united nations educational, scientific and cultural organization the **abdus salam** international centre for theoretical physics **4** maniversary 2004

SMR 1585 - 9

WORKSHOP ON DESIGNING SUSTAINABLE ENERGY SYSTEMS 18 October - 5 November 2004

Representation of Load Variation in MESSAGE

Chae Young LIM K.A.E.R.I., Korea Atomic Energy Research Institute, Nuclear Policy Division, Daejeon, Korea

These are preliminary lecture notes, intended only for distribution to participants.

# Representation of Load Variation in MESSAGE

Chae Young Lim

(limcy@kaeri.re.kr)

## Load variation in MESSAGE

- MESSAGE generates equations & constraints at the annual basis or multi-year period basis
- Load variations in a year can also be addressed, if needed
  - Variation in electricity or heat demands
  - Supply pattern of solar power plant
- Load variation in MESSAGE: Daily, Weekly, or Seasonal variation in demands during a year
- Load Variation during a year can be represented by Load Regions and Load Curves

## Load Regions

- Load Variation during a year can be represented by Load Regions and Load Curves
- Load regions are the time slices of a year corresponding to the various loads.
- Each Year can be divided into several Load Regions in various ways
  - Seasonal,
  - Chronological,
  - Ordered
- Number of Load Regions may vary for different years
- Only one set of load regions can be defined in a year
  - Defined Load regions for demand is to use for generating load curves of supply technologies and constraints





## Steps for defining load curves in MESSSAGE

- 1. Define the load regions
- 2. Specify which energy form will have load region in the Energy forms screen
- 3. Define the demands and enter their demand data
- 4. Define load curves in the Demand screen

## Defining load regions(1)

Screen         prev         2002         next           General         Load region definition         Jm Feb Mai Apr Mai Jun Jul Aud Sep Oct Nov Dec           Country: demo1         Holday tables         Day types         Mo         Tu         We         Th         Fr         Sa         Su           Demands         Type:         seasonal         Year: 2002         No. of two 7         T         8         9         10         11         12         31         14         15         17         18         19         20         22         23         24         25         26         27         28         20         31         12         23         22         23         23         22         23         24         25         26	IAEA - MESSAGI	E V demo1 adb	Holid	lay tab	le				×		
General       Jan Feb Mad Apr Mai Jan Jul Aug Sep Dot Nov Dec         Load regions <ul> <li>Country: demo1</li> <li>Hoiday tables</li> <li>Day types</li> <li>Type:</li> <li>Seasonal</li> <li>Y Yesr: 2002</li> <li>No. ct stars</li> <li>Type:</li> <li>Stat dot:</li> <li>Tope:</li> <li>Stat dot:</li> <li>Tope:</li> <li>Stat dot:</li> <li>Tope:</li> <li>Stat dot:</li> <li>Technologies</li> </ul> Name         Stat dot:         Tope:         Stat dot:         Stat dot:         Tope: <td><u>S</u>creen</td> <td></td> <td>prev</td> <td></td> <td></td> <td>2002</td> <td></td> <td></td> <td>next</td> <td></td> <td></td>	<u>S</u> creen		prev			2002			next		
Load regions         Energytoms         Demands         Constraints         Technologies         Storages         Resources         Ok         Reload       Clear         Delete year         Delete season         Ok         Resources         Chain	General	Load region definition	Jan	eb Mar A	Apr Mai	Jun Jul A	Aug Sep	Oct No	v Dec		
Storages   Ok   Resources     Monday   Image: Chain     Monday   Image: Chain   Image: Chain     Image: Chain <th>Load regions Energyforms Demands Constraints Technologies</th> <th>Country:     demo1     Image: Holiday tables     Day types       Type:     seasonal     Image: Year:     2002     Image: No. of stason       Name     Start date     days     parts       Ioneseason     2002-01-01     2     3     2       newseason     2002-07-01     2     3     2</th> <th>Ma 7 14 21 28</th> <th>Tu           1           8           15           22           3           29</th> <th>We 2 9 16 23 30</th> <th>Th 3 10 17 24 31</th> <th>Fr 4 11 18 25 1</th> <th>Sa 5 12 19 26</th> <th>Su 6 13 20 27</th> <th></th> <th></th>	Load regions Energyforms Demands Constraints Technologies	Country:     demo1     Image: Holiday tables     Day types       Type:     seasonal     Image: Year:     2002     Image: No. of stason       Name     Start date     days     parts       Ioneseason     2002-01-01     2     3     2       newseason     2002-07-01     2     3     2	Ma 7 14 21 28	Tu           1           8           15           22           3           29	We 2 9 16 23 30	Th 3 10 17 24 31	Fr 4 11 18 25 1	Sa 5 12 19 26	Su 6 13 20 27		
Monday       Tuesday       Wednesday       Thursday       Friday       Friday<	Storages Resources	Inewseaso1     2002-08-06     1     1       Ok     Reload     Clear     Delete year     Delete season       7% MES     Add     Delete season	SAGE V -	Day ty	pe def	initions				_	
Monday       I <td></td> <td></td> <td></td> <td> Monday</td> <td>Tuesday</td> <td>Wednesda</td> <td>ay Thursda</td> <td>ay Friday</td> <td>Saturday</td> <td>y Sunday</td> <td>Holiday</td>				 Monday	Tuesday	Wednesda	ay Thursda	ay Friday	Saturday	y Sunday	Holiday
Tuesday       I </td <td></td> <td>Monday</td> <td></td> <td>•</td> <td>Г</td> <td>Γ</td> <td>Г</td> <td>Г</td> <td></td> <td>Г</td> <td>Г</td>		Monday		•	Г	Γ	Г	Г		Г	Г
Wednesday       Г		Tuesday		Г	₽	Г	Г	Г	Г	Г	Г
Thursday       I<		Wednesda	v	Г	Г	~	Г	Г	Г	Г	Г
Friday       Г <td></td> <td>Thursday</td> <td></td> <td></td> <td>Г</td> <td><b>—</b></td> <td>₽</td> <td>Г</td> <td></td> <td>Г</td> <td>Г</td>		Thursday			Г	<b>—</b>	₽	Г		Г	Г
Saturday       I<		Friday			Г	Г	Г	◄		Г	Γ
Sunday       □ <td></td> <td>Saturday</td> <td></td> <td>Г</td> <td>Г</td> <td>Г</td> <td>Г</td> <td>Г</td> <td>◄</td> <td>Г</td> <td>Г</td>		Saturday		Г	Г	Г	Г	Г	◄	Г	Г
Workday         I </td <td></td> <td>Sunday</td> <td></td> <td></td> <td>Г</td> <td>Γ</td> <td>Г</td> <td>Г</td> <td></td> <td>•</td> <td>Γ</td>		Sunday			Г	Γ	Г	Г		•	Γ
Chain SunandHol C C C C C C C C C C C C C C C C C C C		Workday		•	•	•	•	☑	Г	Г	Г
	Chain	SunandHo			Г	Γ	Г	Г	Г	~	~
		I SSH			Г	Г	Г	Г	₽	•	•
		anyday		•	~	$\overline{\mathbf{v}}$	•	•	•	~	1

## Defining load regions(2)

General	Load region definition	
Load regions Energyforms Demands Constraints Technologies Storages Resources	Country: demo1      Holiday tables     Day types  Type: seasonal     Year: 2002     No. of seasons 3      Mame     Start date     days parts     oneseason     newseason     2002-01-01     2     3     2     No. of season     newseason     newseason     2002-07-01     2     3     2     No. of season     newseason     newseason     1     Number of     day types      Number of     day types      Number of     parts at     the 1st day     nate     the 2nd     day type	
Chain		

## Link the load region to the Energy forms

AEA - MESSAGE V demo1 adb <u>S</u> creen		Help
General Energy forms		
Load regions tdb adb		
Energyforms Ins Add Del		
Demands level name (double click to show fuels) id	description	
Constraints		
Technologies secondary s		
Storages resources r		
Resources	Double click	
Level: final Ins Add Del Save Quit		
energy form id hasldr ix unittype	unit description	
electricity e 🔽 energy	V MWyr	
oil 🔽 🗖 energy	V MWyr	
Chain		

## Define the demands & enter demand data

creen	<u>H</u>	elp
General Load regions Energyforms Demands Constraints Technologies	Demands         Add       Delete       Import       load curves:       Import         energy form/level       unit       switch       data (double click to edit)         electricity/final       MWyr       cg       200         oil/final       MWyr       c       50         Annual       demand       Comment       Import	
A - MESSAG	E V demol adb H	elp
EA - MESSAG creen General Load regions	E V demo1 adb	elp
A - MESSAG reen General Load regions Energyforms	E V demo1 adb Hereitary form/level unit energy form/level unit electricity/final p edit)	
A - MESSAG reen General Load regions Energyforms Demands Constraints	E V demo1 adb	
A - MESSAG reen General Load regions Energyforms Demands Constraints Technologies	E V demo1 adb H Demands Add Delete Impot load curves electricity/final edit) energy form/level unit electricity/final edit) comment Impot comment Impot	

#### Define load curves

