NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Roll-up Calculations

GADS Wind Training Module 21
March 2021

RELIABILITY | RESILIENCE | SECURITY




Content

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Note: WTG = Wind Turbine Generator

NCF = Net Capacity Factor – % of installed capacity that the plant achieved over a period

Are all Hours Equal?

Over time companies will acquire multiple wind plants, with different WTG types, running in different wind regimes. Determining an overall performance value becomes challenging. First the value of an hour needs to be understood.

Is an hour just 60 minutes or 3,600 seconds or does it define a period in which something happens?

Is there value in a Force Outage Hour? Are all Force Outage Hours equal?

Can I say “One Hour of Forced Outage is equal to $200”?

What types of factors can influence the value of a Forced Outage Hour?

- Anything that impacts NCF
- Number of WTG’s
- Capacity of WTG’s
- MWH rate

Roll-up Testing

During this test, 5 roll-up methods will be tested:

1. Average
2. Actual generation
3. Expected generation
4. Hours
5. Installed capacity

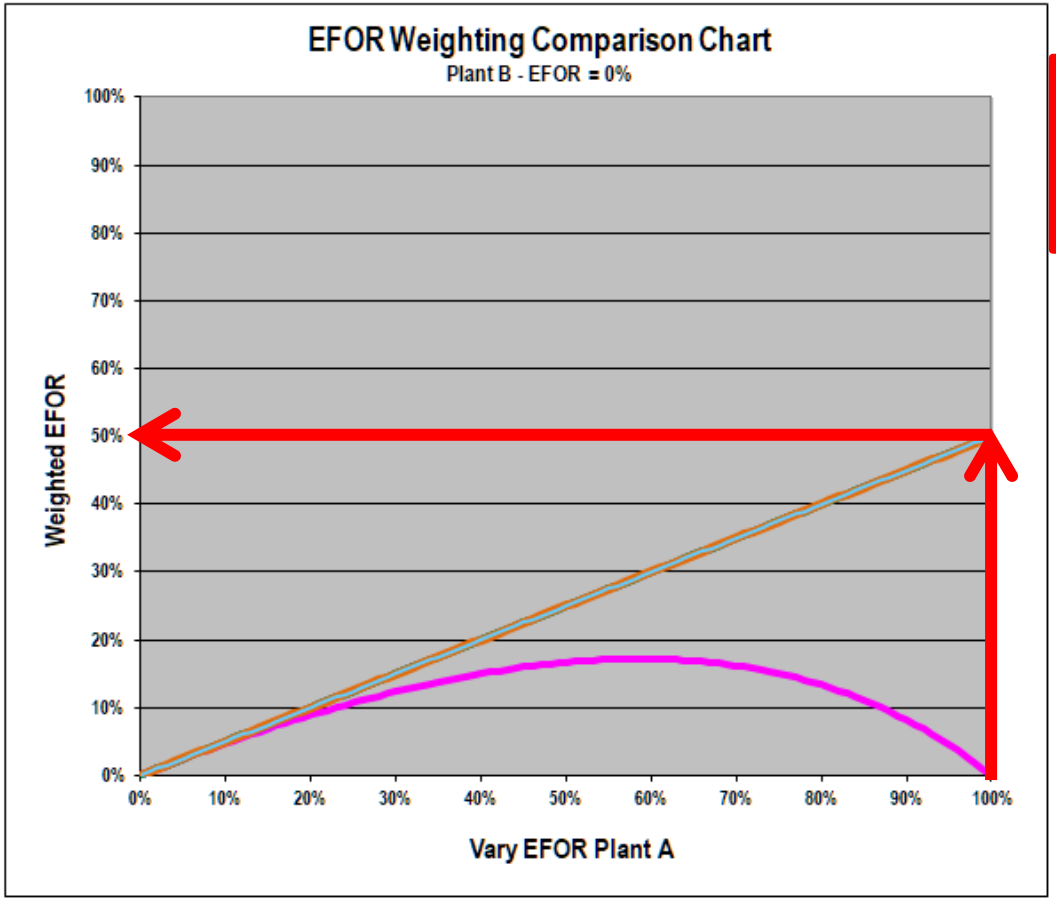
Various plant characteristics will be varied:

1. Turbine count
2. Turbine system capacity
3. Net capacity factor

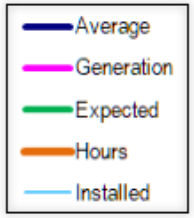
One plant will be held at 0% EFOR (no outages or derates) and the other plant will vary EFOR between 0% and 100%. What the charts will tell us is the roll-up value for the combined plants using each of the 5 methods listed above

Pooled Data

When the WTG count, capacity and NCF are the same this is the same as using the Pooling Equations (hours) in the DRI. Notice that Average, Expected, Hours and Installed Capacity give the same result. What happened to **Generation**?



Assumptions	Plant A	Plant B
#WTG=	20	20
Rating(MW)=	3.0	3.0
Hrs/Mo=	720	720
NCF=	50%	50%
Availability=	Table	100%

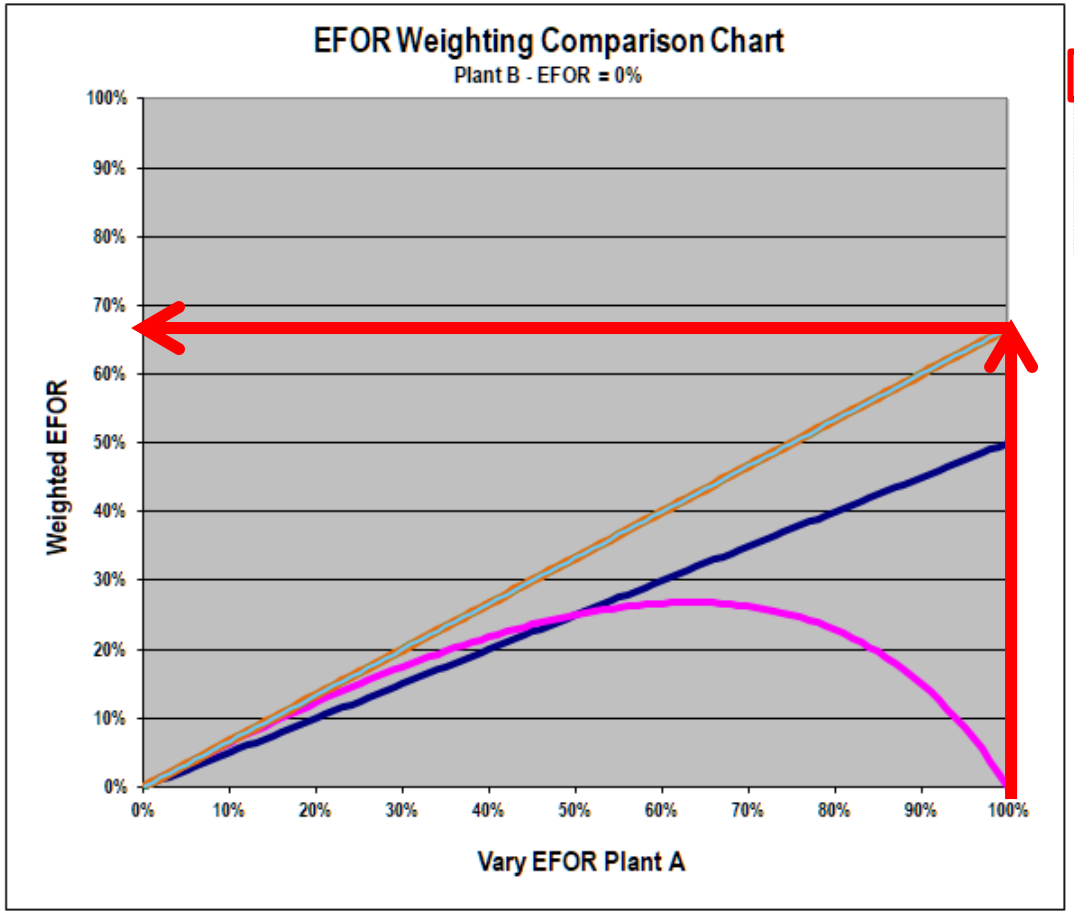


Expect

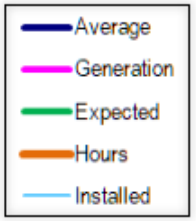
50%

Identical Sites – Different WTG Count

When the WTG count varies and WTG capacity and NCF are the same this is this is another example of the Pooling Equations in the DRI. Notice that Expected, Hours and Installed Capacity give the same result. What happened to **Average**?



Assumptions	Plant A	Plant B
#WTG=	40	20
Rating(MW)=	3.0	3.0
Hrs/Mo=	720	720
NCF=	50%	50%
Availability=	Table	100%

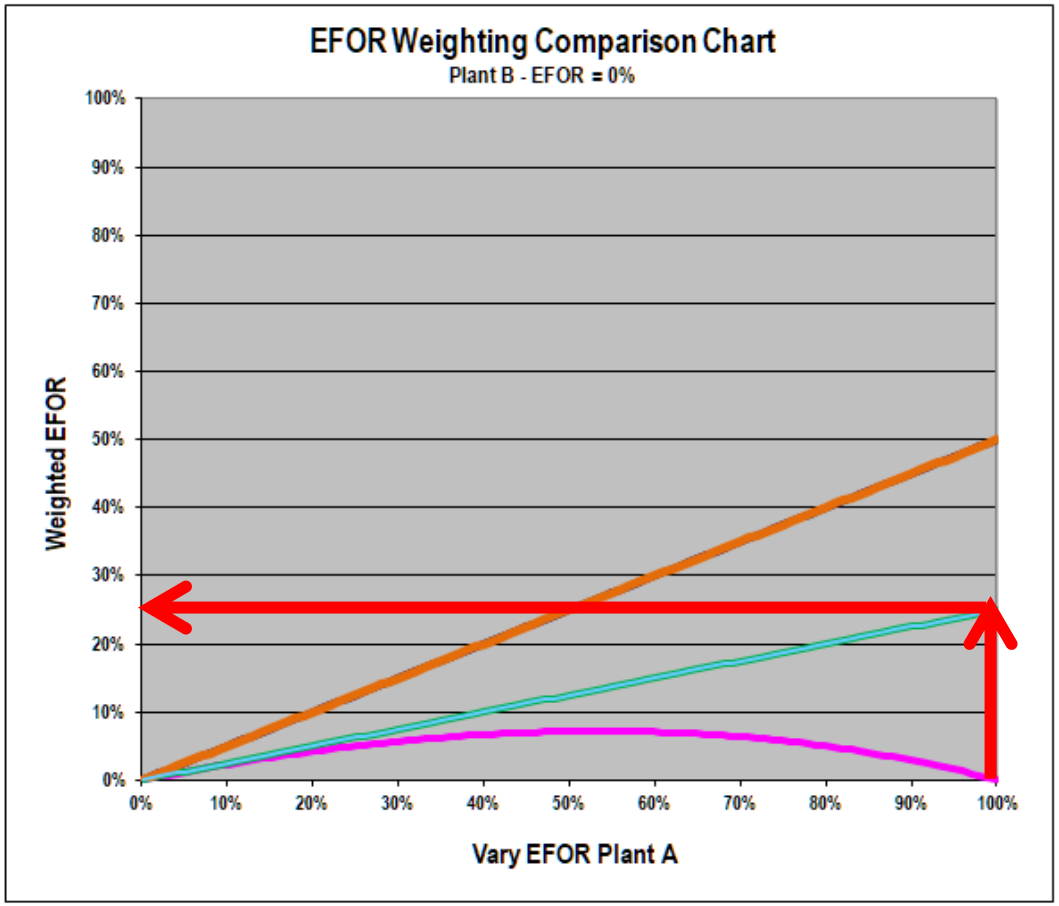


Expect

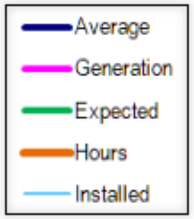
66%

Identical Sites – Different WTG Capacity

When the WTG capacity varies and the count and NCF are the same the roll-up values change significantly. Notice that Expected and Capacity give the same result, and Average and Hours. What happened to **Hours**?



Assumptions	Plant A	Plant B
#WTG=	20	20
Rating(MW)=	1.0	3.0
Hrs/Mo=	720	720
NCF=	50%	50%
Availability=	Table	100%

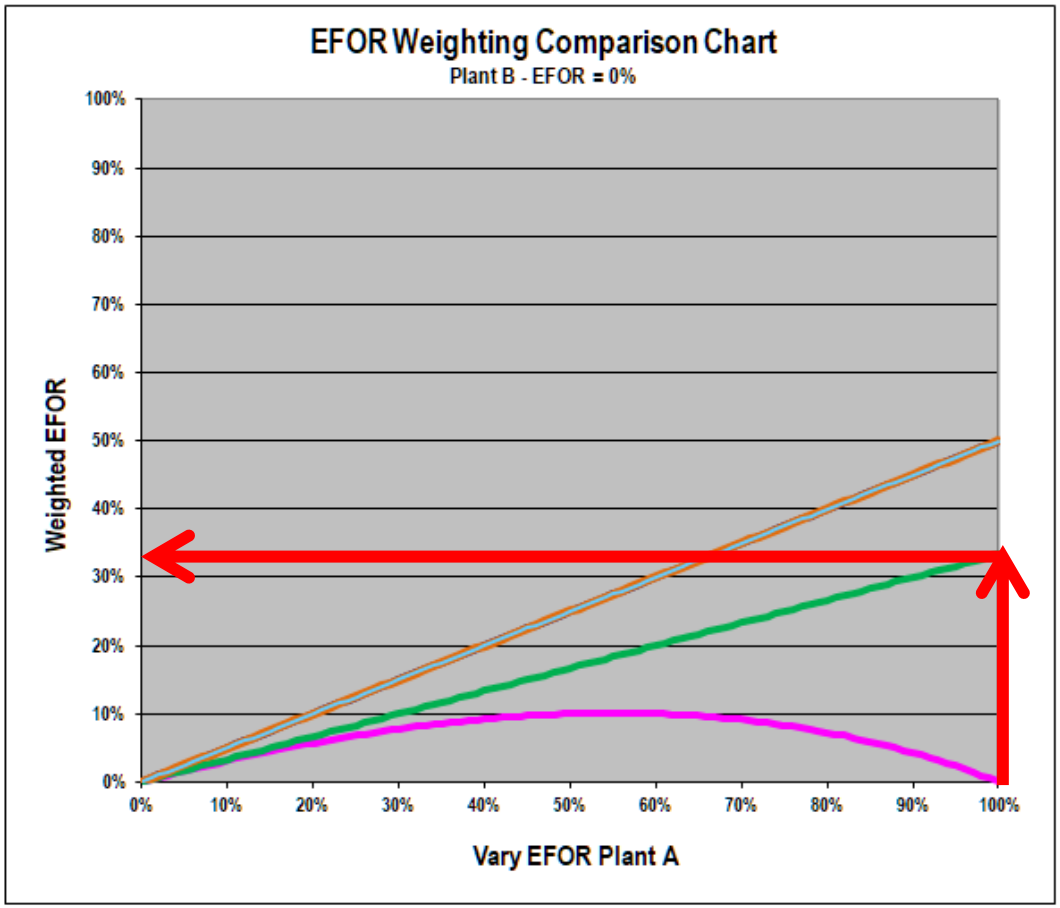


Expect

25%

Identical Sites – Different NCF

When the WTG NCF varies and capacity and count are the same additional variation can be seen in the roll-up values. Notice that Average, Expected, Hours and Installed Capacity give the same result. What happened to **System Capacity**?



Assumptions	Plant A	Plant B
#WTG=	20	20
Rating(MW)=	1.0	1.0
Hrs/Mo=	720	720
NCF=	25%	50%
Availability=	Table	100%

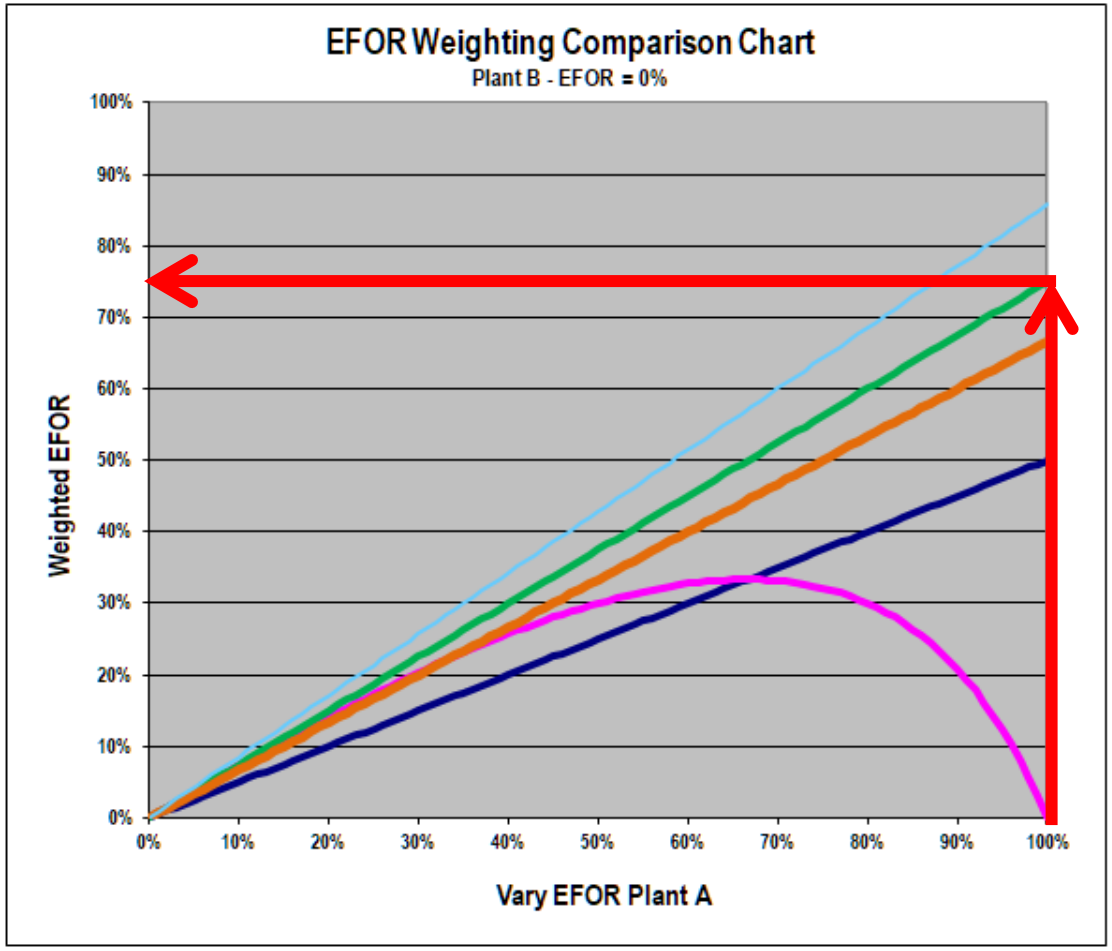
Average
Generation
Expected
Hours
Installed

Expect

33%

Everything Different

When all the plant traits are varied, there is a wide distribution in roll-up values. Expected energy gives the best result.



Assumptions	Plant A	Plant B
#WTG=	40	20
Rating(MW)=	3.0	1.0
Hrs/Mo=	720	720
NCF=	25%	50%
Availability=	Table	100%

Average
Generation
Expected
Hours
Installed

Expect

75%

Questions and Answers