

Distributed Generation Study

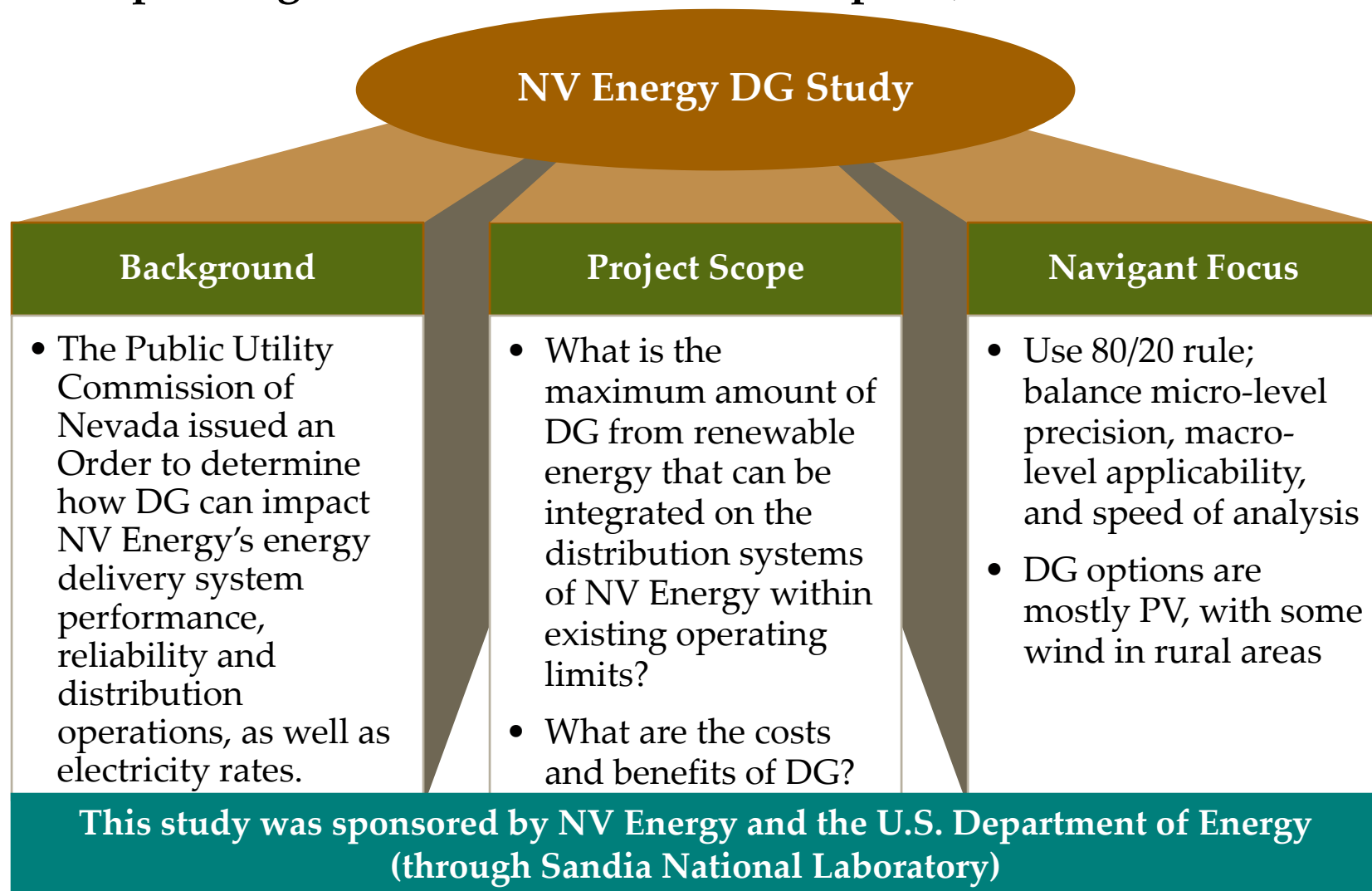
*Presentation to California Energy Commission
IEPR Committee Workshop*



June 22, 2011

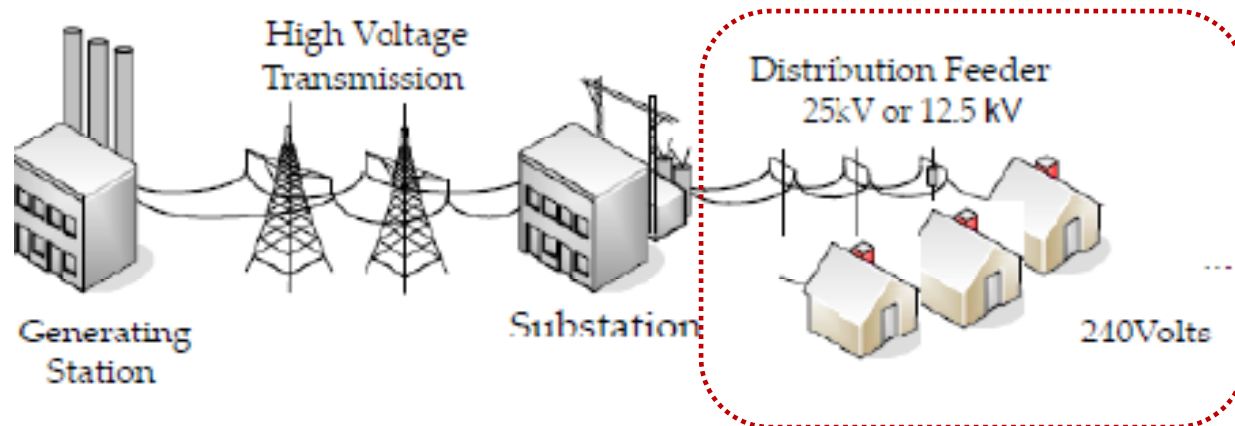
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Navigant identified the maximum amount of DG that can be installed within operating limits and assessed DG impacts, costs and benefits.



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.



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

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

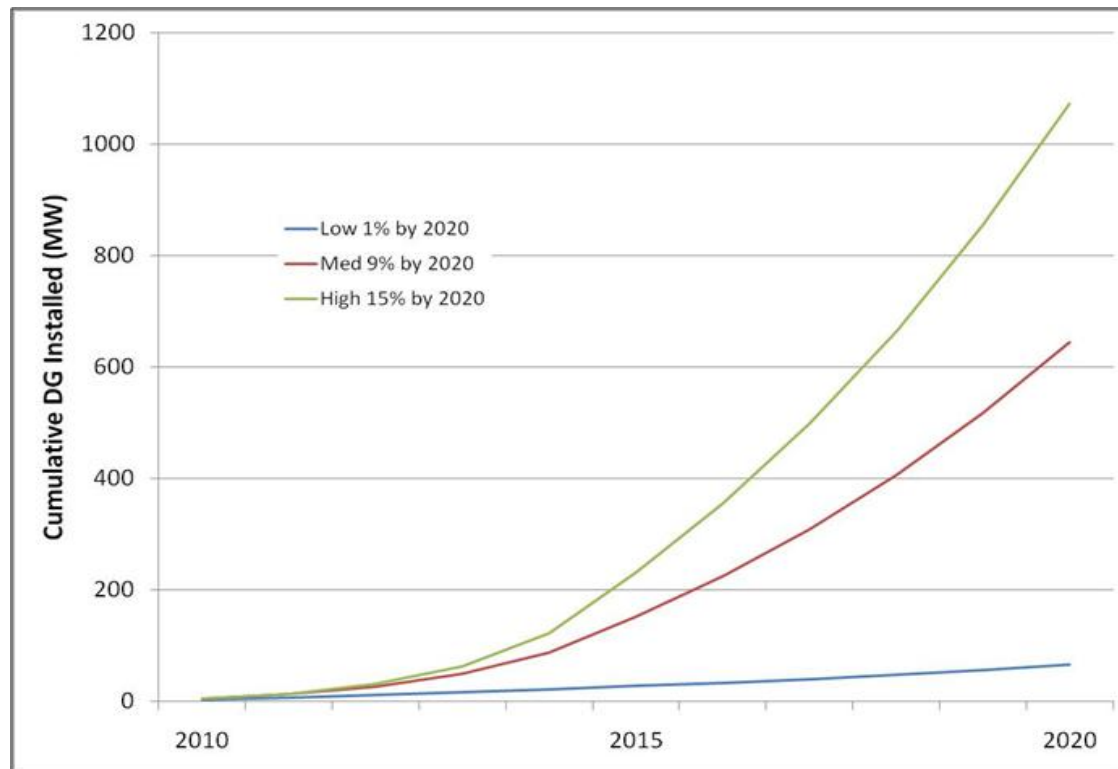
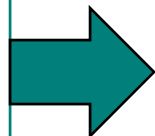
Study Assumptions

- 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

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



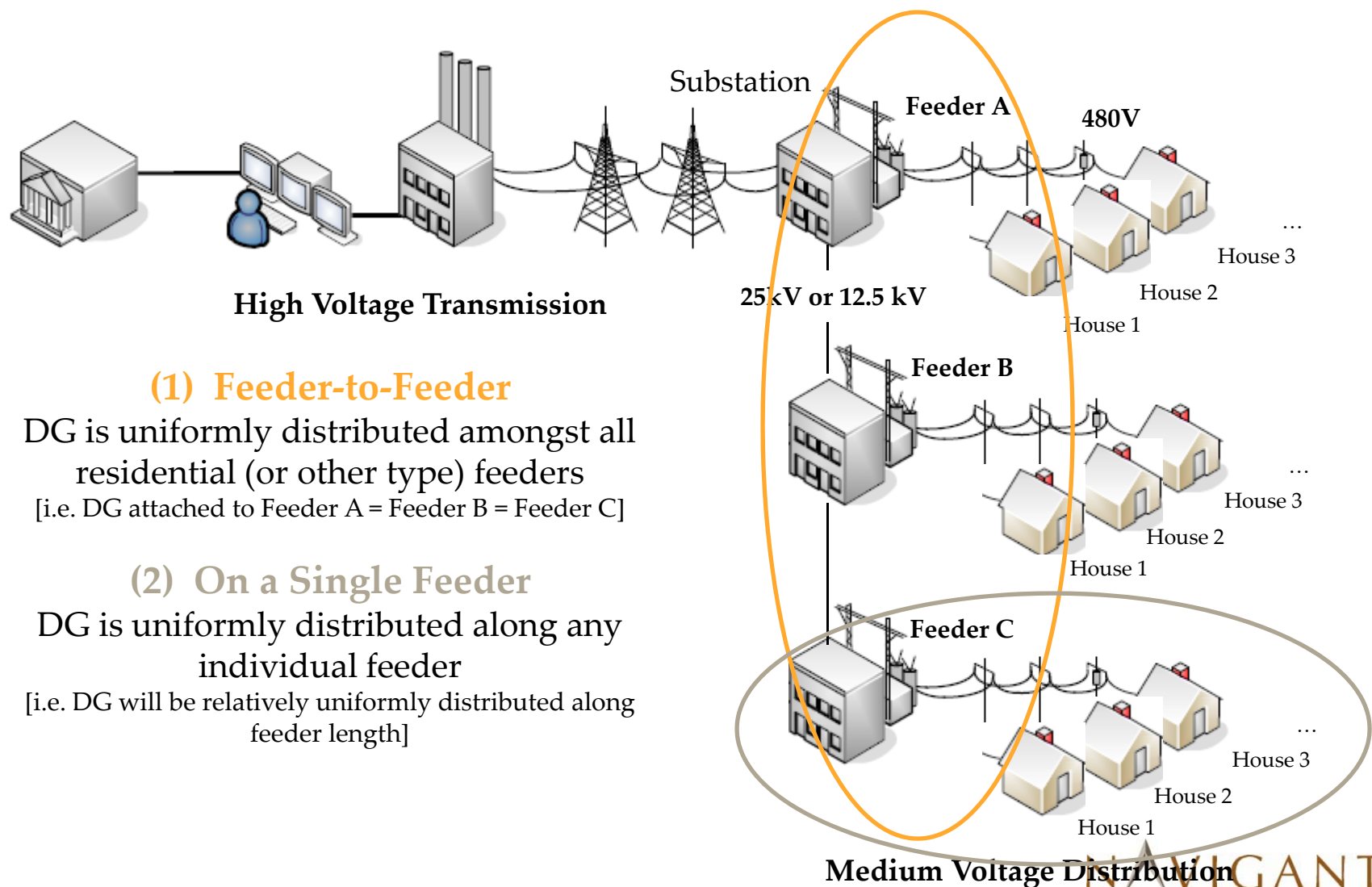
12 feeders were selected to represent the entire NV Energy distribution system. Feeders in the North tend to be longer with low load density.

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

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

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



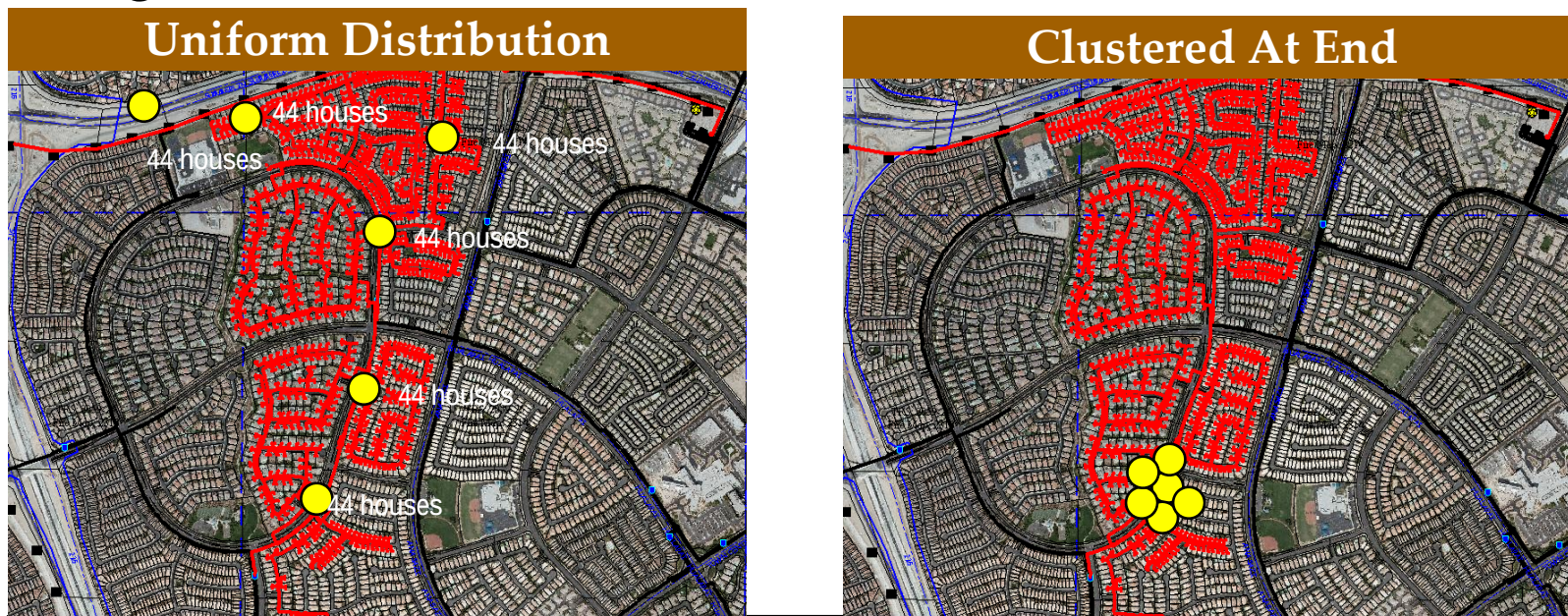
(1) Feeder-to-Feeder

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]

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



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

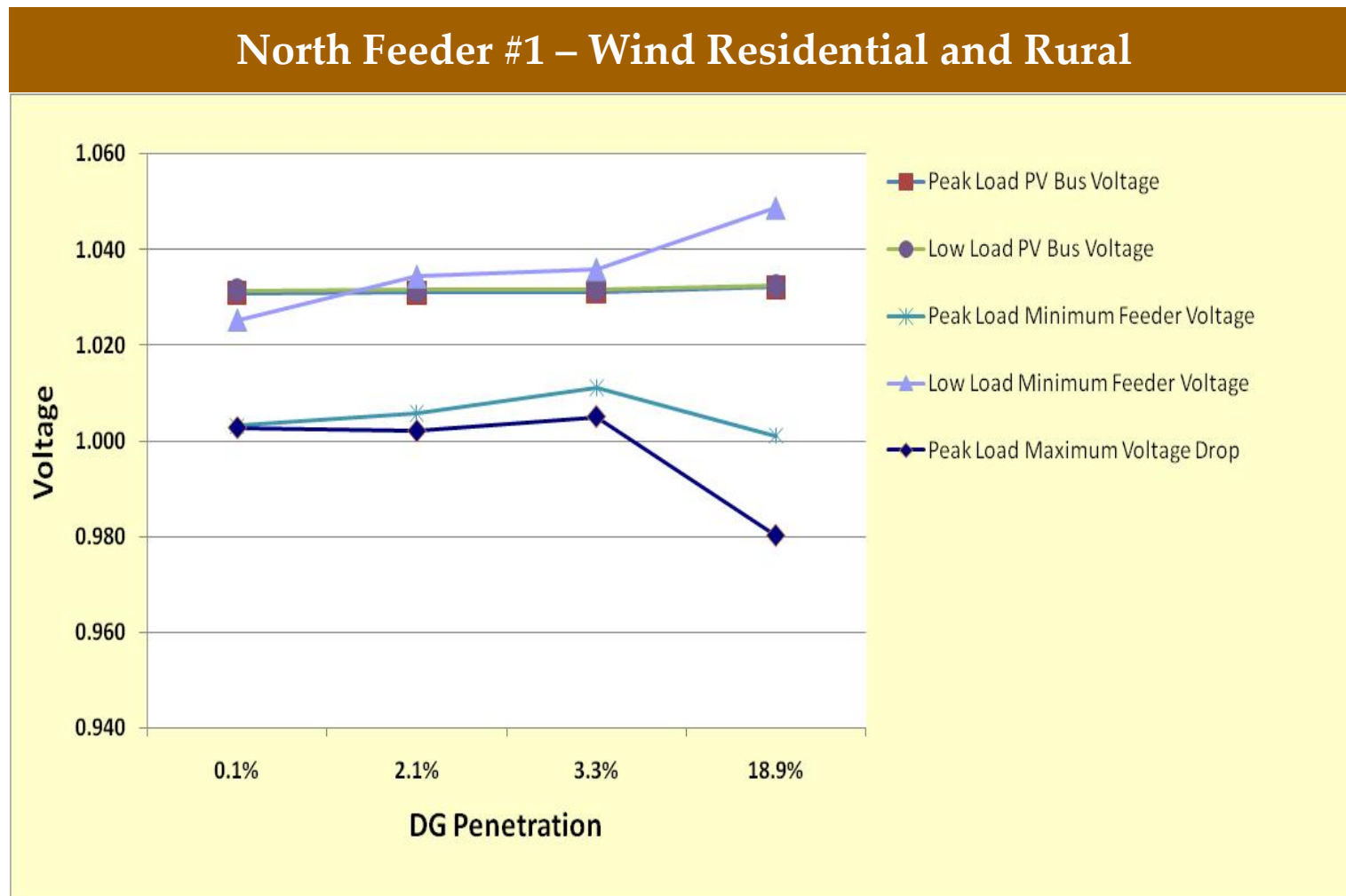
Houses per connection point: 44

Calculation:

$$\frac{1040 \text{ kW / Feeder}}{4 \text{ kW / house}} = 44 \frac{\text{houses}}{\text{connection point}}$$

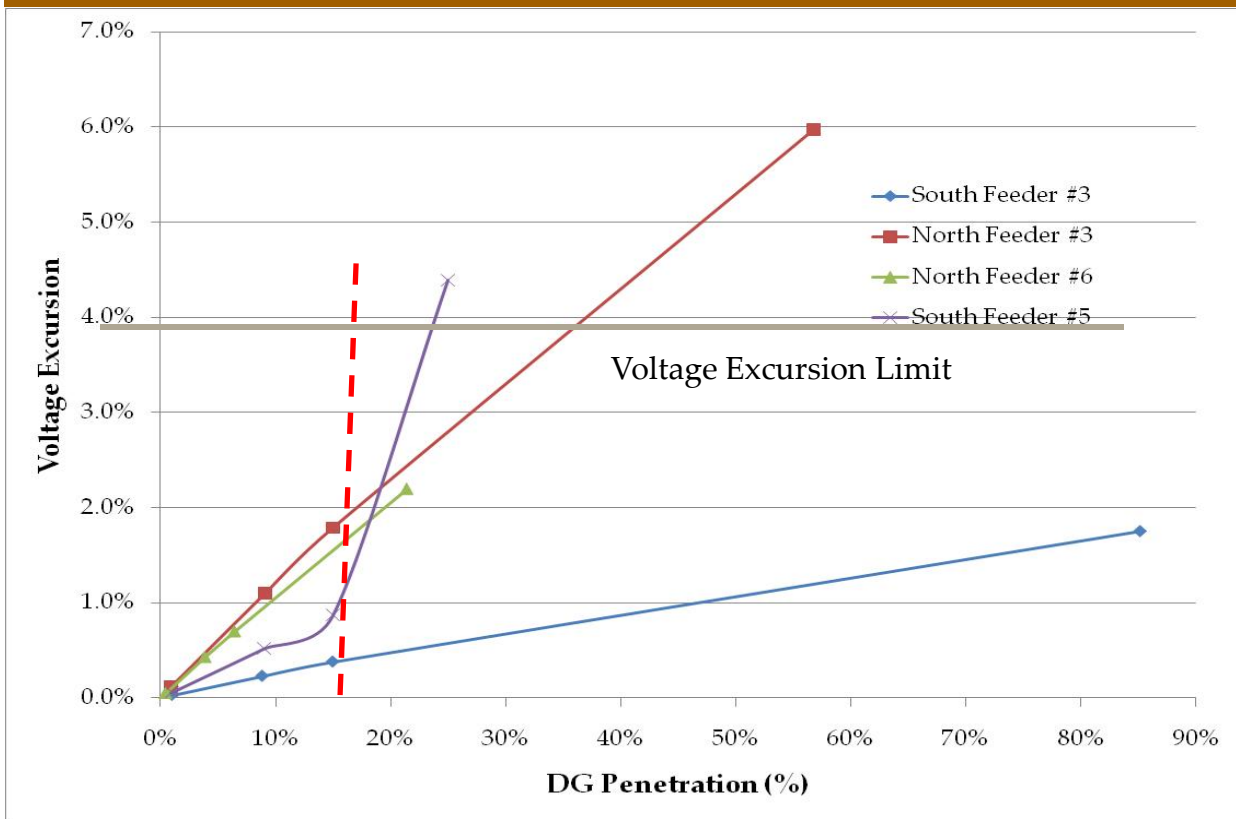
● Connection point

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



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

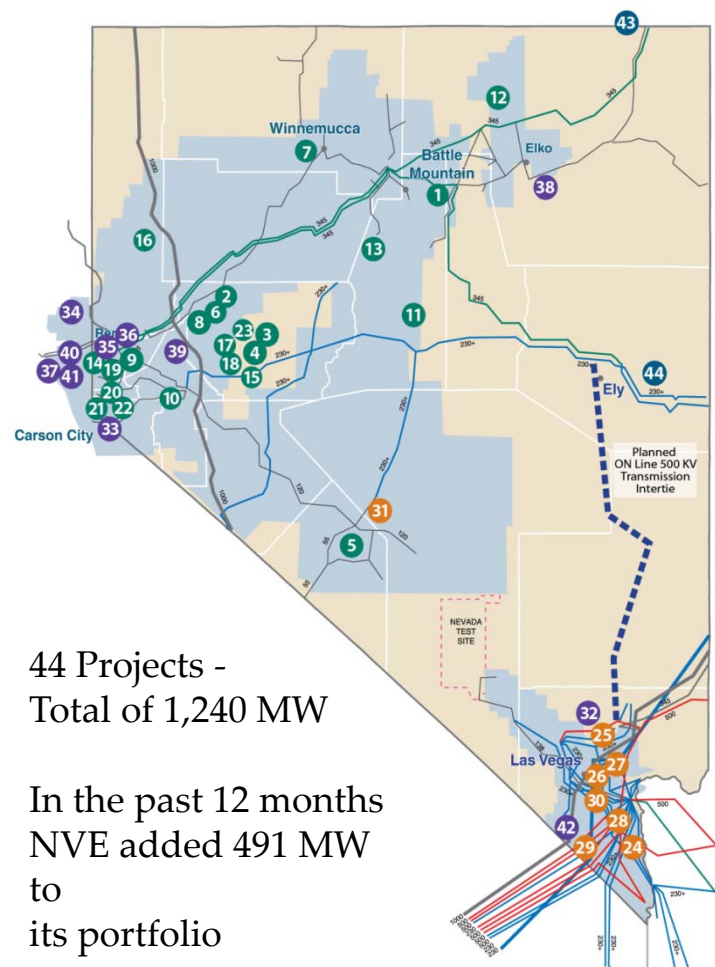
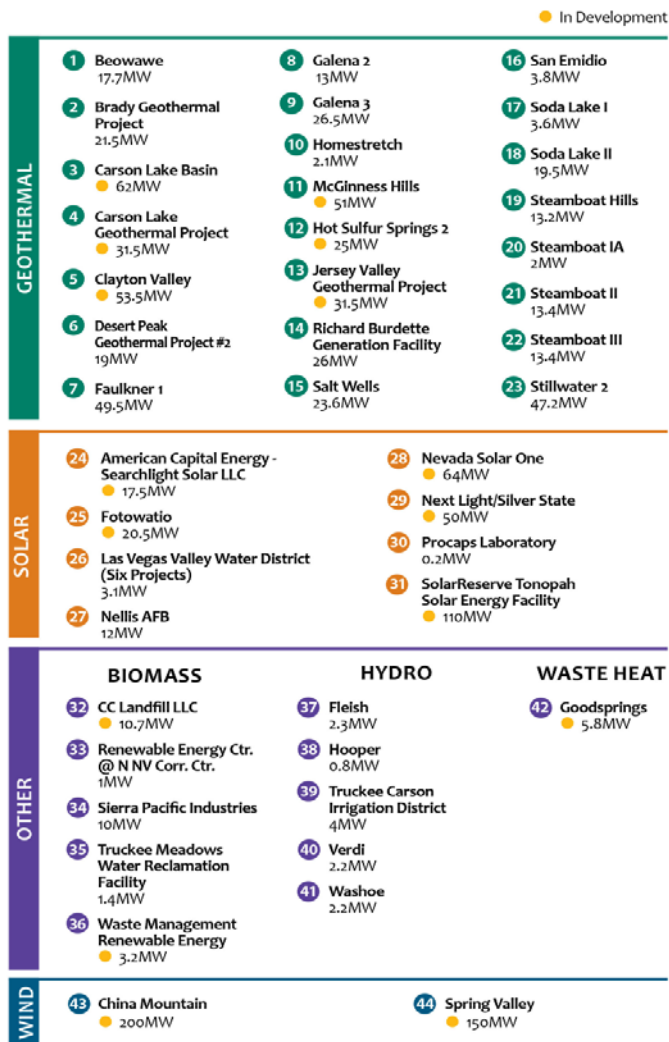
Representative Feeders: DG Clustered at End of Feeders



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.

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

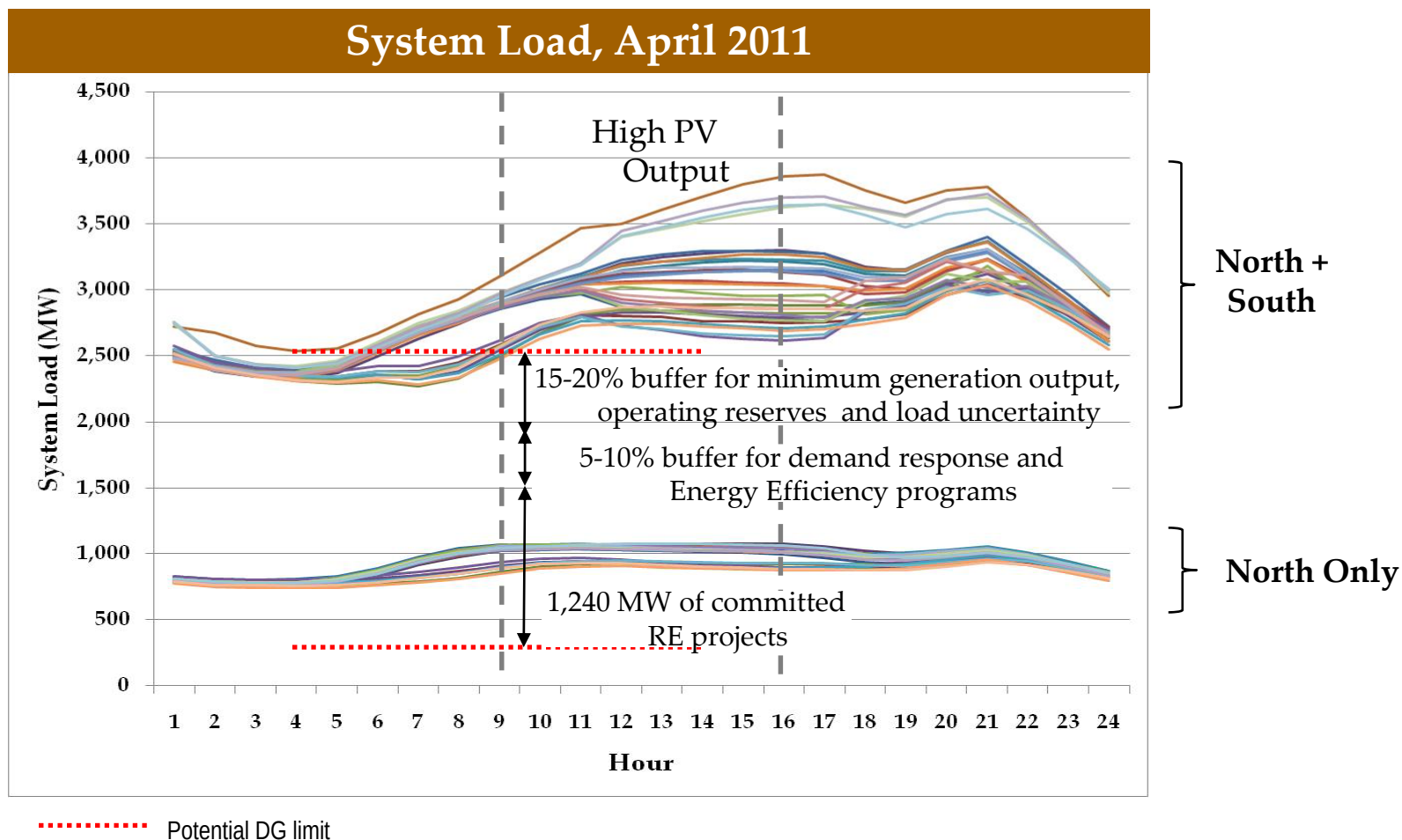


44 Projects -
Total of 1,240 MW

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

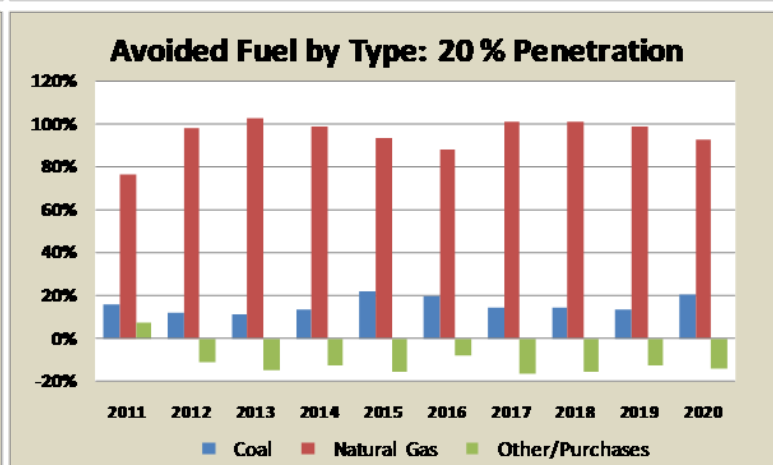
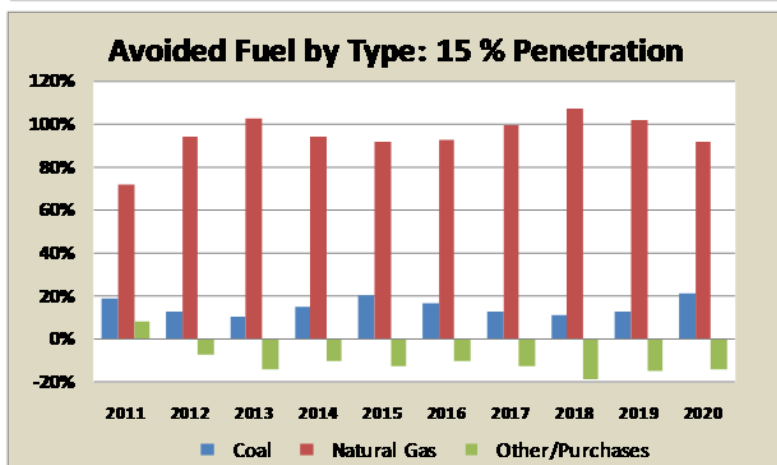
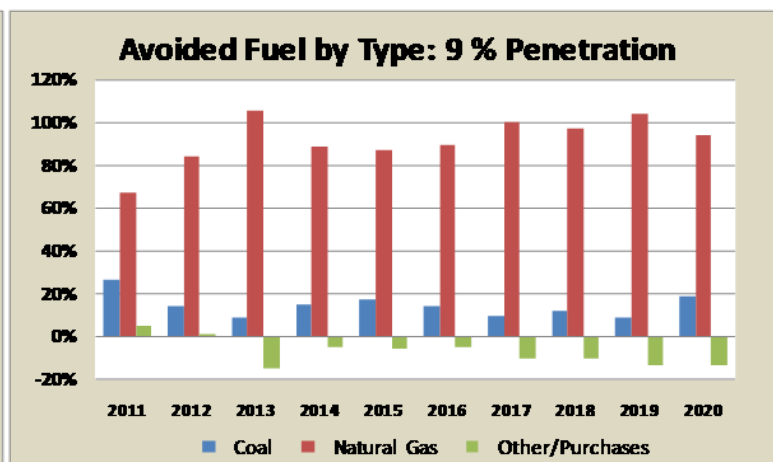
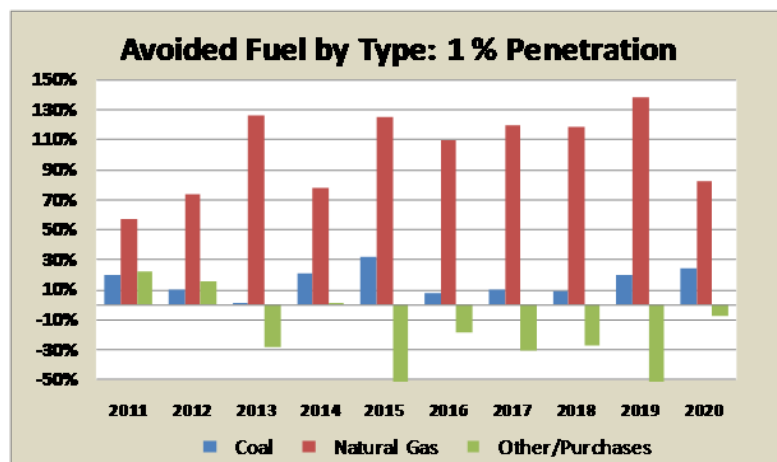
*Includes renewable energy under contracts approved by the PUCN. Does not include renewable energy under consideration in the 2010 NV Energy Renewable RFP.

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.



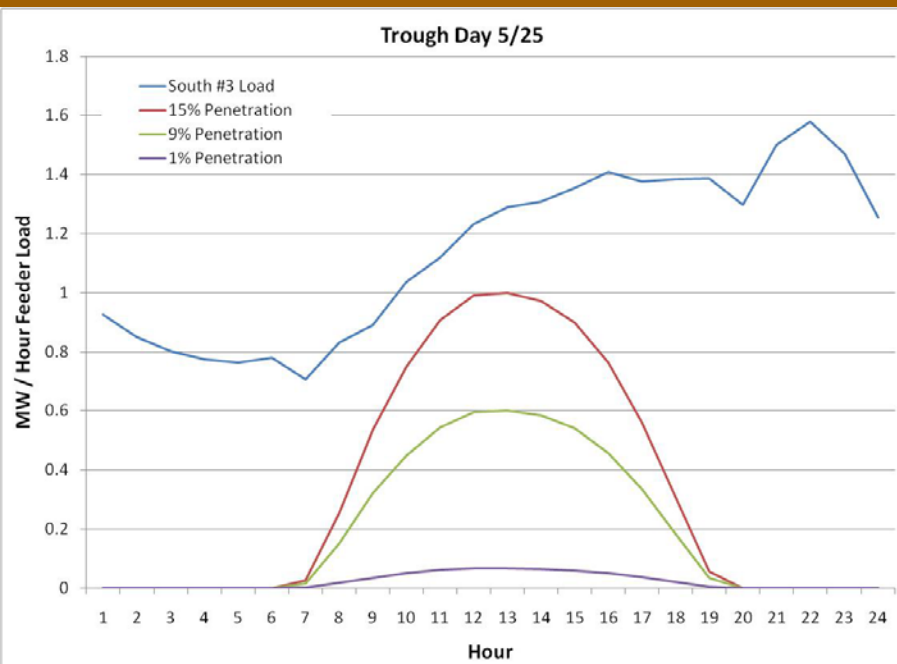
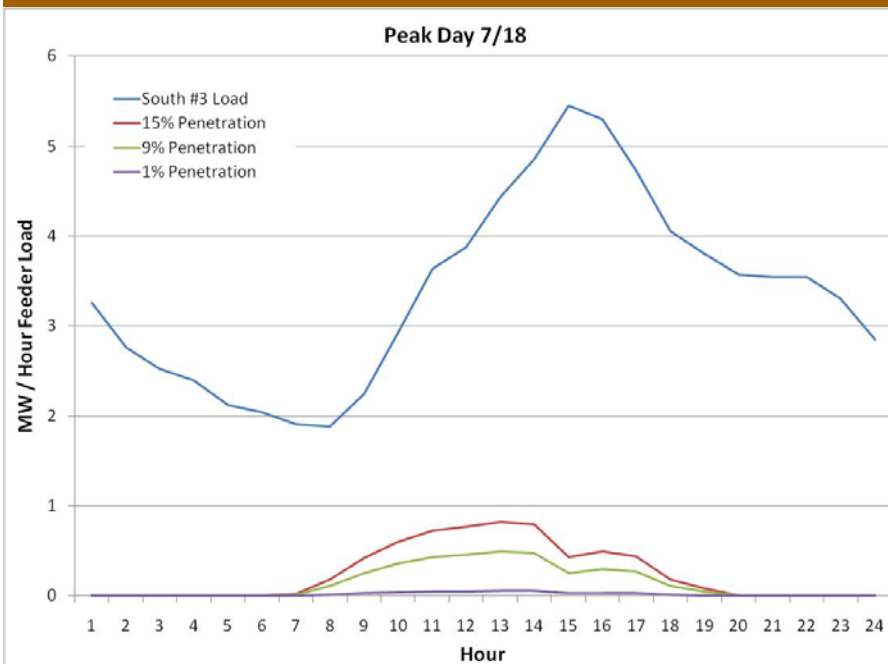
For all scenarios, mostly natural gas-fired generation is displaced by DG output, with smaller amounts of coal-fired generation.

» Most generation at the margin burns natural gas



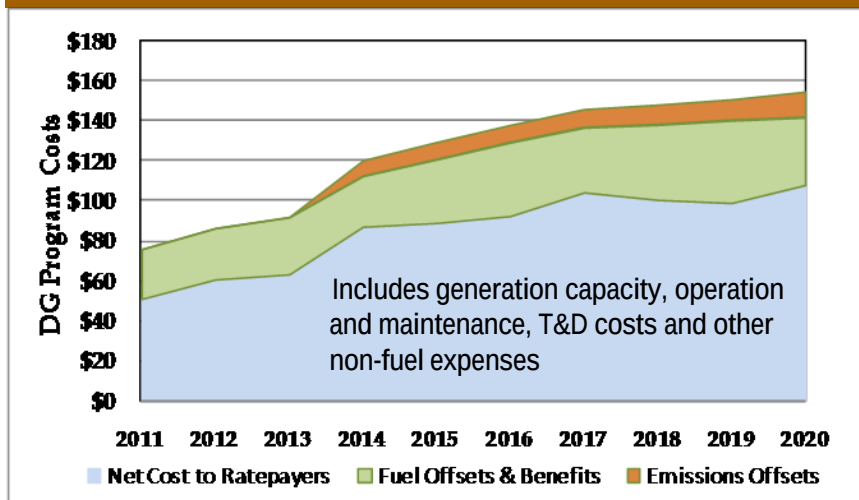
Most feeders peak at 6-8 pm, when PV output is low.

South #3, Residential, 65% of NVE

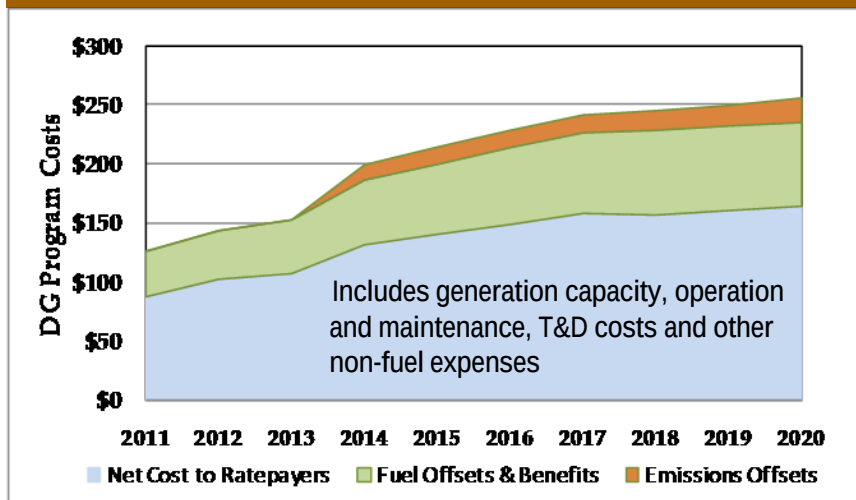


Net costs for higher penetration levels of DG create a revenue gap of between \$50 million to \$150 annually under current retail rates.

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



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



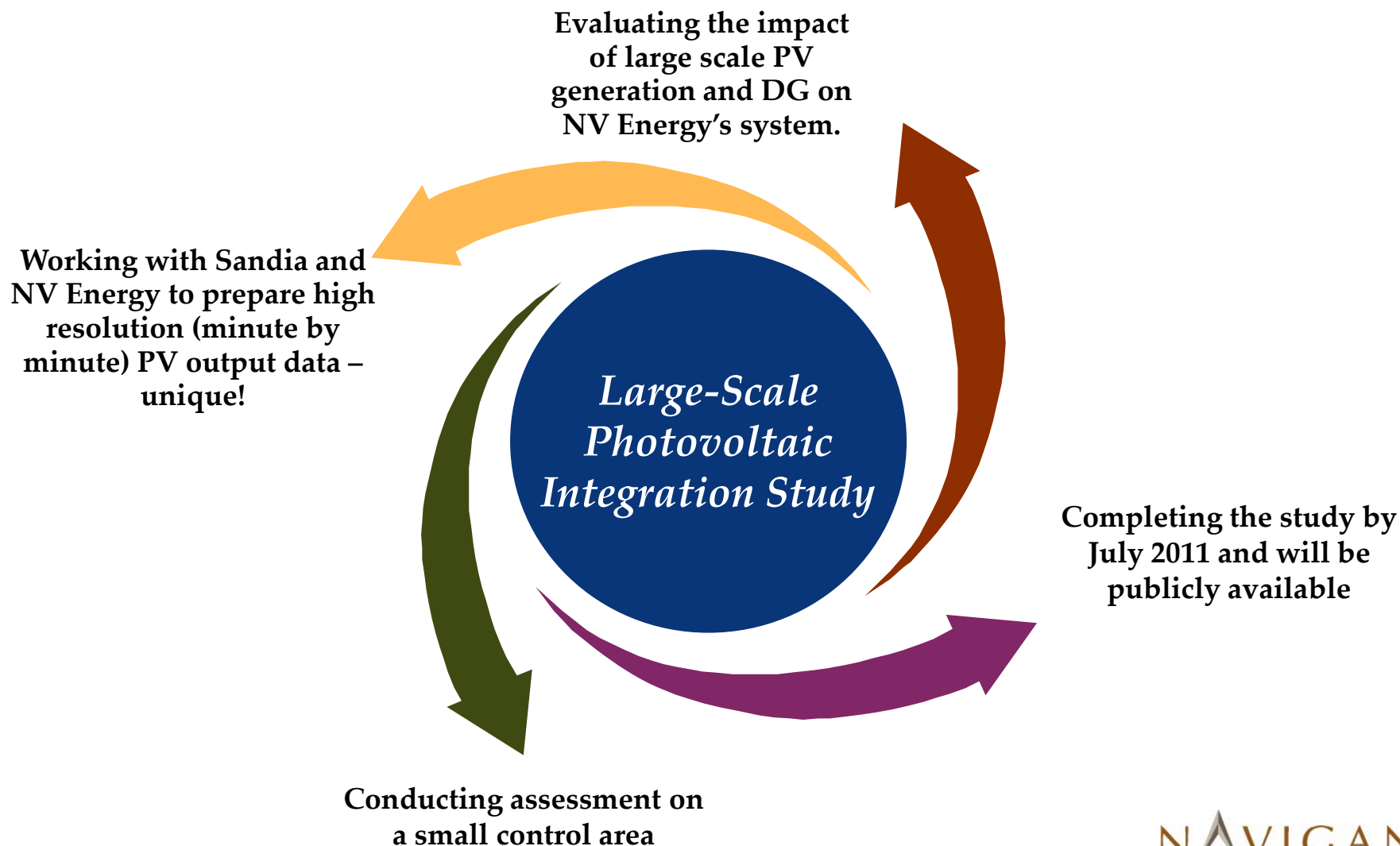
NV Energy's distribution system is not the limiting factor with regard to how much DG can be installed within existing operating limits.

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.

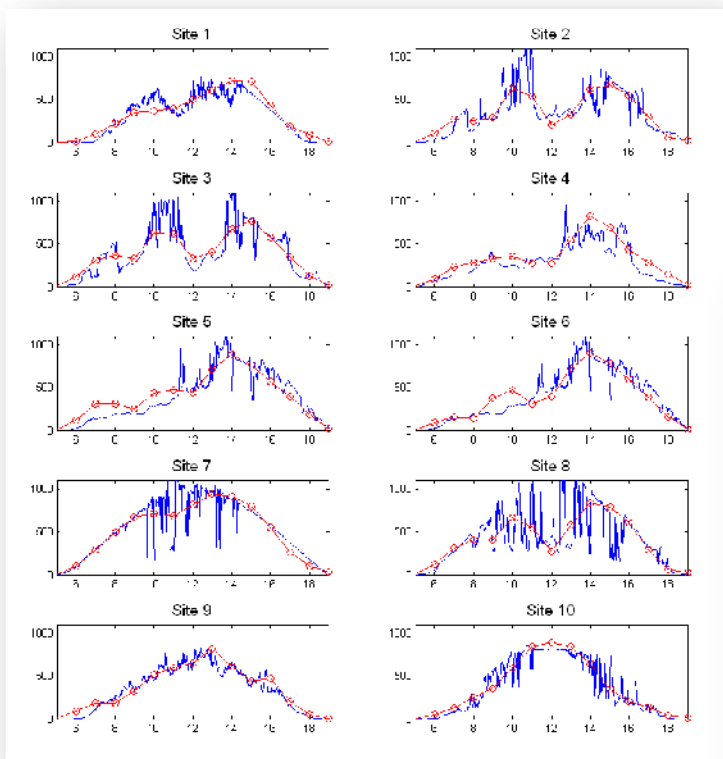
NV Energy will include DG in its ongoing *Large-Scale Photovoltaic Integration Study*. The PV study will be completed and submitted to the PUCN in July 2011.

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

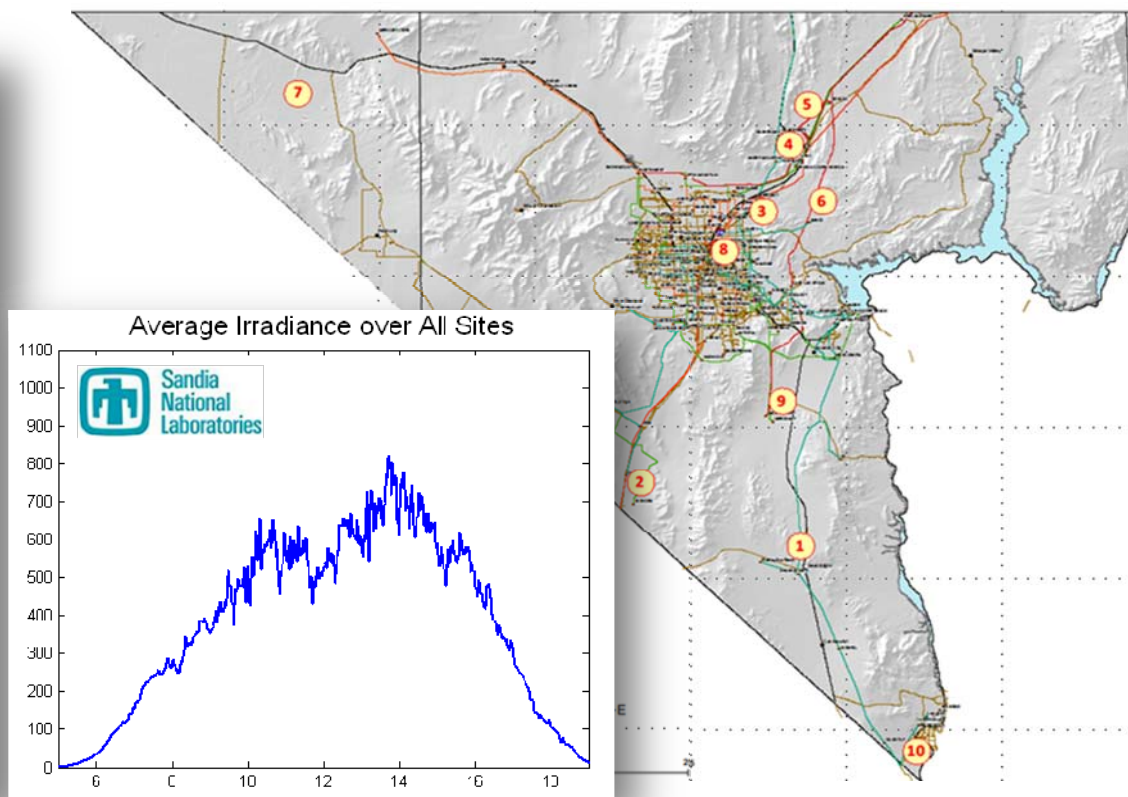


Sandia National Laboratories developed a set of high-resolution, time-correlated PV output data for use in the NV Energy integration study.

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.

Key CONTACTS



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