

# Örnekleri ile Türkiye elektrik talebi, sistemi ve bekleyen sorular

Barış Sanlı

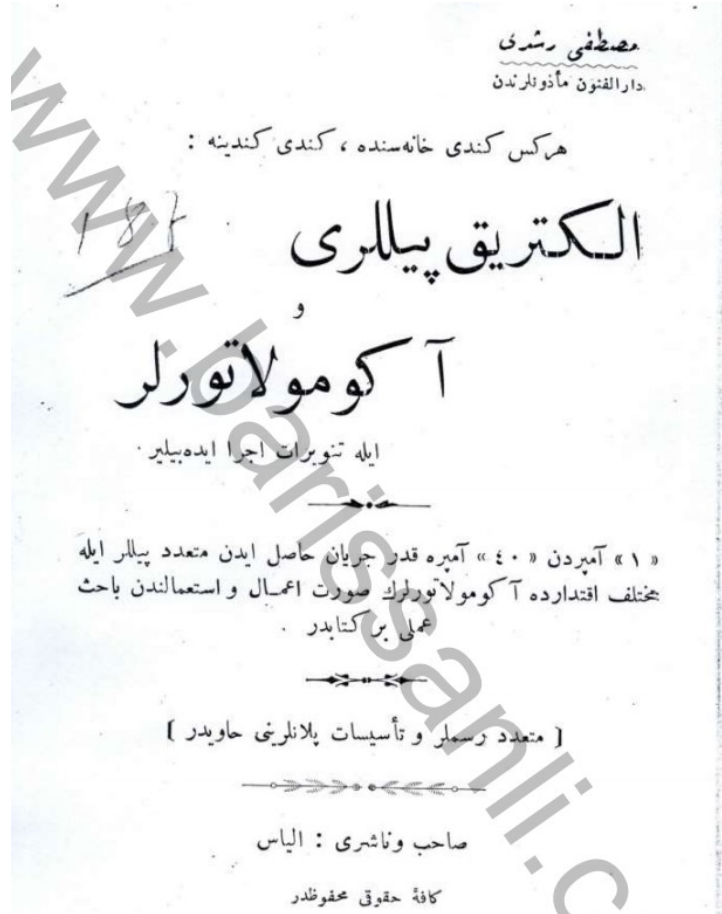
[www.barissanli.com](http://www.barissanli.com)

# Açıklama

- Bu sunumun içindeki görüşler/fikirler sadece Barış Sanlı'ya ait olup, çalıştığı, ilişkili olduğu kurum ve STK'ların görüşleri/fikirleri değildir. Şahsi fikirleri sadece kendisini bağlar
- Executive Master programı olduğu için çok teknik detaya girmek yerine örnekler anlatılmaya çalışılmıştır.

# Tarihsel bir Giriş

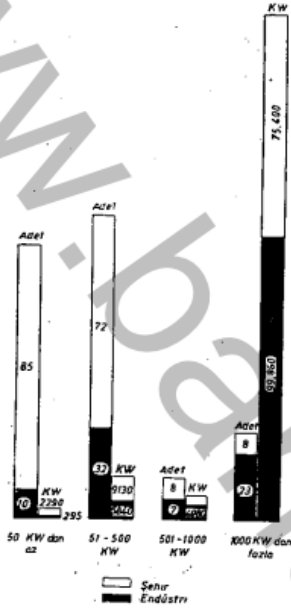
# 1915 – Osmanlıca Elektrik pilleri kitabı



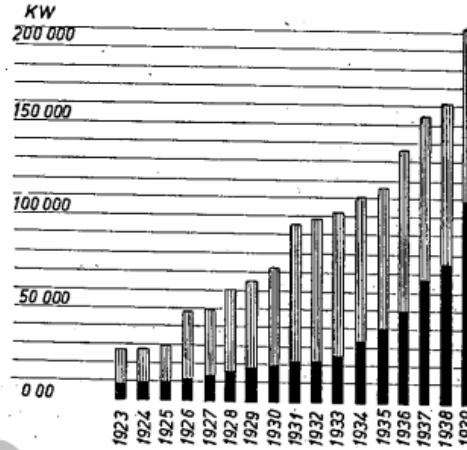
# 1940 - Santraller kaçça avrılır

Cumhuriyet devrinde memleketimizde, gerek şehir ve gerek endüstri ihtiyaçları için kurulan santrallerin adedi 221 ve takatleri de 172.718 kilowat artarak, 1939 senesinde 242 ye ve 202.382 kilowata balığ olmuştur, şu halde 7 misli kadar artmıştır. Bu artış E. İ. E. İdaresinin istatistiklerine göre cetvel 5 de gösterildiği gibi inkişaf etmiştir.

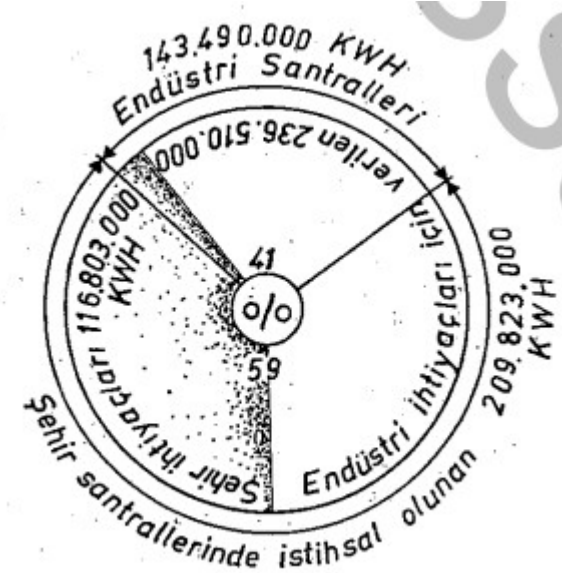
Cumhuriyetten evvel endüstri santrallerinin adedi şehir santralleri adedinden çok fazla olduğu halde, takatleri yarısı kadar idi. Bu vaziyet 1933 senesine kadar aşağı



Şekil 3. Memlekette kurulu elektrik santrallerinin takat büyüklüklerine göre tasnifi.



Şekil 4. Memlekette kurulu elektrik santrallerinin takatlerinin artışı.



Cetvel 9. Santrallerin istihsal kaynağına göre tasnifi.

| İstihsal Kaynakları | 1938 Vaziyeti |         |          | 1939 Vaziyeti |         |          |
|---------------------|---------------|---------|----------|---------------|---------|----------|
|                     | Adet          | Kilowat | Nisbet   | Adet          | Kilowat | Nisbet   |
| Taşkömürü           | 50            | 151.072 | 78,35 %  | 54            | 151.358 | 74,90 %  |
| Linyit              | 16            | 8.853   | 4,60 %   | 24            | 15.318  | 7,60 %   |
| Mayı mahruk         | 85            | 24.137  | 12,50 %  | 94            | 26.185  | 12,80 %  |
| Sair mahruklar      | 18            | 2.184   | 1,15 %   | 16            | 2.591   | 1,30 %   |
| Su kuvveti          | 26            | 6.560   | 3,40 %   | 28            | 6.930   | 3,40 %   |
| Muhtelit            | 16            | —       | —        | 26            | —       | —        |
| Yekün               | 211           | 192.806 | 100,00 % | 242           | 202.382 | 100,00 % |

# Tarihsel gelişim - 1955

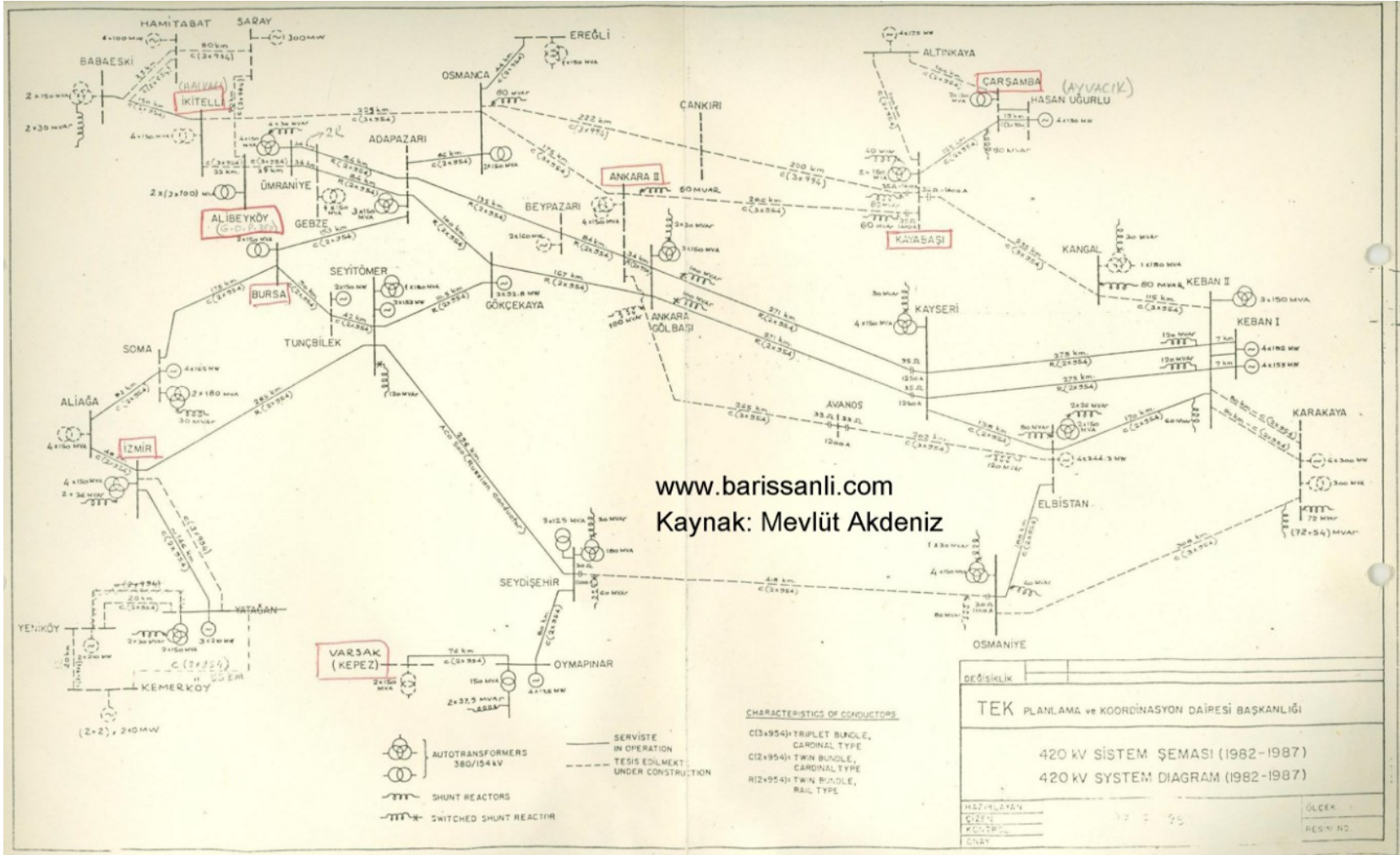


# Büyük santraller

- Keban 1965-1974 – (1974 ilk 4 türbin; 1981 diğer 4 türbin) 1330 MW – 675 km<sup>2</sup>
- Karakaya 1987 – 1800 MW- 268 km<sup>2</sup>
- Atatürk 1992 –2400 MW - 817 km<sup>2</sup>



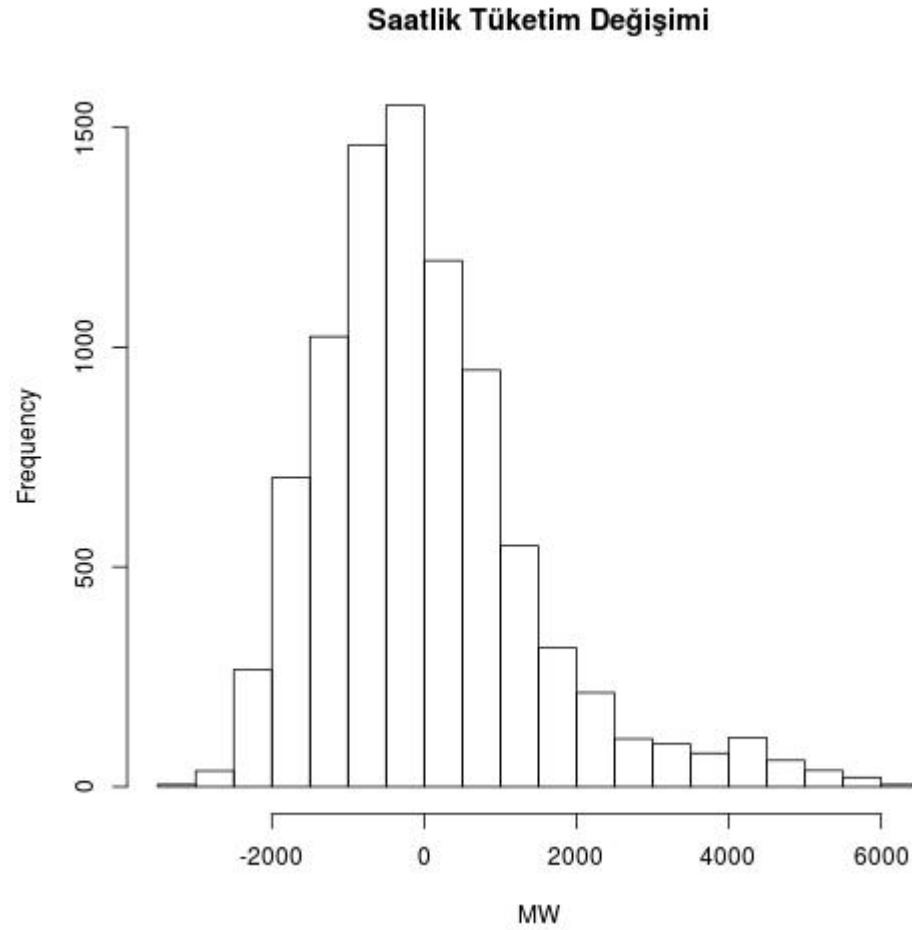
# Tarihsel Gelişim - 1982-1987





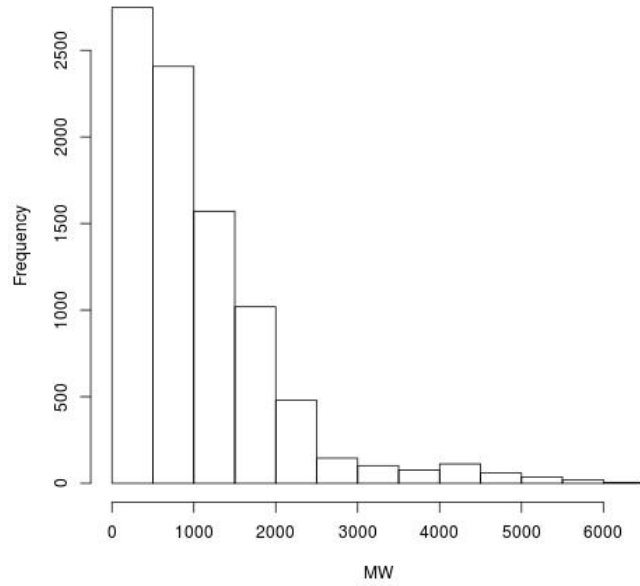
# 2016 Yılıının İncelemesi

# Saatlik tüketim değişimi

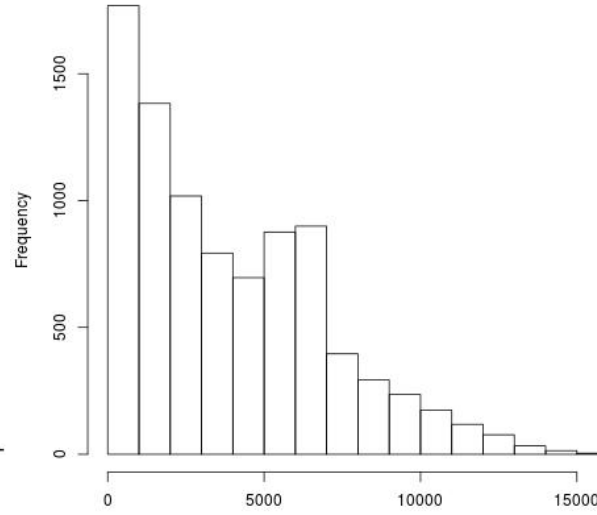


# 2016 yılı için tüketimin 1-12 saat arasındaki farkın dağılımı

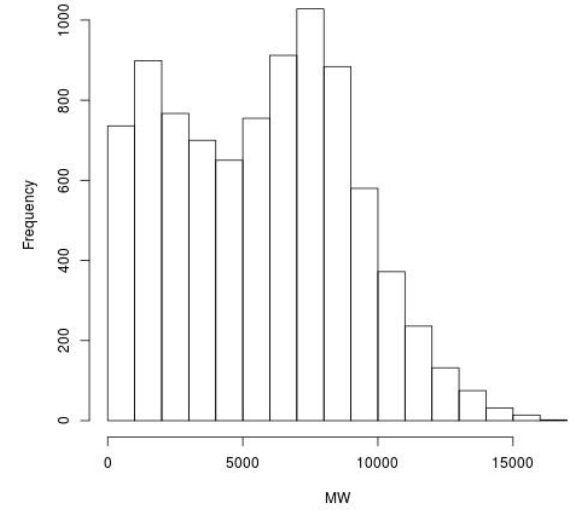
1 SAATLIK DEGISIM



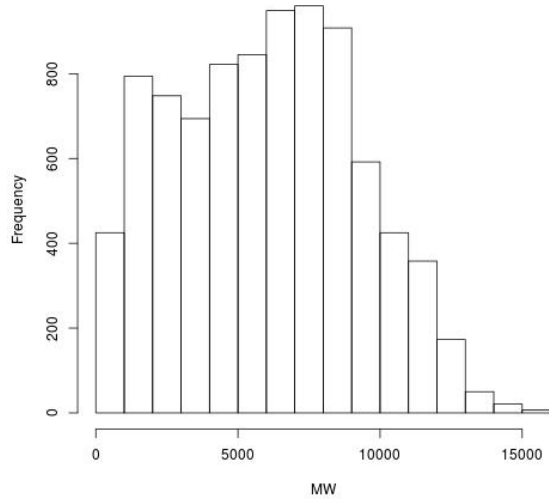
5 SAATLIK DEGISIM



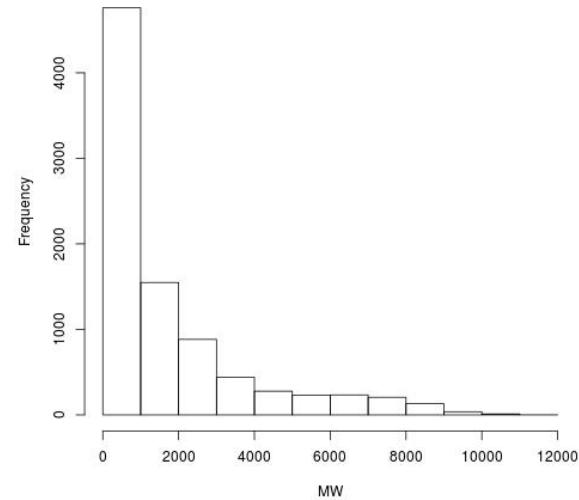
9 SAATLIK DEGISIM



12 SAATLIK DEGISIM

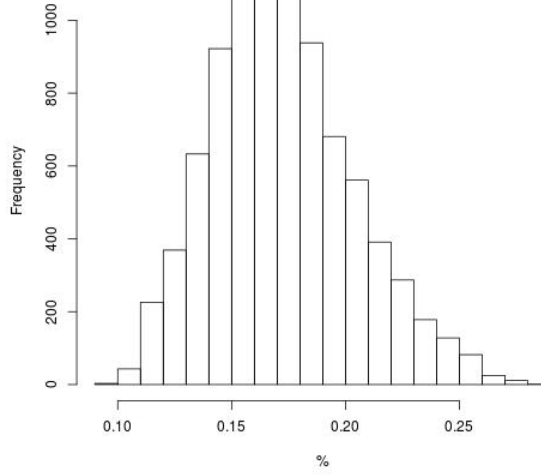


24 SAATLIK DEGISIM

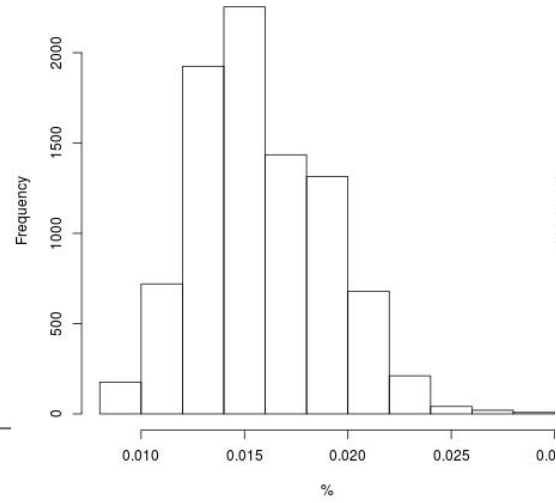


# 2016 yılı üretim kaynaklarının saatlik oran değişimi

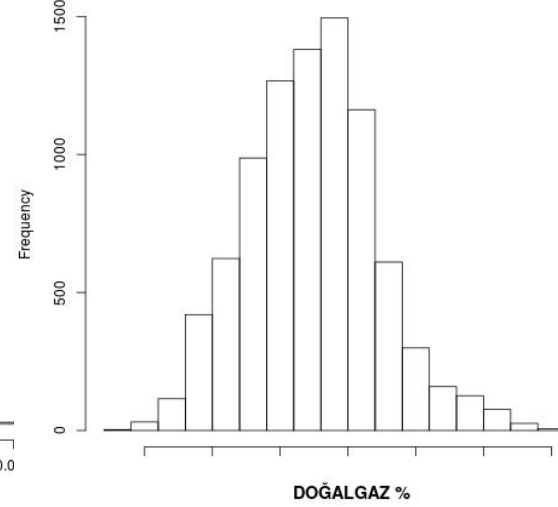
İTHAL KÖMÜR %



JEOTERMAL %

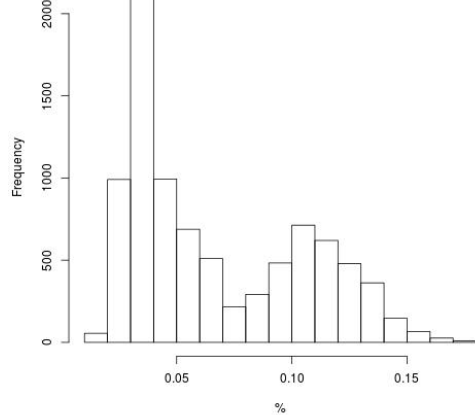


BARAJLI %

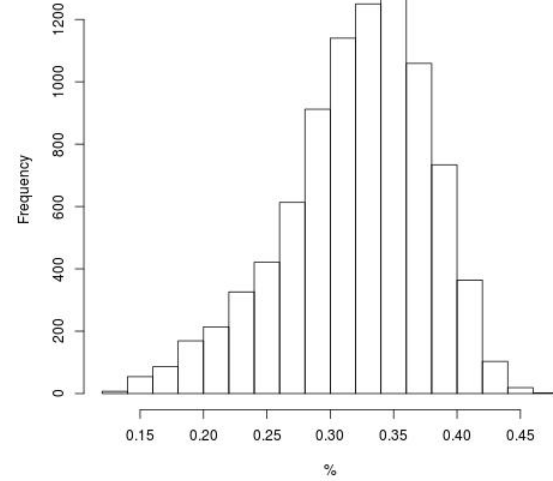
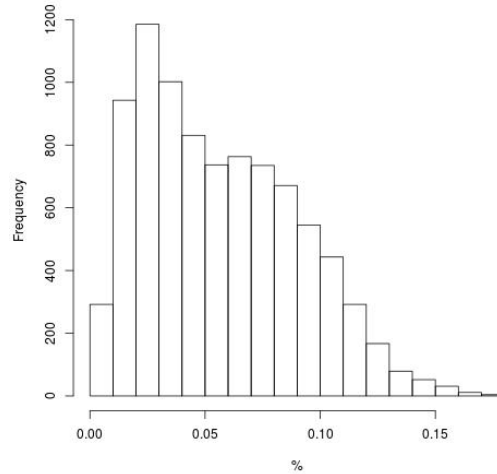


DOĞALGAZ %

AKARSU %

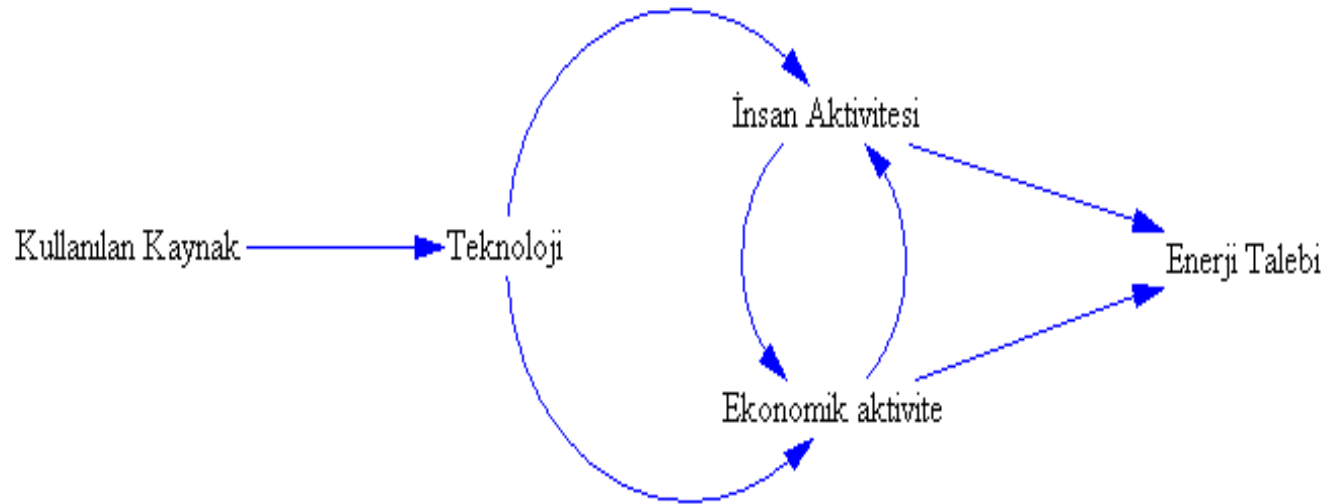


RÜZGAR %



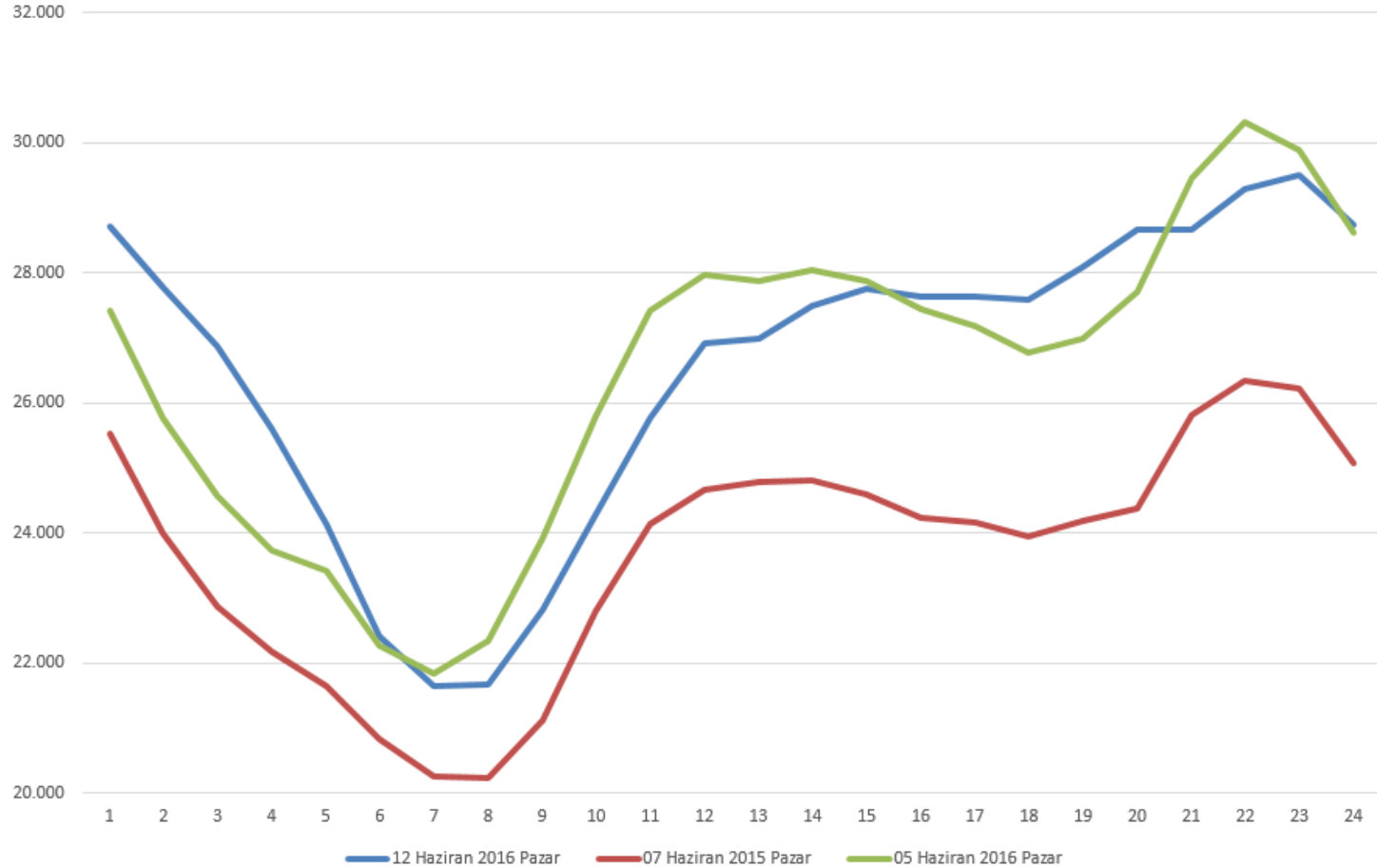
# Enerji Talebi

Enerji Talebi'nin Etkenleri



# 2016 ilk teravih

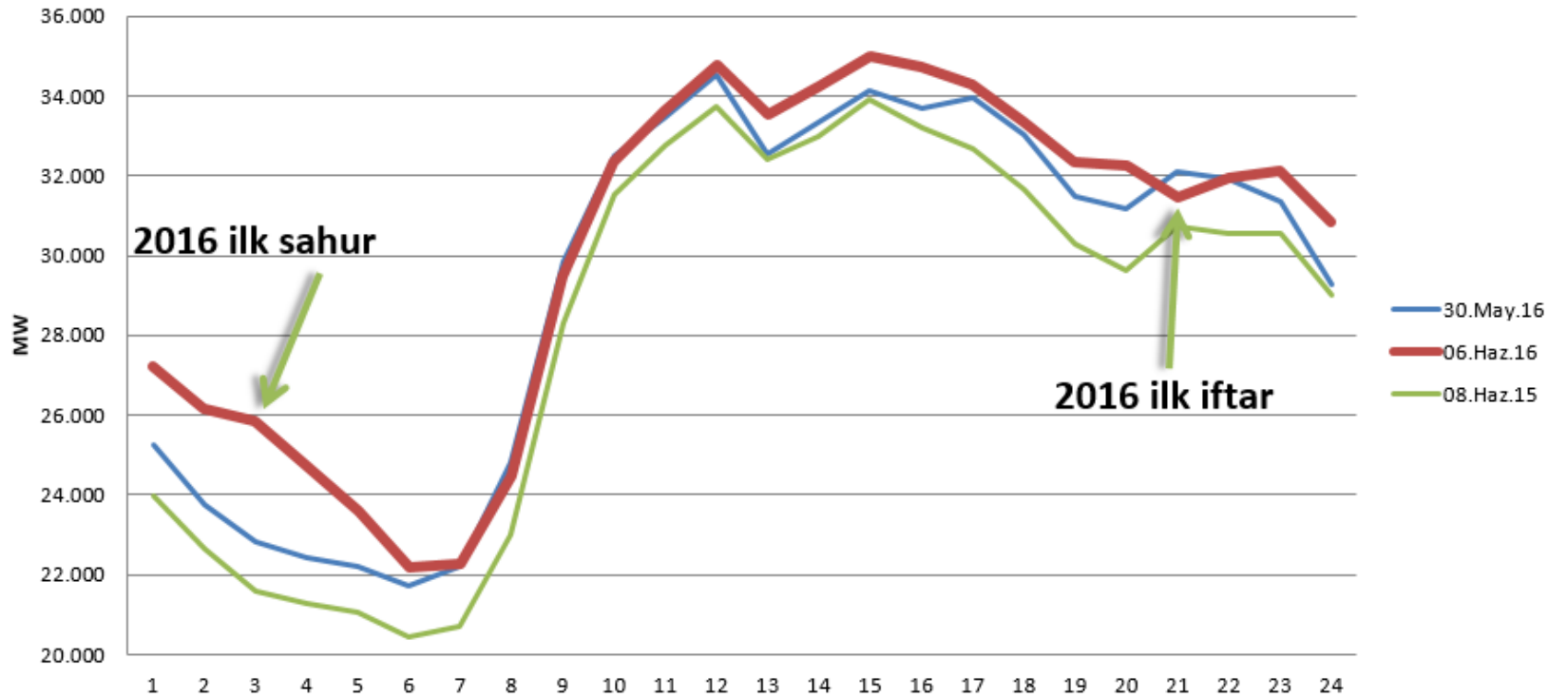
## İlk Teravih





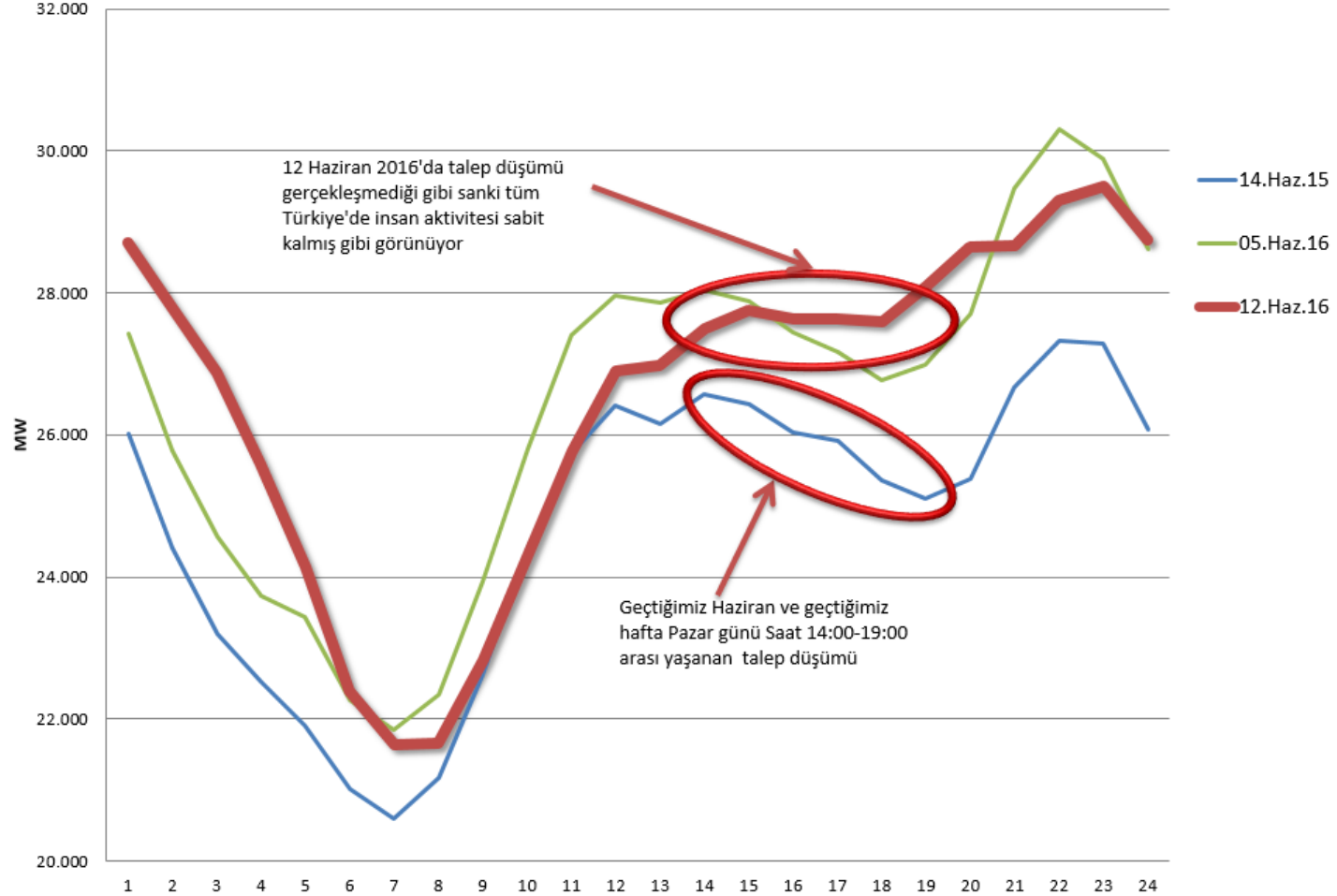
# 2016 -1 Ramazan

6 Haziran 2016 - 1 Ramazan - Elektrik Tüketimindeki Değişim

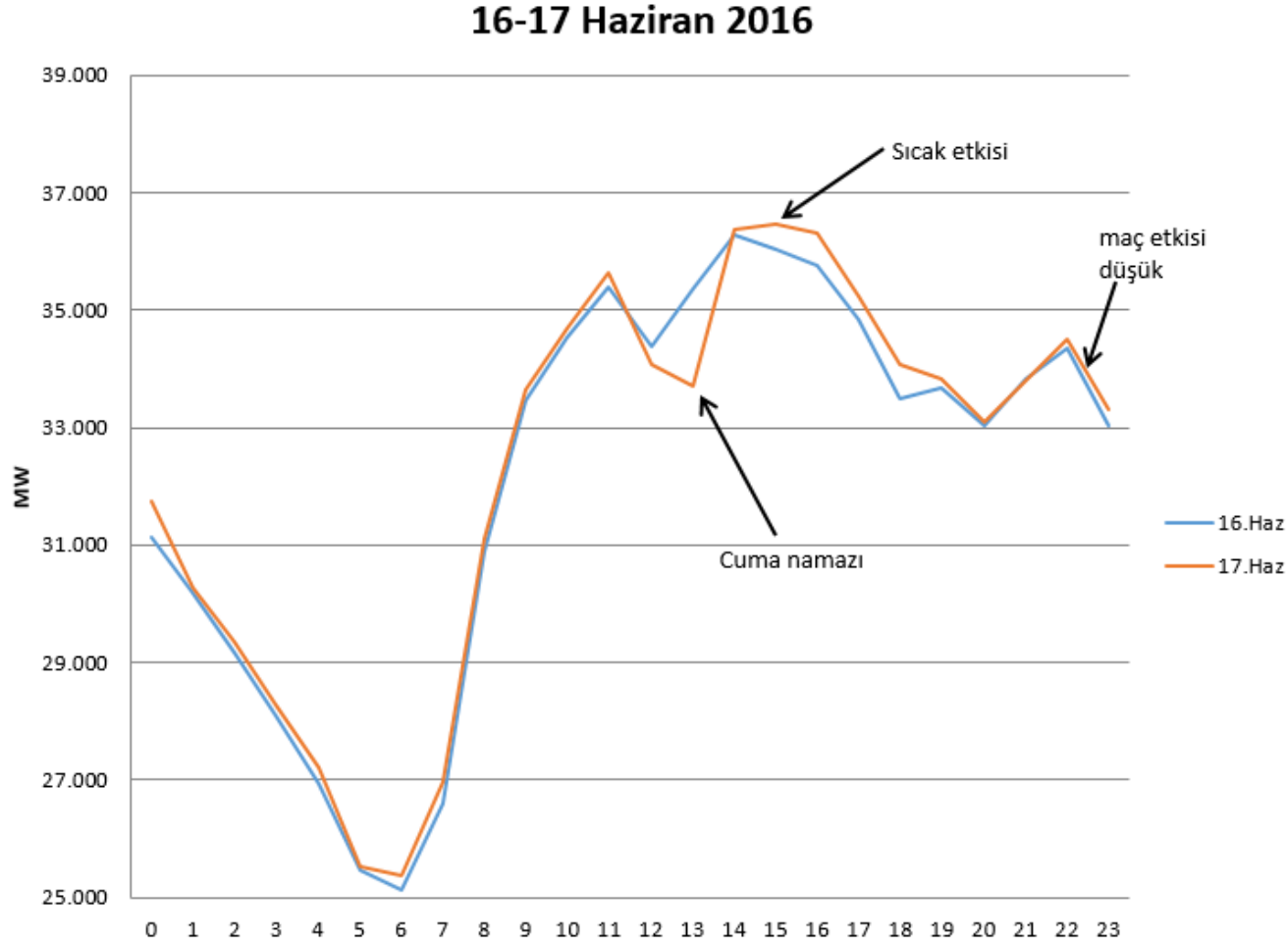


# 2016 – 12 Haziran Futbol maçı

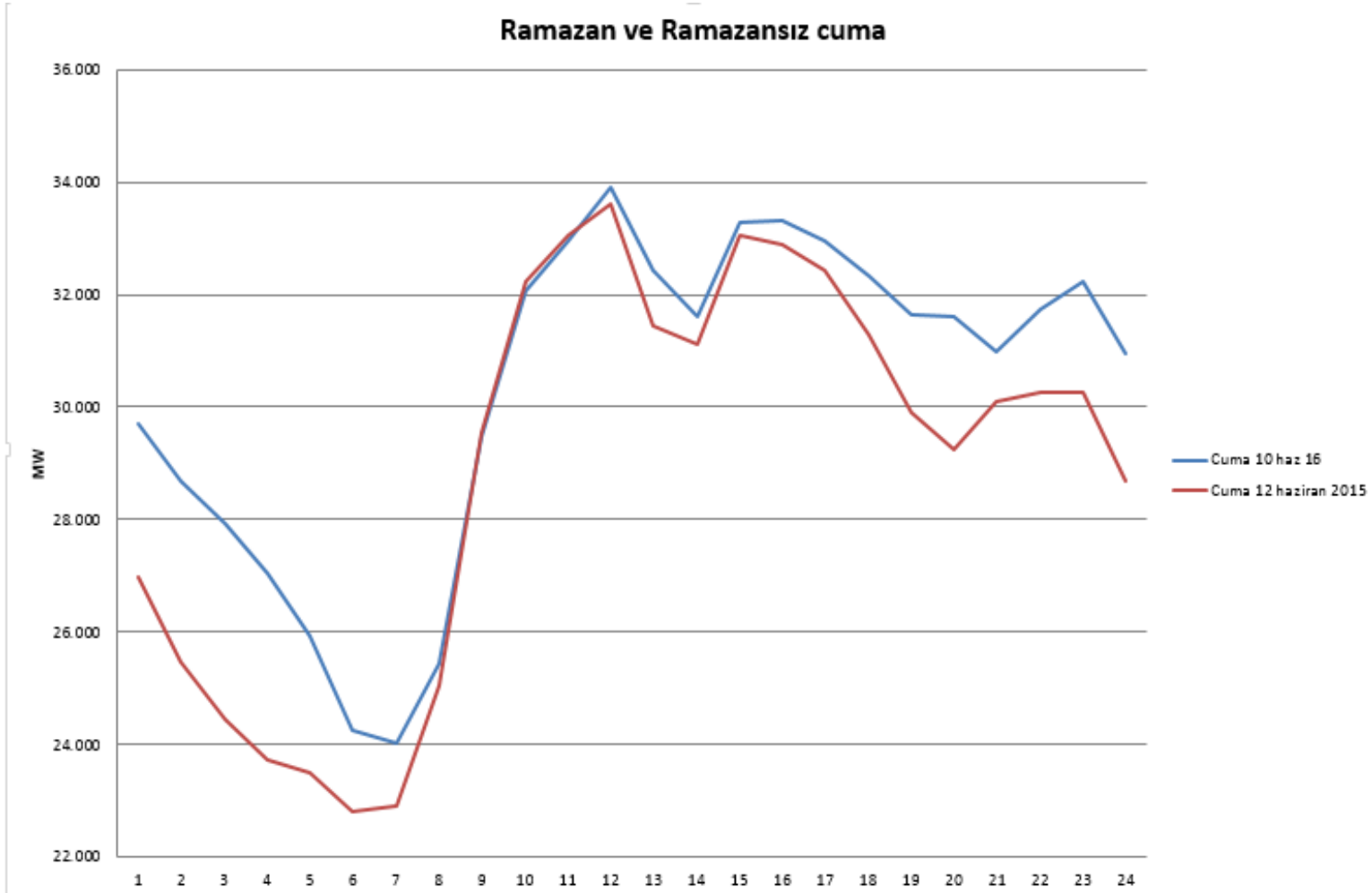
12 Haziran 2016 - Türkiye-Hırvatistan saat 16:00



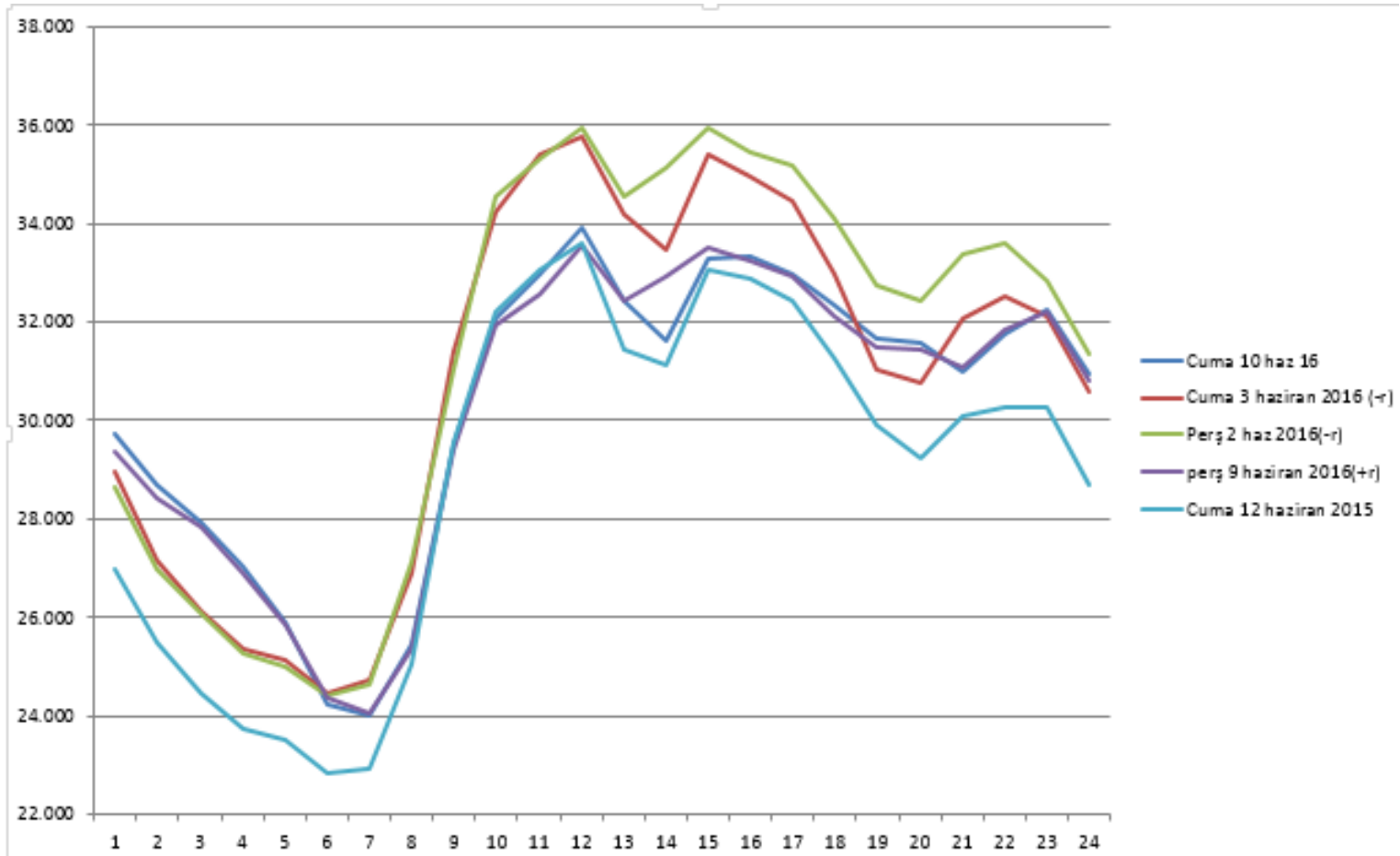
# 16-17 Haziran



# Cuma – Ramazan farkı

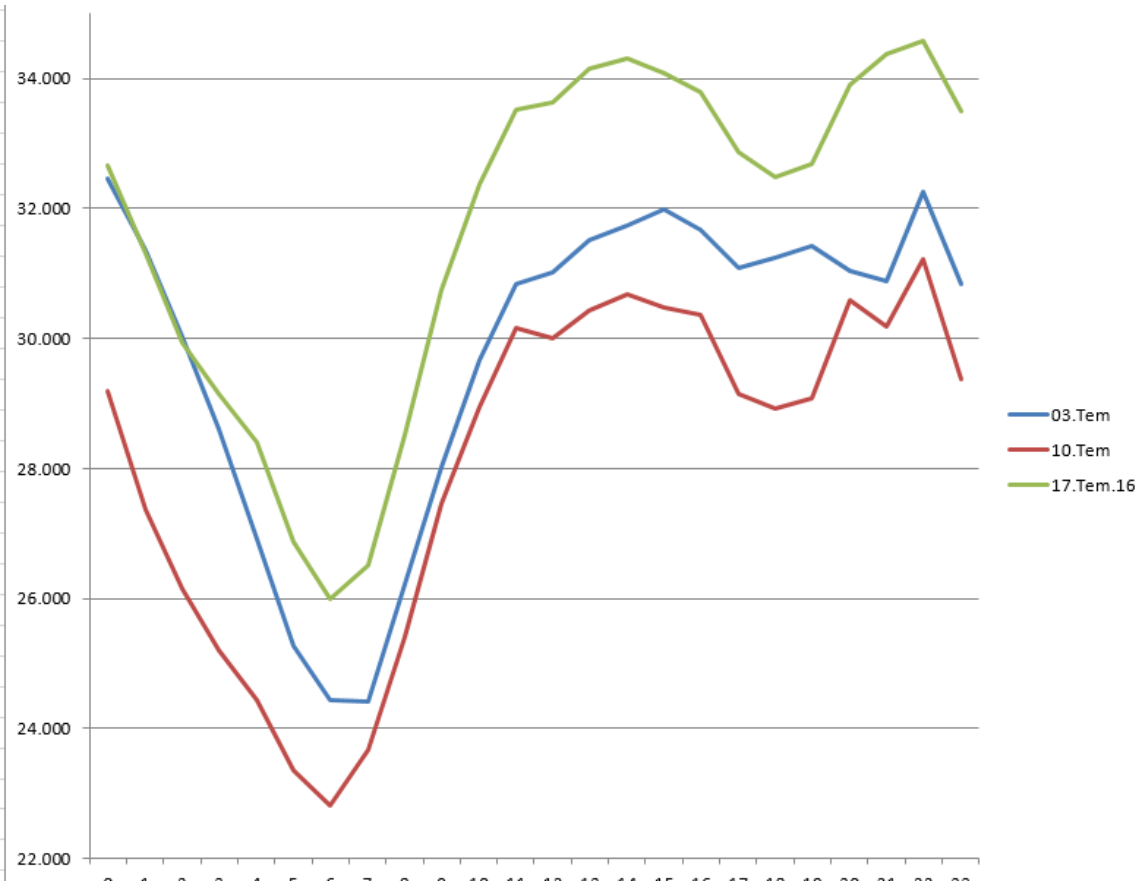


# Perşembe-Cuma farkı

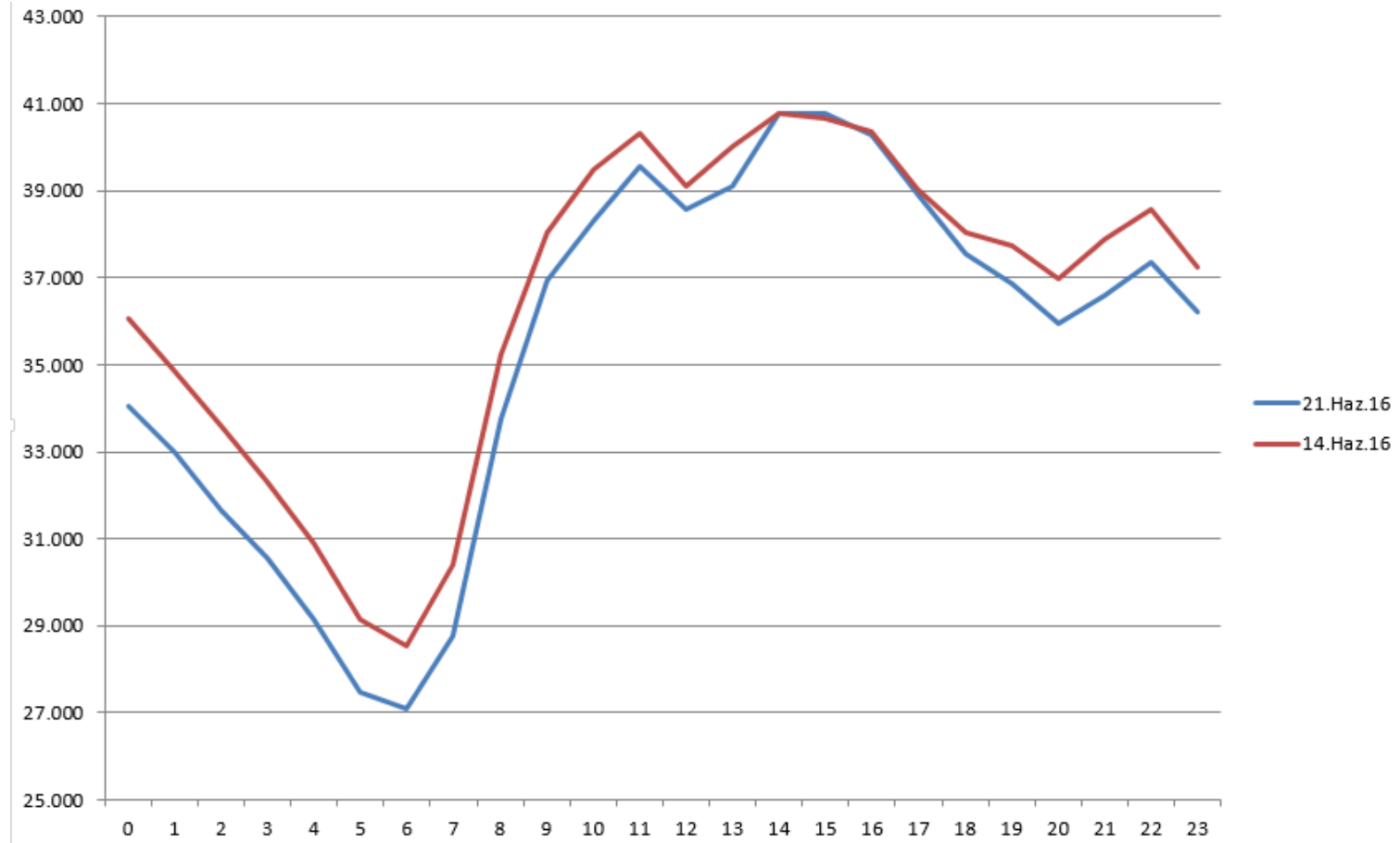


# Ramazan – Euro 2016 Final

|    | ramazan | euro final |           |
|----|---------|------------|-----------|
|    | 03.Tem  | 10.Tem     | 17.Tem.16 |
| 0  | 32.465  | 29.190     | 32.653    |
| 1  | 31.361  | 27.360     | 31.302    |
| 2  | 30.018  | 26.141     | 29.944    |
| 3  | 28.600  | 25.193     | 29.143    |
| 4  | 26.919  | 24.428     | 28.412    |
| 5  | 25.281  | 23.352     | 26.860    |
| 6  | 24.428  | 22.805     | 25.983    |
| 7  | 24.417  | 23.663     | 26.505    |
| 8  | 26.213  | 25.409     | 28.526    |
| 9  | 28.021  | 27.458     | 30.748    |
| 10 | 29.660  | 28.949     | 32.362    |
| 11 | 30.835  | 30.163     | 33.513    |
| 12 | 31.026  | 29.996     | 33.621    |
| 13 | 31.512  | 30.425     | 34.158    |
| 14 | 31.738  | 30.675     | 34.302    |
| 15 | 31.995  | 30.475     | 34.091    |
| 16 | 31.661  | 30.362     | 33.797    |
| 17 | 31.084  | 29.138     | 32.874    |
| 18 | 31.238  | 28.915     | 32.476    |
| 19 | 31.433  | 29.083     | 32.686    |
| 20 | 31.050  | 30.582     | 33.895    |
| 21 | 30.878  | 30.191     | 34.385    |
| 22 | 32.267  | 31.225     | 34.590    |
| 23 | 30.835  | 29.381     | 33.494    |
|    | 714.937 | 674.558    | 760.321   |

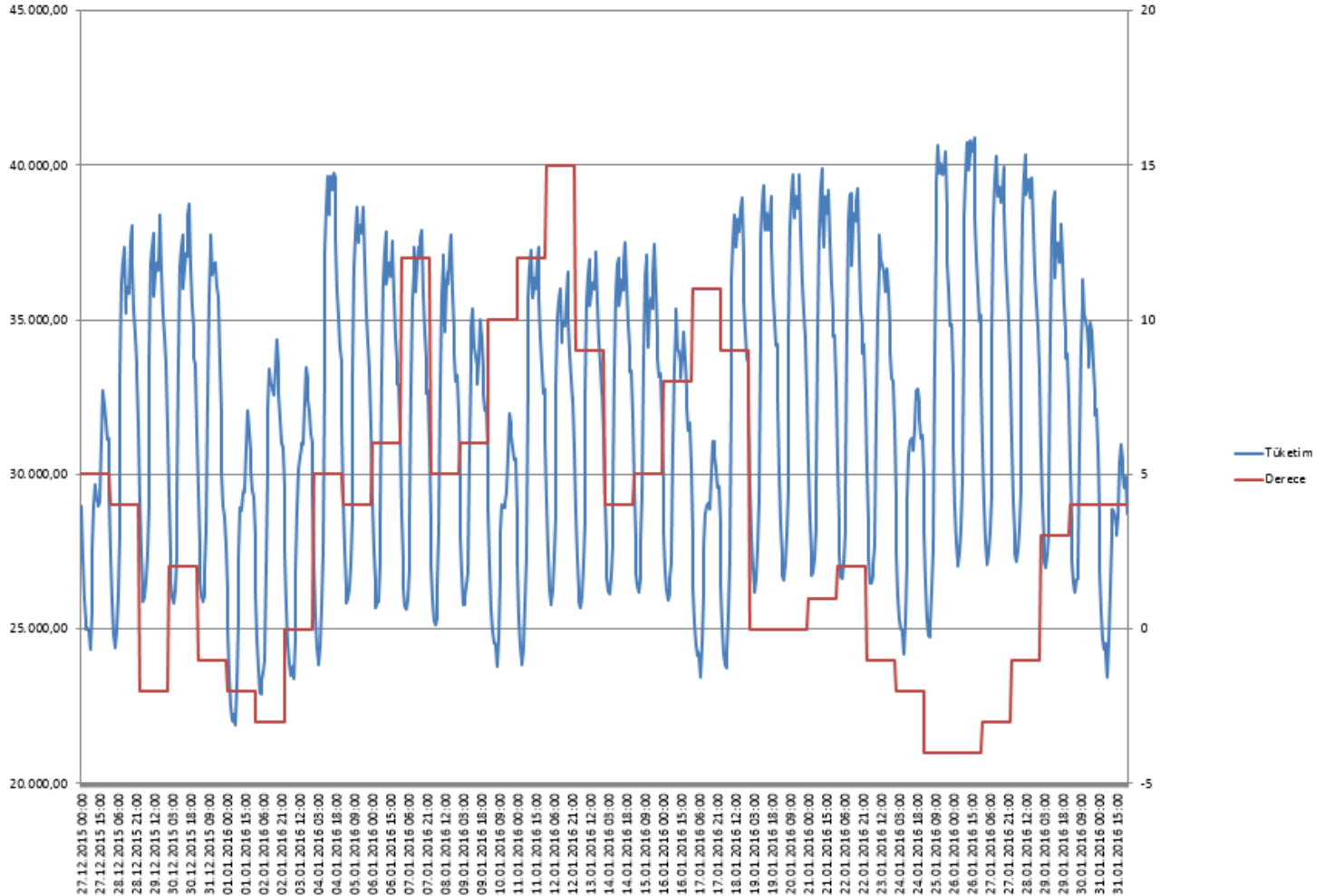


# 14-21 Haziran



# 2016 Sıcaklık-Tüketim ilişkisi

2016 Ocak Sıcaklık - Tüketim

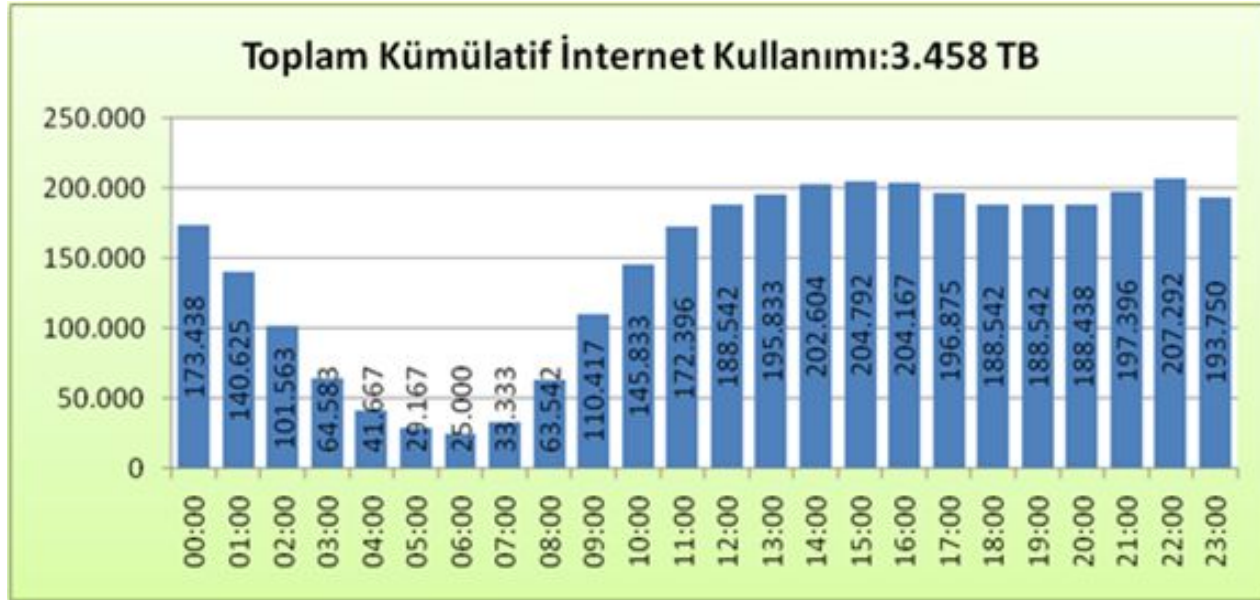




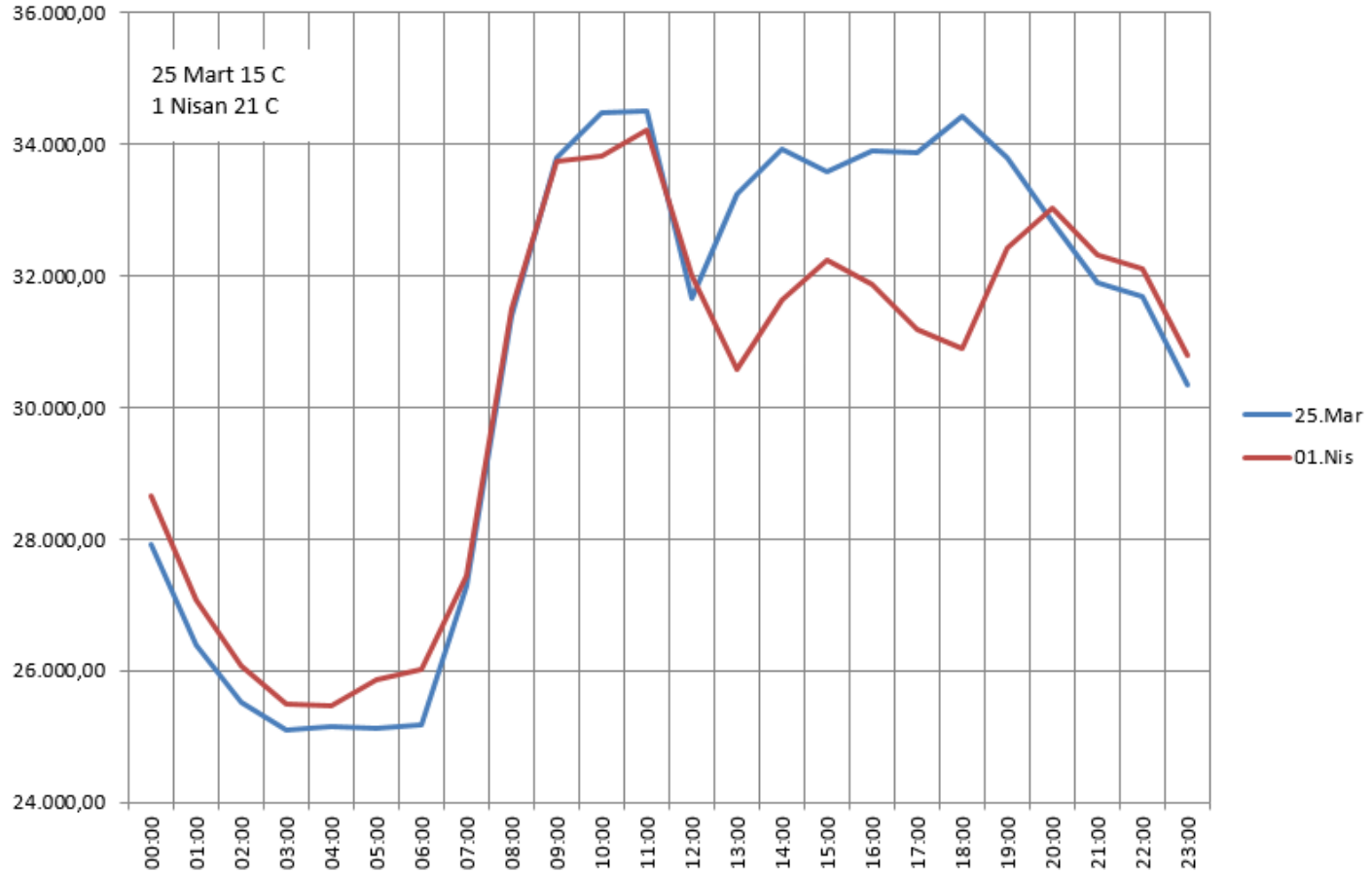
# İnternet kullanımı vs Elektrik ilişkisi

## VERİ KULLANIMI RAMAZAN'DA YÜZDE 10 ARTTI

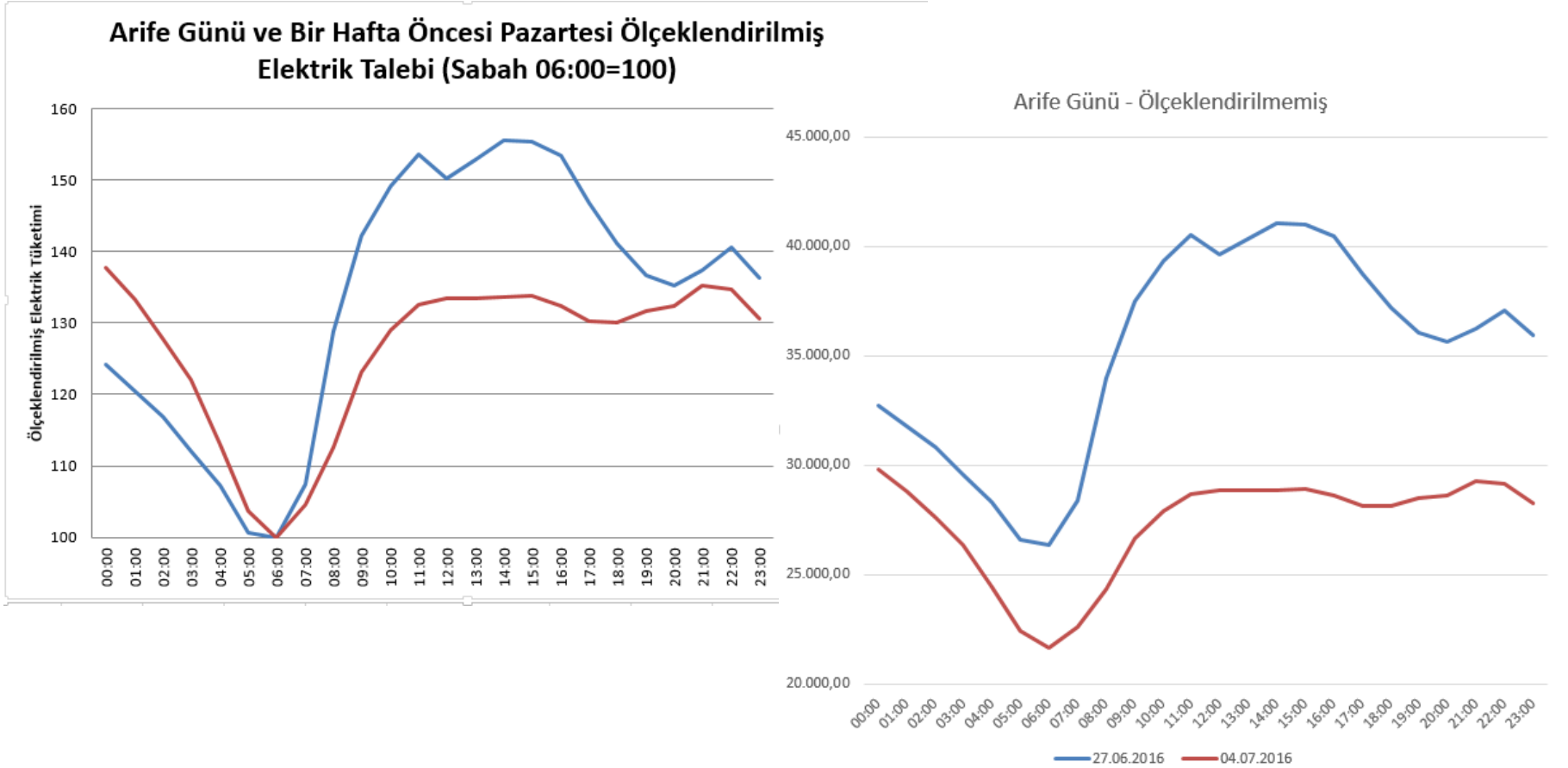
Genel Müdür Yılmaz, Ramazan'ın başlamasıyla birlikte veri kullanımının yüzde 10 artış gösterdiğine dikkat çekerek "Hafta içi veri kullanımında, Ramazan öncesine göre yüzde 7'lik bir artış var. Gündüz saatlerinde ise bu artış yüzde 10'a çıkıyor. Hafta sonunda ise veri kullanımında, Ramazan öncesine göre yüzde 8,7'lik bir artış söz konusu. Hafta sonu gündüz saatlerinde ise Ramazan öncesine göre veri kullanımında artış yüzde 10,9'a çıkıyor. Ramazan ayında veri kullanımının en çok olduğu gün ise hafta içi Cuma, hafta sonu Cumartesi olarak öne çıkıyor. Ramazan öncesinde hafta içi internete en çok ilgi gösterilen gün Perşembe idi. Ramazan öncesinde ve Ramazan boyunca hafta sonu en çok internet kullanılan gün Cumartesi olarak öne çıktı" diye konuştu.



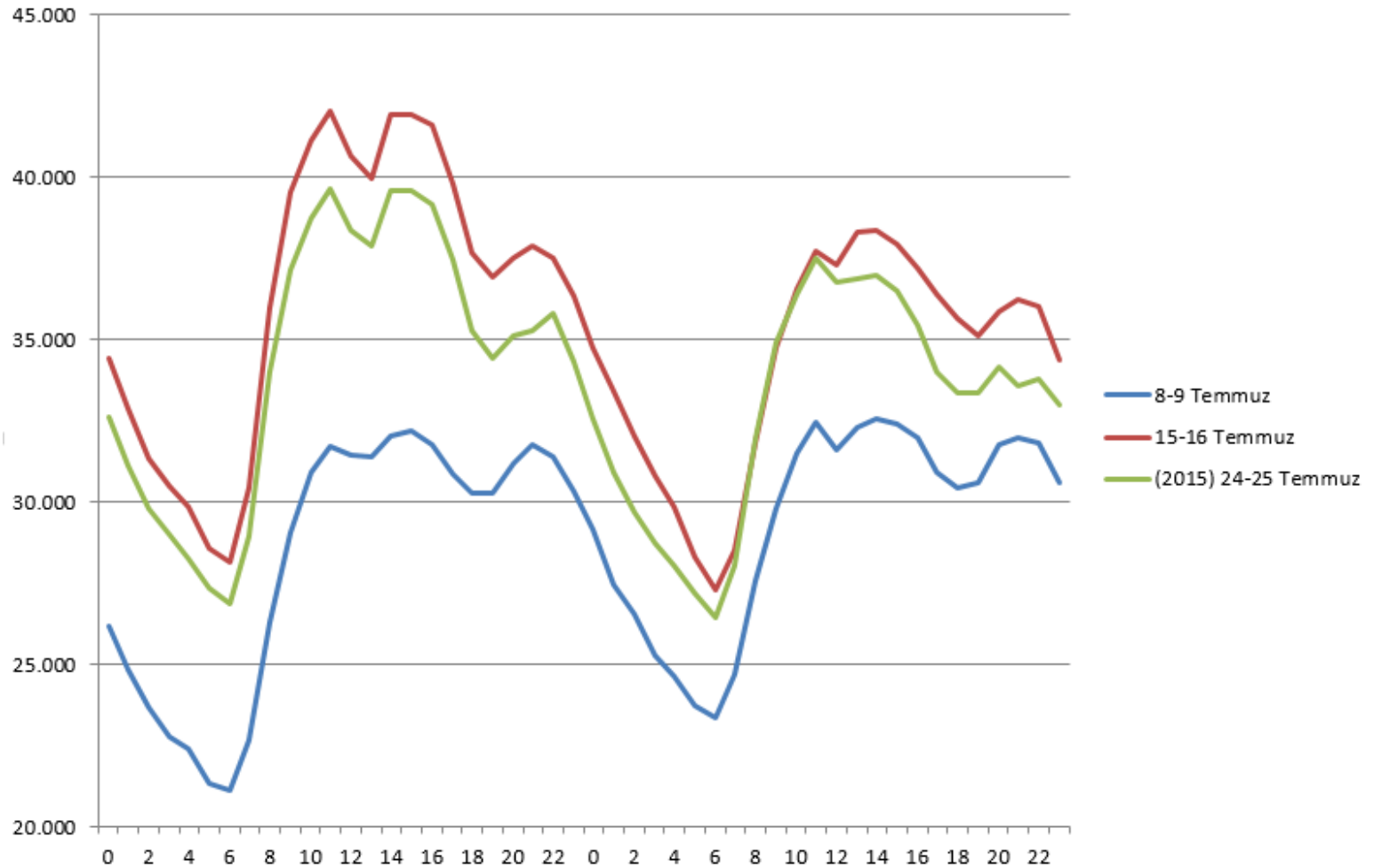
# Sıcaklığın etkisi – Cuma günü



# Ramazan Arife günü

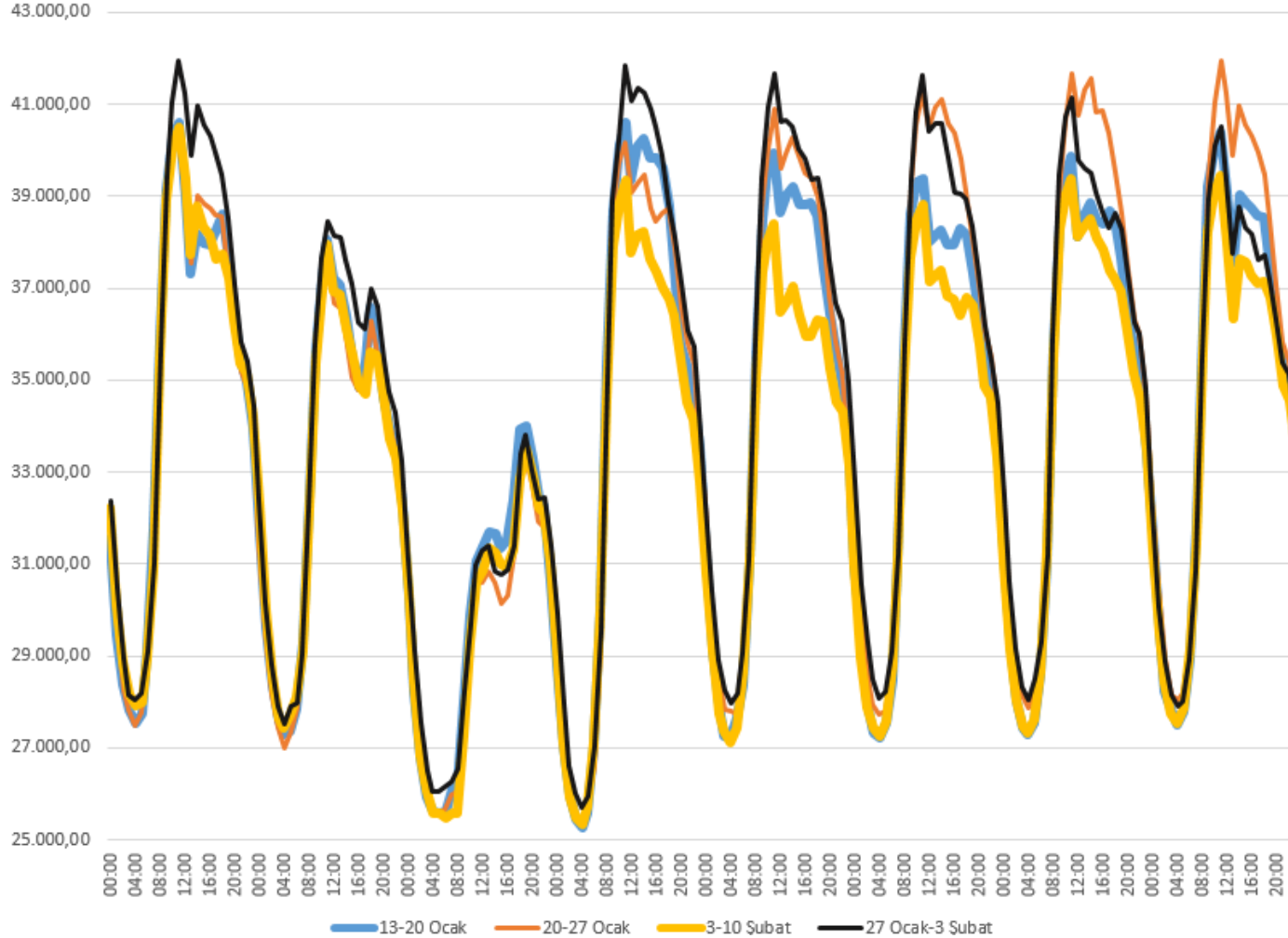


# 15 Temmuz



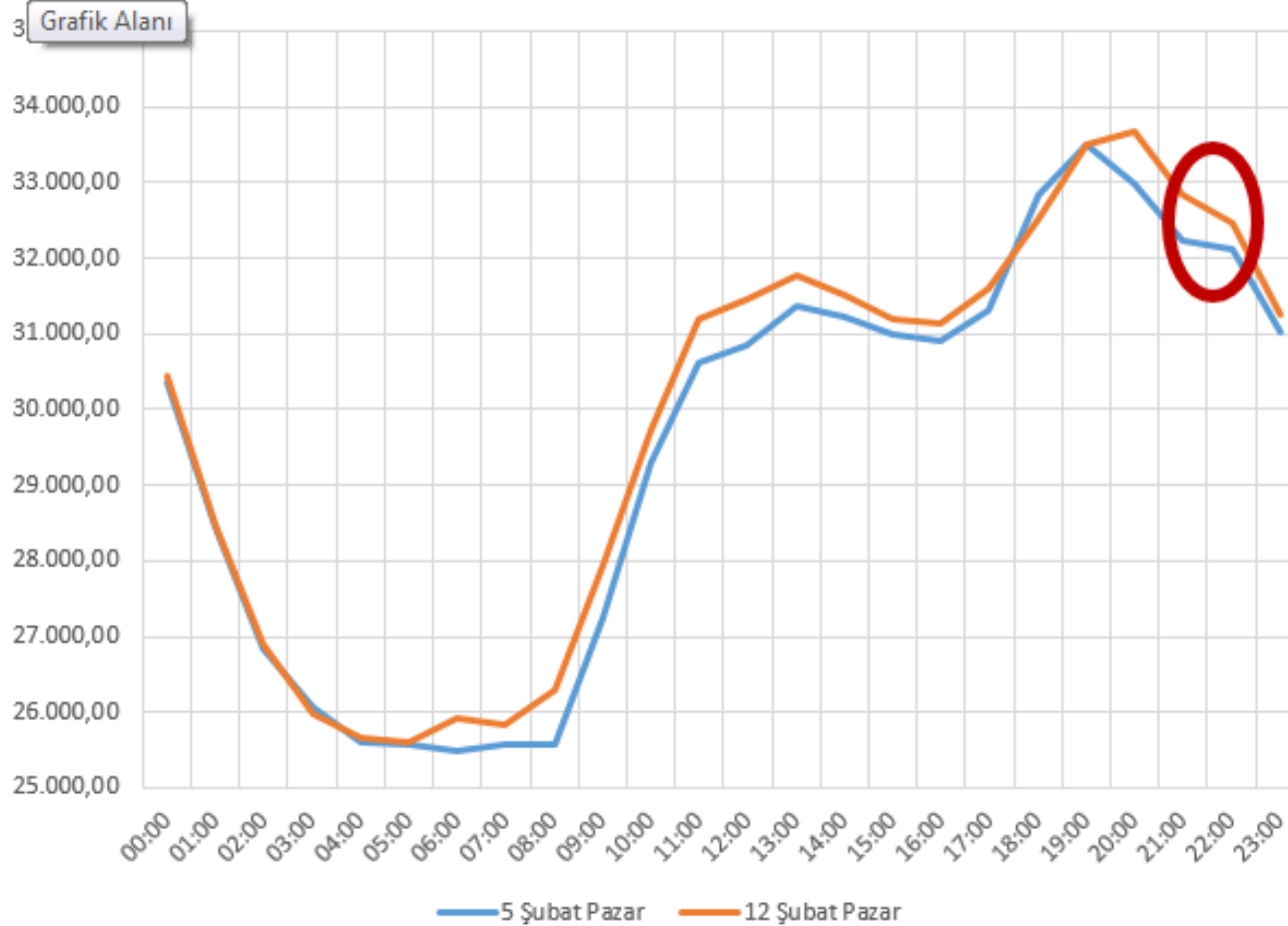
# 2017 Sömeſtr tatili

Sömeſtr Tatilleri - 20 Ocakta baſlıyor



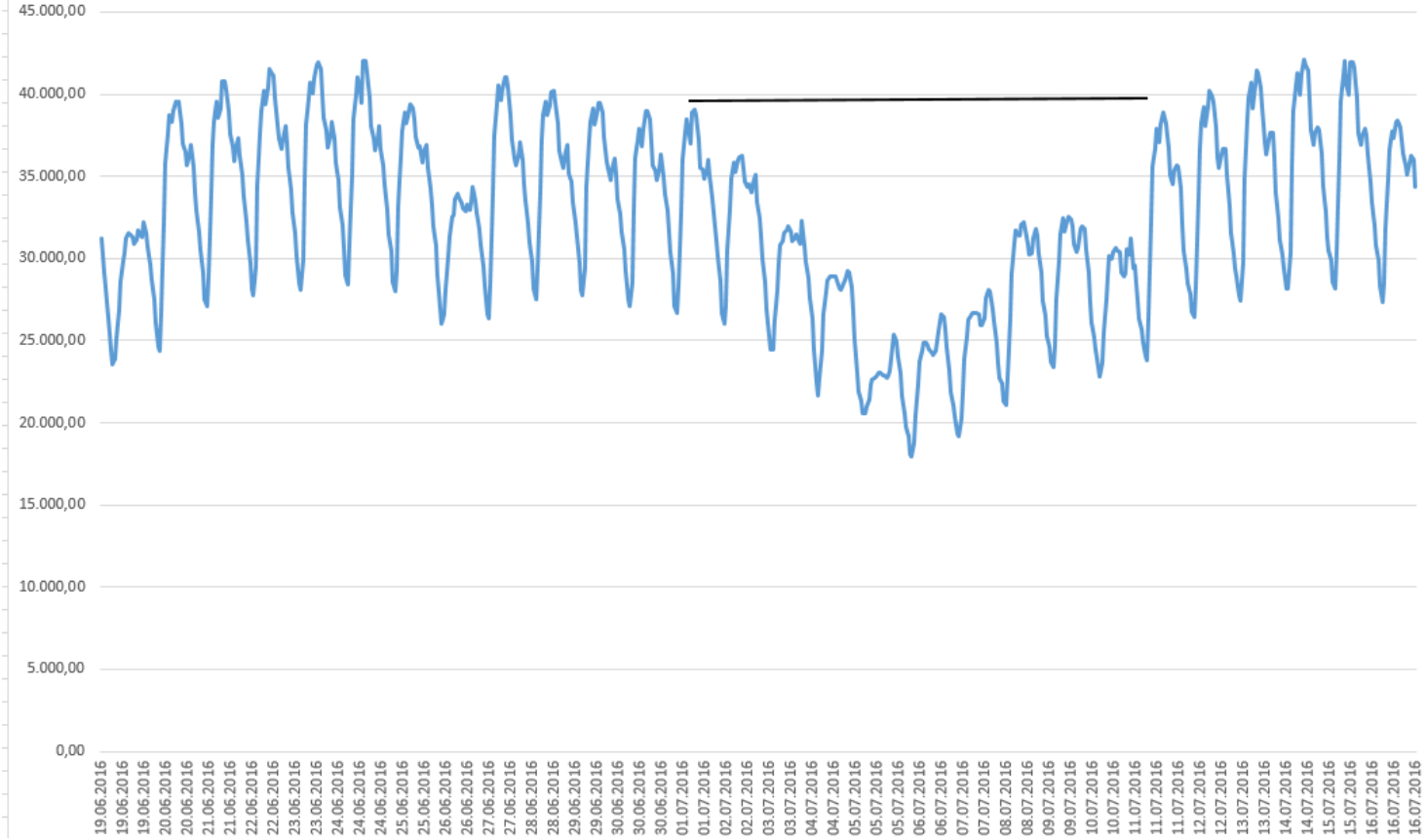
# Derbi ma

5 řubat Pazar - FB-BJK 20:45

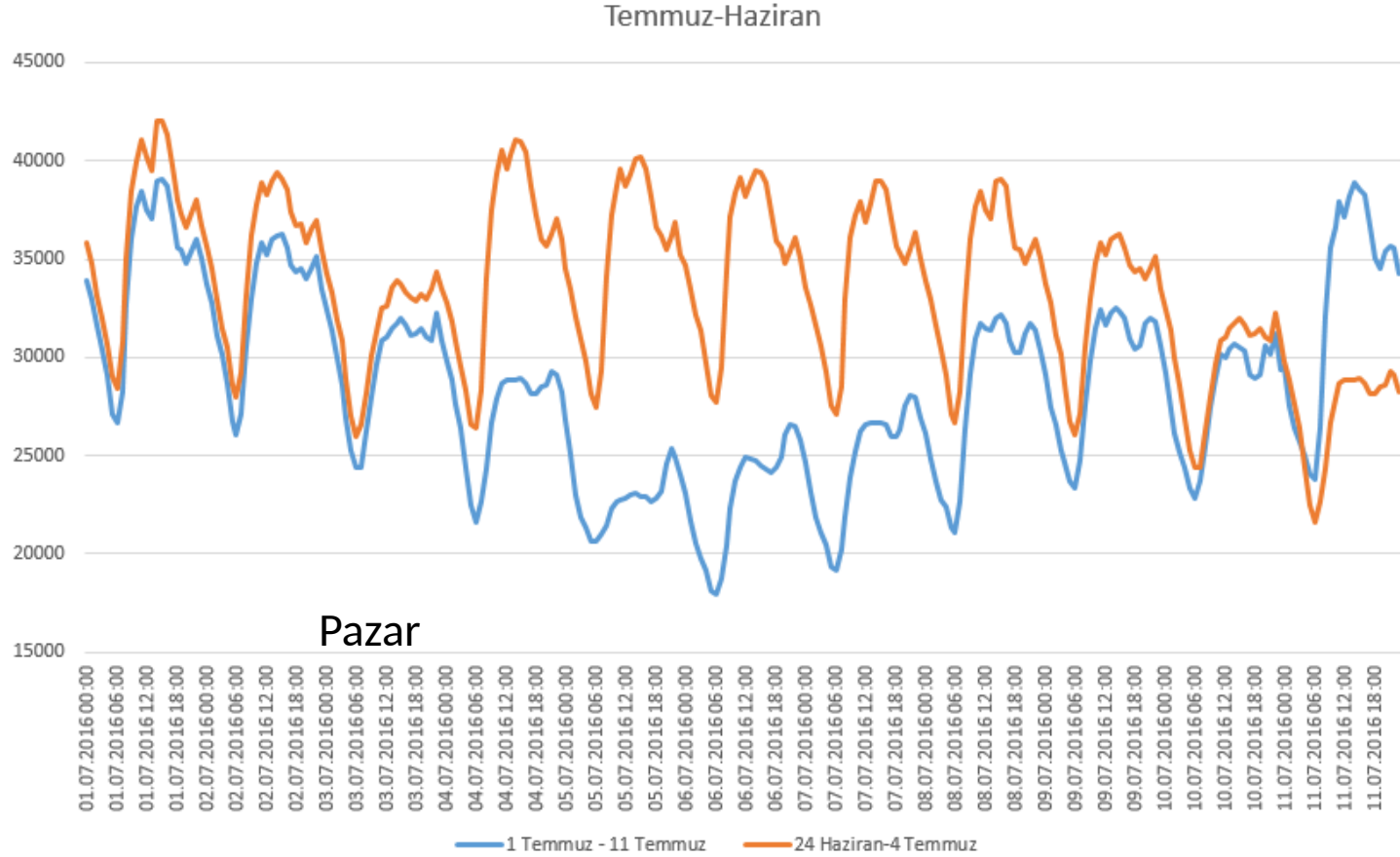


# Uzun tatil

19 Haziran -13 Temmuz (1 Temmuz Cuma'dan 11 Temmuz Pazartesi Bayram Tatili)

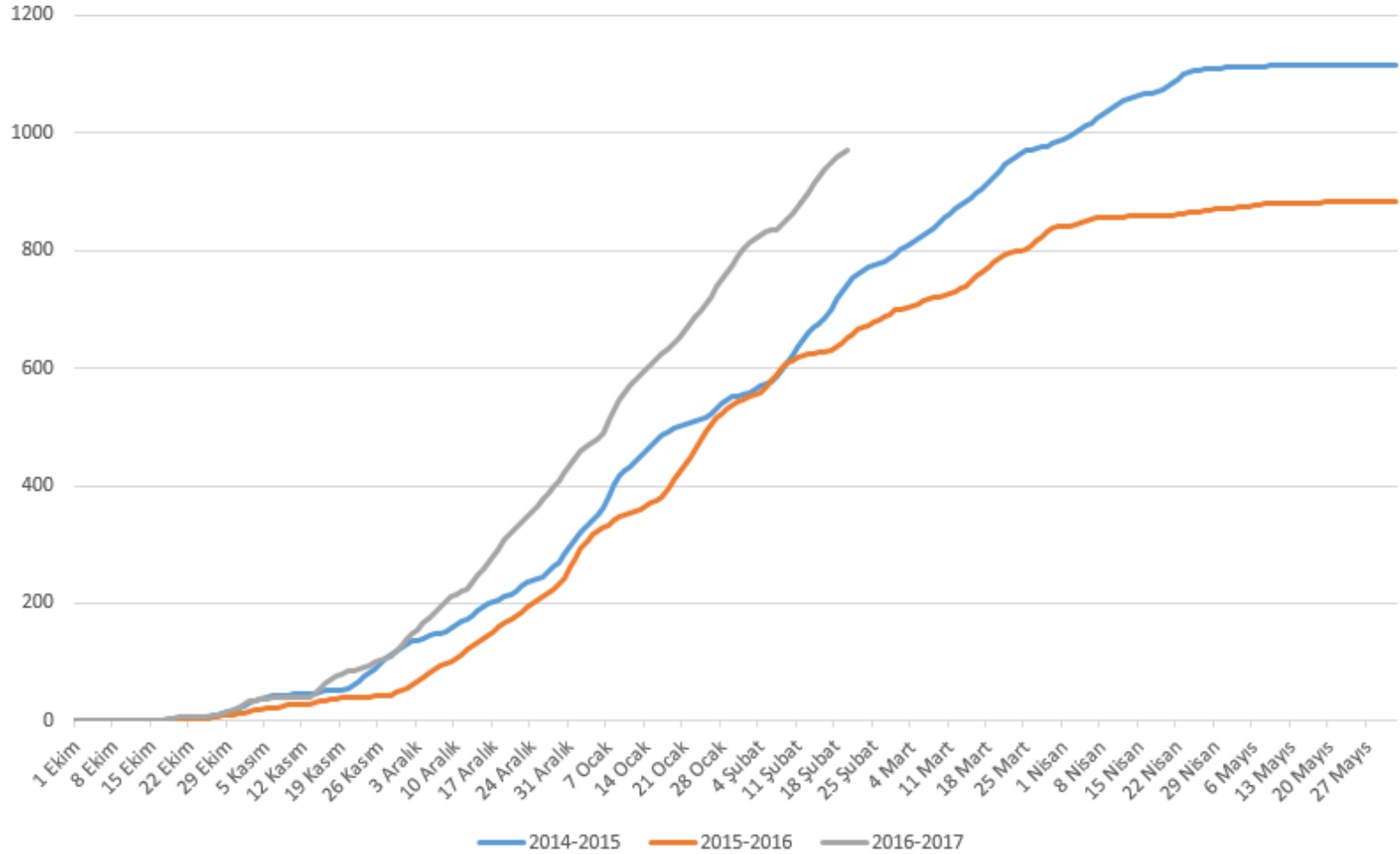


# Hafta Kıyaslama

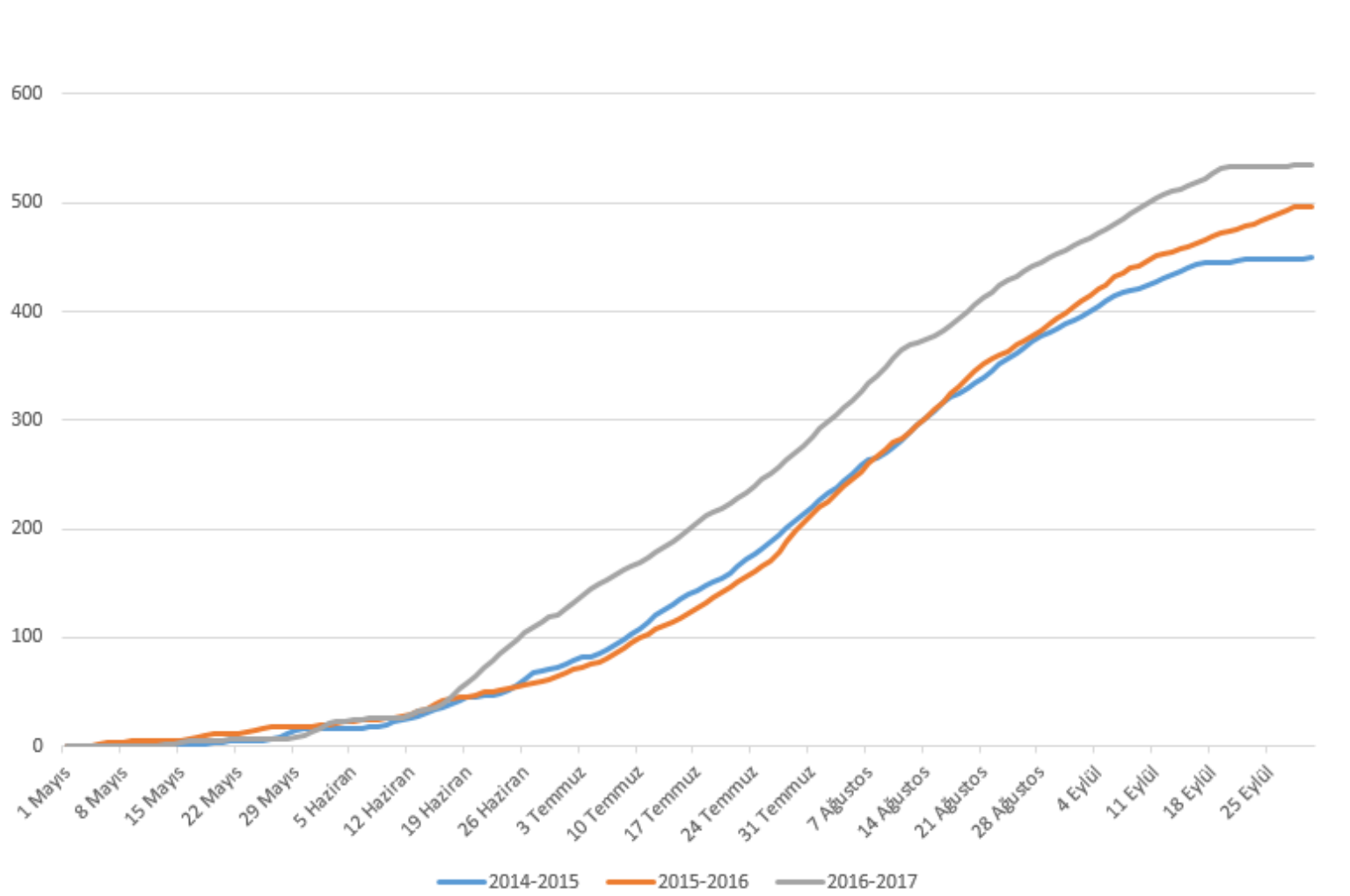




# Isıtma Yılı (1 Ekim -1 Haziran ısıtma ihtiyacı)



# 1 Mayıs- 1 Ekim soğutma dönemi



# Libreoffice Calc+R

The screenshot shows the LibreOffice Calc application interface. The menu bar includes Edit, View, Insert, Format, Sheet, Data, Tools, R4Calc, and Window. The toolbar contains various icons for file operations and editing. The spreadsheet grid shows columns A through K and rows 1 through 2800. A data table is visible in the lower part of the grid, with columns for date, time, and a numerical value.

The R Addon: Coding window is open, displaying the following R code:

```
library(dtt)
dct({#D4:D22})
{$OUT#E4:E22}<-{$BASE}
a<-dct({#D4:D22})
a[4:19]<-0
a
{$OUT#F4:F22}<-{$BASE}
dct(a,inverted=TRUE)
{$OUT#G4:G22}<-{$BASE}
PLOT: plot( {#D4:D22}, type="o",col="red"); lines({#G4:G22},col="blue")
```

The R console window is also open, displaying the following text:

```
R version 3.2.3 (2015-12-10) -- "Wooden Christmas Tree"
Copyright (C) 2015 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

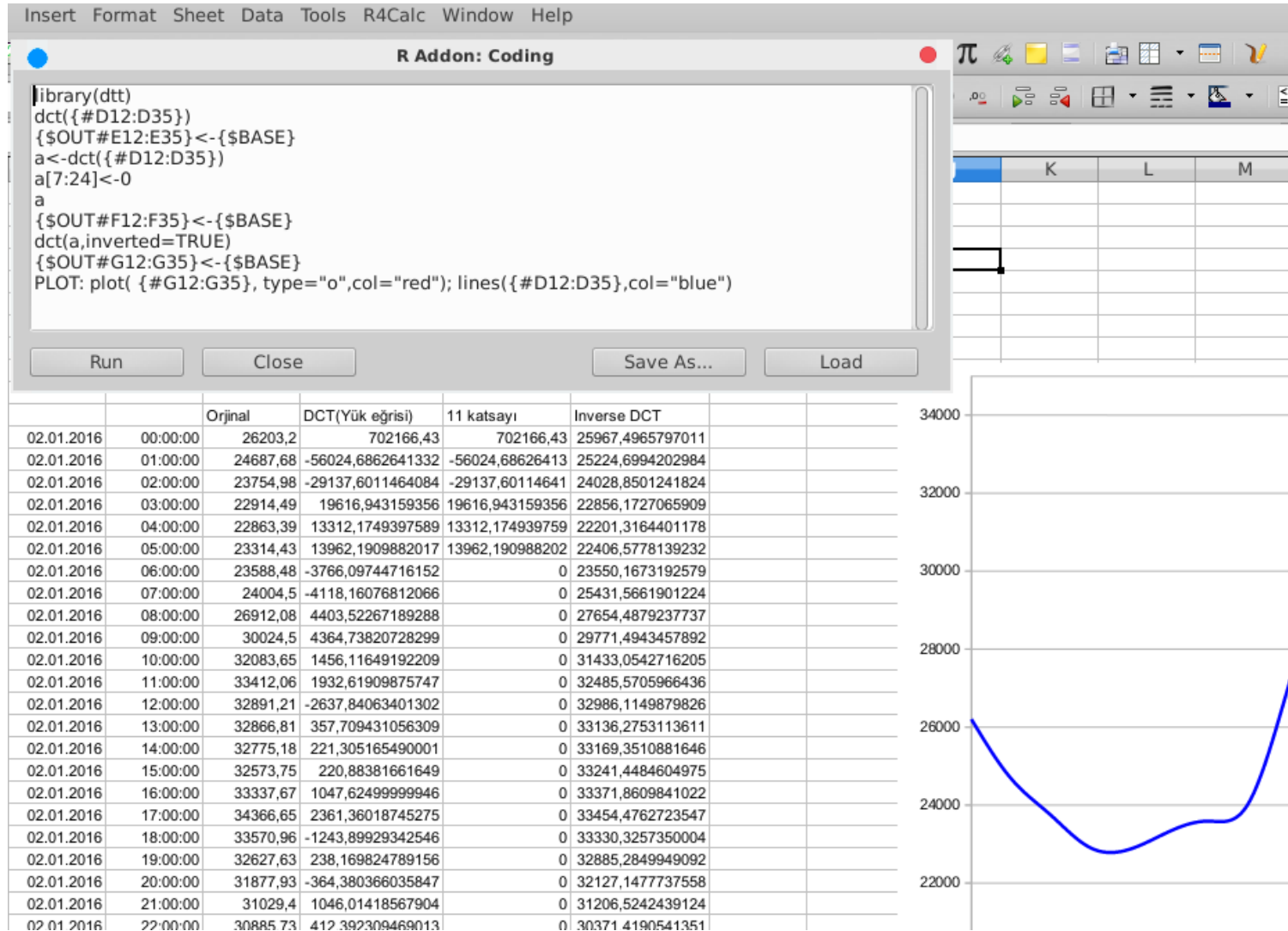
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Previously saved workspace restored]

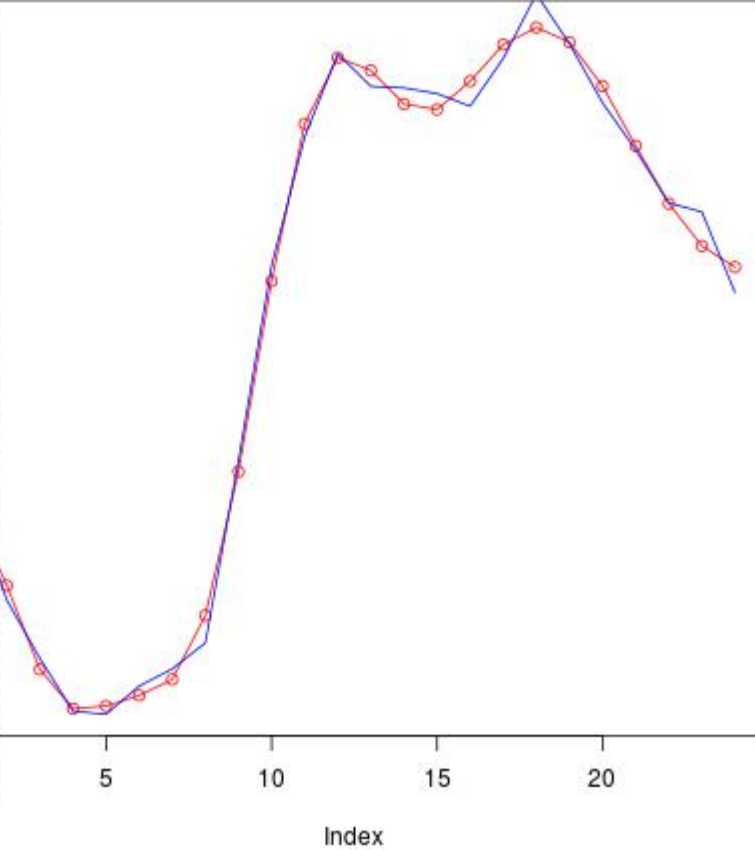
> library(Rserve)
> Rserve()
```

# Libreoffice içinde DCT dönüşümü



# DCT 24 saati -> 11 Katsayıya sıkıştırmak

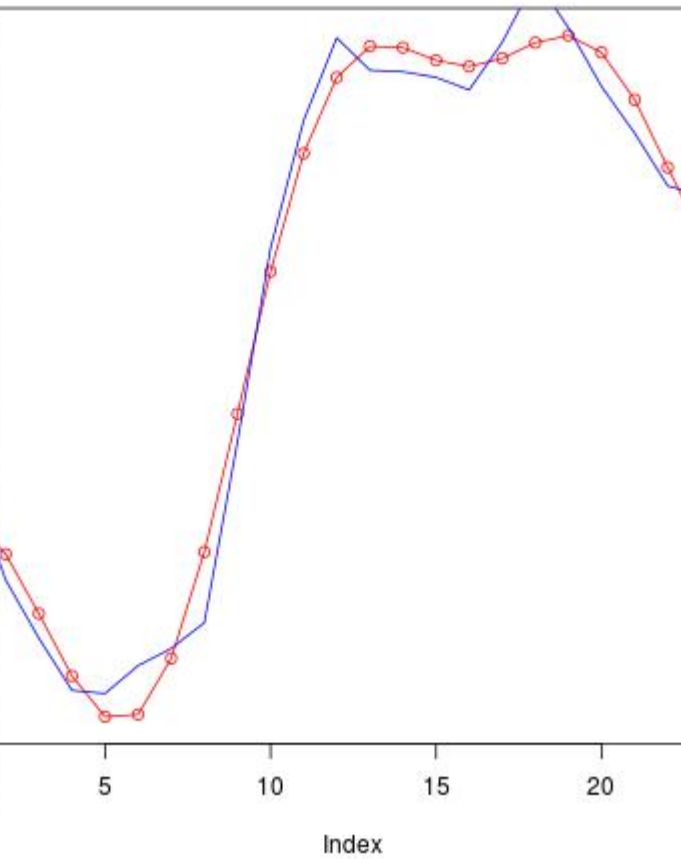
c(26086,249753091, 24920,2505663404, 23580,3853296888, 22952,8578194798, 22996,1116678813, 23164,7732093654, 23419,9856124921, 24441,7354155395, 26737,7038299604, 29262,8076762223450, 32292,93010037203352, 33350,9420034177, 33143,7344389012, 32609,4880034052, 32522,7809410255, 32974,4123170112, 33557,5756632327, 33832,3099534327, 33595,665865246, 32894,6058625982, 31943,0954121596, 31018,98926911, 30342,7921156342, 30004,2203607205)



|            |          | Orjinal  | DCT(Yük eğrisi)   | 11 katsayı      | Inverse DCT      |
|------------|----------|----------|-------------------|-----------------|------------------|
| 02.01.2016 | 00:00:00 | 26203,2  | 702166,43         | 702166,43       | 26086,249753091  |
| 02.01.2016 | 01:00:00 | 24687,68 | -56024,6862641332 | -56024,68626413 | 24920,2505663404 |
| 02.01.2016 | 02:00:00 | 23754,98 | -29137,6011464084 | -29137,60114641 | 23580,3853296888 |
| 02.01.2016 | 03:00:00 | 22914,49 | 19616,943159356   | 19616,943159356 | 22952,8578194798 |
| 02.01.2016 | 04:00:00 | 22863,39 | 13312,1749397589  | 13312,174939759 | 22996,1116678813 |
| 02.01.2016 | 05:00:00 | 23314,43 | 13962,1909882017  | 13962,190988202 | 23164,7732093654 |
| 02.01.2016 | 06:00:00 | 23588,48 | -3766,09744716152 | -3766,097447162 | 23419,9856124921 |
| 02.01.2016 | 07:00:00 | 24004,5  | -4118,16076812066 | -4118,160768121 | 24441,7354155395 |
| 02.01.2016 | 08:00:00 | 26912,08 | 4403,52267189288  | 4403,5226718929 | 26737,7038159674 |
| 02.01.2016 | 09:00:00 | 30024,5  | 4364,73820728299  | 4364,738207283  | 29782,8767622245 |
| 02.01.2016 | 10:00:00 | 32083,65 | 1456,11649192209  | 1456,1164919221 | 32292,9173720352 |
| 02.01.2016 | 11:00:00 | 33412,06 | 1932,61909875747  | 0               | 33350,9124734177 |
| 02.01.2016 | 12:00:00 | 32891,21 | -2637,84063401302 | 0               | 33143,7344389012 |
| 02.01.2016 | 13:00:00 | 32866,81 | 357,709431056309  | 0               | 32609,4880034052 |
| 02.01.2016 | 14:00:00 | 32775,18 | 221,305165490001  | 0               | 32522,7809410255 |
| 02.01.2016 | 15:00:00 | 32573,75 | 220,88381661649   | 0               | 32974,4123170112 |
| 02.01.2016 | 16:00:00 | 33337,67 | 1047,624999999946 | 0               | 33557,5756632327 |
| 02.01.2016 | 17:00:00 | 34366,65 | 2361,36018745275  | 0               | 33832,3099534327 |
| 02.01.2016 | 18:00:00 | 33570,96 | -1243,89929342546 | 0               | 33595,665865246  |
| 02.01.2016 | 19:00:00 | 32627,63 | 238,169824789156  | 0               | 32894,6058625982 |
| 02.01.2016 | 20:00:00 | 31877,93 | -364,380366035847 | 0               | 31943,0954121596 |
| 02.01.2016 | 21:00:00 | 31029,4  | 1046,01418567904  | 0               | 31018,98926911   |
| 02.01.2016 | 22:00:00 | 30885,73 | 412,392309469013  | 0               | 30342,7921156342 |
| 02.01.2016 | 23:00:00 | 29600,07 | -153,117216706135 | 0               | 30004,2203607205 |

# DCT 24 Saati -> 7 katsayıya

c(25677,5448839615, 25104,5974954899, 24148,9520489909, 23146,1244023305, 22491,2681358575, 22526,6797387316, 23430,0653944495, 25141,6144943827, 27364,5362282400, 22965,269282098260, 301553,1856106428923207, 5.5222923833, 33276,0668837223, 33256,3772361695, 33049,2491633562, 32951,4967647579, 33081,9092883626, 33334,3743475463, 33450,4276598088, 33175,2366906488, 32417,0994694955, 31326,6261687209, 30251,3171293267, 29584,7956660635)

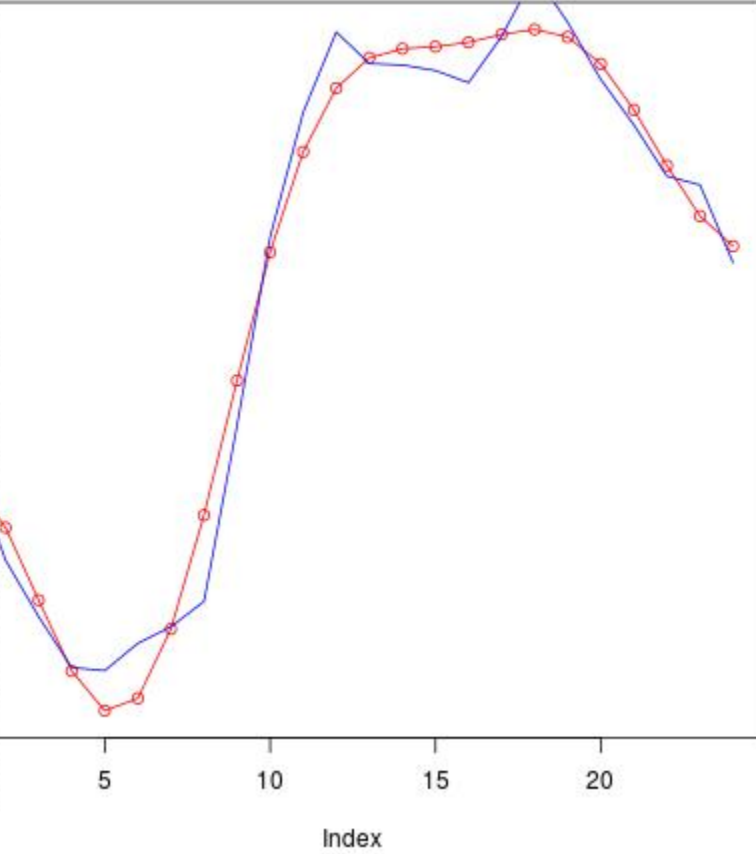


|            |          | Orjinal  | DCT(Yük eğrisi)   | 11 katsayı      | Inverse DCT      |
|------------|----------|----------|-------------------|-----------------|------------------|
| 02.01.2016 | 00:00:00 | 26203,2  | 702166,43         | 702166,43       | 25677,5448839615 |
| 02.01.2016 | 01:00:00 | 24687,68 | -56024,6862641332 | -56024,68626413 | 25104,5974954899 |
| 02.01.2016 | 02:00:00 | 23754,98 | -29137,6011464084 | -29137,60114641 | 24148,9520489909 |
| 02.01.2016 | 03:00:00 | 22914,49 | 19616,943159356   | 19616,943159356 | 23146,1244023305 |
| 02.01.2016 | 04:00:00 | 22863,39 | 13312,1749397589  | 13312,174939759 | 22491,2681358575 |
| 02.01.2016 | 05:00:00 | 23314,43 | 13962,1909882017  | 13962,190988202 | 22526,6797387316 |
| 02.01.2016 | 06:00:00 | 23588,48 | -3766,09744716152 | -3766,097447162 | 23430,0653944495 |
| 02.01.2016 | 07:00:00 | 24004,5  | -4118,16076812066 | 0               | 25141,6144943827 |
| 02.01.2016 | 08:00:00 | 26912,08 | 4403,52267189288  | 0               | 27364,5362280341 |
| 02.01.2016 | 09:00:00 | 30024,5  | 4364,73820728299  | 0               | 29651,3924209808 |
| 02.01.2016 | 10:00:00 | 32083,65 | 1456,11649192209  | 0               | 31553,1561964289 |
| 02.01.2016 | 11:00:00 | 33412,06 | 1932,61909875747  | 0               | 32775,5222923833 |
| 02.01.2016 | 12:00:00 | 32891,21 | -2637,84063401302 | 0               | 33276,0666837223 |
| 02.01.2016 | 13:00:00 | 32866,81 | 357,709431056309  | 0               | 33256,3772361695 |
| 02.01.2016 | 14:00:00 | 32775,18 | 221,305165490001  | 0               | 33049,2491633562 |
| 02.01.2016 | 15:00:00 | 32573,75 | 220,88381661649   | 0               | 32951,4967647579 |
| 02.01.2016 | 16:00:00 | 33337,67 | 1047,62499999946  | 0               | 33081,9092883626 |
| 02.01.2016 | 17:00:00 | 34366,65 | 2361,36018745275  | 0               | 33334,3743475463 |
| 02.01.2016 | 18:00:00 | 33570,96 | -1243,89929342546 | 0               | 33450,4276598088 |
| 02.01.2016 | 19:00:00 | 32627,63 | 238,169824789156  | 0               | 33175,2366906488 |
| 02.01.2016 | 20:00:00 | 31877,93 | -364,380366035847 | 0               | 32417,0994694955 |
| 02.01.2016 | 21:00:00 | 31029,4  | 1046,01418567904  | 0               | 31326,6261687209 |
| 02.01.2016 | 22:00:00 | 30885,73 | 412,392309469013  | 0               | 30251,3171293267 |
| 02.01.2016 | 23:00:00 | 29600,07 | -153,117216706135 | 0               | 29584,7956660635 |



# DCT 24 Saat -> 6 katsayı

c(25967,4965797011, 25224,6994202984, 24028,8501241824, 22856,1727065909, 22201,3164401178, 22406,5778139232, 23550,167319258, 25431,5661901224, 27652,2809237237, 2340,029771, 2634034578, 2203070433, 03642006205, 2324035, 5705966436, 32986,1149879826, 33136,2753113611, 33169,3510881646, 33241,4484604975, 33371,8609841022, 33454,4762723547, 33330,3257350004, 32885,2849949092, 32127,1477737558, 31206,5242439124, 30371,4190541351, 29874,7473618031)



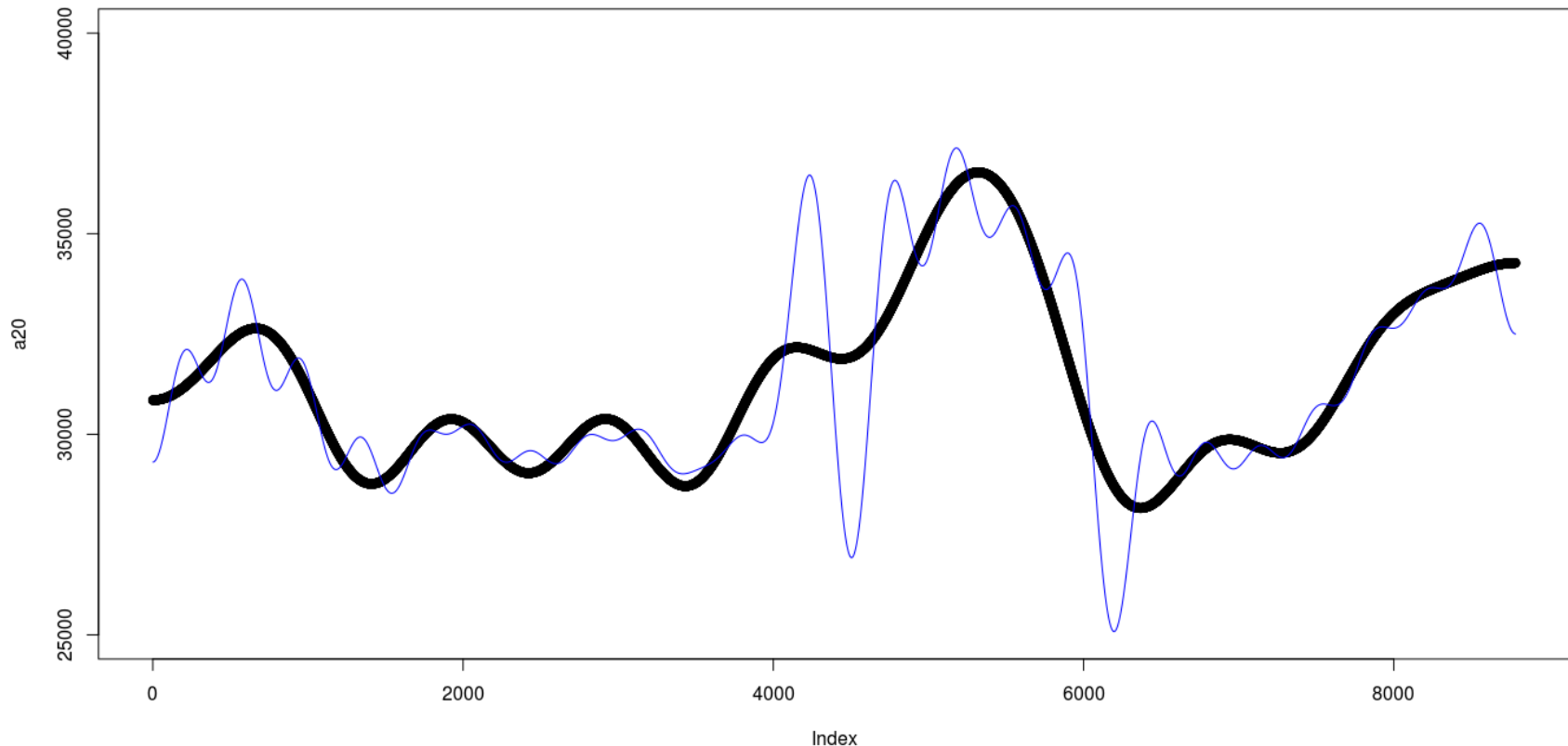
|            |          | Orjinal  | DCT(Yük eğrisi)   | 11 katsayı      | Inverse DCT      |
|------------|----------|----------|-------------------|-----------------|------------------|
| 02.01.2016 | 00:00:00 | 26203,2  | 702166,43         | 702166,43       | 25967,4965797011 |
| 02.01.2016 | 01:00:00 | 24687,68 | -56024,6862641332 | -56024,68626413 | 25224,6994202984 |
| 02.01.2016 | 02:00:00 | 23754,98 | -29137,6011464084 | -29137,60114641 | 24028,8501241824 |
| 02.01.2016 | 03:00:00 | 22914,49 | 19616,943159356   | 19616,943159356 | 22856,1727065909 |
| 02.01.2016 | 04:00:00 | 22863,39 | 13312,1749397589  | 13312,174939759 | 22201,3164401178 |
| 02.01.2016 | 05:00:00 | 23314,43 | 13962,1909882017  | 13962,190988202 | 22406,5778139232 |
| 02.01.2016 | 06:00:00 | 23588,48 | -3766,09744716152 | 0               | 23550,1673192579 |
| 02.01.2016 | 07:00:00 | 24004,5  | -4118,16076812066 | 0               | 25431,5661901224 |
| 02.01.2016 | 08:00:00 | 26912,08 | 4403,52267189288  | 0               | 27654,4879237737 |
| 02.01.2016 | 09:00:00 | 30024,5  | 4364,73820728299  | 0               | 29771,4943457892 |
| 02.01.2016 | 10:00:00 | 32083,65 | 1456,11649192209  | 0               | 31433,0542716205 |
| 02.01.2016 | 11:00:00 | 33412,06 | 1932,61909875747  | 0               | 32485,5705966436 |
| 02.01.2016 | 12:00:00 | 32891,21 | -2637,84063401302 | 0               | 32986,1149879826 |
| 02.01.2016 | 13:00:00 | 32866,81 | 357,709431056309  | 0               | 33136,2753113611 |
| 02.01.2016 | 14:00:00 | 32775,18 | 221,305165490001  | 0               | 33169,3510881646 |
| 02.01.2016 | 15:00:00 | 32573,75 | 220,88381661649   | 0               | 33241,4484604975 |
| 02.01.2016 | 16:00:00 | 33337,67 | 1047,62499999946  | 0               | 33371,8609841022 |
| 02.01.2016 | 17:00:00 | 34366,65 | 2361,36018745275  | 0               | 33454,4762723547 |
| 02.01.2016 | 18:00:00 | 33570,96 | -1243,89929342546 | 0               | 33330,3257350004 |
| 02.01.2016 | 19:00:00 | 32627,63 | 238,169824789156  | 0               | 32885,2849949092 |
| 02.01.2016 | 20:00:00 | 31877,93 | -364,380366035847 | 0               | 32127,1477737558 |
| 02.01.2016 | 21:00:00 | 31029,4  | 1046,01418567904  | 0               | 31206,5242439124 |
| 02.01.2016 | 22:00:00 | 30885,73 | 412,392309469013  | 0               | 30371,4190541351 |
| 02.01.2016 | 23:00:00 | 29600,07 | -153,117216706135 | 0               | 29874,7473618031 |

# Tüm sene grafiği

20 katsayı – siyah

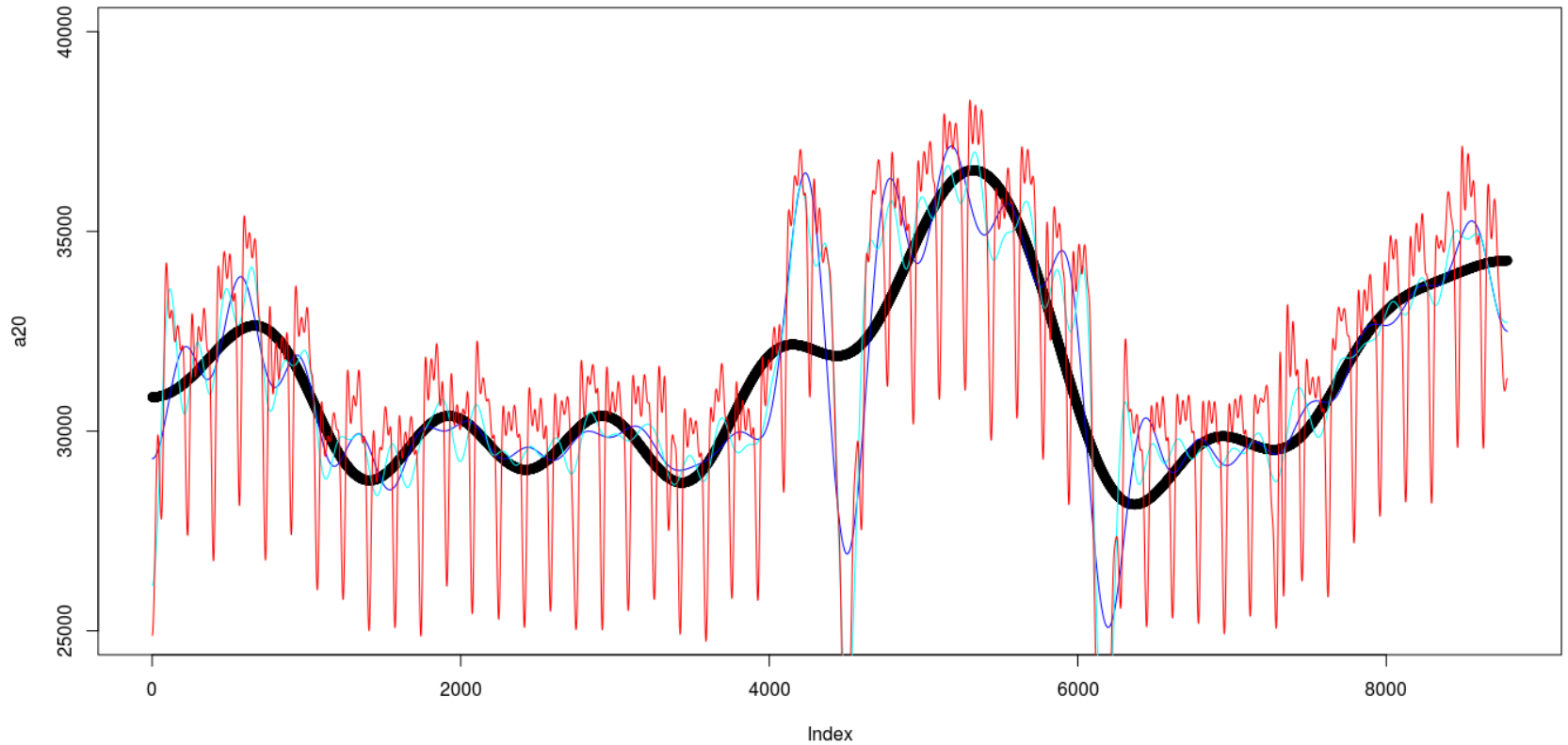
50 katsayı - mavi

```
a<- read.csv("Untitled.csv", header=F , sep = ";", dec=",", stringsAsFactors=FALSE)
library(dtt)
a<-a[,1]
yede<-a
adct<-dct(a)
ydct<-adct
length(a)
adct[20:8784]<-0
a20<-dct(adct,inverted = TRUE)
adct<-ydct
adct[100:8784]<-0
a100<-dct(adct,inverted = TRUE)
plot(a20,mode="lines", ylim = c(20000,42000))
```

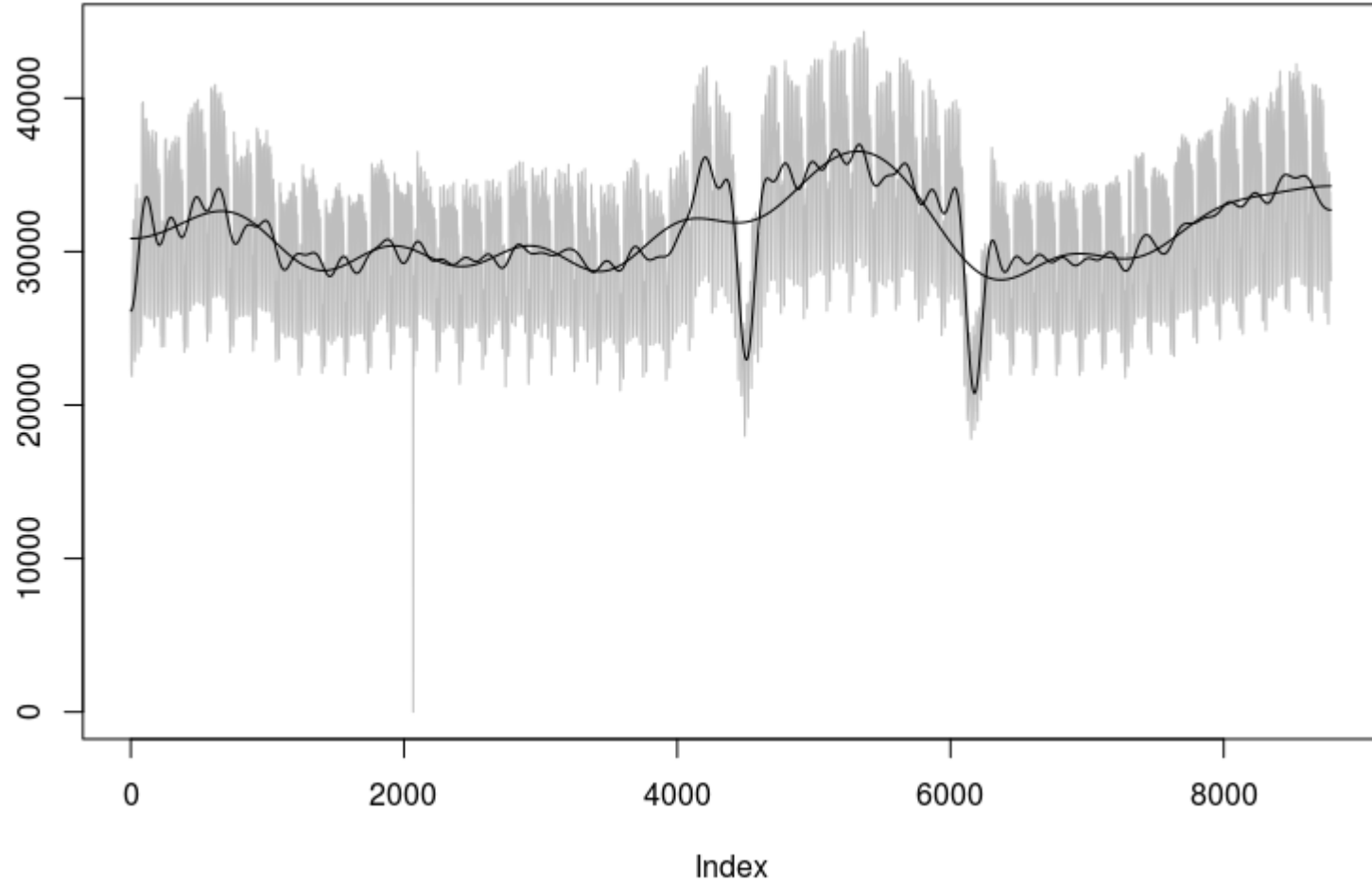




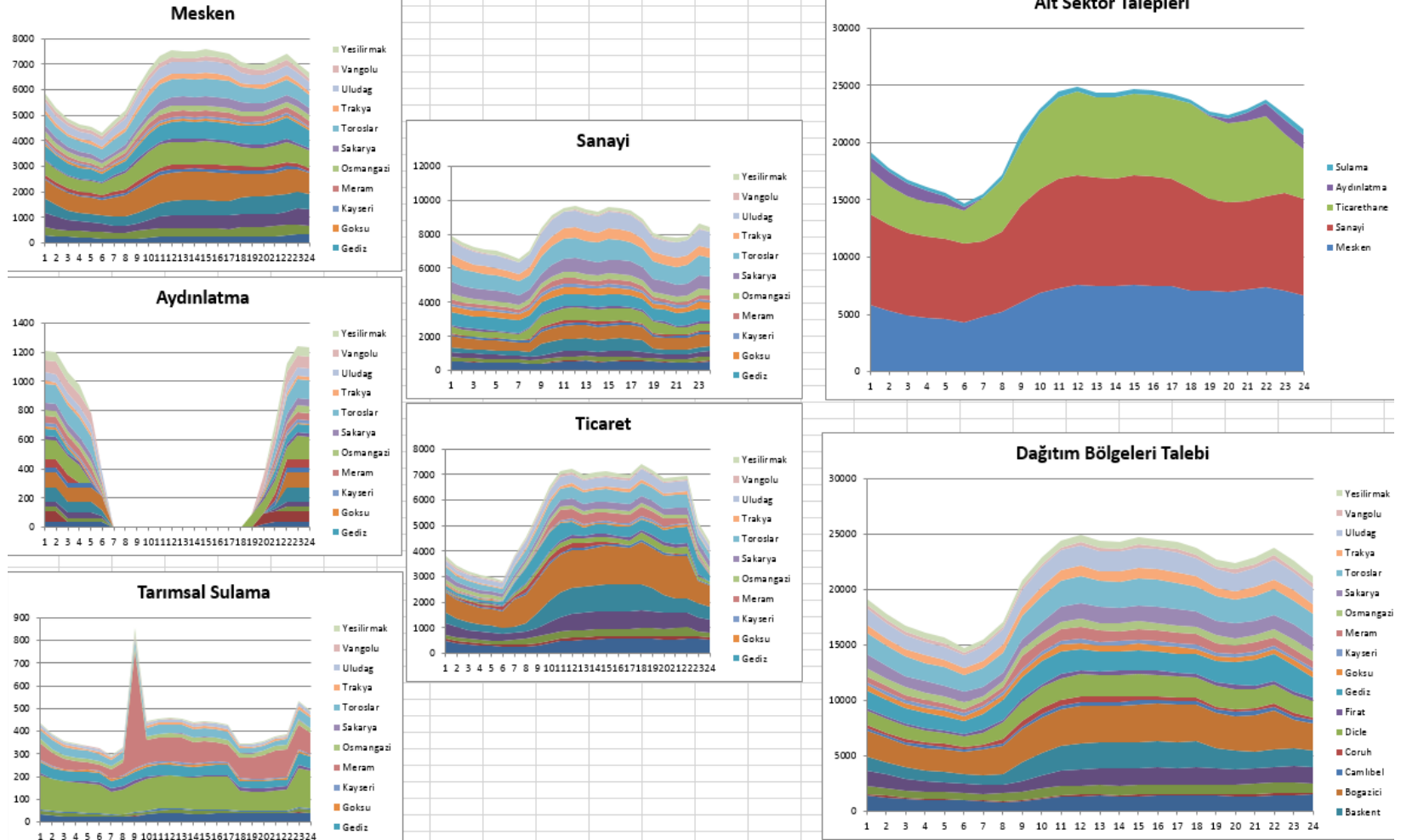
# DCT – 50, 100, 500 katsayı



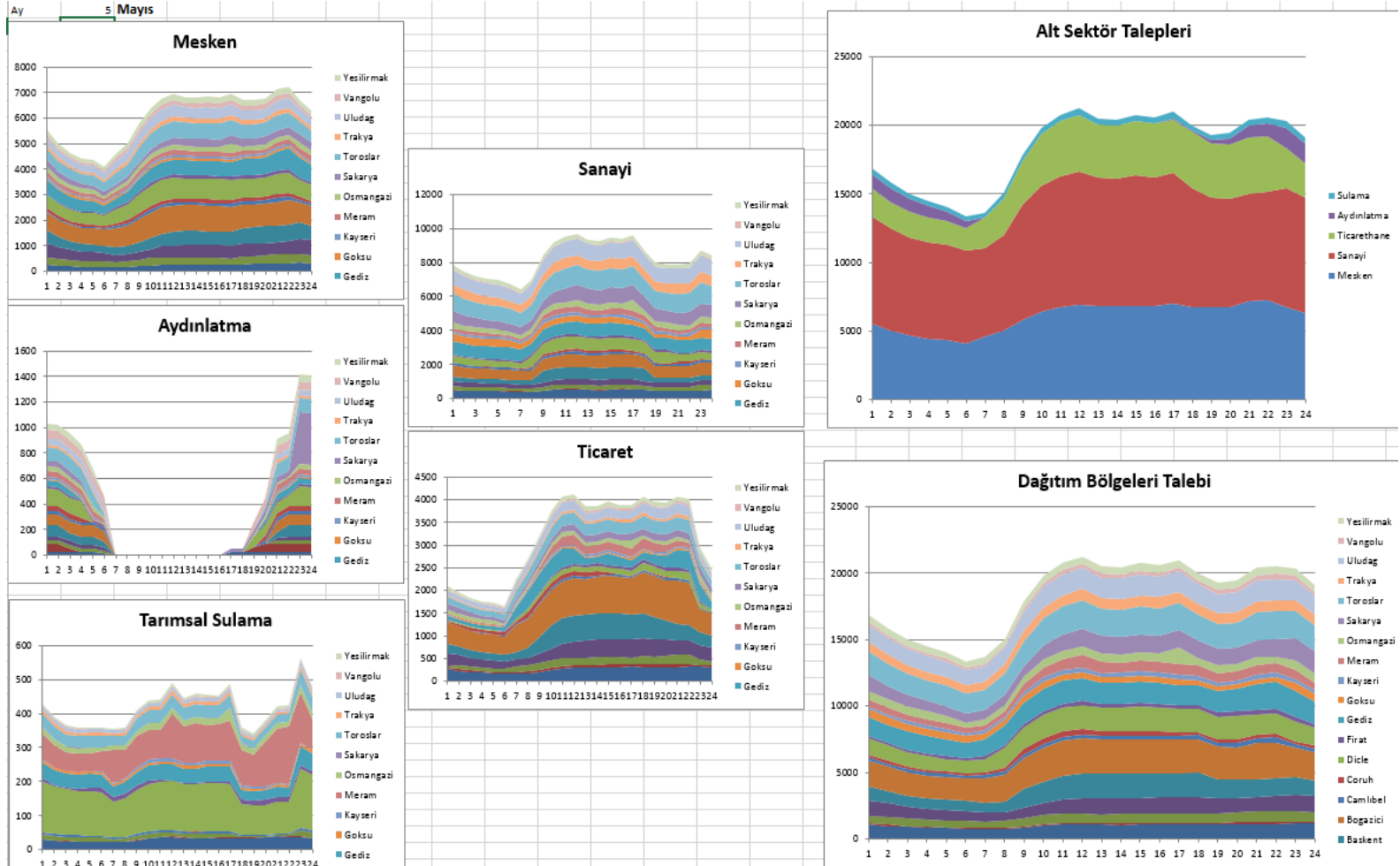
# DCT-20 katsayı ve gerçek yük



# Haziran - Yaz

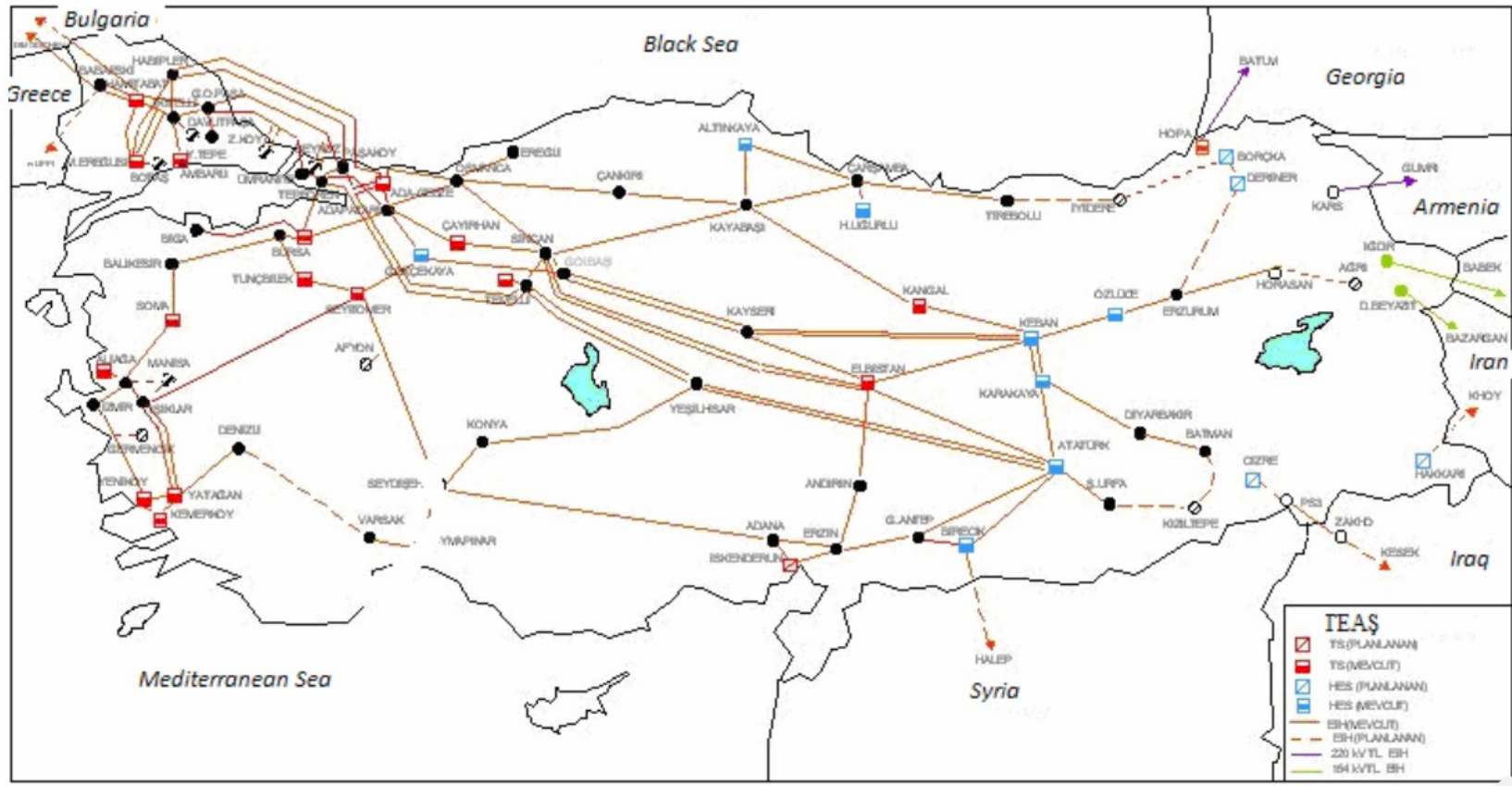


# Mayıs



# Anlık Elektrik Düşüşlerinin Hikayesi

# 17 Ağustos 1999 03:02 Depremi



# 1999

- 26 GW kurulu güç - %60 termik

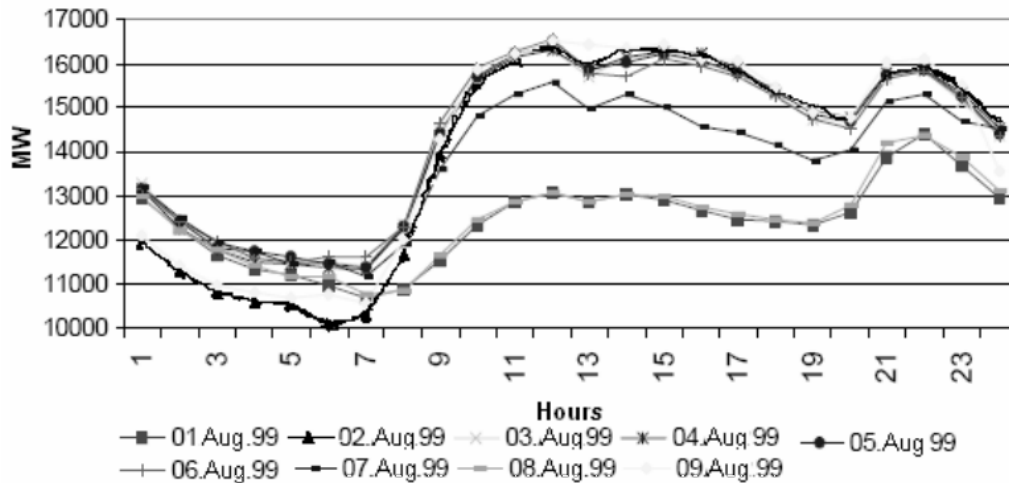
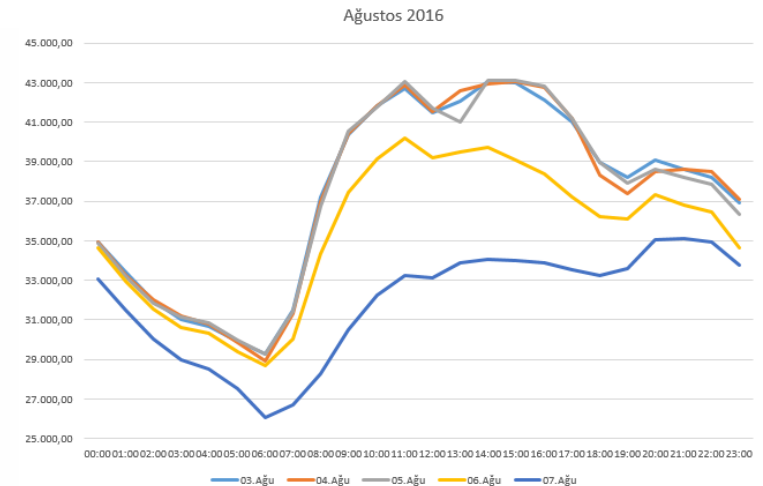


Figure 5

Daily Load Curves belonging to August 1-9, 1999



# Yük akışı -17 Ağustos

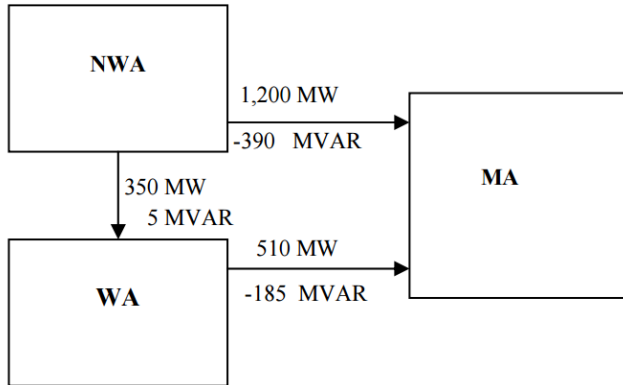


Figure 6

The Power Flow between the Regions at the Minimum Time Range on 17 August 1999

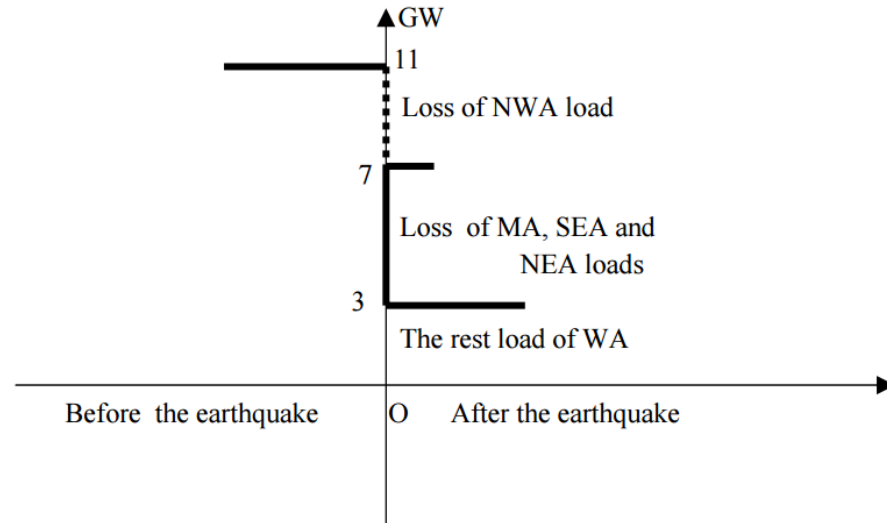


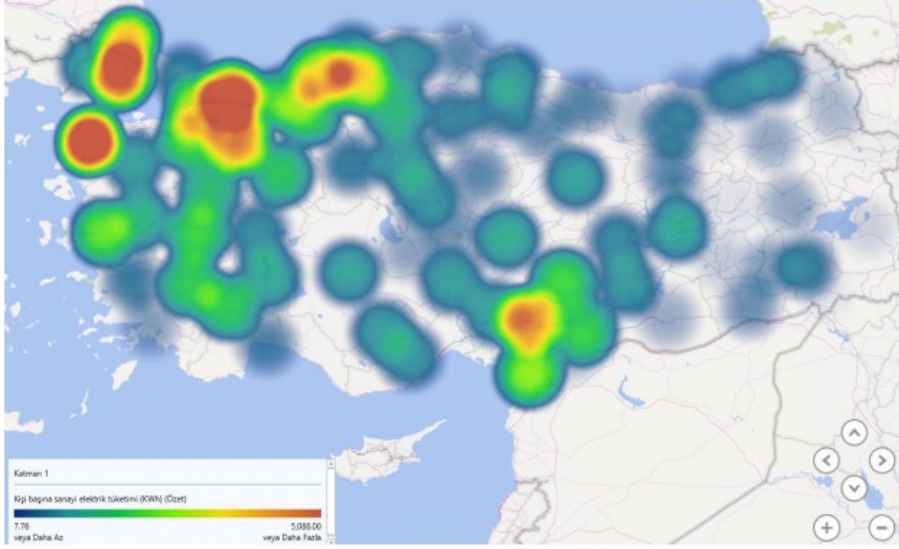
Figure 7

Sudden load reduction of Turkish Power System in the Marmara Earthquake

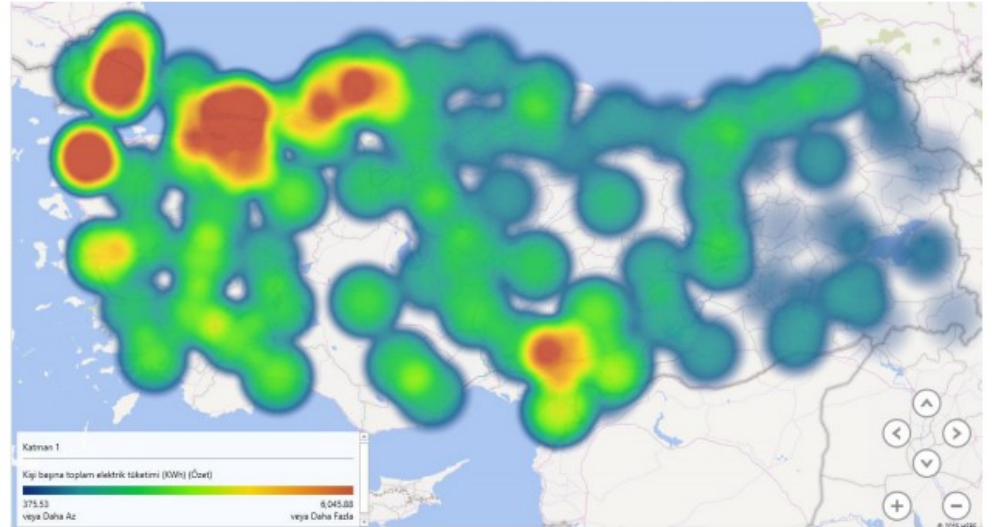


Bölgesel piyasa mı, yerel fiyatlar mı?

# Bölgesel Farklılıklar



Şekil 3. Kişi başına sanayi elektrik tüketimi



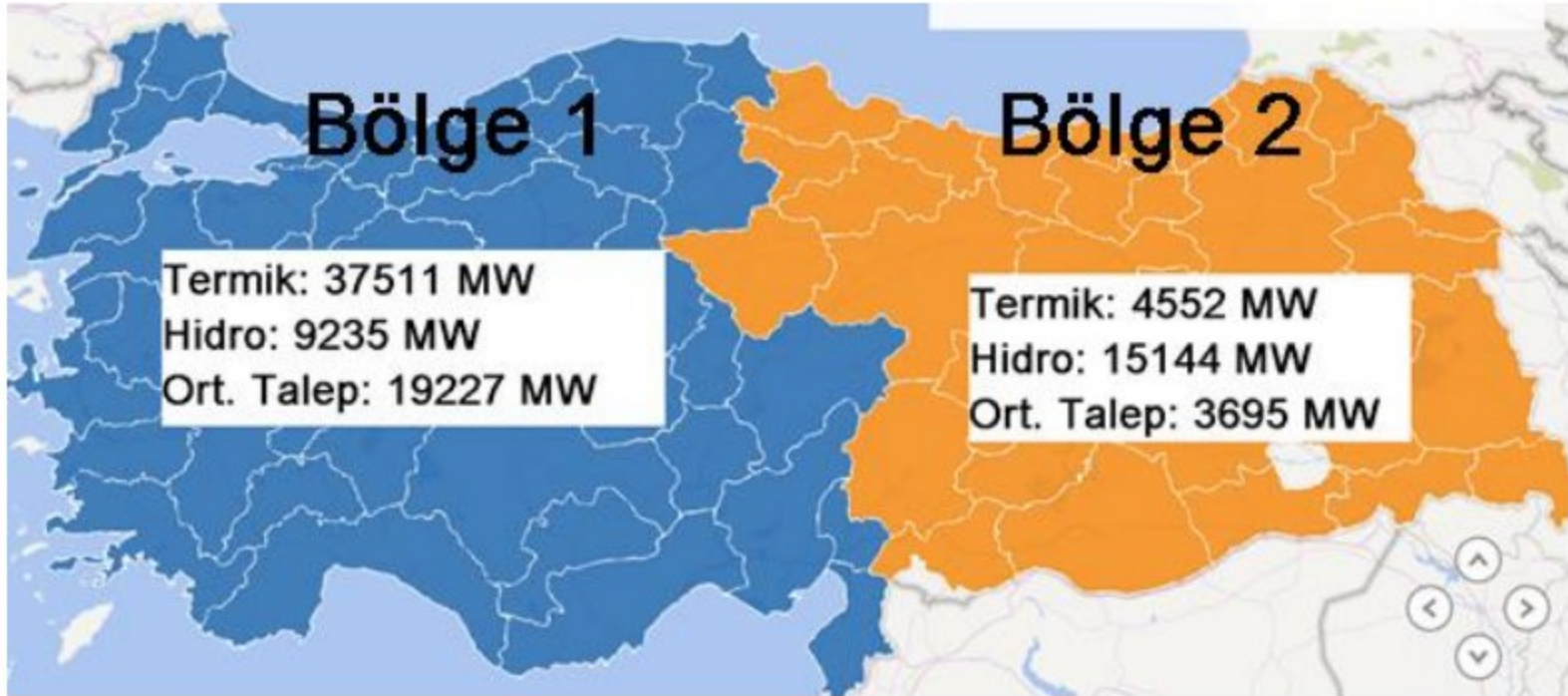
Şekil 4. Kişi başına toplam elektrik tüketimi

# İki ayrı enerji bölgesi mi?



Şekil 5. Doğu ve batı bölgelerinde temel farklılıklar

# Model



Şekil 7. Türkiye iki bölge olarak farklılıklar



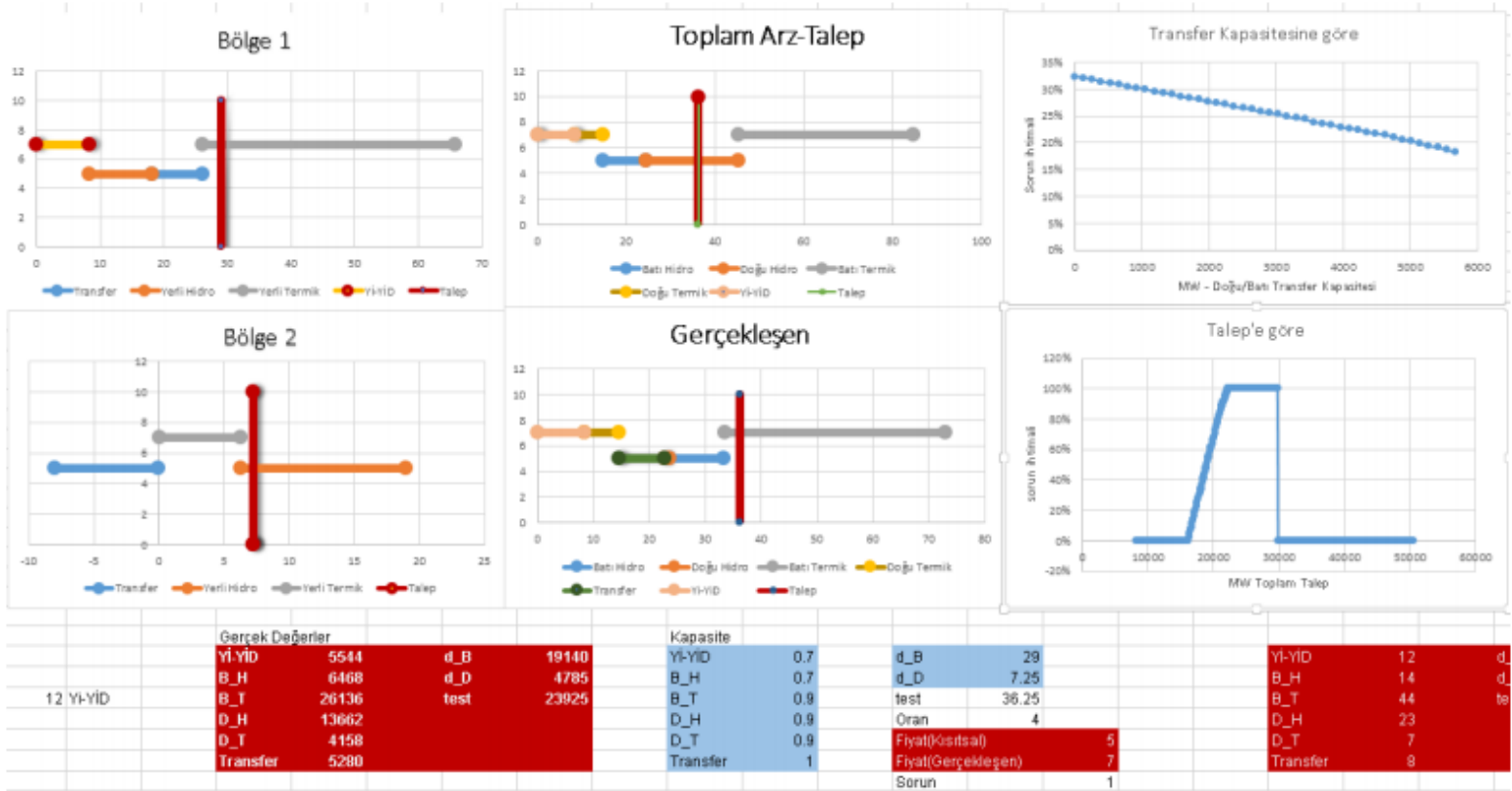
The figure displays a map of Turkey's electrical grid, highlighting the imbalance between generation and consumption at different locations. Two prominent orange boxes illustrate the frequency deviation:

- Left Box (Consumption / Generation):** Shows a frequency of **48.02 Hz**, indicating a deficit where demand exceeds supply.
- Right Box (Generation / Consumption):** Shows a frequency of **52.30 Hz**, indicating a surplus where supply exceeds demand.

The map includes various geographical labels such as Maritsa East3 (BG), Neo Santa (GR), Akhaltsikhe (GE), and Khoy (IR), along with numerous Turkish cities and industrial sites connected by a network of transmission lines.

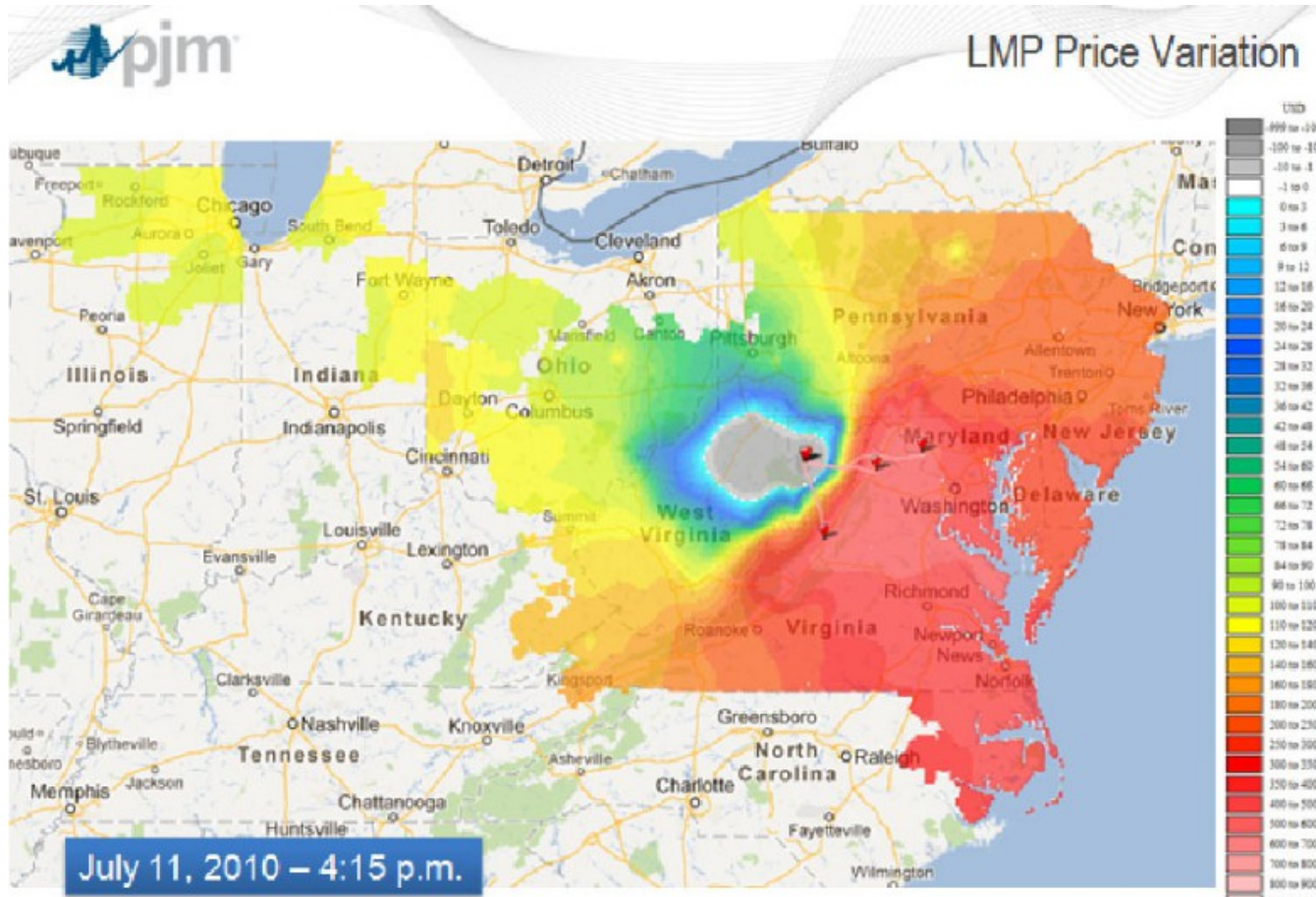
[http://www.cigre-seerc.org/Images/files/turkey\\_presentation\\_2015-06-23.pdf](http://www.cigre-seerc.org/Images/files/turkey_presentation_2015-06-23.pdf)

# Fiyat oluşumu



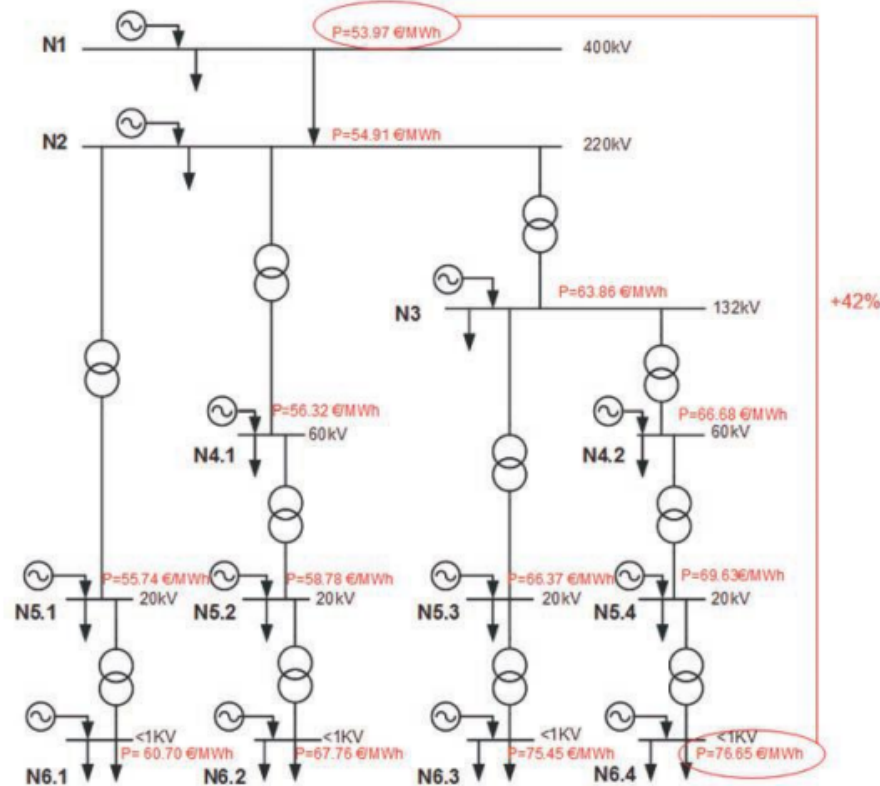
Şekil 14. Simülasyon ekranı

# PJM – LMP (Locational Marginal Pricing)



# LMP çözünürlüğü, nereye kadar

Figure 3.13: Distribution LMPs Using Marginal Loss Values Similar to the Spanish Distribution System



Source: Pérez-Arriaga (2016)<sup>19</sup>

<sup>19</sup> For more details on the modeling used to produce this figure, see Appendix A.



Elektrik piyasalarında  
«kayıp para problemi»

# Sistem

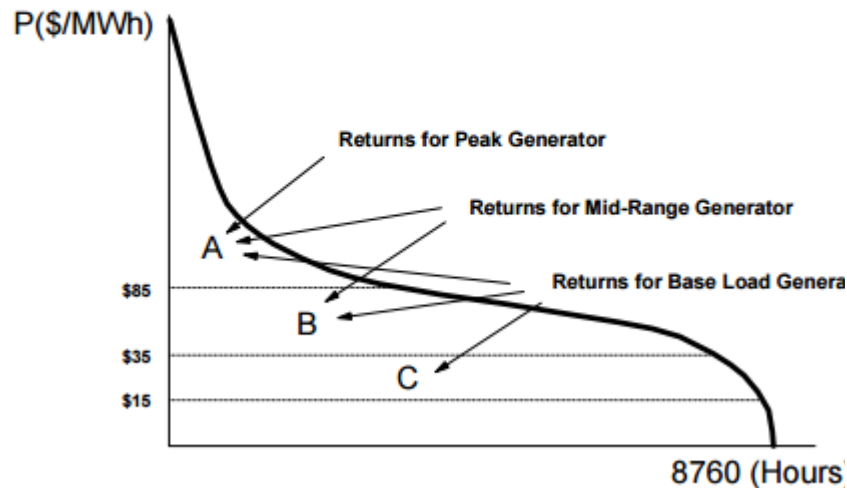
- Herkesin ne üreteceği, ne kadar üreteceği, tüketeciği kesin olarak bilinse
  - Planlama yapılır, üretim-yatırım belirlenirdi
  - Rezerv kapasite gerekmezdi
- Fakat elektrik sistemi belirsizliklerle dolu:
  - Santral devreden çıkabilir
  - Tüketicinin tüketimi değişebilir
  - Hat kopabilir

# Sistem yöneticisi

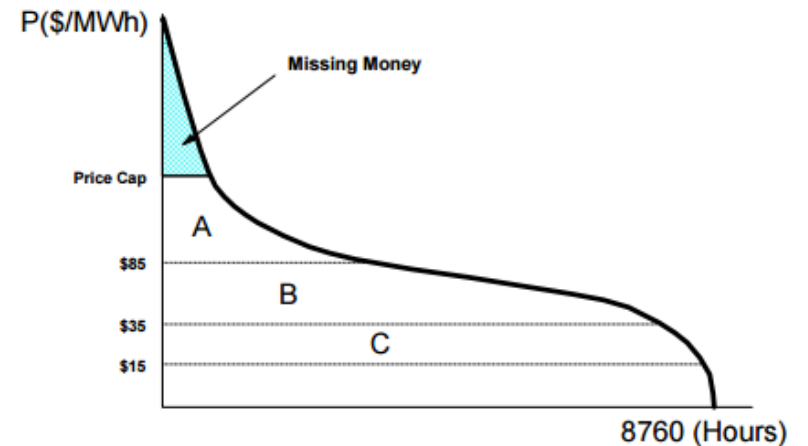
- O zaman kısıtlar koyuyor
  - Maksimum transfer kapasitesi kışın şudur, yazın şudur
  - Talep değiştikçe, yeterli üretim anlık dengeleyecek
- Her kısıt bir kavram/hizmet doğurur
  - Yan hizmetler
    - Dengeleme
    - Rezerv kapasite
    - Emreamade güç
- Ama her hizmet bir kısıt sonucu oluşmaz
  - Emisyon vs

# William Hogan'ın yaklaşımı

A Market Price Duration Curve

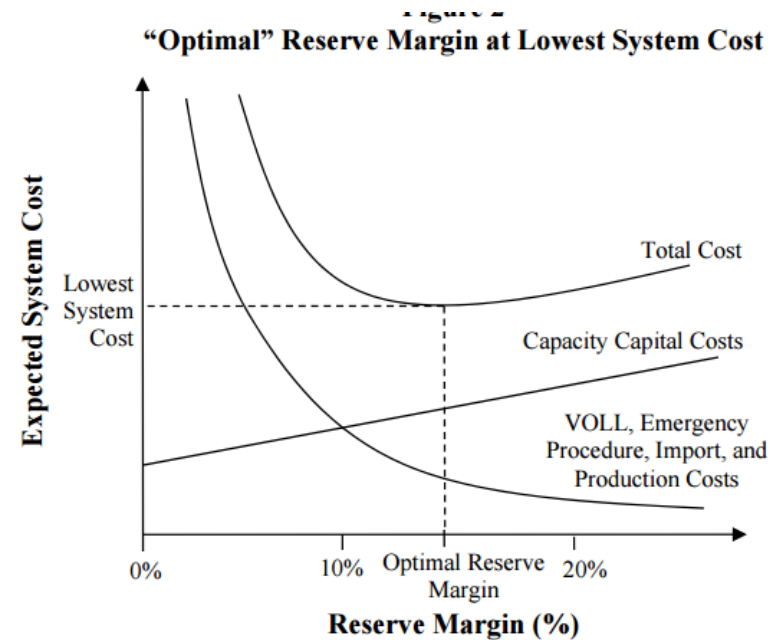
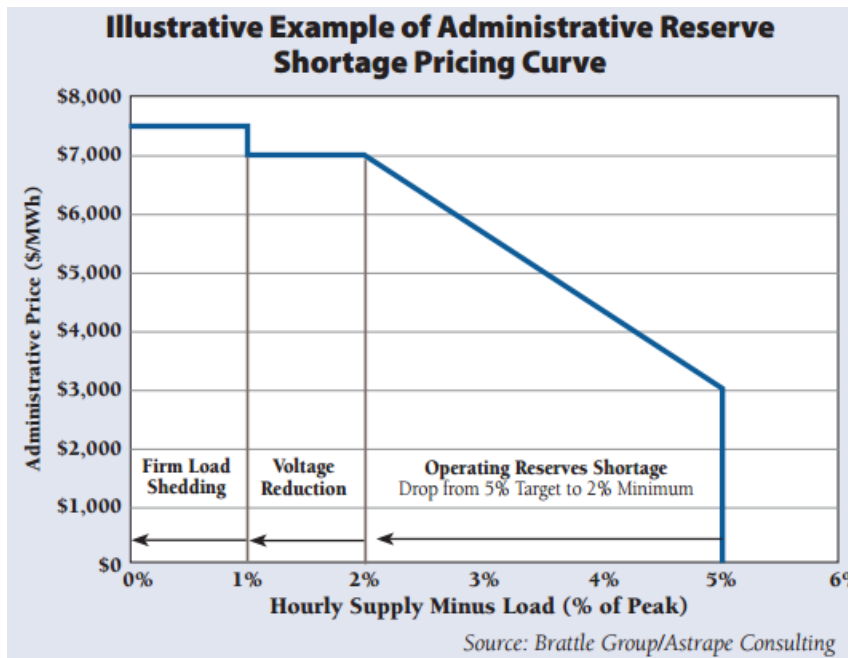


A Price Cap Results in "Missing Money"



Missing money reduces the payments to all types of generation.

# Danışman Dökümanları

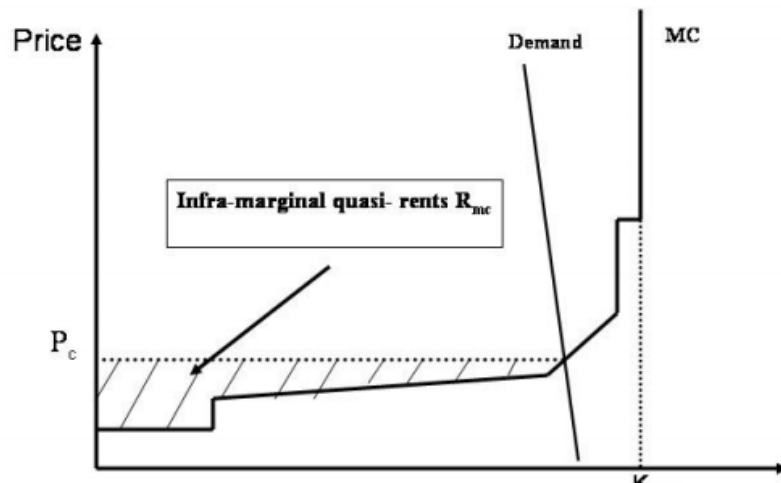


**Notes:**

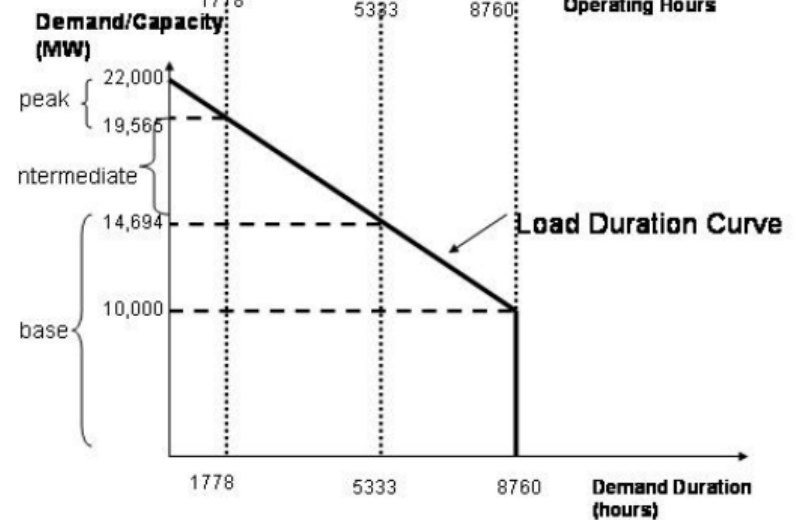
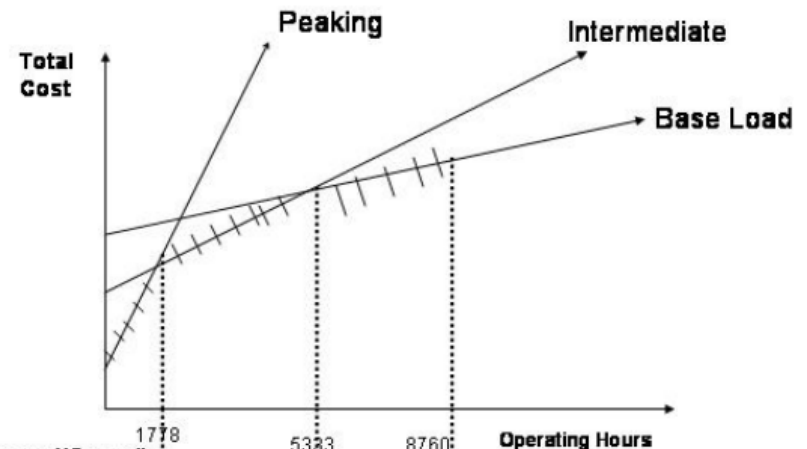
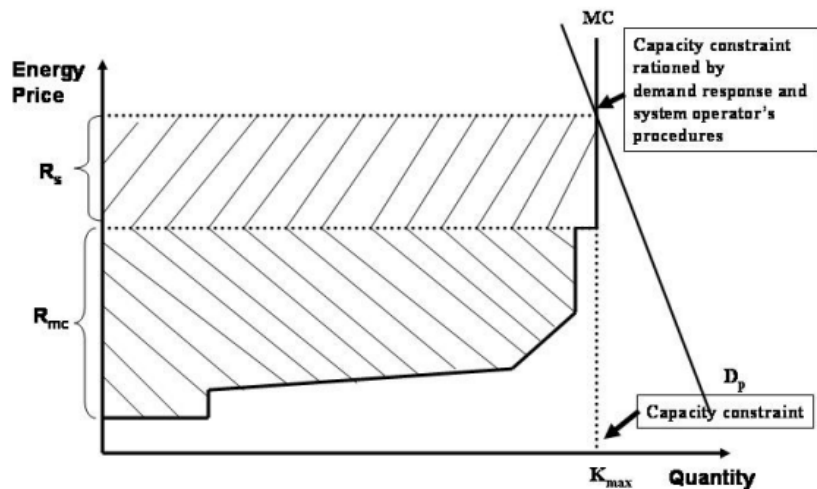
Illustrative figure does not represent any actual or simulated system. See Sections III.A.2–4 for a more thorough discussion and estimate of the economic optimum within a hypothetical simulated system.

# Paul Joskow

SHORT RUN MARGINAL COST PRICING



PRICING WITH BINDING CAPACITY CONSTRAINTS



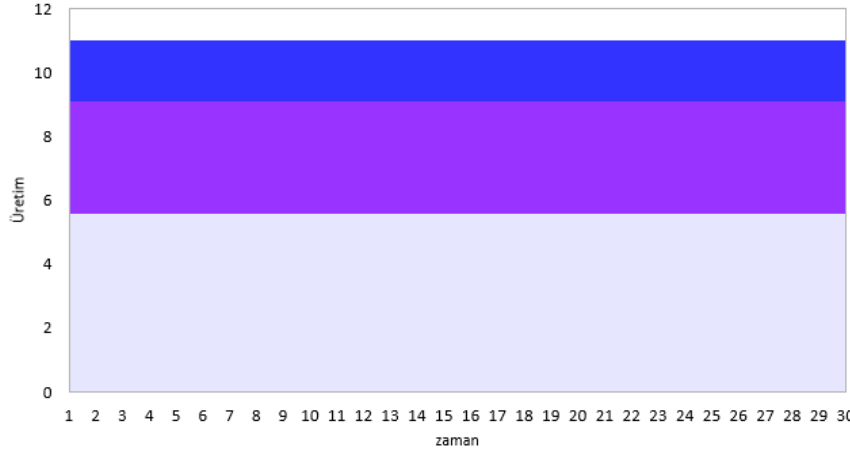
# 3 Elektrik santrali olan bir Piyasa

| Teknoloji | Kapasite | Kapasite Faktörü | CAPEX | OPEX | Yakıt | Muhtemel üretim | Geri dönüş (dönem) | Nihai dönüş süresi |
|-----------|----------|------------------|-------|------|-------|-----------------|--------------------|--------------------|
| A         | 7        | 0,8              | 2000  | 0,5  | 2     | 5,6             | 7                  | 4,61               |
| B         | 7        | 0,5              | 800   | 0,4  | 3     | 3,5             | 7                  | 4,82               |
| C         | 7        | 0,3              | 1800  | 0,5  | 0     | 2,1             | 7                  | 6,89               |

| Teknoloji | Üretim | CAPEX/kWh | OPEX/kWh | Yakıt | Toplam | Teklifi |
|-----------|--------|-----------|----------|-------|--------|---------|
| A         | 5,6    | 1,7       | 0,5      | 2     | 4,2    | 4,2     |
| B         | 3,5    | 1,09      | 0,4      | 3     | 4,49   | 4,49    |
| C         | 2,1    | 4,08      | 0,5      | 0     | 4,58   | 4,58    |

11.2

Teknolojilere göre üretim



3 teknoloji var

A: Baz yük/belki kömür

B: Peaker/doğalgaz gibi

C: Yenilenebilir

■ C  
■ B  
■ A

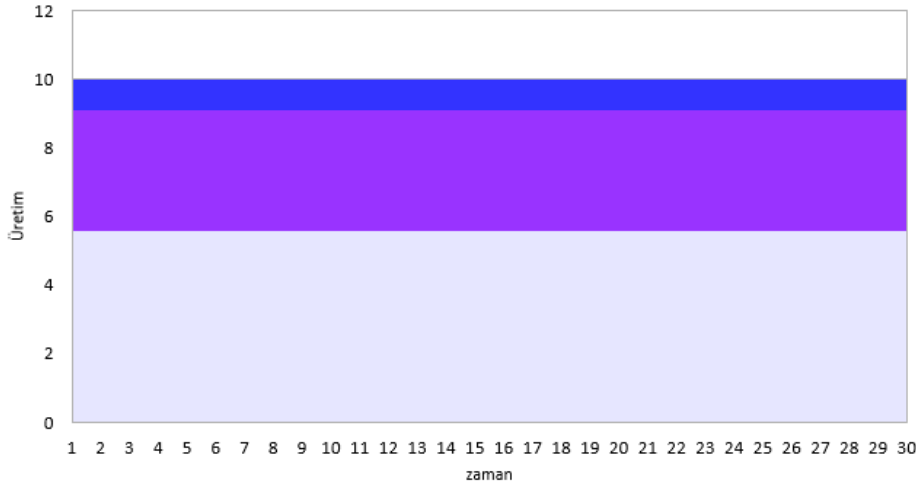
Farzedelim bunlar CAPEX'leri bid etse

Talep 11 iken sorun yok

# Talep 11'den 10'a düşerse

| Teknoloji | Kapasite  | Kapasite Faktörü | CAPEX     | OPEX     | Yakıt | Muhtemel üretim | Geri dönüş (dönem) | Nihai dönüş süresi |
|-----------|-----------|------------------|-----------|----------|-------|-----------------|--------------------|--------------------|
| A         | 7         | 0,8              | 2000      | 0,5      | 2     | 5,6             | 7                  | 4,61               |
| B         | 7         | 0,5              | 800       | 0,4      | 3     | 3,5             | 7                  | 4,82               |
| C         | 7         | 0,3              | 1800      | 0,5      | 0     | 2,1             | 7                  | 14,56              |
|           |           |                  |           |          |       |                 |                    |                    |
|           |           |                  |           |          |       |                 |                    |                    |
|           | Teknoloji | Üretim           | CAPEX/kWh | OPEX/kWh | Yakıt | Toplam          | Teklifi            |                    |
|           | A         | 5,6              | 1,7       | 0,5      | 2     | 4,2             | 4,2                |                    |
|           | B         | 3,5              | 1,09      | 0,4      | 3     | 4,49            | 4,49               |                    |
|           | C         | 2,1              | 4,08      | 0,5      | 0     | 4,58            | 4,58               |                    |
|           |           | 11.2             |           |          |       |                 |                    |                    |

Teknolojilere göre üretim



3 teknoloji var

A: Baz yük/belki kömür

B: Peaker/doğalgaz gibi

C: Yenilenebilir

Talep 11'den 10'a düşünce peaker  
Santralin yatırım geri dönüş süresi  
14 yıla çıkıyor



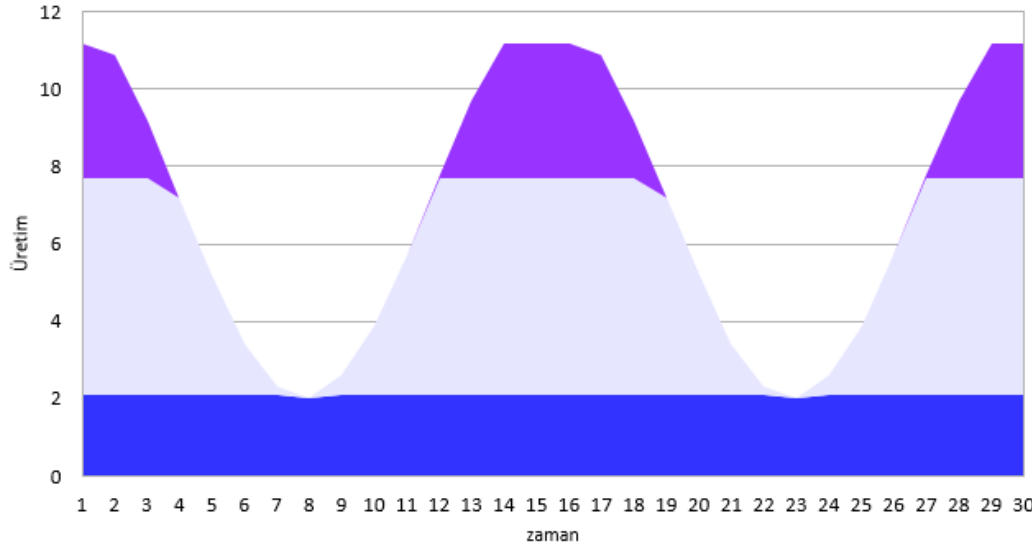
# Model 2- Talep çok deęişken ise

| Teknoloji | Kapasite | Kapasite Faktörü | CAPEX | OPEX | Yakıt | Muhtemel üretim | Geri dönüş (dönem) | Net dönüş süresi |
|-----------|----------|------------------|-------|------|-------|-----------------|--------------------|------------------|
| A         | 7        | 0,8              | 2000  | 0,5  | 2     | 5,6             | 7                  | 15,95            |
| B         | 7        | 0,5              | 800   | 0,4  | 3     | 3,5             | 7                  | 57,80            |
| C         | 7        | 0,3              | 1800  | 0,5  | 0     | 2,1             | 7                  | 10,26            |

| Teknoloji | Üretim | CAPEX/kWh | OPEX/kWh | Yakıt | Toplam |
|-----------|--------|-----------|----------|-------|--------|
| A         | 5,6    | 1,7       | 0,5      | 2     | 2,5    |
| B         | 3,5    | 1,09      | 0,4      | 3     | 3,4    |
| C         | 2,1    | 4,08      | 0,5      | 0     | 0,5    |
|           | 15     |           |          |       |        |

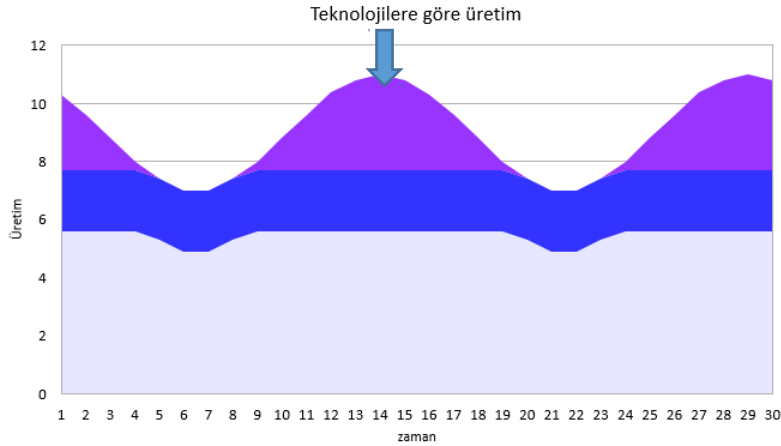
Teknolojilere göre üretim



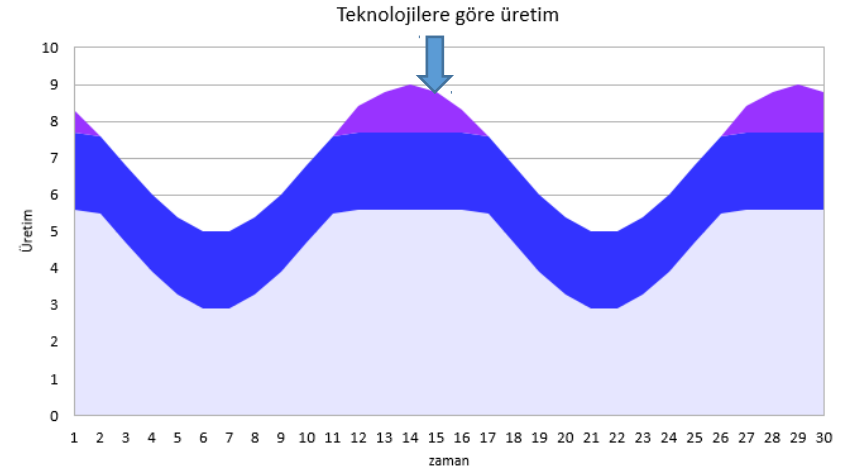
Herkes OPEX'ini teklif ederse yatırım dönüş süreleri sürekli çalışan hariç çok düşük

# Model 3- Voll eklenirse

| Teknoloji      | Kapasite | Kapasite Faktörü | CAPEX    | OPEX  | Yakıt  | Muhtemel üretim | Geri dönüş (dönem) | Nihai dönüş süresi |
|----------------|----------|------------------|----------|-------|--------|-----------------|--------------------|--------------------|
| A              | 7        | 0,8              | 2000     | 0,5   | 2      | 5,6             | 7                  | 4,74               |
| B              | 7        | 0,5              | 800      | 0,4   | 3      | 3,5             | 7                  | 6,91               |
| C              | 7        | 0,3              | 1800     | 0,5   | 0      | 2,1             | 7                  | 6,31               |
|                |          |                  |          |       |        | 11,2            |                    |                    |
| Teknoloji      | Üretim   | CAPEX/kWh        | OPEX/kWh | Yakıt | Toplam |                 |                    |                    |
| A              | 5,6      | 1,7              | 0,5      | 2     | 2,5    | 2,75            |                    |                    |
| B              | 3,5      | 1,09             | 0,4      | 3     | 3,4    | 3,74            |                    |                    |
| C              | 2,1      | 4,08             | 0,5      | 0     | 0,5    | 0,55            |                    |                    |
|                | 11,2     |                  |          |       |        |                 |                    |                    |
| Voll           |          |                  | 6        |       |        |                 |                    |                    |
| Kar beklentisi |          | %10,00           |          |       |        |                 |                    |                    |



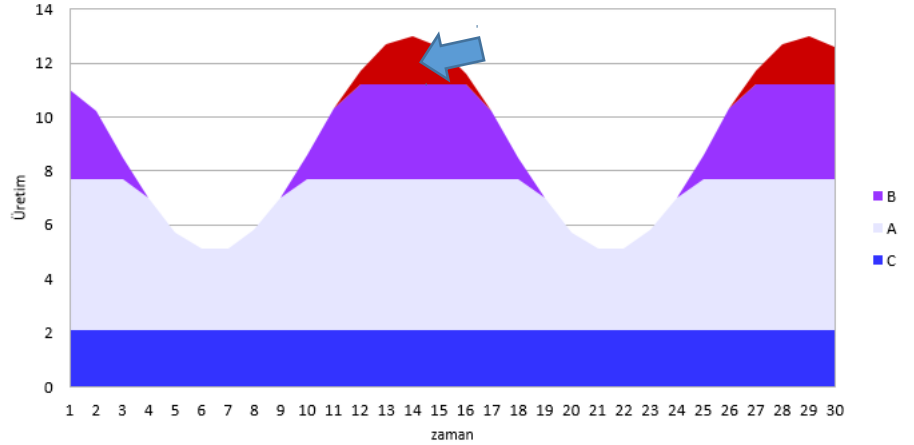
| Teknoloji      | Kapasite | Kapasite Faktörü | CAPEX    | OPEX  | Yakıt  | Muhtemel üretim | Geri dönüş (dönem) | Nihai dönüş süresi |
|----------------|----------|------------------|----------|-------|--------|-----------------|--------------------|--------------------|
| A              | 7        | 0,8              | 2000     | 0,5   | 2      | 5,6             | 7                  | 12,63              |
| B              | 7        | 0,5              | 800      | 0,4   | 3      | 3,5             | 7                  | 112,61             |
| C              | 7        | 0,3              | 1800     | 0,5   | 0      | 2,1             | 7                  | 9,28               |
|                |          |                  |          |       |        | 11,2            |                    |                    |
| Teknoloji      | Üretim   | CAPEX/kWh        | OPEX/kWh | Yakıt | Toplam |                 |                    |                    |
| A              | 5,6      | 1,7              | 0,5      | 2     | 2,5    | 2,75            |                    |                    |
| B              | 3,5      | 1,09             | 0,4      | 3     | 3,4    | 3,74            |                    |                    |
| C              | 2,1      | 4,08             | 0,5      | 0     | 0,5    | 0,55            |                    |                    |
|                | 11,2     |                  |          |       |        |                 |                    |                    |
| Voll           |          |                  | 6        |       |        |                 |                    |                    |
| Kar beklentisi |          | %10,00           |          |       |        |                 |                    |                    |



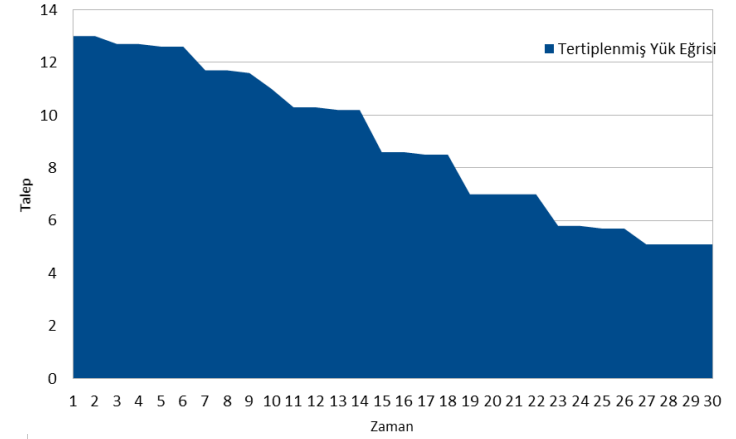
# Model 4- Yokluk fiyatlaması

| Teknoloji | Kapasite      | Kapasite Faktörü | CAPEX    | OPEX  | Yakıt  | Muhtemel üretim | Geri dönüş (dönem) | Nihai dönüş süresi |
|-----------|---------------|------------------|----------|-------|--------|-----------------|--------------------|--------------------|
| A         | 7             | 0,8              | 2000     | 0,5   | 2      | 5,6             | 7                  | 4,33               |
| B         | 7             | 0,5              | 800      | 0,4   | 3      | 3,5             | 7                  | 4,14               |
| C         | 7             | 0,3              | 1800     | 0,5   | 0      | 2,1             | 7                  | 5,90               |
|           | 21            |                  |          |       |        | 11,2            |                    |                    |
| Teknoloji | Üretim        | CAPEX/kWh        | OPEX/kWh | Yakıt | Toplam |                 |                    |                    |
| A         | 5,6           | 1,7              | 0,5      | 2     | 2,5    | 2,75            |                    |                    |
| B         | 3,5           | 1,09             | 0,4      | 3     | 3,4    | 3,74            |                    |                    |
| C         | 2,1           | 4,08             | 0,5      | 0     | 0,5    | 0,55            |                    |                    |
|           | 11,2          |                  |          |       |        | 3,74            |                    |                    |
|           | Voll          |                  | 10       |       |        |                 |                    |                    |
|           | Kar beklentis |                  | %10,00   |       |        |                 |                    |                    |

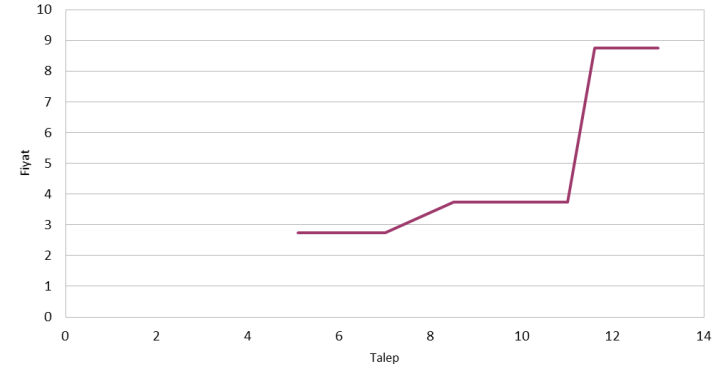
Teknolojilere göre üretim



Tertiplenmiş Yük Eğrisi



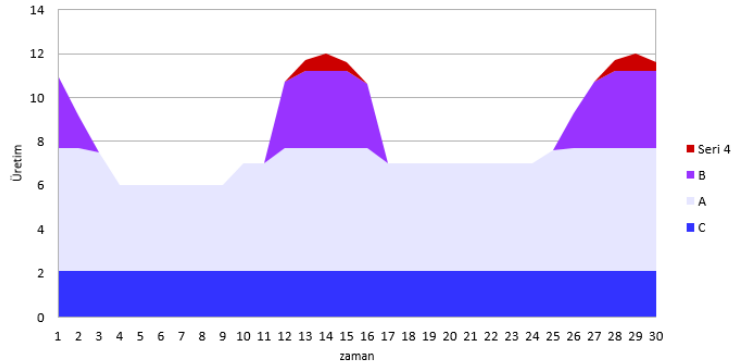
Talep - Fiyat Eğrisi



# Model 5 – Daha kompleks bir model

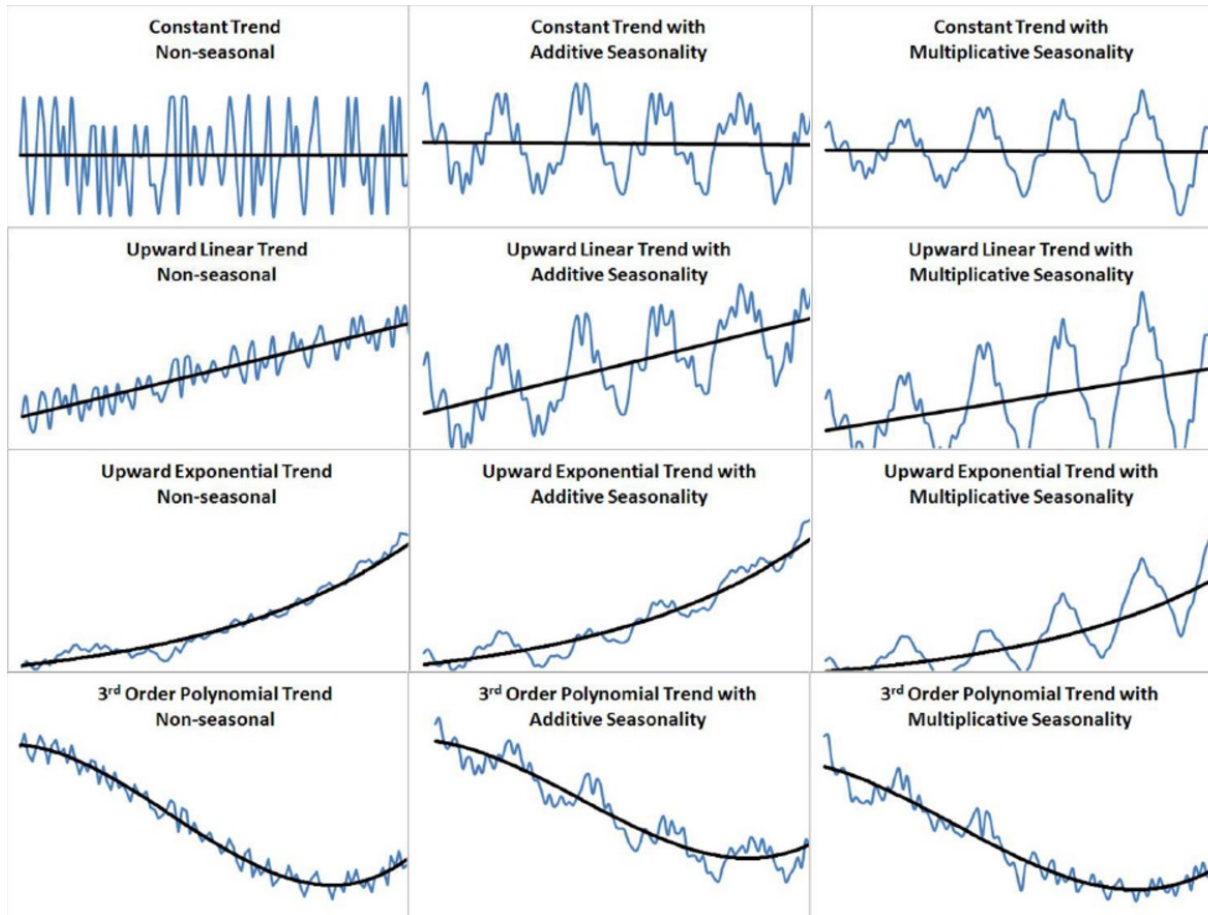
| Teknoloji | Kapasite       | Kapasite Faktörü | CAPEX    | OPEX  | Yakıt  | Muhtemel üretim | Geri dönüş (dönem) | Nihai dönüş süresi |
|-----------|----------------|------------------|----------|-------|--------|-----------------|--------------------|--------------------|
| A         | 7              | 0,8              | 2000     | 0,5   | 2      | 5,6             | 7                  | 8,87               |
| B         | 7              | 0,5              | 800      | 0,4   | 3      | 3,5             | 7                  | 14,38              |
| C         | 7              | 0,3              | 1800     | 0,5   | 0      | 2,1             | 7                  | 8,35               |
|           | 21             |                  |          |       |        | 11,2            |                    |                    |
| Teknoloji | Üretim         | CAPEX/kWh        | OPEX/kWh | Yakıt | Toplam |                 |                    |                    |
| A         | 5,6            | 1,7              | 0,5      | 2     | 2,5    | 2,75            |                    |                    |
| B         | 3,5            | 1,09             | 0,4      | 3     | 3,4    | 3,74            |                    |                    |
| C         | 2,1            | 4,08             | 0,5      | 0     | 0,5    | 0,55            |                    |                    |
|           | 11,2           |                  |          |       |        | 3,74            |                    |                    |
|           | Voll           | 3,74             |          |       |        |                 |                    |                    |
|           | Kar beklentisi | %10,00           |          |       |        |                 |                    |                    |

Teknolojilere göre üretim

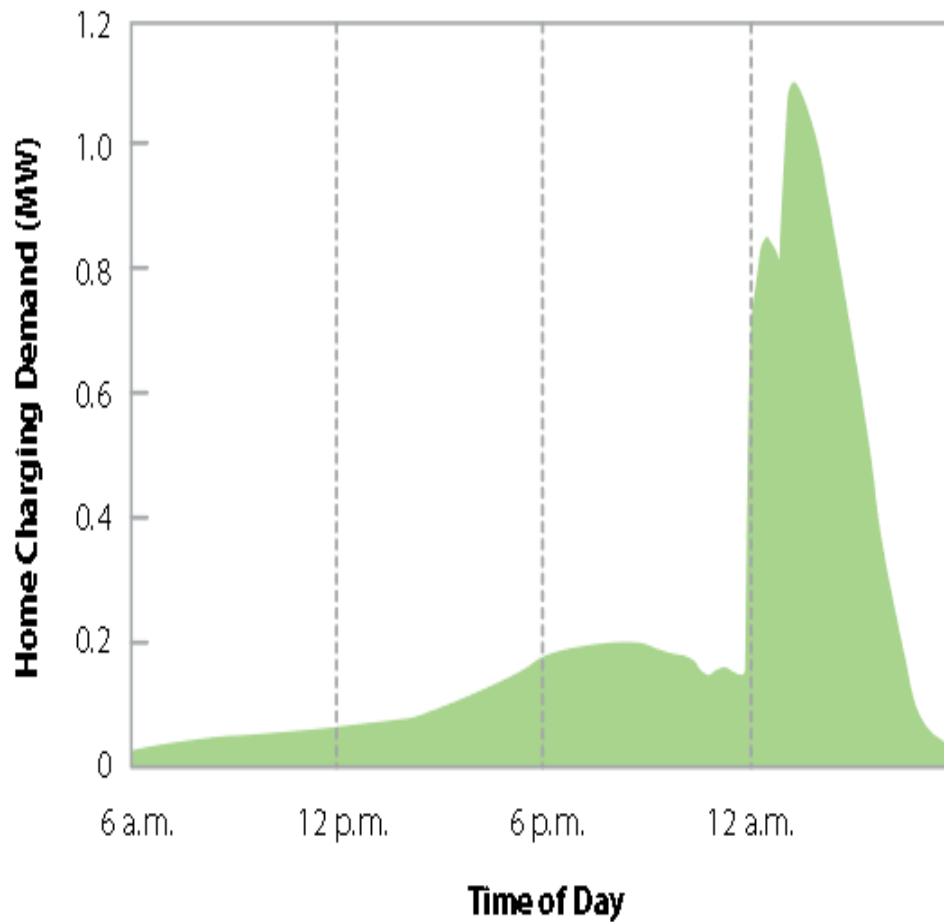


Diğer Hususlar  
Model, Elektrikli Arabalar, Piyasa Yapısı,  
Güneş

# Nasıl modeller

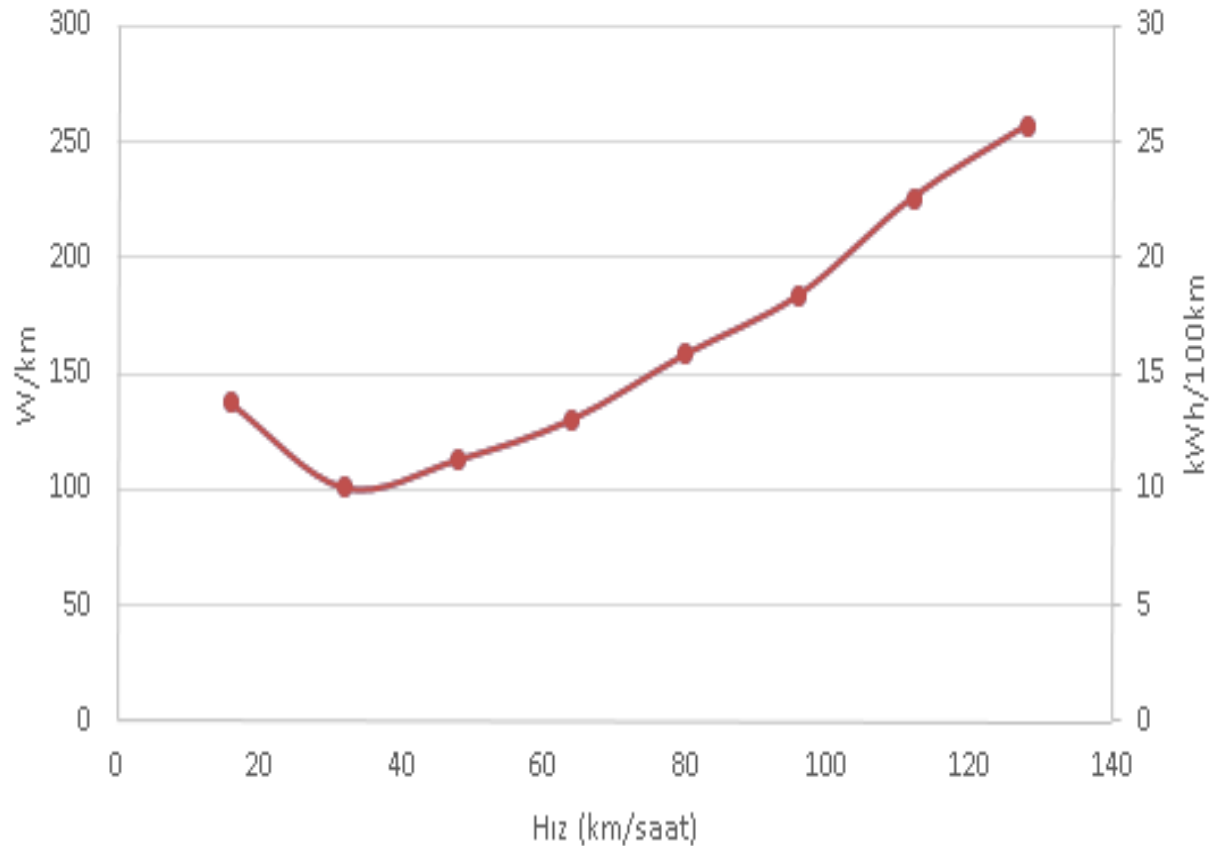


# Elektrikli Arabalar



# Elektrikli Arabaların Elektrik Tüketimi

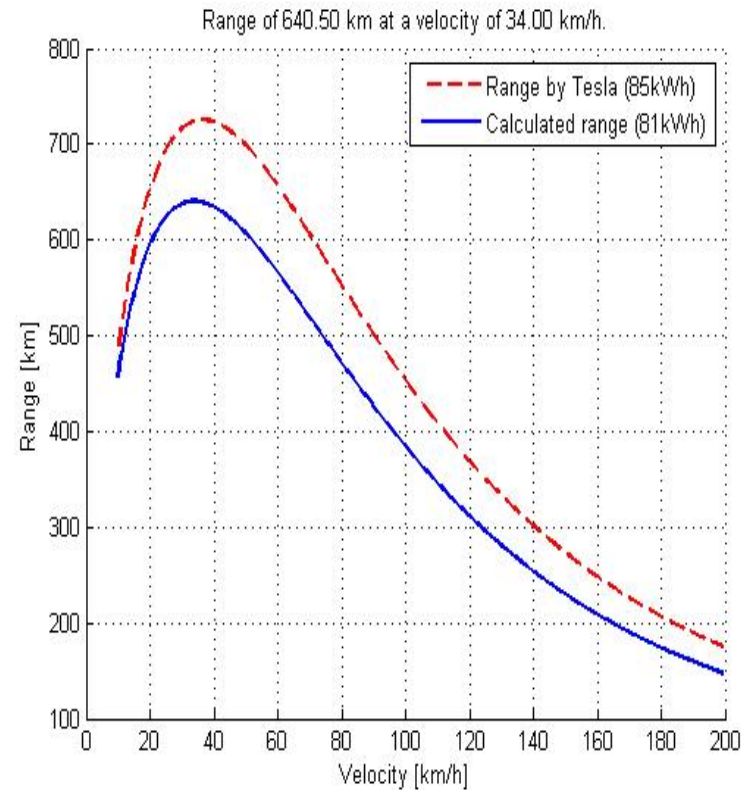
Elektrikli Arabaların Hıza Göre Elektrik Tüketimi





# Diğer Tüketim elemanları

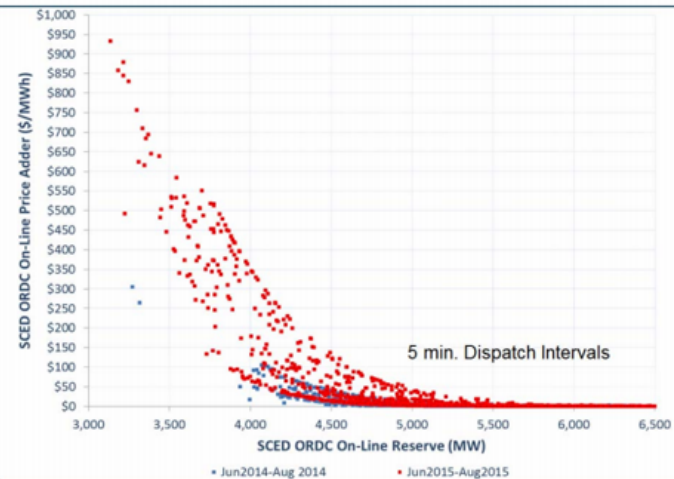
- 3kW-2kW klima
- 300 W ses sistemi
- 80 W ışıklar



# ORDC

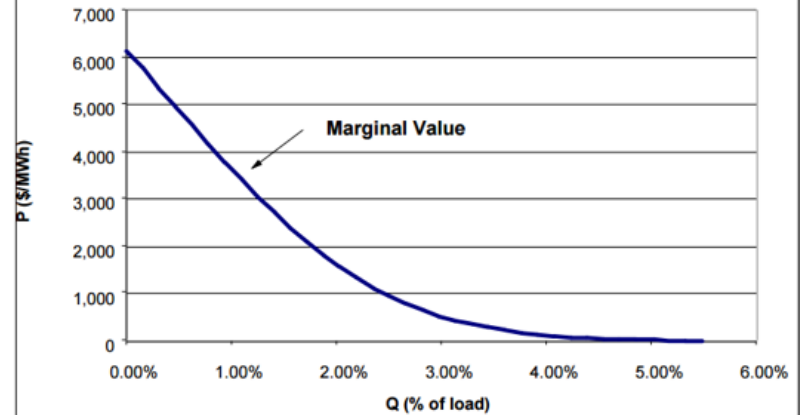
Teksas Piyasası (2015-2014), (Prof W. Hogan, Harvard,  
[https://www.hks.harvard.edu/fs/whogan/Hogan\\_IHS\\_110916.pdf](https://www.hks.harvard.edu/fs/whogan/Hogan_IHS_110916.pdf))

SCED ORDC On-Line Reserve and Price Adder

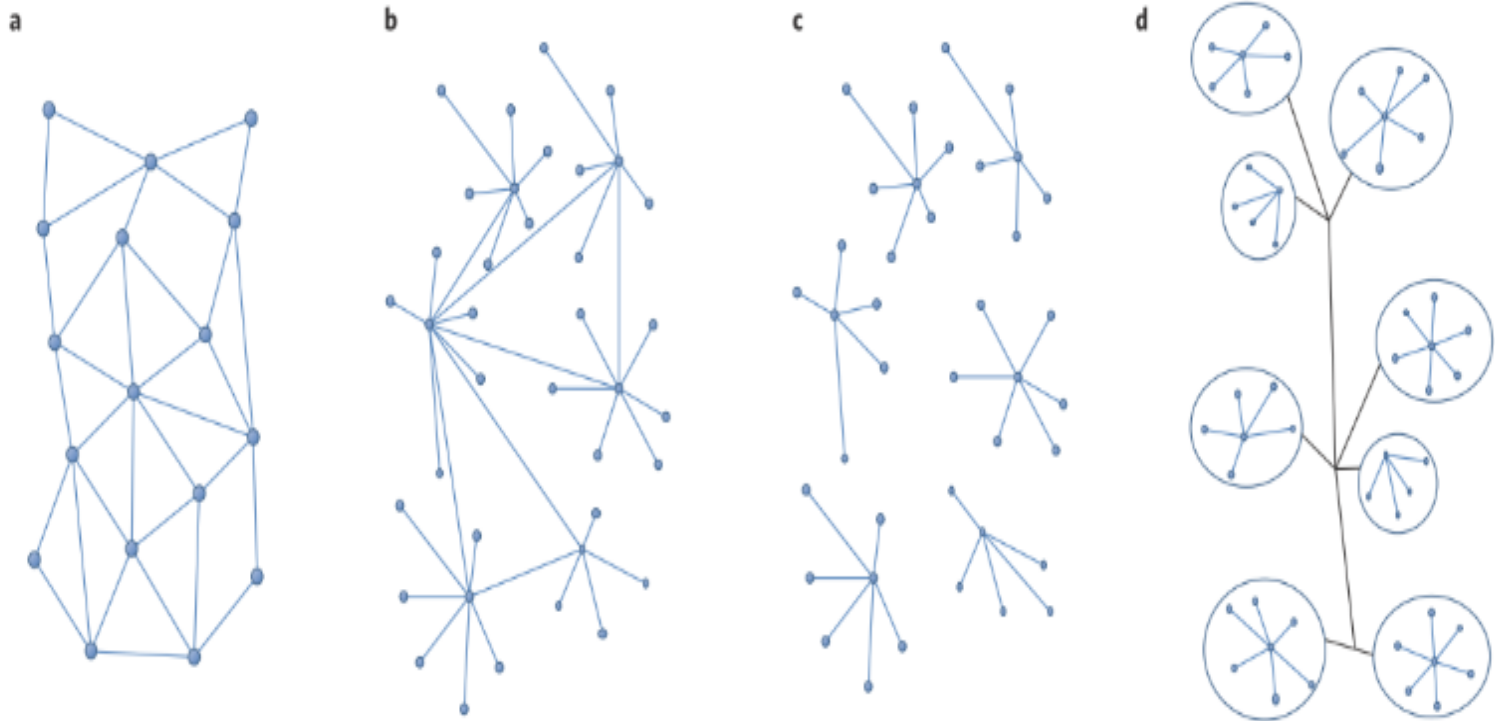


Surendran, Analysis of Reserves and Prices, July 2, 2015-August 23: Hour Ending 17:00, ERCOT TAC Presentation, /

Operating Reserve Demand

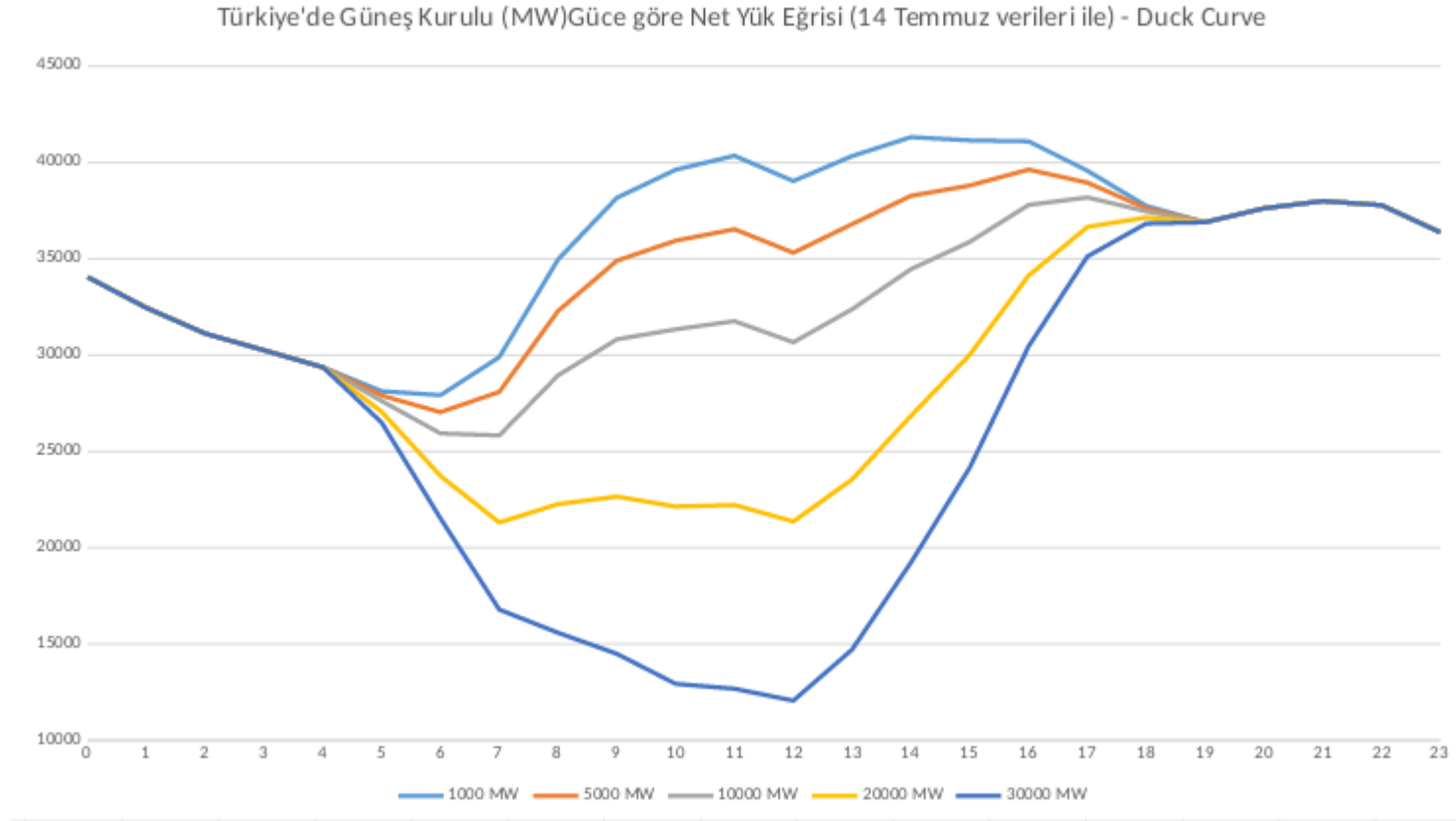


# Değişik Piyasa Yapıları

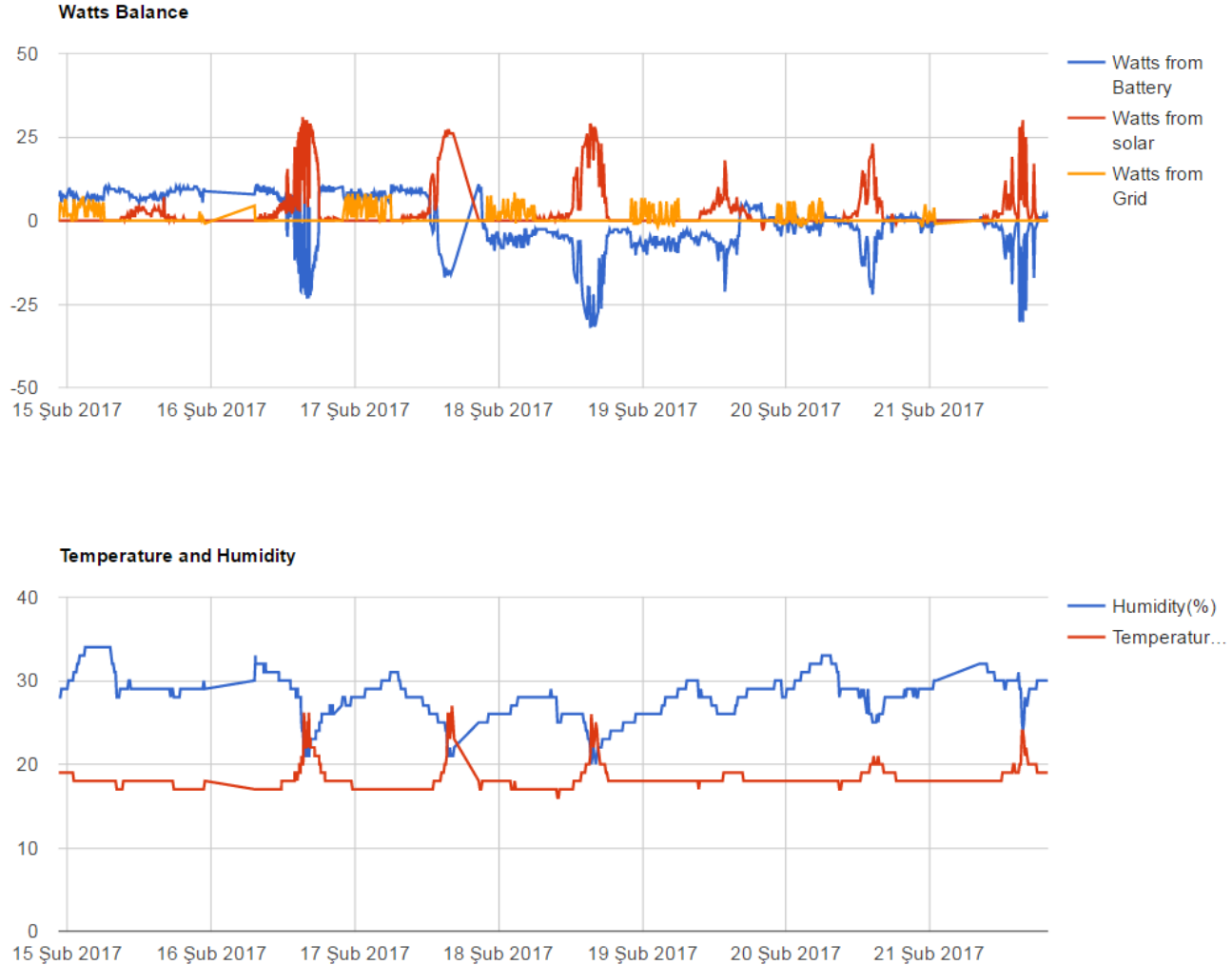


Electricity market design in the prosumer era, Nature Energy 1, Article number: 16032 (2016)

# Türkiye Güneş Gelişimi – Ördek Eğrisi



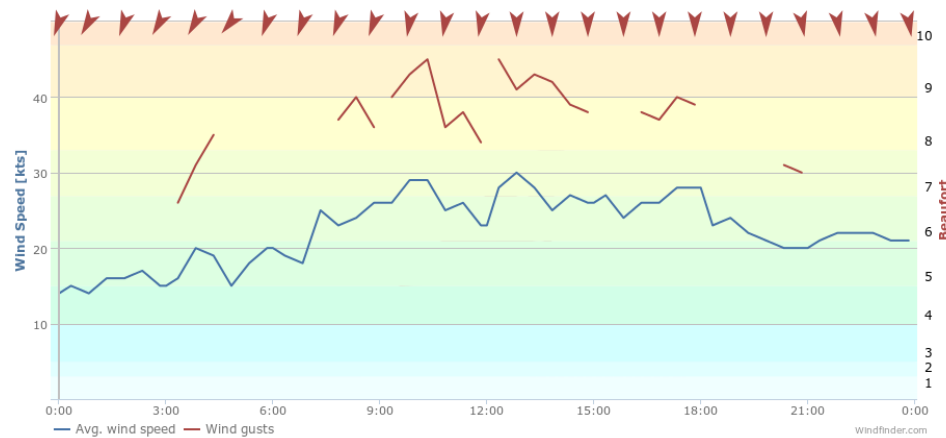
# Evde 40Wlık güneş sistemi ve akü



Bu seneki hava olaylarının farkı

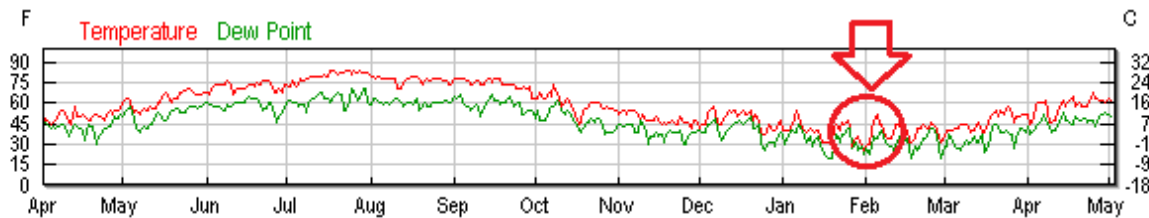
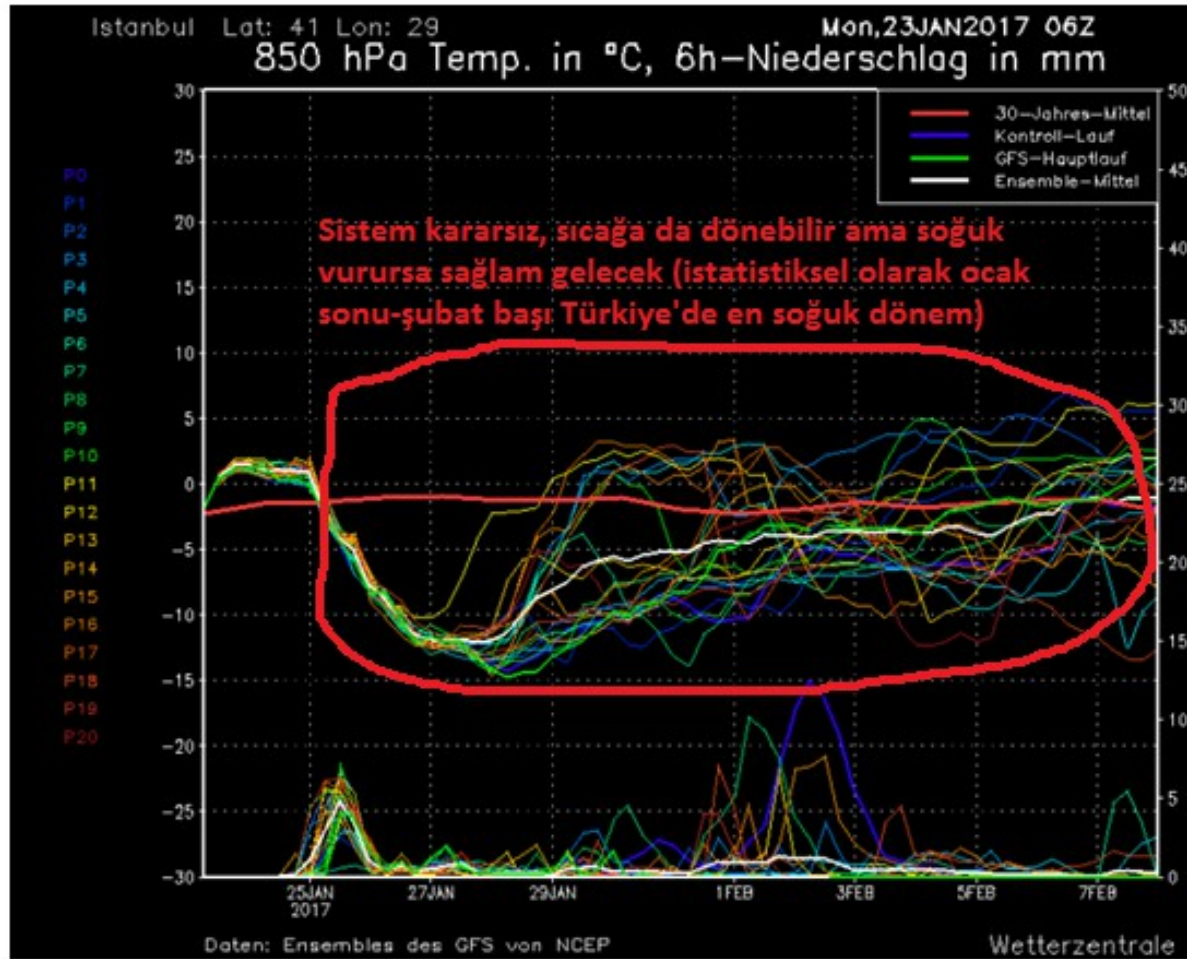
# 10 knot=18.52 km/h

Wind reports from Thursday, December 29, 2016



|            |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.12.2016 | 9  | 8  | 7  | 5  | 4  | 9  | 11 | 18 | ↘ | ↘ | ↘ | ↘ | ↘ | ↘ | ↘ | ↘ | ↘ | 6 | 5 | 5 | 5 | 6 | 5 | 5 | 5 |
| 29.12.2016 | 25 | 28 | 30 | 35 | 35 | 35 | 29 | 27 | ↙ | ↙ | ↙ | ↙ | ↙ | ↙ | ↙ | ↙ | ↙ | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 4 |
| 30.12.2016 | 25 | 24 | 22 | 26 | 28 | 29 | 4  | 9  | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↑ | 4 | 4 | 4 | 4 | 4 | 4 | 6 | 5 |
| 31.12.2016 | 18 | 17 | 15 | 10 | 11 | 12 | 5  | -  | ↑ | ↑ | ↑ | ↗ | ↗ | ↗ | ↗ | ↗ | ↗ | 4 | 4 | 2 | 3 | 3 | 3 | 4 | - |

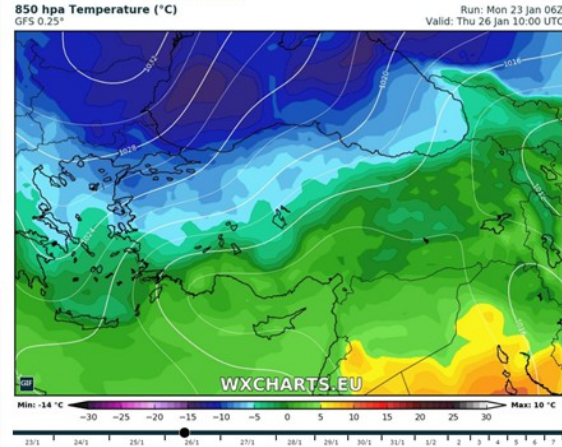
# Bir soğuk hava dalgası



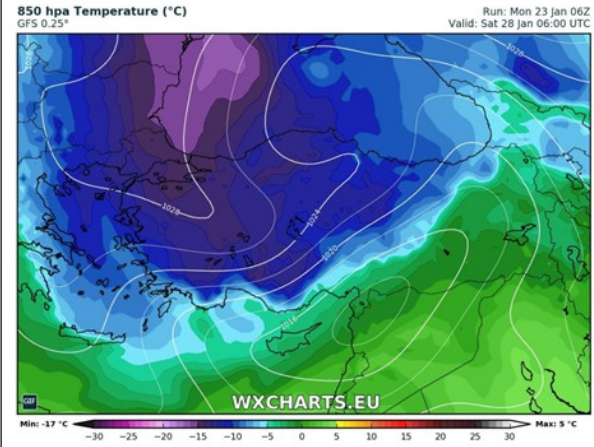


# Gün gün hareketi

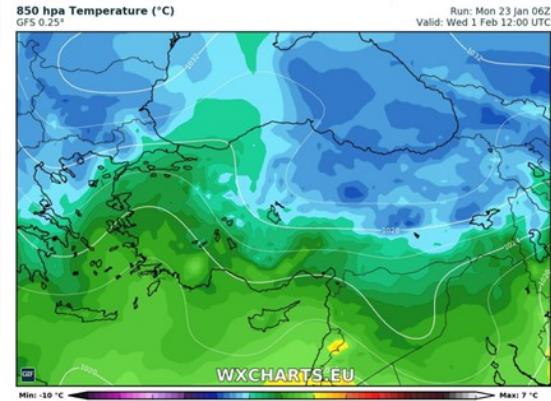
26 Ocak öğlen 13:00'te sistem geliyor (GFS)



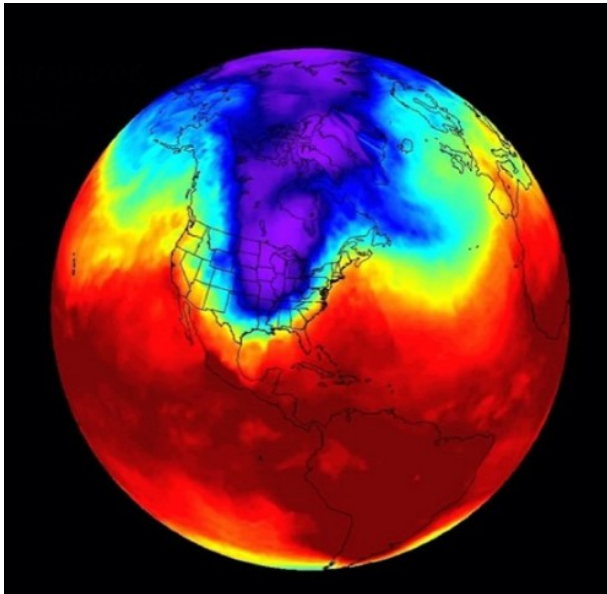
28 Ocak Cumartesi sabah 9 – sistem daha da ağırlaşıyor



1-2 Şubat'a kadar etkisini devam ettiriyor



# Polar Vortex



## What is the polar vortex?

- 1 The polar vortex is a large area of low pressure and cold air surrounding the poles.
- 2 It is bounded by the jet stream – a fast river of wind high in the atmosphere that divides cold air from warm air.

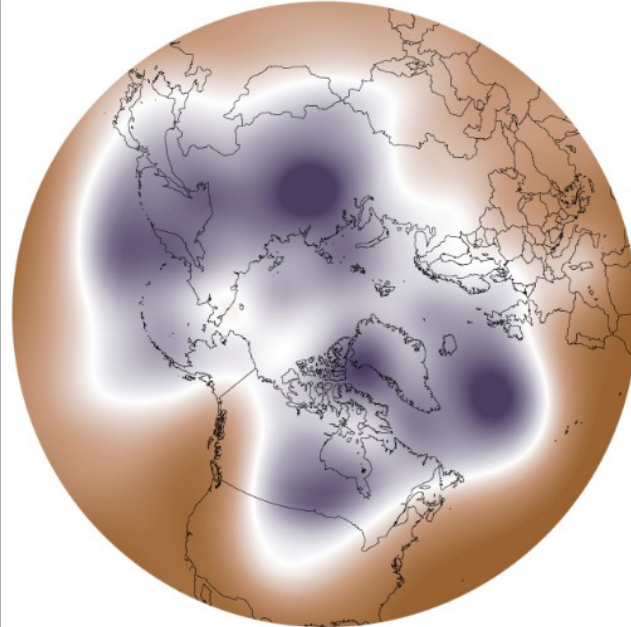
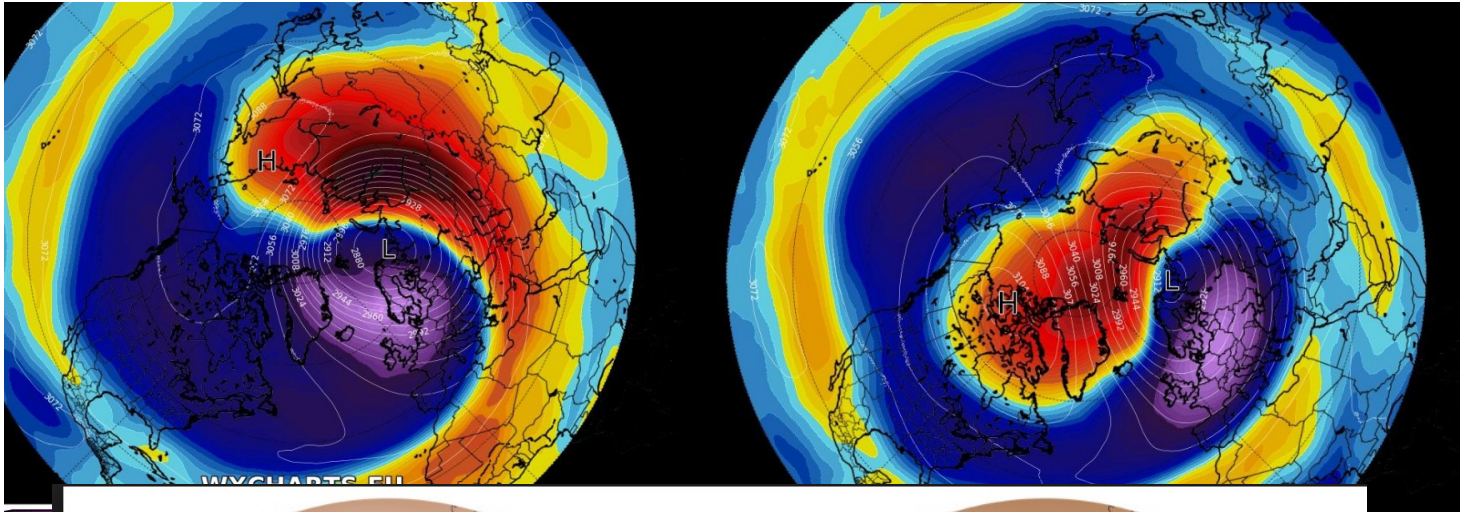


- 3 At times during the winter, a strong ridge of high pressure builds north and drives cold, Arctic air south.
- 4 If you hear 'polar vortex' in the forecast, it's nothing to fear – just be prepared for very cold weather.



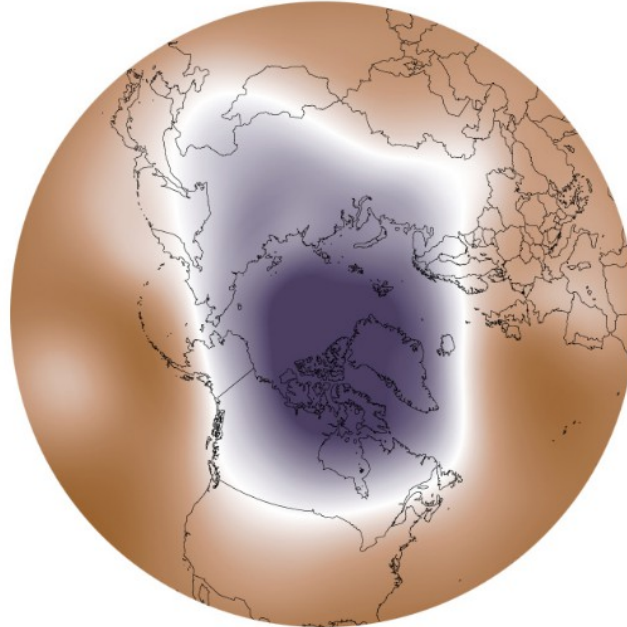


# Türkiye'ye etkisi



500-mb geopotential height (meters)  
5000 5900

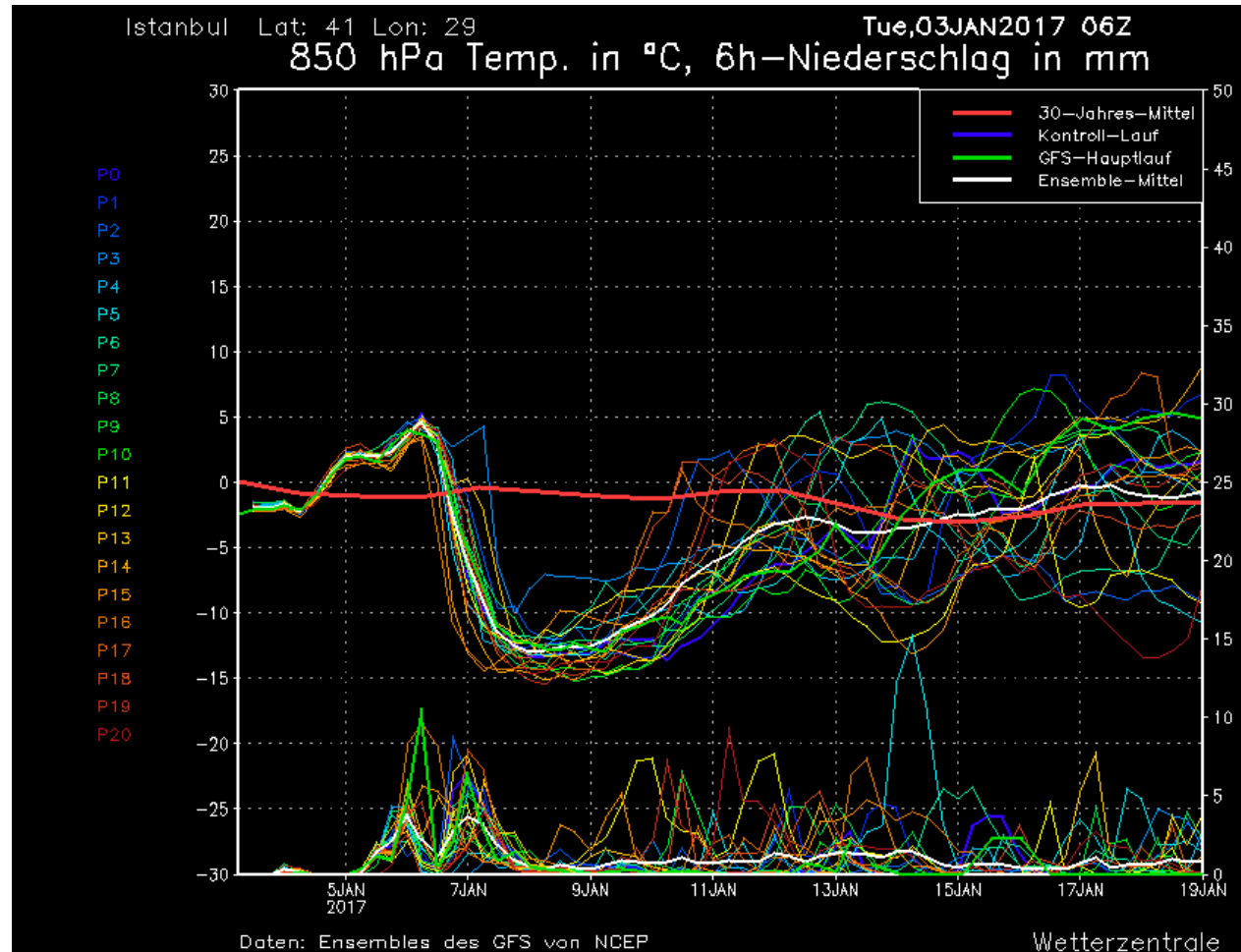
NOAA Climate.gov



500-mb geopotential height (meters)  
5000 5900

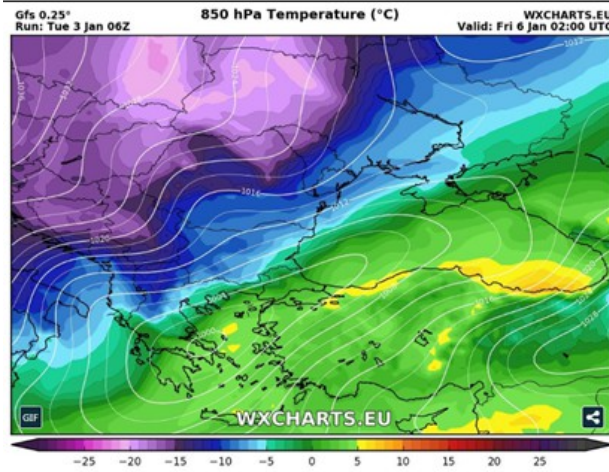
NOAA Climate.gov

# Godzilla

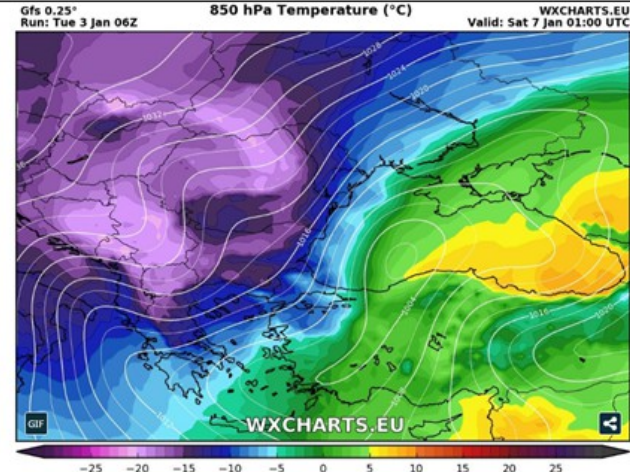




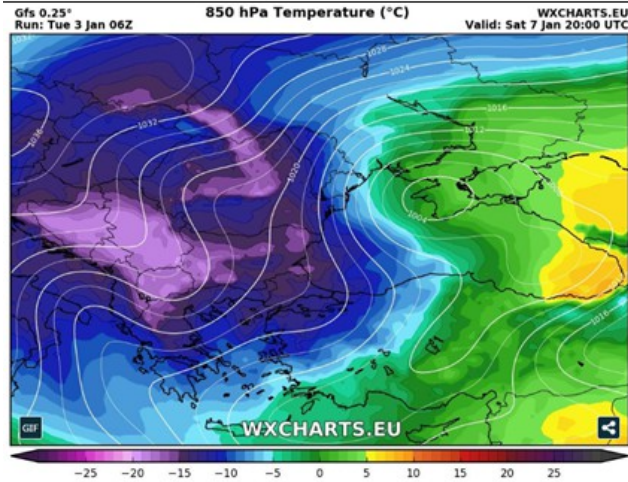
# Tahmin



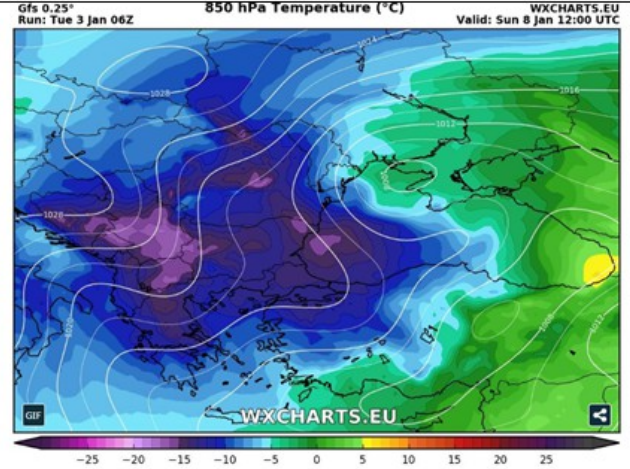
Cuma sabah 05:00 – Kapıkuleden giriş



Cuma'yi-Cumartesi'ye bağlayan gece yarısı

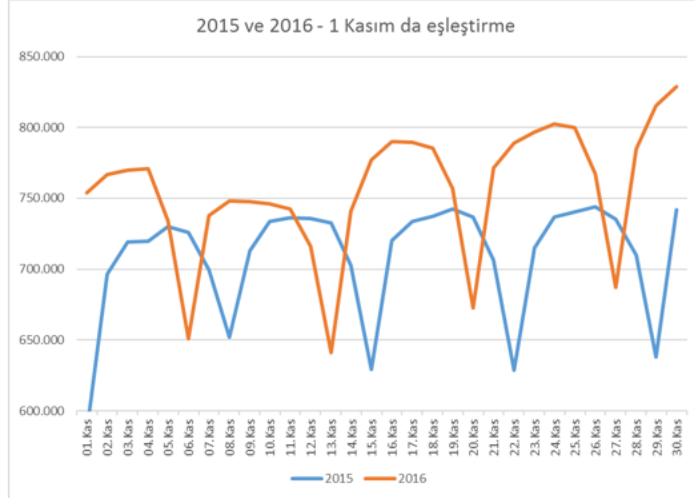


Cumartesi 23:00 (UTC+3:00)

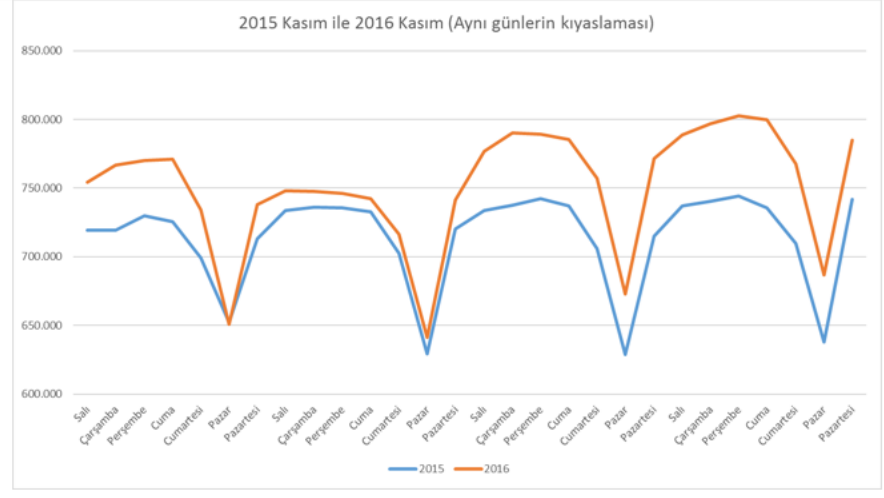


Pazar 15:00

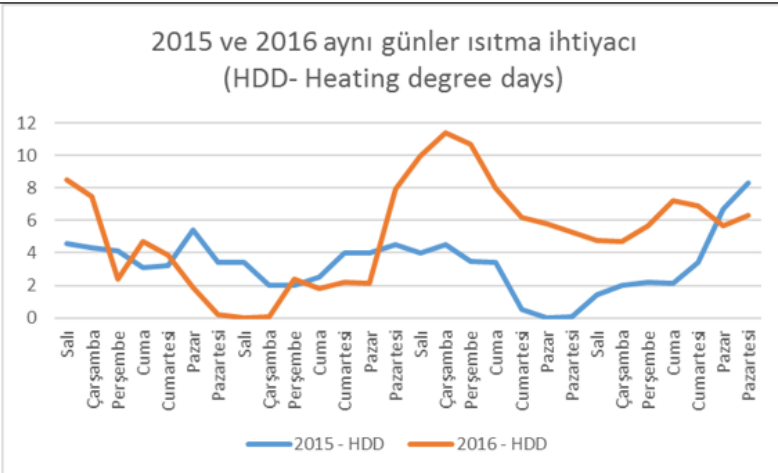
### 1 Kasım 2015 ve 1 Kasım 2016'yı grafiklersek



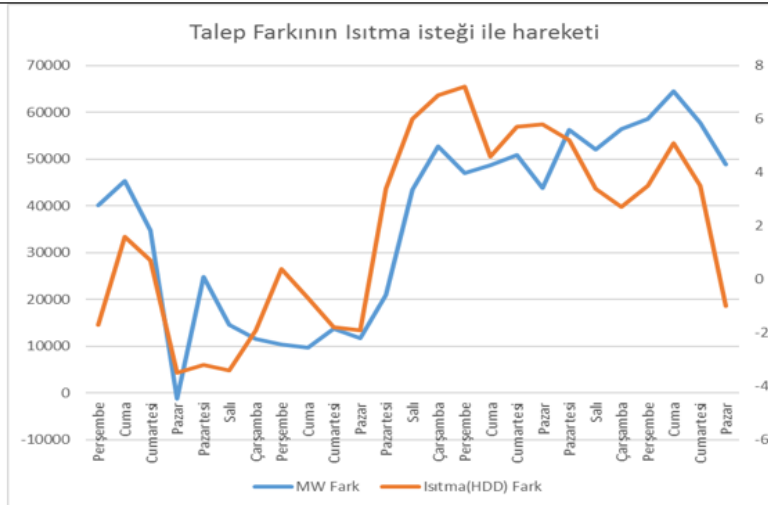
### 3 Kasım 2015 (Salı) ve 1 Kasım 2016 (Salı) grafiklenirse



### Kasım ayları arasındaki soğukluk farkı

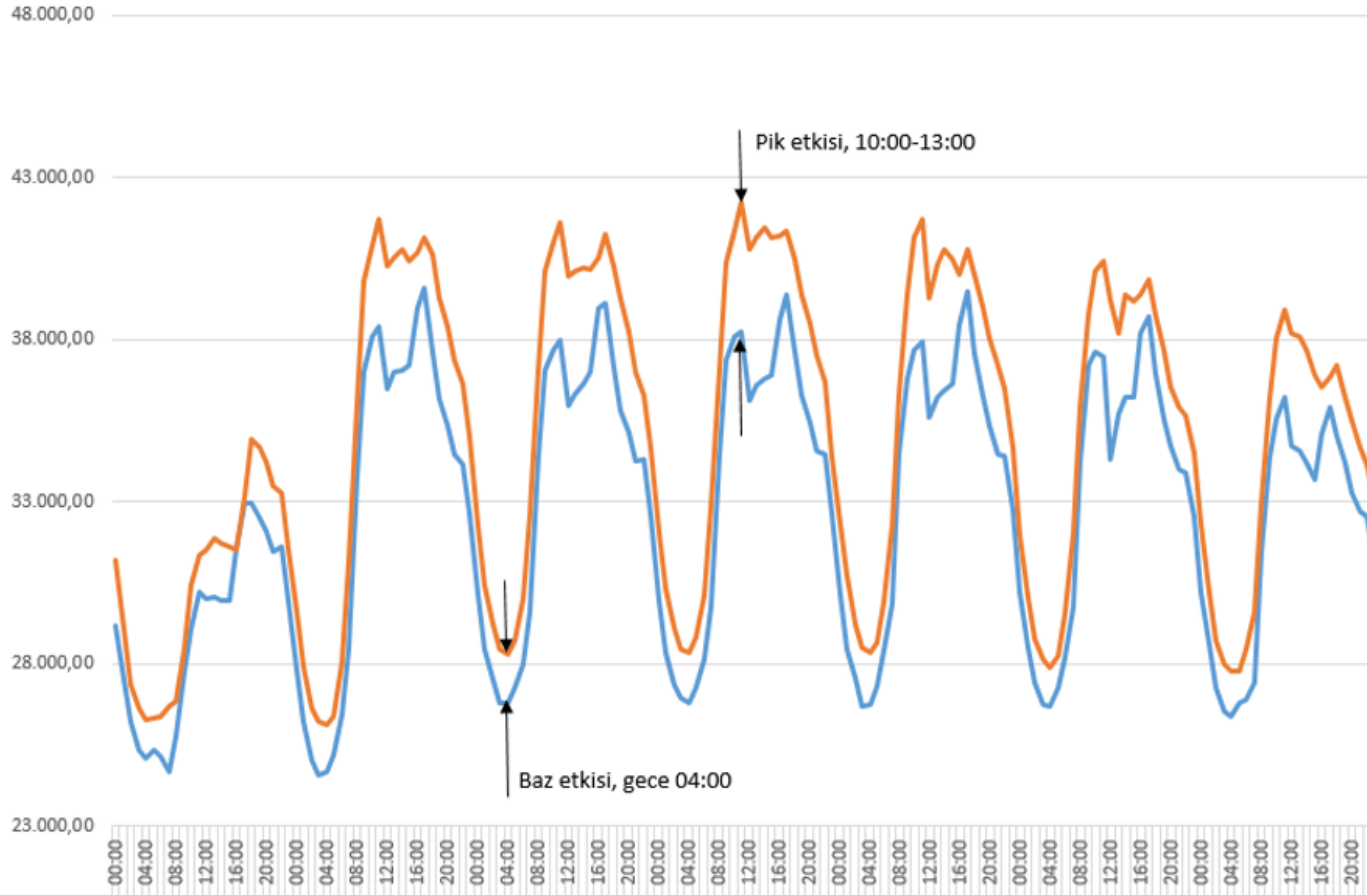


### 2015-2016 aynı günler için ısıtma talebi ve elektrik talep farkları



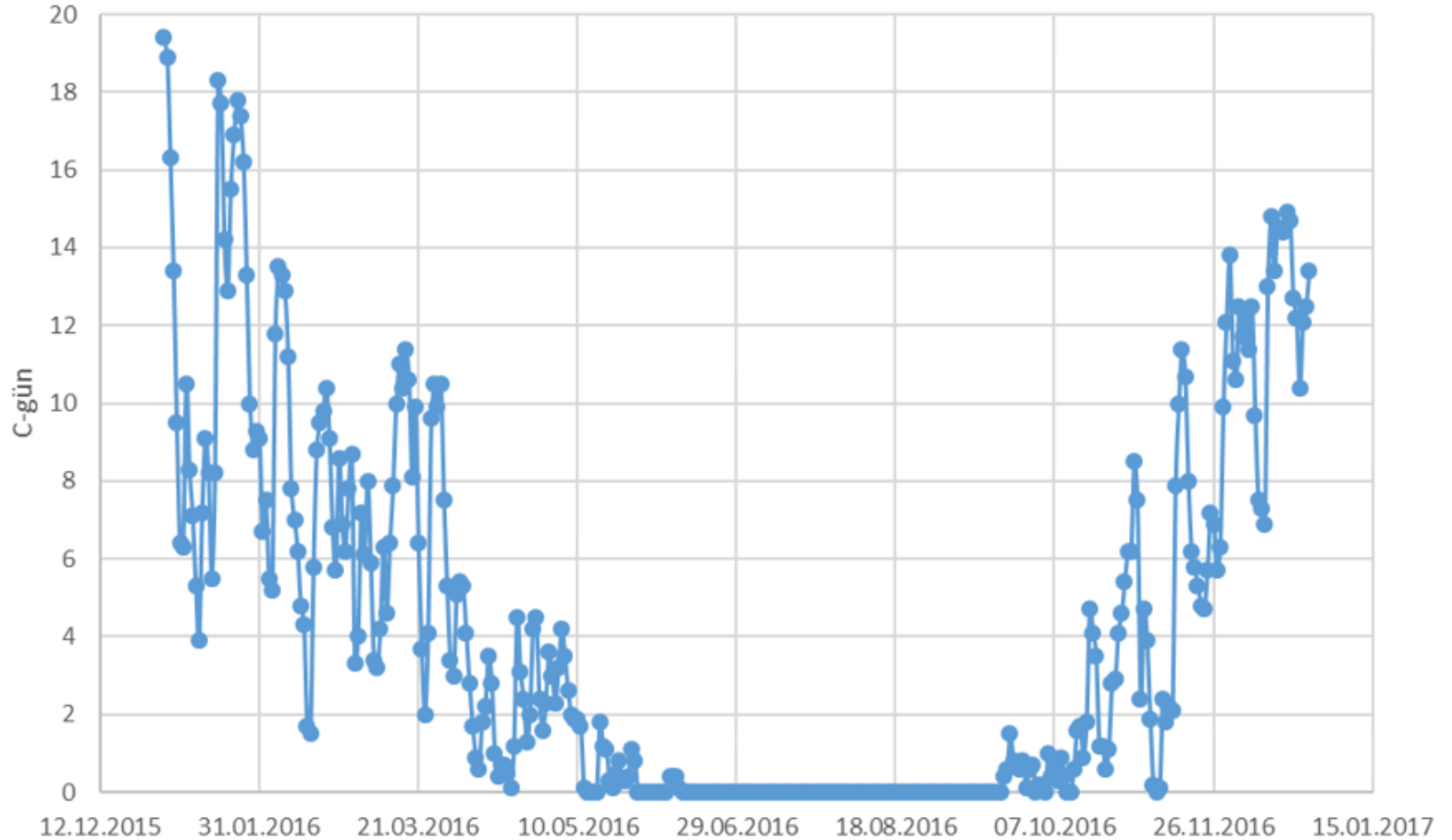
# Aralık kıyaslaması

2015 ve 2016 ARALIK aynı gün kıyaslamaları



# Doğalgaz talebi

18 C dış hava sıcaklığına göre ısıtma Gün Sayısı





# Ücretsiz Türkiye Enerji Modelleri

[www.barissanli.com](http://www.barissanli.com)

# Excel Modeller

- Talep
- Arz
- Kayıp Para
- Bölgesel simülasyon

<http://www.barissanli.com/pdf/etalep/>

### Internet Tabanlı Basit bir Talep Tahmin Programı

Bu programla, sadece deneysel olarak talep tahmini sonuçları elde edebilirsiniz.

#### Yıllık Elektrik Talep Artışını girerek Talep Tahmininde bulunma

Bu metod çok basit olarak, yıllara ait talep tahmin artışlarınızı girerek sonuçları görmenizi sağlar

#### Yearly Electricity Demand Predictions

#### Yıllık Ekonomik Büyüme ve Esnekliğini girerek Talep Tahmininde bulunma

Bu metod ile yıllık ekonomik büyüme ve bunun elektrik talep artışına oranı girilerek sonuç elde edilir

#### Economic Growth Predictions

#### Time Series Data

#### Zaman Serisi verileri :

Türkiye'nin geçmiş yıllara ait büyüme oranları, GSYİH, nüfus, elektrik tüketim verileri basitleştirilmiş ve toplanmış olarak görebilirsiniz

#### Ekonometrik veriler yardımı ile talep tahmini

Bu model de ekonometrik esneklikleri değiştirerek değişik sonuçlar elde edilir

#### INPUTS



ELASTICITY

<http://www.barissanli.com/calismalar/dersler/r/>

## R ile Enerji Verilerinin Analizi ve Modellenmesi

Barış Sanlı (barissanli2@gmail.com)  
www.barissanli.com

[Başlangıç](#)

[R Studio ve ilk kodlar](#)

[Elektrik Talep Analizi - \(Histogram\)](#)

[Elektrik Talep Analizi - \(Filtreleme\)](#)

[Elektrik Talep Analizi - \(Verinin Bileşenleri\)](#)

[Elektrik Talep Analizi - \(Programlamaya Giriş\)](#)

[Doğrusal Regresyon ile Elektrik Talebi](#)

[Üssel Düzgünleştirme ve STL ile Elektrik Talebi](#)

[Elektrik Talebinde Farklı](#)

[Periyodlar \(ARIMA ve TBATS\)](#)

[2015-2024 - Aylık Doğalgaz Talebi](#)

### Giriş

Bu derslerin amacı, ücretsiz bir istatistik programı olan R ile Enerji sektör verilerini kullanarak analiz yapmayı öğretmektir.

Tabii ki, burada gördükleriniz her türlü en doğru, en teorik açıdan geçerli analizler değildir. Bu öğreticiyi hazırlarken, Enerji ve Tabii Kaynaklar Bakanlığı'nın, bir istatistik dersi öğrencisine kolay, bazen yanlış gelebileceğini unutmayın.

Derslerde yazılım olarak R Studio kullanılmakta olup, veri setleri de ilgili sayfalarda verilmektedir.

Henüz bitiremediğim bu çalışmada kafamdaki yol haritası

- Başlangıç - R, Rstudio
- Elektrik talebi üzerinden R komutları ile analiz
- Elektrik talebinin bileşenlerinin görselleştirilmesi
- Model kurulumu
- Veri kaynaklarına erişim

Gibi konular bulunmaktadır.

Eğer yazılanları faydalı bulduysanız, referansları ile paylaşmanızda bir sorun yoktur. Yanlışlar konusunda ise mutlaka mail atın, en azından başkaları

Her şeyden önce bu sayfanın, kodların, resimlerin saatler süren bir emek işi olduğunu unutmayın. O yüzden her türlü hakkı saklıdır.

İyi çalışmalar

Barış Sanlı

24 Ağustos 2014

Ankara

[http://www.barissanli.com/pdf/bsanli\\_maed.xls](http://www.barissanli.com/pdf/bsanli_maed.xls)

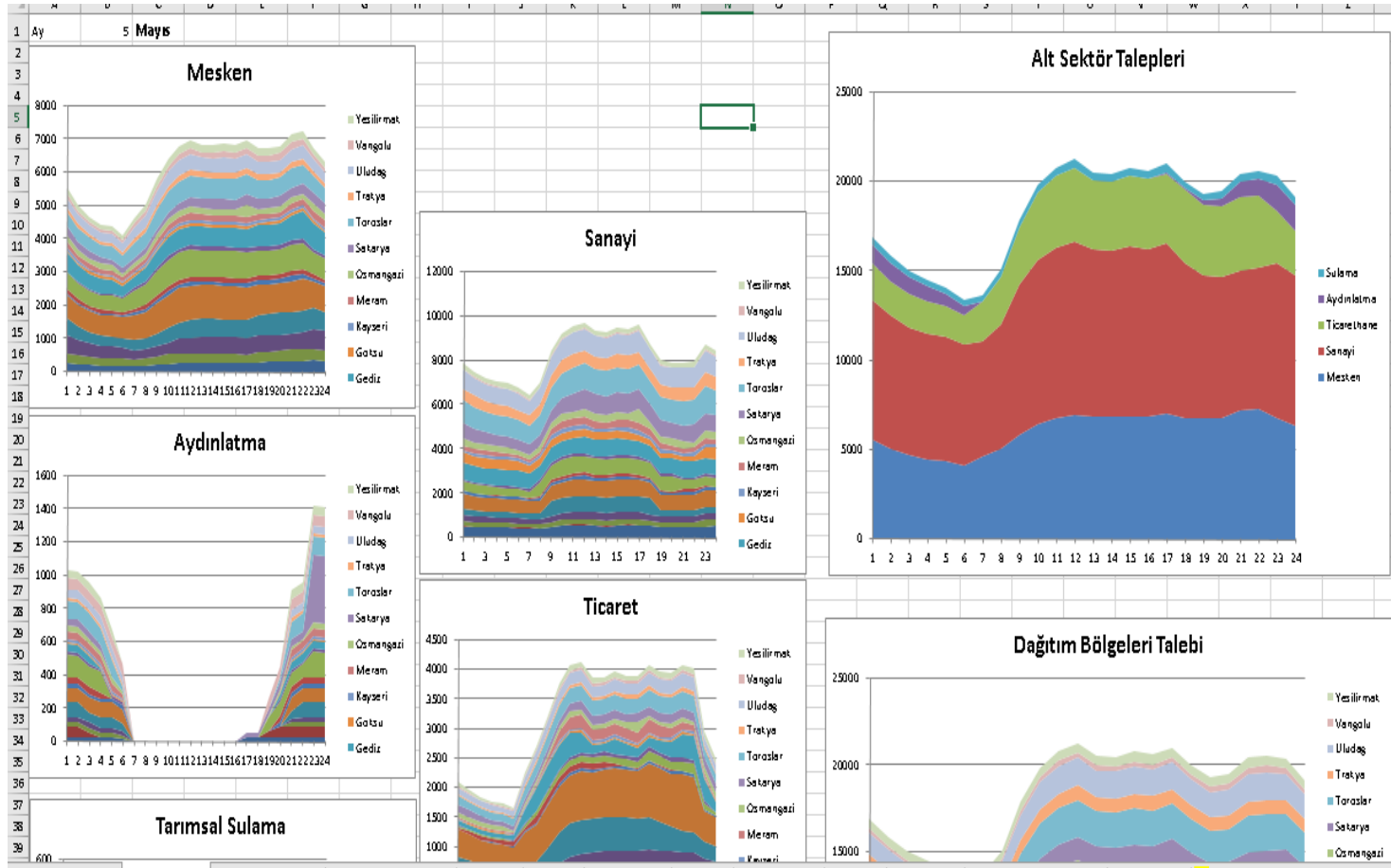
|    |                              | 2003                    | 2004      | 2005      | 2006   | 2007   | 2008   | 2009   | 2010   | 2011     | 2012     | 2013   | 2014   | 2015     | 2016   | 2017   | 2018   | 2019   | 2020   |
|----|------------------------------|-------------------------|-----------|-----------|--------|--------|--------|--------|--------|----------|----------|--------|--------|----------|--------|--------|--------|--------|--------|
| 8  |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 9  | Birim                        |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 10 | Girdiler (Inputs)            |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 11 | Ekonomik Girdi               |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 12 | gdp PPP                      | 2000 yılı milyar ABD \$ | 439.33    | 478.56767 | 501.54 | 527.12 | 550.84 | 561.85 | 522.52 | 539.7679 | 557.5803 | 575.98 | 594.99 | 614.6224 | 631.83 | 649.52 | 667.71 | 686.41 | 705.62 |
| 13 | gdp PPP %                    | %                       |           | 8.9%      | 4.8%   | 5.1%   | 4.5%   | 2.0%   | -7.0%  | 3.3%     | 3.3%     | 3.3%   | 3.3%   | 3.3%     | 2.8%   | 2.8%   | 2.8%   | 2.8%   | 2.3%   |
| 14 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 15 | Nüfus Girdisi                |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 16 | pop                          | milyon kişi             | 71        | 71.332    | 73.101 | 74.142 | 75.199 | 75.951 | 76.71  | 77.47743 | 78.25221 | 79.035 | 79.825 | 80.62333 | 81.43  | 82.244 | 83.066 | 83.929 | 84.801 |
| 17 | pop %                        | %                       |           | 0.9%      | 2.5%   | 1.4%   | 1.4%   | 1.0%   | 1.0%   | 1.0%     | 1.0%     | 1.0%   | 1.0%   | 1.0%     | 1.0%   | 1.0%   | 1.0%   | 1.0%   | 1.0%   |
| 18 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 19 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 20 | Sonuçlar (Outputs)           |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 21 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 22 | Elektrik Üretimi             | GWh                     | 141151    | 148767.13 | 165187 | 177939 | 191117 | 199514 | 196535 | 206810.5 | 217622.7 | 229000 | 240973 | 253570.8 | 266015 | 279071 | 292767 | 307496 | 322967 |
| 23 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 24 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 25 | Toplam Enerji Arz/Talebi     |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 26 | Nihai Enerji Tüketimi        | 1000 tep                | 66796     | 69869.988 | 75034  | 79155  | 83243  | 85724  | 83970  | 87068.52 | 90281.54 | 93613  | 97068  | 100649.7 | 104090 | 107648 | 111327 | 115215 | 119238 |
| 27 | Toplam Enerji Arzı           | 1000 tep                | 83824.566 | 87401.867 | 94421  | 99906  | 105393 | 108795 | 107014 | 11202.2  | 115554.8 | 120078 | 124778 | 129661.6 | 134395 | 139302 | 144388 | 149783 | 155379 |
| 28 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 29 | Genel Enerji / Alt Sektörler |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 30 | industry                     | 1000 tep                | 29582.6   | 30578.689 | 32574  | 34363  | 36094  | 37054  | 35503  | 36793.27 | 38130.91 | 39517  | 40954  | 42442.75 | 43827  | 45256  | 46731  | 48276  | 49872  |
| 31 | residential                  | 1000 tep                | 19634     | 20471.293 | 22114  | 23329  | 24555  | 25345  | 25229  | 26170.19 | 27146.27 | 28159  | 29209  | 30298.44 | 31369  | 32477  | 33624  | 34844  | 36108  |
| 32 | transport                    | 1000 tep                | 12395     | 13338.691 | 14634  | 15545  | 16484  | 17120  | 17290  | 18026.29 | 18794.1  | 19595  | 20429  | 21299.42 | 22174  | 23085  | 24032  | 25050  | 26110  |
| 33 | agriculture                  | 1000 tep                | 3086.4    | 3284.0155 | 3484.6 | 3639.5 | 3792.4 | 3886   | 3834.5 | 3943.564 | 4068.056 | 4190.1 | 4315.8 | 4445.289 | 4569.6 | 4697.4 | 4828.7 | 4966.9 | 5108.9 |
| 34 | nonenergy                    | 1000 tep                | 2098      | 2160.3751 | 2222.3 | 2274.1 | 2323.2 | 2350.6 | 2313.8 | 2349.894 | 2386.531 | 2423.7 | 2461.5 | 2499.908 | 2535.2 | 2571   | 2607.4 | 2644.8 | 2682.7 |
| 35 | transform                    | 1000 tep                | 17028.566 | 17483.503 | 19366  | 20732  | 22143  | 23089  | 23197  | 24311.22 | 25479.38 | 26704  | 27987  | 29331.59 | 30681  | 32092  | 33569  | 35159  | 36824  |
| 36 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 37 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 38 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 39 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 40 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 41 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 42 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 43 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 44 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |
| 45 |                              |                         |           |           |        |        |        |        |        |          |          |        |        |          |        |        |        |        |        |

Anıtlama

MAFEN RANLI | ADDRESS

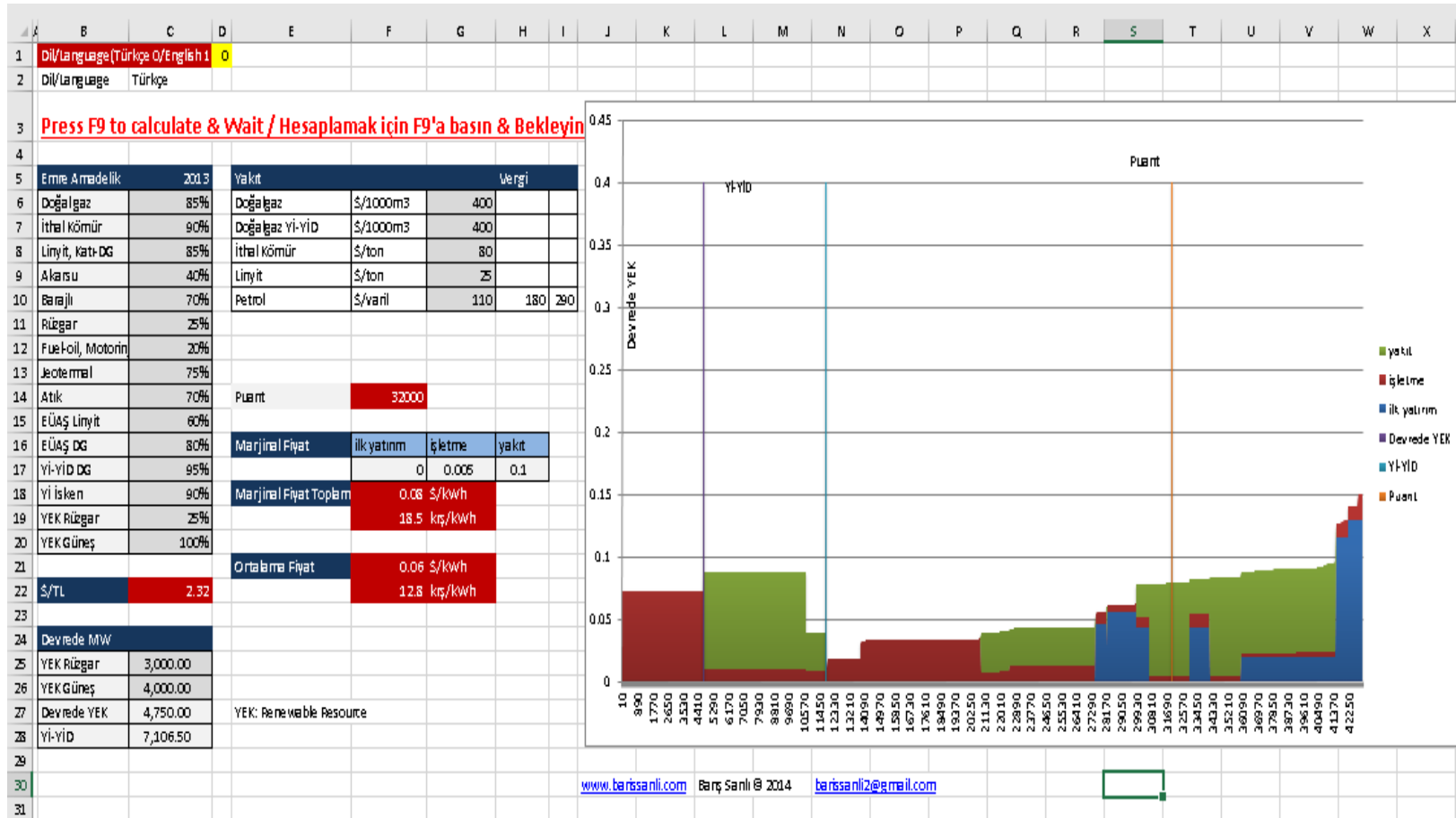
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<http://www.barissanli.com/calismalar/2011/2010i-baris-demandcurves.xlsx>

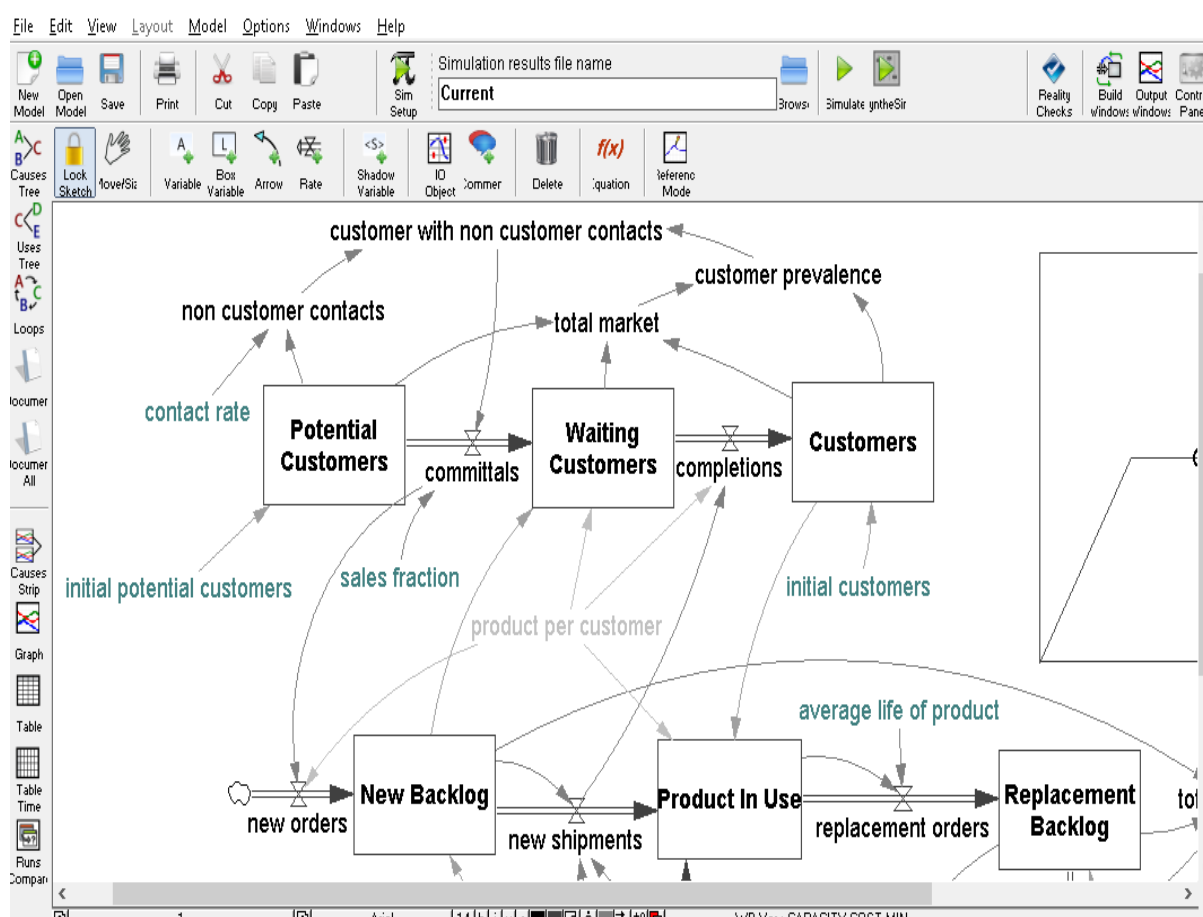


<http://www.barissanli.com/calismalar/2011/2010i-baris-demandcurves.xlsx>

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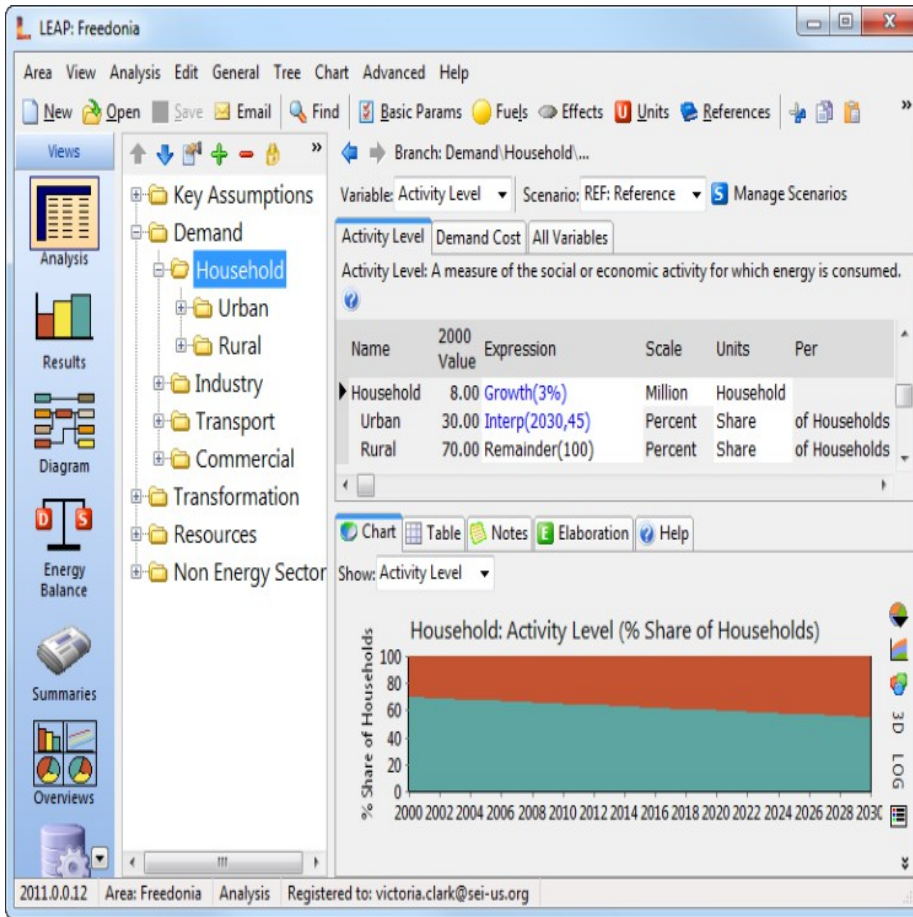


# Excel + Vensim





# LEAP



Türkçe Videolar:

<https://www.youtube.com/user/EnerjiModellemesi>

# GridLAB-D



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## Welcome

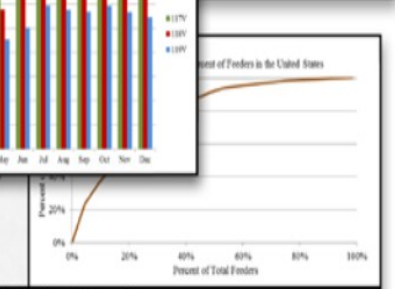
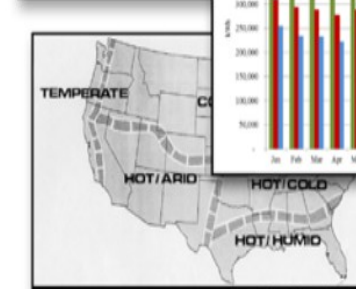
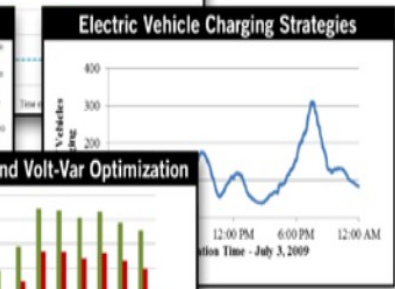
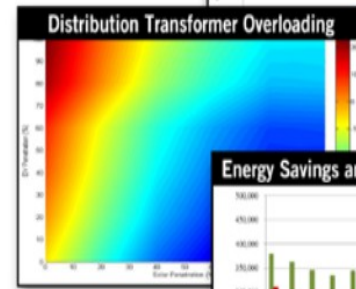
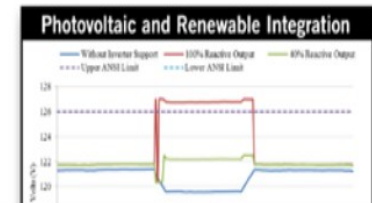
### The Next-Generation Simulation Software

GridLAB-D™ is a new power distribution system simulation and analysis tool that provides valuable information to users who design or operate distribution systems, and to utilities that wish to take advantage of the latest energy technologies. It incorporates the most advanced modeling techniques, with high-performance algorithms to deliver the best in end-use modeling. GridLAB-D™ is coupled with distribution automation models and software integration tools for users of many power system analysis tools.

GridLAB-D™ was developed by the U.S. Department of Energy (DOE) at Pacific Northwest National Laboratory (PNNL) under funding from the Office of Electricity in collaboration with industry and academia. Version 3.1 for Win32, Win64, and several 32 bit Linux/macOS implementations was released in December 2014. See [Downloads](#) to get the latest version.

### What is GridLAB-D™?

GridLAB-D™ is a flexible simulation environment that can be integrated with a variety of third-party data management and analysis tools. The core of GridLAB-D™ has an advanced algorithm that simultaneously coordinates the state of millions of independent devices, each of which is described by multiple differential equations. The advantages of this algorithm over traditional finite difference-based simulators 1) it handles unusual situations much more accurately; 2) it handles widely disparate time scales, ranging from sub-seconds to many years; and 3) it is very easy to integrate with new modules and third-party systems.



# R + RStudio



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## The R Project for Statistical Computing

### Getting Started

R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. To [download R](#), please choose your preferred CRAN mirror.

If you have questions about R like how to install it, please read our [answers to frequently asked questions](#).



### News

- **R version 3.3.1 (Bug in Your Hair)** is now available. This release includes a number of bug fixes and improvements.
- **R version 3.2.5 (Very, Very Scary)** is now available. This release includes a number of bug fixes and improvements.
- **Notice XQuartz users (Mac OS X)** - The new mechanism used by XQuartz. Avoid the old one.
- The **R Logo** is available for download.
- **USE R 2016** will take place at StatCon 2016.

## R ile Enerji Verilerinin Analizi ve Modellenmesi

Barış Sanlı (barissanli2@gmail.com)  
www.barissanli.com

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[R Studio ve ilk kodlar](#)

[Elektrik Talep Analizi - \(Histogram\)](#)

[Elektrik Talep Analizi - \(Filtreleme\)](#)

### Giriş

Bu derslerin amacı, ücretsiz bir istatistik programı olan R ile Enerji sektör verilerini kullanarak analiz yapmayı öğretmektir.

Tabii ki, burada gördükleriniz her türlü en doğru, en teorik açıdan geçerli analizler değildir. Bu öğretimi hazırlarken, Enerji ve Tabii Kaynakları Bakanlığı'nın hazırladığı, bir istatistik dersi öğretilmesi kolay, bazen yanlış gelebilir diye düşünüyorum.

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# Julia



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## JuliaCon 2016

June 21<sup>st</sup> - 25<sup>th</sup>

Massachusetts Institute of Technology, Cambridge,  
Massachusetts

[tickets on sale now](#) | [talks](#)

## Google Summer of Code

Julia gets 12 slots in the Google Summer of Code!

[projects](#) | [ideas list](#)

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Julia is a high-level, high-performance dynamic programming language for technical computing, with syntax that is familiar to users of other technical computing environments. It provides a sophisticated compiler, [distributed parallel execution](#), [numerical solvers](#), and an [extensible mathematical function library](#). Julia's [Data Structures Interface](#) is

# Open Energy Modelling Initiative

[Home](#)[Wiki](#)

## About

We are a grass root initiative of modellers from various universities and research institutes across Europe.

## Aim

Open models and open data will advance knowledge and lead to better energy policies. Open up energy models improves quality, transparency, and credibility, leading to better research and policy advice.

[View manifesto »](#)

## Activities

The openmod initiative is a network, an interest group, and a platform. We exchange ideas and source code, lobby for policy support for open projects, and actively share data, code and knowhow.

[View Projects »](#)

## Connect!

- Come to our next workshop: [28-29 April at KTH Stockholm](#)
- Join our [mailing list](#)
- Add/find open-data and open models on [the wiki](#)
- Write us an e-mail: [mail\[at\]openmod-initiative.org](mailto:mail[at]openmod-initiative.org)

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[http://wiki.openmod-initiative.org/wiki/Open\\_Models](http://wiki.openmod-initiative.org/wiki/Open_Models)

Teşekkürler  
Barış Sanlı  
[www.barissanli.com](http://www.barissanli.com)