->2.2	Wind

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Most feeders in the South were located in greater Las Vegas, which has shorter feeders and higher load density than the North. Many are underground.

Southern Feeders					
Feeder Name	Feeder Description	Voltage (kV)	Length (Miles)	Demand (MW)	Project Type
Feeder No.1	Commercial Convention Center	12	2.2	.03 -> 5.1	Large rooftop PV
Feeder No.2	Commercial Downtown	12	0.2	7.6->14.0	Large rooftop PV
Feeder No.3	Residential	12	2.1	1.2->6.1	Residential rooftop PV
Feeder No.4	Industrial / Commercial	12	1.2	1.9->8.1	Rooftop & ground-based PV
Feeder No.5	Sub-Industrial	12	16.6	1-> 3.4	Large, ground based PV
Feeder No. 6	Wind	12	16.6	0.25->1.1	Wind

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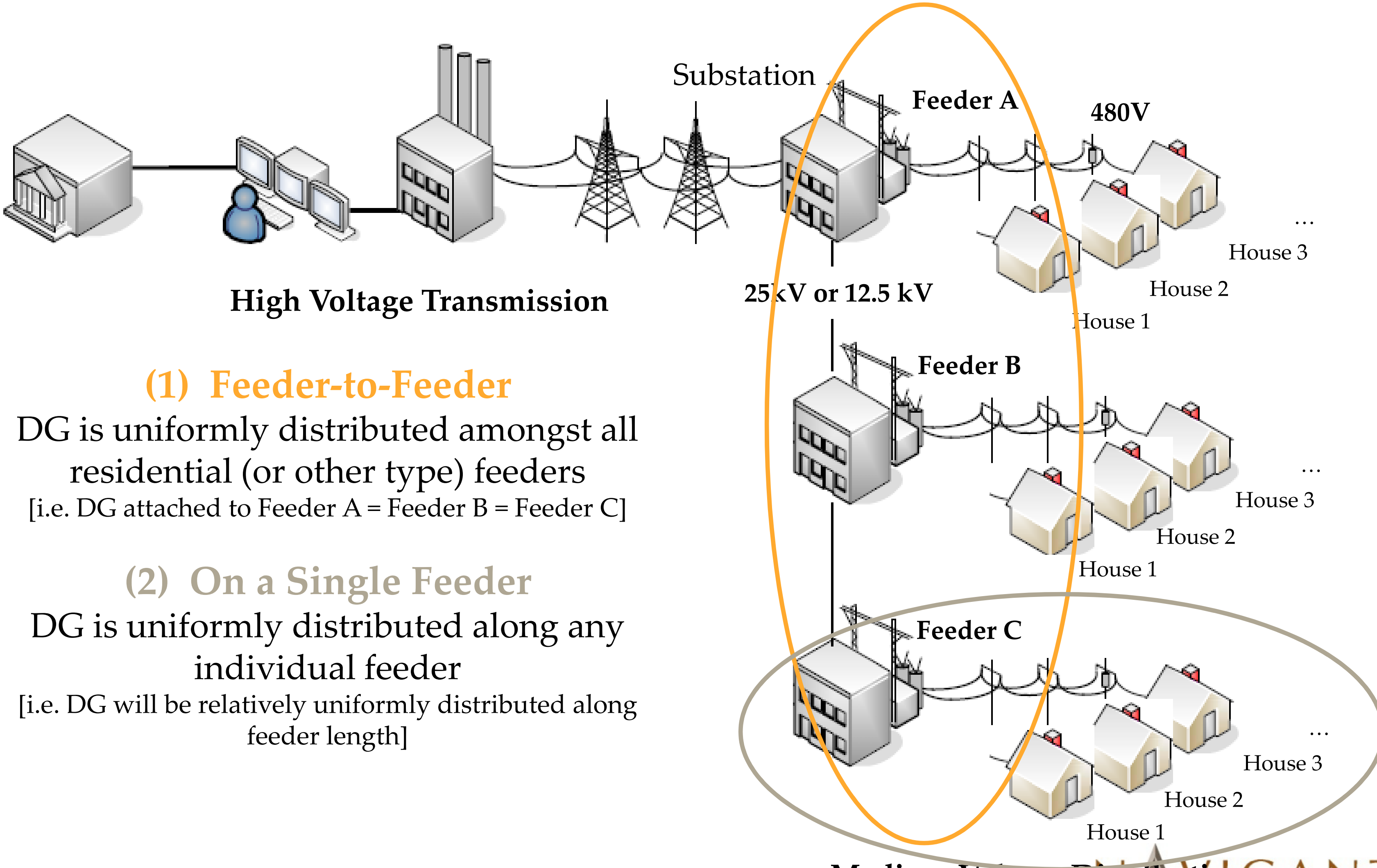
For the base case studies, Navigant assumed that DG will be distributed completely uniformly in two dimensions.



(1) Feeder-to-Feeder

DG is uniformly distributed amongst all residential (or other type) feeders

[i.e. DG attached to Feeder A = Feeder B = Feeder C]

(2) On a Single Feeder

DG is uniformly distributed along any individual feeder

[i.e. DG will be relatively uniformly distributed along feeder length]

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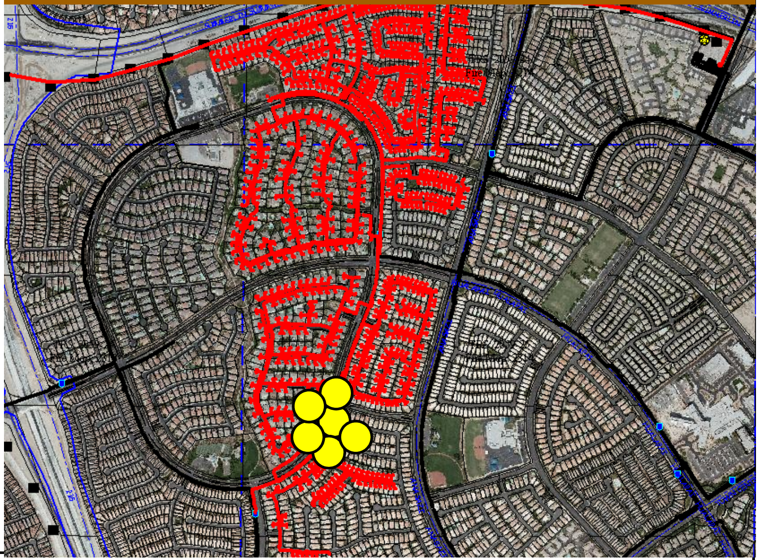
For select feeders, Navigant modeled an "all DG at one end" worst case, to compare the distribution effects of uniform distribution vs. clustering.

Uniform Distribution

Clustered At End



Description of Example

Characteristics:
Feeder: South Feeder #3
Customer Base: 100% residential
DG Penetration Level: 15%
DG Installed on Feeder: 1.04 MW
Connection Points: 6
Demand per household: 4 kW
Houses per connection point: 44

Calculation:

$$\frac{\frac{1040\ kW\,/\,Feeder}{4\ kW\,/\,house}}{6\ connection\ points} = 44\,\frac{houses}{connectionpoint}$$

Connection point

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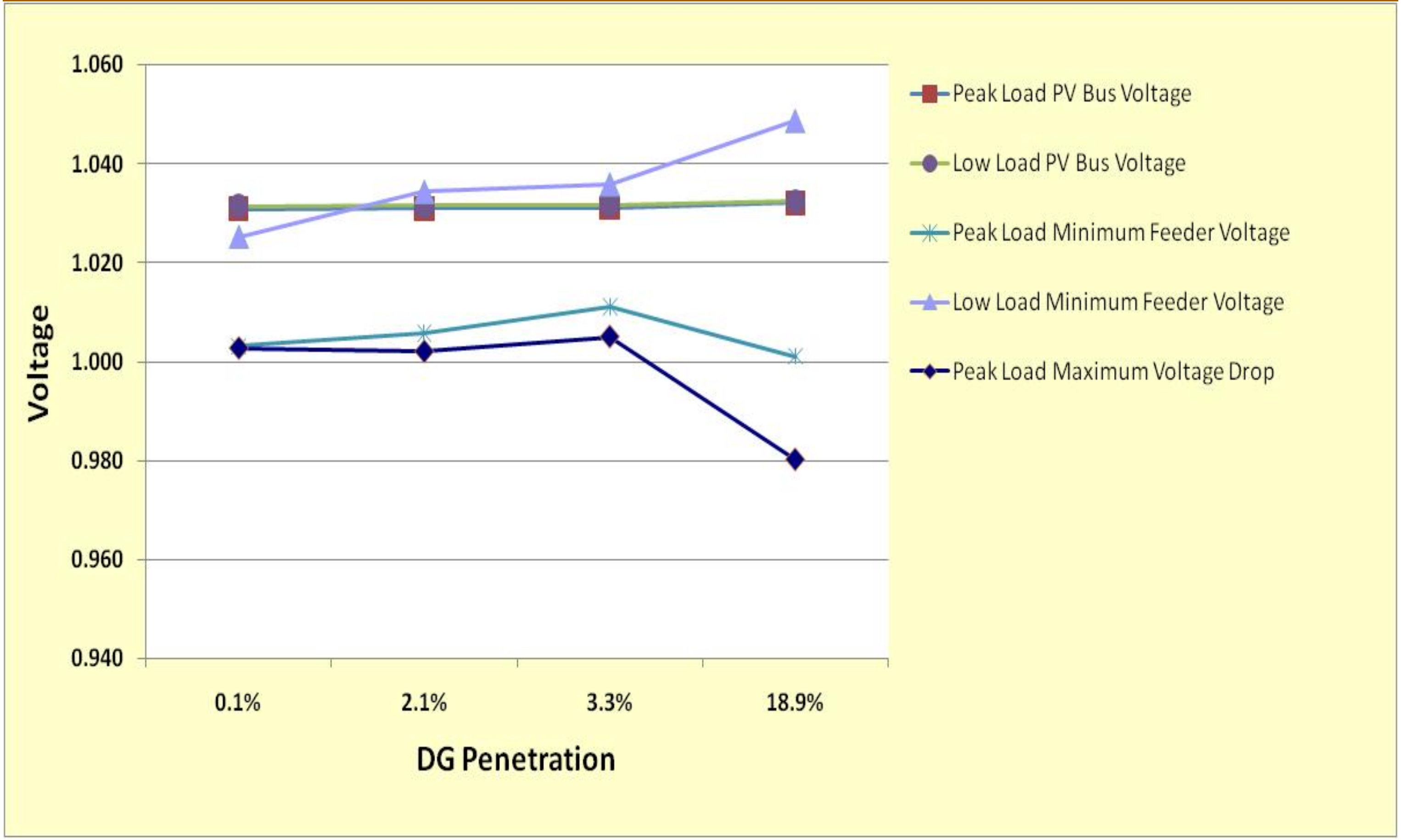
In the North, voltages on some of the longer feeders are within limits as 25kV feeder voltages are more robust.

North Feeder #1 – Wind Residential and Rural



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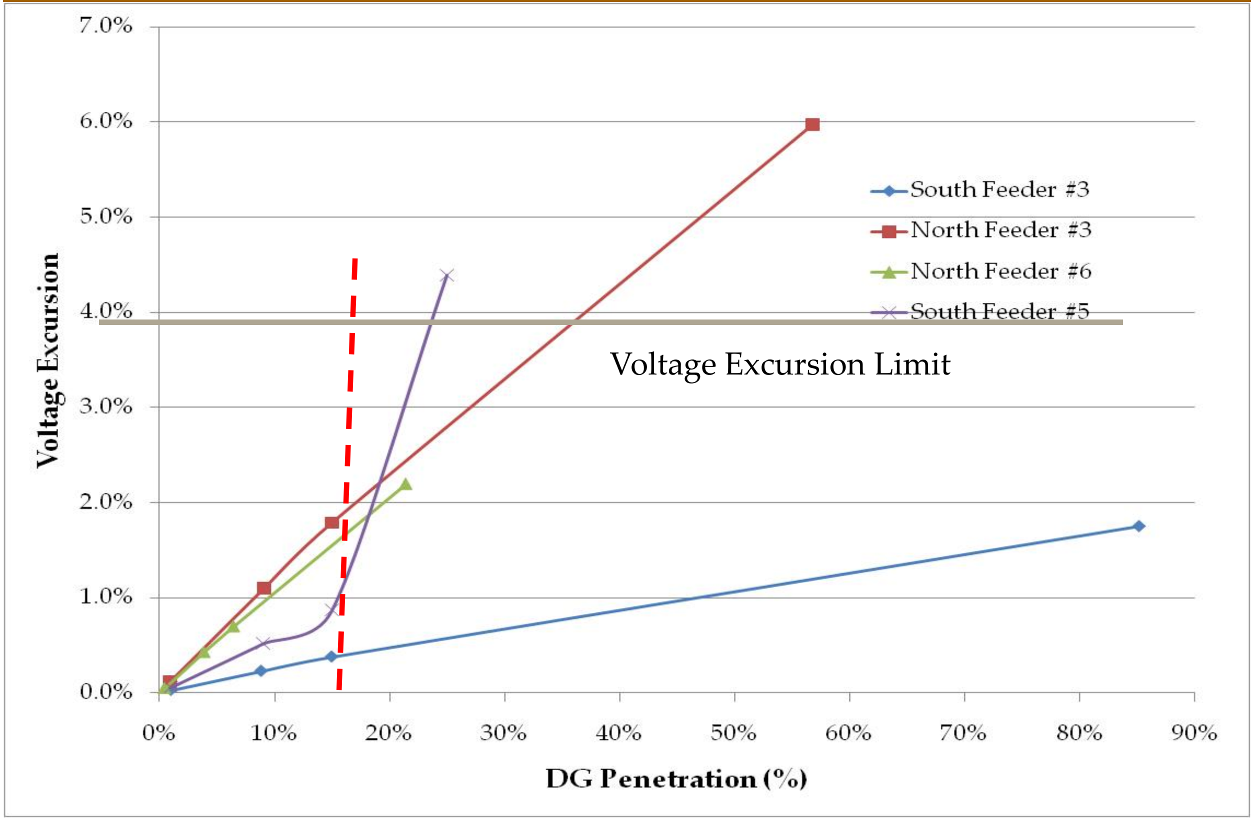
Analysis of representative feeders shows voltage violations in half the cases, specifically when DG is clustered at the end of a feeder.

Representative Feeders: DG Clustered at End of Feeders



Key Take-Aways

- Shorter underground feeders, with large wire size, can accommodate more DG
- Overhead residential lines in the North, and longer feeders in general, can accommodate less.

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The current NV Energy large-scale renewable portfolio includes 1,240 MW* of generation (not including DG).

● In Development

GEOTHERMAL

1. Beowawe 17.7MW
2. Brady Geothermal Project 21.5MW
3. Carson Lake Basin ● 62MW
4. Carson Lake Geothermal Project ● 31.5MW
5. Clayton Valley ● 53.5MW
6. Desert Peak Geothermal Project #2 19MW
7. Faulkner 1 49.5MW
8. Galena 2 13MW
9. Galena 3 26.5MW
10. Homestretch 2.1MW
11. McGinness Hills ● 51MW
12. Hot Sulfur Springs 2 ● 25MW
13. Jersey Valley Geothermal Project ● 31.5MW
14. Richard Burdette Generation Facility 26MW
15. Salt Wells 23.6MW
16. San Emidio 3.8MW
17. Soda Lake I 3.6MW
18. Soda Lake II 19.5MW
19. Steamboat Hills 13.2MW
20. Steamboat IA 2MW
21. Steamboat II 13.4MW
22. Steamboat III 13.4MW
23. Stillwater 2 47.2MW

SOLAR

24. American Capital Energy - Searchlight Solar LLC ● 17.5MW
25. Fotowatio ● 20.5MW
26. Las Vegas Valley Water District (Six Projects) 3.1MW
27. Nellis AFB 12MW
28. Nevada Solar One ● 64MW
29. Next Light/Silver State ● 50MW
30. Procaps Laboratory 0.2MW
31. SolarReserve Tonopah Solar Energy Facility ● 110MW

OTHER

BIOMASS

32. CC Landfill LLC ● 10.7MW
33. Renewable Energy Ctr. @ N NV Corr. Ctr. 1MW
34. Sierra Pacific Industries 10MW
35. Truckee Meadows Water Reclamation Facility 1.4MW
36. Waste Management Renewable Energy ● 3.2MW

HYDRO

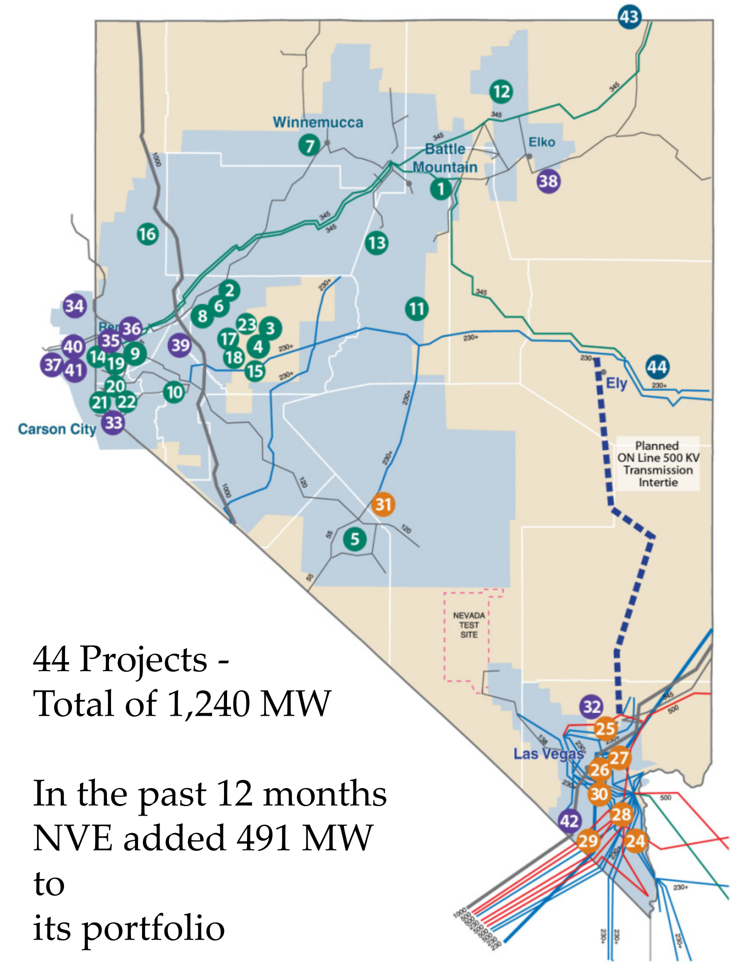
37. Fleish 2.3MW
38. Hooper 0.8MW
39. Truckee Carson Irrigation District 4MW
40. Verdi 2.2MW
41. Washoe 2.2MW

WASTE HEAT

42. Goodsprings ● 5.8MW

WIND

43. China Mountain ● 200MW
44. Spring Valley ● 150MW



44 Projects - Total of 1,240 MW

In the past 12 months NVE added 491 MW to its portfolio

*Includes renewable energy under contracts approved by the PUCN. Does not include renewable energy under consideration in the 2010 NV Energy Renewable RFP.

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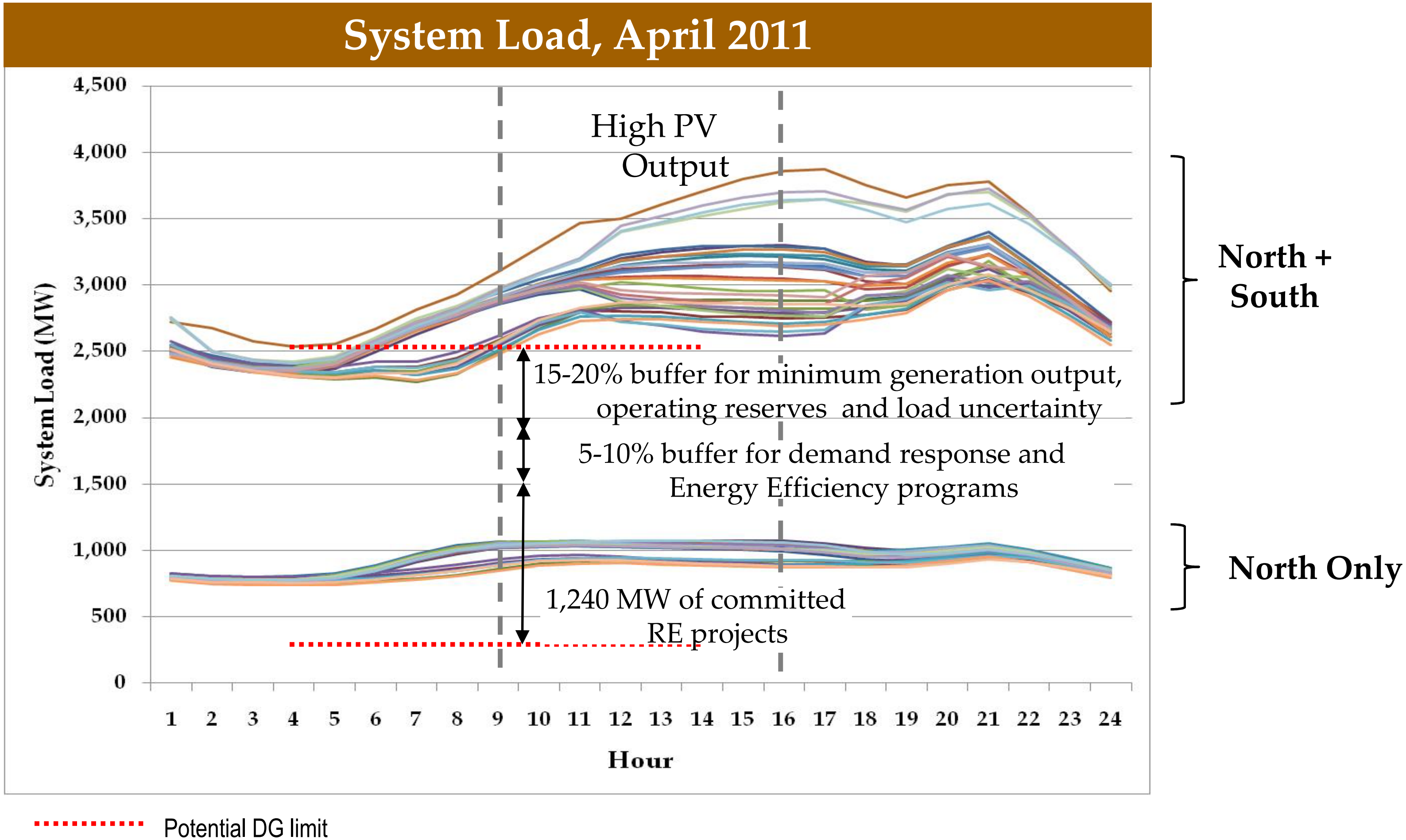
The amount of DG that can be installed will be impacted by other limiting factors. Several of these factors are low load conditions and new large-scale renewable projects.



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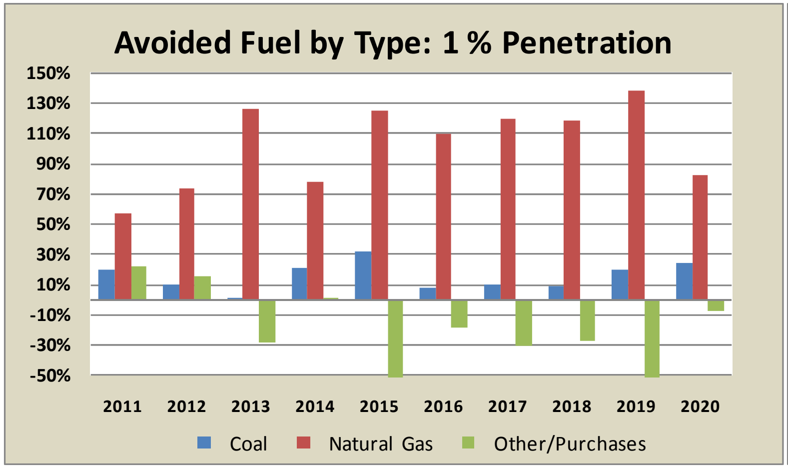
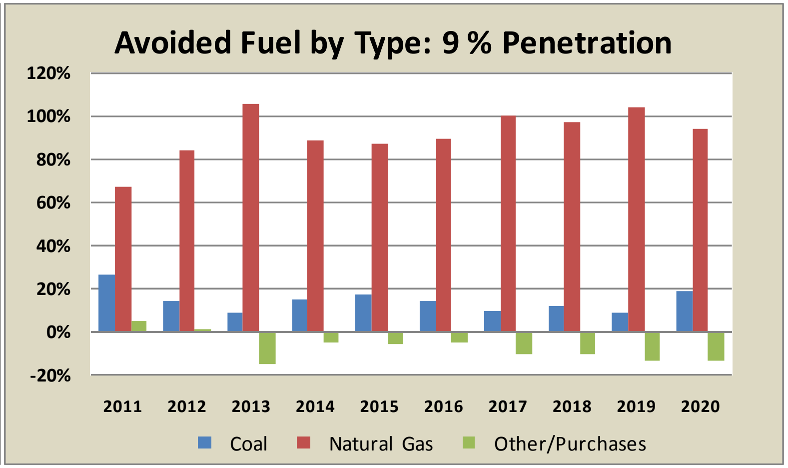
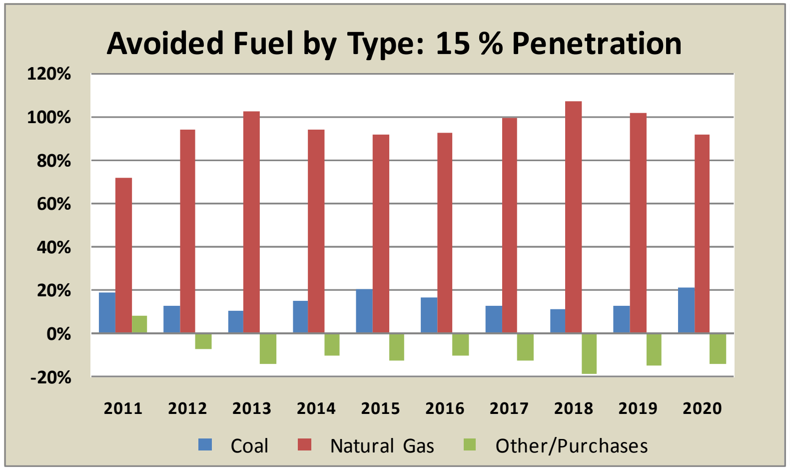
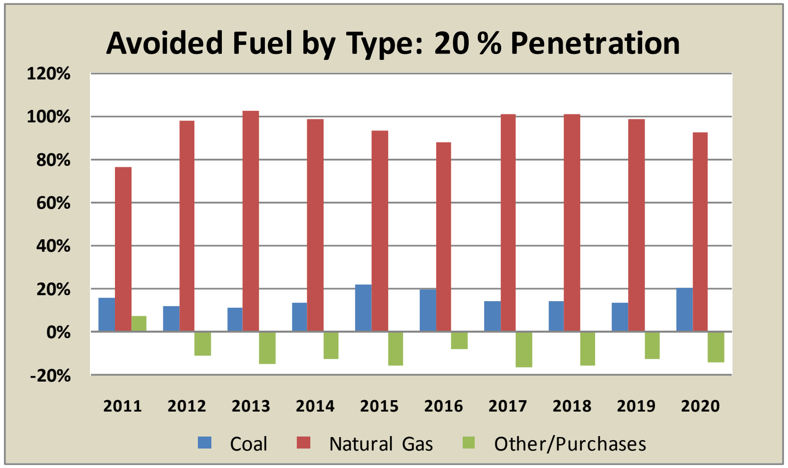
For all scenarios, mostly natural gas-fired generation is displaced by DG output, with smaller amounts of coal-fired generation.

» Most generation at the margin burns natural gas









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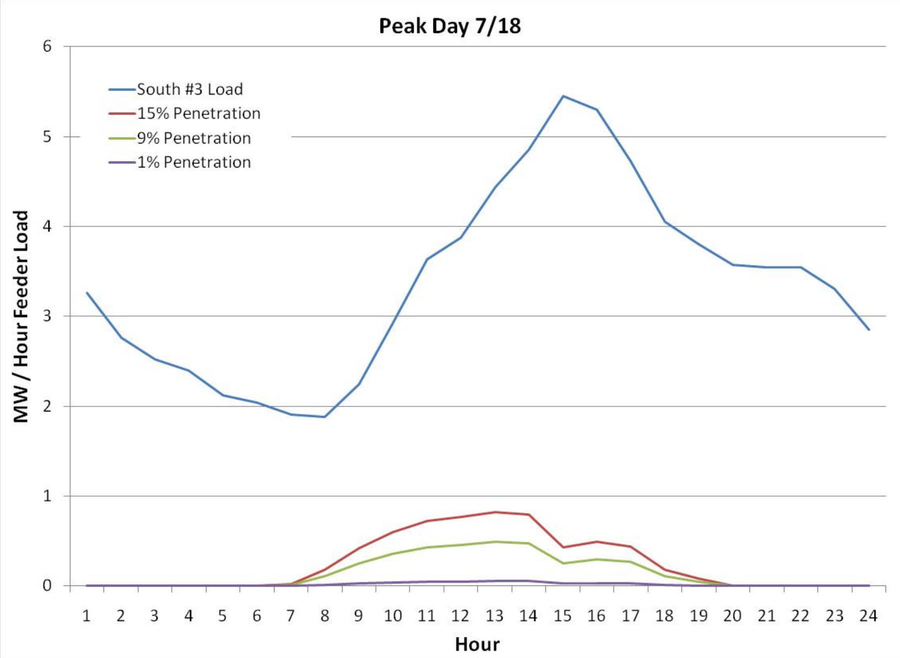
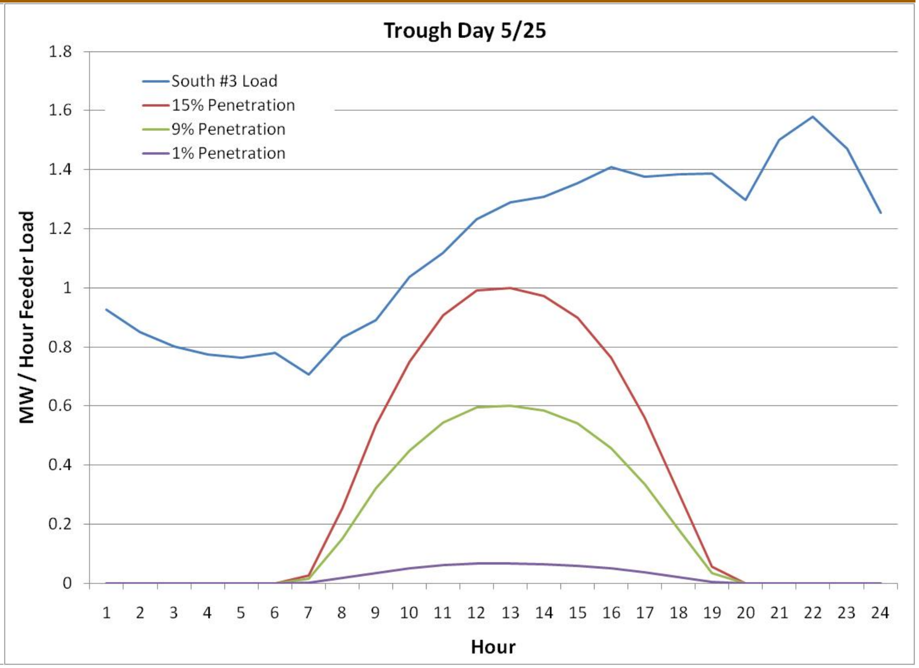
Most feeders peak at 6-8 pm, when PV output is low.

South #3, Residential, 65% of NVE





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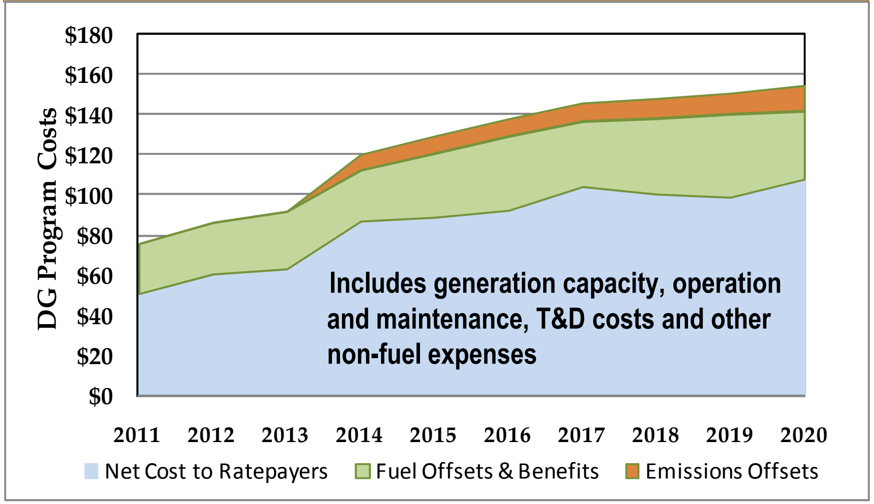
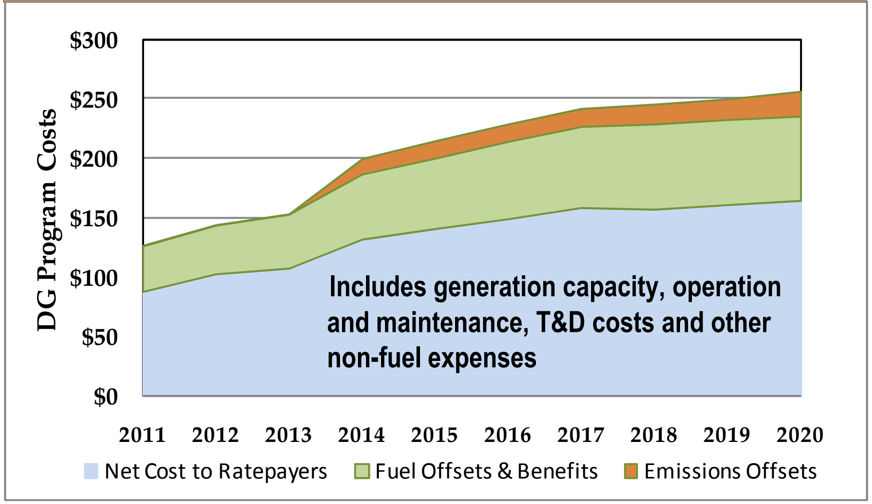
Net costs for higher penetration levels of DG create a revenue gap of between $50 million to $150 annually under current retail rates.

DG Net Metering Cost: 9% Penetration ($ Millions)



DG Net Metering Cost: 15% Penetration ($ Millions)



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NV Energy's distribution system is not the limiting factor with regard to how much DG can be installed within existing operating limits.

Conclusions
• NV Energy's distribution feeders in both the South (Nevada Power Company) and North (Sierra Pacific Power Company) can accommodate greater amounts of DG when evenly distributed; less when clustered. • For higher DG penetration, the impact on the transmission grid and generation operations must be considered. • The presence of large, utility-scale renewable generation may curtail the amount of DG that can be installed on NV Energy's distribution system. • The reduction in revenues from DG energy production is much higher than the utility benefits DG is expected to produce. Thus, new DG installations would result in a subsidy from NV Energy ratepayers to DG owners if current net metering rules were to apply.

NV Energy will include DG in its ongoing *Large-Scale Photovoltaic Integration Study*. The PV study will be completed and submitted to the PUCN in July 2011.

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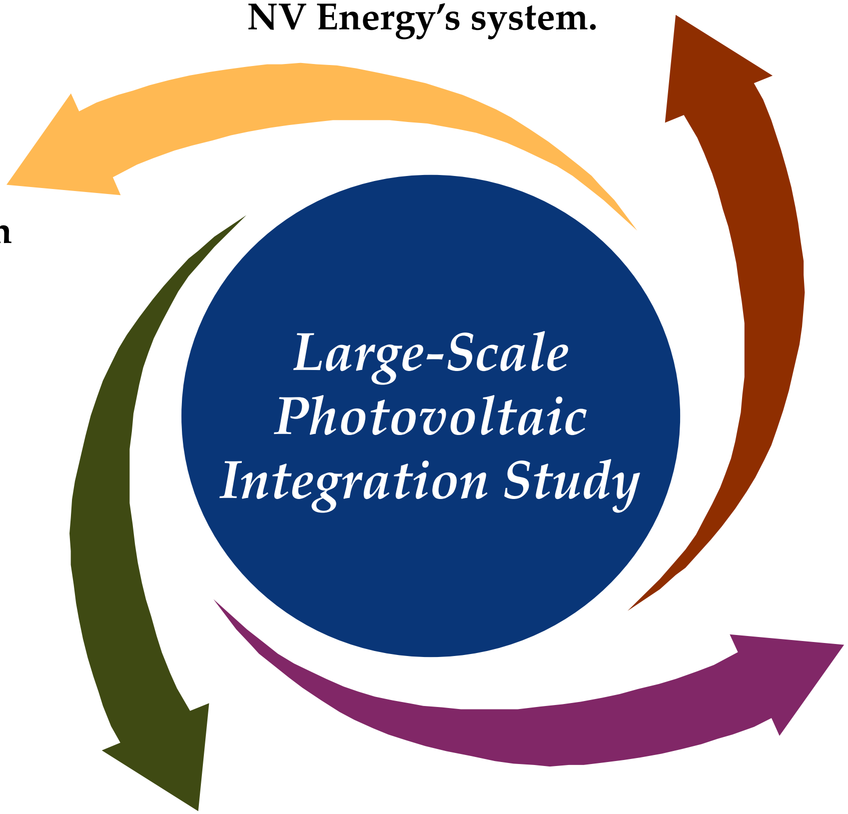
Navigant, DOE, Sandia National Laboratory, and NV Energy are conducting a follow-on PV Integration study.

Evaluating the impact of large scale PV generation and DG on NV Energy's system.

Working with Sandia and NV Energy to prepare high resolution (minute by minute) PV output data – unique!



Completing the study by July 2011 and will be publicly available

Conducting assessment on a small control area

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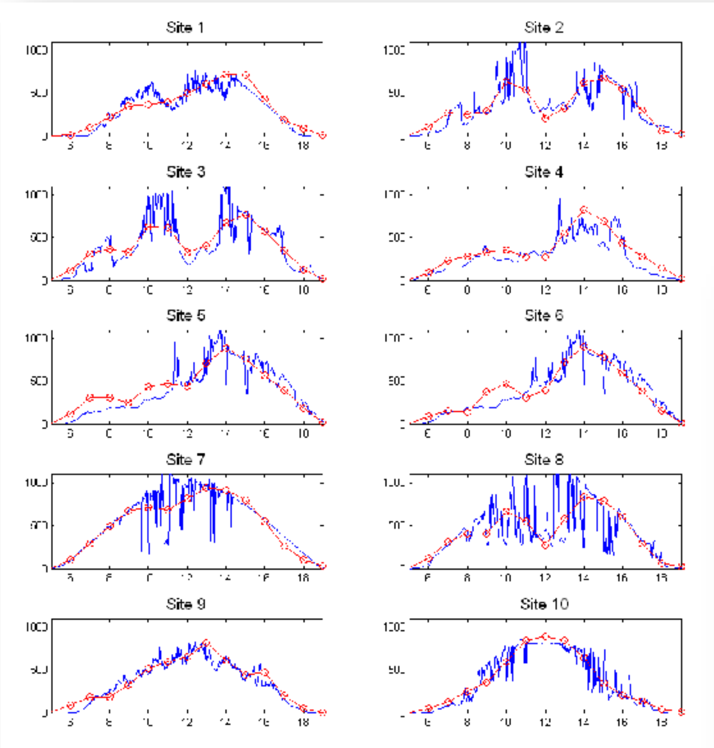
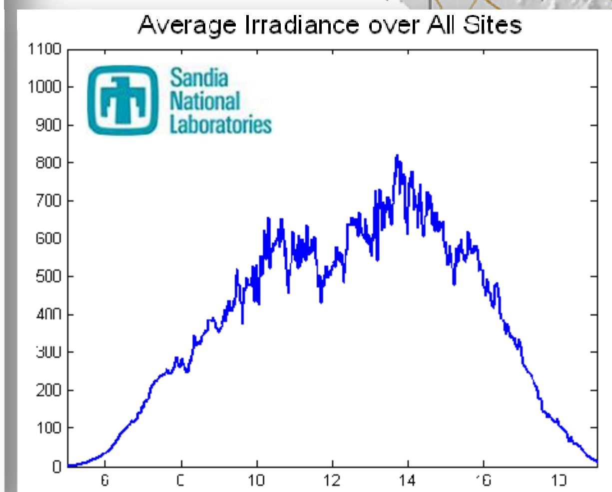
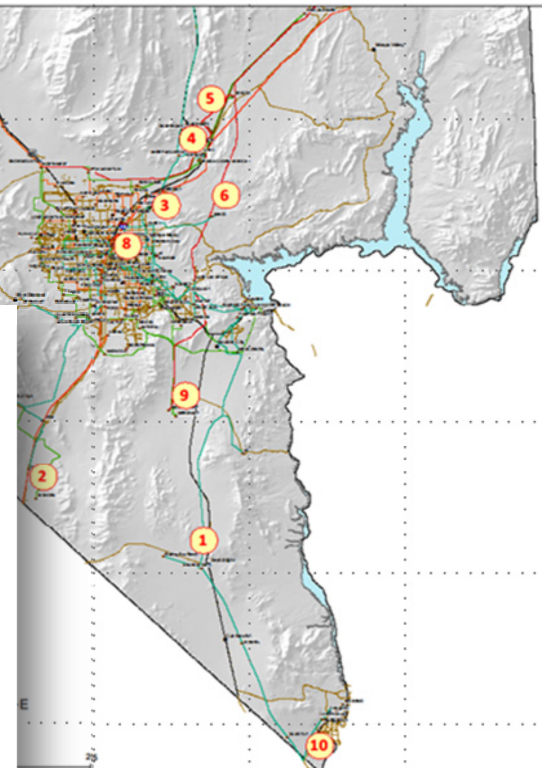
Sandia National Laboratories developed a set of high-resolution, time-correlated PV output data for use in the NV Energy integration study.

Day of Year = 203 (party cloudy on all sites)







RED: Satellite hourly irradiance values
BLUE: 1-minute irradiance estimate (best fit of measured data)

10 sites, each ranging from 5 MW to 300 MW

The method used by Sandia captures the effects of weather conditions, plant characteristics (size, tracking method, etc) and geographic diversity.

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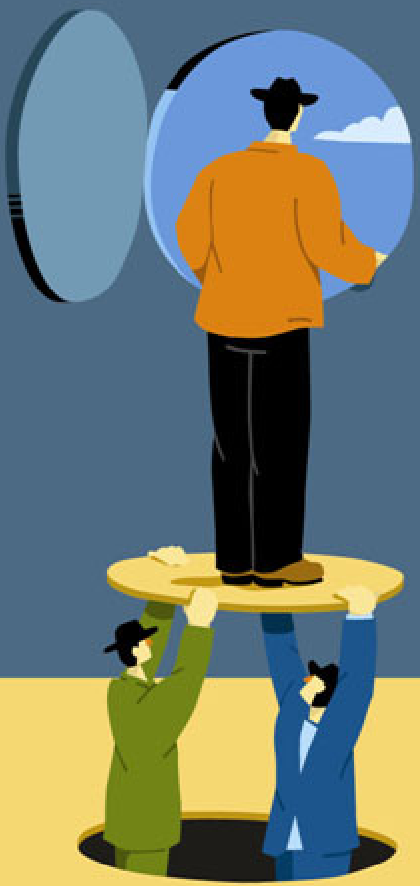
Key CONTACTS



Gene Shlatz
Director
Burlington, MA 01803
(802) 233-1890
eshlatz@navigant.com

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