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**Cédric Carles****Loïc Rogard****Christophe Bouneau**

**Counterfactual history, another history: the Paleo-Energy citizen research program lays claim to an alternative exploration of the past, with a view to unearthing elements that can be useful to both the present and the future. What is your view of a usable (energy-related) past, and what historical approaches should be emphasized in this respect?**

**Loïc Rogard, Cédric Carles** : The Paleo-Energy citizen research program offers an alternative perspective toward energy history, notably by exploring technologies and ideas that were abandoned or forgotten. It is an approach that reveals the wealth of the past, especially periods of crisis when innovation was often stimulated by necessity. When petroleum and coal once again became affordable, these ideas were often set aside, but they nonetheless remain relevant and potentially useful for our present and future.

More specifically, our approach involves rereading patents, an exercise that has been made possible by their digitization. These documents are a trove of information and ideas that can drive what we call “technological remixes.” A striking example is the RegenBox, which revisits the principle of recharging non-rechargeable batteries. This rehabilitated patent today offers a viable alternative to single-use alkaline batteries.

This underscores the importance of teaching patent history and existing patent searches in engineering schools. It is essential to understand the proper role of technology in our society and history, as well as to teach a low-tech approach.

Our approach raises a number of important questions. First, that of cultural and patrimonial heritage, for both organizations and territories. How to transmit knowledge before a retiree leaves the organization? Second, that of non-linear progress, as history is not a simple progression toward the “better,” but rather a succession of experimentation, successes, and failures. Finally, this shared history can serve as a vector for belonging, one that can remove the passion and polarization that mark ideological and political discourses surrounding energy. The question is not simply to be “for” or “against” a particular energy, but rather to understand the complexity of energy as an issue.

**Christophe Bouneau** : Such a citizen program effectively contributes to a cross-fertilization between engineering science and engineering culture on the one hand, and the need for historical teaching of the energy transition on the other, which should not be exclusively experienced in terms of loss and rupture relating to a uniform vision of the Anthropocene. Through the rereading of patents, “technological remixes”—the low-tech approach—can give meaning, via the appropriation of temporalities and territories, to the efforts of engaged civic sobriety, and more broadly those of organized civil society.

**Christophe Bouneau** : The paleo-energy approach is entirely compatible with the global history of energy, both academic or mainstream, enriching it by emphasizing the connection between retrospective and prospective, as well as the role of low tech and technological experiments often categorically classified as failures and technological dead ends.

From the standpoint of regimes of historicity and the analysis of contemporary trajectories over the medium term, our Committee for the History of Electricity and Energy has always integrated the history of the present in its approaches, research, and debates. Its denomination as the history of the present clearly shows its heuristic depth, unlike the supposed instantaneity of immediate history—the history of social media—that in the words of Gérald Bronner leads to “cognitive apocalypse,” especially via the saturation of analyses relating to today’s energy crisis, which has de facto become a permanent regime driven by the ecological crisis. The *Histoire générale de l’électricité en France* (General History of Electricity in France), published in three volumes by Fayard in the 1990s, already explored France’s most recent nuclear trajectory. Our Study Day from last April 13, *Quarante ans de recherche en histoire de l’électricité et de l’énergie auprès d’EDF*

(Forty Years of Historical Research on Electricity and Energy with the EDF), gave prominence to these debates, especially its final round-table entitled *Les acteurs de l'entreprise et le rôle de la recherche historique* (Company Actors and the Role of Historical Research).

Since its very first issue, in seminal articles by Alain Beltran and Geneviève Massard-Guilbaud, the international journal *JEHRHE* has clearly taken a position regarding the utility of the history of the present—hardly a “treason of the intellectuals”—in order to study global energy trajectories, from retrospective to prospective, which is central to debates on the Anthropocene. Finally, a Research-Action Chair such as the one I coordinate in Bordeaux, entitled *Réseaux électriques et sociétés en transition* (RESET, Electrical Networks and Societies in Transition), has helped provide, for its primary patron RTE, historical support for the desirable trajectories of *Futurs énergétiques 2050* (2050 Energy Futures), as part of a human complexity that is reducible to neither the presuppositions of technological efficiency nor the injunctions of a virtuous sobriety.

**Loïc Rogard, Cédric Carles** : Christophe Bouneau’s approach demonstrates the utility

of energy history in shedding light on the present and future energy transition. Recognizing the value of historical analysis is crucial not just as an intellectual exercise, but also as a practical tool. This creates a link between yesterday and tomorrow, capturing successes and failures, with the latter being essential to guiding future decisions relating to energy and technology. Challenging notions of a technological dead end encourages the reevaluation of solutions that were too hastily abandoned.

Christophe Bouneau highlights the importance of studying energy cycles over the “medium term” in order to move beyond ephemeral reactions to crises, and to outline a sustainable energy future, one in which moderation is a strategic choice and not a limitation. We are committed to enriching this analysis by reexamining the energy past not only to preserve technological heritage, but also to reinsert lost knowledge within the current debate on the energy transition.

Our commitment to energy history promotes the exploration of abandoned pathways for technical history, inviting us to see the past as a breeding ground of ideas for a future that is environmentally robust and adapted to current issues.

**Can you identify a past technology or energy policy that you believe was neglected or forgotten, and that could be relevant for our current energy transition? Why do you think it could be useful today?**

**Loïc Rogard, Cédric Carles** : To answer your question, we believe that solar thermal energy is “underdeveloped” in France, despite being a promising avenue for the future, and having a history studded with French pioneers, including Mouchot and Padre Himalaya. We want to underscore a historical energy technology that, albeit forgotten and neglected, could prove relevant in the context of our contemporary energy transition, namely the solar motor designed by the Société Française d’Énergie Thermique et d’Énergie Solaire (SOFRETES, French Thermal and Solar Energy Company) in the 1970s.

This pioneering machine captured the heat from solar radiation and transformed it into mechanical energy, taking its place in the tradition of thermodynamic converters for recovering “waste heat” designed since the late nineteenth century. Unfortunately, in spite of its undeniable potential, after a decade of support this technology was abandoned by the French government, the primary shareholder in SOFRETES.

Alexandre Mouthon’s dissertation, entitled «À la recherche de la chaleur perdue. Le moteur solaire de la Société Française d’Études Thermiques et d’Énergie Solaire (SOFRETES) et l’État français (années 1960-1980)” (In Search of Lost Heat: The

Solar Motor of the French Thermal and Solar Energy Company (SOFRETES) and the French State (1960–1980)), provides an enlightening analysis of the reasons for this negligence. His research has shown that the choice to industrialize the solar motor was depoliticized by certain forms of expertise, while the technological exploitation of this motor in connection with foreign policy “over-politicized” demonstration installations. The company was consequently hindered in reaching its objectives, and fell victim to counter-industrial actions conducted by its competitors, as well as some of its shareholders. In the end, a ministerial ruling was issued against SOFRETES, which resulted in the technology being forgotten.

Today, as we explore solutions for a sustainable energy transition, the solar motor of SOFRETES could represent a viable option. It is an energy alternative that uses a renewable source of energy, the Sun, and can efficiently convert this energy into mechanical force. What is more, this technology could be adapted and improved with current technological advances.<sup>1</sup>

The example of SOFRETES emphasizes the crucial importance of policy in the development and adoption of new energy technologies. It shows the need for lasting industrial and political support in order to ensure the success of such technologies.

**Christophe Bouneau** : The fascinating and turbulent history of the solar energy sector should also be resituated within an international perspective, in which emerging countries played a growing role well before the advent of Chinese technopolitical imperialism in this field. With this in mind, it is important not to underestimate the impact of French technological neocolonialism (often not properly assumed), as recently demonstrated by Jean Gecit in his dissertation.

<sup>1</sup> This assertion should nevertheless be nuanced, as prototypes are needed in order to ascertain the interest of such a retrotech, namely by considering the economic model and maintenance issues.

**Christophe Bouneau** : Two long-term energy pathways—combining technological innovation, sustainable regional development models, and diversified uses for the benefit of consumers (before their proclamation as *consom’acteurs* or consumer actors)—can be emphasized in driving *2050 Energy Futures*.

First, despite the droughts intensified by global warming that make well-reasoned water management an absolute imperative, hydroelectricity remains the leading renewable energy, particularly in France. Its marginal value is absolutely crucial, for thanks especially to PETS, its instantaneous mobilization can avoid selective power cuts and even blackouts. This was notably shown, based on his *Histoire de l’énergie hydraulique* (History of Hydraulic Energy), by Pierre-Louis Viollet in his conference on April 12, 2023 at the Espace Fondation EDF. In our own research, we have studied, based on the Swiss alpine model, the cross-fertilization that occurred in the Pyrenees—thanks to the Compagnie des chemins de fer du Midi (The Midi Railroad Company) and the Union des producteurs d’électricité des Pyrénées occidentales (Western Pyrenees Electricity Producers’ Union)—between hydroelectric power, railroads, and tourism, one that is illustrated by the regional development of the Ossau Valley, which was visited during the interwar period by American engineers, in addition to the electric railroads of the Rhune, Superbagnères, and Cerdanya. This trio behind an economic regionalization helps us move beyond the dictatorship of acceleration denounced by Hartmut Rosa in *Aliénation et Accélération*, as personified by the overemphasized TGV. An elegy to slowness takes us back to the experiences of the eighteenth and nineteenth centuries, before the invention of speedy travel via railway, automobile, and air. We should keep in mind that transportation is responsible for 31% of greenhouse gas emissions in France today.

As shown by Sophie Pehlivanian’s dissertation, based notably on the history of the research conducted by INES, the solar energy industry has been a large cluster of innovation systems representing so many pioneering energy fronts,

which are not limited to the divide between solar thermal energy and photovoltaic solar energy. The scientific and industrial experience developed from the 1960s to the 1980s in solar power stations in the Pyrénées-Orientales—along with Thémis, which functioned on an industrial scale from 1983 to 1986—was certainly too hastily abandoned in favor of the mystique of nuclear power championed by the “nucleocrats,” who were in turn criticized during the first two decades of the twenty-first century. Historicizing the present provides perspective for the debates and energy positions adopted at a time when a large majority of the French electorate once again has a favorable view toward nuclear energy, and not solely due to the activity of the Shift Project...

**Loïc Rogard, Cédric Carles** : Christophe Bouneau shines a light on the historical and geopolitical advances made in solar energy, emphasizing the importance of an energy analysis that is simultaneously local and global. This perspective reveals how power dynamics and the search for sovereignty have shaped the energy choices of nations.

We believe that the historical experience in solar energy should take its place within a broader understanding of innovation systems, one that

is in keeping with current economic, environmental, and social realities. The example of solar power stations in the Pyrénées-Orientales offers an illustration of the hasty abandonment of a promising technology, thereby underscoring the fluctuation of energy policy.

It is crucially important to reconsider the energy technologies of the past from a modern point of view, integrating technical progress in order to adapt them to today’s needs. Christophe Bouneau’s proposal to combine hydroelectricity and solar energy suggests an energy diversification that reduces dependence on single sources.

The notion of *consom’acteur* promoted by Christophe Bouneau is central to the energy transition, emphasizing individual responsibility and the adoption of sustainable practices. Our research, like that of Bouneau, focuses on the complex interaction between policy, industry, and technology, with a view to developing resilient and inclusive energy policies that learn from past errors in order to pursue a sustainable energy transition.

**In light of the history, what is your view of the electrical network’s evolution in connection with the energy transition? Do you see a tendency toward centralization or decentralization? Could you discuss the advantages and disadvantages of these two models?**

**Loïc Rogard, Cédric Carles** : The historical analysis of energy shows that energy transitions are complex phenomena shaped by a multitude of factors. Today, facing issues such as the Ukraine crisis and dependence on Russian energy, not to mention climate change, we must accelerate our transition to a more sturdy and environmentally viable energy model.

The architecture of the electrical network seems to gradually be moving toward a hybrid system, with the capacity to store both electricity and heat. This system would integrate devices for base load power in addition to a range of renewable energies to guarantee resilience and facilitate this transition. We are witnessing a struggle

between two paradigms: the centralized model personified by major providers, and the decentralized model championed by small renewable energy promoters.

Fossil and nuclear energies require vast centralized systems, leading to powerful oligopolies that monopolize power and wealth. On the contrary, the majority of renewable energies are decentralized and local, involving millions of small producers and promoting wealth redistribution along with citizen support.

The central issue is to reconcile these two models, by supplementing and gradually substituting our centralized means of production by

units of renewable production. This also involves fostering professional training and retraining, for no energy transition can be completed without the appropriate human expertise.

In terms of storage, the Storabelle project initiated by Frédéric Pierucci is a convincing example. It envisions transforming thermal coal-fired or nuclear power plants with historical turbines into storage sites, thereby avoiding the construction of new installations. This project perfectly illustrates how we can reuse and adapt our existing infrastructure to meet the challenges of the energy transition.

**Christophe Bouneau** : The hybridization of transportation and energy distribution networks, in terms of both architecture and operational management, represents an essential lever for attaining climate and energy objectives by 2030, objectives which appear to be increasingly critical. In order for smart grids to have a citizen-driven functioning that actively involves consumers, both technological solutionism and appeals to individual responsibility with regard to sobriety are insufficient: all territorial resources of local governance must be mobilized, especially via energy and water syndicates, which are on an inter-municipal and often departmental level.

**Christophe Bouneau** : The trajectory of electrical networks in France and Europe since the early twentieth century is central to our historical research, and more broadly in HSS. It is also one of the topics of the RESET Bordeaux Research-Action Chair mentioned above, which works alongside RTE in trying to understand possible historical bifurcations, in addition to the outlines of 2050 Energy Futures.

With this in mind, three elements can be formulated as a response. First, the vision of energy isolates living in insular autarky of self-production and self-consumption is an illusion—certainly necessary, as all illusions are—one that is simultaneously technological, industrial, human, and social in nature. Unless we can indefinitely reproduce the lifestyle of insular communities, such as the Iles du Ponant, contemporary

societies involve mobility and solidarity, and are marked, when it comes to energy, by the crucial character of interconnection, which is a mutual insurance against risks as well as the quintessence of electrification. The end of the electrical network, and even its complete transfer underground, will not happen tomorrow...

However, “the electrical order” cannot be content with a single super-network architecture centered on Paris, and converging toward the national dispatching center of Saint-Denis. As demonstrated by the studies conducted by the Schéma régional de raccordement des EnR au réseau (Regional Plan for Connecting Renewable Energy to the Network) in Nouvelle-Aquitaine, for regions that have become leaders in the energy transition since the LTECV law of August 2015, a raft of investments is needed to connect electricity transmission networks, as well as to establish vital complementarity between centralized architecture based on the cartography of nuclear installations, and the decentralized networks crucial to linking solar and wind farms. The two most important challenges are the interconnection of new offshore wind farms and the strategic strengthening of cross-border interconnections, which constantly face the vigorous contestation of the BANANA syndrome, whether it be the ongoing interconnection with Spain via the Gulf of Gascony, or the choke point of the interconnection with Italy.

Finally, it is important not to neglect energy storage, both direct and indirect, as an avenue of considerable innovation that helps optimize network functioning and saves energy across the entire economic and social value chain.

**Loïc Rogard, Cédric Carles** : Our analysis, which is inspired by Christophe Bouneau, calls for a nuanced critique of the hybridization of electrical networks. While hybridization is crucial for the flexibility of future networks, ideals of energy autarky must be balanced with security and efficiency, which are often better served by a certain centralization. While attractive in theory, total autarky is subject to technical and economic constraints.

It is crucial to develop smart networks that integrate social and territorial realities, acknowledging issues relating to power and energy justice. The connection between centralized and decentralized networks should form a coherent energy ecosystem in which each element, from the small generator to the major network, plays a decisive role.

As pointed out by Christophe Bouneau, energy storage is decisive, but should be strategically integrated within the network. Taking advantage

of this flexibility involves regulatory reforms and new economic models for stimulating investment.

The technical, financial, and social obstacles of the energy transition are considerable. It is essential to ground ourselves in history in order to avoid repeating errors, as well as to understand the coevolution of technologies and distribution systems with society. The lessons of the past can serve as our compass for a sustainable and just energy future.

**In your opinion, what are the major social challenges that must be overcome to successfully complete the energy transition? Are there innovative social solutions that you see emerging in this context?**

**Loïc Rogard, Cédric Carles** : The energy transformation—a significantly complex endeavor—requires sobriety, optimized energy efficiency, and expanded renewable energy, all while preserving social and environmental equity. One of the challenges is to better inform the general public and scientists, so that they grasp the challenges connected to the climate and resources. It is imperative to reevaluate our energy practices, to demonstrate that more judicious use with less is achievable. The paleo-energy program emphasizes this possibility, without for all that returning to archaic methods of lighting.

A group of “energy designers” in France, under the direction of Pascal Lenormand, is striving to train users in a better understanding of building uses, thereby unlocking significant savings without requiring major works on existing infrastructure. Without adequate popular education, the acceptance of renewable energies is unimaginable. For example, our ACT4energy initiative and the Solidarité Énergétique (Energy Solidarity) campaign seek to instill a circular economy of low-tech knowledge in order to combat energy precarity.

It is crucial to promote renewable energy by avoiding excessive concentration and by promoting equitable distribution across all regions. In *Rétrofutur : une autre histoire des machines à vent* (Retrofuture: An Alternative History of

Wind Machines),<sup>2</sup> our article entitled «Éolien citoyen» (“Citizen Wind Power”) presents positive accounts of citizens’ power stations and municipal corporations that install wind farms.

The social challenges are in the hands of policy decision makers, who must lead by example and initiate genuine and ambitious renovation campaigns, namely by prioritizing energy-intensive housing heated with oil or gas. This improves the national balance of trade, and provides greater purchasing power for modest households, all while having a positive impact on climate and health.

**Christophe Bouneau** : The question of education in the energy transition is central to establishing best practices across different territories and among highly diverse populations. It especially involves helping people understand that “small is beautiful” is not incompatible with major network infrastructure, and that the remix of “the electric order,” to echo the title of Fanny Lopez’s book, will proceed via a neo-electrification of uses on a human scale.

<sup>2</sup> Cédric Carles, Loïc Rogard, Philippe Bruyère, *Rétrofutur : une autre histoire des machines à vent*, (Paris, Paleo-énergie Press, 2018).

**Christophe Bouneau** : I would like to underscore three major social challenges connected to the energy transition.

The first is undeniably educational. The path is indeed very narrow in the quest to combine indispensable technological efficiency and sober behavior on the part of *consom'acteurs*; this cannot be reduced to a rhetorical or even political presentation as a form of penury or precarity. Even though technological solutionism is regularly excoriated—Schumpeter is nevertheless alive and well—and neo-electrification offers new and responsible social uses for mobility and housing.

The second challenge involves the regulation of digital uses, which are ever more intensive in terms of electricity and attention, during an era of artificial intelligence, ChatGPT, and the promises of the metaverse: for the time being, digital sobriety mostly involves wishful thinking, unless we multiply digital detox centers in dead zones...

The third challenge is territorial, for within just France, the pathways of the energy transition outline an *Archipel français* (French Archipelago) far beyond the binary of Paris and the French desert or virtuous vegan city-dwellers, refusing the technological solutionism of air conditioning, resilient toward air conditioning in the face of rural possessors of “electron tanks” corresponding to renewable energy deposits. France as it relates to energy—with respect to its economy, diversified landscapes, and new lifestyles—is raising before our very eyes the crucial issue of local governance of the energy transition. With this in mind, the Fédération nationale des collectivités concédantes et régies (FNCCR, National Federation of Licensing Authorities and Government Corporations) and its departmental syndicates, which coordinate local public energy services, are for instance leading future-oriented initiatives to deploy Infrastructure de Recharge de Véhicule Électrique (IRVE, Electric Vehicle Charging Infrastructure), and to better manage

public lighting and the energy consumption of public buildings (ACTEE program). In this search for a republican energy equalization, it is important not to forget overseas territories, where the very notion of energy transition collides with multiple social divisions and specific climate constraints.

**Loïc Rogard, Cédric Carles** : Christophe Bouneau stresses the importance of education and territorial intelligence in the energy transition, a view that we share. The transition goes beyond technology and policy—it involves all of society.

The educational dimension is essential for securing the support of citizens, a major challenge in a context of distrust toward institutions. Innovation in social education could emerge from enhanced collaboration with universities, companies, and associations, thereby establishing diversified and accessible knowledge networks.

Christophe Bouneau also raises the issue of digital sobriety, which should be integrated in the design of products and services, with public policies promoting energy efficiency standards for digital devices and infrastructure.

The challenge of territoriality emphasizes the importance of local energy governance that is adapted to the specific needs of territories. The example of the FNCCR illustrates the role of local governments as key actors of innovation in the energy transition. It is crucial to promote economic models that highlight local initiatives and strengthen the energy independence of communities.

In short, these issues call for rethinking our relation to energy, in which citizens are committed actors and not just consumers. For the future of our planet, this transformation requires us to reflect on the role of the individual, as well as our development models and values.

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