NZEB & EV
for Energy Positive Communities

NZEB : Nearly Zero Energy Building
EV : Electric Vehicle

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CSTB Grenoble

Sustainable Places 01/10/2014

ADEME POLINOTEN Project : CEA, IFPEN, DAUPHINE,CSTB

CONTENT

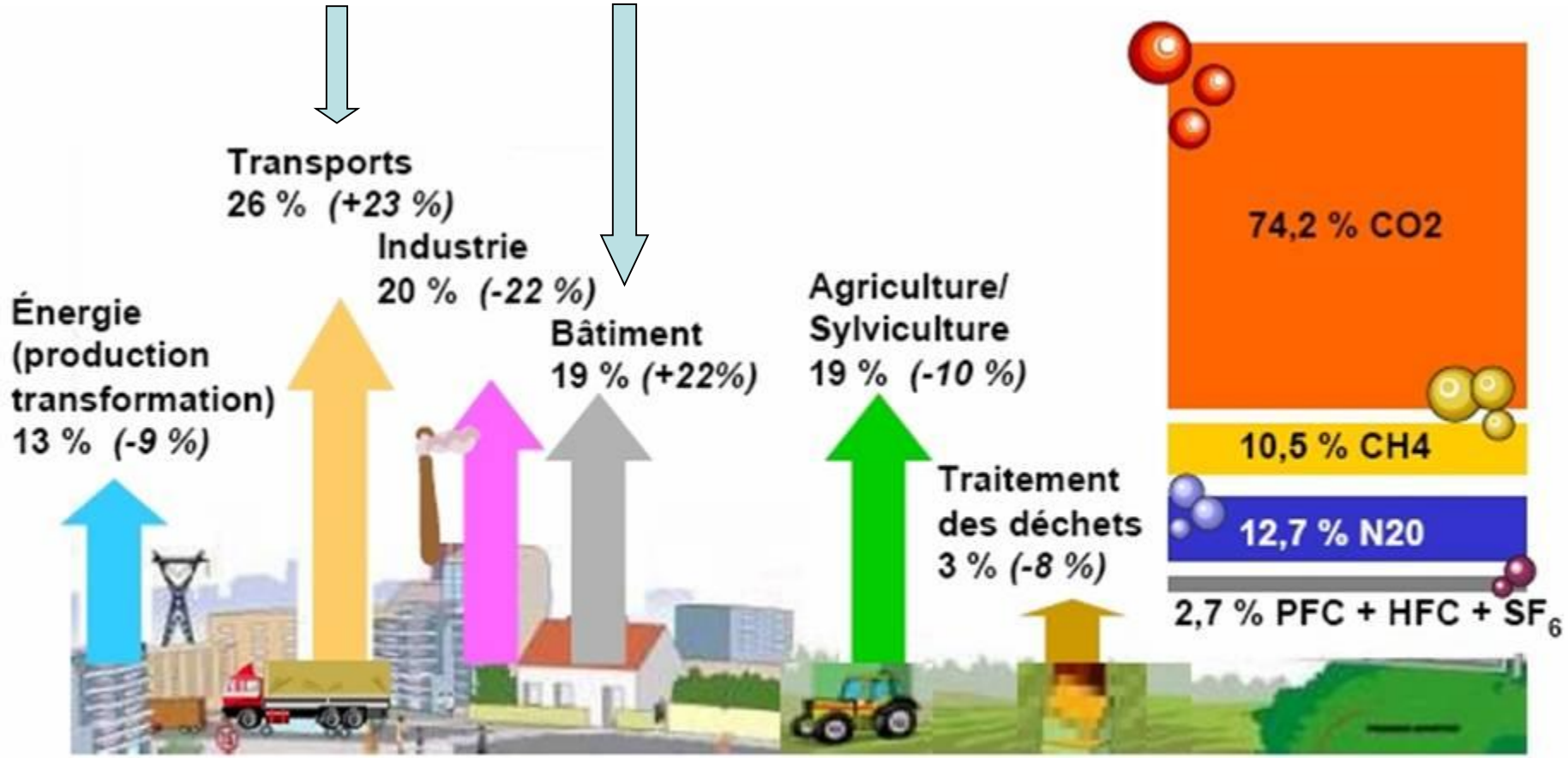
- Context
- Simulation
- Results
- Prospective
- Conclusion

CSTB
le futur en construction

CONTEXT

CO2 EMISSION - FRANCE

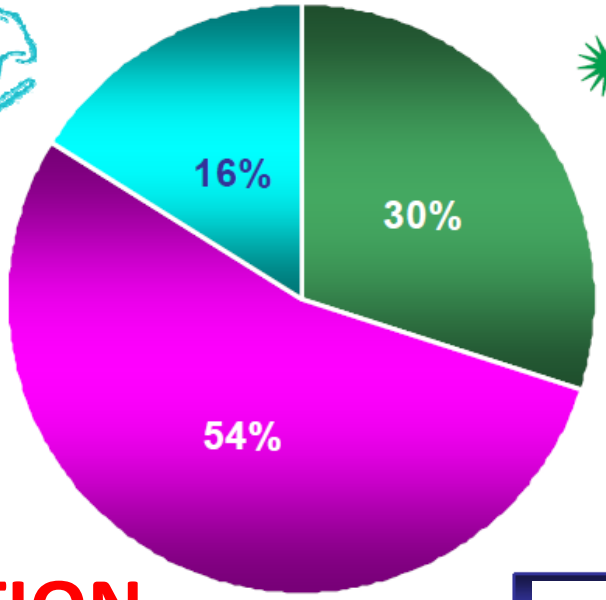
Transportation + Buildings : 47 % GHG – 70 % Energy



Émissions de gaz à effet de serre en France (y compris DOM/COM) en 2004, par secteur (entre parenthèses, l'évolution depuis 1990 ; source : CITEPA/Inventaire SECTEN/Format PNLCC, février 2006)

CO2 EMISSION - HOUSEHOLD

3 : FOOD



2 : HOUSING

1 :TRANSPORTATION

- TRANSPORTATION
- HOUSING
- FOOD

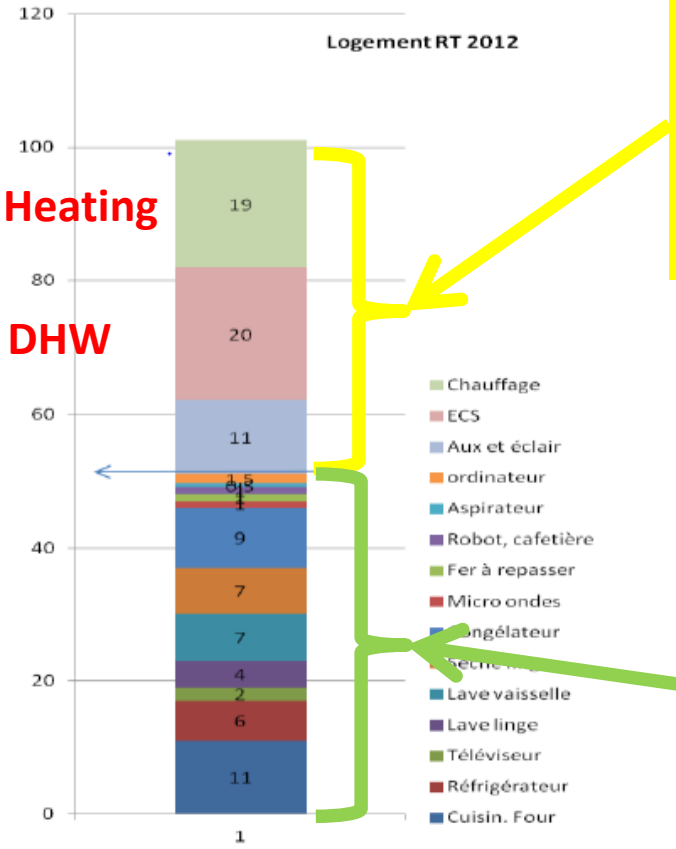
Bilan carbone moyen

En $KgCO^2$ / an

	HOUSEHOLD	PERSON
CARBON FOOTPRINT	14 179	7 388
TRANSPORTATION	7 765	3 972
HOUSING	4 087	2 258
FOOD	2 327	1 159

Source : GREEN INSIDE – IPSOS - 2011

… the household's "energy burden"



1 : THERMAL REGULATION
Heating, Cooling, DHW,
Ventilation,
Lighting & Pumps & Fans
50 kWh-PE/m².year

2 : APPLIANCES & ICT
2700 kWh/year
70 kWh-PE/m².year
(Source ADEME)

3 : MOBILITY
ICE : 9800 kWh/year
EV : 2600 kWh/year
EV : 6700 kWh-PE/year
ICE : 98 kWh/m².y. (100 m²)
EV : 67 kWh-PE/m².y. (100 m²)

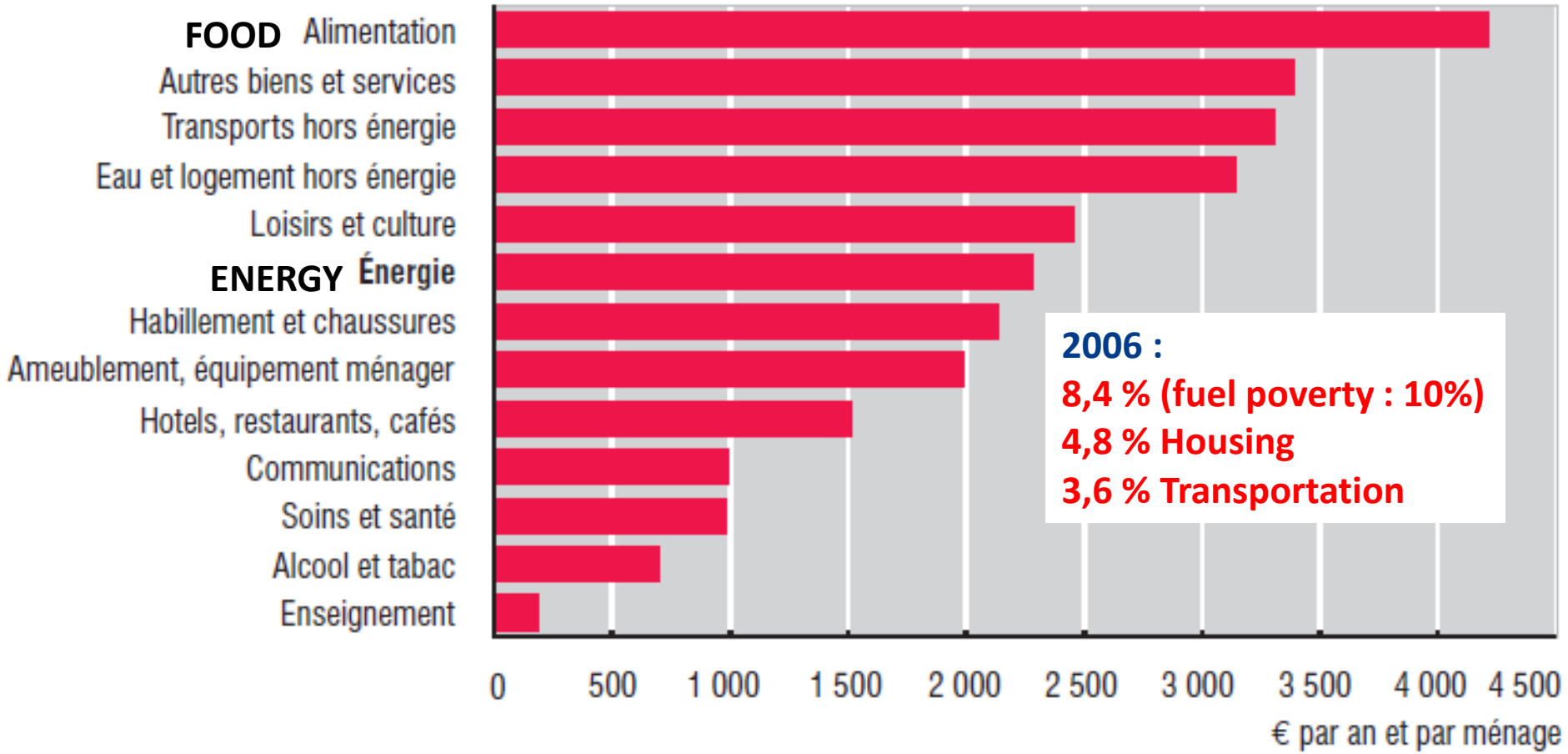
	ICE	EV
Consumption	7l/100km	150Wh/km
	70kWh/100km	15kWh/100km
km/an	14000	14000
Consumption	9800 kWh/year	2600 kWh/year
		6708 kWh-PE/year

4 : EMBODIED ENERGY
Building only
50 kWh-PE/m².year (50 years)

Missing
ENR
Appliances & ICT
Transportation

Source : **PLAN BATIMENT GRENELLE -LA GARANTIE DE PERFORMANCE ENERGETIQUE**

Household's Energy Expenditures (2006)



Champ : ménages métropolitains.
Source : Insee, enquête Budget de famille 2006.

Total : 27381 €/year
Energy : 2300 €/year

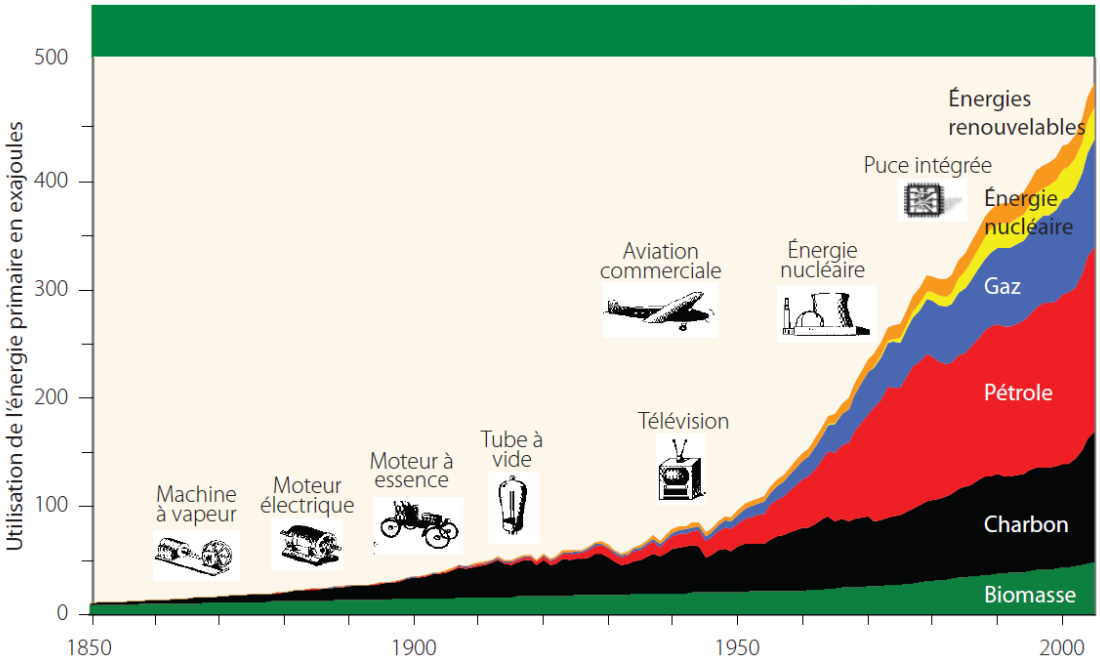
Source : INSEE

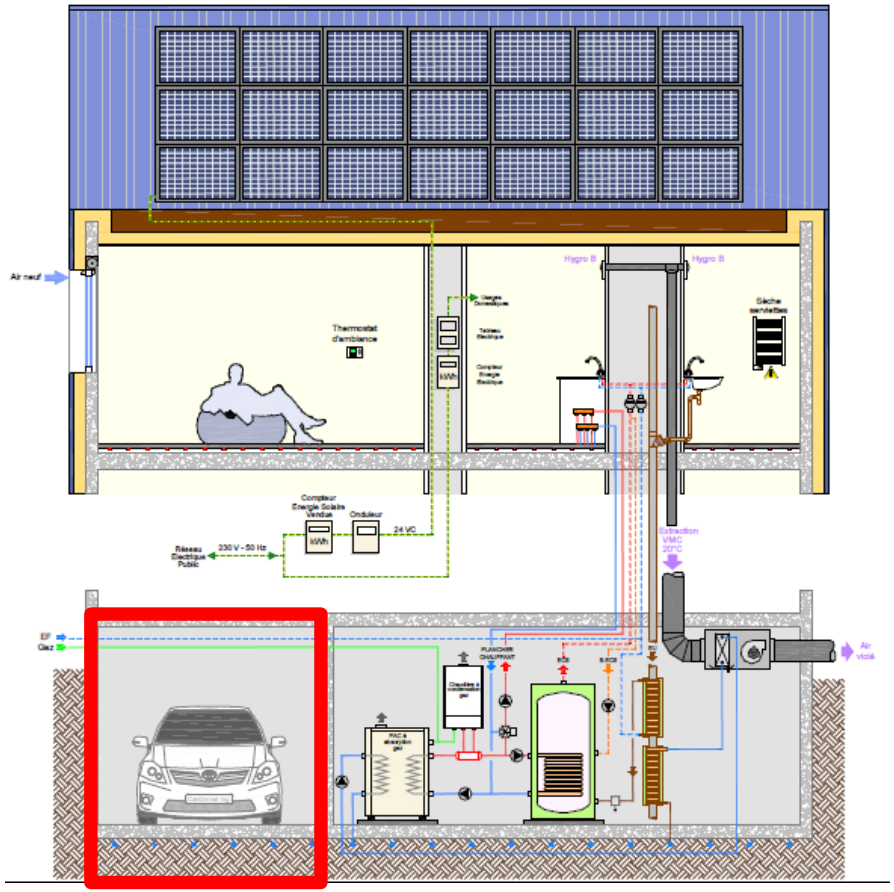
… the TECHNOLOGIES to meet the NEEDS

ICE & BOILER
Since 1850

Resource Depletion
Climate Change
Pollution & Health Impact

→ REN HOME ?

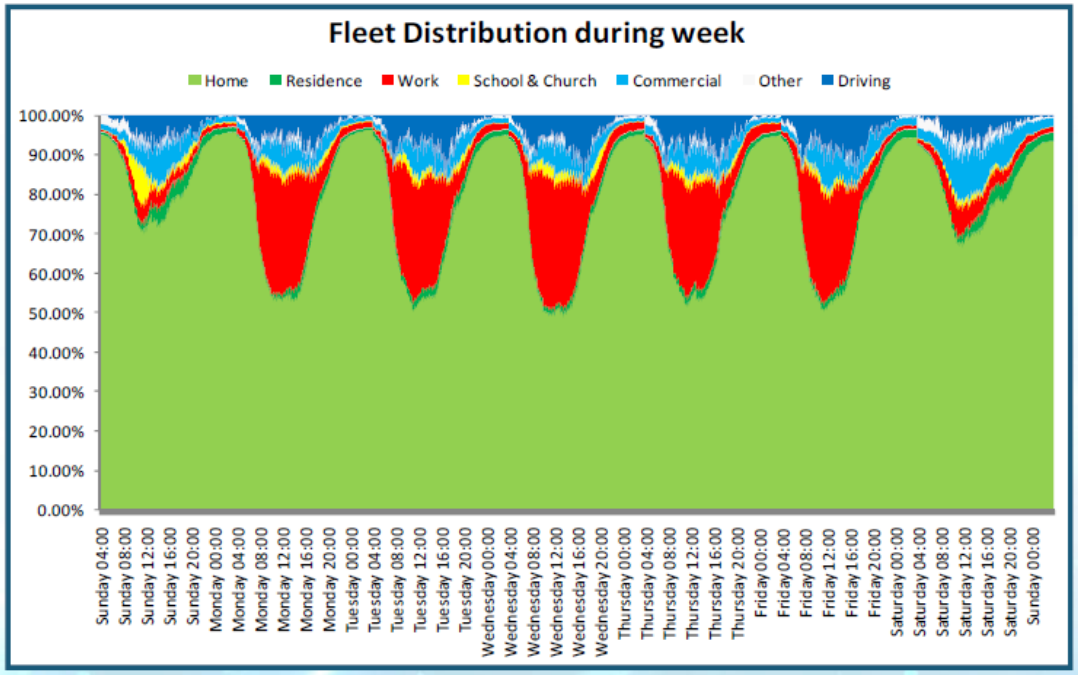




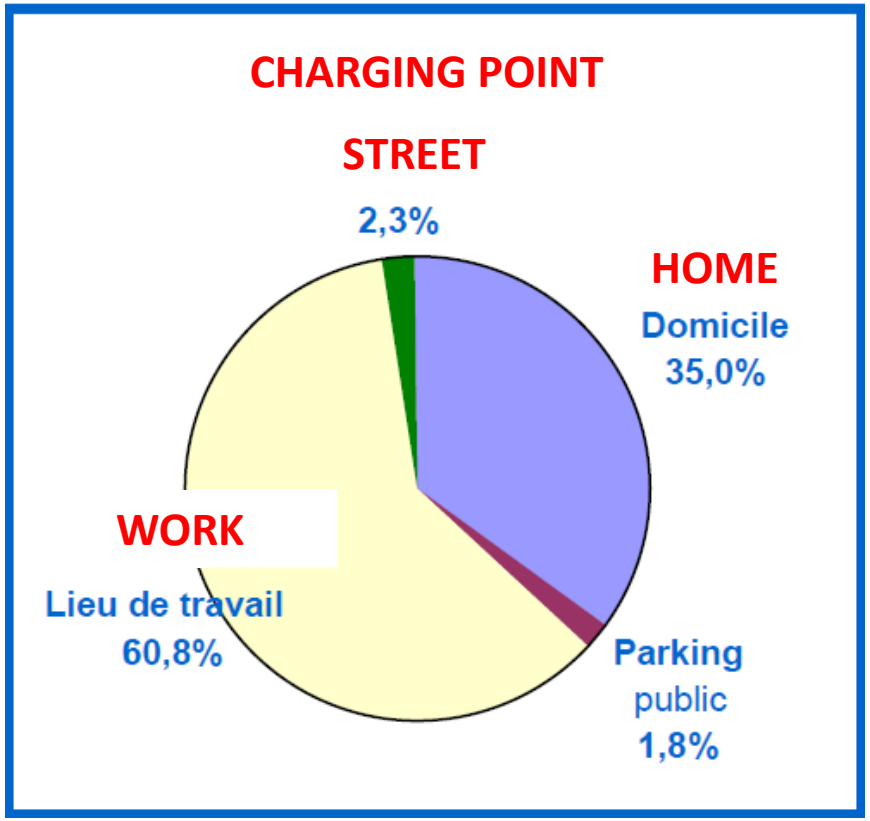
MOBILITY & COMFORT

Source : Cardonnel

Where are the cars ?



Source – GM-SAE



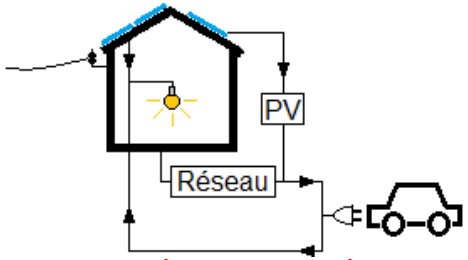
Source : Projet KLEBER - Strasbourg

France

18 Millions of Single Houses = 18 Millions of Charging Points ?

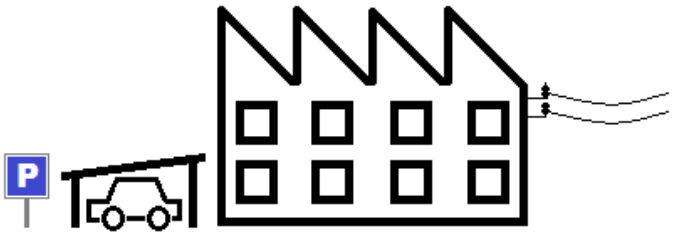
SIMULATION

3 scenario



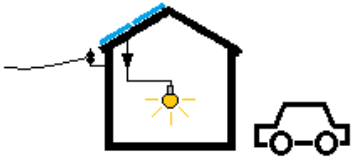
HOME **WORK**

Domicile Travail

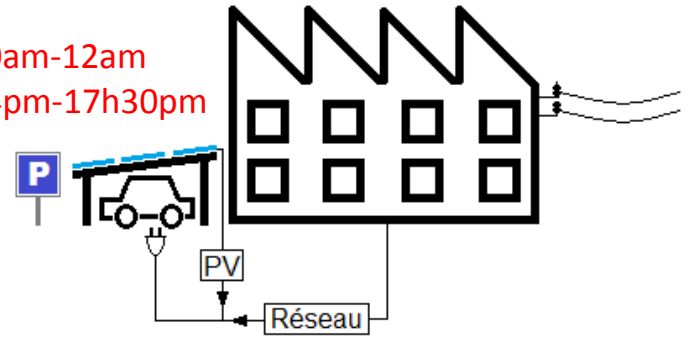


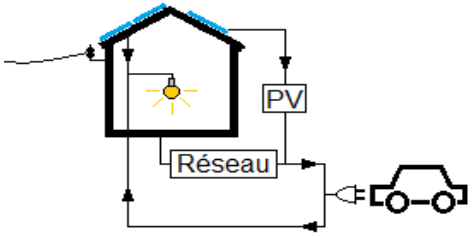
Charge at Night : 10pm-8am
EV Battery used from 6pm-10pm

Charge at Work : 10am-12am 14pm-17h30pm

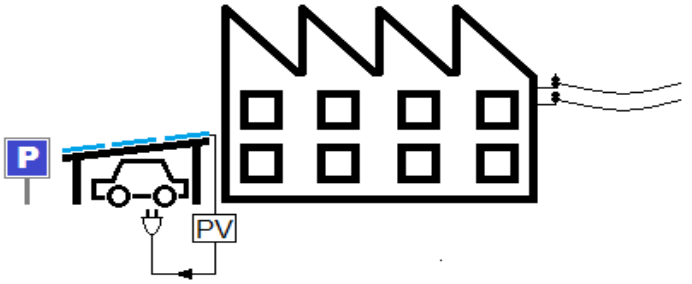


Domicile Travail





Domicile Travail



Every Day Travel : 50 km Round Trip - 16 km Round Trip + 100 km WE

Hypothesis & Scenario

PV & Climate

- 140 Wc/m²
- Whole system efficiency : 86 %
- Two cities - Data from METEONORM
  - Trappes : 973 Wh/Wc
  - Carpentras : 1320 Wh/Wc
- PV surface at work : 13 m^2
- PV surface at home : from 24m^2 à 47 m^2

EV Battery

- **25 kWh**
- EV consumption : 200 Wh/km
- 230 V 16 A - Power =3700 W

Electricity Consumption at Home

- Data from Annex 42 de l'EA
  - Measured in UK 2003 et 2005
  - **Household (65 m² , 2 Childs)**
  - Electricity Consumption : **3028 kWh/year**
- Electricity Profiles : 1 year, every 5 minutes
- Simulation : 1 year
- **Heating and DHW are not taken into account as they do not used electricity as energy source**

Commuting & Travel (WE) Scenario

- Two Average distances : 16 km & 50 km AR
- At home : 6 pm – 8 am
- At work : 8h30 am – 5h30 pm
- Travel : ½ hour
- WE : 50 km/day – 2 am -5 am
- **EV battery used as energy source : 6 pm – 10 pm**
- At home : grid charge : 10h am -8h pm
- At work : grid charge : 10 pm -12 & 2 am- 5h30 am

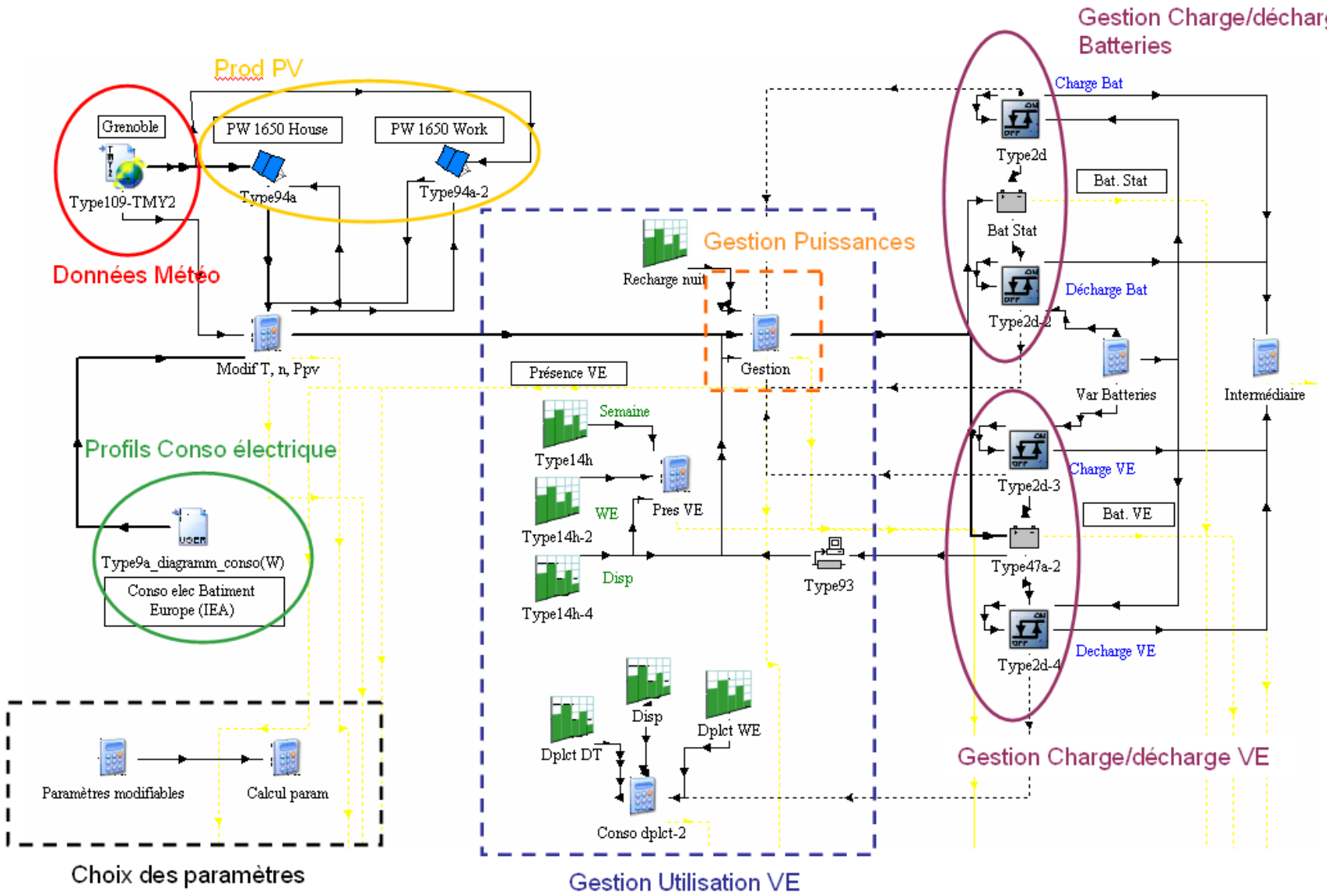
Case Studies

Ref.	km site	PV	PV at Home	PV at Work	PV Surface at Home	PV Surface at Work	Total PV Surface
1a	50T	H	6,72 kWc	0 kWc	47,6 m²	0 m²	47,6 m²
1b	50T	W	3,68 kWc	1,92 kWc	26,1 m²	13,6 m²	39,7 m²
1c	50T	HW	6,72 kWc	1,92 kWc	47,6 m²	13,6 m²	61,2 m²
1d	50C	H	4,96 kWc	0 kWc	35,1 m²	0 m²	35,1 m²
1e	50C	W	2,72 kWc	1,92 kWc	19,3 m²	13,6 m²	32,9 m²
1f	50C	HW	4,96 kWc	1,92 kWc	35,1 m²	13,6 m²	48,8 m²
2a	16T	H	4,64 kWc	0 kWc	32,9 m²	0 m²	32,9 m²
2b	16T	W	3,68 kWc	1,92 kWc	26,1 m²	13,6 m²	39,7 m²
2c	16T	HW	4,64 kWc	1,92 kWc	32,9 m²	13,6 m²	46,5 m²
2d	16C	H	3,36 kWc	0 kWc	23,8 m²	0 m²	23,8 m²
2e	16C	W	2,72 kWc	1,92 kWc	19,3 m²	13,6 m²	32,9 m²
2f	16C	HW	3,36 kWc	1,92 kWc	23,8 m²	13,6 m²	37,4 m²

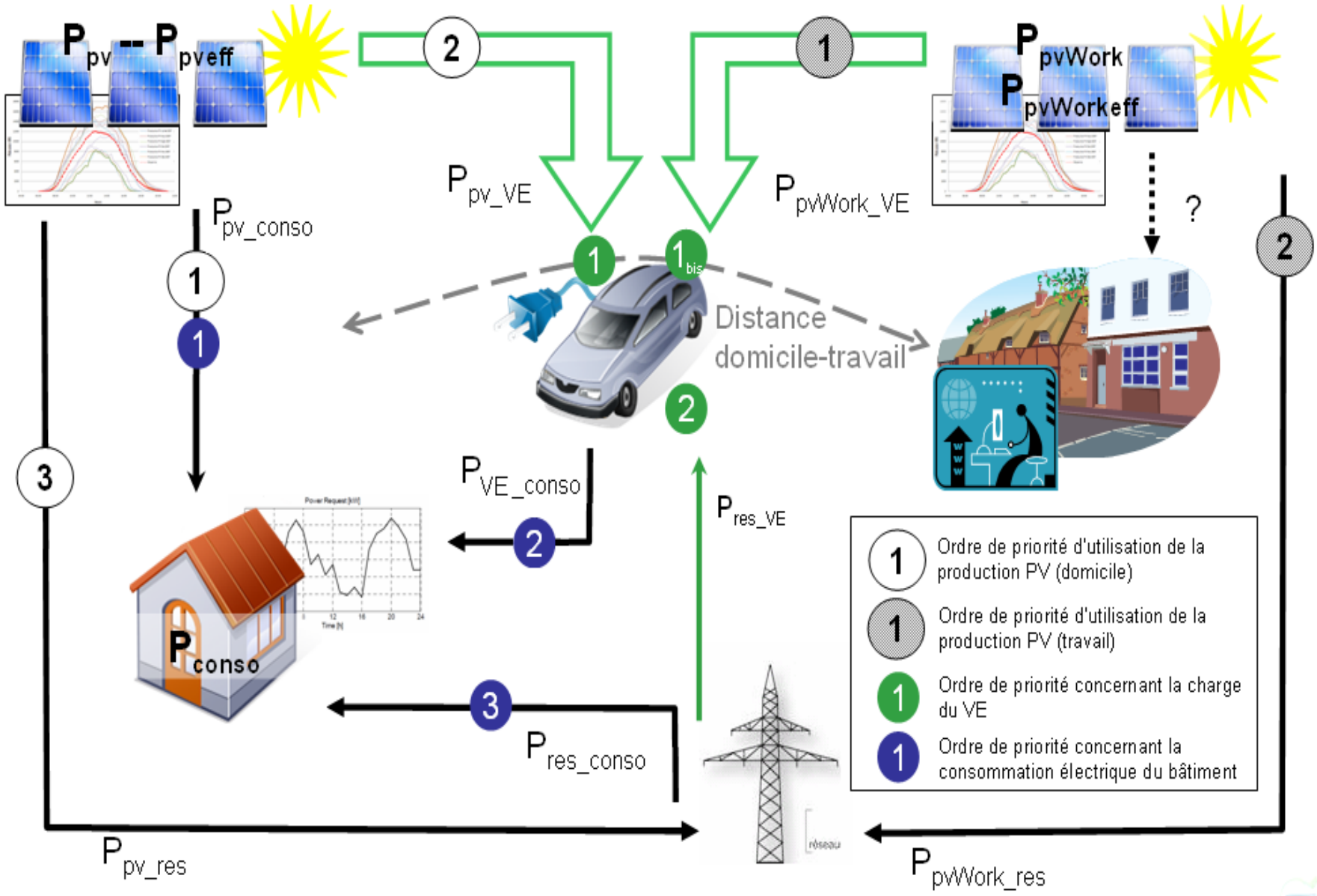
T : Trappes (North) – **C : Carpentras (South)**

H : Home – W : Work

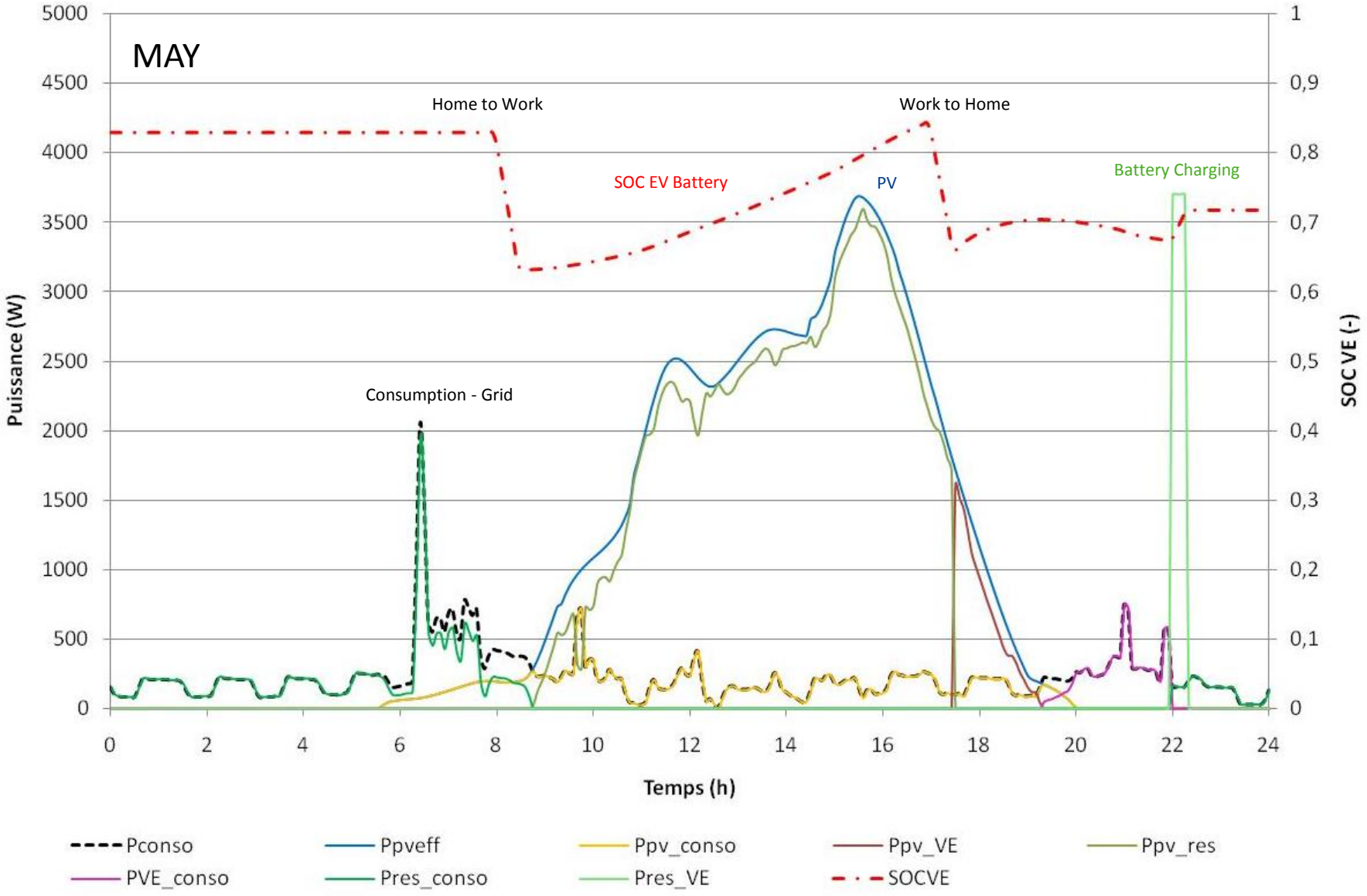
TRNSYS software



Priorities

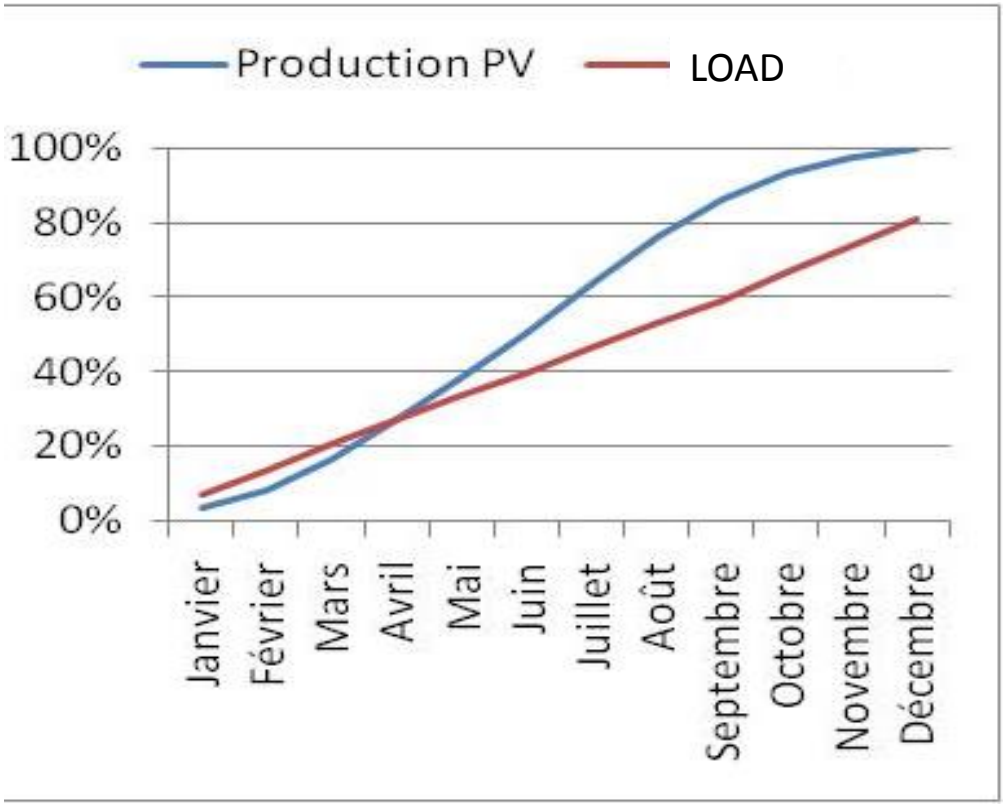

HOME
WORK
P pv -- P pveff
P pvWork
P pvWorkeff
2
1
P pv_VE
P pvWork_VE
?
P pv_conso
1
1
1bis
Distance
domicile-travail
2
2
3
P VE_conso
2
P res_VE
P conso
3
P res_conso
P pv_res
P pvWork_res
réseau
1 Ordre de priorité d'utilisation de la production PV (domicile)
1 Ordre de priorité d'utilisation de la production PV (travail)
1 Ordre de priorité concernant la charge du VE
1 Ordre de priorité concernant la consommation électrique du bâtiment

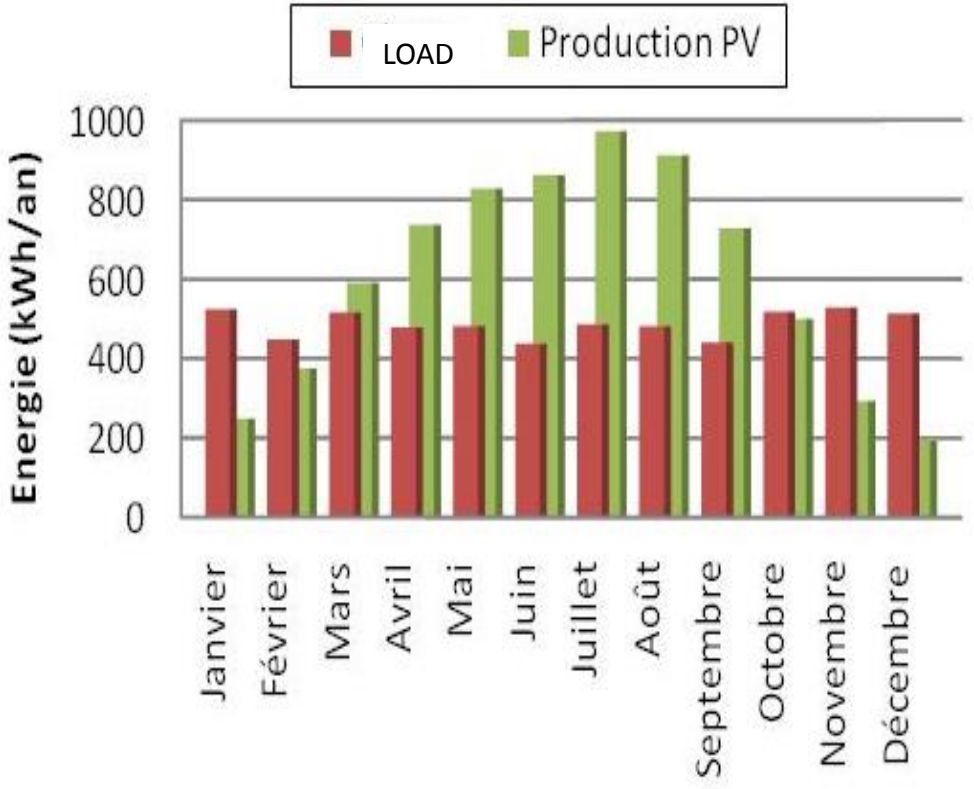
Consumption/Production Profile (at home)
SOC EV battery



RESULTS

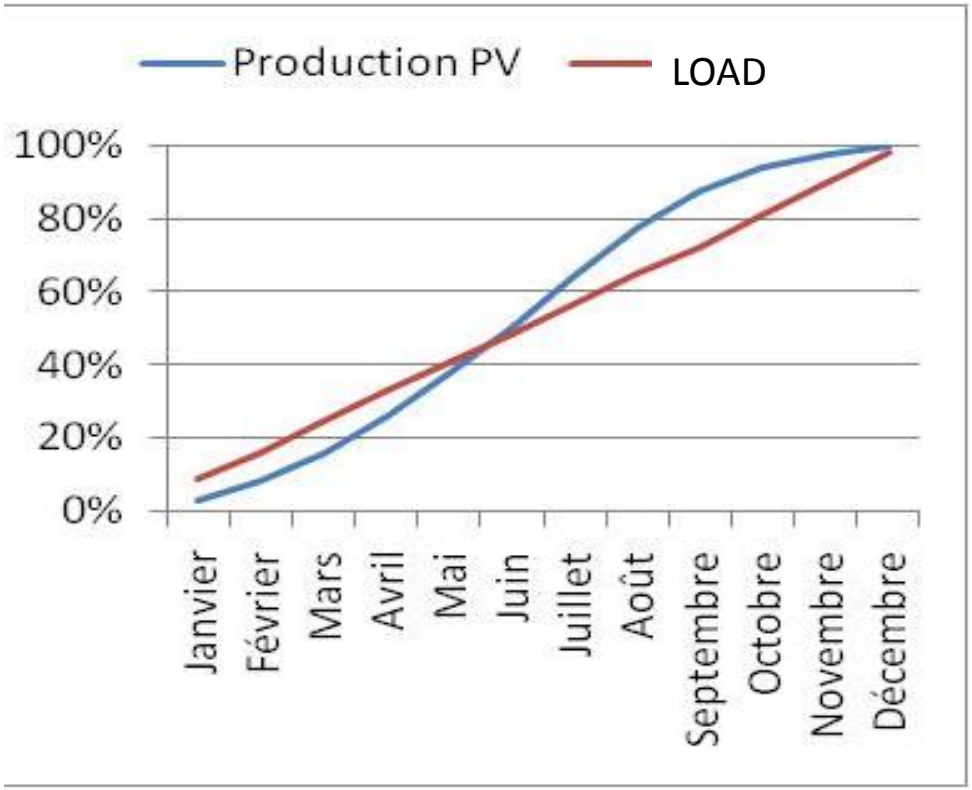
Trappes 50km - PV- At Home

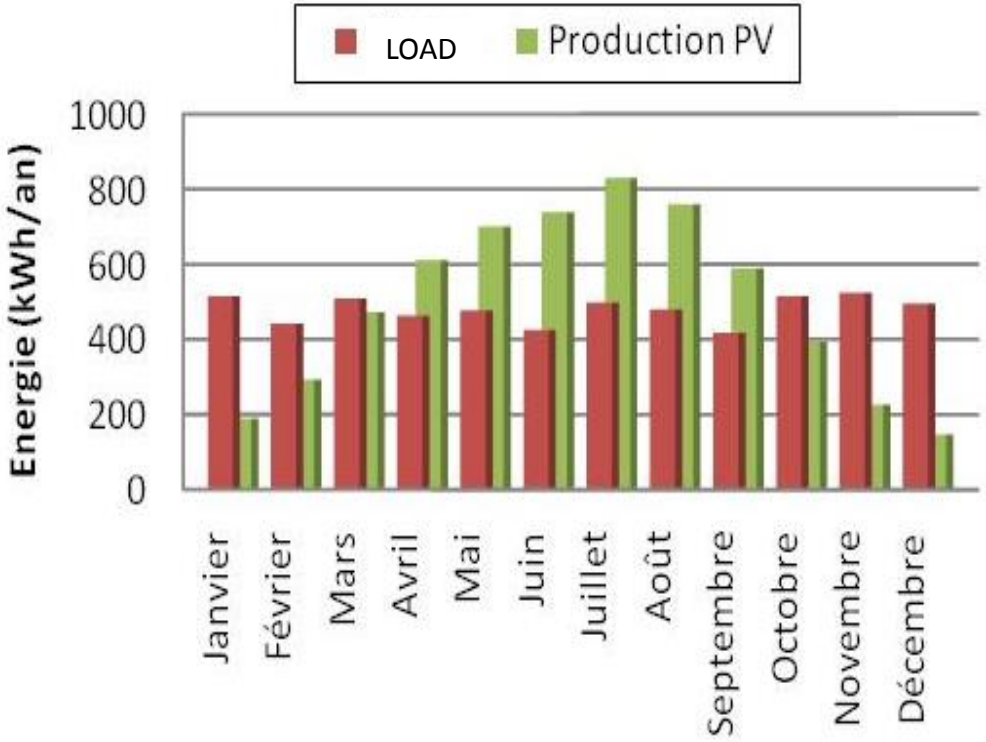




At home	At work	PV surface at home	PV surface at work	Total PV Surface
6,72 kWc	0 kWc	47,6 m²	0 m²	47,6 m²

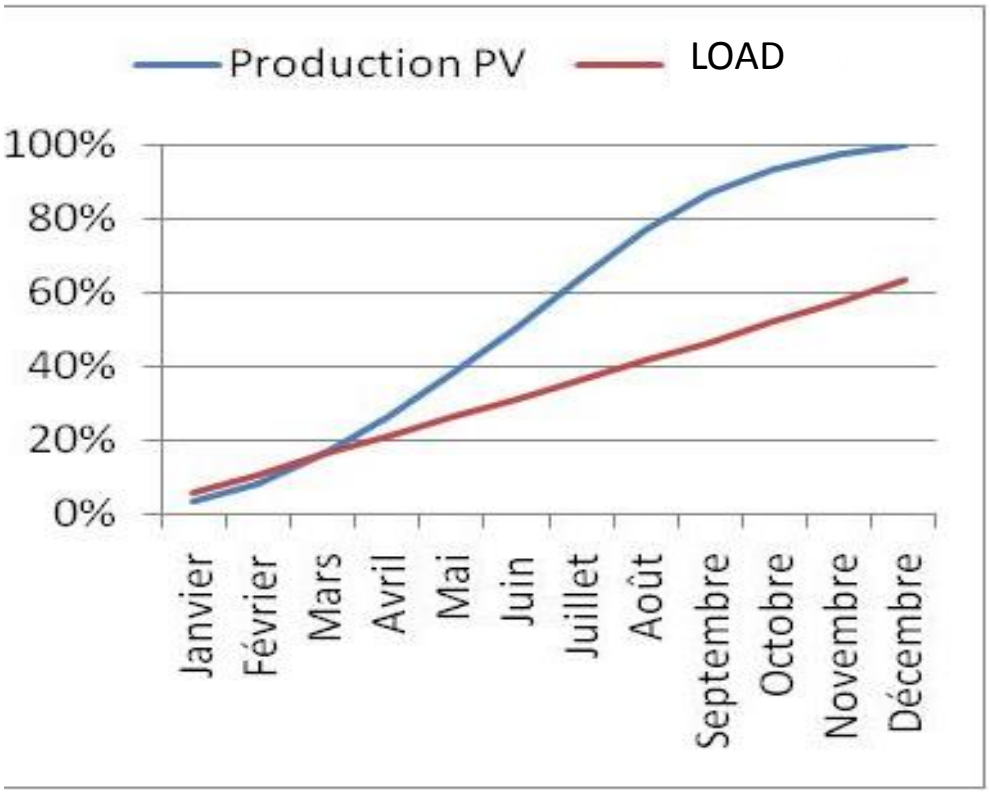
Trappes 50km PV-At Work

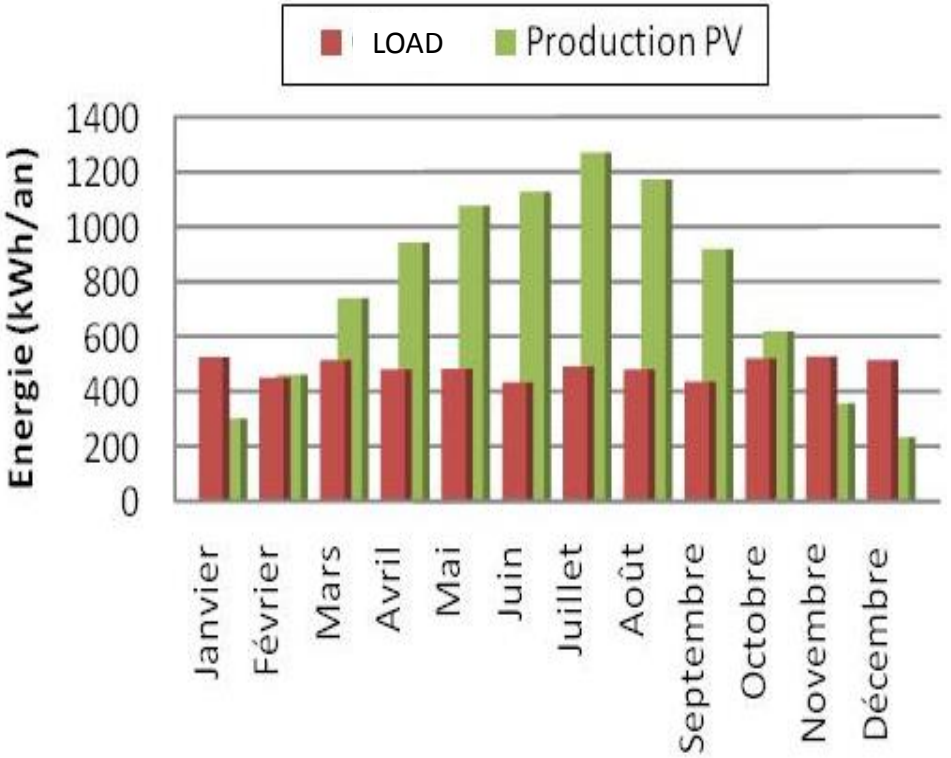




At home	At work	PV surface at home	PV surface at work	Total PV Surface
3,68 kWc	1,92 kWc	26,1 m^2	13,6 m^2	39,7 m^2

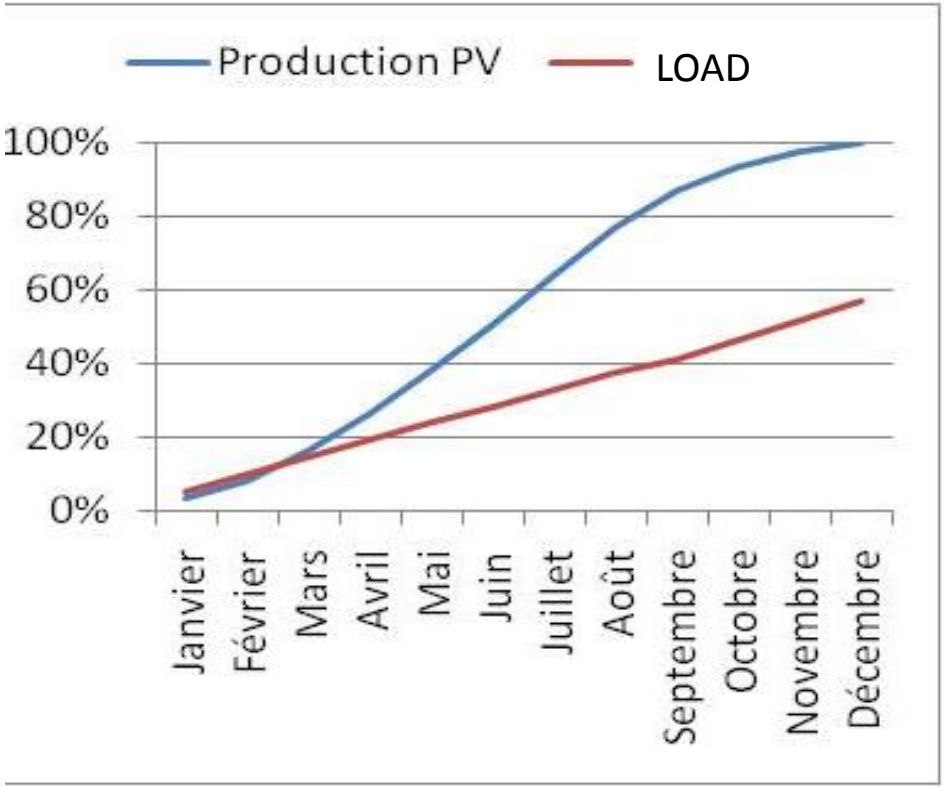
Trappes 50km PV- H+W

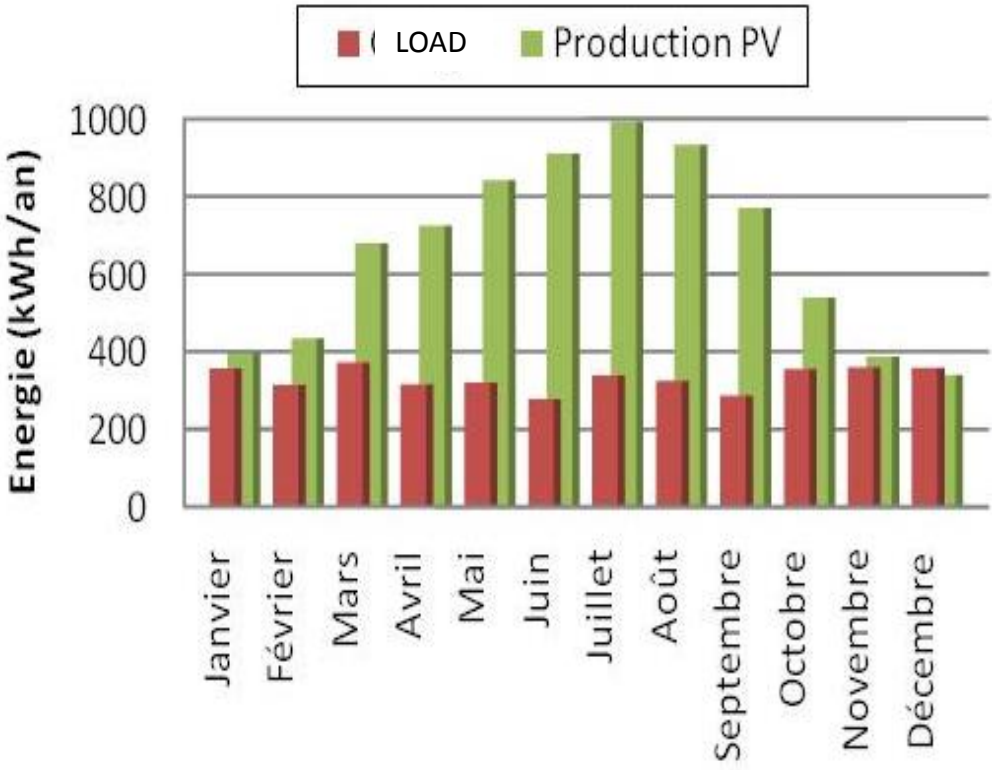




At home	At work	PV surface at home	PV surface at work	Total PV Surface
6,72 kWc	1,92 kWc	47,6 m^2	13,6 m^2	**61,2 m^2**

Carpentras 16km PV- H+W

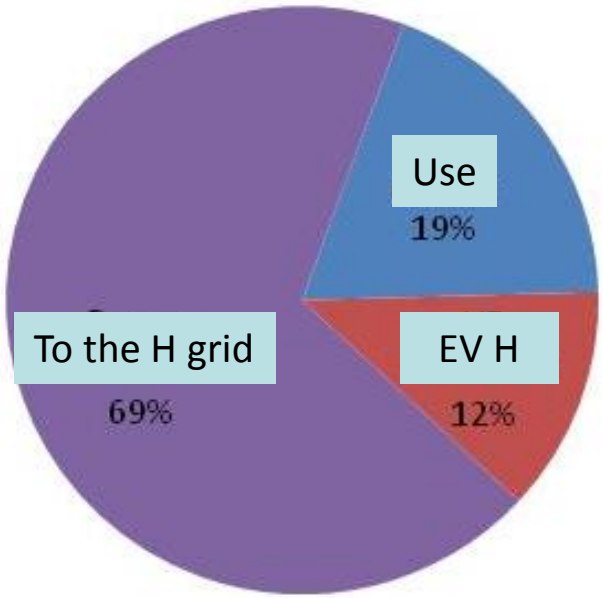


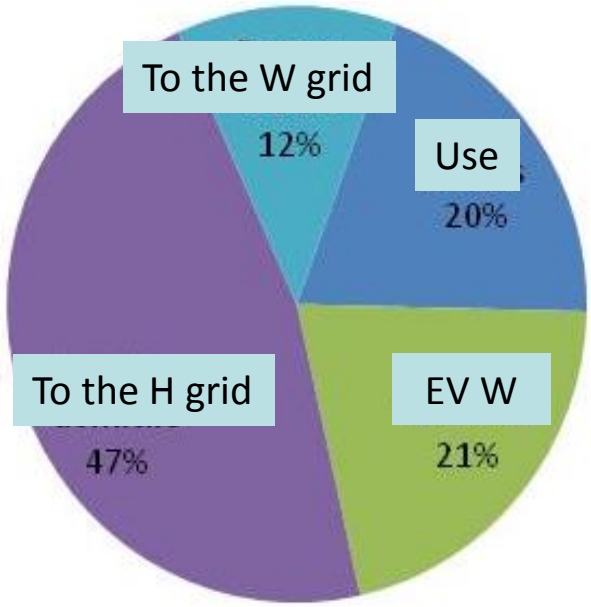


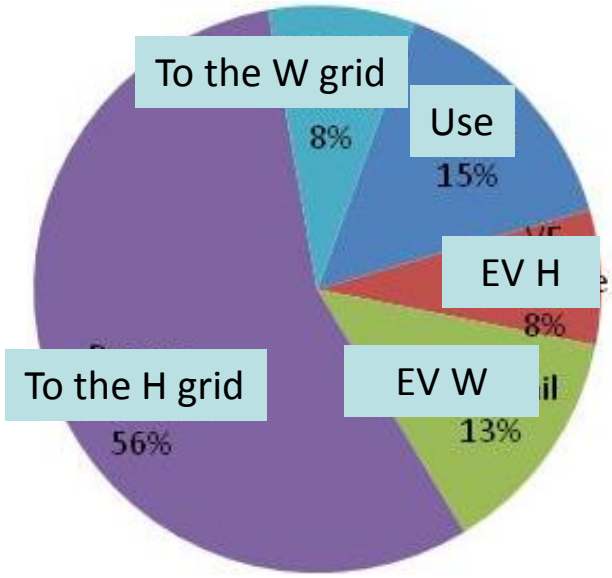
At home	At work	PV surface at home	PV surface at work	Total PV Surface
3,36 kWc	1,92 kWc	23,8 m^2	13,6 m^2	37,4 m^2

Trappes 50km

Use of PV



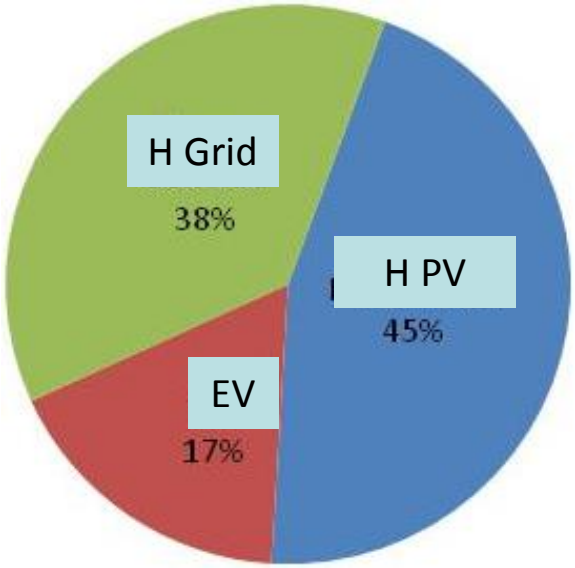


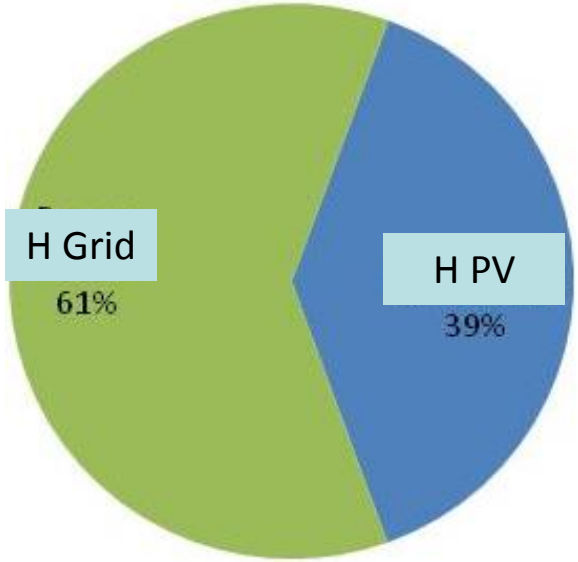


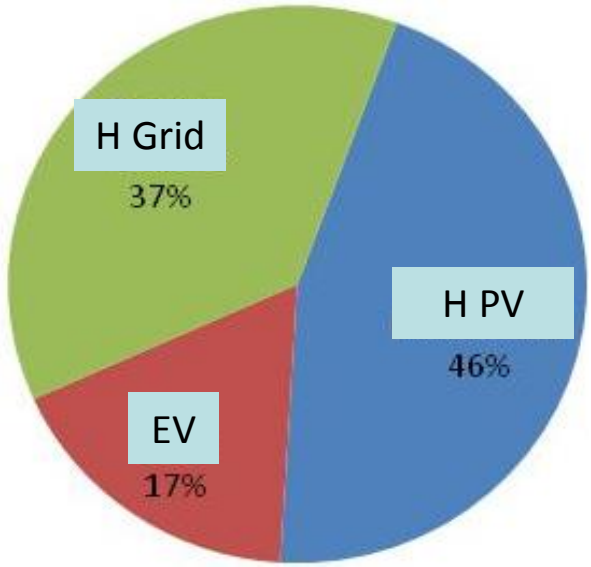
PV	Home	Work	H+W
At home	7238 kWh	3964 kWh	7238 kWh
At work	0 kWh	1985 kWh	1985 kWh
To the grid	4964 kWh	3512 kWh	5921 kWh

Trappes 50 km

Electricity sources for Appliances



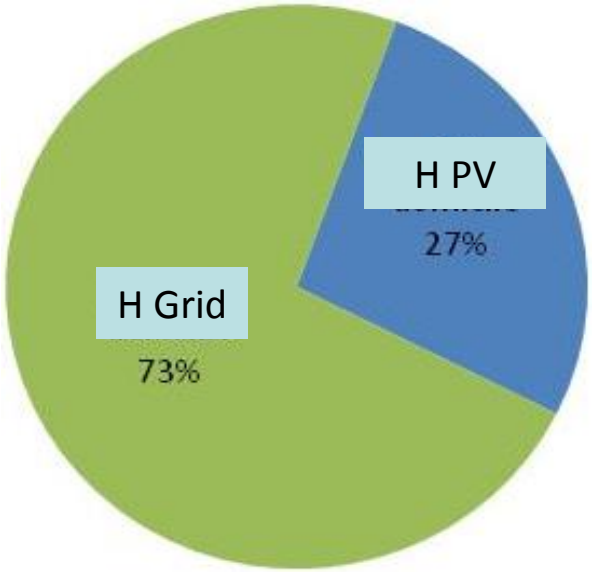


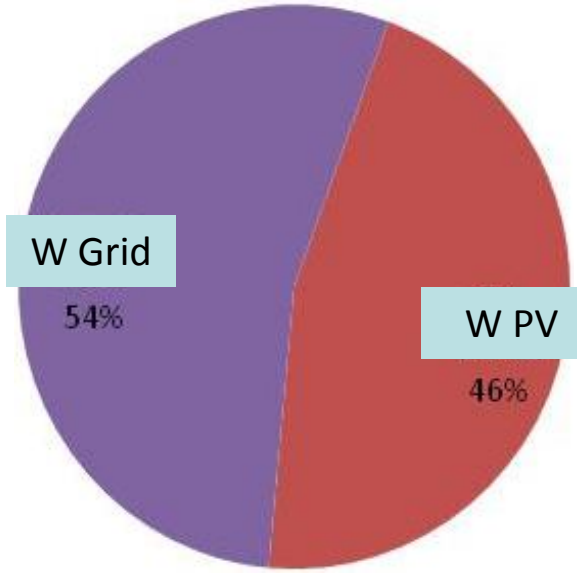


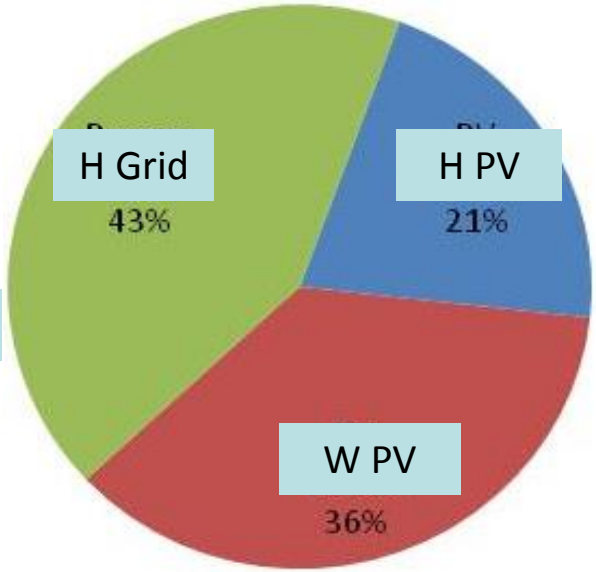
PV	Home	Work	H+W
Cons.	3028 kWh	3028 kWh	3028 kWh
Grid	1133 kWh	1848 kWh	1130 kWh
EV	521 kWh	0 kWh	524 kWh

Trappes 50km

EV Source



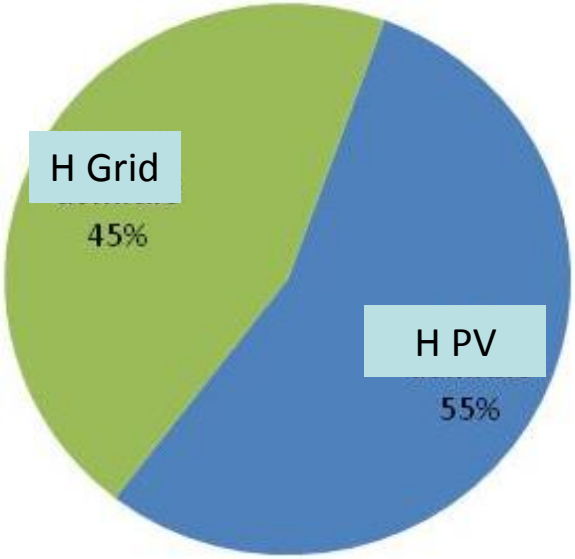


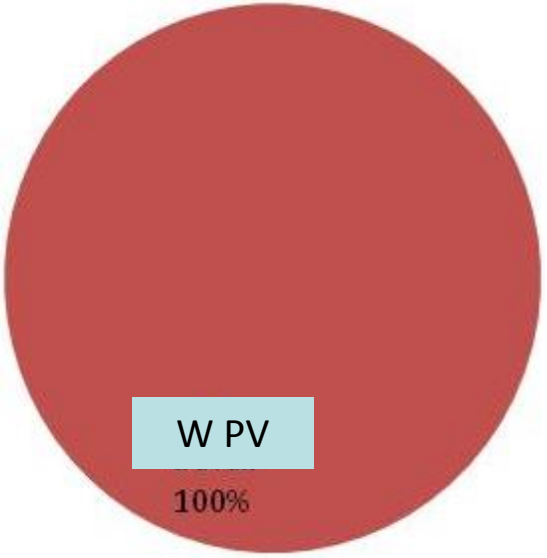


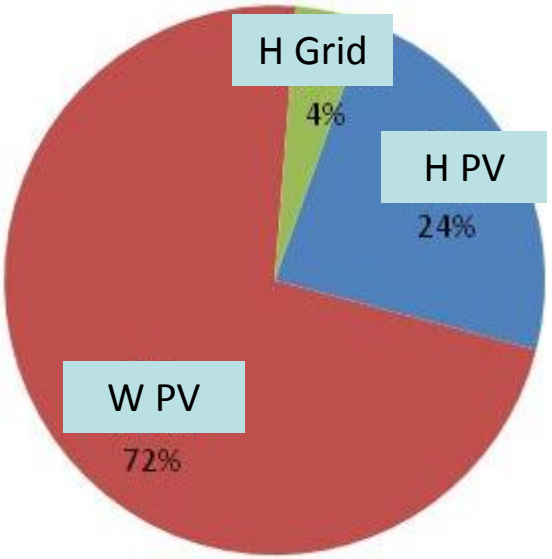
PV	Home	Work	H+W
Cons.	3345 kWh	2735 kWh	3351 kWh
Grid	2446 kWh	1479 kWh	1424 kWh

Carpentras 16km

EV Source

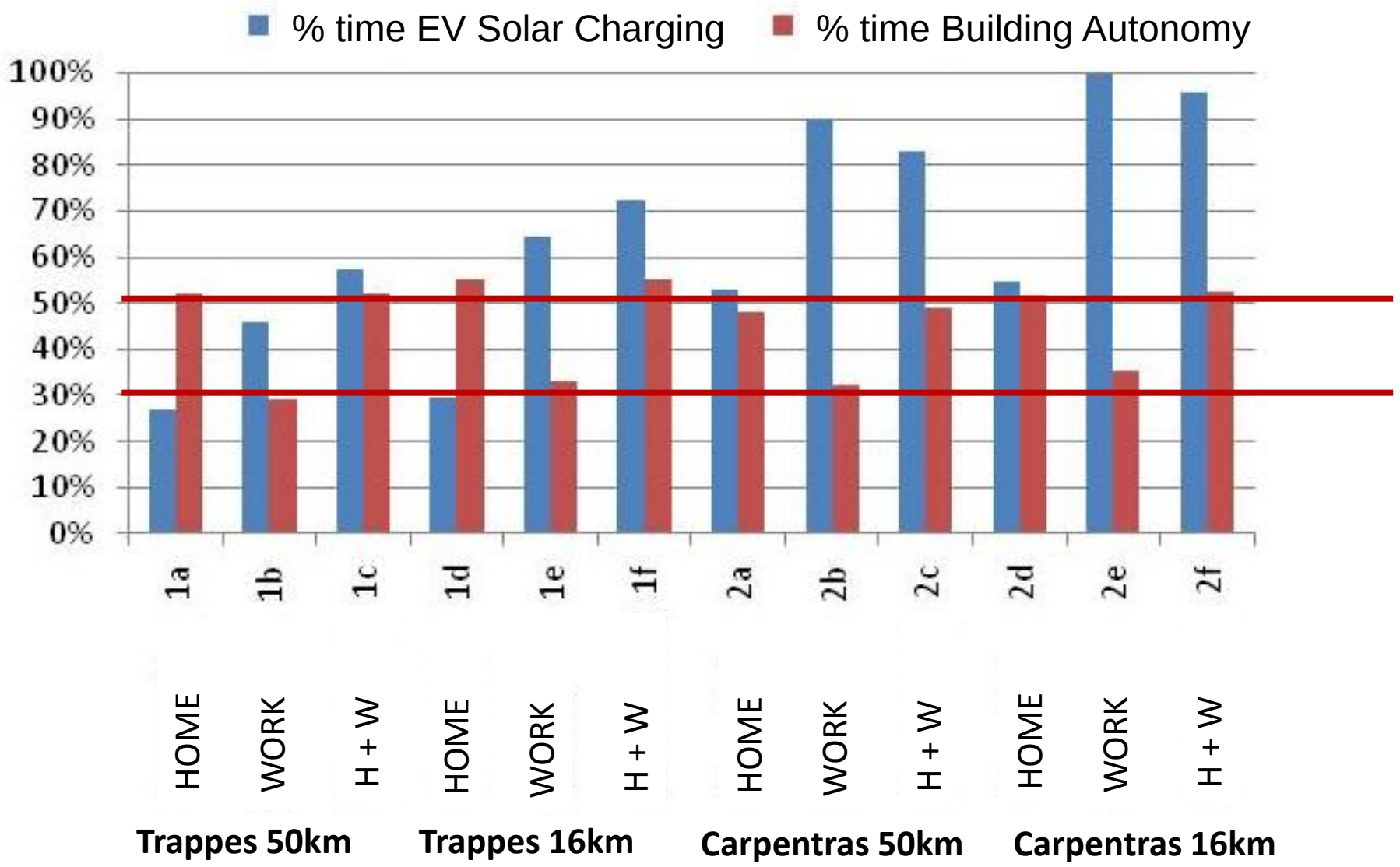






PV	Home	Work	H+W
Cons.	1424 kWh	869 kWh	1511 kWh
Grid	643 kWh	0 kWh	65 kWh

Building Autonomy
EV Solar Charging



PROSPECTIVE

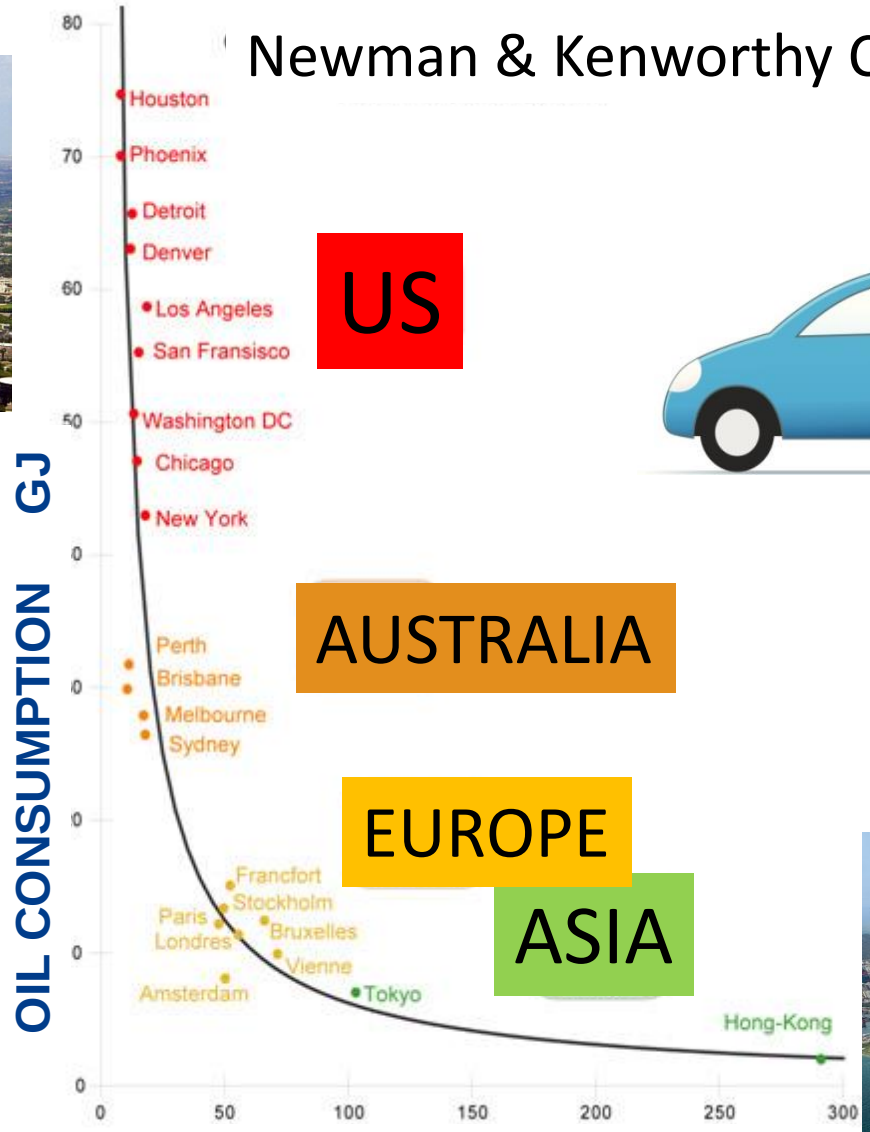
Urban Density

CITIES

50% of world population
(60% in 2030)
75% of energy consumption
75% of GHG
60 % of water consumption
Around 1% of the planet surface

Source : SIEMENS

Newman & Kenworthy Curb

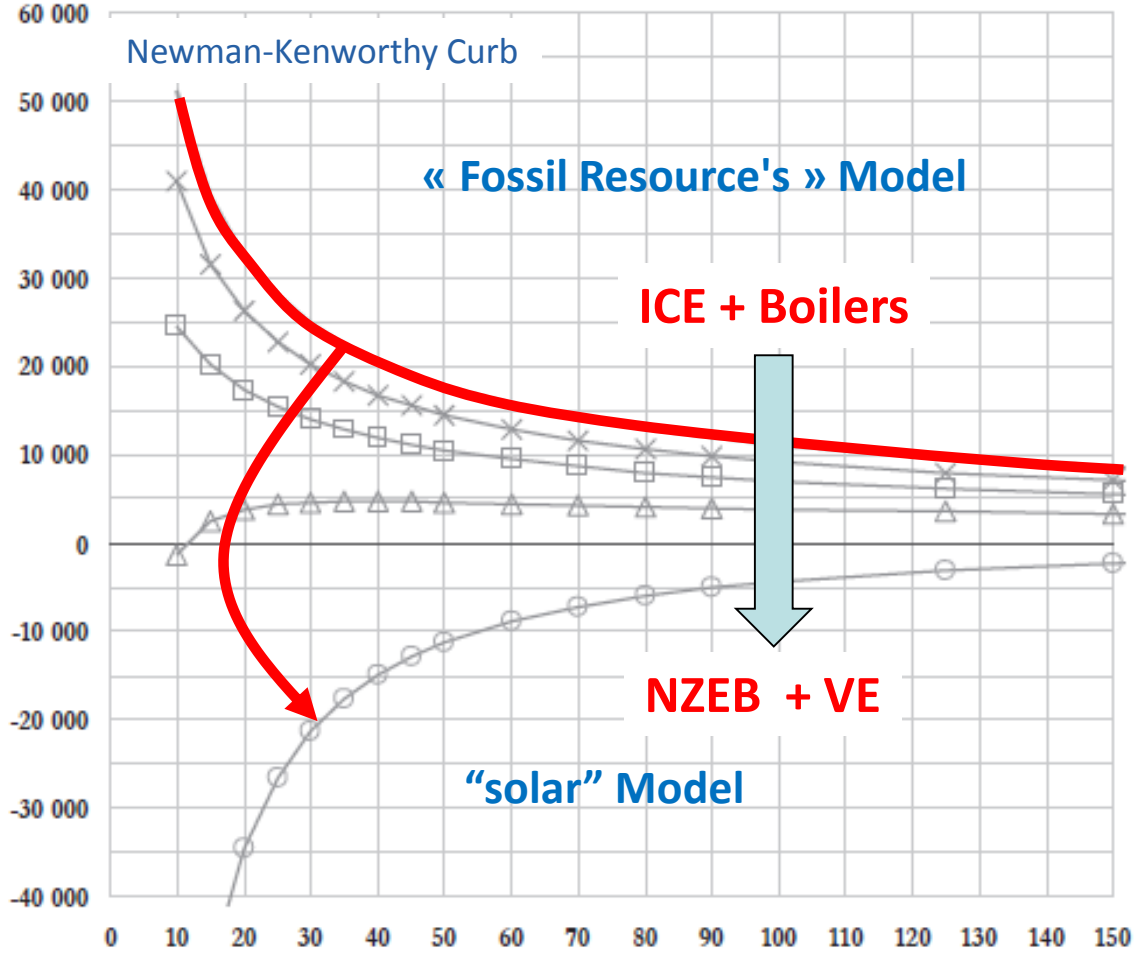


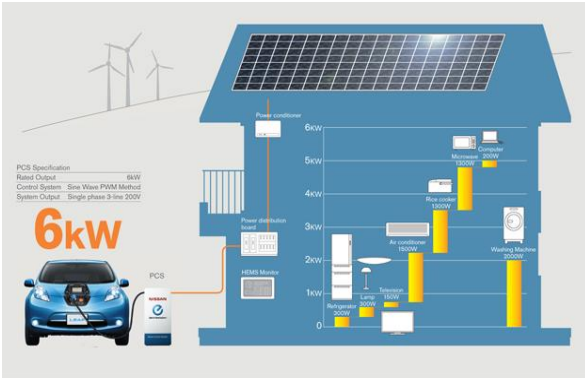
… Energy Transition ?

ENERGY CONSUMPTION

MJ/hab.an

1 kWh = 3,6 MJ





DENSITY

hab./hectare

Source : Dense cities in 2050: the energy option? R. Ménard – ECEEE - 2011

Limitations / questions

- One car, one home, one building …
- Heating & DHW don’t take into account …
- V2G, V2H, V2B ?
- Battery cycling, cost ?
- Consumption model for travelling ?
- Charging point location ?
- “energy gardening” & “grid discretion” ?
- …

CONCLUSION

UBS: Time to join the solar, EV, storage revolution

UBS Investment Research
European Utilities

Leading investment bank UBS says the payback time for unsubsidised investment in electric vehicles plus rooftop solar plus battery storage will be as low as 6-8 years by 2020 – triggering a massive revolution in the energy industry.

Combined, solar and battery systems could reduce power consumption from the grid by 50-60% (family home)

Batteries could reduce demand from conventional generators by 5% during evening hours

California Building Code

New Housing In California To Be "EV Capable"

September 29th, 2014 by Cynthia Shahan

Incentives in US & Canada

Workplace Charging Challenge
U.S. DEPARTMENT OF ENERGY

Thank you
Questions ?

Figure 3.2. *Publicité General Electric sur les systèmes de charge garage.*

Source : Hermes

1912