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Soviet Role in Nuclear Cooperation between Cuba and Hungary in the 1980s

El papel soviético en la cooperación nuclear entre Cuba y Hungría en los años ochenta

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| **Abstract:** Via the plans for constructing a zero-power nuclear research reactor, legal and technical conditions of nuclear knowledge transfer are examined between Hungary and Cuba in the 1980s. The case, rescued via archival investigation, is presented in the context of Cold War Soviet, Hungarian and Cuban political, economic and scientific goals. The studied nuclear cooperation outlines a complex power relation, including ties between the East and the Global South, as well as the hegemonic role of the Soviet Union. The motives and the nature of the behaviour of the countries are analysed as well as the possible survival of these patterns to the 21st century.

Keywords: Nuclear power; International system; Knowledge transfer and exchange; Soviet Union; Hungary; Cuba.

| **Resumen:** A través de los planes de construcción de un reactor de investigación nuclear de potencia cero, se examinan las condiciones jurídicas y técnicas de la transferencia de conocimientos nucleares entre Hungría y Cuba en la década de 1980. El caso, rescatado

mediante una investigación de archivo, se presenta en el contexto de los objetivos políticos, económicos y científicos soviéticos, húngaros y cubanos de la Guerra Fría. La cooperación nuclear estudiada esboza una compleja relación de poder, que incluye los lazos entre el Este y el Sur Global, así como el papel hegemónico de la Unión Soviética. Se analizan los motivos y la naturaleza del comportamiento de los países, así como la posible pervivencia de estos patrones hasta el siglo XXI.

Palabras clave: Poder nuclear; Sistema internacional; Transferencia e intercambio de conocimientos; Unión Soviética; Hungría; Cuba.

INTRODUCTION

A selected group of brilliant Cuban students, graduated as nuclear engineers at the University of Havana, came to Hungary in the 1980s to continue their studies in a two-year postgraduate course at the Budapest University of Technology (*Budapesti Műszaki Egyetem,* BME). Approximately half of them were to return to their alma mater to teach future nuclear specialists, whereas the other group was destined to work as researchers doing investigation with a research reactor to be designed and built by Hungary and placed within a nuclear centre to be constructed by the Soviet Union (Szente-Varga 2024). This nuclear complex was never completed. Yet its story of failure is worth studying because it permits analysing patterns of power and interaction in the Cold War. The case is placed and investigated within Cuban and Hungarian political, economic and scientific goals and ambitions related to the nuclear field, and more widely, within the bipolar context. Therefore, despite the fact that the scope of this writing is Hungarian-Cuban cooperation on the peaceful uses of atomic energy, no thorough examination can be made without taking into account the role and interests of the Soviet Union. It was the Soviet leadership which drew the basic coordinates, and countries such as Hungary and Cuba had to move in the boundaries established. This entailed limits but not passivity. Within the instituted confines, they tried to maximize their national interests.

"The Soviet Union's control over its satellites was much weaker than was believed during the years of the Cold War" (Stone 1996, 3). A stricter control could have resulted in increased financial costs as well as a higher possibility of conflicts. By leaving them some room for action, the Soviet leadership in fact contributed to the maintenance of the Socialist bloc, as countries enjoyed this kind of "freedom", leaders could use it to create more support for themselves (Soviets were not necessarily popular in these countries) and Socialist countries would interact with each other –cooperate and compete–, bogging down some of their energies and taking strain off their links with Moscow. But how much room did they really have for manoeuvre? How did the vanguard nature and outstanding importance attached to nuclear science affect these possibilities? To what extent were the above-mentioned countries able to make the most of the available opportunities? At the same time, how did the Soviet Union ensure its hegemonic position in the above-mentioned cooperation, and in the nuclear field, in general? To what extent did these patterns survive? – are some of the questions to be examined.

The paper begins with a literature review inserting the investigation in the research area of New Cold War Studies, and presenting currently available primary sources. Then it goes on to outline the importance of nuclear science in the Cold War in the fields of geostrategy, politics and economics. Soviet, Hungarian and Cuban interests in the nuclear field are analysed in different chapters, highlighting and starting with those of the Soviet Union since it had a decisive effect. Cuban-Hungarian nuclear cooperation is then examined in the above-mentioned context, principally using unpublished, archival material. It reveals the negotiation process connected to the research reactor and under what conditions it would have been constructed, providing us a glimpse at bilateral (Hungarian-Cuban) and trilateral (Hungarian-Cuban-Soviet) ties, as well as at international relations in general, showing both opportunities and constraints.

RESEARCH AND SOURCES

The analysis of the Hungarian-Cuban nuclear cooperation follows –and wants to add to– Cold War Studies beyond classic frameworks. "Besides being about East versus West, the United States versus the Soviet Union, the Cold War is also a story of smaller versus big powers" (Crump and Erlandsson 2020, 1). Therefore, this paper studies the period not only from the optics of the superpowers, this case the Soviets, but also from that of regions and non-superpowers. It attempts to follow the footsteps of contemporary studies of Latin America in the Cold War (Field, Krepp, and Pettinà 2020; Pettinà 2018; Brands 2010; Joseph and Spenser 2008; Joseph 2019) and of small(er) states, such as Hungary (Békés 2019; Borhi 2004) and Cuba (Pedemonte 2020; Prados Ortiz de Solórzano 2020) in the bipolar conflict. Beyond national and regional approach, this investigation also intends to focus on connections and interconnections (Mateos and Suárez Díaz 2012, 55); go global, exploring some of the ties between the East and what is currently referred to as the Global South (Westad 2008; Mark and Betts 2022; Mark, Kalinovsky, and Marung 2020; Newhouse 2017). The studied nuclear cooperation outlines a complex relation, made up of a superpower and two countries within its imperial orbit: one in Europe and another thousands of kilometres away in the Caribbean, yet all members of the trade and economic organization of the Socialist bloc, the COMECON.[1]

COMECON was established "in reaction to *others* and relied on confrontation with the outside world to legitimate [its] existence. Created as an agent of Cold War

[1] The Soviet Union and Hungary were founding states of the organization in 1949 and Cuba joined in 1972. On Hungary's relation to the COMECON, see Germuska (2021, 157-183) and Gerőcs (2022, 249-253).

competition, […] it had to deal with the Western World" (Godard 2018, 109). This implied cooperation among countries of the Socialist bloc, states with different levels of economic development –Czechoslovakia and East Germany being the most developed and Mongolia, Cuba and Vietnam the least–, but all belonging to the semi-periphery of the world economy. The COMECON can be considered as a modernization attempt, largely based on import-substitution policies in order to end dependence on core countries (Gerőcs and Pinkasz 2017, 15). One of the means to achieve these goals was in fact nuclear science.

Technically, the COMECON served as planning framework within the Socialist bloc based on 5-year-long objectives of the Soviet Union's and of the satellite states' energy policy – which sustained the logic of bilateral bargaining between the governments and representatives of the Soviet Union (Szabo and Deak 2020, 72). Based on the asymmetry of these relations, the COMECON functioned as a forum of unilateral imposition for the Soviet hegemon (Holzinger and Knill 2005, 781), regardless of the formalities of being an international institution. Yet, it is worth exploring how far the bilateral ties of the nuclear cooperation and the dynamics of these relationships could serve the mere purpose of unilateral imposition and how much room was left for further cooperation.

This paper relies on Foreign Ministry documents kept in the Hungarian National Archive (*Magyar Nemzeti Levéltár Országos Levéltára*, MNL OL): mostly bilateral Cuban-Hungarian and Hungarian-Soviet agreements and related papers. These sources are often inaccessible to other researchers due to languages barriers, Hungarian being a non-Indo-European language. They can add to and amplify the already available documents, and at the same time, present Cold War connectivity from a new angle, that of a small(er) Socialist bloc country. The archival sources used were complemented by articles published in contemporary press. The limitation of this paper is also linked to sources. Currently, we are not able to access related Cuban documents. But once available, Cuban sources will be the key to make this investigation more profound.

This topic has a very strong human dimension in knowledge exchange and transfer linked to the safe operation of nuclear facilities (Schöbel *et al.* 2022, 1), which due to their complexity and extension (degree programs, scholarships, research trips, joint investigations), are to be discussed in separate papers (see, for example Szente-Varga 2024). Therefore, the scope of this writing is restricted to the interstate level of international relations.

FRAMEWORK: NUCLEAR SCIENCE IN THE COLD WAR

The Cold War was a global struggle, fought on all continents and even in space, and total in nature, encompassing not only the military and political fields, but also economics, social life, arts, sports as well as science (Hecht 2011; Jenkins 2021).

Achieving success in one or more of these areas equalled to getting an advantage in the bipolar struggle and contribute to an eventual victory. Science was of special significance, as it formed an integral part of progress, thought to be both desirable and inevitable, based on the linear perspectives on human development. Possibly space science had the most prestige, closely followed by nuclear science. The focus of this essay will not only be on "what happened to science during the Cold war" but more on "what happened to science because of the Cold war" (Oreskes and Krige 2014, 4).

The Cold War, as an international bipolar system, comprised of countries basically grouped into two camps struggling against each other, considering themselves to be on the right or correct side of the fight and morally superior to their opponents. Leaders were convinced that unless they win, the other side will try to ruin them. It was a zero-sum game (Mujan-Leon 1986, 101; Kanet 2006, 334). Being strong, or at least appear to be, was a clue for survival. Political patronage and goals profoundly affected science, by providing financial and institutional support, shaping and defining priority research areas and offering ample research opportunities related to those (Solovey 2001, 166-167). Inside this bipolar system nuclear technologies also served as a basis to strengthen the hegemon-based power relations, as these technologies required a substantial amount of resources mainly available for superpowers, while the military embeddedness of these technologies shaped their commercial evolution in line with the structure of bipolar system – yet some forms of international nuclear cooperation have been created.

The primary goal of developing nuclear science in the Cold War was for military purposes, peaceful uses came in second place. As a result of military-embeddedness of the nuclear industry, international cooperation of the early years was limited, followed by a slight shift towards more extensive cooperation. The Soviet Union started sharing non-military technologies with satellite states from the middle of the 1950s. In the West, the UK was the first country to sell nuclear reactors, inside and outside Europe. As for the United States, it concluded almost 40 bilateral agreements between 1955 and 1958 in order to guarantee 'controlled support' for certain partner countries, which agreements covered only research reactors and technical assistance – similar to that of the subject of the cooperation in Cuban-Hungarian relations (Goldschmidt 1965, 95, 113).

These steps paved the way within the international nuclear community to shift the right to control and of supervision on the use of nuclear technologies from bilateral to multilateral level, which led to the creation of the International Atomic Energy Agency as well as the Euroatom Community at the end of 1950s. Yet, the technology transfer combined with the extension of control and supervisory rights remained highly debated during the negotiation processes, which shed light on diverse interests of the hegemon/non-hegemon countries regarding the nuclear technologies, which could not be clustered only by using the bipolar logic of the Cold War era (Nelkin and Pollak 1981, 185-199).

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SOVIET INTERESTS IN THE NUCLEAR FIELD

In the 1950s the Soviet Union signed agreements to share and export some of their nuclear technology into People's Republic of China, Czechoslovakia, East Germany, Poland, Rumania, and Hungary for non-military use (Ginsburgs 1961, 49-51). However, the Chinese quickly got independent on the nuclear field and even developed their own nuclear weapon. To make things more complicated, Sino-Soviet relations turned out to be far from optimal. The lesson was learnt. The Soviet leadership halted its nuclear export for a while, and when it was restarted towards countries of the Socialist bloc, safeguards were asked for, including Soviet monopoly on uranium fuel, the adhesion of the recipient countries to the Non-Proliferation Treaty, and agreements between these states and the International Atomic Energy Agency on the pacific uses of nuclear energy (Duffy 1978, 85-88). Only VVER pressurized water reactors –which employ light water as coolant and moderator– were exported, whereas RBMK nuclear reactors –using graphite as moderator and light water as coolant–, able to generate not only electricity but also plutonium, and therefore suitable both for peaceful and military purposes (Marx 1996, 151), were constructed exclusively on Soviet territory (Stolmár 2009, 12; Duffy 1978, 86; ÁBTL 2018, 20).

Soviet achievements on such pioneering and novel fields as space science and nuclear science could be more than upsetting for the other side, such as the building of the first nuclear power station in 1954, the first nuclear-powered surface vessel in 1959, the launching of first artificial satellite, the Sputnik in 1957 or sending Yuri Gagarin, the first man into space in 1961 (Wilczynski 1975, 297). Outstanding Soviet scientific results could contribute to shattering Western confidence, reenforcing the notion of Soviet superpower, and projecting strength in the international arena. Besides scaring off potential enemies, they could make new sympathizers and friends, who would want to receive some these frontier technologies. Therefore, technology transfer could be an important link to the Third World, where the Soviets wanted to extend influence.

Additionally, these steps were essential within the Soviet bloc to create the hegemon-type self-perception of the Soviet Union in 1950s. Within this bloc, Soviet nuclear science and technology transfer maintained and/ or increased bloc cohesion and the dependence of the recipient countries. Although paradoxically, many wanted this nuclear option in order to reduce dependency on (Soviet) crude oil imports and in general, on the Soviet Union. The construction of nuclear power plants with Soviet technology, however, would lead to more intensive and longer term dependency on the hegemon. One of the requisites of this nuclear transfer was that only the Soviet Union could supply fuel to these installations, and all spent fuel rods had to be returned to the Soviets. Without them the power plants in questions could not be run.

From the middle of the 1970s Soviet nuclear exports expanded considerably due to the changes in Soviet oil export policy, whose main priority came to be earning hard currency from the West (Szabo and Deak 2020, 74; Elliot and Cook 2004, 376). This was to be achieved via increasing crude oil exports towards trade partners outside the Socialist bloc and decreasing export flows to East Europe. Decision-makers in Moscow offered a variety of alternatives for Socialist states within CEE region in order to make up for lost imports, including increased amounts of natural gas, electricity as well as nuclear technologies. Thus, Eastern Europe was part of Soviet domestic fuel-switching policies (Gustafson 2014, 274), which confirms the imposition strategy exercised by the hegemon. Change, that is going nuclear, was facilitated by the non-democratic systems of the countries in question, the availability of state financing for the projects (Neumann *et al.* 2020, 1-2), as well as the high prestige associated with the nuclear option.

In parallel with the attractiveness of the nuclear alternative and the lack of capacity of the Soviet Union to satisfy all these new demands, a division of labour was formed among Socialist countries, each specializing in the production of certain nuclear products (Duffy 1978, 92), contributing thus to further interdependency among participating states, and increased Soviet/ Socialist exports and international visibility. Nuclear power plants were products sought for political prestige, economic advantages and also for international reputation. The Soviet capability to export them could be used for propaganda purposes, as a 'proof' of the developed and highly advanced nature of Socialist science and (political) system.

Soviet pledges to make nuclear technology transfer to countries with uranium deposits often went hand in hand with bilateral agreements guaranteeing uranium shipments to the Soviet Union, in need of import. Yet, building a nuclear power plant could cost more than these countries were able to pay. Besides, the Soviet fuel monopoly –which guaranteed that no potential raw material for nuclear weapons would be available in the form of spent fuel outside the Soviet Union (Duffy 1978, 86-88), and thus had strategic importance– was rather expensive. Paradoxically, whereas the propaganda and prestige value of the nuclear constructions grew with the geographical distance from the Soviet Union, so did the expected costs and difficulties. For instance, the nuclear power reactors at Juraguá, Cuba, whose works began in the first half of the 1980s, would have formed part of the first nuclear plant built by the Soviets in the Western hemisphere. Local modifications of plans (changing the site from Caonao to Juraguá), long distance from the Soviet Union and tropical weather, however, contributed to delays (Pérez-López 1987, 80), and the construction remained unfinished, abandoned definitely in 1992. Had the nuclear power plant been built on the island, the transport of the uranium fuel would have been dearly expensive due to the huge distance between Cuba and the Soviet Union.

In general, Soviet goals for promoting nuclear science abroad by sharing scientific knowledge and exporting related technology were mostly motivated by geostrategic and political reasons (Guth 2021, 17). From the 1950s the Soviet Union embarked on sharing nuclear knowledge to allies but cautiously retaining a certain control and supervision. The very first interstate economic organization linked to the COMECON was the Unified Institute of Nuclear Research (OIYal) in Dubna, USSR, established in 1956 to "promote international cooperation in theoretical and experimental research in nuclear physics and to develop and standardize equipment for the use of nuclear research" (Nolting 1983, 19). The first COMECON standing commissions were set up in the same year, nine at the time, covering the areas of coal; electricity; oil and gas; ferrous metallurgy; non-ferrous metallurgy; chemicals; machine building; agriculture and foreign trade (Korbonski 1964, 22). Four years had to pass, when finally in 1960, the Standing Commission for the Peaceful Uses of the Atom was established, "providing a framework to institutionalize networks of interaction and collaboration among scientists" (Zachmann 2015, 322).

From the 1970s, with the onset of Soviet nuclear export on a larger scale, the hegemon increasingly allowed countries of the Socialist bloc to participate in this knowledge and technology transfer, sharing the tasks and further increasing interdependence and bloc cohesion by promoting specialization. International Economic Management Organizations were set up to further such goals, including the International Economic Association for Nuclear Instrument Building, established in 1972 with headquarters in Warsaw and comprising of six countries: Bulgaria, Czechoslovakia, East Germany, Hungary, Poland and the Soviet Union (Nolting 1983, 57). The following year the International Economic Association for the Production of Equipment for Atomic Electric Power Stations (Interatomenergo) was formed by eight states (Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Rumania, Yugoslavia and the Soviet Union), with headquarters in Moscow.

> Bulgaria specialized in the production of technical equipment for biological protection, Hungary was responsible for the relocation and processing machinery for the repair of nuclear power plants; the GDR for the production of transport equipment; Poland for the production of heat exchangers. Romania supplied hydraulic tanks for emergency cooling, Yugoslavia gantry cranes. Two countries –the Soviet Union and the Czech Republic– focused on the production of basic equipment, including reactors (Volosin 1989, 5).

Approximately 50 firms of different Socialist countries participated in Interatomenergo, such as Atommas (Soviet Union), Skoda (Czechoslovakia), Chemimas and Ganz-MÁVAG (Hungary), the heavy industry complex of Magdeburg (GDR), Fakon, Chemak and Rafako (Poland) (Bochkor 1984, 2; APN-MTI 1981, 8; H 1983, 2).

Although in a subordinate position, East European Socialist states could also profit from Soviet plans, gaining experience and knowledge from cooperation, and creating the necessary national educational and research infrastructure for the advancement of nuclear science. Achieved results could contribute to socio-economic progress and increased international visibility.

HUNGARIAN DEVELOPMENTS IN THE NUCLEAR FIELD

This cooperation capacity had already been established in Hungary in the pre-Cold War era: Hungarian-born scientists were among pioneers of nuclear technologies

(Marx 2010), even though many of them accomplished their main achievements after having emigrated to the United States. Leó Szilárd is a classic example for this shift in the locations of nuclear pioneers. He left Hungary shortly after the First World War, continued his studies in Germany, worked at German and British scientific institutions, conceived the nuclear chain reaction in 1933, moved to the US, and later worked for the Manhattan Project at the University of Chicago on nuclear reactor design issues (Goldschmidt 1965, 25-26; Marx 1996, 107-125). Ede (Edward) Teller also formed part of this outstanding group of Hungarian-born scientists working in the United States, and is commonly known as the 'father of the hydrogen bomb' (Blumberg and Panos 1990). Even if these scientists and many others left, the educational system which provided their early formation (secondary school / high school),[2] kept functioning in Hungary until the Second World War and contributed to raising a pool of scholars who could work on the nuclear field.

This capacity was used upon establishing the Central Research Institute for Physics (*Központi Fizikai Kutatóintézet*, KFKI) in 1950, in the early years of the Socialist era. It was soon converted into an international reference institution. At the end of the same decade, in 1959, the first subcritical reactor was planned and built by Hungarian scientists (SR-1), followed by a critical one in 1960 (ZR-1). It was a zero-power nuclear reactor, operating at 10 megawatts. By the beginning of the 1970s, the 6th model, ZR-6 had been developed, with the principal purpose of conducting investigations (Csom 2002), in particular to help with the design and construction of VVER-440 nuclear power plants. These successes must have contributed to the decision taken at the 20th meeting of the COMECON Standing Commission for the Peaceful Uses of the Atom –held in 1971 in Keszthely, in a town next to Lake Balaton–, to establish an international group of investigators to carry out research with the ZR-6 model, in the Central Research Institute for Physics (Veszprémi Napló 1971, 1). The group was formed in 1972, constituted by experts of seven COMECON countries, and led by Zoltán Szatmáry (Marx 1996, 168). Later, in 1980, investigators from Finland, Vietnam and Cuba joined. The results of the research group were used in the nuclear design of the VVER-1000 power plants (Jéki 2006, 83).

This Hungarian-led research on the commercial use of nuclear energy was clearly related to the Soviet-led energy transition of the 1960s and 1970s. The Soviet Union started to promote and offer VVER reactors to COMECON countries from 1965, including Hungary (Bosák 2017). Yet, the Hungarian Gosplan, just like the National Technological Development Committee first criticized the nuclear development

[2] After losing WWI and not being able to spend on the military due to the restrictions imposed by the peace treaty of Trianon "education, science and culture were all seen as strategic sectors of national policy". Following economic and financial recovery, the Ministry of Religion and Public Education got approximately 10% of the government budget from the second half of the 1920s until the end of the 1930s, compared to the period of 1900-1913, when the share was between 2 and 5.5%. Two outstanding ministers of the interwar era, Kunó Klebersberg (1922-1931) and Bálint Hóman (1932-1942) also made sure that education was and remained a priority (Romsics 1999, 172-174).

plans due to financial uncertainties as well as on the grounds of the availability of other affordable energy sources (Szabo and Deak 2020, 78). Modified Soviet oil trade policy (aiming at reducing exports to CEE countries) however, led to the reconsideration of plans, resulting in the construction of Hungarian nuclear reactors, combined with an increased import level of electricity and natural gas. Consequently, the Hungarian energy transition in 1970s was clearly embedded into the Soviet Union's energy policy priorities. "According to estimations by a report of NATO's Economic Committee, Moscow had cut back its oil exports to its Eastern European allies by more than a third by the mid-1970s" (Perović and Krempin 2014, 133). Moreover, prices of imported Soviet crude oil increased significantly. In case of Hungary, they grew more than fourfold between 1970 and 1979, from 15.18 rubles a barrell to 67.9 (Szabo and Deak 2020, 76). This gave a further push to purchase crude oil not from the Soviets, but with their consent, from the Middle East and North Africa (Mark and Betts 2022, 103) as well as to look for other energy sources, other than oil.

The construction program of the four Hungarian VVER reactors in Paks was launched in 1970s and they started to operate in 1983, 1984, 1986 and 1987 respectively (IAEA 2022). Interestingly, the building of the nuclear power plants in Cuba began in 1983 and 1985, just before the completion of the Hungarian program. Thus Hungary, with a similar size and population as those of Cuba could become an example for the Cuban leadership, a kind of proof, that this sort of development can be carried out by a Socialist camp country.[3] Similar programs of other CEE COMECON countries have also been completed in this era.

CUBAN DEVELOPMENTS IN THE NUCLEAR FIELD

Cuban interest in nuclear technology has been closely related to the lack of energy resources and dependence on imports as well as to energy security, including the goal of providing energy for growing needs in the future. Yet the nuclear program did not only encompass the production of electrical energy via nuclear power plants, which was its most important aspect, but all other related fields in medicine, industry, agriculture, water issues. In general, all peaceful aims of nuclear energy.[4] Ironically, the principal aim of reducing dependence on (Soviet) oil imports was to be achieved by producing energy in nuclear power plants constructed with Soviet technology. Besides the goals of economic growth, providing a higher standard of living for the population and attaining more economic freedom, and in this way obtaining an improved position vis-à-vis the Soviet Union, Cuban leadership also ambitioned a leading role in Latin

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3 The population of Hungary was 10.7 million and of Cuba 9.8 million in 1980. Cuban territory covers 109 884 km^2, Hungarian 93 030 km^2.

4 Interview with a senior researcher at CEADEN, online (19 February 2022).

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America in nuclear science, a kind of proof not only of their superior level of scientific knowledge but also of their political system.

Nuclear technology tends to be associated with the Cuban Revolution, however it had antecedents in the previous era, when Fulgencio Batista made an agreement –with British and US partners– to construct a nuclear power plant on the island (Benjamin-Alvarado and Belkin 1994, 20). The project did not materialize; being intercepted by the change in power. After the Revolution there was a shift in the direction of scientific know-how. What used to arrive from and was expected from the West, had to come from the Soviet Union and the Socialist bloc after 1960. It was in 1967 that a Soviet-Cuban Agreement on the pacific uses of nuclear energy was signed, including the Soviet construction of a zero-power reactor on the island (González 2017, 184). More ambitious Cuban plans got a boost via the 1976 Soviet-Cuban agreement on building –with Soviet technology– advanced models of VVER-440 type nuclear power reactors on the island. "By the breadth, complexity, and importance to economy, the reactor constituted one of the most significant works ever undertaken in the country" (Benjamin-Alvarado 2000, 59). Construction of the first reactor finally began in 1983 and the second one in 1985. "When fully operational, the plant [was to] have four 417-megawatt Soviet VVER pressurized-water reactors" (Castro Díaz-Balart 1990, 49-52). Plans were geared to special Cuban needs using a more advanced model (model V-318 model with anti-seismic features) (Benjamin-Alvarado 2000) and having a concrete containment dome (Smith 1995, 4).

There was a visible institutionalization of nuclear affairs in the decade of the 1980s covering scientific-educational and administrative-representative-organizational goals. The Cuban Atomic Energy Commission [*Comisión de Energía Atómica de Cuba*] and 'its executive branch', the Executive Secretariat for Nuclear Affairs [*Secretaría Ejecutiva para Asuntos Nucleares*] (*Nucleus* 2009, 3; Castro Díaz-Balart 2017, 33) were created in 1980 – the previous would soon be engaged in representing Cuban interests on the international field, including negotiations with Hungary. The Centre for Applied Nuclear Development Studies [*Centro de Estudios Aplicados al Desarrollo de la Energía Nuclear*] tasked with scientific research; the Centre for Radiaton Protection and Hygiene [*Centro de Protección e Higiene de las Radiaciones*] in charge of environmental radiological survellaince and low-level radioactive waste management within national boundaries; the Higher Institute for Nuclear Science and Technology [*Instituto Superior de Ciencia y Tecnología Nucleares*] responsible for the training of professionals (Castro Díaz-Balart 1990, 49-52) as well as the Nuclear Energy Information Centre [*Centro de Información de la Energía Nuclear*] together with the journal *Nucleus*, with the aim of informing the Cuban public on nuclear energy issues, were also created in the 1980s (Contreras Izquierdo 2014).

Altogether 12 nuclear reactors were planned on the island (Benjamin-Alvarado and Belkin 1994, 20), a clearly overambitious plan with political and ideological zeal. The Soviet Union could have showcased Cuba and use it as a propaganda tool (Bain 2005, 773-774), as by the time works began on the second reactor in Juraguá in

1985, there were only three nuclear reactors working in all Latin America: Atucha 1 (constructed between 1968 and 1974) and Embalse (1974-1984) in Argentina, and Angra 1 (1971-1985) in Brazil. Four others were under construction: Laguna Verde 1 (1976-1989) and Laguna Verde 2 (1977-1994) in Mexico, Atucha 2 (1981-2016) in Argentina and Angra 2 (1976-2001) in Brazil (World Nuclear Association 2022).[5] The nuclear program of Cuba, had the clear aim of making Cuba a nuclear energy producing nation, the 4th one in Latin America, after Argentina, Brazil and Mexico trying to cut the development gap between these countries and the island state (Contreras Izquierdo 2014).

CUBAN-HUNGARIAN NUCLEAR COOPERATION

The nuclear cooperation between Cuba and Hungary took place not only in a Cold War context, but more precisely, under the circumstances of the so-called Little or Second Cold War. This period, beginning from the Soviet invasion of Afghanistan, brought about the worsening of relations between the two superpowers. The aged Soviet leadership considered the developments of the 1970s such as the crude oils crises and the end of the war in Vietnam (seen as a US failure) as signs of a decline in the power of the West and therefore an opportunity for the Soviet Union to tilt the Cold War balance in its favour. This resulted in a more aggressive Soviet foreign policy, trying to change the status quo and urging other Socialist countries to follow suit. Cuban revolutionary export was revived in the 1980s, and unlike in the 1960s, this time it had Soviet backing (Anderle 2004, 155).

Under the circumstances of increased international tensions, the importance of Latin America grew for the Soviet Union. Not because of direct interests, but because it was a national security area of its greatest rival. Having Soviet presence on the subcontinent –as well as a successful Socialist country in the Caribbean in the very vicinity of the US–, could foster Soviet prestige in the international arena and distract US attention from spheres that really mattered for the USSR (Desjeans and Clement 1987, 223). It was in this context that a COMECON reunion was celebrated in Prague, Czechoslovakia in 1980, where the participating countries supported the plan for the accelerated development of science and technology of the Republic of Cuba until 1990 (*Plan para el desarrollo accelerado de la Ciencia y de la Técnica de la República de Cuba hasta 1990*). It consisted of various programs, number 12 (nuclear energy) being designated as a task for Hungary.[6]

5 Years in brackets show start of construction and the year of commercial operation date.

6 National Archives of Hungary, Budapest. Magyar Nemzeti Levéltár Országos Levéltára, MNL OL (XIX-J-1-k) 1986 IV Kuba 61. doboz [box] 84, 84-5, Magyar-kubai együttműködés a Kubában épülő zero potenciájú atomreaktor témájában [Hungarian-Cuban cooperation on constructiong a zero potential nuclear reactor in Cuba].

Not much later bilateral, Hungarian-Cuban negotiations started. At the end of March 1981, a delegation of the brand new Cuban Atomic Energy Commission arrived in Hungary to discuss details.[7] The Hungarian partner was tasked with the preparation of a reactor for investigations and teaching, type ZR-6 and its installation in Cuba. Yet the centre of nuclear investigations, where the research reactor would be placed, was to be built by the Soviet Union, which thus retained an active role and certain control in the project. The agreement between the Cuban and Hungarian governments was signed in February 1982 in the Hungarian capital, whereas reaching the agreement between the Cuban Atomic Energy Commission and the Committee for Atomic Energy of the Hungarian People's Republic took another year, and was finally signed in March 1983, in Havana. In a parallel way, in order to delineate accurately future tasks and to ensure Soviet monitoring, respective bilateral protocols were elaborated, and signed between the Soviet and the Cuban governments in 1981 and between the Soviet and Hungarian governments in 1983. Languages further confirm power dynamics. Whereas Cuban-Hungarian deals were written in Spanish and in Hungarian, both versions being equally certified and authentic, the Soviet-Hungarian protocol was only prepared in Russian.

Despite the ambitious plans, the prolonged elaboration of the agreements, combined with the worsening economic outputs entailed that the project did not go ahead as planned. The original agreements made between the Cuban and the Hungarian governments and also between the corresponding atomic energy agencies, were to be in vigour only until the end of 1985. These laid down the share of tasks between the parties, namely Hungary was made responsible for planning, building, and transporting the fundamental equipment of the critical nuclear system, combined with the security reporting as well as assistance tasks (guaranteed also in the Hungarian-Russian bilateral agreement). The Cuban part was in charge of further construction works, while the nuclear fuel transport and the general construction works were kept for the Soviet Union. Consequently, the technical framework of the research reactor had been based on Hungarian as well as Soviet technological requirements with some modifications due to local circumstances in Cuba. The hegemon's presence can be identified in the fuel-related prerogative combined with the Soviet technology's role already present in form of advanced VVER-440 type reactor models. Yet, the financial aid for research reactor's construction was to be guaranteed by the Hungarian partner under the cooperation scheme of the COMECON. A line of credit of 1 million transferable rubles was extended, valid until the end of 1985. The Cuban part announced in January 1985 that it would not be able to receive the reactor before 1988. The readjustment of

7 MNL OL (XIX-J-1-k) 1981 IV Kuba 56. doboz, 84-54 – Magyar-Kubai Műszaki-Tudományos Együttműködési Albizottság ülése. TESCO jelentés. Magyar-kubai műszaki konzultáció nukleáris kritikus rendszer Kubába történő szállításáról [Meeting of the Hungarian-Cuban Technical-Scientific Cooperation Subcommittee. TESCO report. Hungarian-Cuban technical consultation on the delivery of a critical nuclear system to Cuba].

the plans included the provision of another line of credit worth 1.5 million transferable rubles (payable in 20 instalments with an interest rate of 3%, starting 12 months after the last shipment) and a new agreement between the Cuban and the Hungarian atomic commissions, signed in Budapest on 10th March 1988.[8]

Yet, the continuation of the project had many further obstacles. The agreement signed in March 1988 had a very short validity, only until the very end of 1990. What is more, the Cuban side already confirmed in February 1988 –that is, before the signing of the new agreement– that it was not prepared to receive the necessary nuclear equipment before 1991.[9] Therefore, reaching an agreement valid until 31st December 1990 definitely fell short of their plans, entailing the necessity of another round of negotiations with options for the decade of the 1990s. Not only the Cubans experienced problems. Some of the Hungarian firms had already prepared the required equipment but could not get the money for their work due to the delay in the project. Conscious of this difficulty, and possibly with the aim of maintaining Hungarian interest, the Cuban partner offered to use its line of credit to cover these costs.

Events at the end of the 1980s took an unexpected turn and international changes overwrote all previous plans and expectations. The Socialist bloc (destination of 95% of Cuban exports and origin of 75% of Cuban imports) (Anderle 2004, 165-166) got dismantled around 1989/90, organizations such as the COMECON and the Warsaw Pact as well as the Soviet Union itself ceased to exist and altogether, the bipolar confrontation and system ended. It was questionable whether the Castro regime could survive. By 1993 industrial production had contracted by more than a third, various firms stopped functioning; the *zafra* reached less than 4 million tons (the worst since 1959), electricity use came to be limited, and the government started the preparation of the population for the so-called zero option –no electricity, no transportation– (Anderle 2004, 166). Several projects had to be halted, including the nuclear program, which officially came to an end in 1992, leading to the abandonment of the construction of both the nuclear power plant and the research reactor.

CONCLUSIONS

Even via the failure of the construction of the nuclear power plant and the research reactor there are some lessons to be learnt on the Socialist bloc's power structure in

8 MNL OL (XIX-J-1-k) 1988 IV Kuba 60. doboz [box] 84-5 – Nukleáris kritikus rendszer létesítéséről szóló egyezménnyel kapcsolatos jegyzőkönyv jóváhagyása [Approval of the protocol related to the agreement on the establishment of a nuclear critical system].

9 MNL OL (XIX-J-1-k) 1988 IV Kuba 60. doboz [box] 84-1 – Magyar-kubai atomenergia-bizottságok közötti 1983.III.11-én aláírt nukleáris kritikus rendszer kubai létesítésében való együttműködésről szóló Egyezmény kiterjesztése [Extension of the agreement between the Hungarian and Cuban Atomic Energy Committees signed on 11 March 1983, on cooperation in the establishment of a nuclear critical system in Cuba].

relation to nuclear technologies. To start with, the military-based roots of nuclear energy contributed to the commercial evolution of nuclear technologies. Therefore, the nuclear evolution reflected the structure of bipolar system at the beginning of the Cold War era. Interestingly, the Soviet Union seemed to be less reluctant to break the main rule of secrecy at least with its satellite countries. Moreover, this also contributed to the international nuclear cooperation via the creation of the international organization of IAEA with control/supervisory powers over the use of such technologies. Theoretically, the dissemination of commercial nuclear technologies among Socialist states also reflected some economic considerations, but the latter were seemingly less important within the Soviet bloc. After the 1970s' oil crisis the Soviet goals changed and Soviet oil trade and currency policy targeted the Western bloc countries for 'hard currency' instead of concluding barter arrangement schemes with East European countries, as before. This shift resulted in new alternatives for these countries with the increased import of natural gas, electricity as well as transfer of nuclear technologies.

In the Global South, including Cuba, expansion of Soviet nuclear technology also had potential ideological impact with the expansion of the Soviet or Socialist bloc countries' reactors as highly advanced 'products' of Socialist science. This type of energy transition was clearly characterized by the hegemon-related imposition, yet COMECON also served as a bureaucratic and financial framework for development and cooperation – even if Cuban programs have also led to agreements with the IAEA to secure UN control and supervision over the new instalments.

The share of burdens and tasks also reflected the hegemon-like leading role for the Soviet partner with responsibilities and control reserved for the Soviet Union: general construction of VVER reactors, monopoly over the fuel to be used, as well as building the island's nuclear research centre. Yet, some responsibilities were upheld for Hungary, such as construction tasks over the Cuban research reactor, notwithstanding the financial support to be guaranteed for the project.

Due to the collapse of the Socialist bloc no facilities were concluded, leaving the participating countries without the expected benefits. Hungary could not make it to be a successful exporter of research reactors, whereas Cuba was not able to turn into a nuclear country. None of the two could improve its international position and gain more independence –room for manoeuvre– from Moscow. Yet the cooperation did have some positive outcomes, especially in terms of raising nuclear professionals.

OUTLOOK: ONCE A HEGEMON ALWAYS A HEGEMON?

In a broader context, the bilateral and trilateral dynamics of the nuclear cooperation in the 1980s can shed light on the relevance of Soviet Union-related energy systems as well as prevailing challenges arisen from the Soviet-led energy transition. Studying such relations could also support us to understand better the current power dynamics of energy-related conflicts, which cannot be underestimated in light of the Russia-Ukraine war of 2022. It seems that some of the key patterns characterizing the behaviour of Soviet Union with respect to (nuclear) energy, survived in Russian energy policies in the 21st century.

The hegemon-like role perception of the Soviet Union lived on even after its demise and the collapse of the Socialist bloc and its traces are present in the Russian Federation via the use of the natural gas supply (in broader context, energy) as a strategic tool. Yet, the tectonic changes due to the Russian-Ukrainian war of 2022 will presumably demonstrate, whether this role can be upheld, or the war will lead up to a clear repositioning (even self-repositioning) of Russia as a substantial power within the international order. In this regard the export of Russian nuclear technologies could play a pivotal role in preserving or not such position in the course of the general 'repositioning process' from both import and export sides.

Nuclear cooperation between Cuba and the Russian Federation was gradually revived in the 2010s. In September 2016 an intergovernmental agreement was signed on cooperation in peaceful uses of atomic energy, soon to be followed by news –on the webpage of Rosatom– that the Cuban government manifested interest in "non-energy applications [that] stand for nuclear medicine, agriculture, industry, transport, security, etc. to the extent of building a research reactor" (Interfax 2016). Almost three years later, in autumn 2019, a bilateral agreement was signed in Havana on the construction of a multipurpose irradiation centre on the island (Rosatom 2019). Re-mending and strengthening ties with Cuba and in general, with Latin America –areas far from Russia but close to the rival United States–, can be considered as part of the toolkit used by the Russian leadership in their attempt to gather allies and try to alter the current world order towards more multipolarity (Szente-Varga 2022).

As for Hungary, the government plans to keep the decisive role of the nuclear power on the supply side, as it has signed a bilateral agreement with the Russian Federation including the construction of two further nuclear units (Paks2) next to the existing ones near the Hungarian town of Paks. The CEE EU countries have to reconcile their energy sectors built up during the Socialist period with the legal and economic EU requirements on free-market principles and interconnected visions of the EU's internal market (Szabo and Deak 2020, 70-96). Theoretically, this could be achieved even with Russian-designed reactors based on the free choice of national energy mixes and technological neutrality. Yet the tight relationship with the Russian partner could be delicate in light of the sanctions related to the Russian-Ukrainian war, which could target more energy sources and potentially technological transfer in the mid-term future, and also because nuclear technology transfer implies long-term dependency and commitment towards the source country.

The power relations of the 2020s, though different to a large extent compared to those of the second Cold War period, show some similar patterns with respect to the hegemon-like self-perception of the Soviet Union and the Russian Federation. However, there is neither a COMECON-like organization now technically functioning as a cooperation forum, nor a bloc of satellite states. Therefore, the export of nuclear technologies is built up by the Russian side following bilateral rather than multilateral logics, yet with similar geopolitical intentions. In case of the former satellite states not just the collapse of the Soviet bloc but also their later repositioning affected the potential of the nuclear technology export-related role of Russia. As for Hungary, constraints could become even more relevant, if the EU's further sanction packages would include more extensive bans or restrictions on technological transfer.

Cuba's mere option as exporter of nuclear technologies remains Russia due to the ongoing comprehensive economic embargo imposed by the United States. Nuclear cooperation with Cuba could also foster Russian prestige in the international sphere but it would be very costly. Yet, in light of the inevitable reallocation of resources due to the Russian-Ukrainian war, financial constraints are likely to play an increasing role.

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