The HOMER Simulation Tool
PROS & CONS

ECREEE Regional Training of Trainers Workshop:
HOMER software for RE project design

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I. IDEAL EXAMPLE

Considerations:

Dimensioning and Simulating

What is dimensioning and simulating in this training?

IDEAL EXAMPLE

"Consider that our purpose is to build a spacecraft to reach the moon."

Before building it, you have **to understand the physics behind and the available technology** before you start such a complex project.

- The equations are related to **the model,** that will explain the behavior of your spacecraft in the context.
- The available technology **refer to the inputs** you will use (among other parameters such as restrictions).

Oversized results

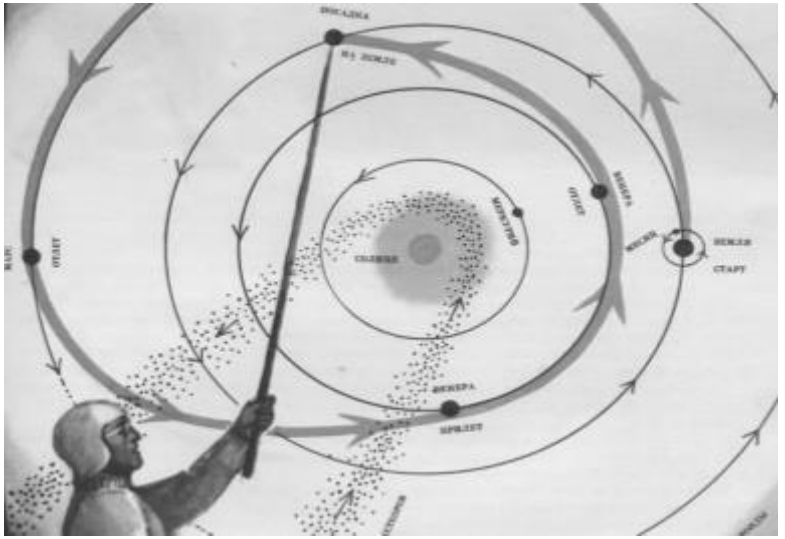
If you have the technology and the real inputs, but you don't understand the model, it is very likely that your solution will be either oversized or wrong.

Unrealistic results

If you understand the model, but you don't have the proper technology data and real inputs, it is very likely that your solutions will be either unrealistic or wrong.

Criteria and convergence

- It is the human, with criteria who drives the simulation software to converge to feasible solutions.



- If you start a simulation without criteria, probably you will face a situation of many (or none) results without finding a good solution.

Simulating different sizes and all the possible combinations

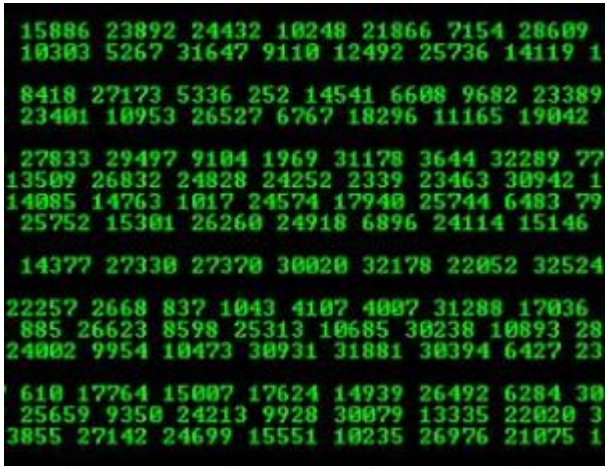
IN THIS IDEAL EXAMPLE OF A SPACECRAFT,

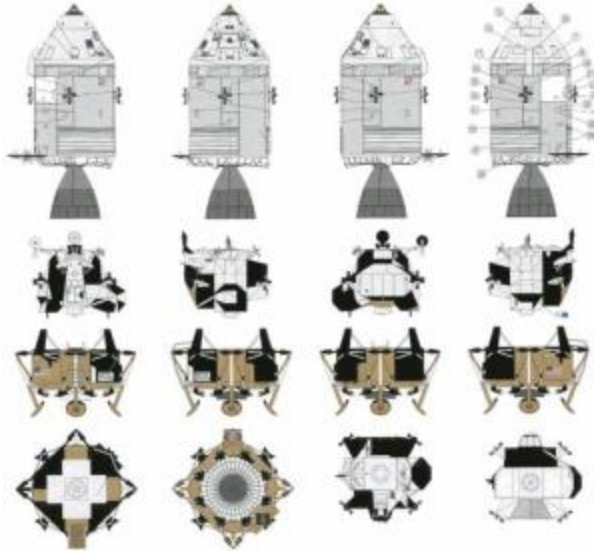
Through a **computer simulation** we can try different sizes (or dimension) of the components for a spacecraft, as well to set different technology combinations and restrictions …

[the computer **runs** the model **with our inputs**]

… and then we can analyze the results: **a list of feasible technology combinations.**

Finally, we select the more convenient solution for our purpose taking into account several parameters and conditions.

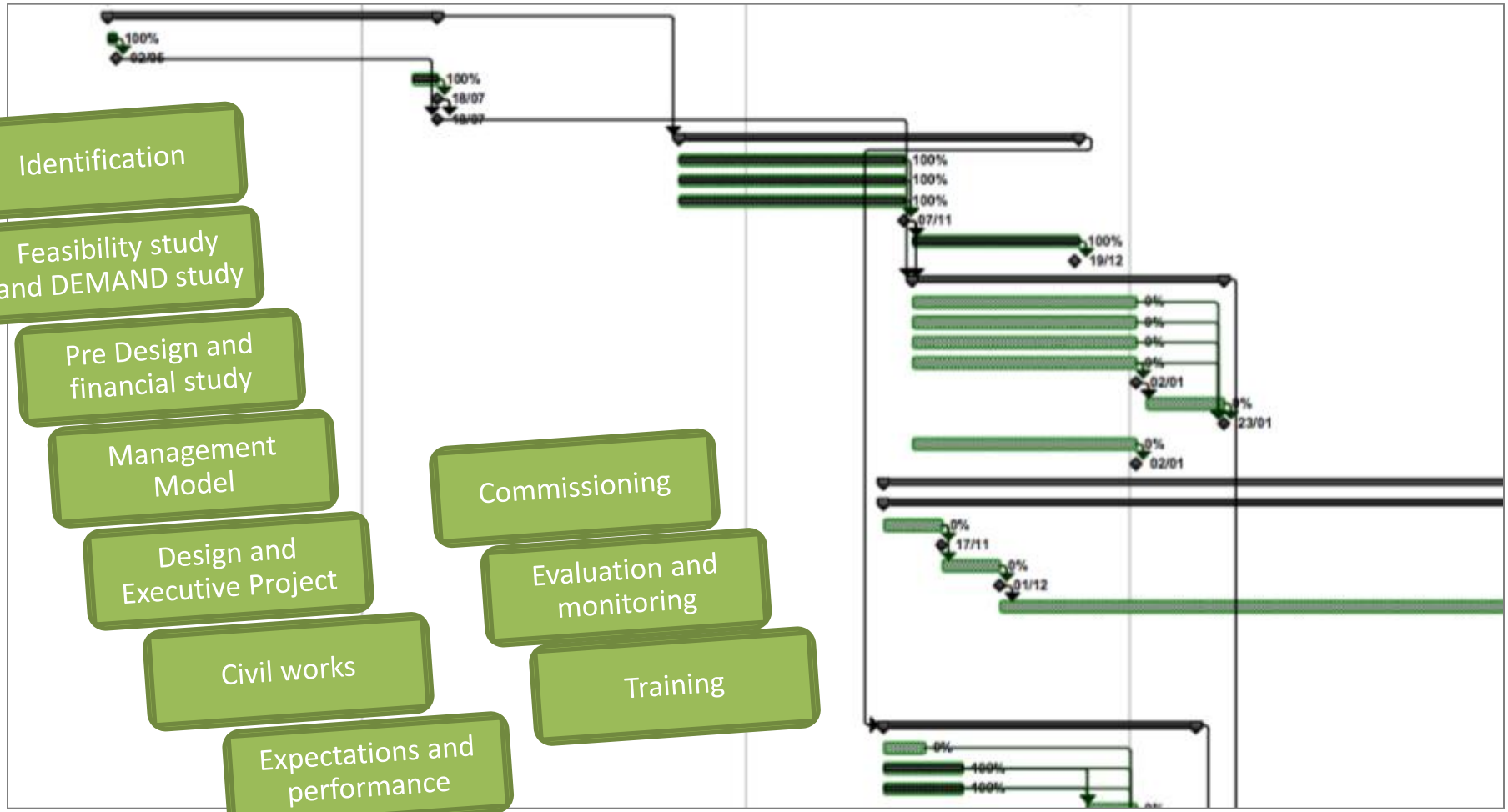




II. HYBRID ENERGY SYSTEM SIMULATION

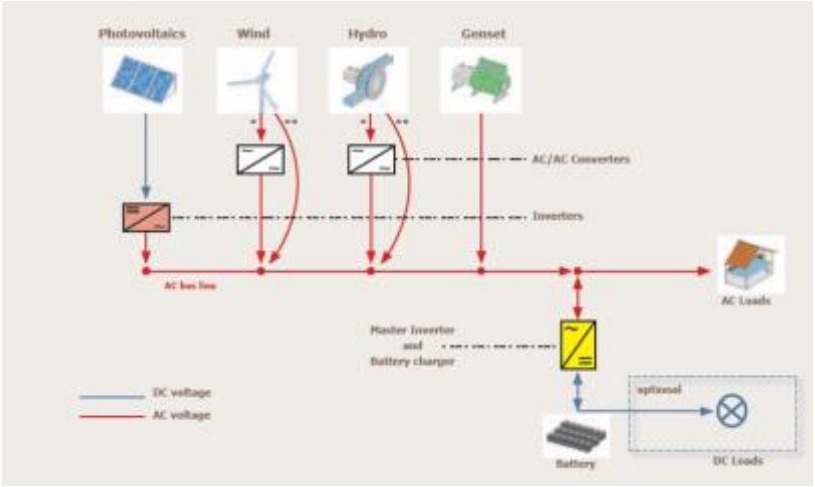
What HOMER software does.

Life cycle project: stages, dimensioning, simulation and design



MAIN PURPOSE OF THE SIMULATION: "to dimension conveniently"

- **TO DIMENSION an hybrid energy system**
  - **Generator size**
    - **for a given energy demand**
    - **for a given list of available technology and restrictions to consider**



HOMER SIMULATES DIFFERENT SIZES (dimensioning) OF THE SYSTEM

- A dimensioning tool (also referred to as a sizing tool) performs dimensioning of the system: given an energy requirement, it determines the *optimal size of each of the different components of the system*
- With simulation tools, as opposed to dimensioning tools, the user must specify the nature and size of each component. *The tool then provides a* detailed analysis of the behavior of the system.

- **Simulation tools can also be used for sizing**. This requires that the user correctly identify the key variables and then repeatedly run the simulation, adjusting the variables manually **to converge** on an acceptable sizing. Some packages automate this process.

Source: IEA, 2011

Simulation in HOMER

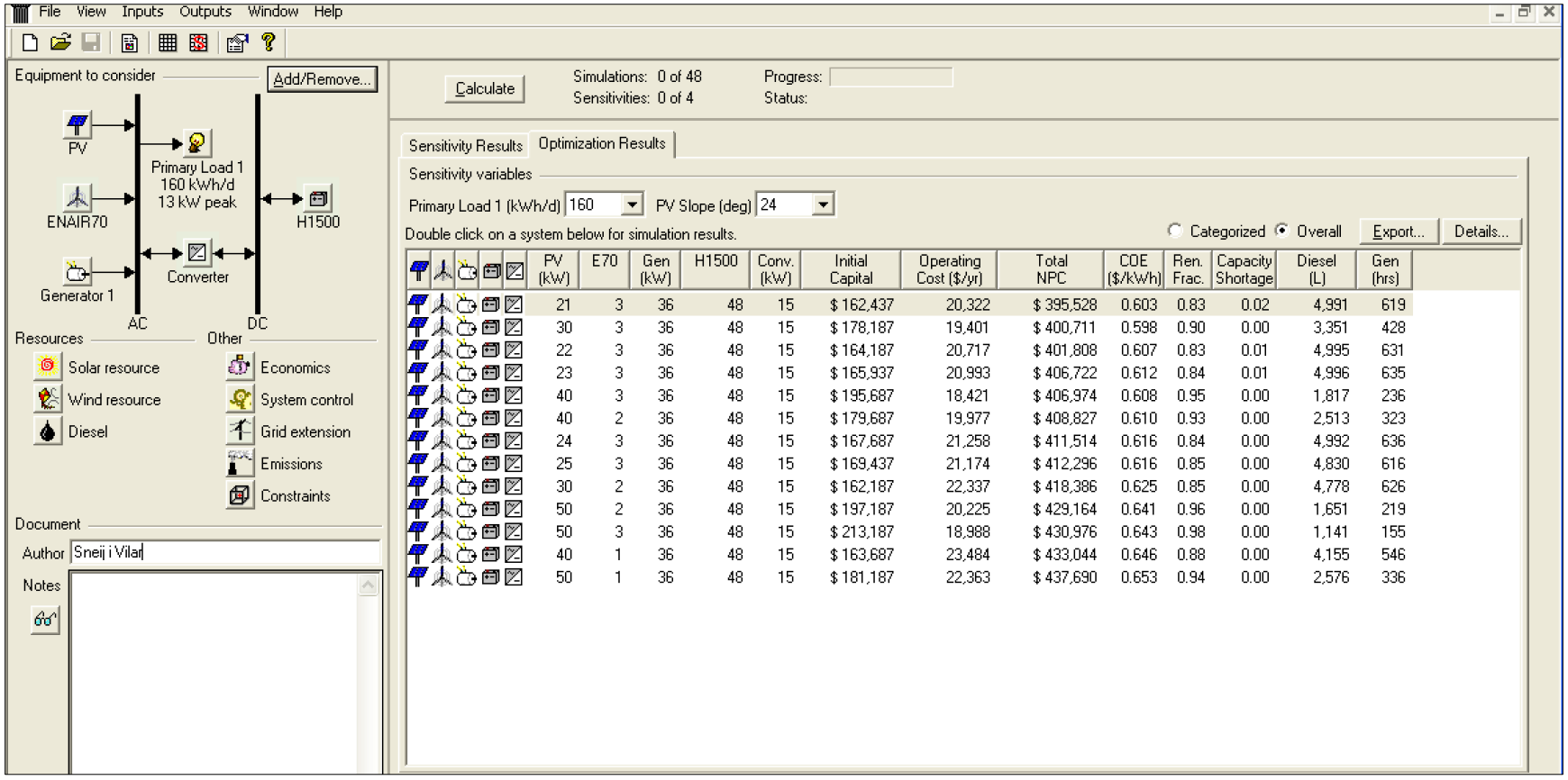
- To use HOMER, you provide the model with **inputs**, which describe technology options, component costs, and resource availability.

- HOMER uses these inputs to **simulate different system configurations, or combinations of components**, and generates results that you can view as a list of feasible configurations sorted by net present cost.

- HOMER also **displays simulation results in a wide variety of tables and graphs** that help you **compare configurations and evaluate** them on their economic and technical merits.

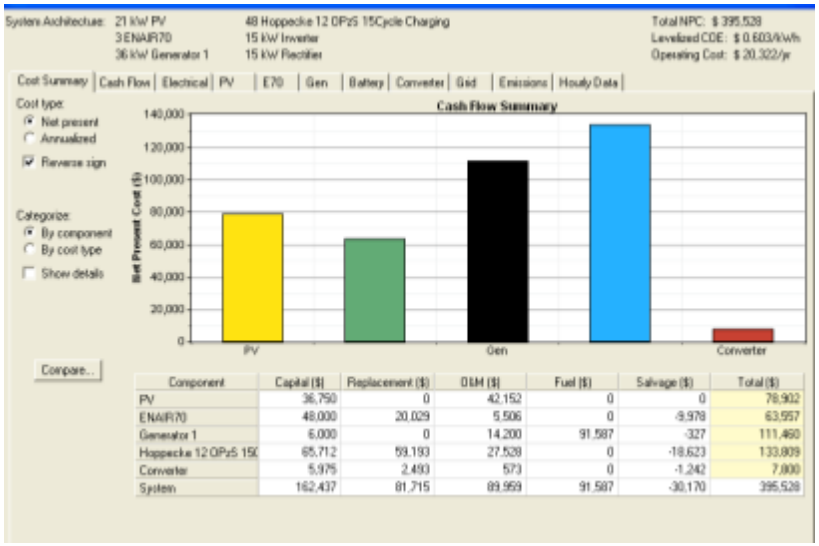
Source: HOMER ENERGY, 2011

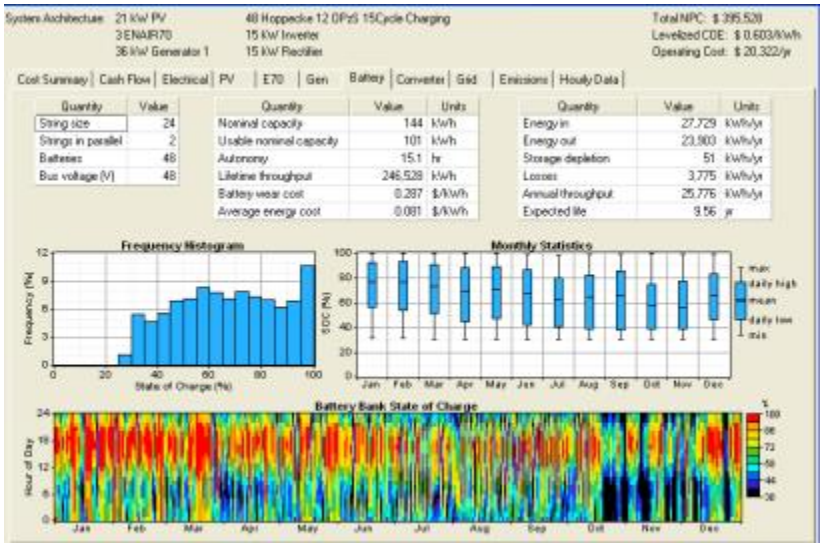
List of feasible solutions

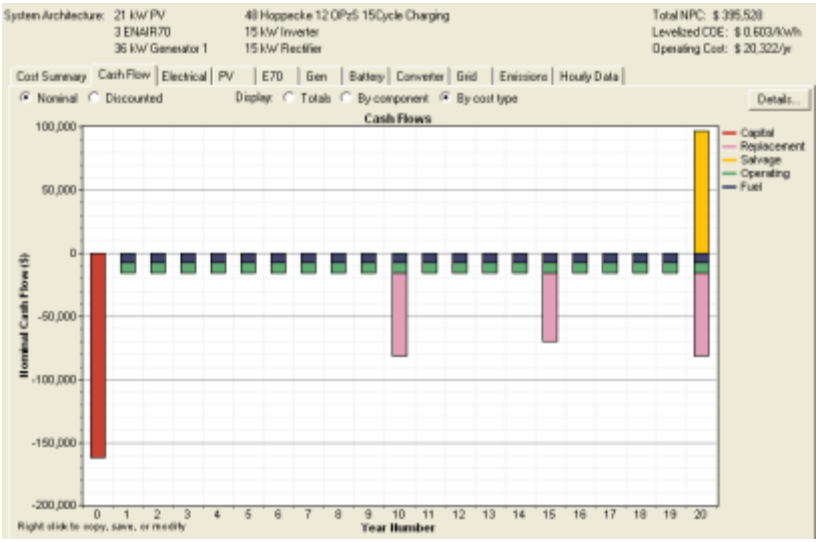


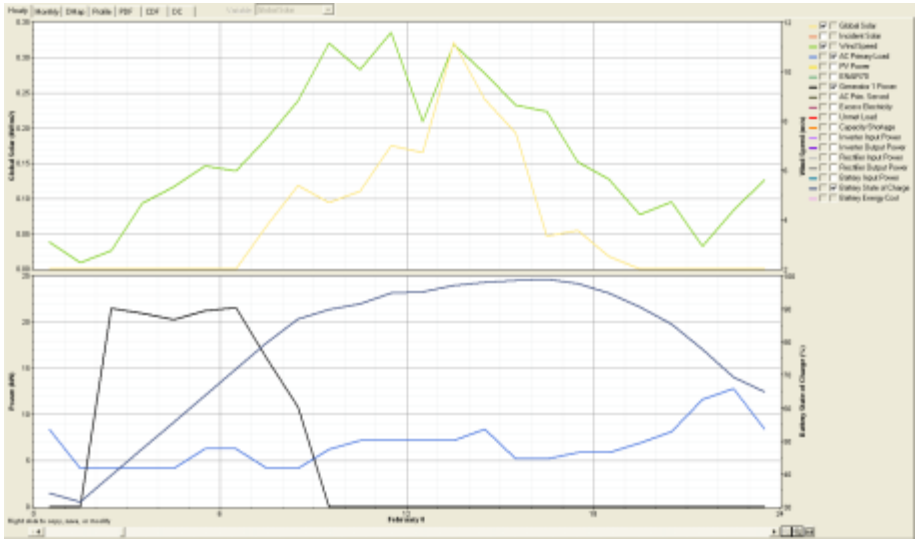
PV (kW)	E70	Gen (kW)	H1500	Conv. (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.	Capacity Shortage	Diesel (L)	Gen (hrs)
21	3	36	48	15	$ 162,437	20,322	$ 395,528	0.603	0.83	0.02	4,991	619
30	3	36	48	15	$ 178,187	19,401	$ 400,711	0.598	0.90	0.00	3,351	428
22	3	36	48	15	$ 164,187	20,717	$ 401,808	0.607	0.83	0.01	4,995	631
23	3	36	48	15	$ 165,937	20,993	$ 406,722	0.612	0.84	0.01	4,996	635
40	3	36	48	15	$ 195,687	18,421	$ 406,974	0.608	0.95	0.00	1,817	236
40	2	36	48	15	$ 179,687	19,977	$ 408,827	0.610	0.93	0.00	2,513	323
24	3	36	48	15	$ 167,687	21,258	$ 411,514	0.616	0.84	0.00	4,992	636
25	3	36	48	15	$ 169,437	21,174	$ 412,296	0.616	0.85	0.00	4,830	616
30	2	36	48	15	$ 162,187	22,337	$ 418,386	0.625	0.85	0.00	4,778	626
50	2	36	48	15	$ 197,187	20,225	$ 429,164	0.641	0.96	0.00	1,651	219
50	3	36	48	15	$ 213,187	18,988	$ 430,976	0.643	0.98	0.00	1,141	155
40	1	36	48	15	$ 163,687	23,484	$ 433,044	0.646	0.88	0.00	4,155	546
50	1	36	48	15	$ 181,187	22,363	$ 437,690	0.653	0.94	0.00	2,576	336

Evaluation of **each solution**: economics and technical performance







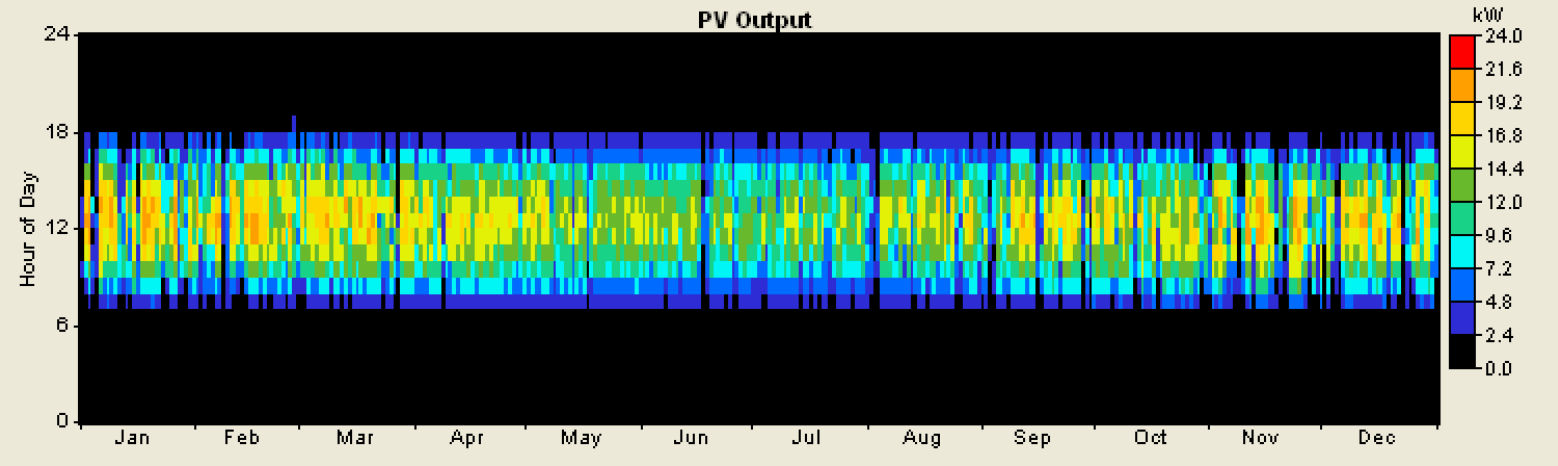


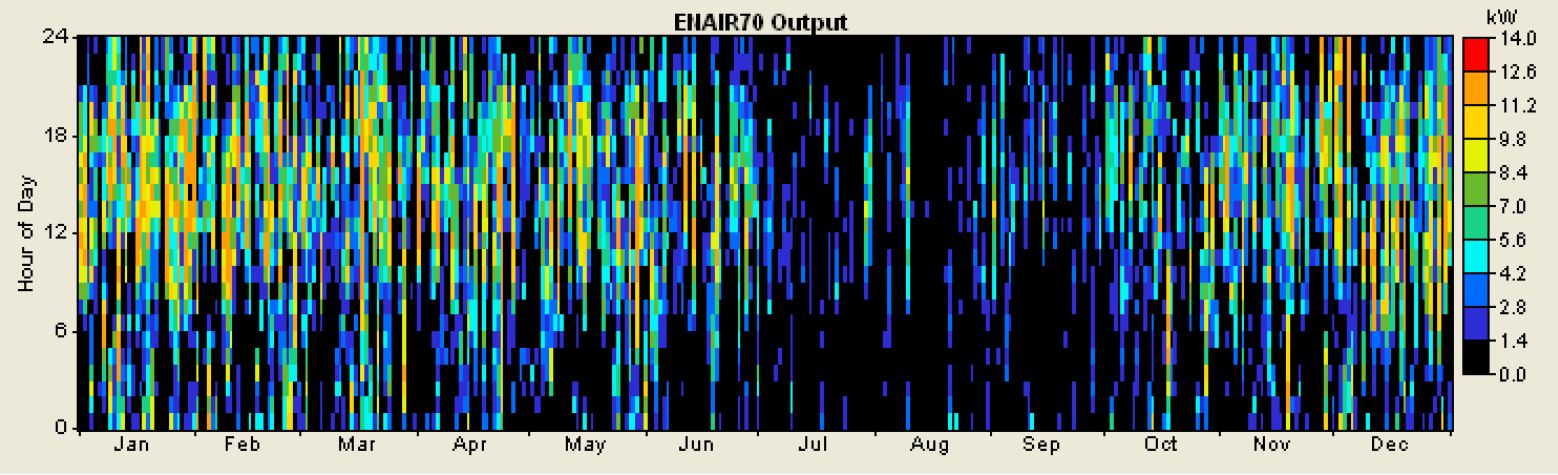
How does HOMER work ?

- HOMER simulates the operation of a system by making energy balance calculations for each of the 8,760 hours in a year.
- For each hour calculates the flows of energy to and from each component of the system.
- HOMER performs these energy balance calculations for each system configuration that you want to consider.
- It then determines whether a configuration is feasible, i.e., whether it can meet the electric demand under the conditions that you specify.
- It estimates the cost of installing and operating the system over the lifetime of the project.

Source: HOMER ENERGY, 2011

Hourly energy balance calculations





III. PROS & CONS

Advantages and Disadvantages

HOMER

Among other aspects to debate, we may say that for this training HOMER has some advantages and disadvantages.

PROS	CONS
Simulates a list of real technologies, as a catalogue of available technologies and components.	Quality input data needed (sources).
Very detailed results for analysis and evaluation.	Detailed input data (and time) needed.
Determines the possible combinations of a list of different technologies and its size.	Experienced criteria is needed to converge to the good solutions.
It is fast to run many combinations.	If you miss key values or sizes, HOMER will not guess them!
You can learn from the results, and optimize.	You can loose yourself if you don't set the adequate questions.

IV. HOW CAN THIS SIMULATION TOOL BE USEFUL TO YOU?

Examples, outputs, results and analysis

Two scenarios after this training

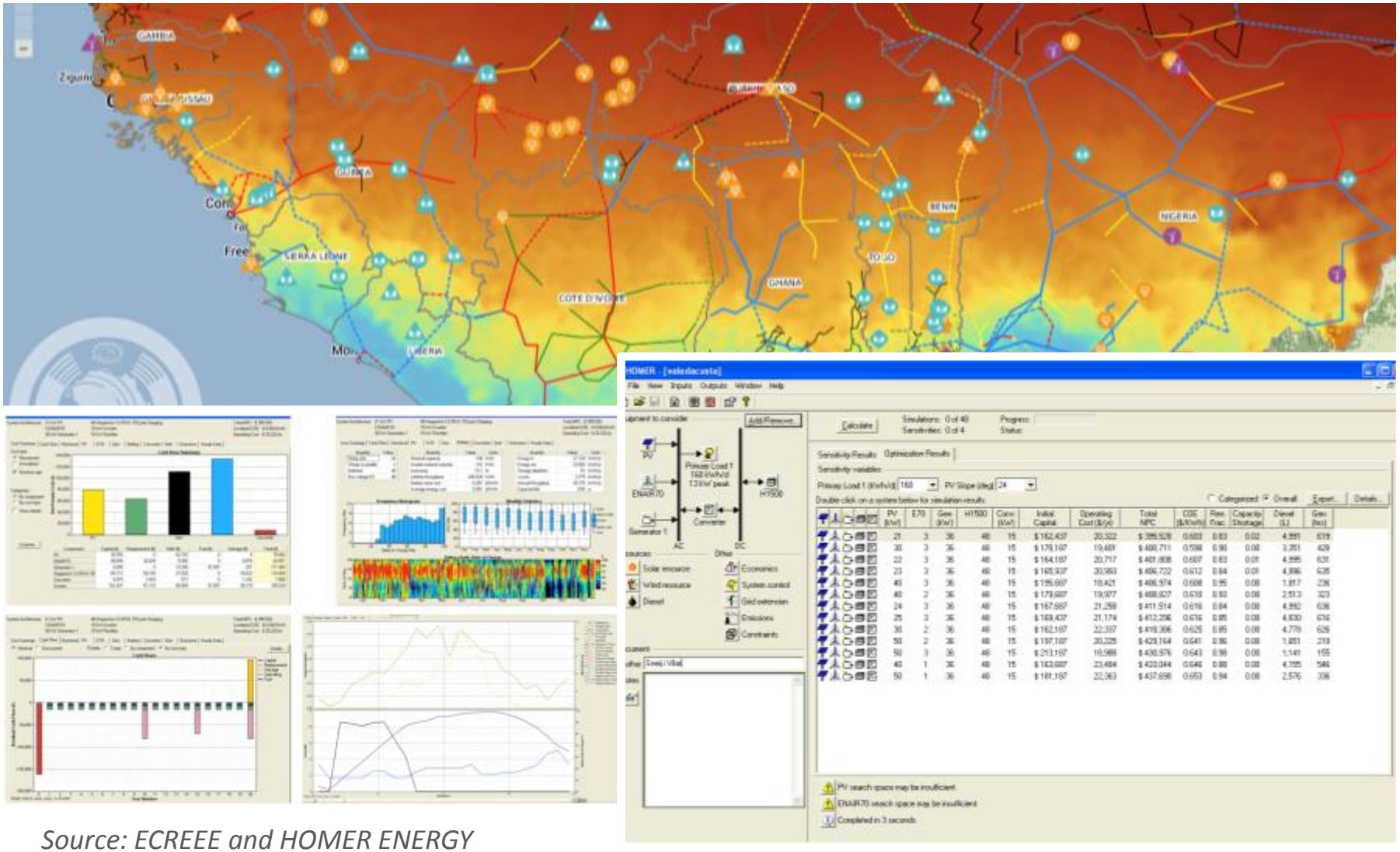
- **Audit of projects**
  - You will be able to create a HOMER file, input the data used in a project or in a proposal, and get a list of feasible solutions. You may use the results to establish a dialogue with the hybrid system designer, and require more answers or justifications.

- **Site appraisal**
  - You will be able to create a HOMER file, input relevant data and get a list of feasible solutions. You may use the results to develop insight into your designs (or plans), exploring the implications, reasoning key aspects and establish recommendations.

Audit scenario

Source: SOTEC, SMA and TTA

Appraisal scenario



Source: ECREEE and HOMER ENERGY

References

- *HOMER Energy (2011), Getting Started Guide for HOMER Legacy (Version 2.68), Homer Energy and National Renewable Energy Laboratory, Colorado. http://www.ecowrex.org/document/getting-started-guide-homer-legacy-version-268*
- *IEA, (2011), Report IEA-PVPS T11- 01:2011 World-wide overview of design and simulation tools for hybrid PV systems. http://www.ecowrex.org/document/world-wide-overview-design-and-simulation-tools-hybrid-pv-systems*

ECOWAS Regional Centre for
Renewable Energy and Energy Efficiency

Centre Régional pour les Energies Renouvelables
et l'Efficacité Energétique de la CEDEAO

Centro Regional para Energias Renováveis e
Eficiência Energética da CEDEAO

Merci! Thank you! Muito obrigado!

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