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WHICH ENERGY
PROVIDER IS THE LEAST
RELIABLE?
- AN AEMR CASE STUDY

Number of Approved Outages and Recovery Time

Status	Reason	Start Time	
		Count of AEMR_OUTAGE_TABLE 2016	Recovery Time Minutes 2016
Approved	Consequential	181	0
	Opportunistic Maintenanc..	106	555
	Forced	1,264	313
	Scheduled (Planned)	380	4,485

Number of Approved Outages and Recovery Time

Status	Reason	Start Time	
		Count of AEMR_OUTAGE_TABLE 2017	Recovery Time Minutes 2017
Approved	Consequential	127	0
	Opportunistic Maintenanc..	102	331
	Forced	1,622	276
	Scheduled (Planned)	320	5,001

In 2016 and 2017, **forced outages occurred the most (1,264 and 1,622 times respectively)**. Although most of the recovery time occurred with planned outages, the number of **forced outages is near 30% higher**, suggesting unreliable energy providers.

Outages Per Month

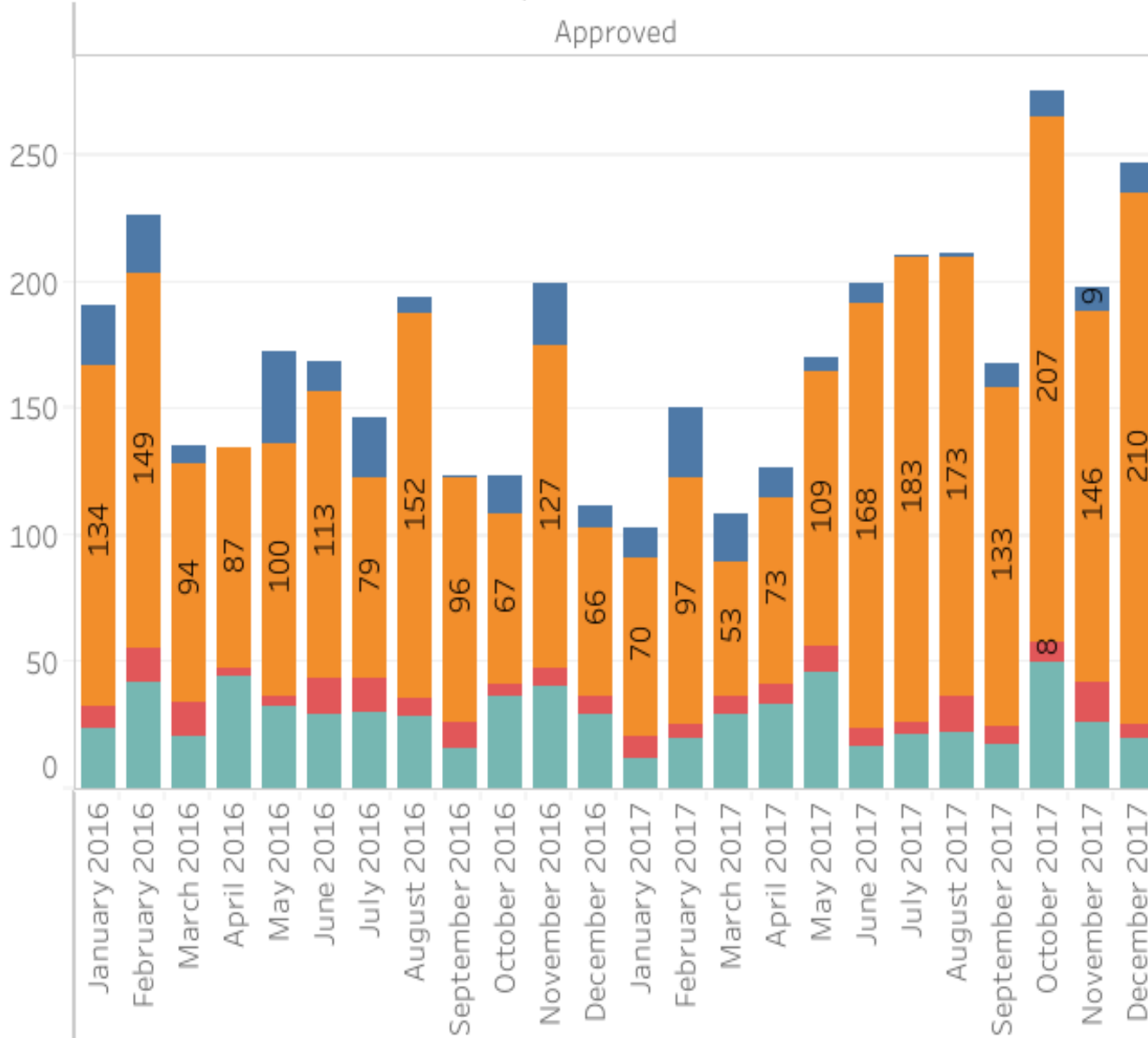
Status / Month of Start Time

Approved

Reason

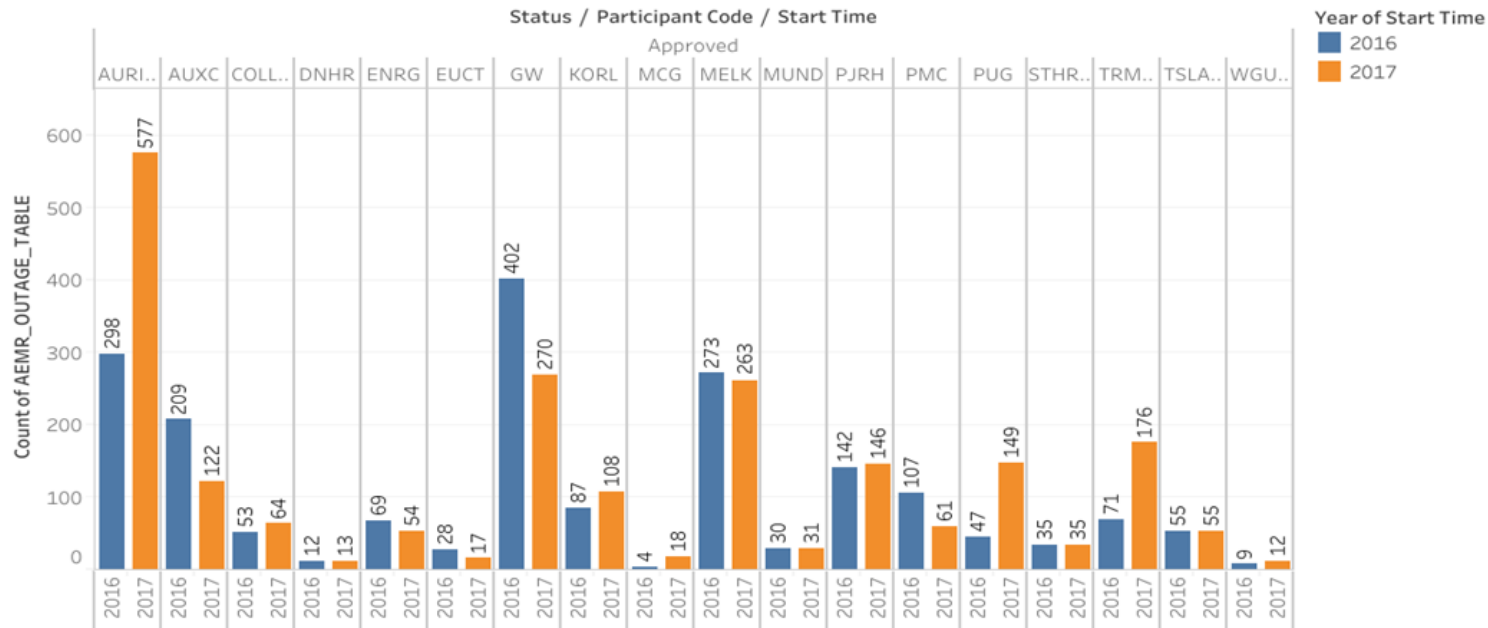
- Consequential
- Forced
- Opportunistic Maintenance (Planned)
- Scheduled (Planned)

Count of AEMR_OUTAGE_TABLE

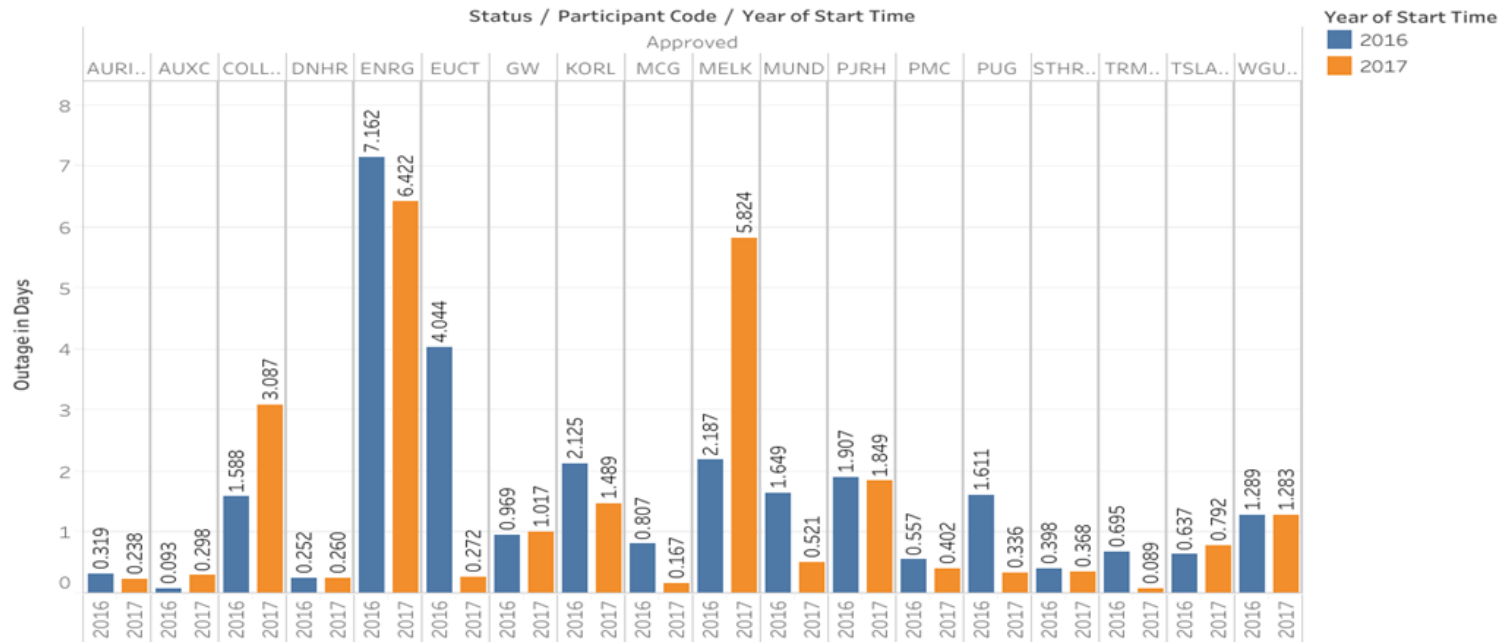


The **maximum** number of outages occurred in **October of 2017** (207 outages) and **December 2017** (210 outages).

Outages Per Energy Provider (2016/2017)



Outage in Days per Provider



Auricon has the highest number of outages, increasing by 93.6% from 2016 to 2017.


Although **ENRG** had a combined total of **13.5 days** in outages, it had one of the lowest total outages of 123, also decreasing from 2016 to 2017.

GW had the second greatest number of outages at **672**, but that total **decreased** from 2016 to 2017 **by 32.8%**. It's outages only equates to 2 days over the two-year period.

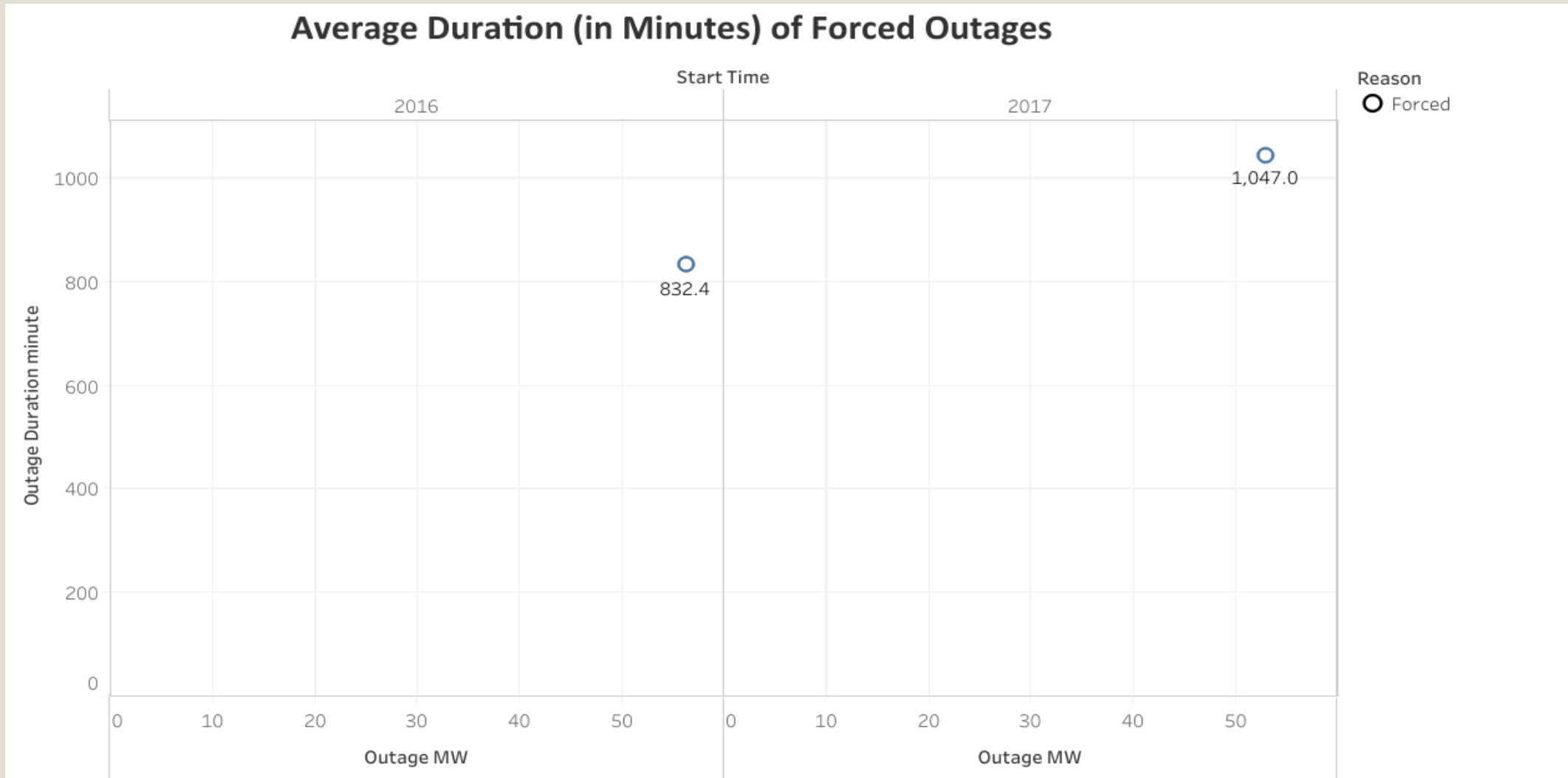
Melk had a moderate number of outages with **536 and 8 days** over the 2016-2017 period.

Forced outages have increased by 12% from 2016 to 2017. It is the only type of outage that increased.

Outage Percentage by Reason (2016/2017)

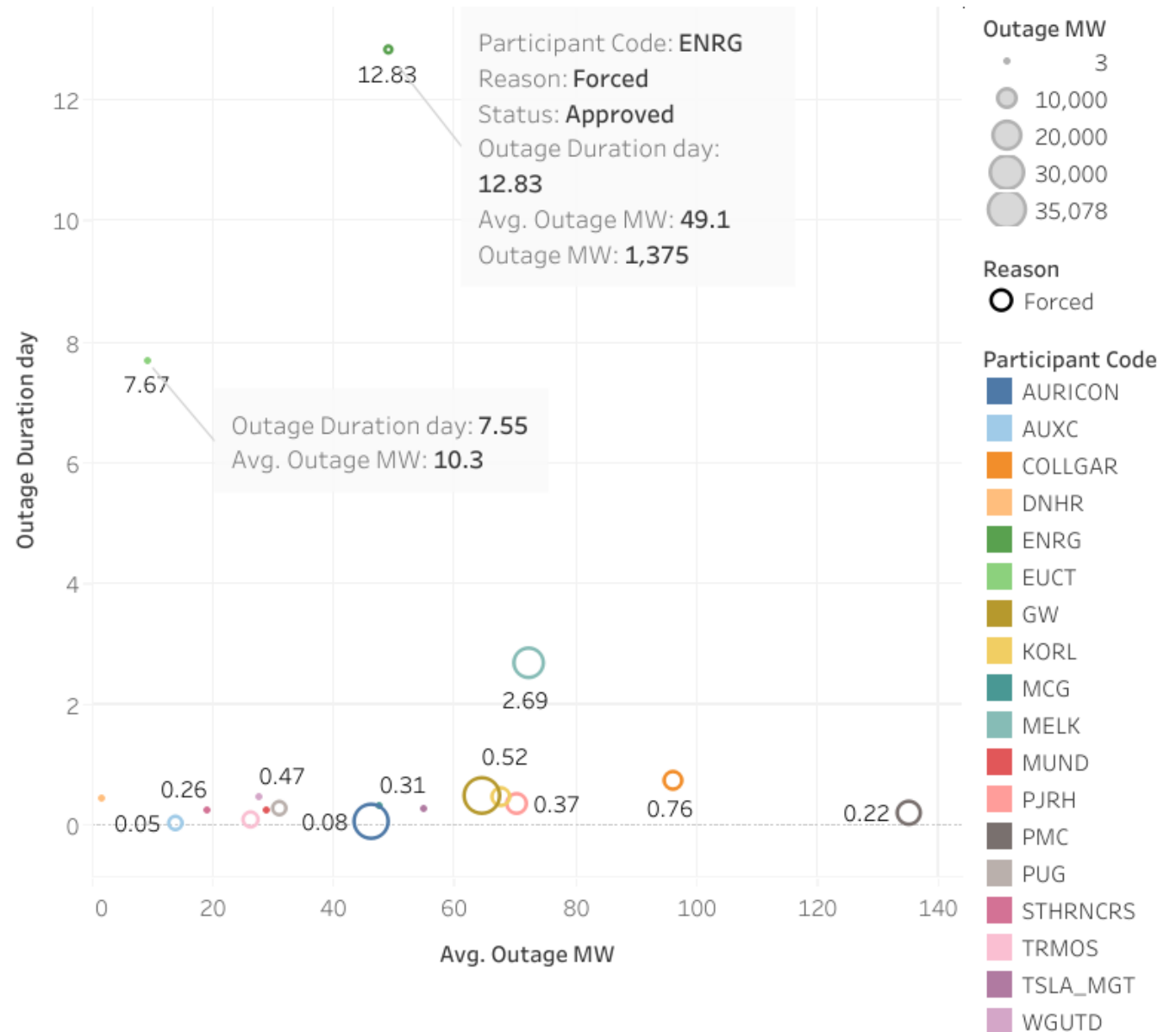
Status	Reason	Start Time		% of Total Count of AE..
		2016	2017	
Approved	Consequential	59%	41%	 41% 59%
	Forced	44%	56%	
	Opportunistic Maintenanc..	51%	49%	
	Scheduled (Planned)	54%	46%	

The average duration of a forced outage in 2016 was 832.4 minutes or 0.58 days. In 2017, the average duration was 1,047.0 minutes or 0.73 days. This is an increase of 20% from 2016 to 2017.



The most unreliable energy providers in terms of total energy loss are ENRG and EUCT. ENRG has an average outage duration of almost 13 days with a 49.1 MW loss of energy per day. EUCT has an average of 8 days of outages with an average energy loss of 10.3 MW.

Avg Outages (in Days) and Energy Loss



Summary

- Forced outages have increased by 30% from 2016 to 2017
- The number of outages for Auricon has increased by 93% from 2016 to 2017 causing unreliability.
- ENRG has the most energy loss averaging 49.1 mw per day over 13 days of outages.

SQL Queries:

- These first set of queries are used to find the total number of outage events for each provider, as well as the average duration of the event in days, throughout the 2016-2017 time period.

Query 1.1

```
SELECT
COUNT(*) AS Total_Number_Outage_Events,
Status, Reason
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) = 2016
GROUP BY Reason
ORDER BY Reason;
```

Query 1.3

```
SELECT
COUNT(*) AS Total_Number_Outage_Events,
Status, Reason
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) = 2017
GROUP BY Reason
ORDER BY Reason;
```

Query 1.5

```
SELECT
Status, Reason,
COUNT(*) AS Total_Number_Outage_Events,
ROUND(AVG((TIMESTAMPDIFF(minute, Start_Time, End_Time)/60)/24), 2) AS Average_Outage_Duration_Time_Days,
YEAR(Start_Time) AS Year
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) IN ('2016', '2017')
GROUP BY Status, Reason, Year
ORDER BY Reason, Year;
```

SQL Queries:

- This set of queries was used to find the total number of outage events each month, for each provider, for each year of 2016 and 2017.

Query 2.1

```
SELECT
Status, Reason,
COUNT(*) AS Total_Number_Outage_Events,
Month(Start_Time) As Month
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) = 2016
GROUP BY Reason, Month(Start_Time)
ORDER BY Reason, Month(Start_Time);
```

Query 2.2

```
SELECT
Status, Reason,
COUNT(*) AS Total_Number_Outage_Events,
Month(Start_Time) As Month
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) = 2017
GROUP BY Reason, Month(Start_Time)
ORDER BY Reason, Month(Start_Time);
```

Query 2.3

```
SELECT Status,
COUNT(*) AS Total_Number_Outage_Events,
MONTH(Start_Time) As Month,
YEAR(Start_Time) As Year
FROM AEMR
WHERE Status = 'approved' AND MONTH(Start_Time) > 0 AND MONTH(Start_Time) < 13 AND
YEAR(Start_Time) IN ('2016', '2017')
GROUP BY Status, Month, Year
ORDER BY Month, Year;
```

SQL Queries:

- This third set of queries was used to find the participant codes for the providers and duration of the outages in days during 2016-17.

Query 3.1

```
SELECT
COUNT(*) AS Total_Number_Outage_Events,
Participant_Code,
Status,
YEAR(Start_Time) As Year
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) IN ('2016', '2017')
GROUP BY Participant_Code, Year
ORDER BY Year, Participant_Code DESC;
```

Query 3.2

```
SELECT
Participant_Code,
Status,
YEAR(Start_Time) As Year,
ROUND(AVG(TIMESTAMPDIFF(minute, Start_Time, End_Time)/60)/24, 2) AS Average_Outage_Duration_Time_Days
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) IN ('2016', '2017')
GROUP BY Participant_Code, Status, Year
ORDER BY Average_Outage_Duration_Time_Days DESC;
```

SQL Queries:

- o In the second part of this case study, I drilled down further to find the providers with the most forced outages in number and percentage in 2016-17.

Part 2: Query 1.1

```
SELECT
COUNT(*) AS Total_Number_Outage_Events,
Reason,
YEAR(Start_Time) As Year
FROM AEMR
WHERE Status = 'approved' AND Reason = 'forced' AND YEAR(Start_Time) IN ('2016', '2017')
GROUP BY Reason, Year
ORDER BY Reason, Year;
```

Part 2: Query 1.2

```
SELECT
SUM(CASE WHEN Reason = 'forced' THEN 1 ELSE 0 END) AS Total_Number_Forced_Outage_Events,
COUNT(*) AS Total_Number_Outage_Events,
ROUND((SUM(CASE WHEN Reason = 'forced' THEN 1 ELSE 0 END)/COUNT(*)*100, 2) AS Forced_Outage_Percentage,
YEAR(Start_Time) As Year
FROM AEMR
WHERE Status = 'approved' AND YEAR(Start_Time) IN ('2016', '2017')
GROUP BY Year
ORDER BY Year;
```

SQL Queries:

- o This set of queries was used to retrieve the average number of minutes and megawatts lost on forced outages of each provider, over the 2016-2017 period.

Part 2: Query 2.1

```
SELECT Status,  
YEAR(Start_Time) As Year,  
ROUND(AVG(Outage_MW), 2) AS Avg_Outage_MW_Loss,  
ROUND(AVG(ROUND((TIMESTAMPDIFF(MINUTE, Start_Time, End_Time))), 2)), 2) AS Average_Outage_Duration_Time_Minutes  
FROM AEMR  
WHERE Status = 'approved' AND Reason = 'forced' AND YEAR(Start_Time) IN ('2016', '2017')  
GROUP BY Year  
ORDER BY Year;
```

Part 2: Query 2.2

```
SELECT Status,  
Reason,  
YEAR(Start_Time) As Year,  
ROUND(AVG(Outage_MW), 2) AS Avg_Outage_MW_Loss,  
ROUND(AVG(ROUND((TIMESTAMPDIFF(MINUTE, Start_Time, End_Time))), 2)), 2) AS Average_Outage_Duration_Time_Minutes  
FROM AEMR  
WHERE Status = 'approved' AND YEAR(Start_Time) IN ('2016', '2017')  
GROUP BY Status, Reason, Year  
ORDER BY Year;
```

SQL Queries:

- In this final set of queries, I found the average megawatt loss for forced outages per provider labeled by participant code. I also converted the average number of days of outages to average number of minutes of forced outages, over the 2016-2017 period.

Part 2: Query 3.1

```
SELECT Participant_Code,  
Status,  
YEAR(Start_Time) As Year,  
ROUND(AVG(Outage_MW), 2) AS Avg_Outage_MW_Loss,  
ROUND(AVG(TIMESTAMPDIFF(MINUTE, Start_Time, End_Time)/60/24),2) AS Average_Outage_Duration_Time_Days  
FROM AEMR  
WHERE Status = 'approved' AND Reason = 'forced' AND YEAR(Start_Time) IN ('2016', '2017')  
GROUP BY Participant_Code, Status, Reason, Year  
ORDER BY Year ASC, Avg_Outage_MW_Loss DESC;
```

Part 2: Query 3.2

```
SELECT Participant_Code,  
Facility_Code, Status,  
YEAR(Start_Time) As Year,  
ROUND(AVG(Outage_MW), 2) AS Avg_Outage_MW_Loss,  
ROUND(SUM(Outage_MW),2) AS Summed_Energy_Lost  
FROM AEMR  
WHERE Status = 'approved' AND Reason = 'forced' AND YEAR(Start_Time) IN ('2016', '2017')  
GROUP BY Participant_Code, Facility_Code, Status, Year  
ORDER BY Year ASC, Summed_Energy_Lost DESC;
```