Intermittent Energies Storage via Chemicals - Le Bourget-du-Lac - France – 1, 2 July 2009

Buildings as Power Plant & Electric Vehicle as Home Appliance coupling with stationary electric storage, Simulation & Optimization

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Abstract: This study aims to assess the connection between an energy producing (and consuming) building coupled with an electric vehicle and a stationary electricity storage. The building is equipped with photovoltaic panels used principally for on-site consumption but still grid connected. Using a set of data including meteorological information, electric household appliances consumption profiles, and different scenarios of transport, the system is simulated using TRNSYS 16 on one year. Priority will be given to household consumption and electric vehicle recharge, directly or via storage. Electric grid is only used if necessary to re-inject electricity left over or as a support. The possibility to recharge the electric vehicle at work, with a photovoltaic production, is also considered. Main purposes of this study are to prove viability and benefits of electric vehicle in such a system, optimize dimensioning of the local electricity production and storage, and estimate possible autonomy level.

Purposes & Assumptions

- Take into account buildings & vehicles for a better global efficiency
- Rationalize photovoltaic production
- Minimize electric grid impact of:
  - Photovoltaic (PV) production
  - Electric vehicle (EV) recharge
- Guarantee quasi-zero emission transport
- No correlation in time between PV production and EV recharge places

Tested solutions:

-Stationary storage

-Recharge EV at work

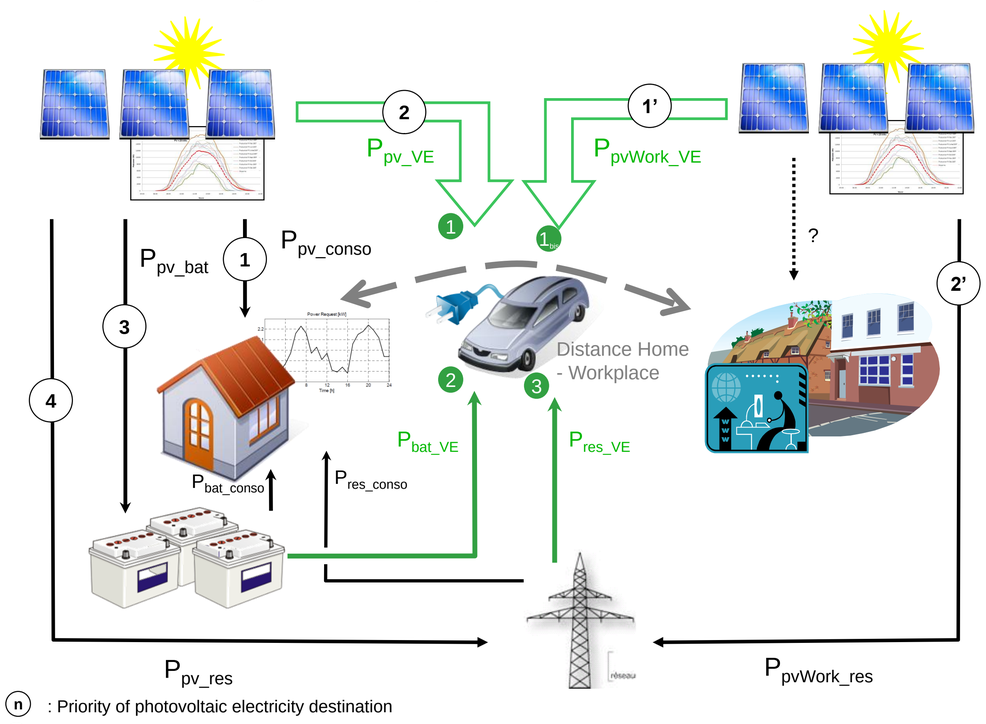
- …

Hypothesis:

- EV specifications: 30 kWh ; 150 Wh/km ; (= Bolloré BlueCar performances)
- Distance between home & workplace = French median distance (8 km)
- Very simple battery model (Power as an input)
- Household electric profile consumption from 1 year IEA statements

Methodology

- Dynamic simulation with TRNSYS 16
  - One year of simulations
  - Daily household consumption
  - Meteorological data
  - Two EV's use profiles (working days & week-end)
- Different priorities for electricity flows
  - Priority for household electric consumption & EV
  - Electric grid as a support

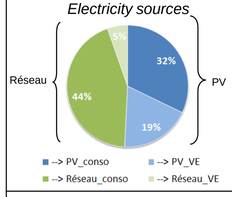
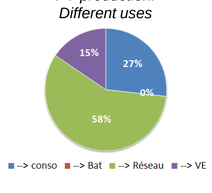
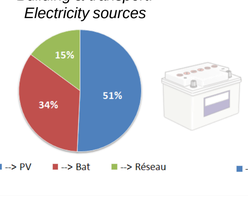
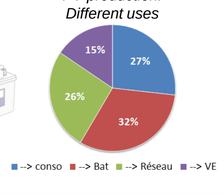
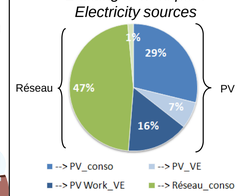
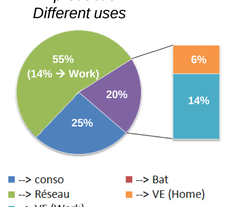
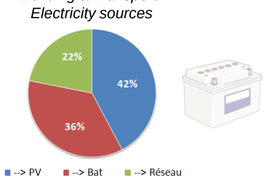
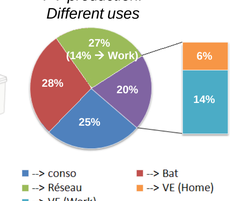


(n) : Priority of photovoltaic electricity destination

1 : Priority of EV recharge origin

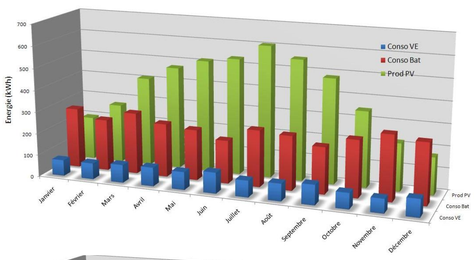
First results

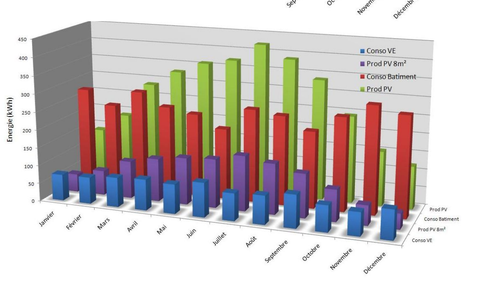
Example of different scenarios*

	Without Storage	With Storage (58 kwh – autonomy = 2 days)
PV at Home (30 m² -3.6 kWc) 	*Building & Transport: Electricity sources*  *PV production: Different uses* 	*Building & transport: Electricity sources*  *PV production: Different uses* 
	On 1 year, independant 35.4 % of time	On 1 year, independant 83.4 % of time
PV at Home (22 m² - 2.6 kWc) & at Work (8m² - 1 kWc) 	*Building & Transport: Electricity sources*  *PV production: Different uses* 	*Building & Transport: Electricity sources*  *PV production: Different uses* 
	On 1 year, independant 31.9 % of time	On 1 year, independant 78.9 % of time

* - Evaluation of the PV power plant is made according to total electricity consumption (household consumption & EV consumption) with Grenoble meteorological data.

- Evaluation of the electricity storage is made in order to have a complete autonomy of 2 days.





Monthly energetic needs & production on 1 year, with and without PV production at work

Observations

- **Stationary storage:**
  - allow to extand global autonomy of the system
  - is especially interesting for household electric consumption

BUT expensive & lifetime limited

- **Recharge at work:**
  - No additional cost
  - Permit to extand EV autonomy regarding electric grid

BUT global efficiency not very significant (in this case)

Followings

- ❑ Test more specific scenarios
- ❑ Optimize sizing of PV power plant and storage capacity in order to meet total electric needs
- ❑ Integrate economic factor

Interrogations:

- ❑ Modelling more precisely batteries (for EV & stationary storage)?
- ❑ Interest for a large scale application?
- ❑ The other possible EV uses: → V2G – V2H

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