Symposium pour l'électronique & le numérique durables

Le 12 décembre 2024, Grenoble

AVEC tech & fest

NANOELEC. Univ. Grenoble Alpes Labex μElec FRANCE 2030 PROGRAMME DE RECHERCHE ÉLECTRONIQUE

UGA Université Grenoble Alpes NSAG UGA Grenoble INP UGA Sciences Po Grenoble

cea CHU Grenoble Alpes cnrs INRAE Inria Inserm La science pour la santé From science to health IRD Institut de Recherche pour le Développement Linksium

Symposium pour l'électronique & le numérique durables

Le 12 décembre 2024, Grenoble

EN PARTENARIAT AVEC tech&fest

Au delà de la quête de la performance en électronique de conversion

Intervenant : Jean Christophe CREBIER

G2Elab Grenoble Génie Electrique Grenoble Electrical Engineering

UGA Université Grenoble Alpes

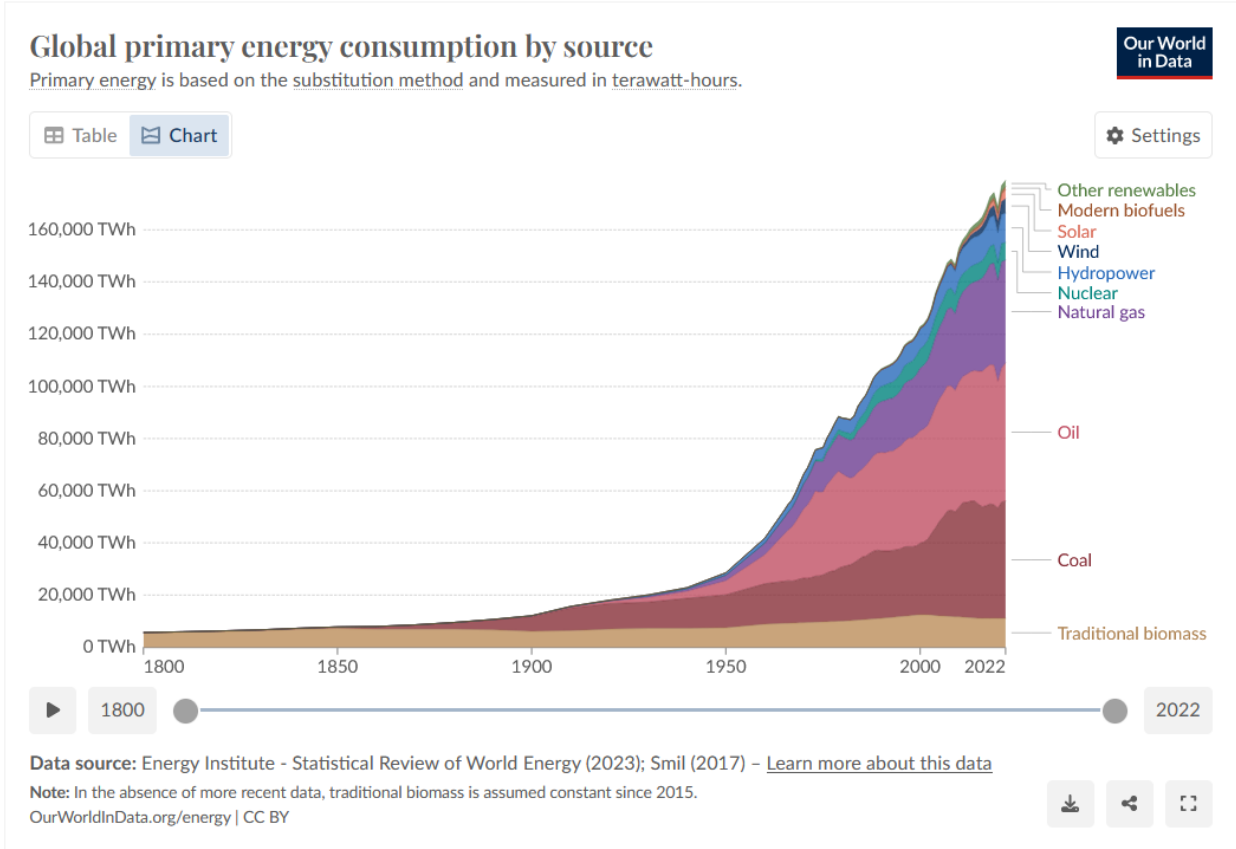
cnrs

GRENOBLE INP UGA

Context and motivations

-Electrification of our modern society is becoming a reality, not the energy transition !

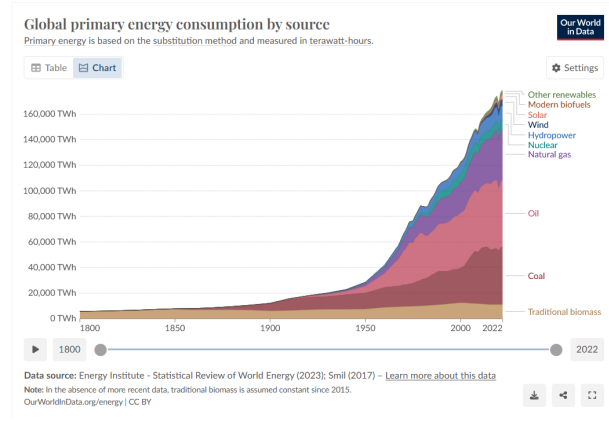
In particular we are very far from decreasing GHG emission as necessary

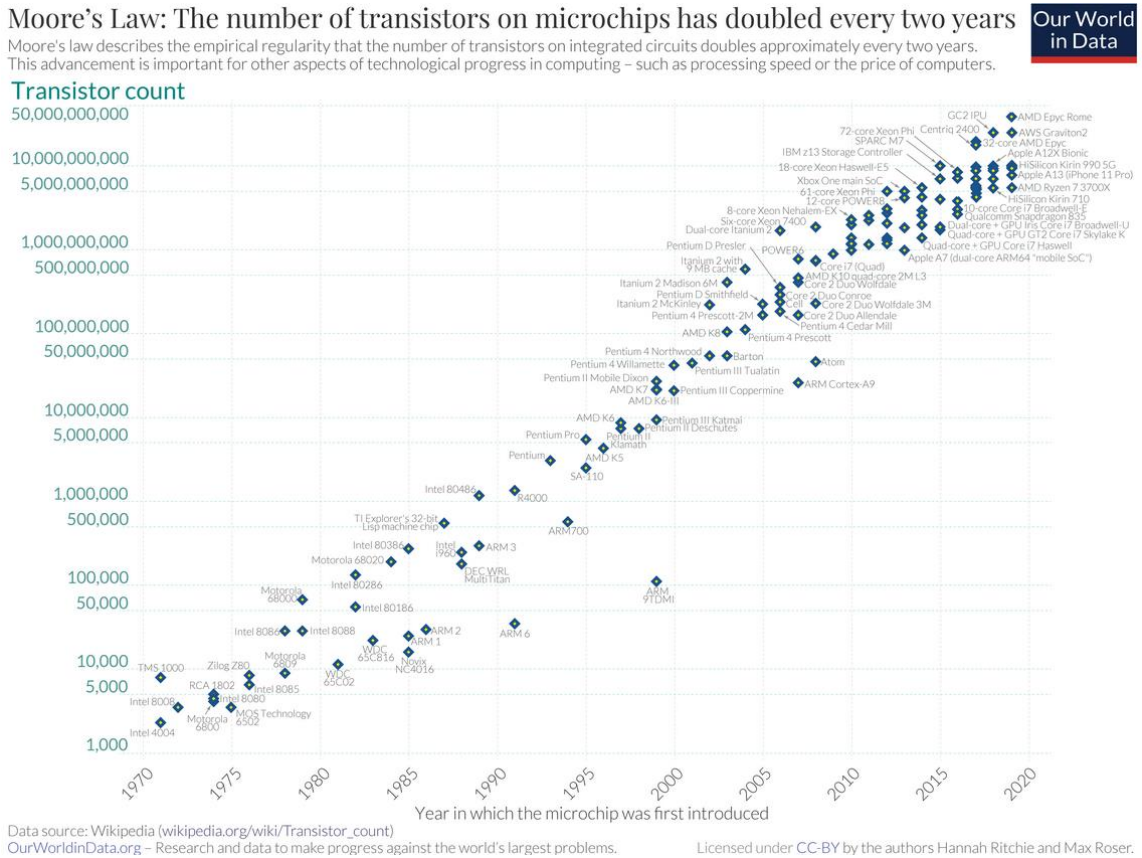


Context and motivations

-Electrification of our modern society is becoming a reality, not the energy transition !
In particular we are very far from decreasing GHG emission as necessary

-Quest of **performance always ends up** to further energy consumption and **rebound effects** !
Most, not to say all, great efficiency improvement have been used to offer more or to go further



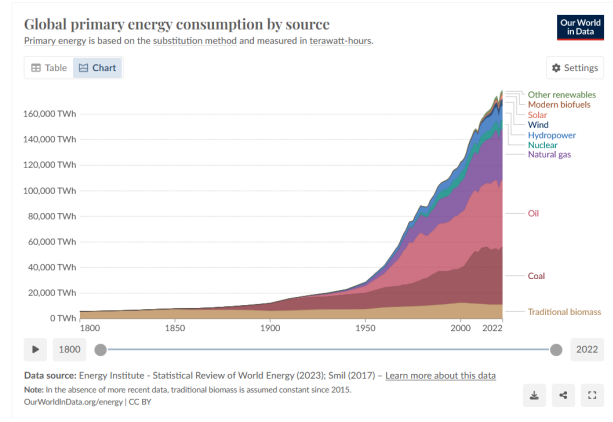


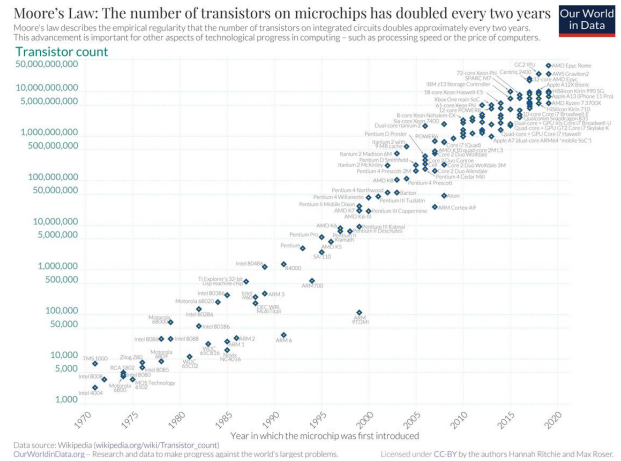
Context and motivations

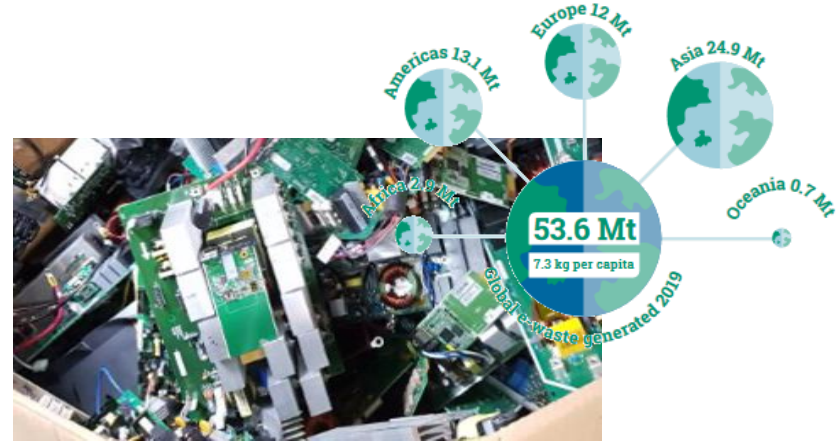
-Electrification of our modern society is becoming a reality, not the energy transition !
In particular we are very far from decreasing GHG emission as necessary

-Quest of performance always ends up to further energy consumption and rebound effects !
Most not to say all great efficiency improvement have been used to offer more or to go further

-Electronics are **fast growing wastes,** even faster than expected !!!!
Expected to reach 75Mt by 2030 in 2019
It is now expected to reach 82Mt by 2030…



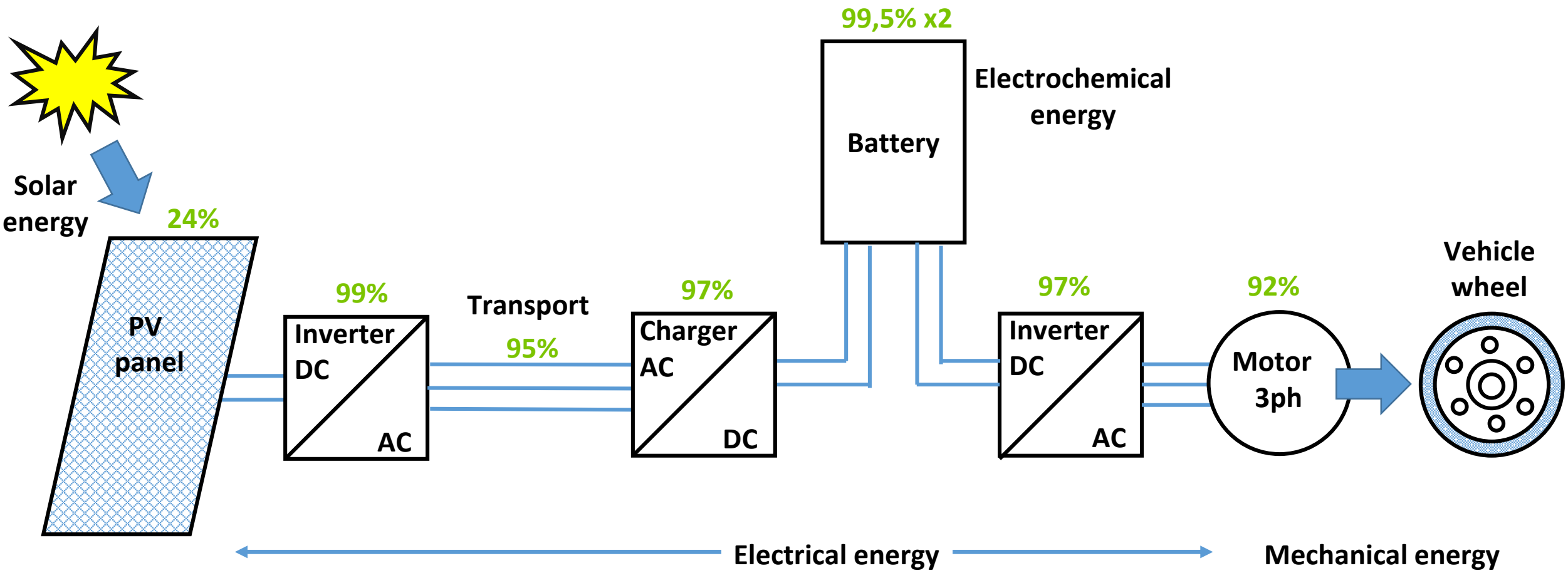




53,6Mt WEEE in 2019

Limits of performance quest in power electronics

What to expect now from higher efficiencies in Power Electronics
Example: From the solar panel to the electric vehicle…

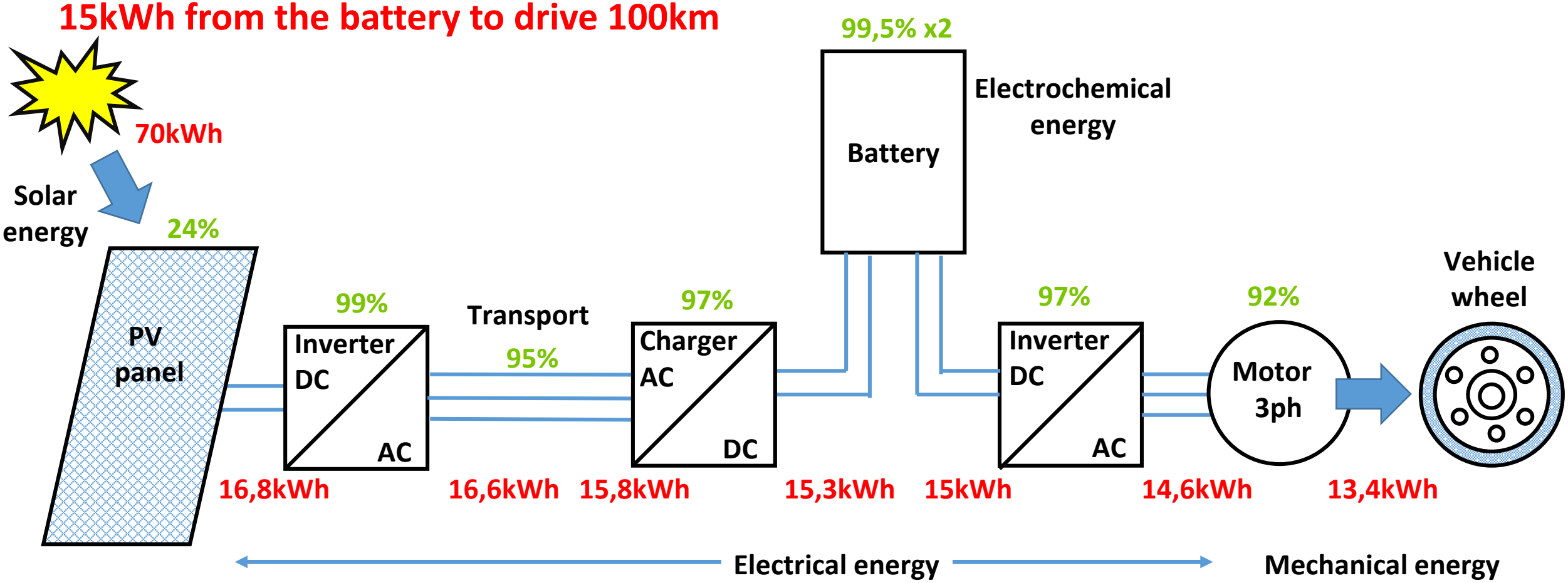


Limits of performance quest in power electronics

What to expect now from higher efficiencies in Power Electronics

Example: From the solar panel to the electric vehicle…

15kWh from the battery to drive 100km

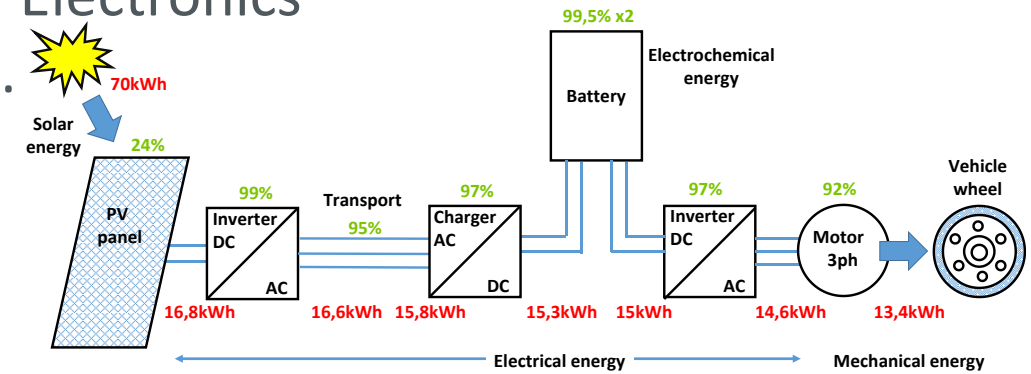


Limits of performance quest in power electronics

What to expect now from higher efficiencies in Power Electronics

Example: From the solar panel to the electric vehicle…

15kWh from the battery to drive 100km



	1	2	3	4	5
Conversion system	Efficiency gain (in point of η)	Techno maturity – R&D challenge	Average energy gain (kWh) up to 2050	Average energy gain (kWh) from 2050	Energy benefits
Solar panel	*3*	*High*	*6.4*	*12,7*	*Very high*
Transport	2,5	Very high	0,2	0,5	Average
Power electronics	De 0,5 à 1,5	Very high	0,3	0,6	Low
Battery	0,5	High	0,1	0,2	Low
Motor	4	Very high	0,3	0,6	Average
All except PVs	**10**	**Very high**	**0.9**	**1,8**	Ave/High
Final energy consumption changes	**-10p. techno gain**	**Very high**	**0.9**	**1,7**	Ave/High
	-10p. usage reduc.	**Low**	**1,7**	**1,7**	High

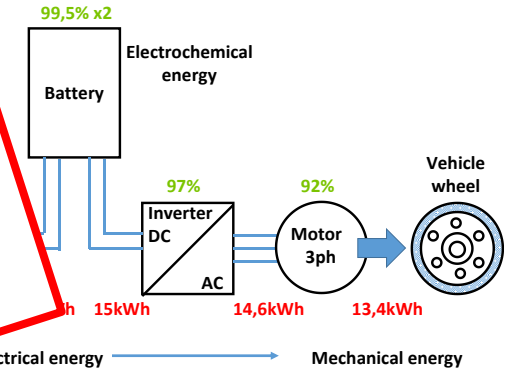
Limits of performance quest in power electronics

What to expect now from higher efficiencies in Power Electroni

Example: From the solar panel to the electric vehicle

15kWh from the battery to drive 100km

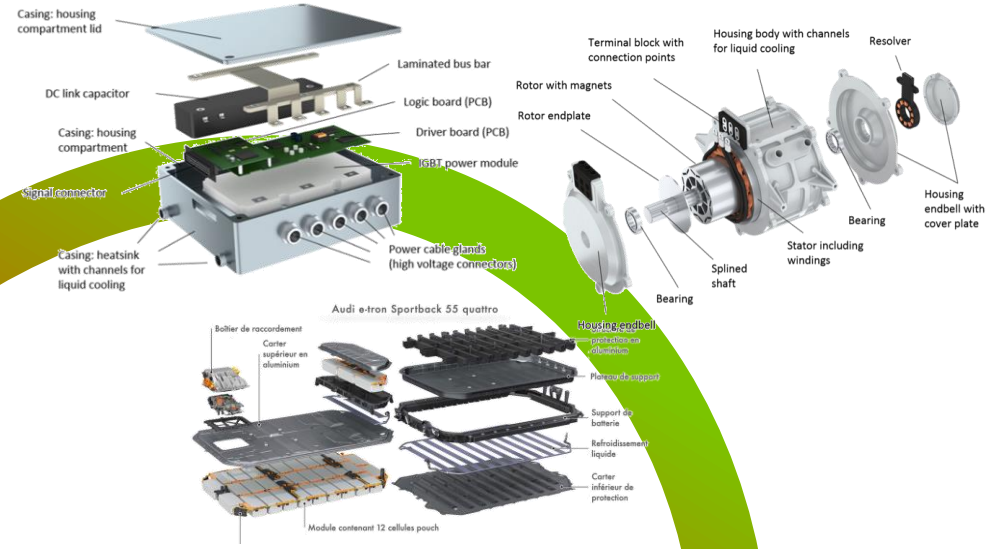
All our efforts to design/research for performance might be canceled out by extra driving or greatly exceeded by usage changes



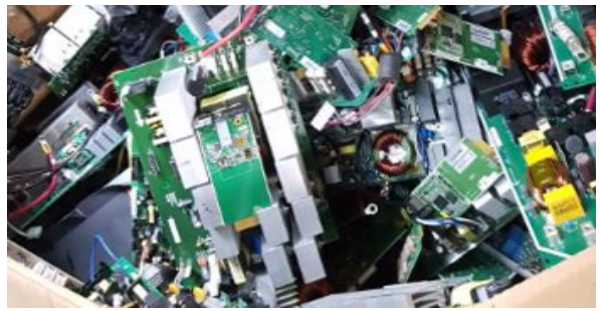
				4	5
			gain (kWh) up to 2050	Average energy gain (kWh) from 2050	Energy benefits
Sola			*6.4*	*12,7*	*Very high*
Trans		Very high	0,2	0,5	Average
Powe electro	,5 à 1,5	Very high	0,3	0,6	Low
Battery	0,5	High	0,1	0,2	Low
Motor	4	Very high	0,3	0,6	Average
All except PVs	**10**	**Very high**	**0.9**	**1,8**	Ave/High
Final energy consumption changes	**-10p. techno gain**	**Very high**	**0.9**	**1,7**	Ave/High
	-10p. usage reduc.	**Low**	**1,7**	**1,7**	High

Context and motivations (2)

Electrical Engineering products **require energy and lots of raw materials**. they induce **numerous pollutions** at every manufacturing step !

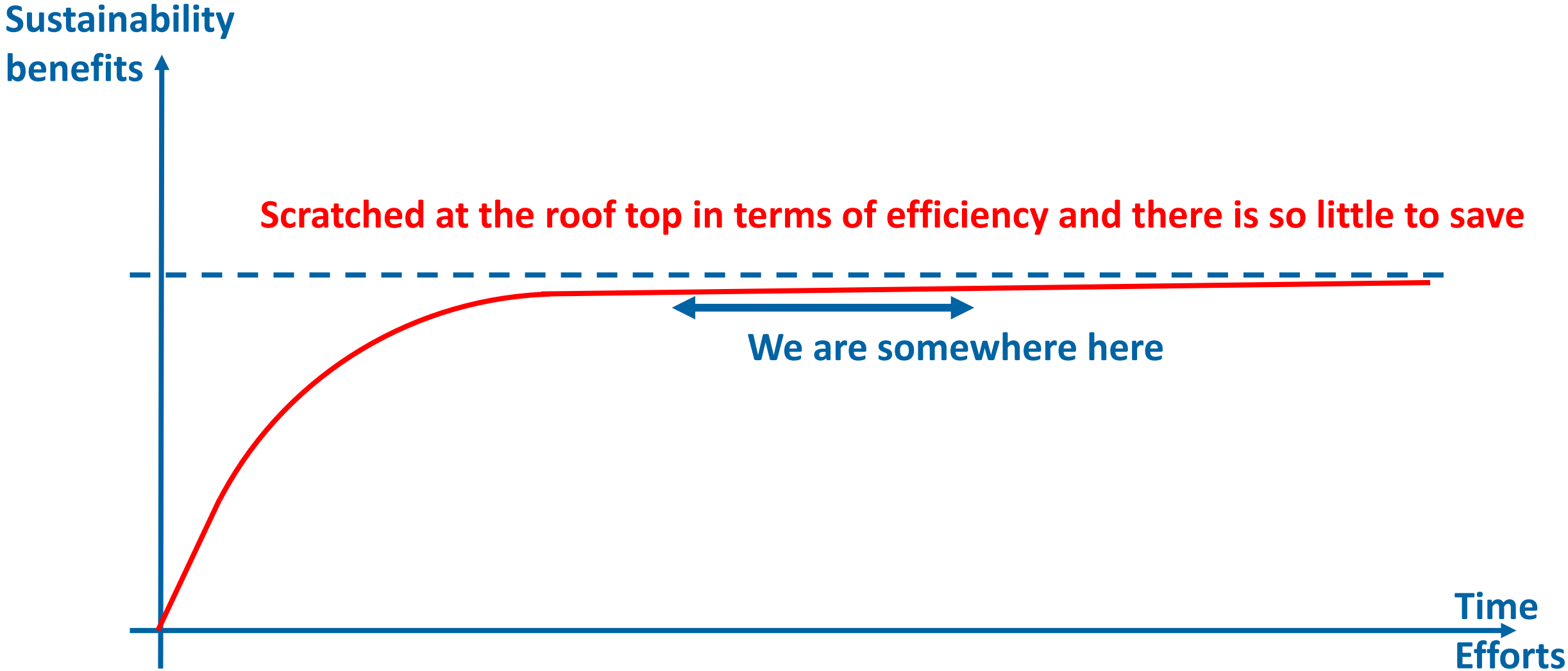


The end of usage of Electrical Engineering products induces **lots of waste, difficult to recycle** or even to « valorize »



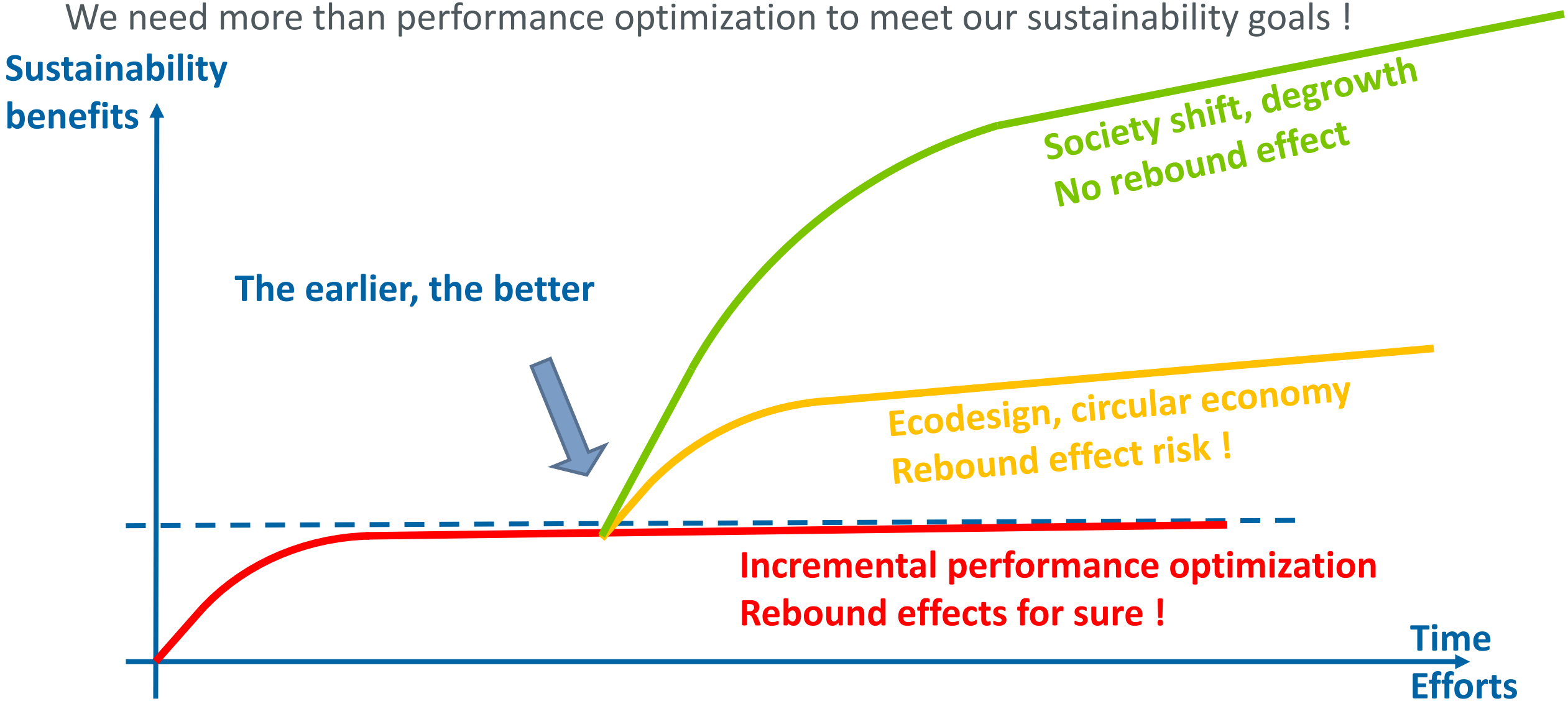
Limits of performance quest in power electronics

We need more than performance optimization to meet our sustainability goals !



Limits of performance quest in power electronics

We need more than performance optimization to meet our sustainability goals !

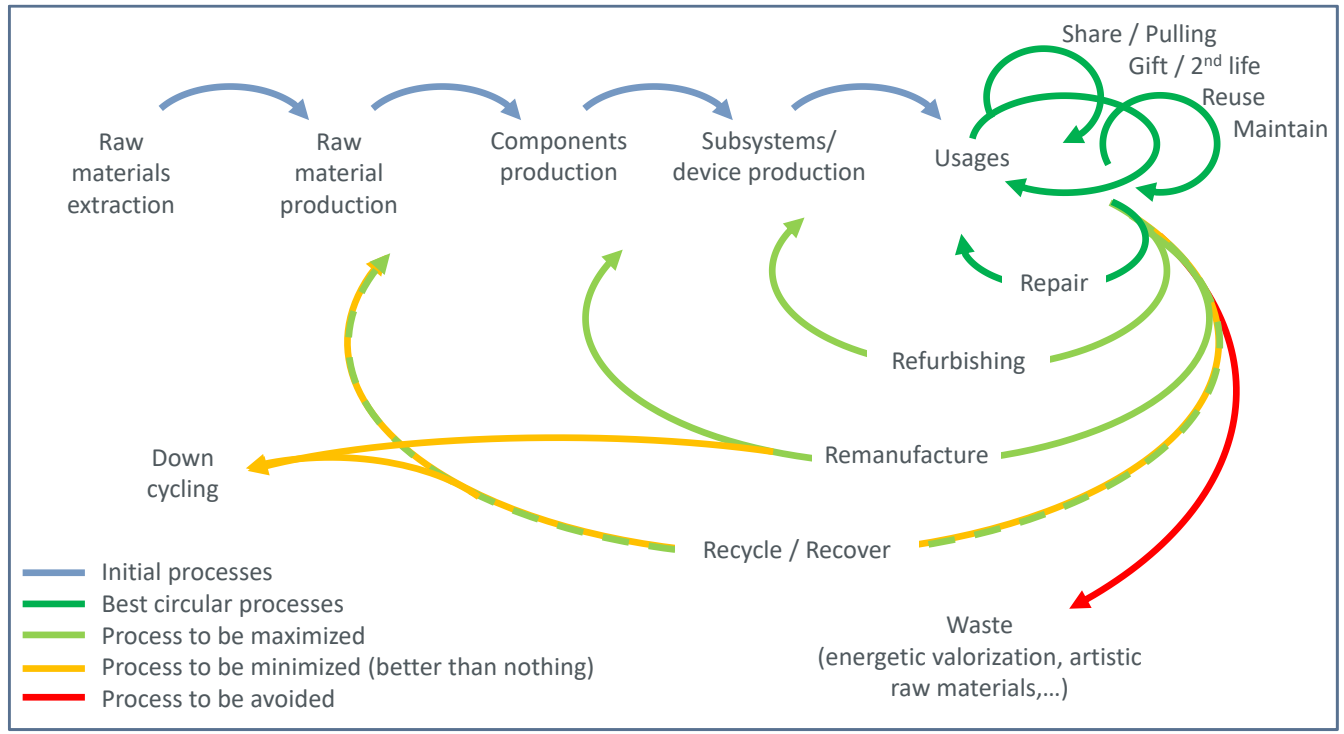


From better to good enough (Michael Z. Hauschild – Pr. DTU)

Stop foolish ourselves with expected benefits from extra performances and High tech…
Society needs our version of the story !

Let's develop sustainable offers and business approaches
Produce local and less, use more,
re-use, repair, refurbish for ever,
and ultimately recycle and recover !

Integrated technologies and regular introduction of disruptive technologies prevent us from deploying circular opportunities



Source : ANR VIVAE Project

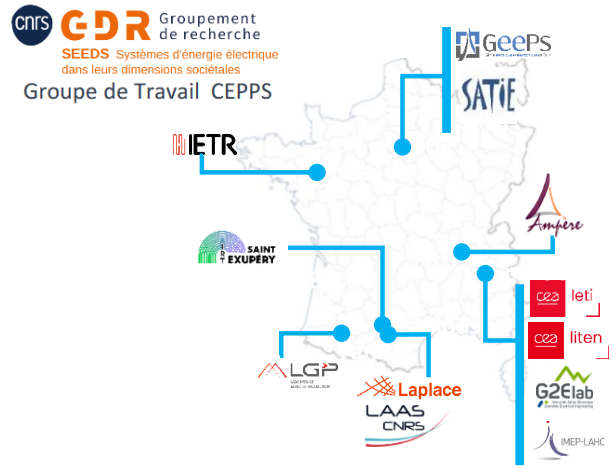
Possible workflow in power electronics

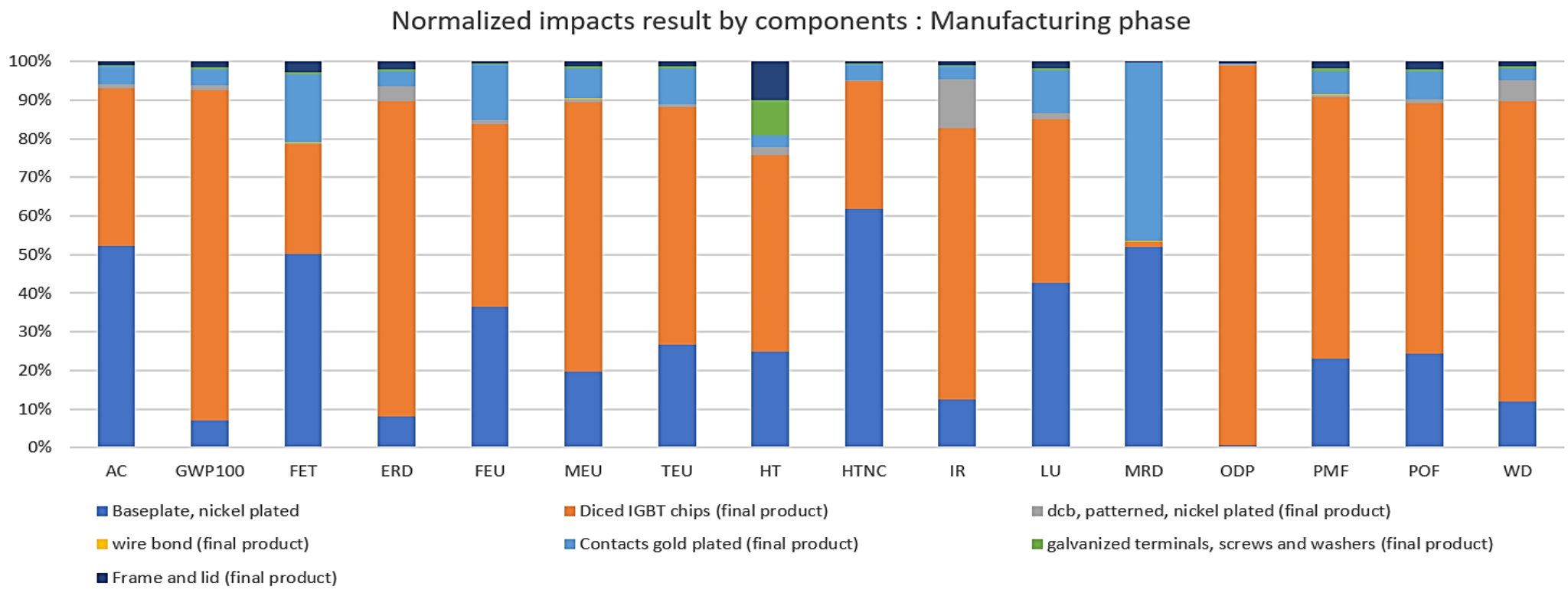
Team up to reach critical mass to direct research topics and promote cooperation

Possible workflow in power electronics

Team up to reach critical mass to direct research topics and promote cooperation

Demonstrate technologies are heading us to the wall. Communicate and advertise on it !



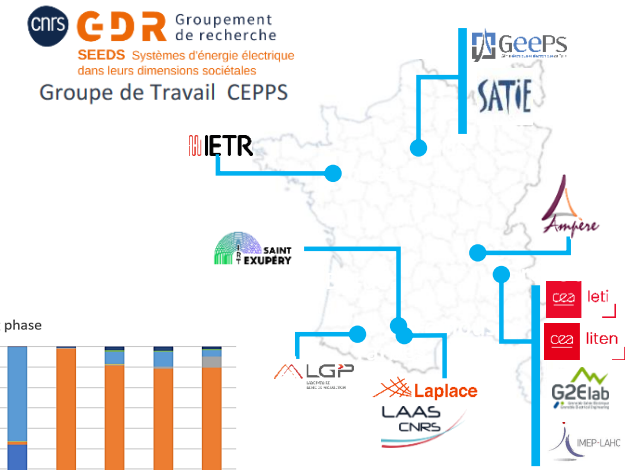


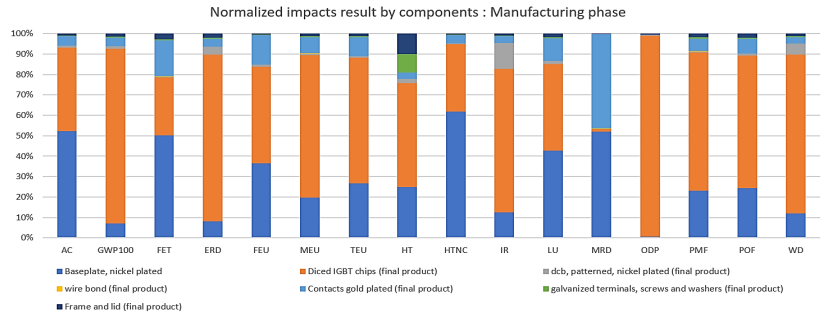
Possible workflow in power electronics

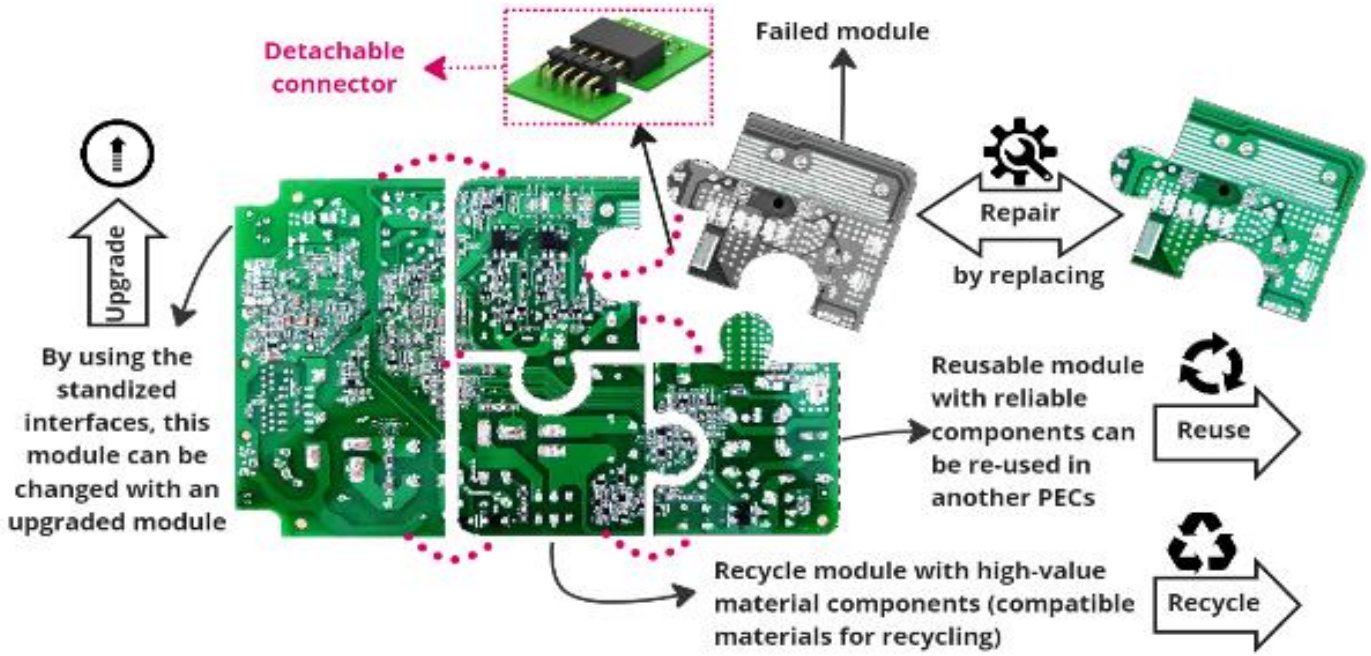
Team up to reach critical mass to direct research topics and promote cooperation

Demonstrate technologies are heading us to the wall. Communicate and advertise on it !

Look for more circular design approach: modular standardized and “convivial” technologies







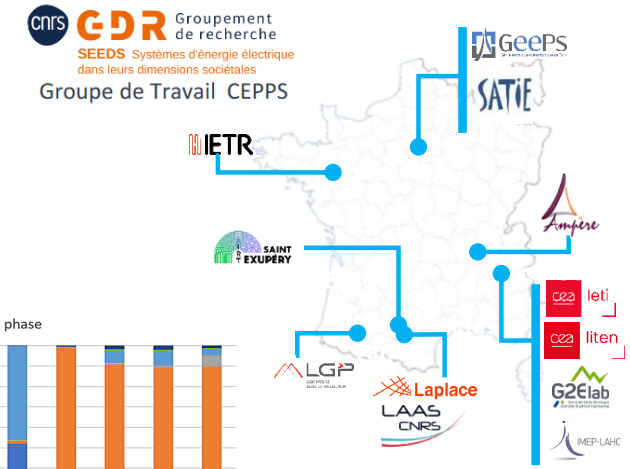
Possible workflow in power electronics

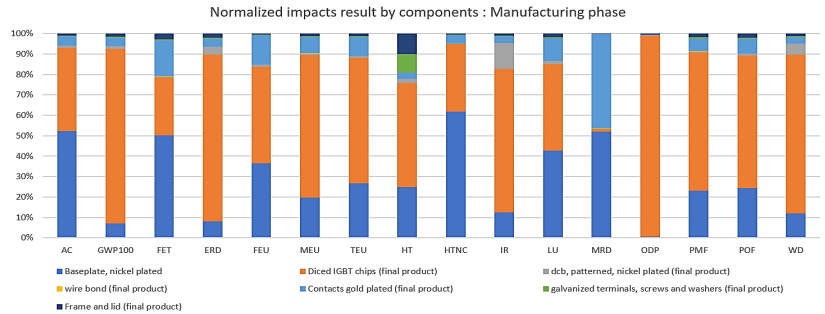
Team up to reach critical mass to direct research topics and promote cooperation

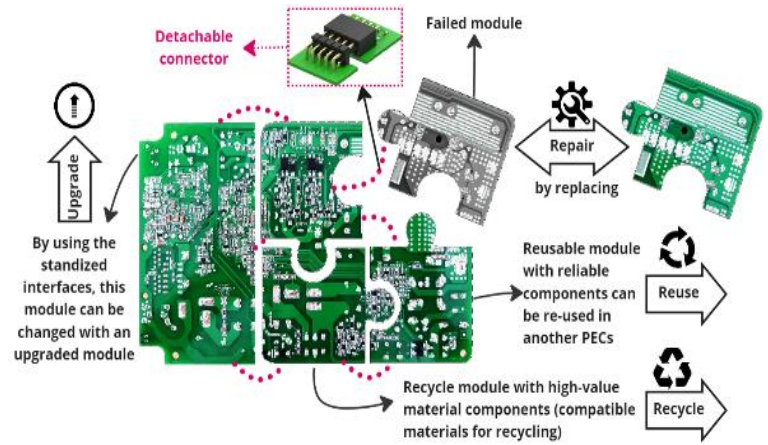
Demonstrate technologies are heading us to the wall. Communicate and advertise on it !

Look for more circular design approach: modular standardized and “convivial” technologies

Provide insight for designers with adapted indicators, design rules and methods



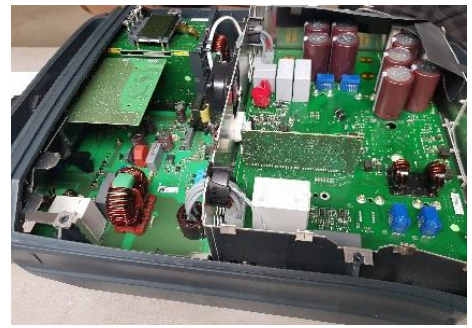


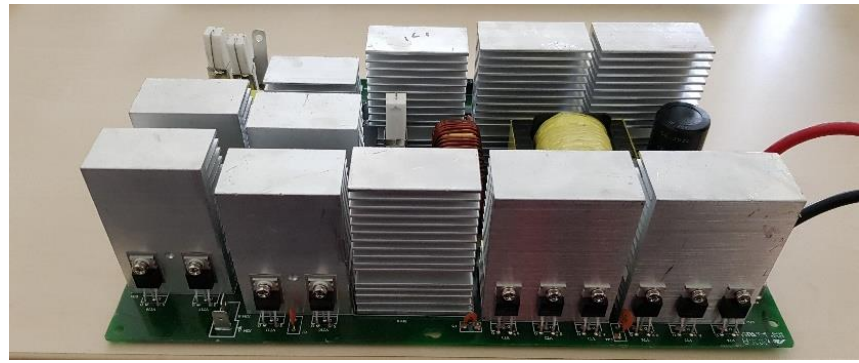


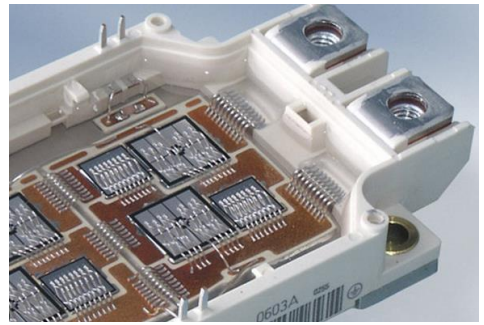
One key target: reduce heterogeneities in Power Electronics

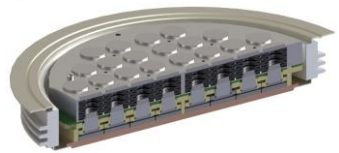
Materials
Components
BOM (Bill of Materials)
Assembly/interconnect technologies
Topologies

<u>But also</u>
Control strategies
Reliabilities
Form factors, thermal inertias, ….









Source : T. Turkbay
PhD candidate G2ELab-I2M

To conclude :

Stop expecting and pretending that technical solutions strike back the environmental burden

Move from the benefit of the doubt to the caution principle

Engineers, researchers, let’s become active and proactive to shift our managers’ mind !

Let’s
Create desirable businesses and added values
Reengage on local, distributed added values
Create/make meaningful daily work plans