"To Light the Lands":
Georgia and the Quest for Electrical Security[1]

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December 14, 2019
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1) Executive Summary

Georgia lacks coal, oil, and gas reserves, and relies on hydropower to provide reliable, large-scale renewable power generation. But the country's overwhelming dependence on hydropower to meet its electrical needs fails to deliver either sufficient energy diversity or sustainability. The government's present approach persists because Georgia lacks both a long-term electrical strategy and the capacity needed to craft one. Additionally, Georgian ministries are biased in favor of new hydropower projects while biased against other renewables and energy efficiency improvements. Finally, the government's plan to address the thorny status of the Enguri Dam is failing to deliver results and must be reassessed.

Given that additional, large hydropower has proved more expensive and difficult to build than Georgia initially anticipated, this memo recommends a quartet of Georgian government reforms to stabilize the Enguri Dam's position within the Georgian grid, institutionalize economy-wide electrical planning, promote non-hydro renewable power, and encourage energy savings.

2) Introduction

Hydropower remains the world's largest source of renewable energy, providing an emissions-free source of uninterruptible power.[2] Georgia's reliance on hydropower has grown substantially since the 2003 Rose Revolution,[3] and Georgia was one of the top twenty nations worldwide for new hydropower construction in 2018.[4] This places Georgia in the same category as nations like China, Brazil, and the U.S., at a moment when many developed nations are actively breaching and removing their hydropower dams.

According to a 2018 *Proceedings of the National Academy of Sciences* paper, "Large dams seem to be everything that one should not try to build if one cares about sustainability."[5] Dams are expensive, ecologically disruptive, drive human displacement, and can be impaired by climate change.[6] While not all of Georgia's hydropower plants (HPPs) are large dams, the question remains: why is Georgia so firmly embracing hydropower at a moment when many others are questioning its underlying value as a sustainable source of energy?

For Georgian leaders, using water to produce electricity represents the past, present, and future of power generation. Because of its lack of fossil fuel resources, Georgia has relied on hydropower since the 1920s. Hydropower provides the overwhelming majority of its present electrical generation. As Georgian policymakers strive to make Georgia electrically self-sufficient on a year-round basis, is harnessing Georgia's rivers the best available means to that end? As a developing middle-income country committed to both European Union and NATO membership, Georgia can offer powerful lessons for what to do (and what *not* to do) when it comes to expanding an incumbent electrical feedstock to fuel economic development.

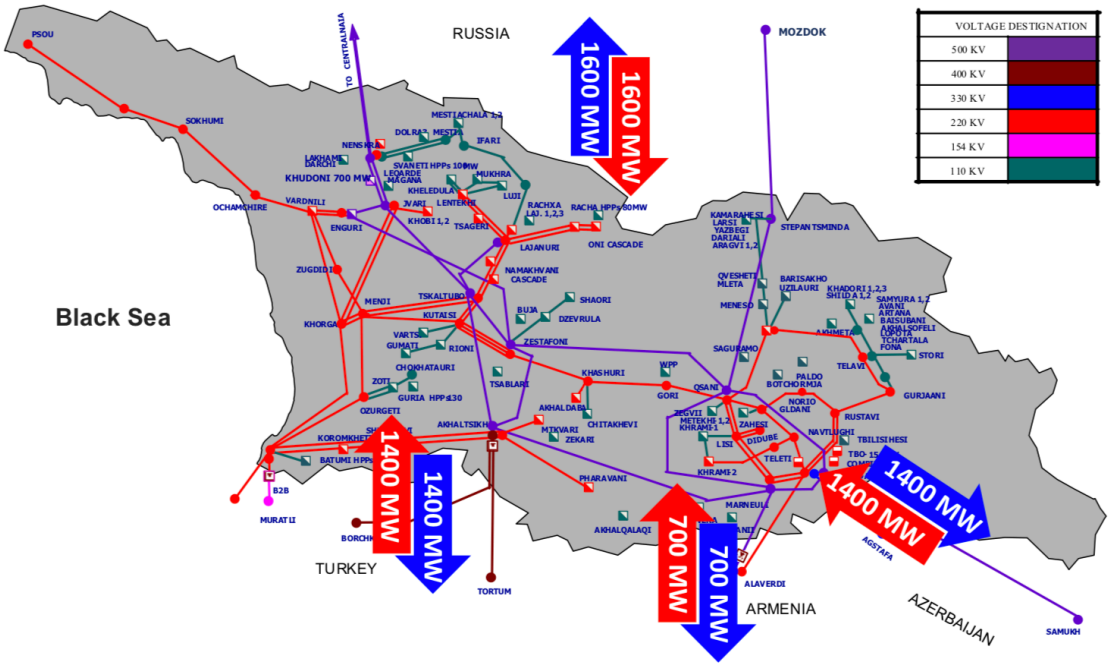
3) Background

Georgian electrical policy is shaped by two scarring experiences in the country's recent history. The first were the chronic blackouts and power shortages of 1990s Georgia, when many

Georgians recount having only four hours of electricity a day in Tbilisi.[7] The second came in the years after the 2003 Rose Revolution, when Gazprom repeatedly threatened to end Georgia's access to imported Russian natural gas – unless Georgia complied with a series of outrageous, extortive demands.[8] Taken together, these events imbued Georgian electrical policy with a fervent, unshakeable imperative: electrical power must be reliable, plentiful, and *domestically-generated*.

In practice, this has meant that the country has worked to rapidly modernize its electrical system such that relatively-cheap and abundant power is now a fact of life for virtually every Georgian. The scale of the accomplishment is staggering to behold: over 20 years, Georgia went from a limping, barely-functional electric system to a near-modern electrical grid. As the country opened up after 2003 under Mikheil Saakashvili, Georgia sought to expand its homegrown power generation capacity in order to drive economic growth, cut ties with Russia, and export power to growing neighbors like Turkey. It was also hoped that new power generation would lessen Georgia's dependence on Enguri Dam, with its burdensome territorial and operational issues. Stalled or mothballed Soviet-era hydropower plant (HPP) projects were resuscitated and readied for financing. Georgia's transmission operator, the state-owned monopoly GSE, raised huge sums from international development donors to refurbish and expand the country's electrical network, including the eventual construction of new east-west power interconnections that linked Turkey into the Georgian grid (see map below). Overall electricity production grew 43 percent between 2002 and 2014.[9]

Figure 1: The Georgian Grid



Cross-border transfer capacities between power systems of Georgia and its neighboring countries as for 2029 ["Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019]

Georgia is a small country, and attracting foreign direct investment in its power sector is difficult without the prospect of export markets to ensure sufficient long-term demand. When Turkey's economy began to deflate, Georgia lost both its most promising export market *and* one of its best rationales for power sector investment (Turkey is also engaged in a massive hydropower plant buildout of its own, and McKinsey analysis suggests that it will become a net electrical exporter by 2023).[10] At the same time, the government increasingly turned to long-term, fixed-price power contracts for new power plants -- Power Purchase Agreements, or PPAs -- to provide the stable revenue streams needed to secure attractive financing from multilateral development banks.

Georgia has since greenlit more than 100 Power Purchase Agreements (PPAs) for projects ranging from the colossal Khudoni hydro dam to an array of smaller, localized hydropower plant (HPP) projects generating only a few megawatts (MW) each.[11] The government-backed PPAs -- and the subsidies they provided -- were non-public and ad hoc, leading to criticism that such deals were deliberately nontransparent and designed to conceal government malfeasance.[12] At a minimum, such practices create the appearance that corruption may be influencing state decision-making.

As of 2019, the vast bulk of Georgia's 4166 MW of installed power generation is hydroelectric: 3220 MW, or roughly 77 percent.[13] The remainder are largely gas thermal plants, burning Azeri gas (with a smattering of Gazprom imports as well).[14] The generation balance shifts dramatically throughout the year: 1 percent of Georgia's power comes from thermal gas plants in summer, while 28 percent (and growing) comes from thermal power in the winter months, when water levels are low and HPP stations are less fecund.[15] Two earlier waves of post-Soviet privatization saw all but Georgia's largest power plant (Enguri) sold off, and those private owners now sell wholesale power primarily through bilateral contracts. As Georgia works to voluntarily comply with EU Energy Community rules, it is attempting to move its complex mixture of regulated, unregulated, and partially-deregulated power assets into a modern, competitive electrical market.

The Enguri Dam and power station in the far Northwest function as a microcosm of all the challenges and dysfunctions of the Georgian electrical system. The power plant represents the backbone of Georgia's power system, but it is mired in a geopolitical dispute with no clear resolution in sight. The facility produces a maximum of 1300 megawatts (MW) at full flow (roughly the output of one large U.S. nuclear reactor), but the dam's power plant and associated cascade facilities lie over the border in Russian-held Abkhazia. A 1990s-era agreement with Georgia supplies the Abkhaz with free electrical power, in exchange for Georgian access to the facility and acknowledgement that it belongs to Georgia.[16] A further complication is that Georgia plans to liberalize its electricity market while retaining state ownership of Enguri, meaning that the new market will be anchored by a subsidized, non-competitive power station. However, without a competitive market, Georgia fears it will never be able to attract the needed investments in new generation to eventually displace Enguri *itself*.

As part of an agreement with the IMF, Georgia has paused the issuance of new HPP PPAs until a new Public-Private Partnership (PPP) framework can be implemented to limit untoward fiscal exposure for the state.[17] A leaked 2018 analysis by the World Bank found that Georgia's initial

bonanza of HPPs was conducted without sufficient fiscal safeguards: the PPA for the 280 MW Nenskra HPP alone could incur €1.8 billion in fiscal costs by 2041.[18]

It is also worth noting the profound tensions between Tbilisi, the capital and home to nearly half the country's population, and Georgia's more rural reaches. While Georgia is growing and getting richer, those gains have not been distributed evenly.[19] This social friction has been thrown into high relief in regions where the central government advocated new hydropower development, sometimes without the consent or buy-in of the local populations (see endnote).[20]

While Georgia's relevant ministries would not characterize it as such, Georgian electrical policy stands at something of a crossroads. Most EU member states (and aspiring members) work to build power supplies that are secure, reliable, diverse, affordable, and sustainable. Though Georgia's electrical system can be credibly characterized as reliable and affordable, the state still worries that it is not sufficiently secure yet – while less-concerned with its lack of diversity and sustainability.

4) Analysis

More than anything else, Georgia's preference for hydropower can be explained by "path dependence," a practice that endures due to historical preference. Freshwater is the country's predominant energy resource, and its use as an electrical feedstock has a long and distinguished national pedigree. Georgia has minimal or nonexistent domestic reserves of coal, oil, and gas. For a country fixated on independence and self-reliance, a renewed commitment to hydroplants seemed obvious to many Georgian leaders and international donors. State subsidies for HPPs explains why the myth of "cheap" greenfield hydropower persists.[21] That state support has helped to crowd out feasible alternatives, like wind and solar power.

Georgia has now found itself with substantial year-over-year growth in electrical demand and no coherent strategy with which to meet it. The areas of concern are as follows:

No long-term energy strategy to guide electrical planning. While the Georgian transmission operator, GSE, has a laudably detailed 10-year network plan, they lack the regulatory authority or the policy reach to craft an authoritative, economy-wide power plan for Georgia. After a series of alarms raised by the IMF, the World Bank, and the Georgian Ministry of Finance, the Georgian Economy Ministry is now attempting to reverse-engineer a prudent, fiscally-sound approach to financing power projects. But a de facto moratorium on new HPP projects and a pledge to enact more stringent environmental and social safeguards will not make Georgia's electrical planning any more coherent.

Lack of in-country technical capacity and accurate data. Not only does Georgia rely on IFIs and MDBs for much of its electrical system financing, it also relies on those institutions to provide much of the technical heft needed to guide its policies and investments (see endnote).[22]

Taken together, this paints a picture of a government that is ill-equipped to competently appraise the impact of its own policy choices. In some areas, hydrological studies date back to the Soviet era and have not been substantially updated since, while more recent analyses are non-public and

proprietary.[23] Georgia is a middle-income nation in a hurry, racing toward EU and NATO membership at a breakneck clip. But urgency does not absolve the government of the need for sober due diligence -- and the painstaking work needed to build that in-government capacity. The government's 2017 decision to subsume the energy ministry within the economy ministry further handicapped Georgia's capacity in this regard (losing one out of every four original ministerial staffers),[24] while also ensuring that GDP growth -- and not sustainability or policy coherence -- would drive electrical development in Georgia.[25]

Is new always better? As discussed, over a hundred PPA memorandums of understanding (MOUs) have been signed by the Georgian government with developers for the construction of new HPPs.[26] One might reasonably assume that issuance of MOUs only began after the modernization of Georgia's *existing* power stations. And yet that is not the case.

Under Lenin in 1920, the USSR began a program of rural electrification that brought large-scale hydropower and transmission lines to Georgia, with construction continuing up through the 1970s.[27] The Soviets built hydropower stations throughout Georgia in an effort to supply plentiful (and free) power to its three South Caucasus republics -- and many such plants remain in operation today, though now in private hands.[28] Some HPPs have turbines and powerhouse equipment that have not been replaced or updated in more than 50 years.[29] Georgia lacks a policy mechanism to incentivize retrofits of its older power plants and is reluctant to impose mandates on private property-holders. As such, Georgia's estimates of both its current power generation and future projected demand fail to account for the gains that greater efficiency of production could yield.[30]

Georgia's draft energy efficiency law primarily contemplates consumer-side energy efficiency measures – rather than supply-side policies to make existing power plants more productive.[31] Georgia assumes that the eventual deregulation of its merchant power plant fleet will provide a powerful incentive to drive efficiency gains.[32]

Non-hydropower renewable energy is dismissed. Data released by the (former) Georgian Energy Ministry and others suggest that Georgia's commercial wind capacity is greater than 1000 MW.[33] GSE itself has identified at least 18 potential utility-scale wind projects for a total of 1330 MW of generation.[34] Georgia has a well-functioning electrical grid with technical losses below 1.5 percent, and rising demand for power.[35] Wind power could help address Georgia's wintertime power shortfalls, and alleviate east-west strains on Georgia's power grid (most hydro is in the west, while the country's best wind power sites are much closer to the population centers in the east).[36] Under these conditions, one might reasonably expect a flowering of Georgian wind power development. And yet Georgia has only one small state-backed wind project, the tiny 20 MW Kartli Wind Farm in Stalin's hometown of Gori.[37]

Many state entities believe that wind power is either too expensive or too technically complex to integrate into Georgia's grid. A GSE spokesman suggested that wind power is too variable and that accompanying battery storage is still cost-prohibitive;[38] officials at the Georgian National Energy and Water Supply Regulatory Commission (GNERC, the electrical regulator) suggested that wind cannot compete effectively in Georgia's current hybrid regulated/deregulated energy market.[39] On the other end of the spectrum, the Georgian Renewable Energy Development

Association (GREDA) and NGOs like Green Alternative believe that a pervasive bias against wind persists among Georgian policymakers who fear the challenges posed by an interruptible (non-baseload) power source like wind.[40]

The truth lies somewhere between these two differing perspectives. Wind power *does* present real grid integration challenges, but they are nowhere near as knotty as those faced by huge industrial states like Germany. Georgian energy policies prize growth and reliability above all else. As such, there has been no political or economic imperative to *diversify* the sources of Georgia's renewable power. Additionally, first-mover wind projects will still require a state subsidy going forward, and the disfavor into which PPAs have fallen has thusly hurt prospects for wind and solar as well.

Enguri is intractable. Enguri is the only major wholly-state-owned hydroplant remaining in Georgia, and it has been long denied a generation tariff (payment for power) that ensures anything resembling a fair rate-of-return. Enguri's functionality comes at the mercy of international donors like the European Bank for Reconstruction and Development (EBRD) who have spent decades committing the necessary financing to stave off calamity.[41] The artificially "cheap" cost of Enguri's power subsidizes the rest of the Georgian power system.

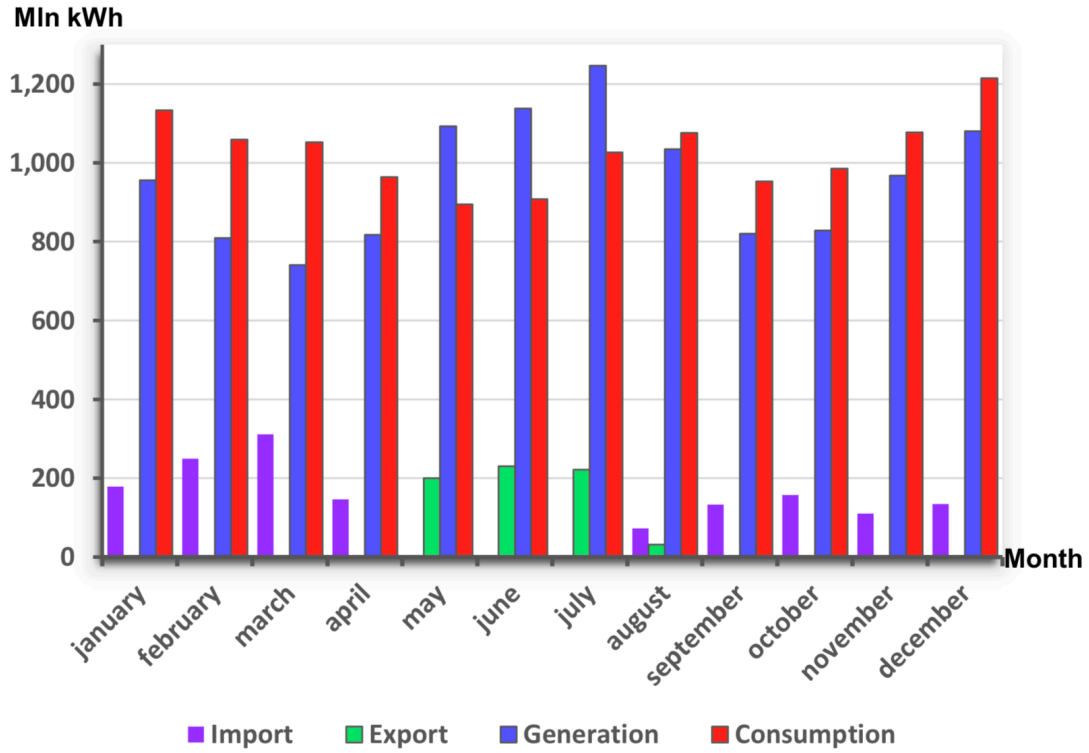
The government's proposed solution to the problem is not working. On one hand, their hope is that continued political reconciliation with Abkhazia could lead to the eventual metering of and payment for power from Enguri (UNDP has developed a pilot project towards this end).[42] On the other hand, Georgia hopes that its investment in massive new upriver HPPs like Nenskra and Khudoni will both extend Enguri's working life and minimize Enguri's "N-1" risk to Georgia's grid.[43]

On the first count, the best hope for now is to urge the Abkhaz to reduce sky-rocketing power demand, given that the strains it places on Enguri could compromise the facility's longevity.[44] Metering and payment for power by the Abkhaz is a decade or more away, if it ever comes.

On the second count, Nenskra and Khudoni and many other upriver plants are stalled by public protest, technical setbacks, and cost overruns. And all the while, Enguri remains in a state of purgatory, stranded between Georgia and Russia and without a reliable revenue mechanism to fund its operations.

Energy *security* does not equal energy *independence*. Georgian leaders are fixated on achieving electrical independence from their neighbors (see Figure 2 below), given that the Azeris have not always proven a steadfast gas supplier during peak demand. 2018 was the first year that Georgia was forced to import power during its summer months, when high water levels usually produce *surplus* HPP power.[45] This fact alarms Georgian policymakers, as they believe it will leash them to neighboring states. Ministers see it as all the greater justification for construction of their troubled suite of new HPP projects.

Figure 2: Electricity Imports and Exports, 2017



Georgian Electrical Supply, 2017. ["Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019]

The problem, of course, is that not all energy security threats are created equal. Georgia presently imports natural gas from both SOCAR (Azerbaijan) and Gazprom (Russia), and seasonally imports electricity from Azerbaijan. Planned storage facilities will help Georgia mitigate the cost of buying pricey wintertime gas imports from SOCAR. Georgia will need firm baseload gas capacity in the winter months for years to come, given that gas is also used as a heating fuel. Because Georgia is a crucial gas transit state for Azeri gas, Azerbaijan is less likely to become a politically-hostile energy supplier for Georgia.[46]

As a small country, Georgia is deeply reliant on its neighbors. Achieving true, year-round energy independence may prove impossible, and attempting it may be so expensive as to outweigh its entire "security" value. Given future demand uncertainty, it is often wiser to rely on imports instead of overbuilding new generation that could later prove uneconomical. The market for Georgia's exported electrical power declined by 65 percent between 2010 and 2012.[47] Such demand uncertainty counsels caution.

5) Policy Recommendations – Government of Georgia

In the interest of building an electricity system that is diverse, reliable, affordable, and sustainable, the Georgian government should take the following four steps:

I. Ameliorate Enguri Dam's precarious financial position. Very little can be solved in Georgian energy electrical policy without a better solution for Enguri. Given that payment for

power from Abkhazia appears a distant prospect, Georgia must take the painful steps necessary to fortify Enguri. With Nenskra, Khudoni, and other new HPPs mired in delay and controversy, Georgia also cannot rely on large new hydropower to displace Enguri in the near-term. Without new revenues, financing will prove difficult for the long-planned repair and renovation of Enguri's dilapidated and inert Vardnili cascade (a system of downstream smaller power facilities).

This should entail:

a) Economy Ministry and Georgian regulators' enactment of a gradually rising compensatory tariff for the energy produced by Enguri. By denying the dam a fair rate-of-return for the power it generates, Georgia uses Enguri to subsidize the rest of its grid. A more realistic, cost-of-operation tariff will provide (badly-needed) revenue for Enguri's upkeep. Additionally, if Georgia ever hopes to transition Enguri into the deregulated energy market, the dam must have a stable financial position. This could entail some increase in retail power prices over time, but Georgia is already working to better shield its poorest consumers from untenable rate hikes.

b) Compensation by the Georgian government for Enguri power consumed by Abkhazia. Georgia needs to stop obscuring the true, capital-intensive cost of Enguri's operation. If Enguri cannot seek cost recovery from its Abkhaz power users, the government of Georgia should help make whole the station's costs and provide a cash subsidy for the operation of the dam. While such a subsidy would arguably ratify the unpleasant status quo at Enguri -- whereby 40 percent of the station's power flows to Abkhazia for free -- prospects for change on the Abkhaz side seem remote at present. Gradually rising tariffs (as discussed above) can help plug the hole in Enguri's finances over time, but a more immediate revenue source is needed now.

Enguri cannot maintain a state of good repair without stable revenues. EBRD and EIB funds for emergency repairs cannot sustain the power station in perpetuity. The dam's senior operators believe that it can function for decades to come -- but only with needed investments in its physical plant.

The politics around Abkhazia -- and by extension, Enguri -- remain "hot" and a source of sensitivity for the present Georgian political regime. This boil must be lanced. If ministers are not comfortable addressing the topic, a resolution will be forever deferred. While the painstaking process of diplomatic rapprochement with the de facto Abkhaz government remains a worthy endeavor, it may not yield results any time soon. Whistling past the graveyard will not solve the problem -- and these reforms will force that painful conversation.

II. Create an independent government agency charged with developing a long-term electrical strategy for Georgia. Putting the Ministry of Economy in charge of Georgia's electrical buildout is problematic. It has resulted in a system that prioritizes short-term economic needs, and it favors new power plant construction at the expense of energy diversity and sustainability. GSE attempts to play something of a strategy-setting role in Georgia, but its authorities (as the transmission manager) and political autonomy are limited.[48]

Georgia needs an expert, analytically-rigorous independent agency that can dispassionately assess power needs and craft policy.[49] This body should absorb some functions presently held by the energy division of the economy ministry, and it should operate as standalone cabinet-level agency. It should be financed by some of the fee collection revenue already contemplated in Georgia's draft energy law. If Georgia restarts PPA issuance or some other form of state aid, the present policy-making structure cannot be relied upon to avoid the mistakes of the past.[50] While the recent creation of a public-private partnership (PPP) administration facility within the prime minister's office represents an attempt to address this need, it is likely to replicate the same overly-political bias of energy planning that already handicaps the economy ministry. Instead, this proposed new agency should have directive power for GSE, GNERC, and ESCO (respectively, the transmission operator, the regulator, and the system monitor), and be responsible for crafting a clear long-term strategy that will govern future Georgian power investments and more responsibly steward existing assets. All the aforementioned agencies currently take policy direction from the economy ministry, but do not sufficiently coordinate their activities. Regulatory independence is a goal of the EU energy community, and this recommendation is likely permissible under that framework.[51]

Additionally, this agency should be charged with conducting a nation-wide assessment of existing and future HPPs for a) technical feasibility; b) fiscal impact; c) social and environmental impacts; and d) hydrological suitability (i.e., if a given river site is still best suited to a new dam). Some of this information already exists, in the form of studies conducted by private hydro developers, USAID, and the IFIs. But much of it is non-public, and there is no government clearinghouse suited to vet all of it. At a moment in which climate change threatens to radically alter precipitation patterns worldwide, even water-rich Georgia cannot assume that its rivers will run forever and unchanged.[52]

III. Provide a high-level signal of political support for non-hydro renewable power. Feasibility concerns are not the only barrier to further wind and solar development in Georgia. Equally important is the fact that the government simply *appears* to be unfriendly to non-hydro renewables. Indeed, GSE's ten-year plan asserts that wind and solar power will create a "negative effect to system stability," and proceeds to erect a demanding series of hurdles for future installations to clear.[53] As prices for renewable power fall and technologies improve, many of Georgia's objections should melt away.[54] If Georgia desires energy *diversity* as well as self-sufficiency, it should send the clear message that renewables are welcomed. This can be accomplished by:

- Prompt passage of the EU-mandated renewable energy law;
- Ministerial-level public interventions setting out wind and solar development as a national priority;[55]
- Continued limited issuance of transparently-negotiated 12-month wind and solar power PPAs for new "first-mover" utility-scale projects;
- A commitment to fully explore subsidy devices for renewables once Georgia's competitive electrical market is fully operational (USAID is already researching these options for Georgia).

An unspoken truth of Georgian power policy is that prices need to rise in order for diverse, non-PPA generation to enter the country's market. That is part of the reason Georgia is moving toward a deregulated market. As prices gradually rise over time, Georgia should ensure that the most prudent (and not just the cheapest) assets are built.

IV. Enactment of incentives to encourage energy efficiency savings in generation. It is always cheaper to save energy than to build new power plants. And yet, energy efficiency is a negligible element of the Georgian energy system.[56] Georgia needs to enact policies that drive energy-saving in existing power stations. As discussed, Georgia's older power stations are privately-owned and come with minimal upkeep costs – thus providing little incentive for owners to make efficiency improvements. While Georgia's draft energy efficiency law (November 2019) takes important steps towards better government policies on energy conservation, it is mostly silent on supply-side policies, listing generation incentives and mandates as possible "policy alternatives" to be explored.[57] For HPPs, the draft law does little more than suggest that feasibility studies conducted once every 15 years should consider "improvements in the performance of hydropower."[58]

Georgia is developing the infrastructure to provide energy audits for all interested power generators and industrial energy consumers. This is a good start, but it needs to be paired with enabling policies and a services sector that can implement those energy audits. Commercial energy-saving performance contracts (ESPCs) should be mandated for all deregulated power stations where substantial energy savings are possible. ESPCs are an innovative, cost-neutral way to finance energy upgrades, whereby today's efficiency investments are financed by tomorrow's energy savings. Georgia's draft energy law contemplates broader use of such vehicles, but leaves those discretionary policies in the hands of the Ministry of Economy.

While an efficiency mandate would cut against Georgia's libertarian ethos in power market regulation, it is entirely in keeping with their massive intervention in those same markets (via PPAs, Enguri, and the like). Breaking the link between economic growth and power demand will be essential to a more efficient and sustainable Georgian energy system. Advocates of Georgian hydropower should embrace this effort: making existing HPP stations 'smarter' and more productive will ensure hydropower's role in the Georgian energy system for decades to come.

6) Conclusion

None of this will be easy. There are powerful historical reasons that Georgia's power system looks the way it does. Building new hydropower is a labor- and materials-intensive process that can sustain construction jobs for years; wind turbines, on the other hand, are manufactured outside of Georgia. The faltering status quo rewards many parties in modern Georgia, but it does not serve the national interest.

The reforms advocated herein will require a willingness to upset a number of politically-sensitive applecarts. But the moment of reckoning for Georgian energy policy will arrive regardless. Georgian officials have already created a system in which retail electrical prices will be allowed to gradually rise over time, so as to establish a competitive electrical market. Should not that "pain" also help usher in a better energy policy for Georgia in the process?

Several experts interviewed for this paper believe that many of Georgia's largest planned HPPs will never be built: rural communities in Svaneti and elsewhere have lost all trust in the central government and private power developers. If this proves correct, what then? What is the economic and security value of a power plant that never actually produces a single kilowatt-hour of electricity? Georgia's government remains wholly committed to a dramatic expansion of hydropower, with some associated wind power development. If the former fails to materialize, the government will need alternatives. Nothing will prove more disruptive for Georgia's leaders than a power system that grows more expensive, less reliable, and less secure over time.

Hydropower plants will remain the backbone of Georgia's electrical system for decades to come, and in that Georgia has little choice. Where Georgia *can* alter course is in that which is still unbuilt. Given all the challenges facing the country, modernization of Georgia's electrical system may not seem all that pressing. But it is the backbone of the nation's economy and, if poorly managed, a source of tremendous instability.

Water is free; using it to generate power is not. Large-scale hydropower is only "cheap" when one discounts ecological impacts, the social disruption created by displacement, inevitable cost-overruns,[59] limited functionality during low-water periods, and the substantial cost of breaching and removing HPP installations once their useful life expires. For Georgia, it is not a question of being anti-hydro or pro-hydro, but rather one of when and where hydropower makes the most sense. At present, Georgia lacks the capacity to make such an assessment.

A more diverse electrical ecosystem in Georgia will make the country's grid less prone to weakness, as well as making it more sustainable and less expensive. Breaking old, bad habits in this sector will be unpleasant at times, but Georgia has endured far more dramatic deprivations in its last three decades. Georgia has already done the thankless spadework of rebuilding its electrical system after near-collapse in the 1990s. All that remains is to match the country's electrical system with the modern, Western-facing future to which Georgia aspires.

Endnotes

[1] From *The Knight in the Panther's Skin* (translator: Lyn Coffin):
"The news of the death of her sister over the seas did carry.
All the viziers were distressed, and they refrained from making merry.
*'Hers was a face **to light the lands**; now this face they will soon bury.'"*
[2] "2018 Hydropower Status Report," International Hydropower Association, https://www.hydropower.org/keyfacts2018.
[3] "Georgia," USAID, September 10, 2015, https://www.usaid.gov/energy/smartutilities/reform-stories/georgia.
[4] "2018 Hydropower Status Report: Sector Trends and Insights," International Hydropower Association, https://www.hydropower.org/sites/default/files/publications-docs/2018_hydropower_status_report_0.pdf.
[5] Emilio F. Moran, Maria Claudia Lopez, Nathan Moore, Norbert Müller, and David W. Hyndman, "Sustainable Hydropower in the 21st century," *Proceedings of the National Academy of Sciences* (PNAS), No. 47, November 20, 2018.
[6] "Just One-Third of the World's Longest Rivers Remain Free-Flowing," World Wildlife Fund, (WWF), May 9, 2019, https://www.worldwildlife.org/stories/just-one-third-of-the-world-s-longest-rivers-remain-free-flowing.

[7] Georgia's economy contracted by 78 percent between 1988 and 1995. By 2002, Georgia's total primary energy supply was just one-fifth of what it had been in 1990. ["Chapter 5: Georgia's Energy Subsidies," *Inventory of Energy Subsidies in the EU Eastern Partnership Countries*, OECD, 2018.]
[8] Tornike Sharashenidze, "Georgia's Gazprom mystery," *European Council on Foreign Relations*, Dec. 22, 2015, https://www.ecfr.eu/article/commentary_Georgias_Gazprom_mystery5061.
[9] "Chapter 5: Georgia's Energy Subsidies," *Inventory of Energy Subsidies in the EU Eastern Partnership Countries*, OECD, 2018, p. 173.
[10] "Georgia Energy Strategy," July 2018. Powerpoint prepared for GSE by McKinsey & Company.
[11] A PPA spreadsheet supplied by the Finance Ministry catalogues all outstanding PPAs.
[12] Manana Kochladze, Chairwoman, Green Alternative, interview with the author, Tbilisi, October 22, 2019.
[13] "Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019, p. 10.
[14] Murman Margvelashvili, Director Energy Studies, World Experience for Georgia. Interview with the author, Tbilisi, Oct. 14, 2019.
[15] "Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019, p. 37.
[16] Power demand from Abkhazia grew nearly 80% in the ten years prior to 2017, according to Murman Margvelashvili at World Experience for Georgia (WEG) think tank.
[17] "Georgia: Letter of Intent, Memorandum of Economic Financial Policies, and Technical Memorandum of Understanding," International Monetary Fund (IMF), December 4, 2018.
[18] Joseph Melitauri and Arthur Kochnakyan, "Assessment of Fiscal Costs and Tariff Impacts of Power Purchase Agreements," *The World Bank*, Feb 22, 2018.
[19] Regional governments have no ability to levy their own taxes, and rely almost entirely on the central government for funding.
[20] Upper Svaneti, in river-rich far northwestern Georgia, has been home to some of the most vehement anti-HPP civil unrest. One of the lynchpins in the government's strategy to provide cold weather baseload power, the IFI-financed Nenskra HPP met with such substantial local resistance that the project's original developer abandoned it in 2018. Khudoni, another greenfield mega-dam slated for the Svaneti region, sparked much of the initial public outcry over HPP development and displacement in Georgia. Khudoni's difficulties come with a certain irony: popular protests had also forced the Soviet Union to abandon the original iteration of the dam, begun in 1978 and mothballed in 1988.
[21] "To attract investors, the government establishes tariffs for new electricity plants at a higher level than for the existing ones…Electricity lines and land used as water reservoirs by electricity plants are also exempt from property tax." ["Chapter 5: Georgia's Energy Subsidies," *Inventory of Energy Subsidies in the EU Eastern Partnership Countries*, OECD, 2018.]
[22] The World Bank was asked to examine the fiscal impact of Georgia PPAs, and published their findings earlier this year. Ministries are still awaiting a holistic environmental and social assessment for hydropower development from the World Bank. USAID is working with a Georgian think tank to develop a 5-year energy strategy document. GSE has asked USAID to help them determine whether Georgia is overbuilding its grid. USAID is also producing a study for Georgia on the feasibility of non-PPA power subsidy schemes.
[23] Giorgi Chikovani, CEO, Georgian Energy Development Fund (GEDF), Interview with the author, Tbilisi, Oct. 15, 2019.
[24] "New Government Wins Confidence Vote," *Civil Georgia*, Dec. 22, 2017, https://old.civil.ge/eng/article.php?id=30753.
[25] Daniel Potash, Chief of Party of USAID Energy Program in Georgia, Phone interview with author, Oct. 16, 2019.
[26] David "Dato" Chipashvili, International Financial Institutions Monitoring Programme Coordinator, Green Alternative, Interview with the author in Tbilisi, Oct. 16, 2019.
[27] Ketevan Tadiashvili, "Neoliberal Globalization in Post-Soviet Georgia: Protests Against the Nenskra Dam in Svaneti," University of Ottawa School of International Development and Global Studies, 2018, p. 21.
[28] Ketevan Tadiashvili, "Neoliberal Globalization in Post-Soviet Georgia: Protests Against the Nenskra Dam in Svaneti," University of Ottawa School of International Development and Global Studies, 2018, p. 21.
[29] The 113 MW Khrami 1 HPP was commissioned in 1947; the 48 MW Riono HPP in 1933; the 36 MW Zahesi HPP in 1927, and so forth.
[30] One Georgian NGO noted that the amount of energy that could be saved by switching Tbilisi's streetlights to LED bulbs is roughly equivalent to the entire wintertime electrical generation of the Nenskra HPP. [David "Dato"

Chipashvili, International Financial Institutions Monitoring Programme Coordinator, Green Alternative, Interview with the author in Tbilisi, Oct. 16, 2019.]
[31] "Law of Georgia On Energy Efficiency," November 2019. Draft law provided to the author by the EU Energy Secretariat.
[32] Janez Kopač, EU Energy Community Secretariat, Phone interview with the author, Nov. 20, 2019.
[33] Alina Prokopenko, "Wind Power Status in Russia and the CIS Countries: Regional Wind Power Market and Potential," World Wind Energy Association (Germany), 2012, http://wwindea-org.nhj.fnq.mybluehost.me/webimages/Russia%20and%20CIS%20Wind%20Energy%20Report_pw.pdf.
[34] "Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019, p. 293-4.
[35] "Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019, p. 36.
[36] Alina Prokopenko, "Wind Power Status in Russia and the CIS Countries: Regional Wind Power Market and Potential," World Wind Energy Association (Germany), 2012, p. 55-56.
[37] "Economy minister announces Gori wind farm to be privatised shortly," *Agenda.ge*, June 19, 2019, https://agenda.ge/en/news/2019/1611.
[38] Mikheil Zibzibadze, Head of HR & Communications, GSE, Interview with author, Tbilisi, Oct. 15, 2019.
[39] Nikoloz Sumbadze, Deputy Director, GNERC, Interview with the author, Tbilisi, Oct. 18, 2019.
[40] Giorgi Abramishvili, Executive Director, Georgian Renewable Energy Development Association (GREDA), Interview with the author, Tbilisi, Oct. 18, 2019.
[41] Loretta Martikian, "EBRD finances modernisation of Enguri power plant," EBRD, Jan. 10, 2018, https://www.ebrd.com/news/2018/ebrd-finances-modernisation-of-enguri-power-plant.html.
[42] Otari Tarimanishvili, "Abkhazian Electricity Grid Rehabilitation Project: Electricity Grid Improvement Project," United Nations Development Programme (UNDP), January 28, 2019.
[43] "N-1" resilience refers to the notion that a given electrical system can withstand a single-point system failure and not collapse. In other words, at no point can a lone problem cascade and disable the whole grid. Enguri represents just such a vulnerability in Georgia's grid – it is too central and important, and its failure could be catastrophic.
[44] Levan Mebonia, Chairman of the Board of Directors, Engurhesi, Interview with the author, Zugdidi, Oct. 17, 2019.
[45] Luka Chachibaia, Chief Technical Officer, Georgian Renewable Power Company (GRPC), Interview with the author, Tbilisi, October 22, 2019.
[46] Robert Ichord, Senior Fellow, Atlantic Council, Interview with the author, Nov. 8, 2019.
[47] Chapter 5: Georgia's Energy Subsidies*," Inventory of Energy Subsidies in the EU Eastern Partnership Countries*, OECD, 2018, p. 174.
[48] Mikheil Zibzibadze, Head of HR & Communications, GSE, Interview with author, Tbilisi, Oct. 15, 2019.
[49] 33 American states now employ Integrated Resource Planning processes to make sure that future power demand is met in the most cost-effective manner possible, usually with a planning horizon of 20 years. See https://blog.aee.net/understanding-irps-how-utilities-plan-for-the-future.
[50] As the Georgian Renewable Energy Development Association (GREDA) has suggested, some existing HPP PPAs will need to be canceled for nonperformance sooner or later, and it will be politically painful -- but it must happen, if stranded state PPA subsidies (and associated balance sheet liabilities) are to be freed up and redirected to more feasible projects.
[51] Compliance with the EU energy acquis includes a "Strategic Environmental and Social Assessment of Development Scenarios for Electricity Sector Projects" by Georgia, and the prongs of this recommendation could likely be folded into (or supplement) that process. [Janez Kopač et al, "Energy Governance in Georgia: Report on Compliance with the Energy Community Acquis," Energy Community Secretariat, July 2017.]
[52] By way of example, Georgian hydro projects generally observe a 10 percent standard for so-called "sanitary flow" -- meaning the percentage of original, undammed water flow that still passes through an HPP after operation begins. However, this "standard" is just an observed community practice, is not reflected in law or regulations, and is often not well-enforced -- and many Georgian rivers have paid a steep ecological price.
[53] "Ten Year Network Development Plan of Georgia 2019-2029," Georgian State Electrosystem (GSE), April 25, 2019, p. 292.
[54] Giorgi Chikovani, CEO, Georgian Energy Development Fund (GEDF), Interview with the author, Tbilisi, Oct. 15, 2019.
[55] Dato Chipashvili, a lead campaigner at Green Alternative, believes that feed-in tariffs are unnecessary and that wind power should flourish on its own if Georgia's electrical market is truly competitive. This is an odd feature of

environmental debates in Georgia: some of the strongest advocates for full and fair electrical market competition are NGOs pushing for EU energy acquis compliance.

[56] Georgia's Energy Efficiency Centre (EEC) has done some exploratory work of this kind, but the EEC is politically irrelevant.

[57] "These Alternative Policy Measures shall make use of the technical / investment measures set out in the NEEAP. For example: Incentivizing / mandating Energy Efficiency measures in industry, beyond energy audits," ["Law of Georgia On Energy Efficiency," November 2019. Draft law provided to the author by the EU Energy Secretariat.]

[58] "Law of Georgia On Energy Efficiency," November 2019. Draft law provided to the author by the EU Energy Secretariat.

[59] "Ansar et al. in a global analysis of 245 large dams built between 1934 and 2007 found that costs of large dams were 96% higher than predicted costs and that 1 out of 10 large dams cost up to three times more than originally estimated." Emilio F. Moran, Maria Claudia Lopez, Nathan Moore, Norbert Müller, and David W. Hyndman, "Sustainable Hydropower in the 21st century," *Proceedings of the National Academy of Sciences* (PNAS), No. 47, November 20, 2018.