

# What Is the Best Compass Direction for Panels?

- Solar Tracking Systems
  - Automatically Follow the Sun.
    - 33% more Energy than Fixed Tilt
    - Generally Cheaper to install 33% more Fixed Tilt panels.
- Fixed Panels
  - South is Best

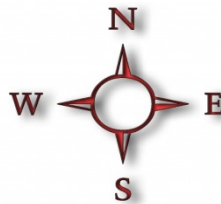


# What Direction does your Roof Face?

- Google Maps to the Rescue!



8 degrees  
West of  
South

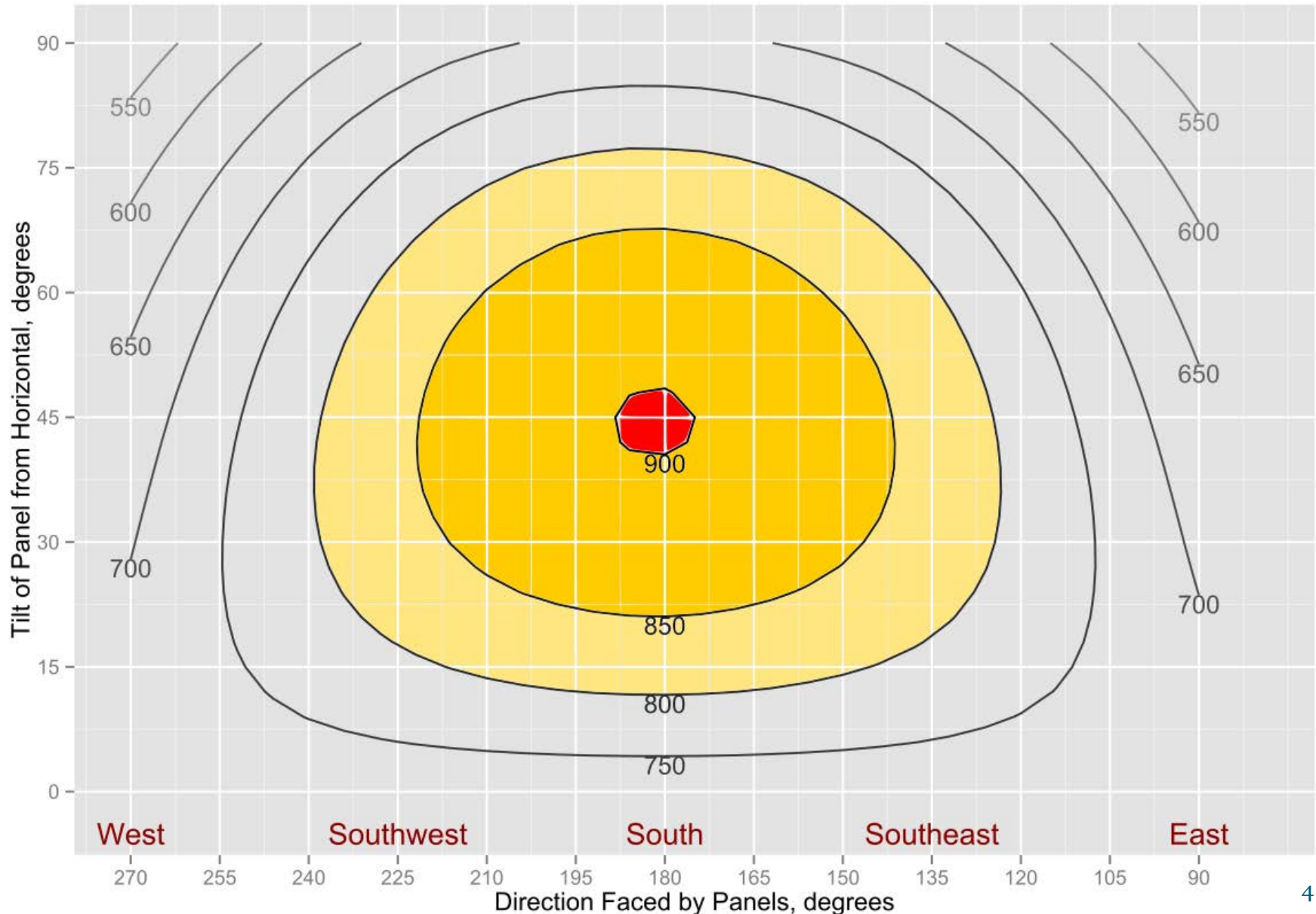


# What Tilt Up from Horizontal should I Pick?

- If no Clouds:
  - Tilt up from Horizontal = Latitude
- But there are Clouds!!
  - Lots of Cloudy days: Face Panels more Upward
- Ability to Shed Snow is Somewhat Important in Alaska !
  - More than 60 – 65 degrees up from Horizontal to Shed most Snow
- Cost, Aesthetics, Wind

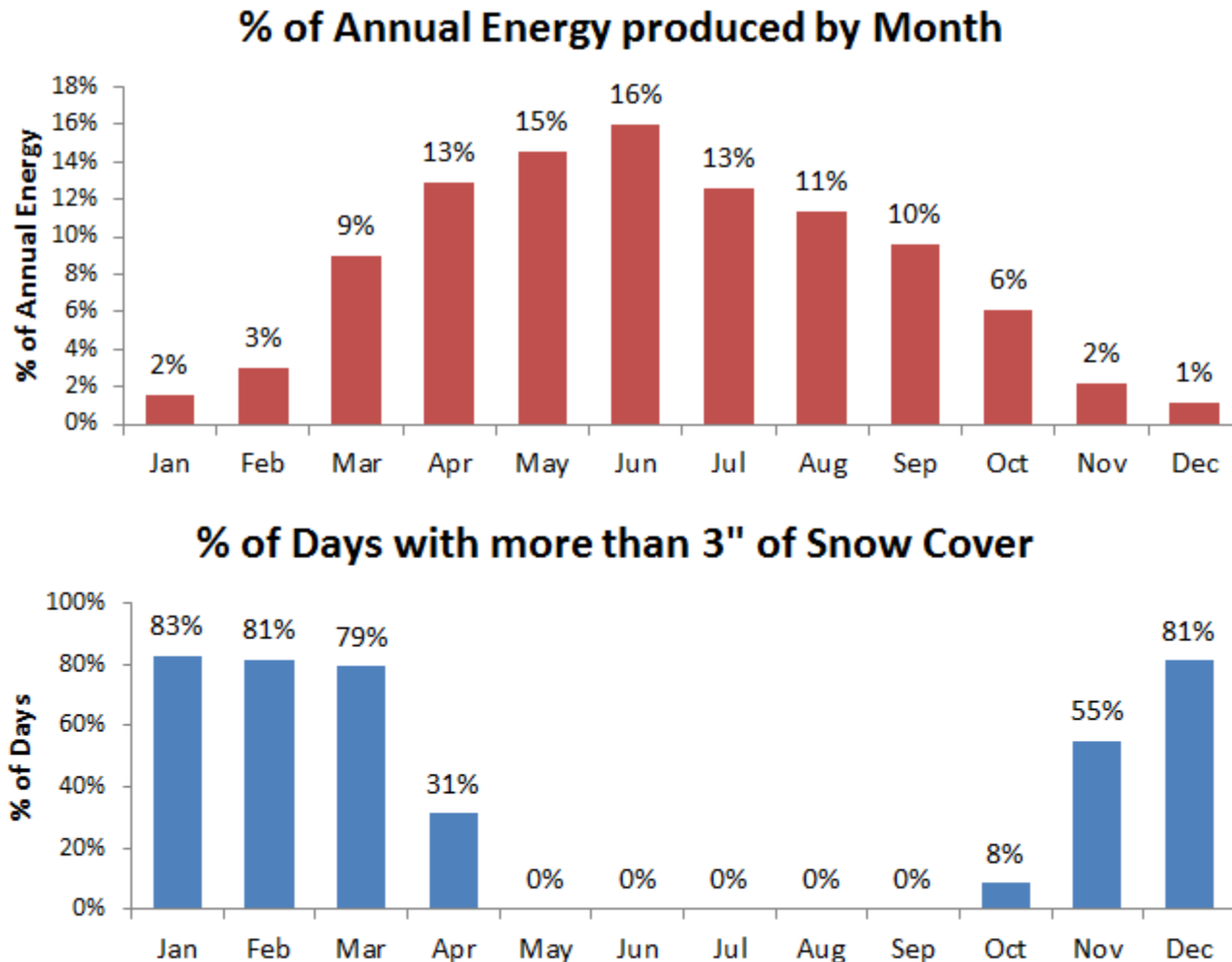
# Grid-Tied Solar Output vs Orientation: Anchorage

Annual kWh per kW of Array (3% Shading Loss, 5% Snow Loss)



# How important is Snow Cover on Panels?

## Anchorage Solar and Snow Data

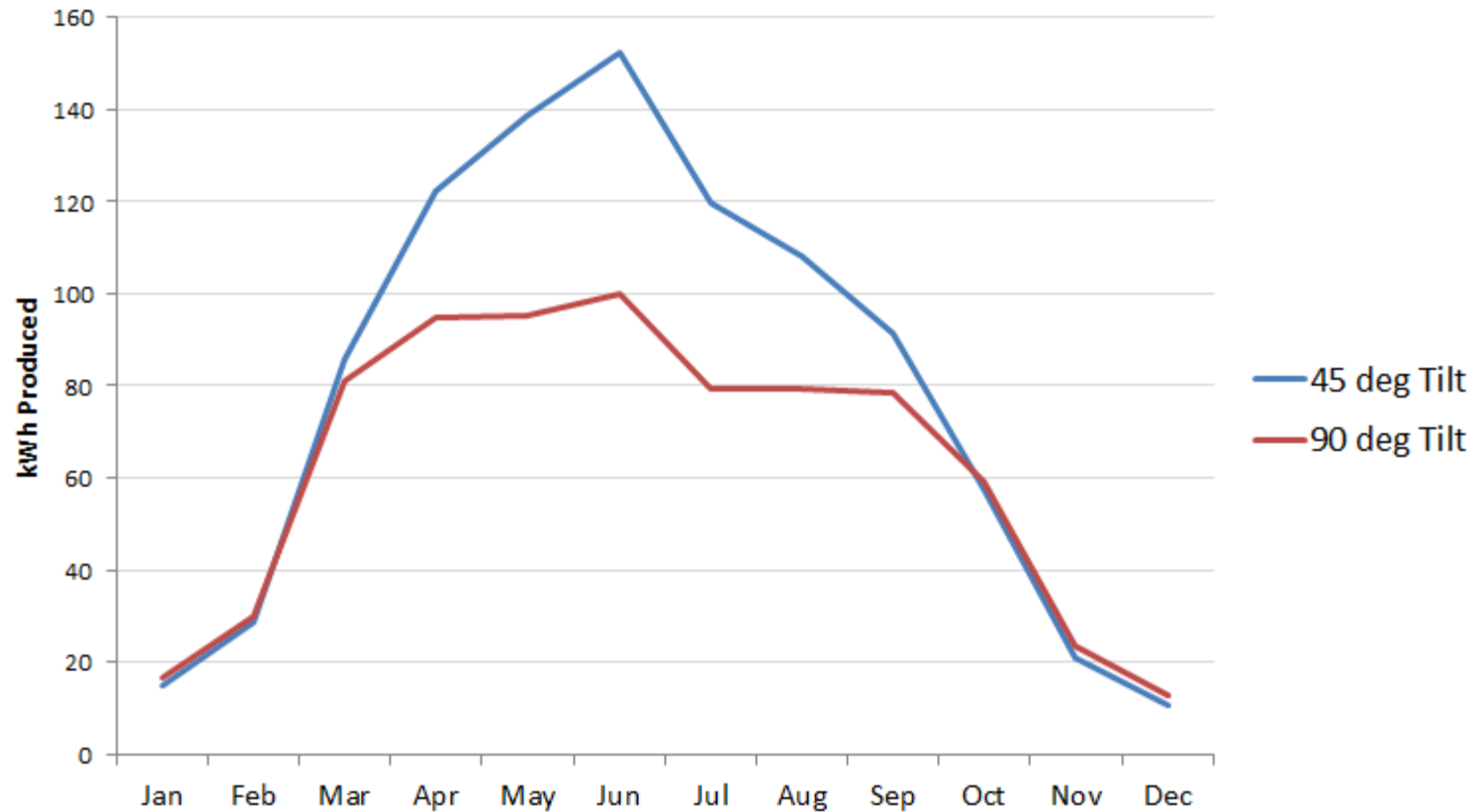


# Benefit of Adjusting Tilt Spring & Fall

- For Anchorage, a 33° Summer Tilt (early April – August) and a 65° Winter Tilt maximizes Output.
  - Compared to a 65° Tilt year-round, you get **7.3% more** kilowatt-hours.
  - Compared to a 45° Tilt year-round, you only get **2.4% more** kilowatt-hours
    - *Assuming* you keep the 45° Tilt free of snow!

# Off-Grid Tilt Optimization

Winter Months may be More Important



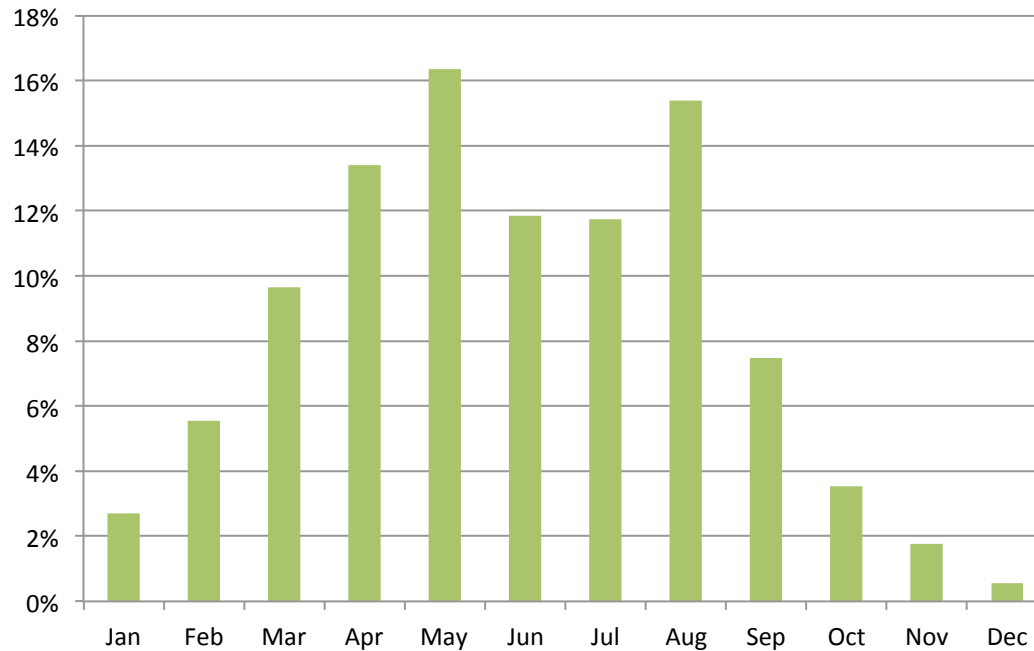
# Site Issues

- **Site Issues (Continued)**
  - Shading
    - Solar Production Annually and Hourly in Anchorage
    - Shading Effects on PV Production
    - Tools for determining Shading
    - System Optimization for Shading Issues
  - Mounting Options
    - Roof Mount
    - Ground Mount
    - Pole Mount
    - (BIPV) Building Integrated PV
    - Tracker
  - Snow Build-up
    - Angle Needed To Shed Snow
    - Graph of Monthly Production and overlay typical snowfall for a couple Alaskan sites
    - Snow Covering bottom of Panel:
      - Superiority of Landscape Orientation
      - Standoffs to Elevate Panel
    - Means of Cleaning Snow



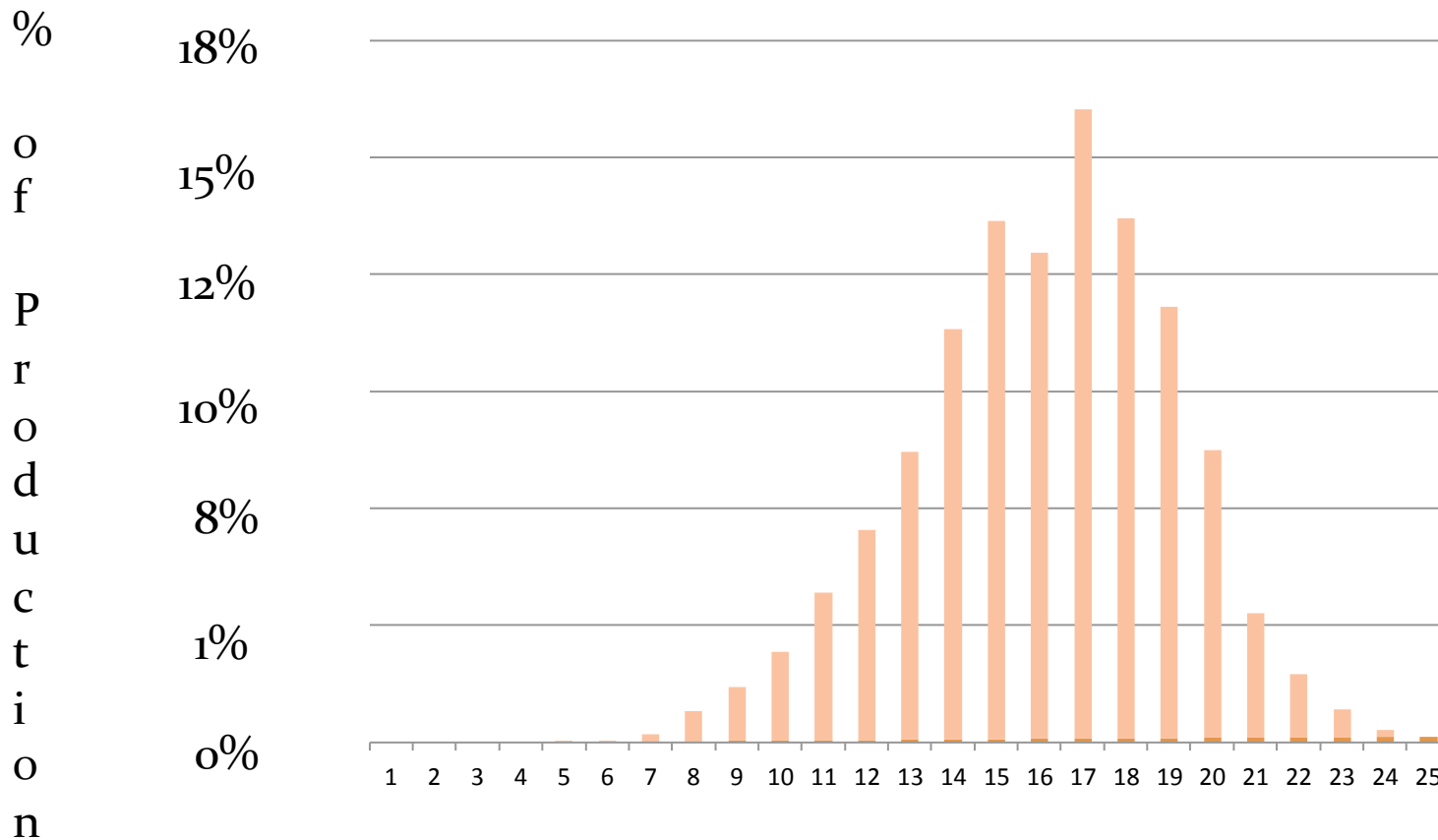
# Site Issues

## Annual Solar Production in Anchorage



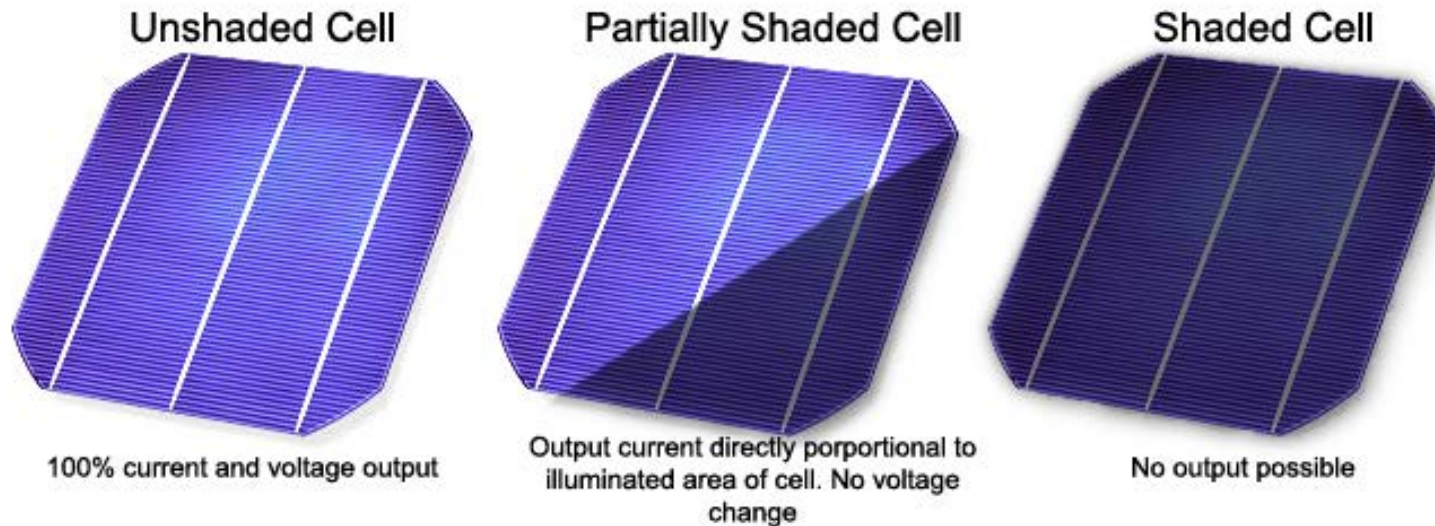
# Site Issues

## Average Daily Solar Production in Anchorage



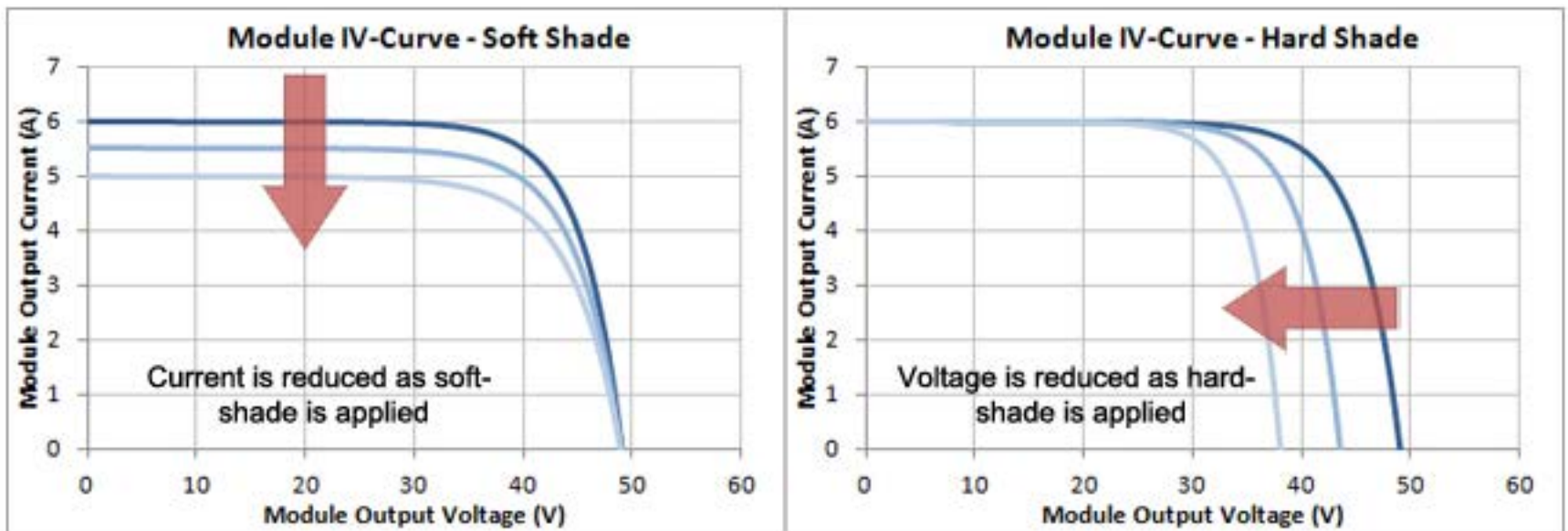
# Site Issues

## Shading Effects on Solar



# Site Issues

## Shading Effects on Solar



Soft Shade: A reduction in irradiance, usually caused by upper layer clouds

Hard Shade: A visible shadow or shade cast on an array by object

# Site Issues

## Tools for Determining Shading



Solar Path Finder



Solarmetric SunEye



Apps on  
Smartphone



# Site Issues

## System Optimization Due to Shading Issues

- Remove any Trees or Objects that will cause consistent shading
- Utilize Micro Inverters or DC Optimizers rather than a string inverter
- Wire panels in strings least effected by shading (Usually Horizontally)
- NEVER put panels on the same string facing different directions.

# Site Issues

## Mounting Options



Top of Pole Mount



Roof Mount



Ground Mount



Building Integrated PV (BIPV)



Dual Axis Solar Tracker



# Site Issues

## Mounting Options – Roof Mount

- Great for locations with roof space
- Low Cost
- Low Footprint
- Rated for high winds
- Not easily adjustable
- Very inaccessible for snow or maintenance
- Can cause vibration in High winds





# Site Issues

## Mounting Options – Ground Mount

- Great for locations with a lot of land
- Easy Snow Removal
- Rated for high winds
- No vibration on residence
- Scalable for Large Arrays
- Large Footprint
- Can block view
- Requires trenching
- Expensive for small systems



# Site Issues

## Mounting Options – Pole Mount

- Great for locations with a lot of land
- Adjustable for seasonal optimization
- Can have almost no snow cover
- Rated for high winds
- No vibration on residence
- Large Footprint
- Can block view
- Requires trenching
- More expensive than roof mount



UAF Sustainable Village – If we do not count the street lights installed for the Village, this solar install, direct to GVEA's grid, offsets 100% of the four homes electrical usage.

# Site Issues

## Mounting Options – Building Integrated PV (BIPV)

- Reduces Construction Cost
- Visually More Appealing
- Can have almost no snow cover
- Rated for high winds
- Usually has to be planned in the design phase
- Hard to replace panels if there are any issues
- Angle is fixed so your production is reduced





# Site Issues

## Mounting Options – Solar Tracker

- Most Efficient Mounting
- Doesn't have to be adjusted
- Can have almost no snow cover
- Rated for high winds
- Tends to have the most maintenance
- Because it is moving there are failures occasionally
- It is extremely expensive
- Large Footprint
- Have to Trench



# Site Issues

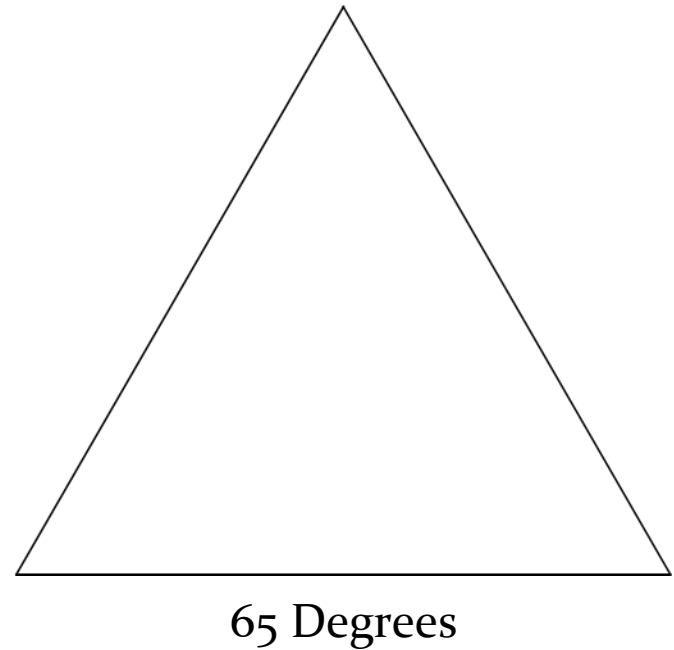
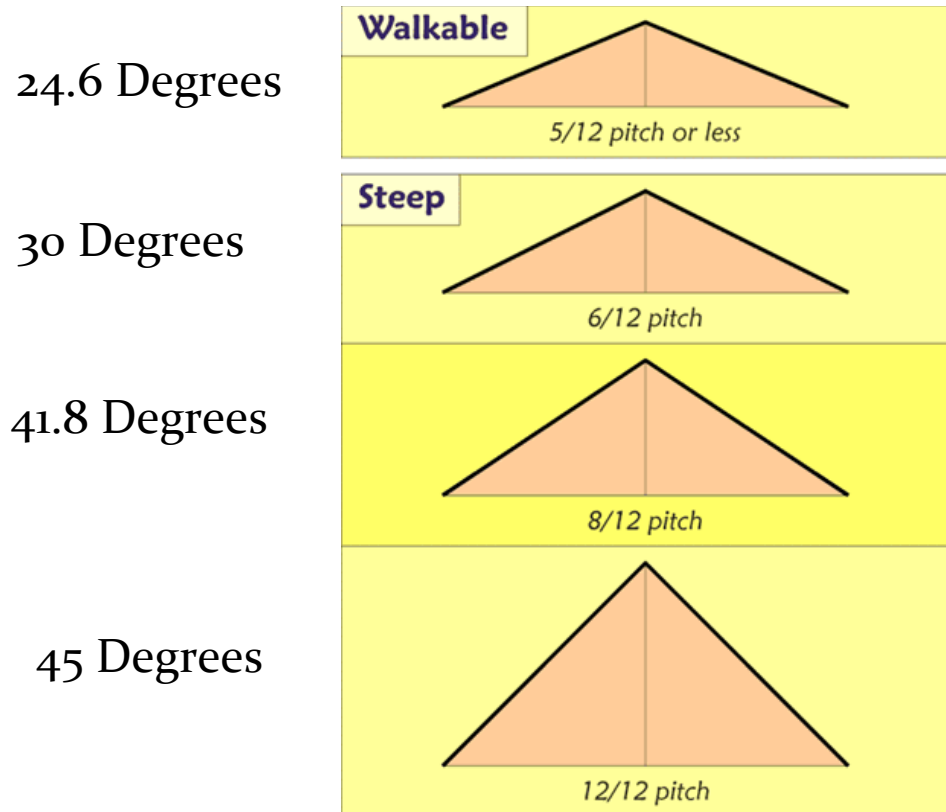
## Snow Buildup



100% Covered equals 0% Producing

# Site Issues

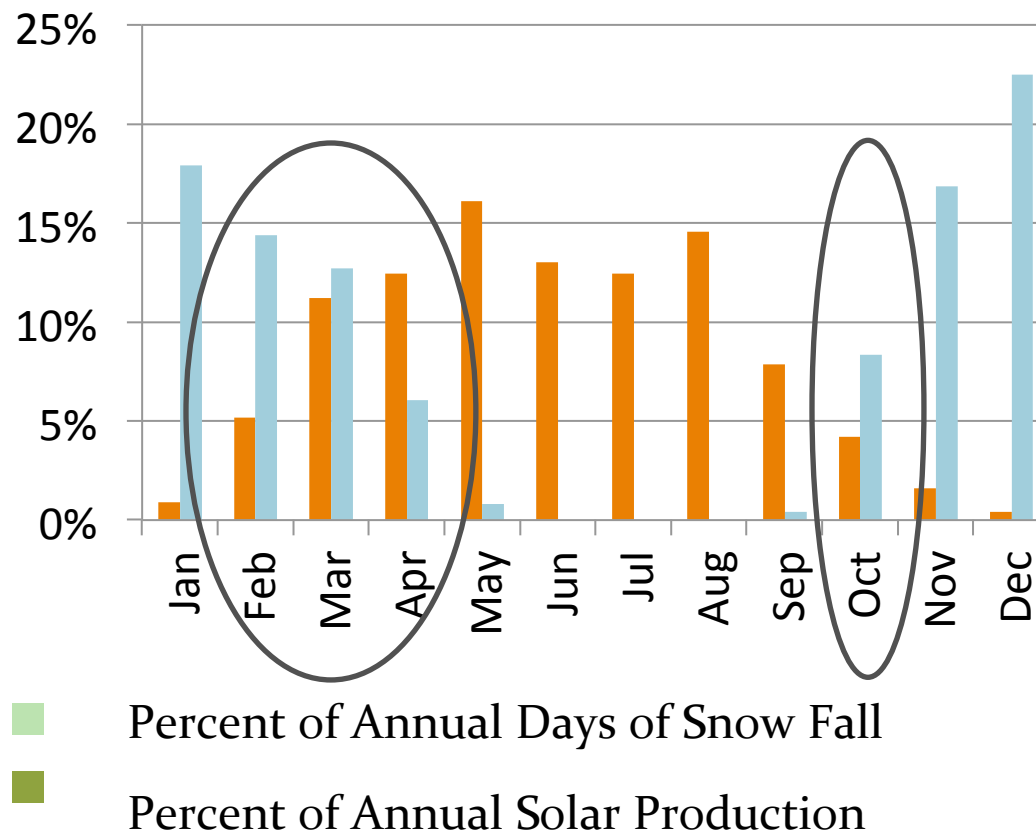
## Snow Buildup – Angle Needed



It's really all about dry  
snow vs. wet snow!!

# Site Issues

## Snow Buildup – Snow vs Production Months



# Site Issues

## Snow Buildup – Shading from Snow



Portrait



Landscape

\*String vs Parallel Connection



# Site Issues

## Snow Buildup – Means of Cleaning Snow

- Panels are fairly durable. So a plastic shovel with no metal in it can often be used to clear panels for a roof mount.
- Trackers and Pole Mounts usually only require a good shake for them to slide off
- Vertical Panels rarely accumulate snow, and if so it is not on there very long
- Lower residential roofs sometimes use extension squeegees to clear their panels.