



Research article

Operationalizing transformative capacity: State policy and the financing of sustainable energy transitions in developing countries

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APPENDIX A

Table A.1. Exploratory research of regulative, normative, and cultural-cognitive structures in finance across key dimensions.

Dimension	Regulative Structures	Normative Structures	Cognitive Structures
Basis of compliance	Driven by expedience, such as avoiding penalties and securing participation in industry and markets.	Driven by social obligation and ethical standards in finance (e.g., transparency).	Practices are taken for granted and perceived as natural.
Basis of order	Financing laws, formal rules, and regulatory standards maintain order (e.g., JSE listing requirements).	Ethical expectations within finance guide actions (e.g., responsible lending practices).	Shared belief systems and common understandings shape how financing decisions are made.
Mechanisms	Coercive mechanisms (e.g., audits, legal actions, and regulatory fines).	Normative mechanisms, social reputation, and ethical standards.	Mimetic behaviors—actors adopt widely accepted financing practices (e.g., financial statements, risk models).
Logic	Actions are based on cost-benefit analysis (e.g., profit maximization, shareholder value).	Actions are based on ethical or moral correctness.	Actors' actions align with what is culturally accepted or unquestioned.
Indicators	Promulgated rules, laws, and sanctions—observable in adherence to financial regulations, audits, and monitoring.	Certification and accreditation (e.g., certifications in ethical investing or green bonds).	Common beliefs and practices—observable in industry practices, such as credit scoring models.
Affect	Fear, guilt, or innocence based on regulatory compliance (e.g., fear of fines, lawsuits, or loss of licenses).	Shame or honor related to adhering to or violating ethical financial norms (e.g., reputation impact).	Certainty when following common practices (reducing risk), or confusion when practices deviate from the norm.
Basis of legitimacy	Legitimacy is gained by adhering to frameworks (e.g., qualified/unqualified audits).	Stems from following societal norms and ethical standards (e.g., sustainable finance).	Stems from practices that are culturally supported and perceived as correct (e.g., notions of debt and equity).

Source: Developed from Scott (2014)

APPENDIX B

Table. B.1 Exploratory research on key renewable energy and green hydrogen policy instruments in South Africa.

	Renewable Energy (general)	Green Hydrogen (specific)
Regulatory Instruments	<ul style="list-style-type: none"> – Climate Change Act 22 of 2024 – National Energy Act 34 of 2008 – Climate Change Bill 2021 – Carbon Tax Act, 2019 – Gas Act No 48 of 2001 – National Environmental Management Act (NEMA) – Renewable Energy Certificates – Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) – Electricity Regulation Act 4 of 2006 – Environmental Impact Assessment Regulations, 2014 – Mineral and Petroleum Resources Development Act, 28 of 2002 (MPRDA) 	<ul style="list-style-type: none"> – <i>Hydrogen certification and hydrogen trade rules</i> – <i>Regulations, codes, and standards for hydrogen refueling</i> – <i>Independent product and component testing and verification facilities</i> – <i>Hydrogen Fuel Quality Standards for Fuel Cell Vehicles</i> – <i>Standards and codes to develop South Africa's GH mobility sector</i> – <i>Standards and codes for production, storage, transport, use</i> – <i>A single "one-stop" mechanism to facilitate all the licensing and authorization processes</i> – <i>Guarantees of Origin (GO) system</i>
Economic Instruments	<ul style="list-style-type: none"> – Income Tax Act, 1962 Incentives. E.g., R&D tax deduction, Energy Efficiency Allowance – Critical Infrastructure Programme (CIP) – Support Programme for Industrial Innovation (SPII) – Capital Projects Feasibility Programme (CPFP) – Technology and Human Resources for Industry Programme (THRIP) – Special Economic Zone incentives 	<ul style="list-style-type: none"> – Hydrogen South Africa (HySA) RDI Programme – HySA Competitive Fund – Just Energy Transition Investment Plan (specifies green hydrogen) – Strategic Integrated Projects for Green Hydrogen – <i>Incentives for companies to start using GH2 and ammonia for power</i> – <i>Incentives for transport users that use hydrogen as a fuel</i>
Information Instruments	<ul style="list-style-type: none"> – White Paper on National Climate Change Response 2011 – Nationally Determined Contribution 2020 – Just Transition Framework – Integrated Resource Plan (IRP), 2019 – Integrated Energy Plan, 2016 – South African Renewable Energy Masterplan – Beneficiation strategy for minerals industry of South Africa (2011) – Department of Public Works and Infrastructure Green Building Policy (2018) – National Development Plan 2030 – Presidential Climate Commission 	<ul style="list-style-type: none"> – The South African Green Hydrogen TVET Ecosystem Just Transition Strategic Framework (2022) – Hydrogen Society Roadmap for South Africa 2021 – Green Hydrogen Commercialisation Strategy for South Africa (2023) – South Africa Hydrogen Valley Final Report (2021) – Green Hydrogen Panel – HySA Strategy (2007) – South African Green Hydrogen Summit – Technology demonstrations. E.g., fuel cells for off-grid rural electrification, mining forklifts, and refueling stations.

Note: Instruments in italics have been tabled but have not yet been deployed.

Source: Compiled from DSI (2021) and DTIC (2023)

APPENDIX C

Table. C.1. Summary of regulatory instrument impacts with representative quotes.

Financing structures	Regulatory Impacts	Representative Quotes
Regulative	New instruments demand regulatory compliance, compelling actors and financiers to align practices with evolving standards and frameworks.	<p>“There’s a whole lot of [regulations] around what we do, and we need to be 100% sure that we fund into a project that is within those regs and complies with those regs because if you’re outside of that too, you open yourself up to a lot of problems.” [Interview 22].</p> <p>“Where [an SMME] is developing a product or a service and they want to go to the bureau, just to standardize it or just to go get an approval or licensing or register IP, that [funding] is also accommodated” [Interview 16].</p> <p>“I think the amount of potential litigation that’s happening elsewhere in the world, in Europe, etc., is starting to set a precedence in terms of, I think, what we need to be aware of when what might sort of essentially end up impacting our own operations here in South Africa” [Interview 23].</p> <p>“In general, the South African financial regulations are mostly very sensible... they’re trying to make sure that the system is stable” [Interview 17].</p>
Normative	Regulatory instruments establish norms about the governance of financing activities, shaping expectations about the state’s role in market regulation and intervention.	<p>“I think that the renewable program was a very good example around how government could come in and allow for these renewable projects, and some of them were really innovative type technologies that wasn’t as well proven at the point” [Interview 18].</p> <p>“[There are] pension funds regulations of what you need to invest in, but there isn’t a regulation saying X percent of your [portfolio] has to be sustainable” [Interview 21].</p> <p>“[There are] a lot of lessons in the REIPPPP programs and public-private partnerships. We’ve established [Public Private Partnership Agreements] quite intricate ones and mechanisms of de-risking, etc. All those lessons are quite valuable” [Interview 15].</p>
Cultural-cognitive	Through compliance processes, actors must internalize new structures and adapt to regulatory constraints and opportunities.	<p>“The way [the banks are] structuring the deals, they’re getting around Basel. They’re structuring more short-term deals, but on a rolling basis, so they ultimately stay in for the full 20 years, but on paper, they’re in for short periods of time” [Interview 9].</p> <p>“Eventually, we agreed that we’d put a statement out explaining why we don’t adhere to the [Equator] principles. But we just don’t do enough transactions that would qualify. So, all it’s doing is adding costs. It would be a cost for the membership, and then a cost of actually doing the reporting” [Interview 19].</p>

Table. C.2. Summary of the economic instrument impacts of policy with representative quotes.

Financing structures	Economic Impacts	Representative Quotes
Regulative	New standards, frameworks, and processes are developed to maximize benefits/minimize the costs of economic instruments.	<p>“Our [lending] principle is that they need to be globally competitive businesses. They need to not be reliant on government subsidies and support...But there’s import tariffs, which makes it difficult to import components and assemble locally and because they end up producing at a premium price” [Interview 15].</p> <p>“We have an online system now, which is called grant management system, where every application, even from the Statement of Interest stage, has to enter into that system” [Interview 16].</p> <p>“I don’t think any amount of policy is going to force banks to give up, you know, the golden goose to, you know, move [renewable energy assets] out into the system” [Interview 1].</p> <p>“It is challenging to justify socially driven programs on a financial basis. So, you look at supplementing internal funding with grant funding as well” [Interview 24].</p>
Normative	Economic incentives and disincentives inform expectations about economic feasibility and shape beliefs about the government’s role in the economy.	<p>“For you to drive innovation some of the innovation spend is in R&D and companies a little bit. Government still must keep on doing the R&D spend through universities; that must keep happening and, etc.” [Interview 18].</p> <p>“So, you need to bring a number of parties together [for large-scale renewable energy projects], you need to also see if you can get potential concessions really early on from government to help with the development” [Interview 23].</p> <p>“If you’re going to do hydrogen, do you know who’s going to take it off? And is there some sort of guarantee that you’ve got a proven market?” [Interview 21].</p>
Cultural-cognitive	Economic interventions reinforce cognitive models that underpin economic decision-making and frame policy problems as economic.	<p>“These assets that we have funded, invested in, have all got government offtake...So beyond that [time horizon], we don’t really place much value [on the assets]” [Interview 9].</p> <p>“So, if you talk about instruments, tax benefit for decarbonizing for decarbonization, where’s the tax benefit? What’s the incentive for people to decarbonize?” [Interview 7].</p>

Table. C.3. Summary impacts of informational instruments with representative quotes.

Financing structures	Informational Impacts	Representative Quotes
Regulative	Stakeholder engagement provides feedback to align the resources and strategic objectives of policymakers and stakeholders.	<p>“We do give commentary for things like...a new law or change of framework or standard if it is open to public consultation” [Interview 4].</p> <p>“If you want to have legislation that’s implementable, infuse the private sector [in the hydrogen roadmap] from day one...I was very heartened that they took that advice to heart” [Interview 24].</p> <p>“As I said, National Treasury, [feedback] is usually unsolicited, to kind of give them an opinion, even though they haven’t asked for it. Sometimes they’re angry with us, and sometimes they’re not, but that’s our job” [Interview 1].</p> <p>“But it’s been very positive recently because the way we share the message about hydrogen; it’s not only a decarbonization thing, it’s also a global trade opportunity. It’s also a just transition opportunity. So, an opportunity for [the country] to position itself competitively” [Interview 15].</p>
Normative	Strategic communication informs expectations of development pathways and shapes beliefs about the government’s role in market development.	<p>“So, it was through those [Hydrogen Roadmap] consultations that the level of awareness around this green hydrogen economy and the hydrogen economy in general started to actually permeate through society” [Interview 12].</p> <p>When the Hydrogen Society Roadmap was announced in South Africa; when Anglo, and specifically when Anglo launched the first mining haul truck in the world running on hydrogen, that captured people’s imagination” [Interview 24].</p> <p>“So, you need your policies clear on the mix of energy of government’s targeting, so it makes it easier for the guys to say okay, well, we’re okay to take a bet on a renewable deal” [Interview 10].</p>
Cultural-cognitive	Informational instruments can shape cognitive models and decision-making frameworks and provide certainty to financing and market actors.	<p>“I think we are now getting to the point where [we are] demonstrating those [green hydrogen] technologies and actually showing people that these things do work” [Interview 12].</p> <p>“I don’t think the importance of the green economy needs to be discussed or mentioned to funders. There [are] so many international initiatives, government initiatives, policies, by purpose that is driving that” [Interview 11].</p>

APPENDIX D

Table. D.1 Matrix of findings on policy impacts on financing structures.

	Regulative	Normative	Cultural-cognitive
Economic	Disrupt and weaken regulative structures for preferred outcomes.	Disrupt or transform normative expectations of future economic activities and opportunities.	Reinforce cognitive models and frameworks that underpin economic decision-making.
Regulatory	Disrupt or transform regulative frameworks to reconfigure and adapt regulative structures.	Reinforce or disrupt normative beliefs in the role of the state.	Reinforce cognitive models underpinning regulatory compliance and risk management.
Informational (Mediated)	Reinforce or disrupt regulative structures for preferred outcomes.	Disrupt or transform normative beliefs for preferred outcomes.	Reinforce cognitive models that underpin economic decision-making and regulatory compliance.
Informational (Interpersonal)	Transform or displace existing frameworks for alternative financing structures.	Transform normative beliefs in the roles and responsibilities of financing actors.	Transform or displace cognitive models for new perspectives on risks and opportunities.



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