



## **FGV ENERGIA**

# **WORKSHOP SOBRE MODELOS DE PROJEÇÃO DE DEMANDA DE ENERGIA ELÉTRICA**

## **Previsão de Carga para a Programa Mensal da Operação - PMO**

**DPL** – Diretoria de Planejamento

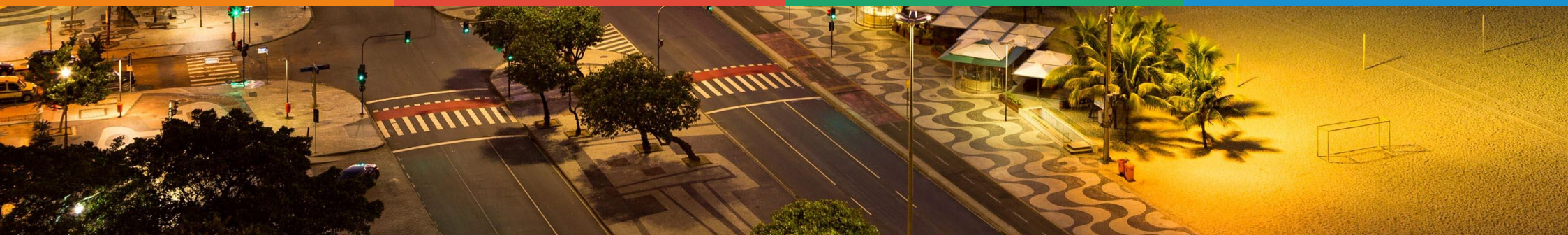
**PE** – Gerência Executiva de Planejamento Energético

**PEC** – Gerência de Previsão de Carga

**Maio/2018**



# O conceito de Carga Global



# GERAÇÃO DESPACHADA CENTRALIZADAMENTE P/ONS

Usinas Tipo: I, II-A, II-B e II-C

**CARGA GLOBAL**

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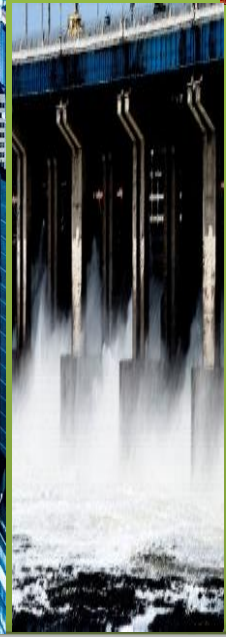
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EÓLICA

FOTOVOLTÁICA

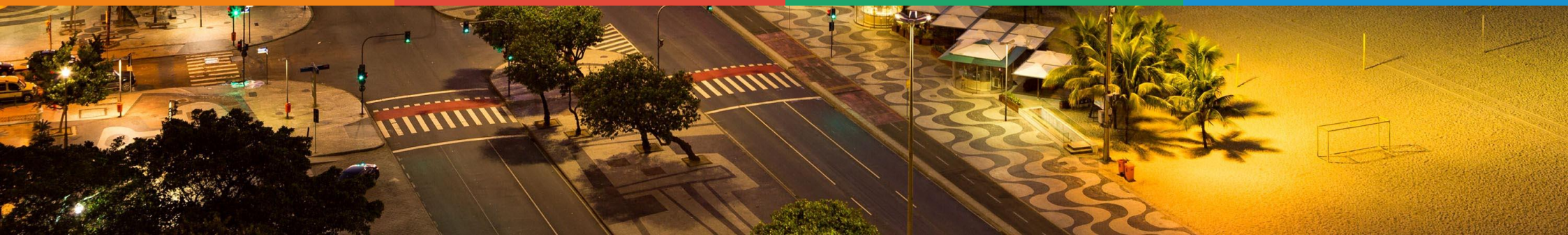
## GERAÇÃO NÃO DESPACHADA CENTRALIZADAMENTE P/ONS – CONECTADAS NA REDE DE DISTRIBUIÇÃO

Usinas Tipo II-B e III

**CARGA DE ENERGIA E DEMANDA PELA ÓTICA DA OFERTA**

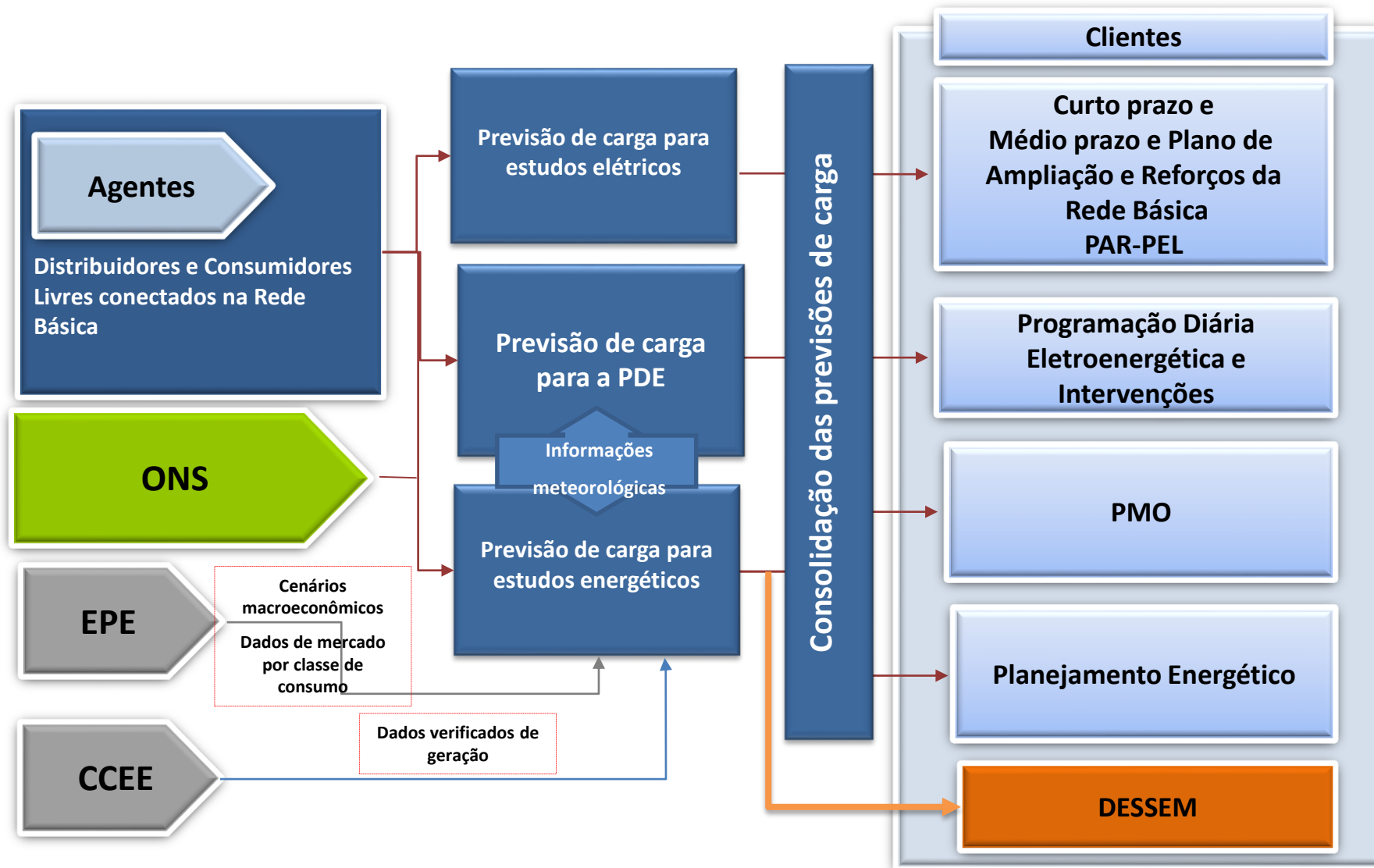


# O Processos de Consolidação da Previsão de Carga

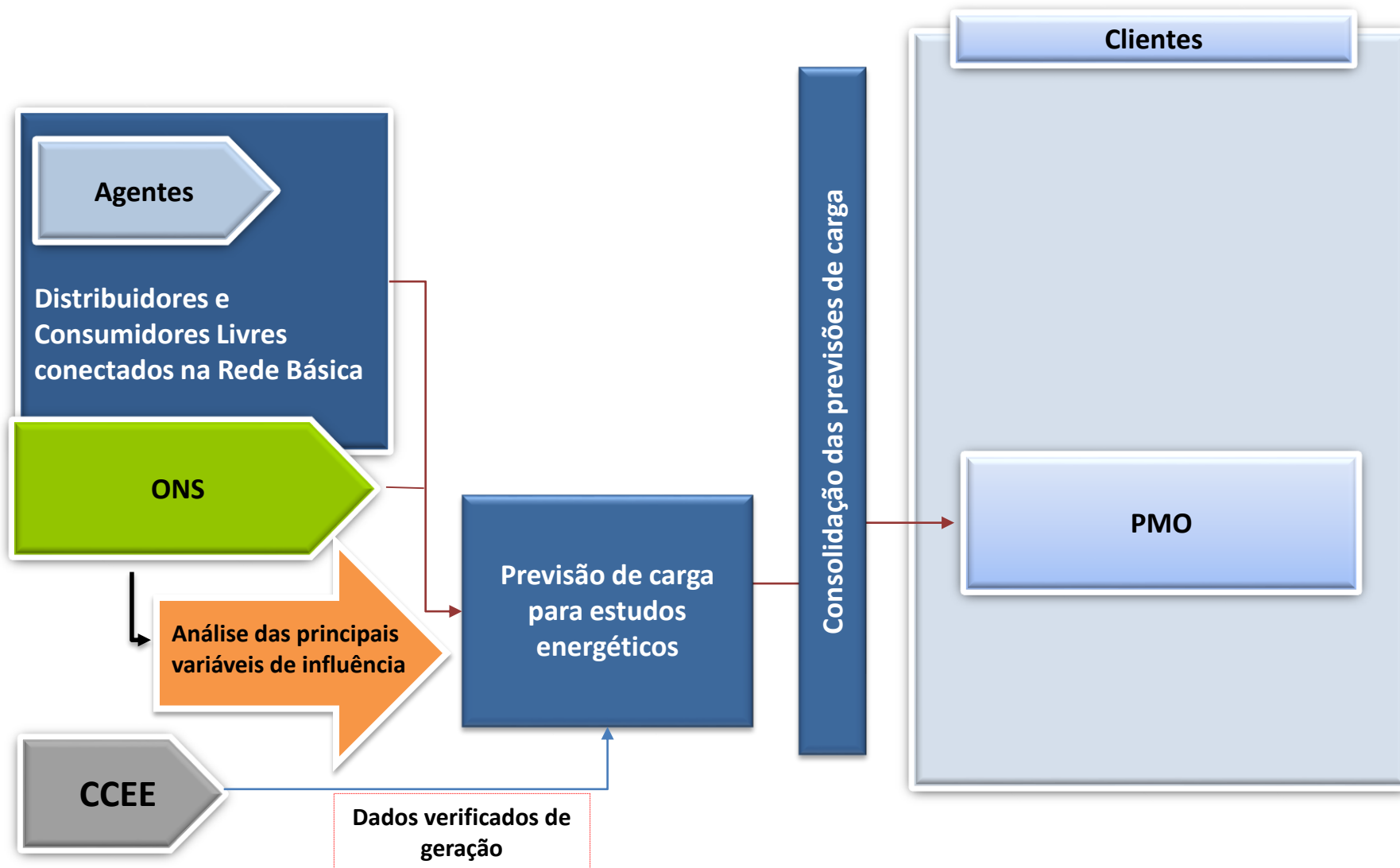


# Os processos de Consolidação da Previsão de Carga

Os processos de consolidação da previsão de carga geram os insumos para os estudos de planejamento e programação da operação eletroenergética e para os estudos de ampliações e reforços.



## O Processo de Previsão de Carga para o PMO



### Econômicos

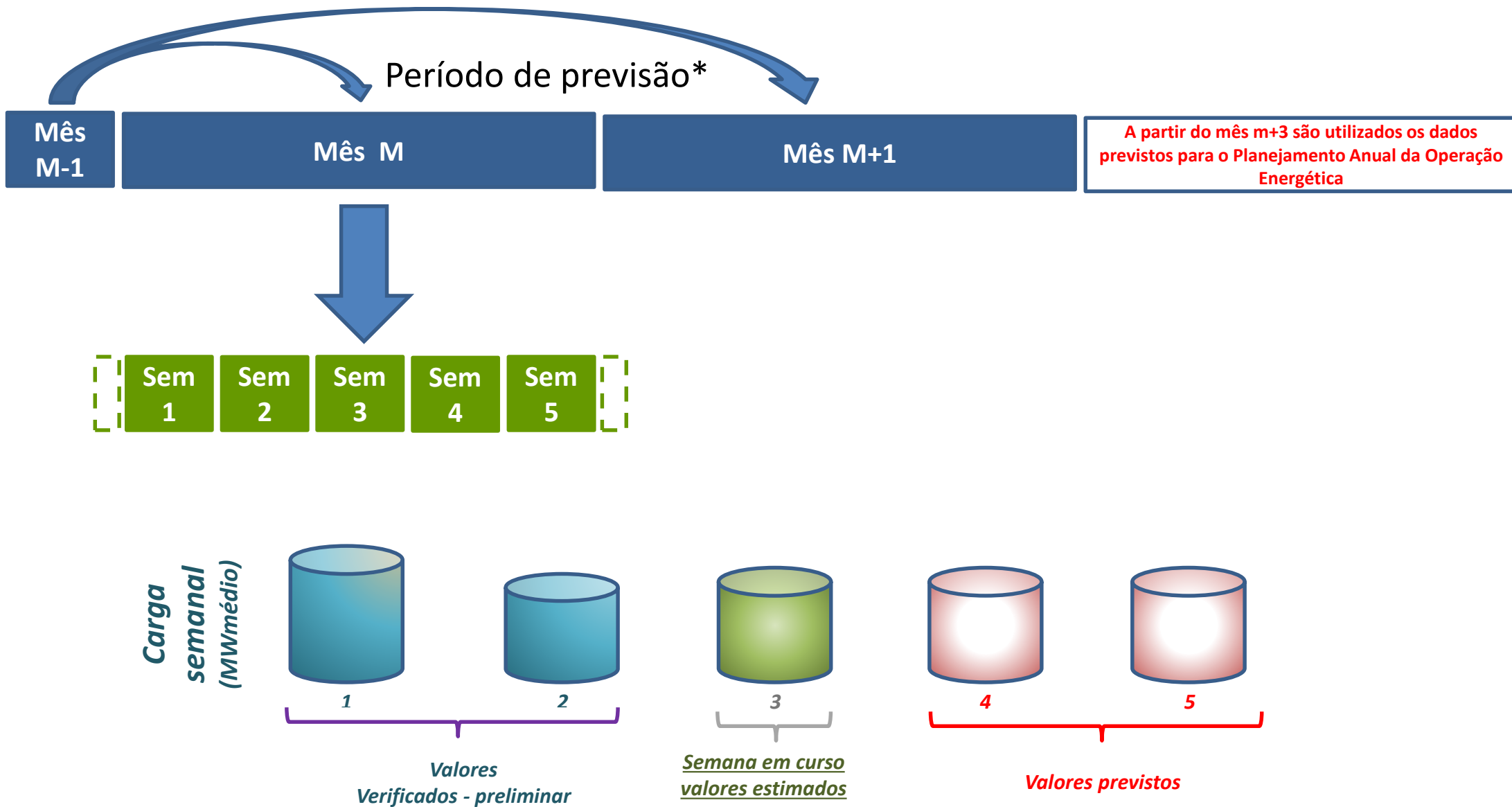
- Medidas Macroeconômicas de curto prazo
  - Políticas de incentivos a produção, nível de estoques, produção industrial, utilização da capacidade instalada.
- Conjuntura Internacional – efeito do comportamento dos principais mercados: preços de commodities
- Carga de grandes consumidores - Livres na RB e Livres na distribuição

### Comportamento do consumidor

- Posses e hábitos de consumo
- Temperatura/desconforto térmico e incidência de chuva
- Perdas – principalmente na distribuição
- Feriados e dias especiais

**Fatores sazonais com efeitos na Carga Global** – incentivo para a geração distribuída

# Cronograma da previsão de carga para o Programa Mensal da Operação Energética

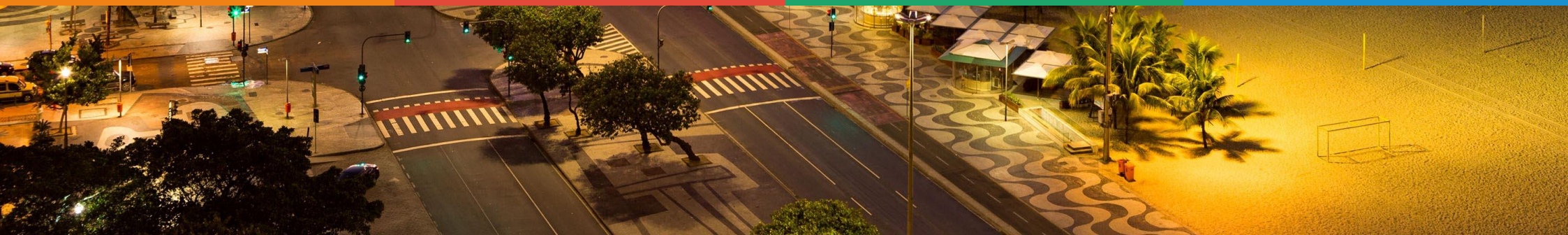


(\*) O período de previsão até 2 meses à frente. O primeiro mês é discretizado por semanas operativas (sábado/segunda-feira)



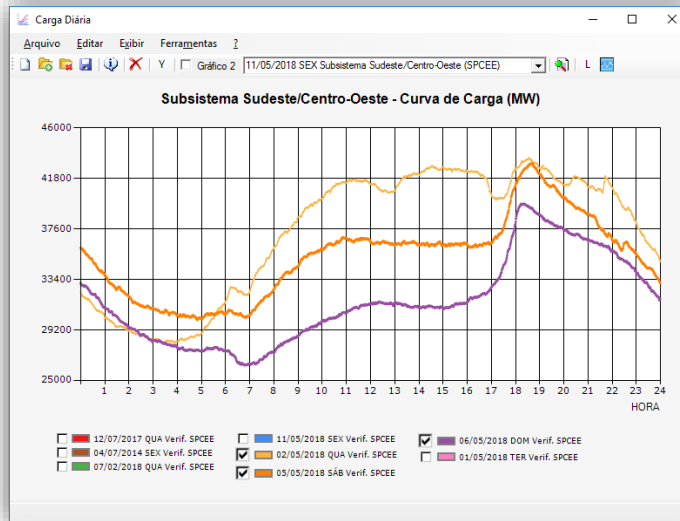


# Modelagem de Previsão de Carga de curto prazo

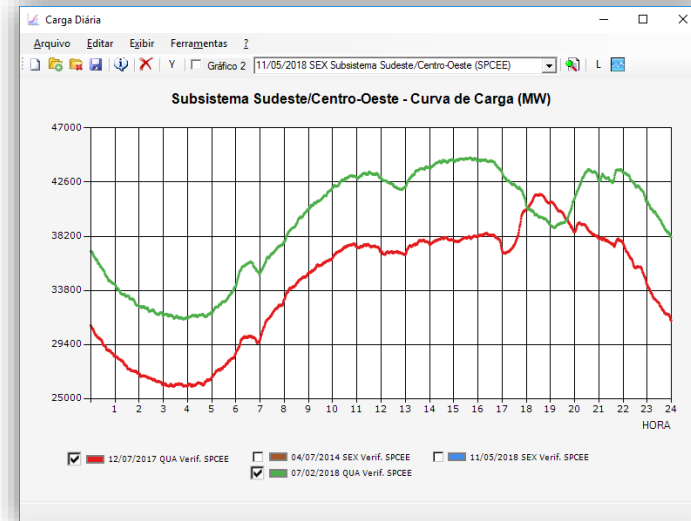


# Características da Carga Diária – Subsistema SE/CO

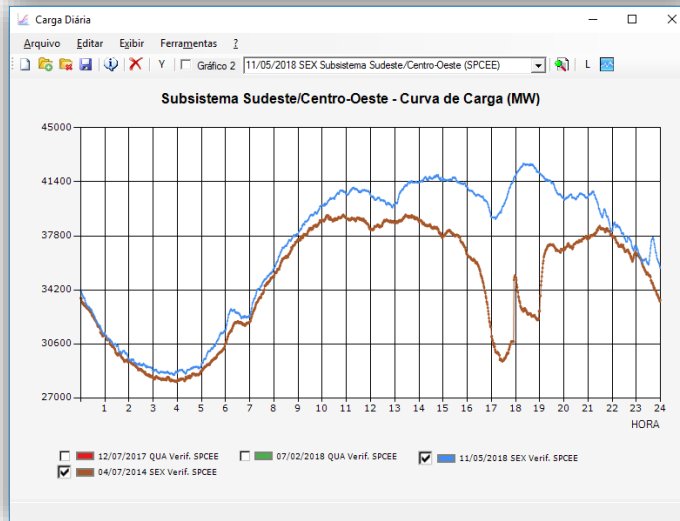
Dia da Semana →



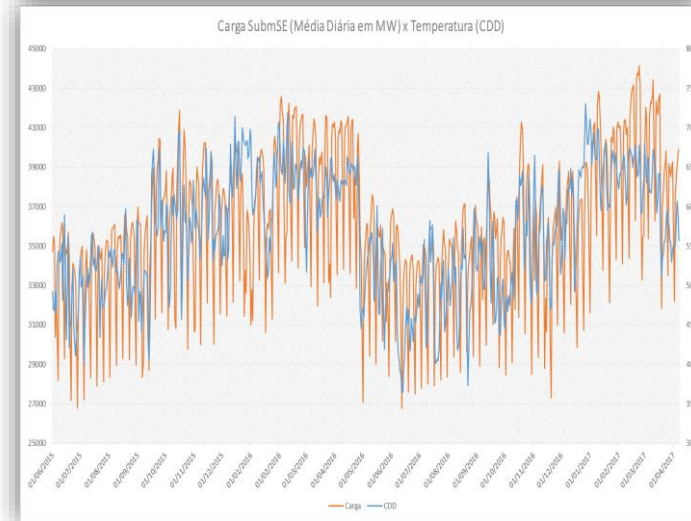
← Sazonalidade



Eventos Especiais →



← Ciclo Semanal



# Sistema SPCEE - Cadastros

The screenshot shows a web browser window with the URL <http://pop.ons.org.br/pop/#402>. The browser tabs include 'Home' and 'Início'. The page header features the ONS logo and the text 'Operador Nacional do Sistema Elétrico'. A green navigation bar contains 'Administração' and 'Favoritos' tabs, and the user name 'EVANDRO LUIZ MENDES' is displayed on the right. A dropdown menu is open under 'Administração', listing various options including 'SPCEE4', 'BPREG', 'SGPV', 'SPDO', 'SGIntegração', and 'SAMUG'. The 'SPCEE4' option is highlighted, and its sub-menu is visible, listing items such as 'Fonte de Dados', 'Origem', 'Grandeza', 'Séries', 'Tipo de Grupo de Série', 'Tipo de Região de Estudo', 'Classificação', 'Periodicidade', 'Agente SPCEE', 'Região de Estudo', 'Associação de Séries', 'Coletor SPCEE', 'Grupo de Séries', 'Associação de Séries a Dias Especiais ou Feriados', 'Parâmetros', 'Agendamento', 'Dia Especial', 'Editar Séries Manualmente', 'Consultar Logs', 'Séries do SPCA', and 'Séries do SCPCB'. The main content area displays the message 'Nenhum dado em exibidos neste momento.'

# Sistema SPCEE - Agendamento

The screenshot displays the SPCEE Scheduling System interface. At the top, there is a navigation bar with the ONS logo and the text "Operador Nacional do Sistema Elétrico". The main header shows "SPCEE4 > Agendamento" and the user name "EVANDRO LUIZ MENDES".

The main content area is titled "Consultar Agendamento". It features a search form with a "Nome:" input field and a "Tipo:" dropdown menu. Below the search form are two buttons: "Pesquisar" and "Todos".

The "Resultados" section contains a table with the following columns: "Agendamento", "Tipo", "Data/Hora", and "Job". The table lists several scheduled tasks, including "Sagic Subsistemas 29/03/2018", "ANNSTLF NE", "Carga Verificada", "SC DIS", "ANNSTLF Subsistemas DOM", "ANNSTLF Subsistemas SAB", and "Prévia dos Subsistemas 12:29".

At the bottom of the table, there is a pagination bar showing "Mostrando 1 a 25 de 40 itens" and navigation buttons: "Primeira", "Anterior", "1", "2", "Próxima", and "Última".

Below the table, there are three buttons: "Desassociar Job", "Excluir", and "Cadastrar".

	Agendamento	Tipo	Data/Hora	Job
<input type="checkbox"/>	Sagic Subsistemas 29/03/2018	Programado	03/05/2018 10:03:00	●
<input type="checkbox"/>	ANNSTLF NE	Programado	24/04/2018 11:31:00	●
<input type="checkbox"/>	Carga Verificada	Programado	12/03/2018 08:26:00	●
<input type="checkbox"/>	SC DIS	Programado	07/03/2018 11:14:00	●
<input type="checkbox"/>	ANNSTLF Subsistemas DOM	Recorrente	seg 10:02:00	●
<input type="checkbox"/>	ANNSTLF Subsistemas SAB	Recorrente	seg 10:01:00	●
<input type="checkbox"/>	Prévia dos Subsistemas 12:29	Recorrente	seg 12:29:00 ter 12:29:00 qua 12:29:00	●

# Base de Dados - SPCEE

The screenshot displays the Microsoft SQL Server Management Studio interface. The main window shows a query executed in the SPCEE\_OPER\_PROD database. The query is a SELECT TOP 1000 statement from the tb\_seriehistorica table. The results grid shows 226 rows of data with columns including id\_seriehistorica, id\_regiaoestudoserie, id\_periodicidade, id\_tpeehistorica, id\_tprandezaseriehist, id\_origemseriehist, sgl\_seriehistorica, nom\_seriehistorica, and sts\_seriehistorica. The Properties window on the right shows connection details for PRD-SQL-09 (ONS\evandro).

```

/***** Script for SelectTopNRows command from SSMS *****/
SELECT TOP 1000 [id_seriehistorica]
, [id_regiaoestudoserie]
, [id_periodicidade]
, [id_tpeehistorica]
, [id_tprandezaseriehist]
, [id_origemseriehist]
, [sgl_seriehistorica]
, [nom_seriehistorica]
, [sts_seriehistorica]
, [dsc_seriehistorica]
, [flg_seriecalculada]
, [val_liminferiorseriehist]
, [val_limsuperiorseriehist]
FROM [SPCEE_OPER_PROD].[dbo].[tb_seriehistorica]
    
```

id_seriehistorica	id_regiaoestudoserie	id_periodicidade	id_tpeehistorica	id_tprandezaseriehist	id_origemseriehist	sgl_seriehistorica	nom_seriehistorica	sts_seriehistorica	ds
1	1	195	1	2	2	1	SME_SE_CA_PROPRIA_MW	Subsistema Sudeste/Centro-Oeste	1
2	2	195	1	2	2	1	SME_S_CA_PROPRIA_MW	Subsistema Sul	1
3	3	195	1	2	2	1	SME_NE_CA_PROPRIA_MW	Subsistema Nordeste	1
4	4	195	1	2	2	1	SME_N_CA_PROPRIA_MW	Subsistema Norte	1
5	7	195	1	2	2	1	ACO_SE_CA_TOT_MW	Área Sudeste (exclui CO)	1
6	8	195	1	2	2	1	ACO_S_CA_MW	Área Sul (inclui MS)	1
7	9	195	1	2	2	1	ACO_NE_CA_TOT_MW	Área Nordeste	1
8	10	195	1	2	2	1	ACO_N_CA_TOTAL_MW	Área Norte/Centro-Oeste(Exclui MS)	1
9	11	195	1	2	2	1	SIS_BR_CA_PROPRIA_MW	SIN	1
10	13	195	1	2	2	1	UFE_MS_CA_MW	Mato Grosso do Sul	1
11	15	195	1	2	2	1	CIA_RGE_CA_MW	RGE	1
12	18	195	1	2	2	1	UFE_ES_CA_TOT_MW	Espirito Santo	1
13	19	195	1	5	2	8	CVC-SP	São Paulo (CVC)	1
14	20	195	1	2	2	1	UFE_SP_CA_TOT_MW	São Paulo	1
15	25	195	1	2	2	1	UFE_SC_CA_MW	Santa Catarina	1
16	37	195	1	2	2	1	UFE_MG_CA_TOT_MW	Minas Gerais	1
17	39	195	1	2	2	1	UFE_RJ_CA_TOT_MW	Rio de Janeiro	1
18	40	195	1	2	2	1	ARE_SCT_CA_TOT_MW	NE Área Centro	1

# Base de Dados - SPCEE

The screenshot displays the Microsoft SQL Server Management Studio interface. The main window shows a T-SQL script for a stored procedure named [CapturaDadosR]. The script includes comments in Portuguese and SQL code for altering the procedure, declaring variables, and performing data capture operations. The Object Explorer on the left shows the database structure for PRD-SQL-09. The Properties window on the right shows connection details for the current connection.

```
USE [SPCEE_SubmSE]
GO
/***** Object: StoredProcedure [dbo].[CapturaDadosR]    Script Date: 14/05/2018 16:15:40 *****/
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
-----
-- Author:      <Author,,Name>
-- Create date: <Create Date,,>
-- Description: <Description,,>
-----
ALTER PROCEDURE [dbo].[CapturaDadosR]
-- Add the parameters for the stored procedure here
    @Cont int, @SerieCarga int, @SerieTempVer1 int, @SerieTempPre1 int, @SerieTempVer2 int, @SerieTempPre2 int, @Parc1 Real , @Parc2 Real, @pdias int
AS
BEGIN
    -- SET NOCOUNT ON added to prevent extra result sets from
    -- interfering with SELECT statements.
    SET NOCOUNT ON;

    -- Intervalo da Série
    Declare @Delay1 int, @Delay2 int, @DataPrev1 int, @DataPrev2 int
    SET @Delay1 = @Cont
    SET @Delay2 = @Delay1 + @pdias

    --SET @Delay1 = 1
    --SET @Delay2 = 365
    SET @DataPrev1 = @Delay1
    SET @DataPrev2 = @Delay1-7

    /* Copia os dados de carga da base original no intervalo minuto*/
    /* e salva os dados na tabela temporaria #SE_dados_carga */

    IF OBJECT_ID ('tempdb..#SE_DADOS_CARGA') IS NOT NULL
        DROP TABLE #SE_DADOS_CARGA

    --274
    SELECT * INTO #SE_DADOS_CARGA FROM [LINKED_SE].[spcee_oper_prod].[dbo].[gr_itemserie]
    WHERE id_seriehistorica = @SerieCarga AND din_ocorrencia between CONVERT(char(10), CONVERT(date,GETDATE()-@Delay2), 126)+ ' 00:00:00' AND CONVERT(char(10), CONVERT(date,GETDATE()-@Delay1), 126)+ ' 00:00:00'

    /* Cria tabela de carga semi-horaira */

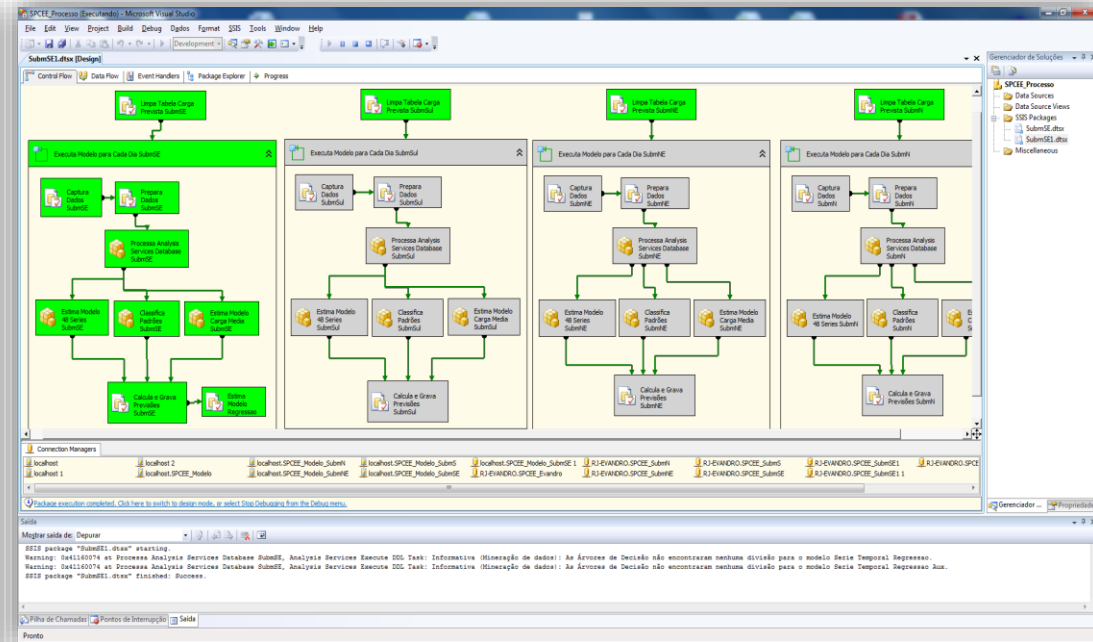
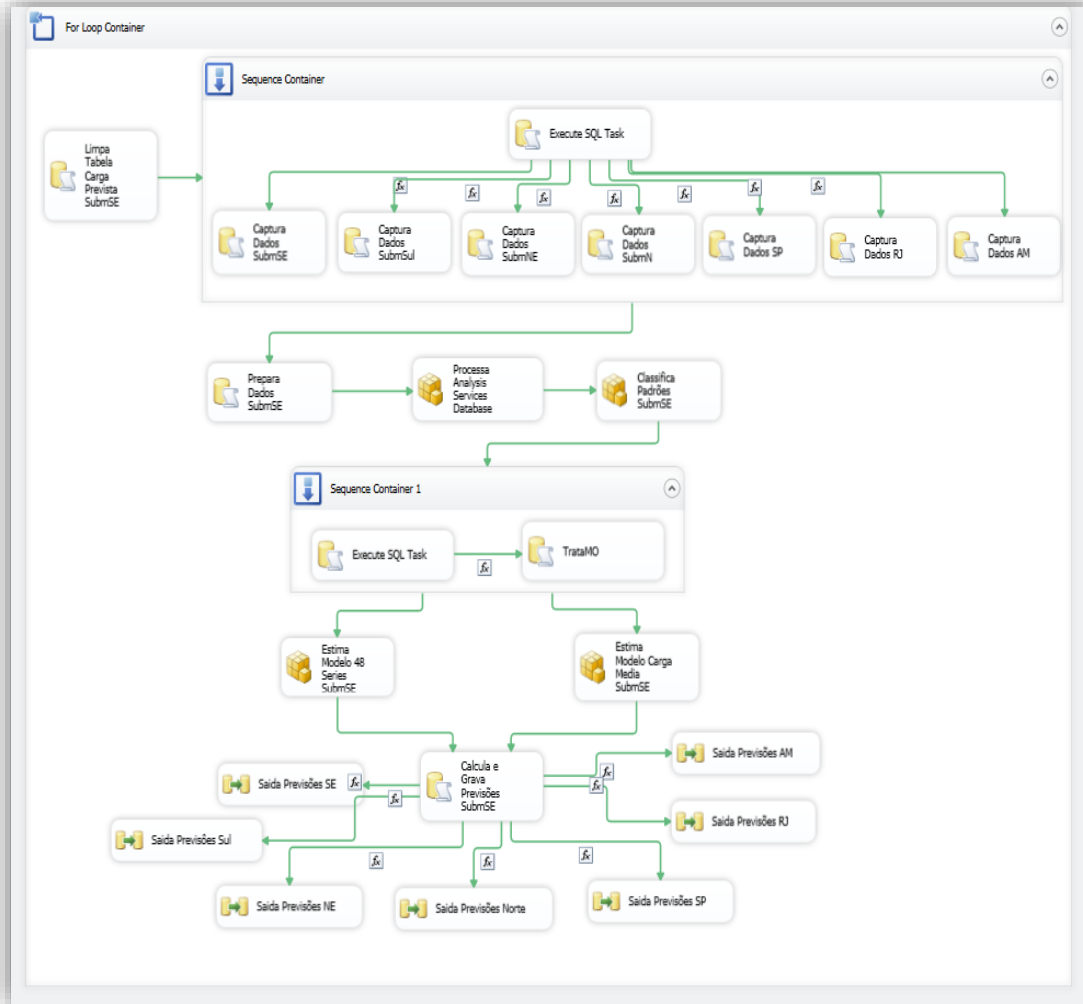
    IF OBJECT_ID ('tempdb..#SE_CARGA') IS NOT NULL
        DROP TABLE #SE_CARGA

    SELECT
        CONVERT(DATETIME,CONVERT(VARCHAR(13),din_ocorrencia, 120) + ':30:00') AS Data,
        CONVERT(VARCHAR(13),din_ocorrencia, 120) AS Dia_Hora,
        @Cont AS [Cont]
    FROM #SE_DADOS_CARGA
    WHERE id_seriehistorica = @SerieCarga
    ORDER BY Dia_Hora, Data

```

Current connection parameters	
<b>Aggregate Status</b>	
Connection failures	
Elapsed time	
Finish time	
Name	PRD-SQL-09
Rows returned	0
Start time	
State	Open
<b>Connection</b>	
Connection name	PRD-SQL-09 (ONS\evandro)
<b>Connection Details</b>	
Connection elapsed time	
Connection finish time	
Connection rows returned	0
Connection start time	
Connection state	Open
Display name	PRD-SQL-09
Login name	ONS\evandro
Server name	PRD-SQL-09
Server version	13.0.4474
Session Tracing ID	
SPID	61

# SSIS/SSAS – Integration Services / Analysis Services



# SSAS - Modelos

SPCEE\_Modelo\_SubmSE - Microsoft Visual Studio

File Edit View Project Build Debug Database Mining Model Tools Window Help

Caixa de Ferramentas

Serie Temporal R...ssao.dmm (Design) Serie Temporal R... Aux.dmm (Design) Página inicial

Mining Structure Mining Models Mining Model Viewer Mining Accuracy Chart Mining Model Prediction

Mining Model: Serie Temporal Regressao Viewer: Microsoft Neural Network Viewer

Input: Attribute Value

Output: Output Attribute: Carga T Value 1: 36.760,648 - 38.428,123 Value 2: <Missing>

Attribute	Value	Favors 36.760,648 - 38.428,123	Favors <Missing>
DF Carga T 7	-2,055,451 - -293,715		
Carga T 7	36.466,633 - 38.151,258		
DF Temp T 7	-7,900 - -2,638		
DF Carga T 1	-4.993,000 - -1.493,455		
DF Temp T 7	-2,638 - -0,359		
DF Carga T 1	-1.493,455 - 18,568		
DF Carga T 1	18,568 - 1.530,392		
DF Temp T 7	-0,359 - -1,920		
DF Carga T 1	1.530,392 - 4.192,000		
DF Temp T 7	1,920 - 6,260		

Gerenciador de Soluções

SPCEE\_Modelo\_SubmSE

- Data Sources
  - SPCEE Subm SE.ds
  - Data Source Views
    - SPCEE Subm SE.dsv
- Cubes
- Dimensions
- Mining Structures
  - Serie Temporal.dmm
  - Serie Temporal Diaria.dmm
  - Perfil.dmm
  - Serie Temporal Regressao Aux.dmm
  - Serie Temporal Regressao.dmm
- Roles
- Assemblies
- Miscellaneous

Gerenciador de Serviços Caixa de Ferramentas

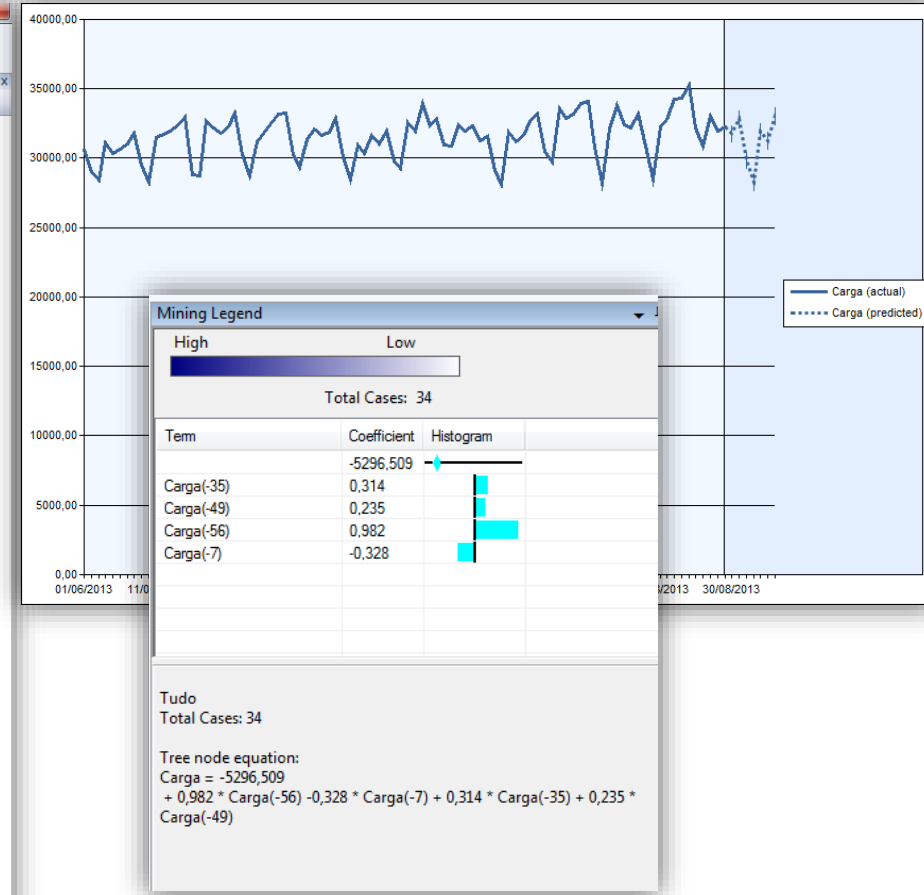
Saida

Mostrar saída de: Compiler

```

----- Implantação iniciada: Projeto: SPCEE_Modelo_SubmSE, Configuração: Development -----
Performing an incremental deployment of the 'SPCEE_Modelo_SubmSE' database to the 'localhost' server.
Generating deployment script...
Add MiningStructure Serie Temporal Regressao
Done
Sending deployment script to the server...
Done
Deploy complete -- 0 errors, 0 warnings
===== Implantação: 1 com êxito, 0 com falha, 0 ignorado =====
    
```

Status: Deployment Completed Successfully







# Integração R – SQL Server

## R no SQL Server 2016 (procedure)

```

CREATE PROCEDURE [dbo].[loess_proc] (@span_parm float = 0.00)
AS
BEGIN
    exec sp_execute_external_script
        @language = 'R',
        @script = N'
            dados <- data.frame("x"=as.numeric(seq(from=0, to=1439, by=1)))
            dados$y <- as.matrix(InputDataSet["val_itemserieoriginal"])
            dados$loess <- loess(y ~ x, span = span_parm, data=dados)$fitted
            OutputDataSet <- as.data.frame(dados)
        ',
        @input_data_1 = N'
            SELECT [id_seriehistorica]
                , [din_ocorrencia]
                , [val_itemserieoriginal]
            FROM [gr_itemserie]
            WHERE id_seriehistorica = 18
            AND CONVERT(DATE,din_ocorrencia) = '2016-06-21'
            ORDER BY din_ocorrencia ASC
        ',
        @params = N'@span_parm float',
        @span_parm = @span_parm
    WITH RESULT SETS ((minuto int, original float, loess float));
END
    
```

minuto	original	loess
0	1238,330688	1202,096701
1	1215,486694	1201,044471
2	1234,295166	1200,001796
3	1220,752197	1198,96916
4	1198,400146	1197,947051
5	1207,380371	1196,935954
6	1170,579712	1195,936355
7	1161,768433	1194,948738
8	1188,507813	1193,973591
9	1175,570923	1193,011399
10	1157,629761	1192,062647
11	1181,65271	1191,127821
12	1189,283081	1190,203348
13	1164,946411	1189,285577
14	1174,515503	1188,374884
15	1193,906982	1187,471642

```

Imports System.Data.SqlClient

2 references
Public Class frmMain
    0 references
    Private Sub Processar_Button_Click(sender As Object, e As EventArgs) Handles Processar_Button.Click
        Dim myConn As New SqlConnection("Database=SPCEE_OPER_PROD;Server=RJ-DK-321-22154\SQLEXPRESS;Integrated Security=SSPI")
        Dim adapter As SqlDataAdapter = New SqlDataAdapter("loess_proc", myConn)
        adapter.SelectCommand.CommandType = CommandType.StoredProcedure
        adapter.SelectCommand.Parameters.Add("@span_parm", SqlDbType.Float).Value = CSng(ComboBox1.SelectedItem)
        Dim ds As New DataSet
        adapter.Fill(ds, "loess_proc")
        DataGridView1.DataSource = ds.Tables("loess_proc")
    End Sub
    
```

minuto	original	loess
1050	1535,52734375	1419,8290479816785
1051	1526,2890625	1419,8042394778704
1052	1509,5606894531	1419,7778537277898
1053	1520,03503417969	1419,7499106450209
1054	1548,57727050791	1419,7204301431473

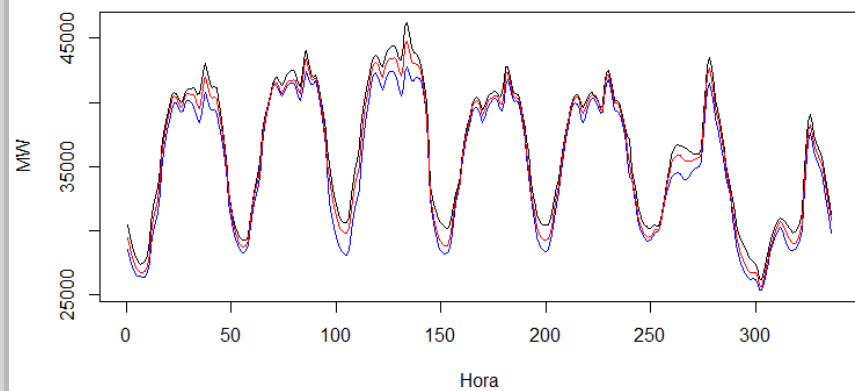
# Modelos de Previsão de Carga para o PMO – Ensemble

The screenshot displays the RStudio environment with the following components:

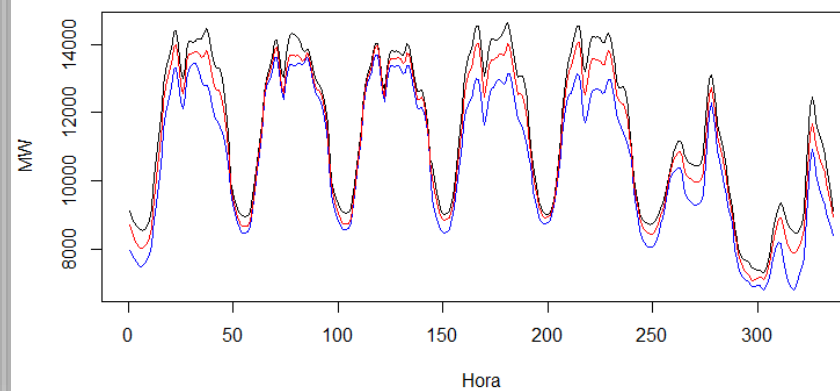
- Source Editor:** Contains R code for loading libraries (e.g., `library("RODBC")`), setting the working directory, and defining a `GetData` function that connects to a database and queries load data for specific dates and times.
- Environment:** Lists various data objects such as `alfa_Gpo`, `Carga_Gpo`, `Carga_Prev`, and `CargaTempMed`.
- Console:** Shows the execution of a loop that prints the first few rows of data for different substation categories (e.g., "274 - submSE").
- Viewer:** Displays a line plot titled "274 : SubmSE : Carga Prevista : 2018-05-20". The y-axis is labeled "MW" (ranging from 25000 to 45000) and the x-axis is labeled "Hora" (ranging from 0 to 300). The plot shows several overlapping lines representing different ensemble models, all exhibiting a strong daily cyclical pattern.

## Modelos de Previsão de Carga para o PMO – Ensemble

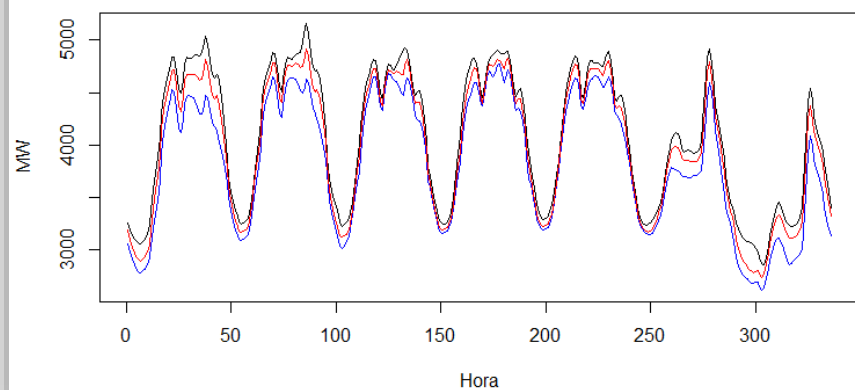
274 : SubmSE : Carga Prevista : 2018-05-20



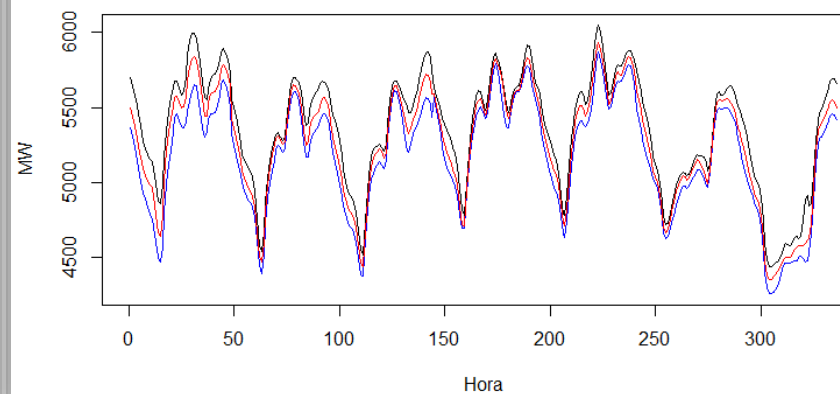
275 : submSul : Carga Prevista : 2018-05-20



276 : submNE : Carga Prevista : 2018-05-20



4 : submNorte : Carga Prevista : 2018-05-20



O previsor do ANNSTLF é constituído por três(3) módulos: duas Redes Neurais Artificiais – RNA, para previsão de carga e um módulo onde as previsões são combinadas usando um algoritmo recursivo de mínimos quadrados.

### Base Load Forecaster (BLF)

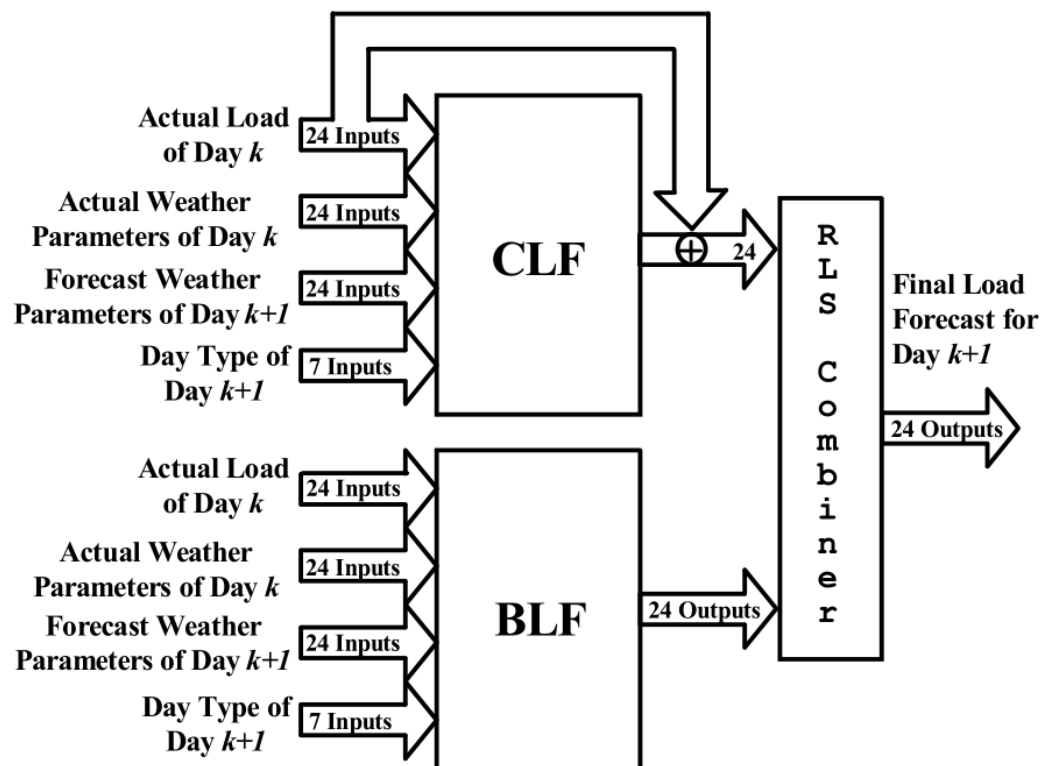
RNA que prevê a carga horária para o dia seguinte (24 valores)

### Change Load Forecaster (CLF)

RNA que prevê a variação horária da carga de um dia K para o outro para o dia K+1

### Recursive Least Squares (RLS)

Combinação linear das saídas das RNAs: BLF e CLF



# Modelos de Previsão de Carga para o PMO – ANNSTLF

ANNSTLF -

View Window Help

Region: SE/CO

Main - SE/CO

Load Forecaster

System Settings

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

ANNSTLF

Artificial Neural-Network Short-Term Load Forecaster Version 6.1.0

Exit

EPRI, 3420 Hillview Ave., Palo Alto, CA 94304-1395  
Copyright ©2016 Electric Power Research Institute, Inc. All rights reserved.

Ready

ANNSTLF - [Load Forecaster - SE/CO]

View Window Help

Setup Load Forecaster to Run on: 05/04/18

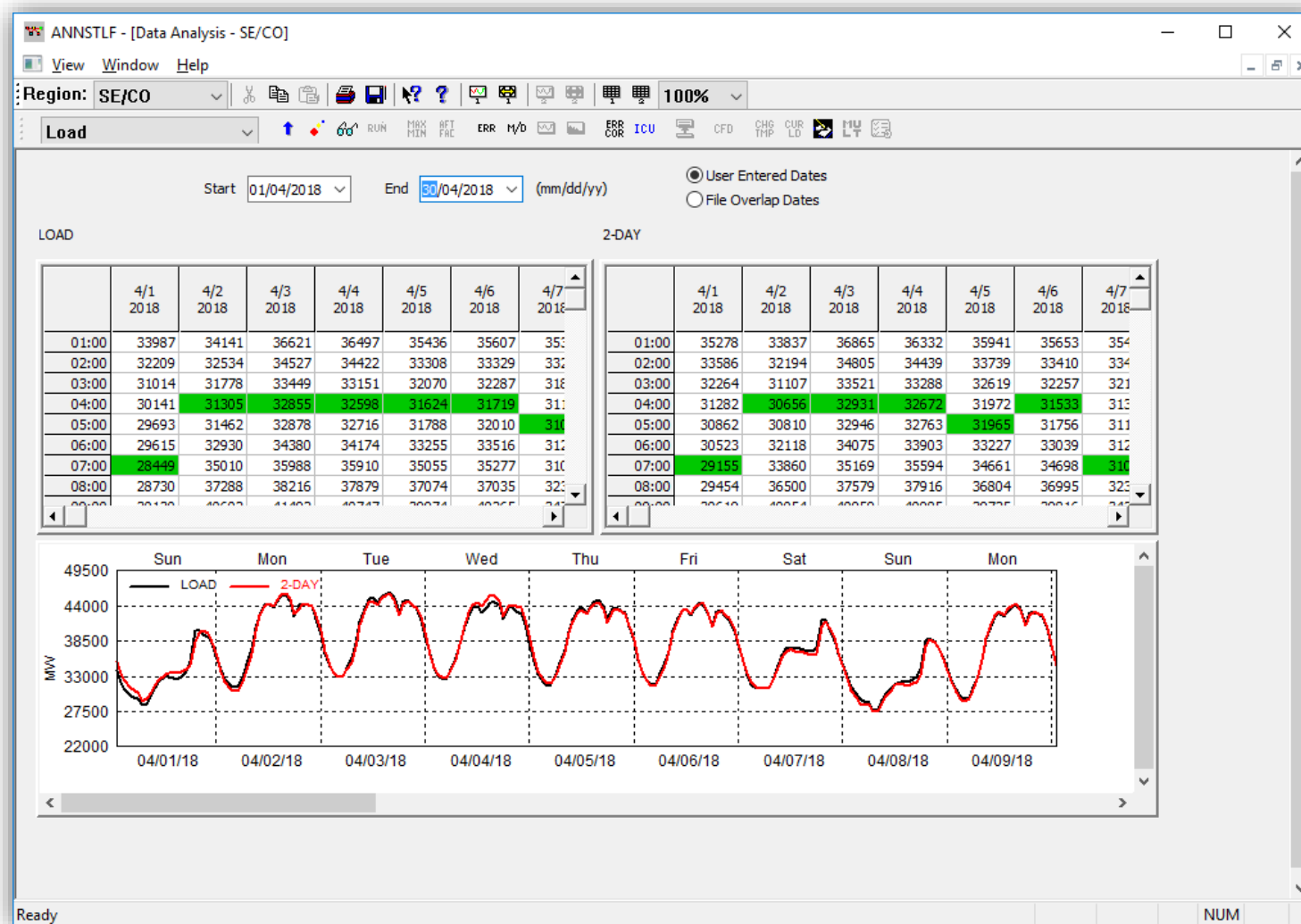
Region: SE/CO

Temperature

	Yesterday Load Thu 05/03	Yesterday Temp Thu 05/03	Today Load Fri 05/04	Today Temp Fri 05/04	Today Forcst Temp Fri 05/04	Temp Sat 05/05	Temp Sun 05/06	Temp Mon 05/07	Temp Tue 05/08
01:00	33446	22	34114	22	22	22	22	21	21
02:00	31526	22	31823	21	21	22	22	21	21
03:00	30471	22	30701	21	21	22	21	21	21
04:00	29997	22	30153	21	21	21	21	21	21
05:00	30194	21	30411	21	21	21	20	21	21
06:00	31703	21	31791	21	21	21	20	21	21
07:00	33590	21	33564	20	20	20	20	21	21
08:00	35208	23	35289	21	21	21	21	21	21
09:00	37972	23		22	22	23	23	21	21
10:00	39998	24			24	25	25	22	22
11:00	41422	24			25	27	26	23	22
12:00	42002	26			27	29	28	23	22
13:00	41160	26			29	30	29	24	23
14:00	42094	27			30	31	29	24	23
15:00	42963	27			31	31	29	24	23
16:00	43079	28			30	30	28	24	23
17:00	42629	27			30	29	27	24	23
18:00	41393	26			29	27	25	23	22
19:00	43526	25			27	26	24	23	22
20:00	42452	24			25	25	24	22	21
21:00	41889	23			24	24	23	22	21
22:00	41553	22			24	23	23	22	21
23:00	39557	22			23	23	23	21	21
24:00	37050	22			23	22	23	21	21
<b>Total</b>	<b>916874</b>		<b>257846</b>						

Ready

# Modelos de Previsão de Carga para o PMO – ANNSTLF



## Modelos de Previsão de Carga para o PMO – ANNSTLF

ANNSTLF - [Error Analysis - SE/CO]

View Window Help

Region: SE/CO

MAPE

Error Analysis Results for Combined: 4/1/18 - 4/30/18

Holiday  Half-Holiday  Day-by-Day Error  Month-by-Month Error

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Workday	Weekend	All Days
1	2.08	2.23	0.94	1.85	1.63	0.89	1.52	1.76	1.29	1.63
2	1.90	2.49	0.98	1.76	1.45	0.55	1.81	1.72	1.34	1.62
3	2.08	2.07	1.19	1.69	1.24	1.01	1.94	1.67	1.59	1.65
4	2.22	1.93	0.93	1.49	1.09	0.83	1.76	1.56	1.41	1.52
5	2.32	1.91	1.13	1.39	1.03	0.83	2.05	1.59	1.59	1.59
6	2.62	1.80	1.51	0.99	1.13	0.81	1.67	1.66	1.34	1.57
7	3.36	2.11	1.43	1.55	0.95	0.54	1.55	1.95	1.17	1.73
8	3.49	1.39	1.09	1.67	1.06	0.57	1.65	1.82	1.25	1.66
9	3.29	1.26	1.32	1.64	1.39	1.25	1.48	1.85	1.40	1.73
10	3.21	1.45	1.48	1.45	1.47	1.30	1.37	1.88	1.34	1.73
11	2.99	1.58	1.59	1.25	1.26	1.02	1.12	1.80	1.08	1.60
12	3.19	1.89	1.84	1.29	1.24	0.64	1.04	1.95	0.89	1.66
13	3.17	1.97	2.09	1.28	1.31	1.24	1.40	2.02	1.34	1.83
14	3.70	1.90	2.37	1.40	1.51	1.38	1.82	2.25	1.65	2.08
15	3.77	1.84	2.08	1.58	1.57	1.18	2.15	2.24	1.79	2.12
16	3.92	2.25	2.01	1.49	1.65	1.21	2.01	2.34	1.71	2.17
17	3.42	2.43	1.58	1.19	1.40	1.44	1.57	2.07	1.52	1.92
18	2.16	2.20	1.73	1.32	1.22	2.63	1.74	1.75	2.07	1.84
19	1.76	1.26	1.20	1.21	1.45	2.41	2.30	1.40	2.34	1.66
20	2.20	1.39	1.13	0.55	0.70	0.40	1.86	1.24	1.31	1.26
21	2.52	1.71	1.45	0.60	1.04	0.72	2.17	1.51	1.63	1.55
22	2.65	1.69	1.62	0.83	1.05	1.03	2.45	1.62	1.92	1.70
23	3.06	2.28	1.40	1.07	1.11	0.53	2.13	1.84	1.53	1.76
24	3.22	2.03	2.38	1.30	1.39	0.74	2.67	2.12	1.94	2.07
All Hours	2.85	1.88	1.52	1.33	1.26	1.05	1.80	1.82	1.52	1.74
Daily	2.63	1.69	1.49	0.97	1.08	0.79	1.46	1.62	1.21	1.45
Peak	1.66	1.46	1.71	1.34	1.10	1.39	1.24	1.46	1.30	1.41

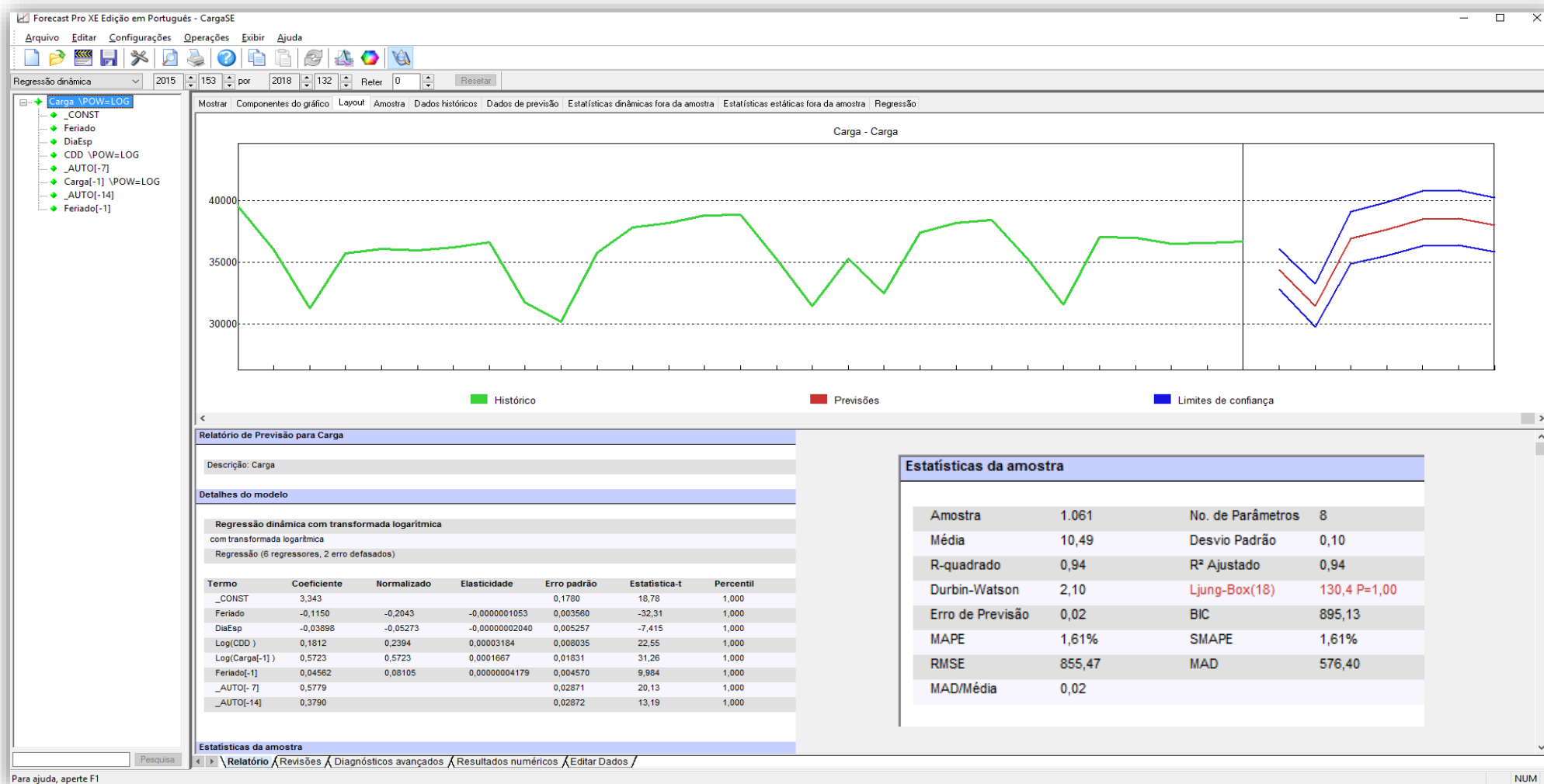
Ready NUM

Estão disponíveis as seguintes medidas na análise dos erros:

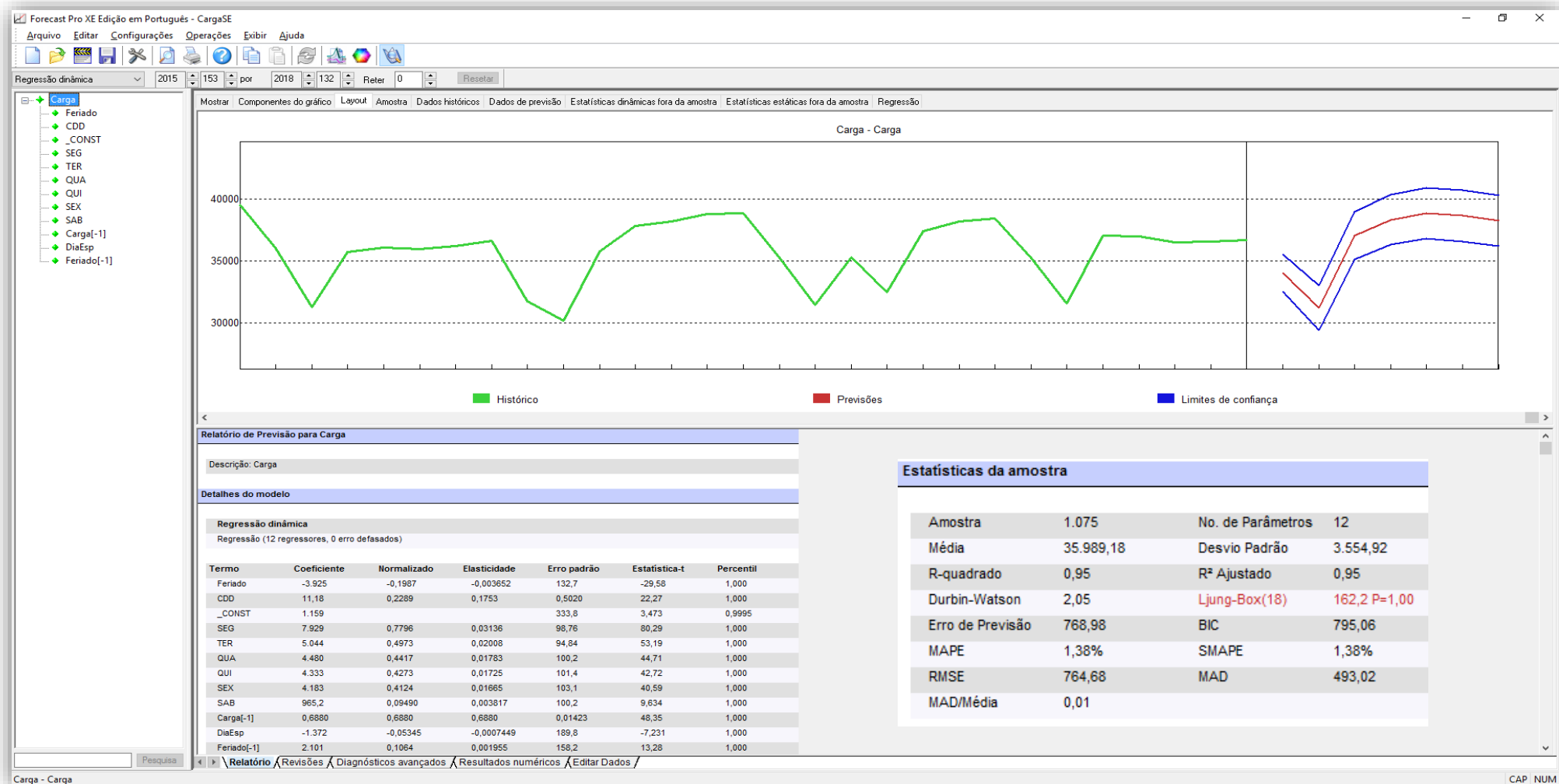
- **MAPE** (Mean Absolute Percentage Error)
- **MAD** (Mean Absolute Deviation)
- **SD** (Standard Deviation of Absolute Errors)
- **Maximum APE** (Maximum Absolute Percentage Error)
- **Maximum AD** (Maximum Absolute Deviation)



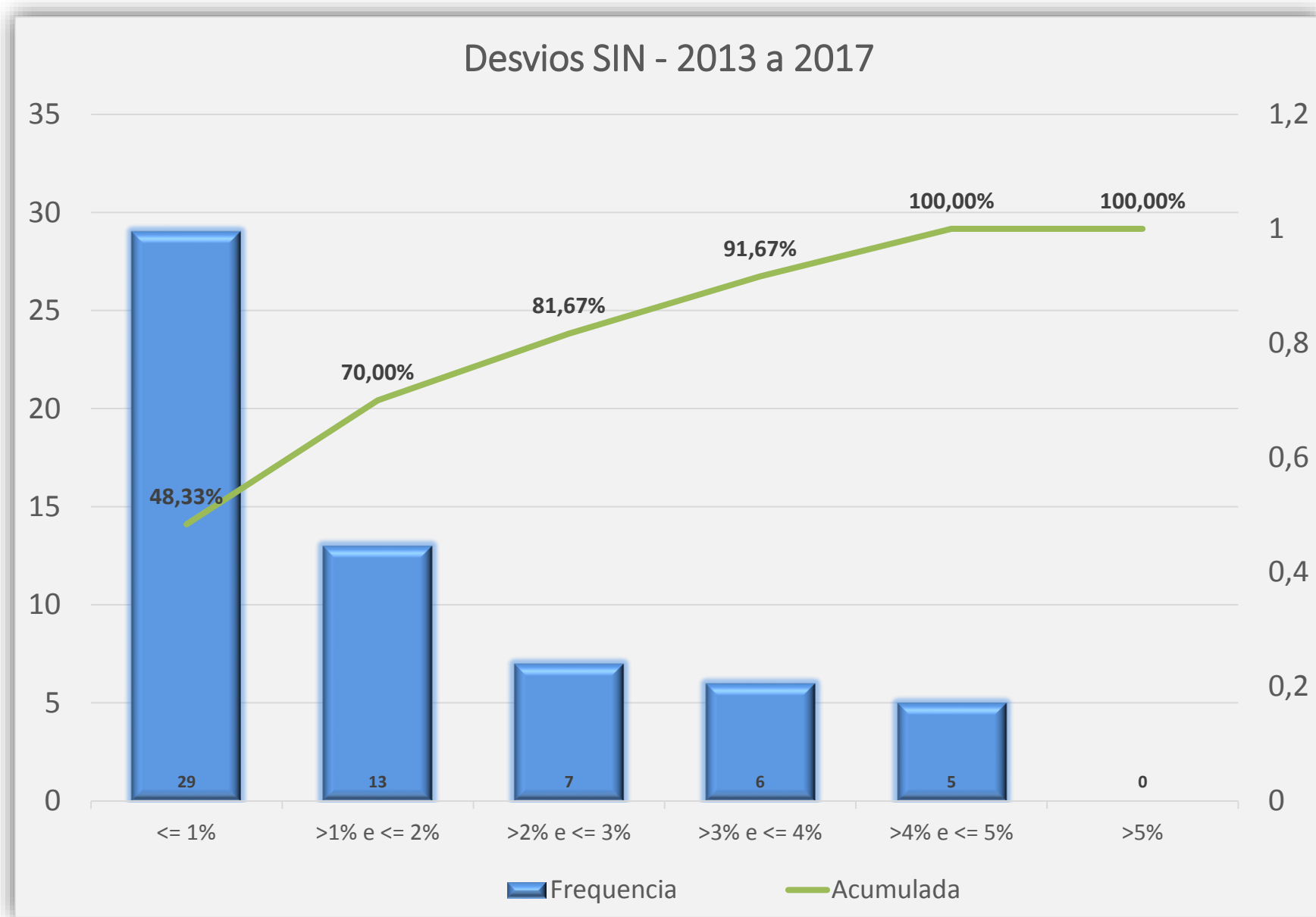
# Modelos de Previsão de Carga para o PMO – FPW (Regressão Dinâmica)



# Modelos de Previsão de Carga para o PMO – FPW (Regressão Dinâmica)

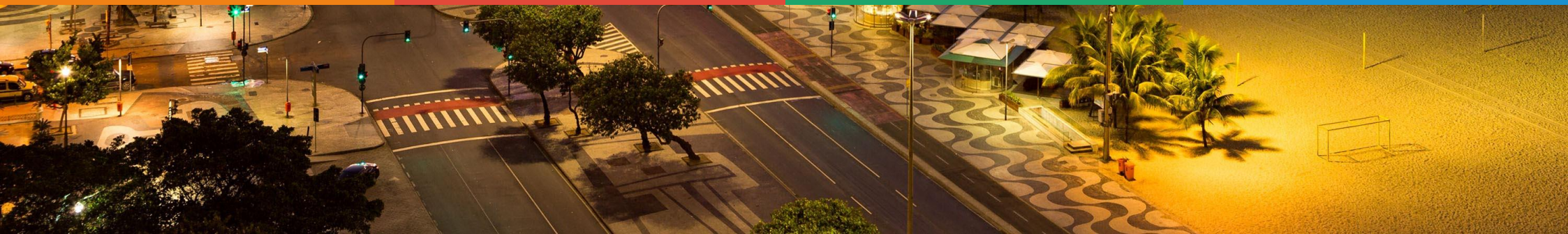


## Resultados PMO – Desvios de Previsão





# Desenvolvimento do modelo PrevCargaPMO



## Modelagem para Previsão de Carga Global para o PMO (semanal/mensal por Subsistema)

### Motivação:

- Reprodutibilidade
- Transparência
- Consideração da Carga Global

### Programa Mensal da Operação - PMO

- **PrevCargaPMO (Carga Global)**

### Contratação do Cepel:

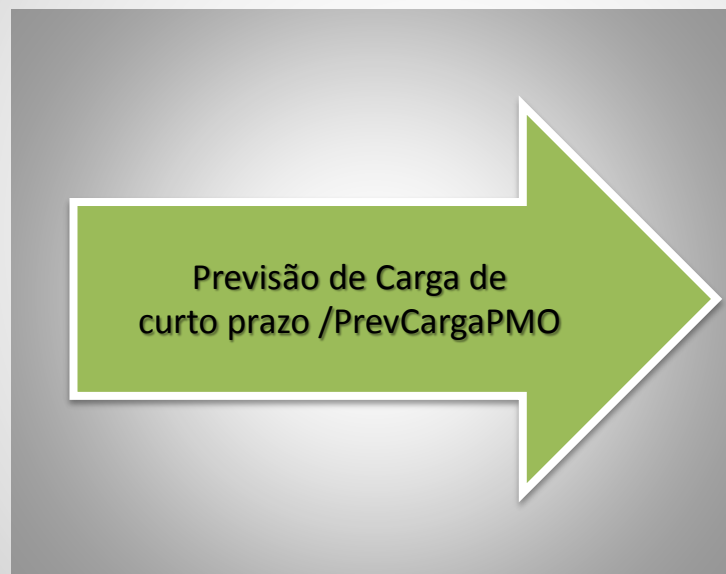
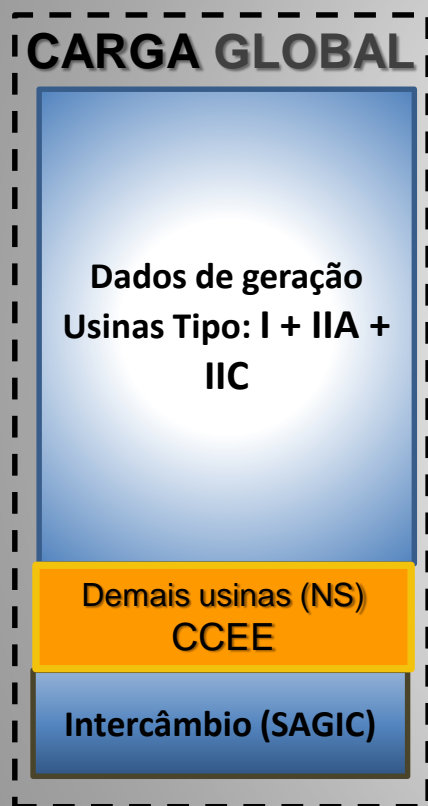
- ✓ Parceria existente
- ✓ Experiência técnica

## ONS/CEPEL – Desenvolvimento do modelo PrevCargaPMO

Estimativa para o mês em curso (M-1)

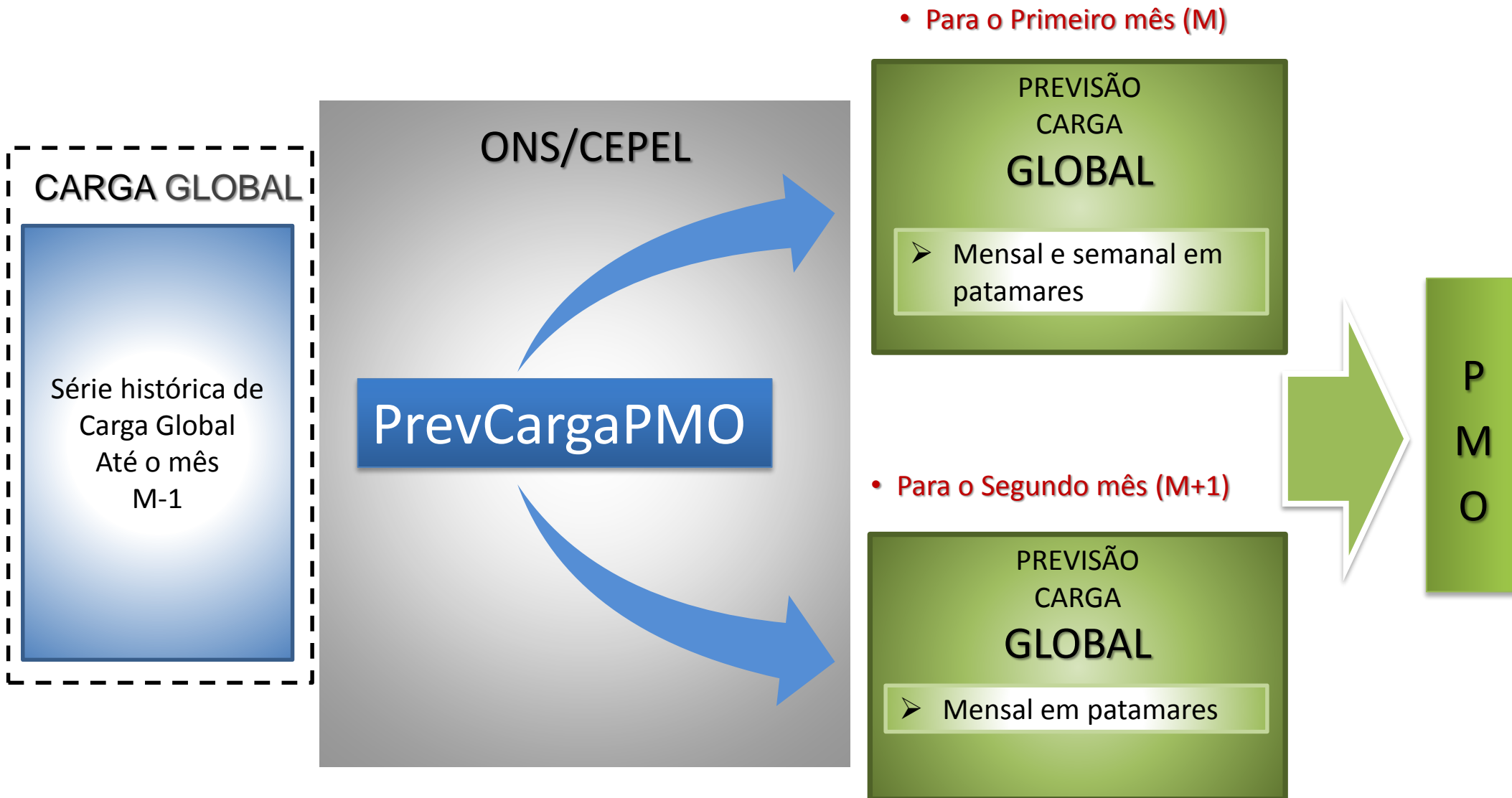
- Dados verificados até o dia D

- Dados estimados para os dias dia D + 1, D+2 ...



# Previsão da Carga Global para o PMO (por Subsistema)

## Previsão para os meses M e M+1





**FIM.**