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- in Energy for
- Sustainable Development

Novel procedure to formulate load profiles for off-grid rural areas - the Load Pro Gen software

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Rural electrification and Load Demand

Load Demand assessments are required in rural electrification especially because **power systems** are often **off-grid**

Rural plants are frequently based on:

- **Renewable Energy Sources [RES]** – Conversion technologies based on these sources are not fully predictable, not-dispatchable
- **Storage systems** – To ensure continuity of the service

Load Demand
estimation



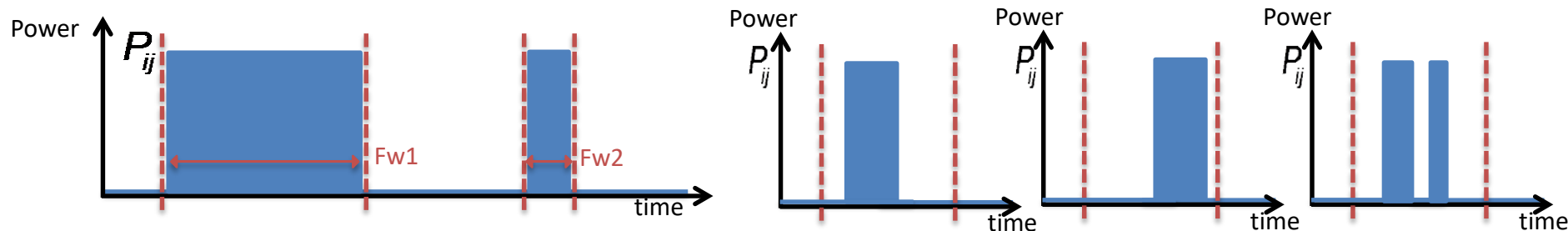
Allows

optimal sizing of plant and battery



Common approaches

- Profiles are defined without any explanations about their origin (*Bala and Siddique, 2009; Nandi and Ghosh, 2010; Kanase-Patil et al., 2011*).
- Profiles are derived by employing other ones from similar contexts (*Nfah and Ngundam, 2009, 2012; Phrakonkham et al., 2012; Semaoui et al., 2013; Sen and Bhattacharyya, 2014*).
- Profiles are formulated without any defined procedure, but by employing assumptions on electric appliances functioning periods and/or load factors, in order to build up a coincidence behavior (*Al-Karaghoul and Kazmerski, 2010; Gupta et al., 2010; Bekele and Tadesse, 2012*).

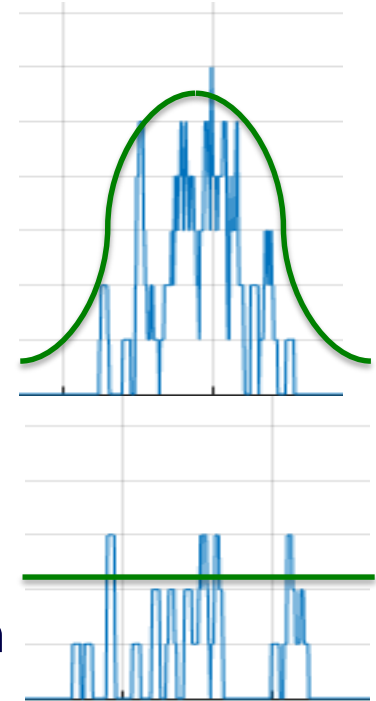


The Load Pro Gen approach

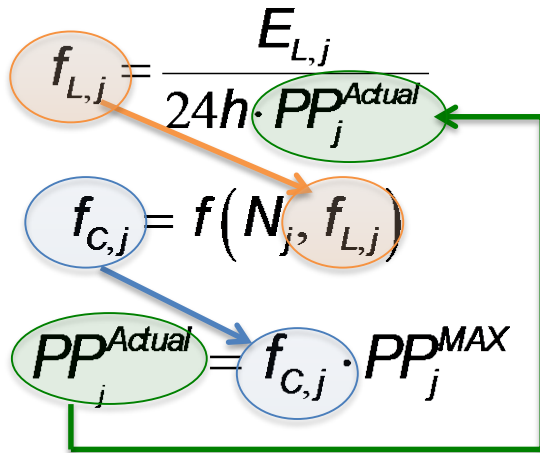
A stochastic method

The switching on times are defined with Specific Probability Distribution Functions:

- If the appliance contributes to the power peak → Sampling with normal distribution
- If the appliance doesn't contribute to the power peak → Sampling with uniform distribution



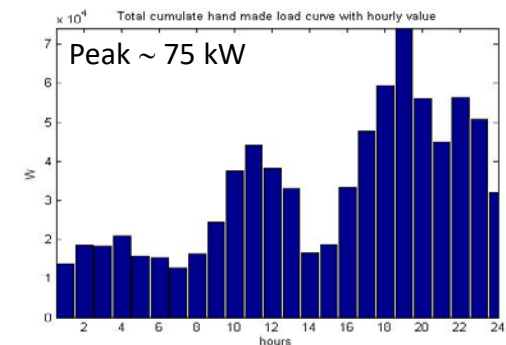
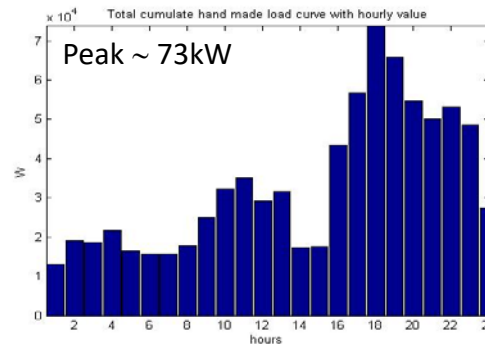
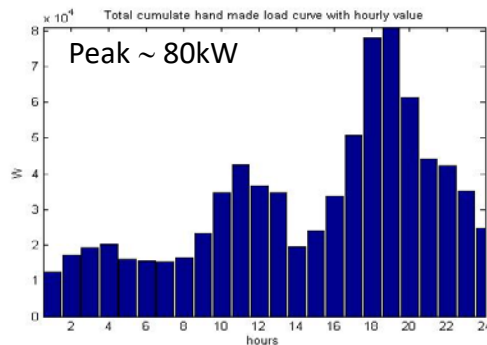
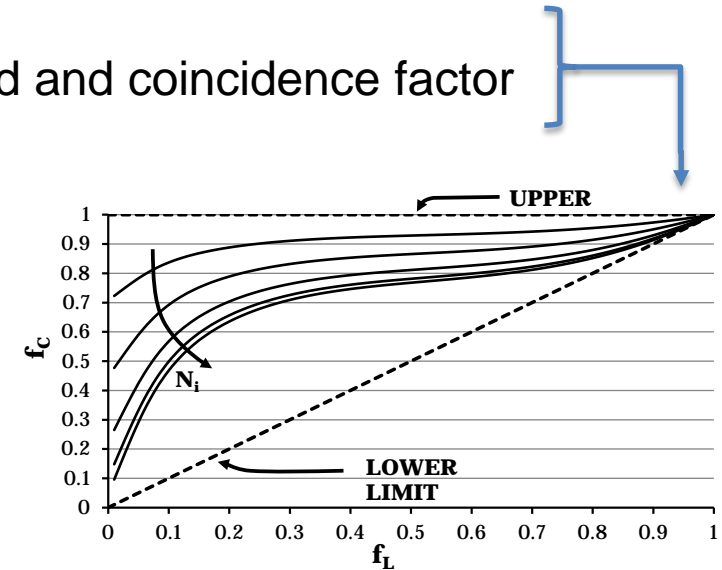
The Load Pro Gen approach



Load factor

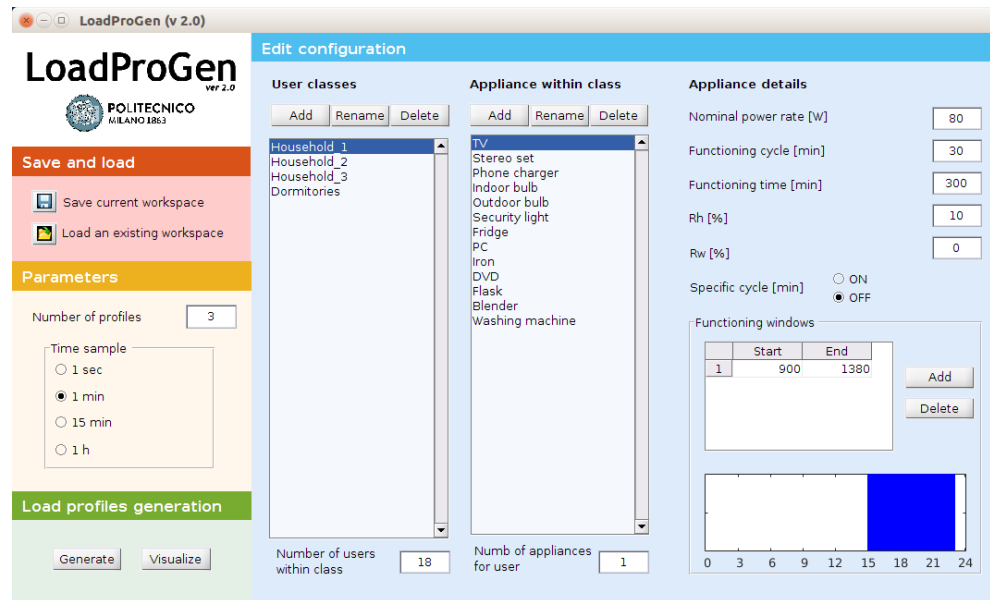
Correlation between load and coincidence factor

Coincidence factor



Matlab tool LoadProGen

- With simple inputs seen before it generates the desired numbers of electrical load profiles
- You can use LoadProGen from the command window or the graphical version of the tool



DOWNLOAD: <https://it-it.facebook.com/energy4growing2014/>

PUBLICATION: Stefano Mandelli, Marco Merlo, and Emanuela Colombo. "Novel procedure to formulate load profiles for off-grid rural areas." *Energy for Sustainable Development* 31 (2016): 130-142.




Matlab tool LoadProGen - Examples




- Lights, fridge and mill

LoadProGen (v 2.0)

LoadProGen ver 2.0

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Save and load

-  Clear workspace
-  Save current workspace
-  Load an existing workspace

Parameters

Number of profiles

Time sample

- ☐ 1 sec
- ☒ 1 min
- ☐ 15 min
- ☐ 1 h

Load profiles generation

Edit configuration

User classes

- Household
- Mill

Number of users within class

Appliance within class

- Mill

Numb of appliances for user

Appliance details

Nominal power rate [W]

Functioning cycle [min]

Functioning time [min]

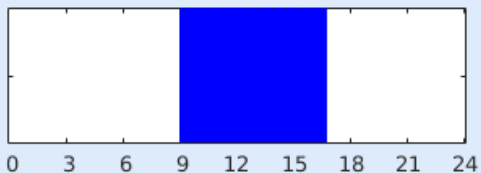
Random variation of func. time [%]

Random variation of func. window

Specific cycle [min] ☐ ON ☒ OFF

Functioning windows

	Start	End
1	540	1000



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- Lights, fridge and mill

