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Augmenting the National Green Hydrogen Mission

Assessing the Potential Financial Support through Policies in India

Ribhav Pal, Vishal Tripathi, Karan Kothadiya, Prateek Aggarwal, and Deepak Yadav

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About CEEW

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The Council's current initiatives include: State-level modelling for energy and climate policies; consumer-centric smart metering transition and wholesale power market reforms; modelling carbon markets; piloting business models for solar rooftop adoption; fleet electrification and developing low-emission zones across cities; assessing green jobs potential at the state-level, circular economy of solar supply chains and wastewater; assessing carbon pricing mechanisms and India's carbon capture, usage and storage (CCUS) potential; developing a first-of-its-kind Climate Risk Atlas for India; sustainable cooling solutions; developing state-specific dairy sector roadmaps; supporting India's electric vehicle and battery ambitions; and enhancing global action for clean air via a global commission 'Our Common Air'.

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The National Green Hydrogen Mission in India is augmented by various state-level green hydrogen policies

Image: iStock

Executive summary

Green hydrogen is a clean energy carrier that can help decarbonise several hard-to-abate sectors of the Indian economy, enhance India's energy self-reliance (*Aatma-nirbhar Bharat*), and reduce its expenditure on imported fossil fuels. As the global green hydrogen sector is still in its early stages, India has the opportunity to deploy green technologies at scale and secure a significant share of the global supply of green energy solutions. To realise its goals of energy independence and decarbonisation, numerous policies have been announced at the central and state level in India to address challenges and offer incentives for large-scale green hydrogen production.

The *National Green Hydrogen Mission* (NGHM), launched by the Ministry of New and Renewable Energy (MNRE) in January 2023, is a key policy initiative with a budget of INR 19,744 crore (approximately USD 2.5 billion). It offers holistic support to the sector through various mission components designed to generate demand, incentivise supply, and strengthen critical enablers of the green hydrogen ecosystem (MNRE 2023). Additionally, the *Green Hydrogen Policy* (GHP) by the Ministry of Power offers a waiver on inter-state transmission system (ISTS) charges and provides guidelines for sourcing renewable energy (RE) for green hydrogen projects, among other provisions (Ministry of Power 2022).

Complementing these national policies, the states of Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, and West Bengal have introduced green hydrogen policies, while Punjab and Haryana's policies are currently in the draft stage. Five states – Gujarat, Tamil Nadu, Odisha, Kerala, and Madhya Pradesh – support green hydrogen through their industrial or power sector–related policies. Some state-level policies offer financial incentives and exemptions for both power- and non-power-related aspects, while others offer only one of the two. It is essential to consider the increased financial support for green hydrogen in India through various state- and central-level policies, alongside the NGHM.

A. Research objectives

This report aims to quantify the power- and non-power-related financial support provided by the state and central governments for developing India's green hydrogen economy. To this end, we covered the following aspects:

- Map hydrogen production targets and export announcements across states
- Estimate potential green hydrogen consumption across states
- Identify and quantify the potential support for green hydrogen within state and central level policies

We expect the study's findings to inform industrial and financial sector stakeholders on the governmental support available for green hydrogen projects. Additionally, it will enhance India's attractiveness as a market for investments, advancing the NGHM goal of establishing India as a hub for green hydrogen.

B. Methodology and interpretations

We use official policy documents – either notified or in draft form – for each of the 12 states to quantify the potential financial support for green hydrogen. To determine the amount of support, the following factors were considered:

- **Policy components considered:** Under power-related support components, we include waivers of inter (ISTS)- and intra-state transmission system (InSTS) charges, electricity duty (ED), wheeling charge, and power tariff rebates. Our analysis' three main non-power-related components are capital subsidies, interest subvention, and State Goods and Services Tax (SGST) reimbursement. While the analysis also considers other components such as blending subsidies, consumption subsidies, vehicle subsidies, support for refuelling stations, land procurement, and research and development (R&D) expenditure, these account for a smaller share compared to overall potential support.
- **Baseline green hydrogen production:** We consider a baseline green hydrogen production for each state by 2030 and scale the financial support under each component of the respective policies. If a state policy specifies green hydrogen production targets, we consider those targets as the state's baseline. If no targets are mentioned in the state-level policy, we estimate the baseline using a bottom-up approach based on the overall domestic demand from the Phase 1 focus sectors in the NGHM. The bottom up estimation of demand includes:
    - An assumption that the Phase 1 of the NGHM will focus on hydrogen consumption in refineries and non-urea fertiliser production.
    - In Phase 1, refineries are projected to consume 1 million tonnes per annum (MTPA) of green hydrogen, while non-urea fertiliser plants are expected to use 0.5 MTPA by 2030.
    - Additionally, the announced export-oriented projects to the tune of 3.5 MTPA are considered to meet the NGHM production target.
    - Based on current hydrogen production levels, we allocate domestic demand for the two sectors (refineries and non-urea fertilisers) across states. Table ES 1 shows the state-wise baseline green hydrogen production considered in the analysis.

Table ES1 The total estimated baseline green hydrogen production is 8.33 MTPA by 2030

Sr. no.	State	Estimation approach	Green hydrogen production target in policy (MTPA)	Green hydrogen consumption in refineries (MTPA)	Green hydrogen consumption in non-urea fertilisers (MTPA)	Green hydrogen production for exports (MTPA)	Total baseline green hydrogen production (MTPA)
1	Gujarat	Bottom-up estimation	-	0.45	0.13	1.60	2.18
2	Rajasthan	State target-based	2.00	-	-	-	2.00
3	Tamil Nadu	Bottom-up estimation	-	0.07	0.03	1.07	1.17
4	Uttar Pradesh	State target-based	1.00	0.03	-	-	1.00
5	Andhra Pradesh	State target-based	0.50	0.03	0.11	0.27	0.50
6	Maharashtra	State target-based	0.50	0.05	0.04	0.27	0.50

Sr. no.	State	Estimation approach	Green hydrogen production target in policy (MTPA)	Green hydrogen consumption in refineries (MTPA)	Green hydrogen consumption in non-urea fertilisers (MTPA)	Green hydrogen production for exports (MTPA)	Total baseline green hydrogen production (MTPA)
7	Odisha	Bottom-up estimation	-	0.03	0.11	0.17	0.31
8	Haryana	State target-based	0.25	0.08	-	-	0.25
9	Kerala	Bottom-up estimation	-	0.06	0.04	0.12	0.22
10	Punjab	State target-based	0.10	0.03	-	-	0.10
11	West Bengal	Bottom-up estimation	-	0.03	0.02	-	0.05
12	Madhya Pradesh	Bottom-up estimation	-	0.05	-	-	0.05
	Total						**8.33**

Source: Authors' analysis

Our assessment of total green hydrogen production of 8.33 MTPA, exceeds the NGHM target of 5 MTPA. We have used 8.33 MTPA to reflect the potential outlay across all states. The actual realisation of this demand will depend largely on the market dynamics, especially for exports. However, it should be noted that the total production of 8.33 MTPA considered in the analysis is lower than a potential green hydrogen production of 10 MTPA, including exports, which is envisaged in the NGHM.

- **Uniform and optimised operational parameters across states:** We consider an optimised proportion of 77 per cent wind energy and 23 per cent solar energy being supplied to all green hydrogen projects in the country. Additionally, we assumed that each state's renewable energy (RE; wind and solar) for green hydrogen production will be sourced from within the state, except for six states – Punjab, Haryana, Odisha, Kerala, West Bengal, and Uttar Pradesh – which are classified as non-windy and would import wind energy from neighbouring states. We also assume that the most cost-effective method for RE procurement is through captive open access in all states except Odisha and West Bengal, where the state-level incentives make distribution company (discom)-based procurement cost economical.
- **Guiding principles for aggregating financial support:** To ensure consistency in support aggregation, we rely on the following guiding principles:
    - **States as independent entities:** We treat each state as a separate entity, meaning that all investments required for meeting each state's green hydrogen production potential are considered to be made within that state, except in non-windy states.
    - **Considered maximum support for each component:** We estimate the highest potential support for each component, unless policy documents specify upper limits. For instance, we consider the maximum limit of INR 60 lakh per vehicle available for the first 500 hydrogen-based vehicles under the vehicle subsidies outlined in Maharashtra Green Hydrogen Policy in quantifying this support component (Government of Maharashtra 2023).
    - **State and central policies read in consonance:** All state-level support components, especially those related to power, are expected to be consistent with the benefits provided by central government policies and regulations. For example, benefits from central policies (such as the GHP, which covers exemption for levy of inter-state transmission charges (ISTS) for the project's

lifespan) and the Uttar Pradesh Green Hydrogen Policy (which includes waivers for wheeling charges, intra-state transmission charges (InSTS) charges, and electricity duty) are combined to quantify the potential support in Uttar Pradesh.

- **Aggregate quantification, not annualised:** The total exemptions under each state's policies are calculated on an aggregate basis over the entire duration as specified by the policies or the equipment's lifetime, rather than on an annualised basis. For example, we quantify and present the total 60 per cent InSTS waiver for non-anchor units under the Maharashtra Green Hydrogen Policy, over the specified duration of 10 years (Government of Maharashtra 2023).

C. Key findings

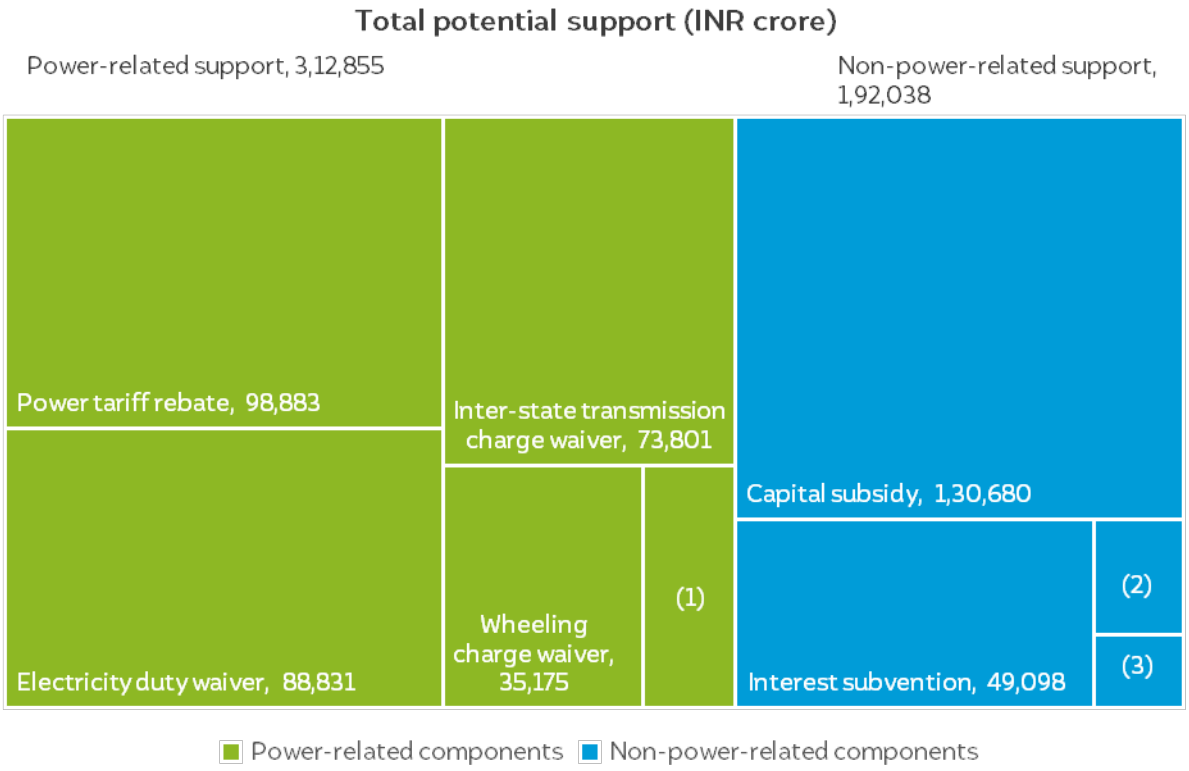
This section quantifies potential support for each component across states. The key findings are listed below:

Aggregate financial support

- We estimate the total potential support to be around INR 5.05 lakh crore (around USD 61 billion)[1] over the duration of these policies. This support may or may not be fully realised, depending on market dynamics and the green hydrogen production achieved by the target year for each state-level policy.
- We estimate that power-related components account for INR 3.13 lakh crore (USD 38 billion), which is 62 per cent of the total, as shown in Figure ES 1. These components include waivers on ED, ISTS and InSTS charges, wheeling charge, and power tariff rebates.
- Capital subsidies, interest subvention, and SGST reimbursement are the three main non-power-related components, totalling INR 1.87 lakh crore (approximately USD 23 billion), which represents 37 per cent of the total potential support.

[1] This includes the support components outlined in the draft policies of Haryana and Punjab.

Figure ES1 Power-related components make up 62 per cent of the total potential support of INR 3.13 lakh crore (USD 60 billion)



Source: Authors' analysis

Note: (1) Intra-state transmission charge waiver, INR 16,164 crore
(2) SGST Reimbursement, INR 7,469 crore
(3) Other non-power components INR 4,791 crore

State-wise assessment of incentives

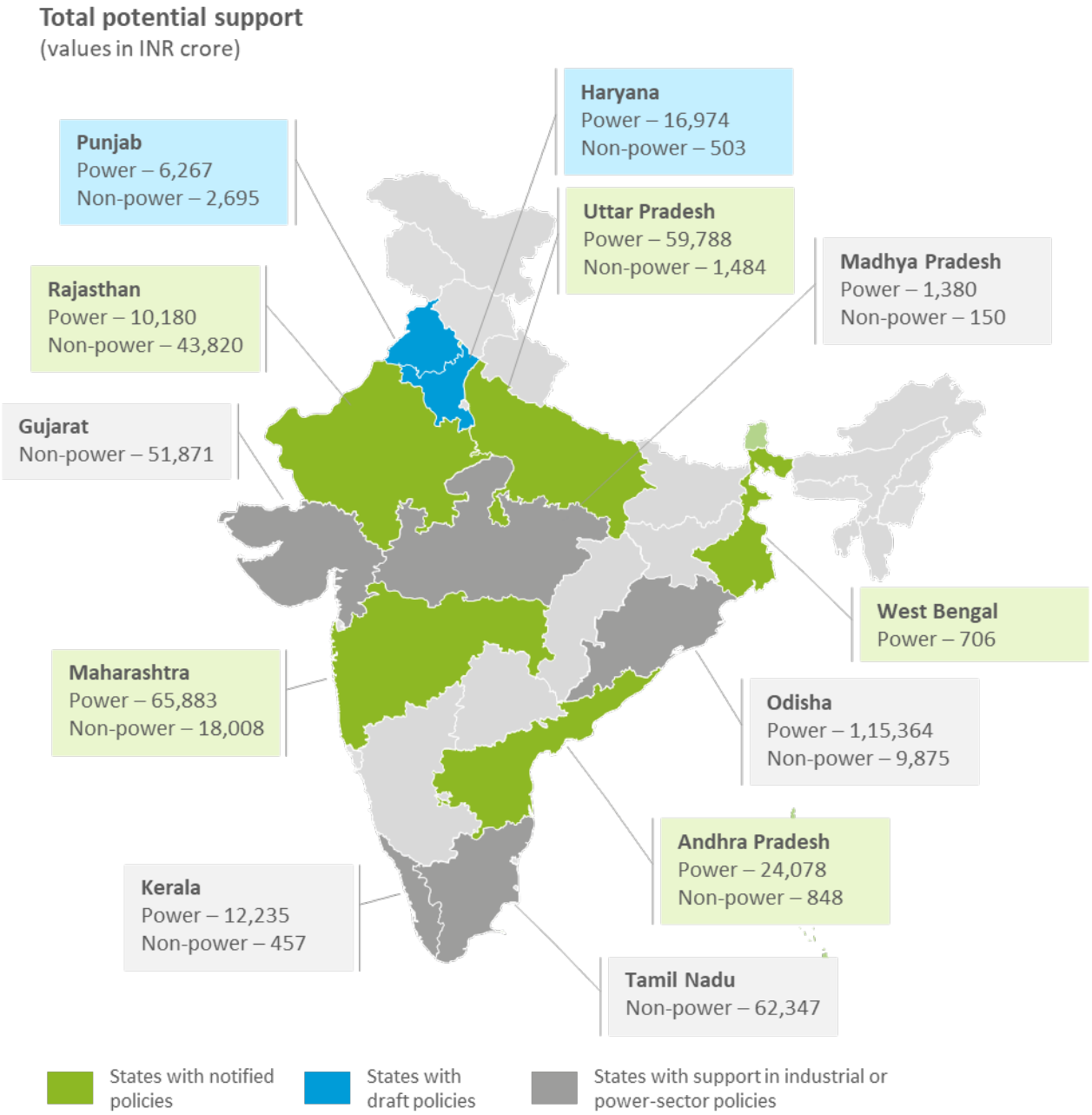
- Seven states – Odisha, Maharashtra, Tamil Nadu, Uttar Pradesh, Rajasthan, Gujarat, and Andhra Pradesh – together represent 92 per cent of the potential support, as shown in Figure ES 2. As indicated in Table ES1, these states also account for 92 per cent of the total green hydrogen production capacity projected through 2030.
    - Power-related components account for 92 per cent of the total potential support in Odisha, Uttar Pradesh, Maharashtra, and Andhra Pradesh combined.
    - Gujarat and Tamil Nadu do not have dedicated green hydrogen policies. Instead, they address it through their industrial policies, offering only non-power-related support for green hydrogen.
    - Rajasthan is the only state with a green hydrogen policy that provides more support for non-power-related initiatives than for power-related ones.
- The remaining five states – Punjab, Haryana, West Bengal, Madhya Pradesh, and Kerala – have fewer support components and contribute only 8 per cent of the baseline green hydrogen production. Consequently, they account for just 8 per cent of the total potential support.

Fiscal implications for state and national governments

- Components with a direct budgetary outlay from state governments—such as capital subsidies, power tariff rebates, and interest subvention account for 66 per cent of the total potential support.
- Foregone revenue items, including ED waivers, SGST reimbursements, and land-related support, make up 19 per cent.

- The waiver of ISTS charges, a nationally socialised cost with no direct fiscal impact on state budgets, accounts for the remaining 15 per cent.

Figure ES2 Seven states – Odisha, Maharashtra, Tamil Nadu, Uttar Pradesh, Rajasthan, Gujarat, and Andhra Pradesh – account for a cumulative 92 per cent of the potential support



Source: Authors' analysis

D. Study limitations

The high-level assumptions used in the analysis significantly affect the study's findings. This section outlines the limitations of our study.

- **Realisable support out of potentially available support:** We limit our analysis to quantifying the total potential support per the state and central government policies. We do not project or quantify the proportion that can actually be realised out of this total potential. Such a quantification can only be done

if green hydrogen becomes cheaper than grey hydrogen or hydrogen purchase obligations (HPO) are enforced on end-consumers and there are guaranteed offtake contracts for exports markets.

- **Changes in capital costs and efficiencies:** We do not account for changes in the capital costs or efficiencies of electrolysers, solar panels, and wind modules over time. As a result, the actual budgetary outlay/support may differ from the amounts indicated in the study.
- **National-level optimisation of RE assets:** We do not optimise for the cost of hydrogen based on the open access charges across various states. The relative distribution of wind and solar power for green hydrogen production will depend on the location-specific profiles which was outside our scope.
- **Variability in RE deployment:** We do not account for differences in RE deployment between states, which can arise from factors such as favourable state policies, cost economics, right of way, and ease of implementation.
- **Constant charges and their impact on estimated benefits:** The study assumes that incentives and charges remain constant during the applicable period. However, as solar and wind power costs decrease due to learning rates, open-access charges could also change in the future. The study does not consider this potential change due to market uncertainties in power pricing and the timeline for green hydrogen offtake.
- **Variation in ISTS charges:** We do not account for differences in contracted ISTS quantum across states, which could potentially change the ISTS charge.

E. Conclusion

The INR 19,744 crore (approximately USD 2.5 billion) allocated under the NGHM is augmented 26 times by the total potential financial support provided by state-level policies and MoP's GHP, estimated at around INR 5.05 lakh crore (about USD 61 billion). The power–related components form 62 per cent of the total support, while the remaining 38 per cent is directed towards non-power related components.

This financial support will strengthen India's ambitious goal of becoming a global leader in green hydrogen production and export. Complementing the NGHM and the GHP, the state-level policies offer a broad range of incentives and exemptions, addressing key aspects critical to the industry. This potential support is not limited to a few states; 7 out of the 12 states that offer support contribute 92 per cent of the total support. Fully realising this potential support could be crucial not only for achieving and surpassing India's green hydrogen targets but also for advancing its decarbonisation, self-reliance, and green industrialisation efforts.

1. Introduction and background

Green hydrogen, produced by water electrolysis using renewable electricity, is a clean energy carrier that can help decarbonise several hard-to-abate sectors of the economy. It can be effectively used as a feedstock in industrial processes such as refining, fertiliser production, steelmaking, and petrochemical manufacturing; as a fuel for heavy-duty long-haul vehicles, ships, and airlines; for cooking; as an energy carrier through green ammonia or other liquid organic hydrogen carriers; and as an energy storage solution for power generation.

In addition to being a decarbonisation solution, domestically produced green hydrogen can support India's *Aatma-nirbhar Bharat* (self-reliance) goals. It provides an opportunity to secure the country's energy needs against geopolitical disruptions and reduce import expenditure on fossil fuels, which are estimated at INR 16.1 lakh crore (approximately USD 200 billion) (MOPNG 2024). As the green hydrogen sector is at a nascent stage globally, India has the opportunity to deploy green technologies at scale and capture a significant share of the global green energy market.

1.1. Policies on green hydrogen in India

Due to its numerous benefits, green hydrogen has gained significant attention from Indian policymakers this decade. Since 2022, several central and state policies have been introduced to address key challenges in the sector and incentivise large-scale green hydrogen production in India.

The *Green Hydrogen Policy* (GHP), announced by the Ministry of Power in February 2022, was India's first policy on green hydrogen. It includes a waiver on inter-state transmission system (ISTS) charges and outlines norms for sourcing renewable electricity for green hydrogen production (Ministry of Power 2022). The policy also introduces provisions such as demand aggregation across various sectors, a single portal for clearances, and land allocation in renewable energy (RE) parks.

The *National Green Hydrogen Mission* (NGHM), launched by the Ministry of New and Renewable Energy (MNRE) in January 2023, is a key policy initiative with a budget allocation of INR 19,744 crore (approximately USD 2.5 billion). The NGHM holistically supports the green hydrogen sector, addressing various aspects of the ecosystem, as outlined in Box 1.

Box 1 The NGHM strategy includes a holistic set of interventions for three components

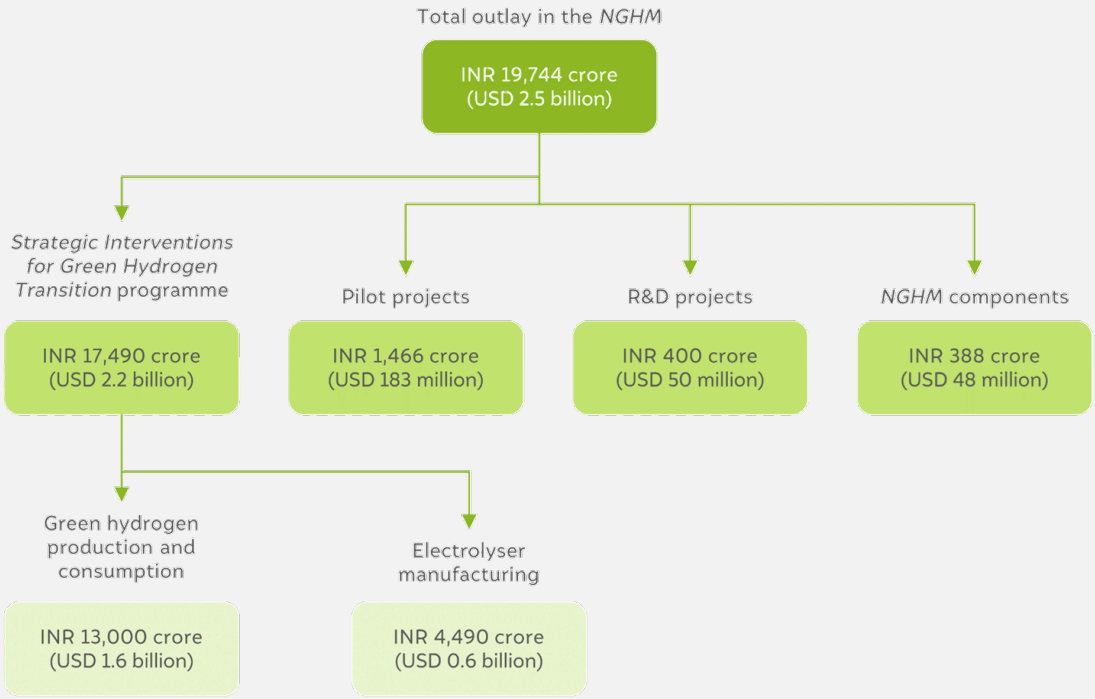
The NGHM outlines a strategy centred on three components, to be implemented in two phases through 2030. The interventions for each component are as follows:

- **Demand creation** aims to promote consumption of green hydrogen across various sectors as a substitute for imported fossil fuels and fertilisers, while also positioning India as a leading exporter of green hydrogen and its derivatives by capturing global market demand.

- **Incentivising supply** of green hydrogen through the *Strategic Interventions for Green Hydrogen Transition* (SIGHT) programme with support for electrolyser manufacturing through a production-linked incentive mechanism and viability gap funding for green hydrogen production.
- **Strengthening key enablers** such as finance, R&D, ease of doing business (EoDB), infrastructure, supply chains, regulations and standards, skill development, and public awareness.

The primary expenditure in the NGHM is under the SIGHT programme, which has already deployed two tranches of incentives. Figure 1 shows the distribution of these incentives in the NGHM.

Figure 1 The SIGHT programme accounts for the largest share of the NGHM outlay



Source: Authors' compilation from (Ministry of New and Renewable Energy 2023)

Since the launch of the NGHM, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, and West Bengal have introduced dedicated green hydrogen policies. Punjab and Haryana's policies are in the draft stage. Figure 2 shows the timeline of policy development by both state and central governments. Gujarat, Tamil Nadu, Odisha, Kerala, and Madhya Pradesh also support green hydrogen through their industrial or power sector related policies.

State-level policies include various components that support the green hydrogen ecosystem, with some offering financial incentives and exemptions for both power-related and non-power-related aspects. This report aims to quantify the total potential support available to the green hydrogen ecosystem in India through these incentives and exemptions. This support complements the funding from the NGHM and the GHP, enhancing India's overall support to the green hydrogen ecosystem.

Figure 2 Policy development on green hydrogen has been enabling in India

Source: Authors' compilation

2. Methodology and interpretations

We analysed state-level green hydrogen policy documents from all 12 states to assess the available incentives. This included examining all elements of financial support from final or draft green hydrogen policies, and relevant policies in the industrial, RE, and power sectors, as illustrated in Figure 3

To calculate the quantum of incentives, we first establish a baseline for green hydrogen production potential for each state by 2030, which is used to scale the incentives of each policy. We also account for consistent parameters in sizing green hydrogen and RE projects, state-specific RE potential, and options for inter- and intra-state RE procurement, which are detailed in Section 2.2. Our interpretation of policy components is outlined in Section 2.3, and we use certain guiding principles to aggregate the support quantum presented in Section 2.4.

Figure 3 Key methodology aspects

Policy support components considered

Benefits in twelve states are quantified under following components

- **Power-related components** – Waivers on inter- and intra-state transmission charges, electricity duty, wheeling charges and power tariff
- **Non-power-related components** – Capital subsidy, interest subvention, SGST reimbursement, subsidy on blending, vehicles, consumption, refueling stations, R&D and land

Baseline green hydrogen production

Mixed approach to establish green hydrogen production baseline

- **Green hydrogen production targets** as stated in states' green hydrogen policies
- **Bottom-up estimation** of green hydrogen production in a state to meet intra-state demand and export demand

Uniform operational parameters

Optimised parameters to minimise LCOH

- **77 per cent wind energy and 23 per cent solar energy** used in a wind-solar hybrid mode
- **RE requirement will be sourced within the state**, except wind power in six states categorised as non-windy
- **RE procurement through captive open access** in all states except Odisha and West Bengal

Guiding principles

Consistency in aggregation through principles

- **States as standalone entities**, with all investments being accrued in the state except non-windy states
- **Maximum support estimated** unless upper limits are explicitly mentioned
- **State and central policies read in consonance** such that both benefits stack up
- **Aggregate quantification of support** over entire duration of policy or equipment lifetimes

Source: Authors' compilation

We sought feedback from the relevant nodal agencies in all states considered. We received responses from six states, including Andhra Pradesh, Haryana, Kerala, Maharashtra, Odisha, and Punjab. These reviews informed both our interpretation of policy provisions, and the assumptions used in our analysis.

2.1. State-wise baseline green hydrogen production potential

The green hydrogen economy is still in its early stages. The quantity of green hydrogen production and consumption across states for the future years have yet to be finalised. We employ a mixed approach to establish each state's baseline green hydrogen production capacities. If a state has set green hydrogen production targets, we use these targets as the baseline. If no targets are specified, we estimate the baseline using a bottom-up approach that incorporates a transition plan from grey to green hydrogen for domestic sectors and any announcements of export-oriented projects. The details of this estimation process are provided in Section 2.1.2.

2.1.1.State-wise production targets in green hydrogen policies

Six states – Andhra Pradesh, Haryana, Maharashtra, Punjab, Rajasthan, and Uttar Pradesh – have set green hydrogen production targets in their policies. All of these targets are valid until 2030 or sooner, aligning with the NGHM timeline. Cumulatively, the production targets across these six states add up to 4.35 MTPA of green hydrogen production. Table 1 details each state's targets.

Table 1 Six states have set a cumulative green hydrogen production target of 4.35 MTPA by 2030

Sr. no.	State	Production target (MTPA)	Target year	Reference
1	Andhra Pradesh	0.50	2028	(Energy Department, Government of Andhra Pradesh 2023)
2	Haryana	0.25	2030	(New and Renewable Energy Department, Haryana 2024)
3	Maharashtra	0.50	2030	(Industry, Energy, Labour and Mining Department, Government of Maharashtra 2023)
4	Punjab	0.10	2030	(Punjab Energy Development Agency, Government of Punjab 2023)
5	Rajasthan	2.00	2030	(Energy Department, Government of Rajasthan 2023)
6	Uttar Pradesh	1.00	2029	(Uttar Pradesh New and Renewable Energy Development Agency 2024)
	Total	**4.35**		

Source: Authors' compilation from state-level green hydrogen policies

We use these targets as the baseline green hydrogen production capacity across the respective states to estimate the financial support provided by the state-level policies. The actual production will depend on various factors such as the economic viability of green hydrogen or hydrogen purchase obligations (HPOs) and guaranteed export offtake, which are not evaluated in this study.

2.1.2. State-wise domestic consumption targets

Currently, hydrogen is used in large quantities in India's fertiliser, refining, and petrochemical industries. Although no mandate for using green hydrogen in these sectors has been announced yet, the NGHM intends to establish such mandates on using green hydrogen in fertiliser and refinery units in its Phase 1 (Ministry of New and Renewable Energy 2023). Therefore, our analysis focuses on these two sectors as contributors to

green hydrogen demand by 2030, excluding other emerging sectors like steel and mobility unless specifically addressed in state-level green hydrogen policies.

Fertiliser production consists of two broad segments: urea and non-urea fertilisers. Urea production is estimated to account for approximately 84 per cent of the total annual grey hydrogen demand of around 3 MTPA. The transitioning to green hydrogen in urea production poses significant economic and technical challenges. We expect the shift in fertiliser production to begin with non-urea fertilisers, where imported ammonia can be more easily replaced with indigenous green ammonia. Although the fertiliser sector holds the largest share of hydrogen consumption in India overall (CFLI India and CEEW 2024), we estimate that by 2030, the sector will consume only 0.5 MTPA of green hydrogen, primarily for non-urea fertiliser production.

According to published literature, the refining sector is expected to demand 1 MTPA of green hydrogen by 2030 (Raj, Lakhina and Stranger 2022). Together, these two sectors are projected to account for a total of 1.5 MTPA of green hydrogen demand by 2030, all of which will be met indigenously. Table 2 indicates the projected green hydrogen consumption across refineries and fertiliser units by 2030.

Table 2 Domestic green hydrogen consumption in key sectors is projected at 1.38 MTPA by 2030

Sr. no.	State	Green hydrogen consumption in refineries by 2030 (MTPA)	Green hydrogen consumption in fertiliser plants by 2030 (MTPA)	Total domestic consumption of green hydrogen in fertiliser and refineries by 2030 (MTPA)
1	Gujarat	0.45	0.13	0.58
2	Odisha	0.03	0.11	0.14
3	Andhra Pradesh	0.03	0.11	0.14
4	Kerala	0.06	0.04	0.10
5	Tamil Nadu	0.07	0.03	0.10
6	Maharashtra	0.05	0.04	0.09
7	Haryana	0.08	-	0.08
8	Madhya Pradesh	0.05	-	0.05
9	West Bengal	0.03	0.02	0.05
10	Uttar Pradesh	0.03	-	0.03
11	Punjab	0.03	-	0.03
12	Rajasthan	-	-	-
	Total	**0.9**	**0.48**	**1.38**

Source: Authors' analysis

2.1.3. State-wise potential exports

The coastal states have signed multiple memorandums of understanding (MoUs) with project developers to establish export-oriented green hydrogen projects. Based on these agreements, we have allocated 3.5 MTPA of green hydrogen production for export.

Table 3 Coastal states in India are well positioned to export 3.5 MTPA of green hydrogen by 2030

Sr. no.	State	Green hydrogen production potential (MTPA, by 2030)	Sources
1	**Gujarat**	**1.60**	(Gupta, eqmagpro 2023), (A. Kumar, Financial Express 2024)

Sr. no.	State	Green hydrogen production potential (MTPA, by 2030)	Sources
2	**Tamil Nadu**	**1.07**	(The Hindu Business Line 2023)
3	**Andhra Pradesh**	**0.27**	(Energy Department, Government of Andhra Pradesh 2023)
4	**Maharashtra**	**0.27**	(Industry, Energy, Labour and Mining Department, Government of Maharashtra 2023).
5	**Odisha**	**0.17**	(Bisoyi, Indian Express 2023)
6	**Kerala**	**0.12**	(Koundal, Economic Times 2024)
	Total	**3.50**	

Source: Authors' compilation

2.1.4. State-wise total green hydrogen production capacity

The total green hydrogen production in each state by 2030 is estimated by drawing on three key figures:

- The state-level production targets indicated in Table 1
- Total domestic consumption in Table 2
- Export target of 3.5 MTPA in Table 3

Table 4 shows the total green hydrogen production for each state. We consider an ambitious scenario where we use the maximum of the state-level production target and the sum of domestic consumption and exports to determine the total green hydrogen production value for a particular state. For example, we use Maharashtra's target of 0.5 MTPA, rather than the sum of its domestic consumption and exports, which is 0.36 MTPA, to quantify the support.

We estimate the baseline green hydrogen production potential to be 3.98 MTPA for the six states based on a bottom-up estimation. In contrast, the states with state-level targets for green hydrogen production account for a total potential of 4.35 MTPA. As shown in Table 4, the four states - Gujarat, Tamil Nadu, Rajasthan, and Uttar Pradesh together represent 76 per cent of the total hydrogen production potential in our analysis.

Table 4 Overall, the potential for green hydrogen production in 12 states is approximately 8.3 MTPA

Sr. no.	State	Estimation approach	Green hydrogen production potential (MTPA, by 2030)
1	Gujarat	Bottom-up estimation	2.18
2	Rajasthan	State target-based	2.00
3	Tamil Nadu	Bottom-up estimation	1.17
4	Uttar Pradesh	State target-based	1.00
5	Andhra Pradesh	State target-based	0.50
6	Maharashtra	State target-based	0.50
7	Odisha	Bottom-up estimation	0.31
8	Haryana	State target-based	0.25
9	Kerala	Bottom-up estimation	0.22
10	Punjab	State target-based	0.10
11	West Bengal	Bottom-up estimation	0.05
12	Madhya Pradesh	Bottom-up estimation	0.05

Total	**8.33**

Source: Authors' analysis

2.2. Parameters for green hydrogen and renewable energy projects

In this section we present overarching operational and cost parameters pertaining to green hydrogen projects that have been consistently considered for all states.

2.2.1. Assumptions on capacity utilisation in RE and the plant load factor of electrolysers

We use industry-reviewed capacity utilisation factors (CUFs), electrolyser plant-load factor (PLF), and the share of wind and solar energy in wind–solar hybrid (WSH) systems to optimise the levelised cost of hydrogen (LCOH) (CFLI India and CEEW 2024). Our assessment includes the following parameters:

- Electrolyser PLF – 74 per cent
- Renewable energy CUFs – 26 per cent for solar and 34 per cent for wind
- Energy procurement split – 77 per cent from wind generation units and 23 per cent from solar generation units

The aforementioned parameters result from the cost optimisation model for green hydrogen based on the assumptions outlined in our previous publications (Biswas, Yadav and Guhan 2020). The solar energy PLF reflects a 30 per cent oversizing on the direct current (DC) side, while the wind CUF data is derived from the NREL reV model for a 100 m hub height (Maclaurin, et al. n.d.).

2.2.2. State-wise assessment of RE potential and capacity

To achieve the ambitious target of producing 5 MTPA of green hydrogen, India will need to develop an additional 100–125 gigawatts (GW) of RE capacity, on top of its existing target of 500 GW by 2030 (CFLI India and CEEW 2024). Meeting this green hydrogen production target will require substantial RE availability across different states. Therefore, we also evaluate the RE potential across various states to identify any potential bottlenecks in meeting these green hydrogen production targets.

India's solar energy potential has been estimated by the National Institute of Solar Energy (NISE) based on data from the Waste Land Atlas of India 2010 (Central Electricity Authority 2023). Similarly, India's wind energy potential is derived from the National Institute of Wind Energy's (NIWE) Wind Potential Atlas, measured at 150 meters above ground level (National Institute of Wind Energy 2023). The states with significant potential for both solar and wind are Rajasthan, Maharashtra, Madhya Pradesh, Gujarat, and Andhra Pradesh.

Further assessment related to the optimisation of RE costs for meeting the power demand and green hydrogen production capacity is beyond the scope of this report. For instance, a refinery in Haryana might opt to source wind energy from Rajasthan or Tamil Nadu, depending on factors such as RE costs, infrastructure requirements, and land clearance. Analysis of these factors was not included in this report.

2.2.3. Categorisation of states as windy and non-windy

We believe the procurement strategy for RE is based on the principle that each Indian state has enough solar potential, to generate the required solar energy within its own geographical boundaries. This is supported by various state policies that incentivise the establishment of solar power plants within state borders, ensuring that the solar energy needed for green hydrogen production can be sourced intra-state.

A significant contribution from wind energy is required to achieve optimal hydrogen production costs for a WSH system. Given the variability in wind potential across different states, this analysis categorises the states into two distinct groups: windy and non-windy.

- **Windy states:** These states have substantial wind energy potential and can generate the required wind power within their borders. The six states identified as windy in this analysis are Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu. In these states, both solar and wind energy needs are met using local RE resources, maximising the use of regional wind potential.
- **Non-windy states:** These states have limited wind energy potential and rely on external sources to meet their wind energy needs. The six non-windy states identified in this analysis are Punjab, Haryana, Odisha[2], Kerala, West Bengal, and Uttar Pradesh. They currently have either negligible or no installed wind capacity (Ministry of New & Renewable Energy 2025).[3] Additionally, their wind potential is insufficient to generate the required wind energy to meet the green hydrogen production targets. While the solar energy needs are met through intra-state resources, wind energy requirements are sourced from neighbouring windy states. For instance, Uttar Pradesh wind energy demand will be fulfilled using Rajasthan's wind generation. This approach ensures that even non-windy states can benefit from wind energy by utilising the resources of nearby states.

2.3. Interpretation of support components specified in policies

The financial implications of the various incentives offered under the central policies, rules, and state policies – such as green hydrogen, industrial, and renewable energy/power policies – can vary significantly depending on how these benefits are structured and funded. To thoroughly analyse these implications, we have categorised the incentives into three groups: budgetary implication, revenue foregone, and nationally socialised support. Figure 4 provides a bucketing of various power and non-power incentives under three categories. Each category reflects the financial impact on the state and the broader national economy differently, ensuring a clear understanding of the fiscal responsibility associated with each incentive.

- **Budgetary implication:** Incentives in this category require the state government to allocate funds directly in its annual budget. These are typically expenses that the state must cover through its fiscal resources. For example, subsidies for infrastructure development – such as constructing transmission and distribution networks[4], refuelling stations, or providing capital subsidies for setting up green hydrogen production facilities – would necessitate a budgetary outlay. These expenditures are planned and included in the state's fiscal planning, reflecting a direct financial commitment by the government to support the sector's growth.
- **Revenue foregone:** This category includes incentives where the state forgoes potential revenue that it could have otherwise collected. These primarily involve tax waivers, exemptions, or reductions that

[2] Odisha is not yet classified as a windy state by MNRE, despite having 12,129 MW of overall wind potential. The wind installations are currently in a nascent stage, and bulk of its wind potential lies in the lower 25-30 per cent CUF range, which is uneconomical for green hydrogen production.

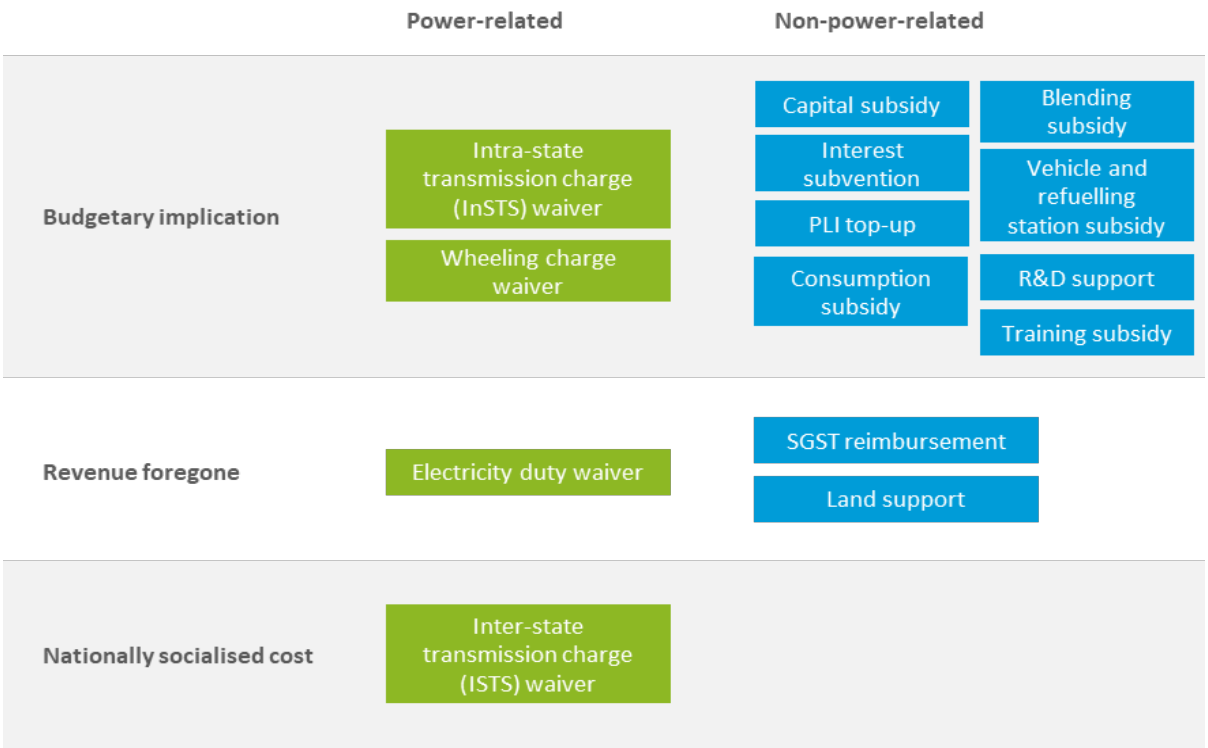
[3] As of 31 March 2025, MNRE's state-wise installed capacity report notes that Kerala has 71.27 MW of installed wind capacity, while Punjab, Haryana, Odisha, West Bengal, and Uttar Pradesh have none.

[4] The State Transmission Utility (STU) builds and maintains intra-state transmission networks. Similarly, the discoms build and maintain the distribution network for the wheeling of power. The cost is recovered from network users, which includes majorly discom consumers, bulk industries, and open access consumers. Producing green hydrogen is an energy-intensive process; socialising the cost to existing network users will lead to an unfair burden and cost increase. Therefore, it is assumed that the state's budget will have to make necessary provisions to make up for the cost incurred/incentives announced in respective state policies. Hence, the intra-state transmission charges waiver and wheeling charge waiver classification is under 'Budgetary Implication'.

enable beneficiaries to avoid payments they normally owe to the state. For instance, waivers on electricity duty (ED) or reimbursements on State Goods and Services Tax (SGST) are considered revenue foregone because the state chooses not to collect these charges, reducing its potential income. Although these incentives do not require budgetary allocation, they impact the state's revenue stream, and this loss must be factored into the overall budget assessment.

- **Nationally socialised costs:** This category is unique because it includes incentives where the financial burden is indirectly borne by state electricity consumers. In the context of green hydrogen policies, a key example is the waiver of ISTS charge for the wheeling of RE power over the ISTS network. Under the current ISTS network cost-sharing regime, the cost of this waiver is distributed across the national grid (or ISTS network) users, primarily states and large consumers. The cost distribution is uneven for some states and is ultimately recovered from their electricity consumers (Kumar and Singh 2024).

Figure 4 Most support components for green hydrogen under central- and state-level policies have a budgetary implication



Source: Authors' analysis

2.3.1. Power-related support components

This analysis assumes that in all states except Odisha and West Bengal, RE for green hydrogen production will be procured through projects established under the captive open-access route due to its favourable cost economics. In Odisha and West Bengal, the incentives provided under state policies make discom-based procurement more cost-effective. Table 5 lists all the primary sources referred to assess power-related waivers. The following charges apply to electricity procured via open access:

- **Inter-state transmission system charges:** In non-windy states, wind energy from neighbouring windy states will be imported via the ISTS network. Technically, the ISTS charge differs for individual states, depending on the ISTS contracted quantum (Kumar and Singh 2024). However, for the sake of simplicity, we consider the national average ISTS charge for our calculations, as the overall ISTS charge pool

remains unchanged. The national average ISTS charge is calculated using the annual ISTS charge for designated ISTS consumers (DICs), the ISTS quantum (in billion units), and adjusted for the share of RE in the ISTS quantum (in billion units). The resulting ISTS charge is INR 0.534 per unit.[5]

- **Intra-state transmission system charges:** Since all states will be generating solar energy within the state and some wind energy as well, the InSTS network of the State Transmission Utility (STU) will be used for the transmission of electricity from the generating station to the green hydrogen production plant or site. The InSTS charges are based on the state's latest transmission or distribution tariff order released by the respective State Electricity Regulatory Commission (SERCs). The transmission charges for long-term and medium-term open access customers (in INR/MW/month) are converted to INR/kWh for consistency.
- **Electricity duty:** When the state's green hydrogen policy provides a waiver for ED, the financial implication of this waiver is calculated based on its duration and percentage. The ED rate for the industrial category is based on the state's current ED order.
- **Wheeling charges:** Wheeling charges apply when using the discoms' distribution network for wheeling of energy. The connectivity level is assumed to be at 33 or 66 kV, making wheeling charges applicable, and the waiver thereof is calculated. The state's green hydrogen policy, integrated RE policy, or WSH policy (whichever is applicable) is referenced to determine the scope of the waiver. As specified in the latest distribution tariff order released by SERC, wheeling charges are used for this calculation.
- **Cross-subsidy surcharge and additional surcharge:** CSS and AS are waived for green hydrogen projects either under the state's green hydrogen policy, the state's green open access (GEOA) regulations, the RE tariff regulations for the captive category, or the *Central Electricity Rules 2005* (and its amendments). The CSS and AS values are derived from the state's latest tariff order and calculated for the entire project lifetime of 25 years.[6] In two states, Odisha and West Bengal, power is assumed to be sourced from discoms due to favourable cost economics. [7]
    - Importantly, in our assumed mode of open-access captive procurement of RE, CSS and AS are not applicable and thus have not been considered in the overall potential state support for the green hydrogen ecosystem. Box 2 explains why CSS and AS waivers should not be counted as support for the green hydrogen or industrial ecosystem in general.

Box 2 Treatment of the cross subsidy surcharge and additional surcharge

Rationale behind excluding CSS and AS waivers from being considered as a support for green hydrogen or the broader industrial ecosystem

The RE capacity that will need to be developed to meet green hydrogen targets represents an entirely new demand—not a shift from existing demand of the discoms, which is usually a concern often cited for not promoting open access (Josey 2024). This new demand is visible in advance, giving discoms full opportunity to plan procurement and capacity addition through robust resource adequacy planning. In this context, levying AS on GH2 production—under the assumption that discoms have stranded capacity would be misplaced. Similarly, applying CSS presumes a cross-subsidy loss that does not exist, since this new demand would not have contributed to discom revenues in the first place. Instead, discoms should

[5] The ISTS charge of INR 0.534 per unit is computed for FY 2023-24. We have assumed that it will remain constant for future years.
[6] AS is not applicable in Andhra Pradesh, Uttar Pradesh, and Kerala, as it has not been specified in the latest tariff orders.
[7] In most states, including Odisha and West Bengal, the discoms have notified a green tariff—typically at a premium above the standard industrial tariff—which allows consumers to claim renewable energy use through official certification.

collect cost-reflective charges for services they may provide to GH2 producers, such as stand-by services and grid balancing, if required.

The *National Tariff Policy 2016* (NTP) emphasises that both CSS and AS should not be so onerous as to stifle competition in the market, particularly in the context of promoting open access (Ministry of Power 2016). Therefore, to support industrial and economic growth, the logic behind the imposition of CSS and AS on any kind of open access transactions (third party or captive), especially for the new RE demand (100–125 GW) resulting from green hydrogen production, should be revisited.

Given the aforementioned factors, exemptions on CSS and AS under state policies and central rules, although quantified in this report, are not included in the total calculated potential support.

Table 5 List of primary sources referred to assess power-related waivers

Category	Policies	Laws, regulations and government orders
State	State's green hydrogen policy	State's green energy open access (GEOA) regulations
	State's integrated renewable energy (RE) policy	State's applicable tariff regulations for RE
	State's wind-solar hybrid policy	State's latest transmission and discom tariff orders
	State's industrial policy	State's order on electricity duty
	State's land policy	
Central	*National Tariff Policy, 2016*	*Electricity Rules, 2005* and subsequent amendments
		Orders on waiver of inter-state transmission system charges

Source: Authors' analysis

2.3.2. Non-power-related support components

Non-power-related components are specified in the states' dedicated green hydrogen policies or broader industrial policies. The states – Gujarat, Tamil Nadu, and Kerala – that support green hydrogen through their industrial policies prioritise it as a thrust sector, offering special incentives. The following are our interpretations, considerations, and assumptions regarding each non-power-related support component:

- **Capital subsidy:** A few states subsidise a portion of capital expenditure for green hydrogen projects, excluding land and buildings. We consider capital expenditure factors, adjust them based on the baseline green hydrogen production as shown in Table 4, and apply the subsidy percentage to determine the potential capital subsidy.
- **SGST reimbursement:** All state policies that offer SGST reimbursement do so with a 100 per cent reimbursement on net SGST for green hydrogen projects. This is calculated as the difference between the output tax liability on green hydrogen sales and the input tax credit from capital goods purchases.
- **Land allocation support:** Some states cap land lease rates for green hydrogen projects. This support is quantified as the difference between the capped and average lease rates, adjusted based on the land requirements for the baseline green hydrogen production mentioned in Table 4. Note that exemptions on stamp duty and land conversion fees have not been included in the calculation of land allocation support.

- **R&D support:** A few state policies provide grants to centres of excellence in academic institutions and start-up incubators, with support capped per entity. This is used to calculate the total budgetary allocation for R&D under the state-level green hydrogen policy.
- **Support for blending with natural gas:** Some state policies offer incentives per kilogram for blending green hydrogen with natural gas. This support is calculated based on the state's estimated natural gas consumption and a volumetric blending factor.
- **Support for vehicles and refuelling stations:** Some state policies provide incentives per vehicle and refuelling station, with a cap on the total number supported. The budgetary allocation for hydrogen use in mobility is calculated based on this cap and the incentives provided per vehicle and refuelling station.

2.4. Guiding principles for calculating the aggregate quantum of incentives

To ensure consistency in aggregating the quantum of incentives for each support component across states, we relied on the following guiding principles:

- **States as standalone entities:** We treated each state as an independent entity, meaning all investments needed to meet each state's green hydrogen production potential were attributed to that state. The only exception was the investment in wind infrastructure in non-windy states, as discussed in Section 2.2.
- **Maximum support estimated:** We estimated the maximum potential support for each component based on the baseline green hydrogen production potential unless policy documents specified explicit upper limits. In such cases, we adhered to the upper limits. For example, we used the maximum limit of INR 60 lakh per vehicle available for the first 500 hydrogen-based vehicles under the vehicle subsidy in *Maharashtra Green Hydrogen Policy* to quantify this support component (Industry, Energy, Labour and Mining Department, Government of Maharashtra 2023). For components offering multiple options to beneficiaries, we considered the highest grossing option.
- **State and central policies read in consonance:** All state-level support components, especially power-related components, are expected to be consistent with the benefits of central government policies and rules. For example, benefits under central rules (such as the *Electricity Rules 2005* and its amendments, which cover cross-subsidy surcharge and additional surcharge waivers for the project's duration) and the *Uttar Pradesh Green Hydrogen Policy* (including waivers for wheeling charges, intra-state transmission system, charges, and electricity duty) are combined to assess the potential support available in Uttar Pradesh (Uttar Pradesh New and Renewable Energy Development Agency 2024).
- **Aggregate quantification, not annualised:** The total exemptions for applicable policy durations under each state's policies are calculated on an aggregate basis until the end year of the policy. The benefits are not annualised. For example, we quantify and present the total 60 per cent waiver on InSTS in *Maharashtra Green Hydrogen Policy* over its applicable duration of 10 years, as specified in the policy (Industry, Energy, Labour and Mining Department, Government of Maharashtra 2023).

Captive open access as the preferred mode of RE procurement: Our assessment considers captive open access as the preferred mode of RE procurement in all states (except Odisha and West Bengal) due to its cost advantages. However, for various reasons, the green hydrogen production facility might opt for alternative procurement methods, such as third-party open access, procurement from distribution companies, and power exchanges.

3. State-wise highlights of green hydrogen policies

Each state-level policy (green hydrogen, industrial, and renewable energy /power policies) varies in terms of duration, sectoral focus, targets, and power- and non-power-related provisions. Table 6 summarises the support components for the twelve states considered in this study.

Table 6 Each state offers a distinct structure of support to the green hydrogen sector

Particulars	GJ	RJ	TN	UP	AP	MH	OD	HR*	KL	PB*	WB	MP
Applicable policies												
Green hydrogen policy		■		■	■	■		■		■	■	
Industrial policy	■		■				■		■			■
RE/Power electricity policies												■
Support components – power-related												
Electricity duty waiver		■		■	■	■	■	■		■	■	■
Intra-state transmission charge waiver		■		■	■	■		■		■		■
Wheeling charge exemption		■		■	■	■	■	■		■		■
Power tariff rebate							■					
Support components – non-power-related												
Blending subsidy						■		■				
Capital subsidy		■	■	■		■	■			■		■
Consumption subsidy										■		
Interest subvention	■		■			■			■			
Land support				■	■							
PLI top-up**									■			
Refuelling station subsidy						■				■		
R&D support				■								
SGST reimbursement	■				■		■		■			

Particulars	GJ	RJ	TN	UP	AP	MH	OD	HR*	KL	PB*	WB	MP
Training support												
Vehicle subsidy												

Source: Authors' analysis

Note: 1. We include only the highest-outlay option where policies offer multiple forms of support options

2. Inter-state transmission charge waiver and Electricity Rules 2005 (and its amendments), which fall under the central government's jurisdiction, is an additional component not shown in the table

3. An asterisk (*) indicates policies still in draft stage.

4. **- Production Linked Incentive (PLI)

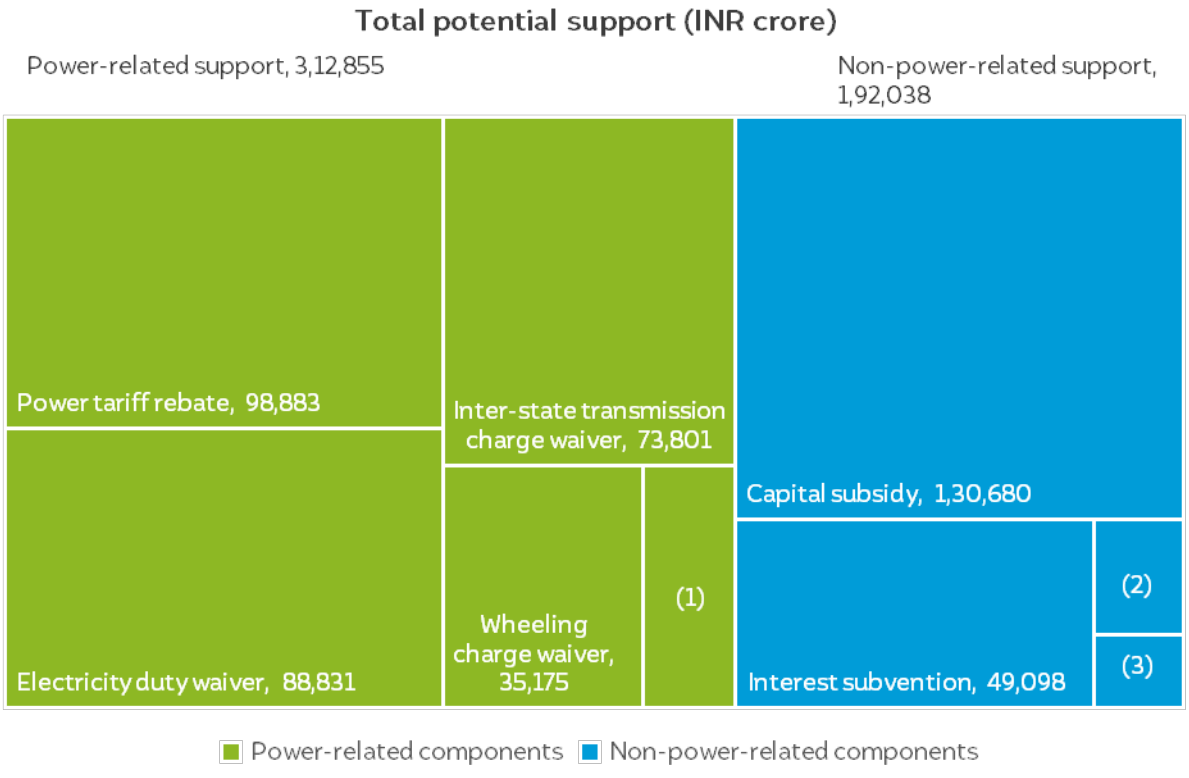
5. Electricity Policies refers to state's integrated Renewable Energy (RE) policies, state's wind solar hybrid policy

Power-related and non-power-related potential support

As shown in Table 6, all states except Gujarat, Tamil Nadu, and Kerala include most of the power-related support components in their policies. Consequently, the power-related components – such as ED waiver, ISTS charge and InSTS charge waivers, wheeling charge waiver, and power tariff rebate – account for INR 3.13 lakh crore (USD 38 billion). This amount represents 63 per cent of the total potential support for green hydrogen from all states, which is approximately INR 5.05 lakh crore (around USD 61 billion). The potential power-related benefit will increase significantly if we include the CSS- and AS-related benefits (see Box 3). However, as discussed in Box 2, these waivers are not included in our overall potential support.

Among non-power-related components, capital subsidy, interest subvention, and SGST reimbursement are the most prominent components, accounting for 37 per cent of the total potential support. In comparison, all others account for just 1 per cent. Figure 5 quantifies the potential support provided by each component across state and central policies.

Figure 5 Power-related support components account for 62 per cent of the potential support

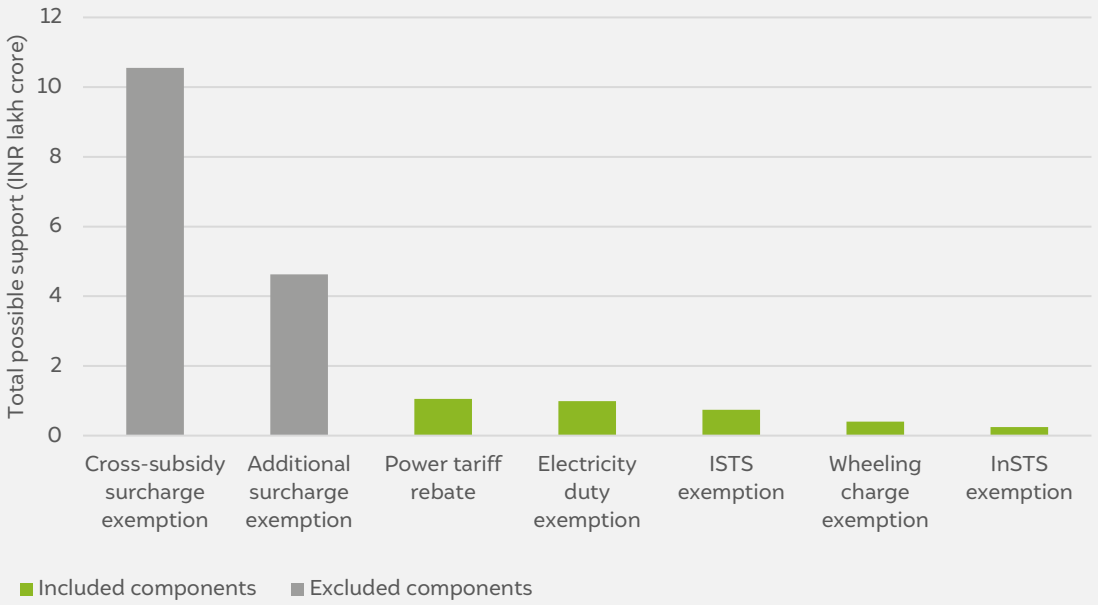


Source: Authors' analysis
Note: (1) Intra-state transmission charge waiver, INR 16,164 crore
(2) SGST Reimbursement, INR 7,469 crore
(3) Other non-power components INR 4,791 crore

Box 3 **Fully accounting for the waivers of additional and cross-subsidy surcharges could increase power-related support by 4.9 times or INR 15.2 lakh crore**

Additional and cross-subsidy surcharges are not included in the total potential support calculation for reasons discussed in Box 2 of Section 2. However, for comparison, we quantified the potential support from these components. As evident from Figure 6, the support from additional surcharges and cross-subsidy surcharges could be significantly higher than that from all other power-related components.

Figure 6 Cross-subsidy surcharge and additional surcharge could lead to a significant increase in the support by the states



Source: Authors' analysis

State-wise assessment of incentives

The distribution of the potential support for green hydrogen across states depends on several factors, including the baseline green hydrogen production shown in Table 4, the type of support outlined in Table 6 summarising the support components for the twelve states considered in the study and the corresponding provisions for each support in the state-level green hydrogen policies. Figure 7 depicts the state-wise power- and non-power-related potential support. According to our estimation, seven states – Odisha, Maharashtra, Tamil Nadu, Uttar Pradesh, Rajasthan, Andhra Pradesh, and Gujarat – account for 92 per cent of the potential support cumulatively. As shown in our assessment, these states also produce 92 percent of the total green hydrogen.

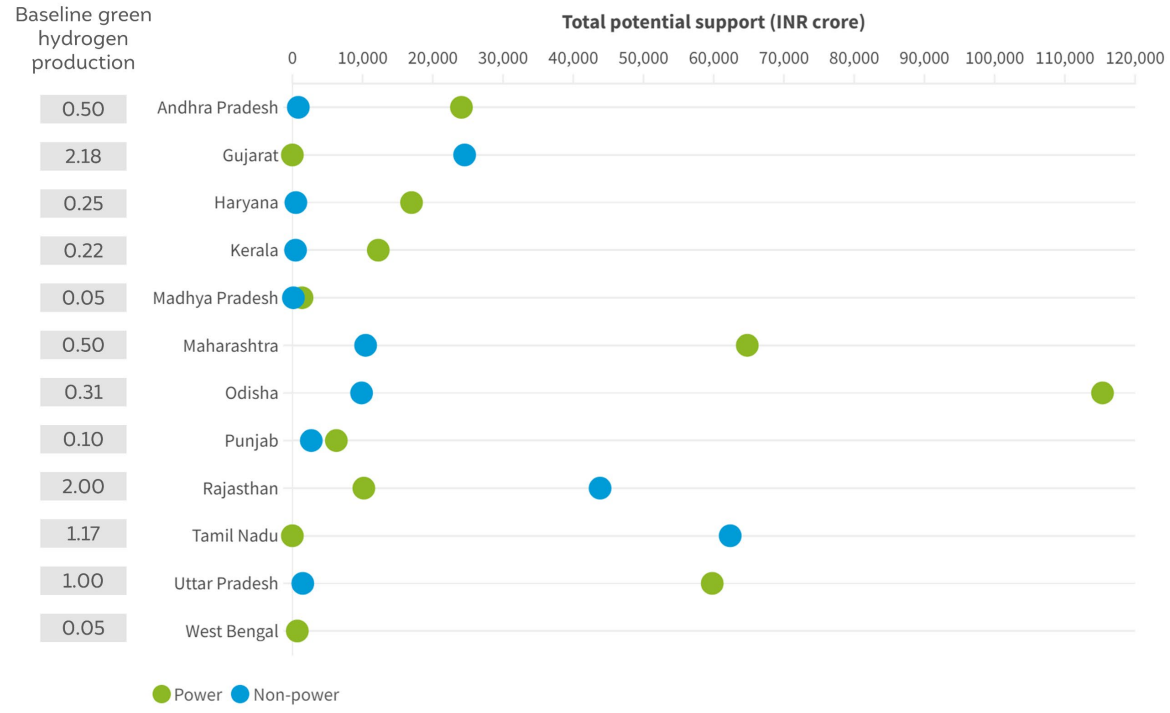
Power-related components account for 92 per cent of the total potential support in Odisha, Uttar Pradesh, Maharashtra, and Andhra Pradesh combined. Gujarat and Tamil Nadu provide only non-power-related support, as the green hydrogen sector is backed by their industrial policies. Rajasthan is the only state with a green hydrogen policy that has a higher quantum of non-power-related support than power-related support.

The remaining states – Punjab, Haryana, West Bengal, Madhya Pradesh, and Kerala – offer fewer support components and account for only 8 per cent of the baseline green hydrogen production. As a result, they represent 8 per cent of the total potential support.

Fiscal implications for state and national governments

Figure 8 displays the distribution of support types in state-level green hydrogen policies across various states. The types of support and their breakdown are discussed in Section 2.3. We estimate that 66 per cent of the total support will require a budgetary outlay. Revenue foregone will account for approximately 19 per cent, with the remainder representing nationally socialised support. This nationally socialised cost mainly applies to non-windy states, which must transport power through the ISTS network.

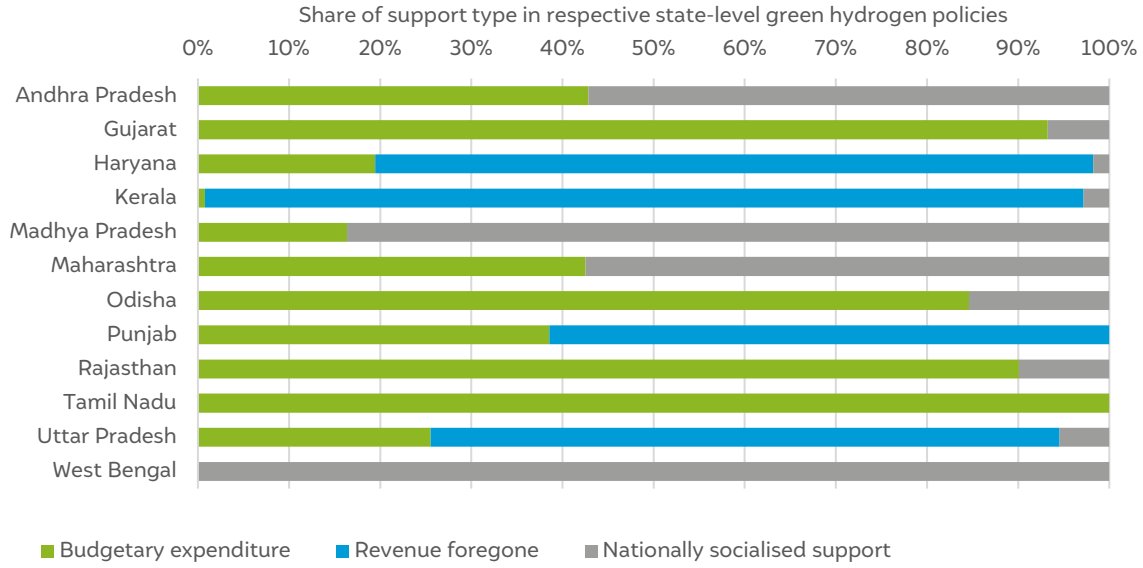
Figure 7 Power-related components offer higher support in most states



Source: Authors' analysis

Note: Refer to Section 3 for exact values of potential support

Figure 8 Around 66 per cent of the total support will entail a budgetary expenditure



Source: Authors' analysis

The following subsections provide details of each component in all state policies and the interpretative considerations and assumptions for each state's policies.

3.1. Odisha

Green hydrogen is mentioned in the Odisha Renewable Energy Policy, 2022 (Energy Department, Government of Odisha 2022). The policy also states that the current benefits outlined in the Industrial Policy Resolution, 2022, shall apply (Industries Department, Government of Odisha 2022). We estimate Odisha's green hydrogen production capacity to be 0.31 MTPA, consisting of 0.14 MTPA for domestic consumption and 0.17 MTPA for announced export projects.

Incentives: Odisha provides the following power and non-power-related incentives.

Power-related incentives:

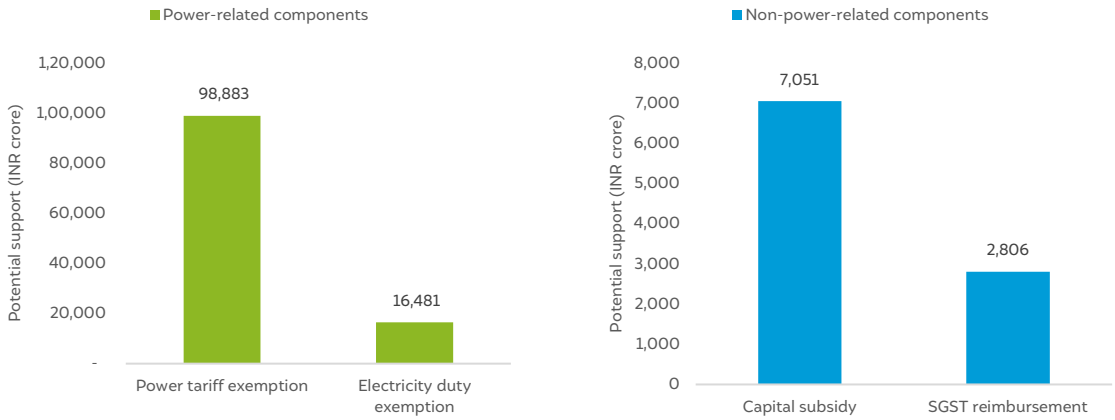
- **Power tariff rebate**: Reimbursement of power tariff of INR 3.00 per unit consumed and purchased from local discoms or Grid Corporation of Odisha (GRIDCO) for 20 years from the commencement date of commercial production (Industries Department, Government of Odisha 2022).
- **Electricity duty exemption:** A 100 per cent exemption from payment of ED for 20 years from the commencement of commercial production (Energy Department, Government of Odisha 2022).

Non-power-related incentives:

- **Capital subsidy:** 30 per cent for green hydrogen, identified as a thrust sector in the Industrial Policy Resolution, 2022 (Industries Department, Government of Odisha 2022).
- **SGST reimbursement:** A 100 per cent reimbursement of net SGST for five years from the date of fixed capital investment, up to a maximum limit of 200 per cent of the cost of plant and machinery (Industries Department, Government of Odisha 2022).

Total potential support: Odisha provides a total potential support of INR 1,25,220 crore for green hydrogen projects. A breakdown of this support is shown in Figure 9.

Figure 9 The total potential support in Odisha is estimated to be INR 1,25,220 crore



Source: Authors' analysis

Power-related support: The total potential support for power-related components is INR 1,15,364 crore. Odisha has moderate potential for solar (25.78 GW) and wind (12.13 GW) energy. We assume that all green power procurement in Odisha will be through discoms, given the attractive power rebate that makes discom power more cost-effective than other options. Therefore, only the power rebate for total units consumed and the exemption from ED are considered as incentives.

Non-power-related support: The total potential support for non-power-related components is INR 9,857 crore. A significant portion of this support comes from capital subsidies for green hydrogen projects in Odisha.

- **Capital subsidy:** The total investment in Odisha for producing 0.31 MTPA green hydrogen is estimated to be INR 23,503 crore. This estimate excludes the investment in wind energy, which is not eligible for capital subsidy. With a 30 per cent capital subsidy on investments for green hydrogen projects within the state, we estimate the total budgetary outlay to be INR 7,051 crore.
- **SGST reimbursement:** We estimate that the potential support through SGST reimbursement in Odisha could amount to INR 2,806 crore. Net SGST is calculated by determining the difference between the output tax liability on hydrogen sales and the input tax credit available for capital goods. The output tax liability is estimated using a LCOH of USD 3.75 per kg (CFLI India and CEEW 2024), a profit margin of USD 0.375 per kg and an SGST rate of 9 per cent for hydrogen. This calculation is then adjusted for an estimated production of 0.31 MTPA over a policy duration of five years. The input tax credit is calculated by considering the total capital expenditure of INR 14,836 crore for electrolysers and INR 8,677 crore for solar energy. The SGST rates considered are 9 per cent for electrolysers and 6.9 per cent for solar power. A detailed breakdown of the investment requirements per MTPA of green hydrogen is provided in the Annexure.

3.2. Maharashtra

Maharashtra Green Hydrogen Policy, launched in October 2023, aims to produce 0.5 MTPA of green hydrogen by 2030. The policy defines anchor units as the first three commissioned green hydrogen or derivative projects in the state, with a capacity of 50 KTPA each.

Incentives: Maharashtra provides the following power and non-power-related incentives.

Power-related incentives:

- **InSTS charges and wheeling charges:** A 50 per cent waiver on InSTS and wheeling charges is available for 20 years on Anchor units, while for Non-anchor units, a 50 per cent waiver on InSTS and a 60 per cent

waiver on wheeling charges is available for 10 years for standalone and hybrid projects (Government of Maharashtra 2023)

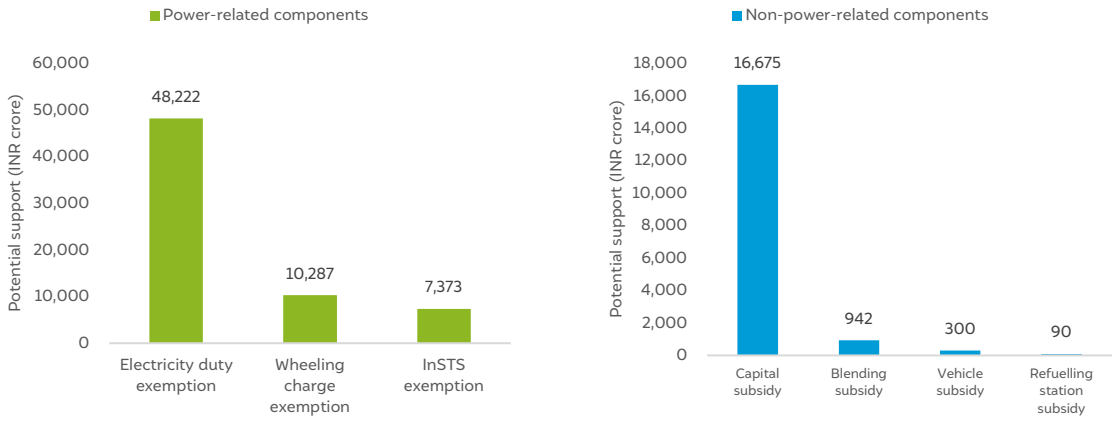
- **Electricity duty:** A 100 per cent exemption on electricity duty is available for 15 years for RE projects linked to Anchor units. For Non-anchor units, standalone RE projects are eligible for a 100 per cent ED exemption for 10 years, while hybrid RE projects receive the same exemption for 15 years (Government of Maharashtra 2023)
- **Cross-subsidy surcharge and additional surcharge:** CSS and AS are waived 100 per cent for green hydrogen RE projects (Government of Maharashtra 2023).

Non-power-related incentives[8]:

- **Capital subsidy:** A 30 per cent subsidy for green hydrogen is available for the first three plants with a capacity of more than 100 kTPA (Government of Maharashtra 2023).
- **Blending subsidy:** A subsidy of INR 50 per kg of green hydrogen blended with compressed natural gas (CNG) or piped natural gas (PNG) (Government of Maharashtra 2023).
- **Interest subvention:** A 1 per cent interest subvention as outlined in the policy (Government of Maharashtra 2023).
- **Vehicle and refuelling station subsidy:** Support of INR 60 lakh per vehicle and INR 4.5 crore per refuelling station, with an upper limit on the number of vehicles and refuelling stations, respectively (Government of Maharashtra 2023).

Total potential support: Maharashtra provides a total potential support of INR 83,890 crore for green hydrogen projects. A detailed breakdown of the support is shown in Figure 10.

Figure 10 The total potential support in Maharashtra is estimated to be INR 83,890 crore



Source: Authors' analysis

Power-related support: Maharashtra, a state with substantial wind (173.87 GW) and solar (64.32 GW) potential, offers power-related benefits totalling INR 65,883 crore. This includes an ED exemption (INR 48,222 crore), a wheeling charge exemption (INR 10,287 crore), and a waiver on InSTS charges (INR 7,373 crore) for green hydrogen production.

Non-power related support: The total potential support for non-power-related components is INR 18,008 crore. A major contributor to this is the capital subsidy for green hydrogen projects in Maharashtra.

[8] Capital subsidy and interest subvention for pipeline projects are also offered by the state, but are excluded from our analysis owing to uncertainties in cost and other key parameters.

- **Capital subsidy:** The estimated total investment in Maharashtra for three green hydrogen projects is INR 55,585 crore. With a 30 per cent capital subsidy on these investments, the total estimated budgetary outlay is INR 16,675 crore.
- **Blending subsidy:** We estimate the total blending support at INR 942 crore, based on the state's annual natural gas consumption of 9 billion cubic meters (bcm) per annum and a 5 per cent hydrogen blending by volume.
- **Vehicle and refuelling station subsidy:** The support is estimated based on incentives of INR 60 lakh per vehicle and INR 4.5 crore per refuelling station, with a maximum of 500 vehicles and 20 refuelling stations, respectively.

3.3. Tamil Nadu

Green hydrogen is mentioned as a sunrise sector in the Tamil Nadu Industrial Policy, 2021 (Industries Department, Government of Tamil Nadu 2021). We estimate Tamil Nadu's green hydrogen production potential at 1.17 MTPA, with 1.07 MTPA for export and 0.10 MTPA for domestic consumption within the state.

Incentives: Tamil Nadu provides the following non-power-related incentives.

Power-related incentives:

- **Cross-subsidy surcharge and additional surcharge:** CSS and AS do not apply to captive RE projects (TNERC 2014).

Non-power-related incentives:

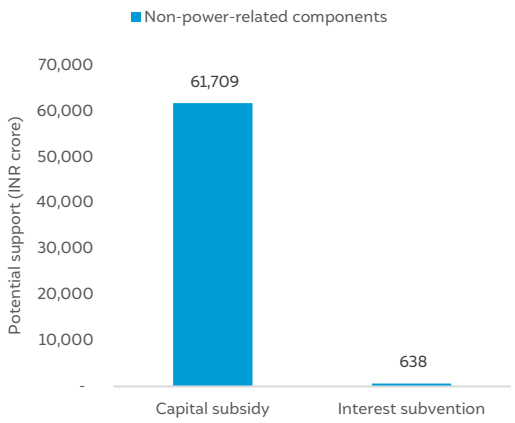
- **Interest subvention:** A 5 per cent rebate on the interest rate is provided to ultra-mega projects on term loans taken for the purpose of financing the project, up to INR 4 crore per annum for a period of six years (Industries Department, Government of Tamil Nadu 2021).

As per the Tamil Nadu Industrial Policy, 2021 developers may also choose any one of the following incentives:

- **Fixed capital subsidy:** A subsidy of 20–33 per cent for green hydrogen projects is available for 10 to 15 years, depending on the investment size, number of jobs created, and the district category where the investment is made (Industries Department, Government of Tamil Nadu 2021).
- **Flexible capital subsidy:** Up to 35 per cent of capital investment for A districts, 37 per cent for B districts, and 40 per cent of capital investment for C districts, based on the project, disbursed over 2.5 times the investment period (Industries Department, Government of Tamil Nadu 2021).
- **SGST reimbursement:** 100 per cent of the SGST payable on the sale of final products manufactured, sold, and registered in the state shall be reimbursed for 15 years (Industries Department, Government of Tamil Nadu 2021).
- **Turnover based subsidy:** Up to 2 per cent of the annual turnover for mega/ultra-mega projects creating more than 2,000 jobs, available for 10 years (Industries Department, Government of Tamil Nadu 2021).

Total potential support: Tamil Nadu provides a total potential support of INR 62,347 crore for green hydrogen projects. The breakdown of this support is indicated in Figure 11.

Figure 11 The total potential support in Tamil Nadu is estimated to be INR 62,347 crore



Source: Authors' analysis

Power-related support: Tamil Nadu is a windy state with significant wind (95.11 GW) and solar (17.67 GW) potential. It supports green hydrogen projects using its renewable energy resources but does not provide specific power-related benefits or exemptions.

Non-power-related support: The total potential support for non-power-related components is INR 62,347 crore. Capital subsidies for green hydrogen projects are a major contributor to the non-power-related incentives in Tamil Nadu and represent the maximum value.

- **Capital subsidy:** The total support in the form of capital subsidies is estimated to be INR 61,709 crore. This estimate is based on the number of projects in each investment category – large, mega, and ultra-mega – entitling them to subsidies of 20 per cent, 23 per cent, and 33 per cent, respectively.
- **Interest subvention:** The total support is estimated to be INR 638 crore, based on a ceiling value of INR 4 crore for six years for approximately 27 projects.

3.4. Uttar Pradesh

Uttar Pradesh aims to achieve a green hydrogen production capacity of 1 MTPA by 2029 (UPNREDA 2024).

Incentives: Uttar Pradesh provides the following power and non-power-related incentives.

Power-related incentives:

- **InSTS charges, wheeling charges and electricity duty:** A 100 per cent waiver on wheeling and InSTS for the captive use of renewable energy and a 100 per cent exemption from ED will apply for 10 years after the commencement of commercial production (Government of Uttar Pradesh 2023).
- **Cross-subsidy surcharge:** A 100 per cent exemption on CSS for captive RE projects (UPERC 2019).
- **Additional surcharge:** AS is not applicable to captive RE projects in Uttar Pradesh under its Open Access Regulation, 2019. The UPERC has not determined it in the latest tariff order for FY 2025.

Non-power-related incentives:

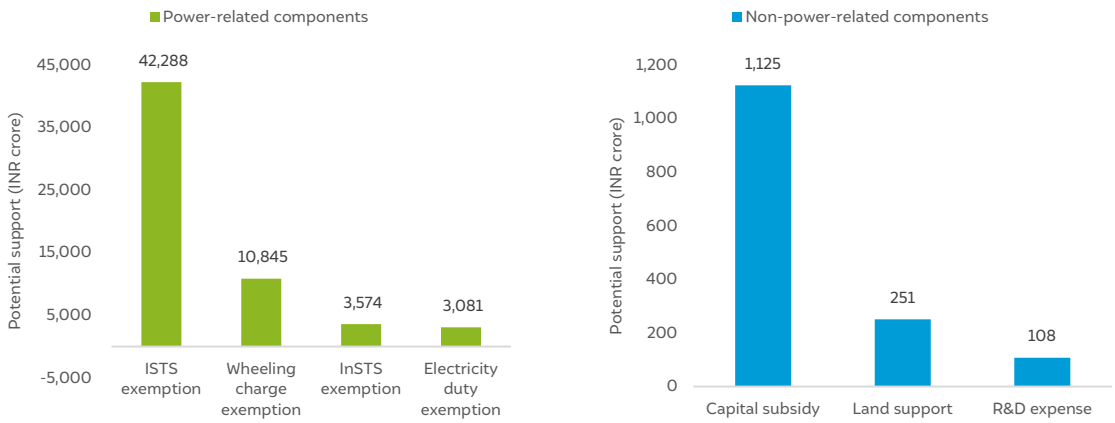
- **R&D and innovation expense:** Support is provided for a fixed number of incubators and centres of excellence, with maximum funding limits on both (UPNREDA 2024).
- **Land support:** The lease rate for government or *gram sabha* land for private developers is fixed at INR 15,000 per acre (UPNREDA 2024).

As per the *Uttar Pradesh Green Hydrogen Policy, 2024* developers may choose any one of the following incentives:

- **Capital subsidy:** 10–30 per cent for green hydrogen for a duration of 10 to 20 years, depending on the investment size and district in which the investment is made, subject to upper limits (UPNREDA 2024).
- **SGST reimbursement:** A 100 per cent reimbursement of net SGST, subject to annual ceiling limits of 10–19 per cent of fixed capital investment, over 6–16 years based on investment size and district in which the investment is made (UPNREDA 2024).
- **Production-linked incentive top-up:** 30 per cent of the sanctioned production-linked incentive (PLI) by the government of India, subject to 100 per cent of the fixed capital investment (UPNREDA 2024).

Total potential support: Uttar Pradesh provides a total potential support of INR 61,272 crore for green hydrogen projects. The breakdown of this support is indicated in Figure 12

Figure 12 The total potential support in Uttar Pradesh is estimated to be INR 61,272 crore



Source: Authors' analysis

Power-related support: Uttar Pradesh, a non-windy state with significant solar potential (22.83 GW) but negligible wind potential, offers power-related incentives totalling INR 59,788 crore. These include a waiver on InSTS (INR 3,574 crore), ED exemption (INR 3,081 crore), and wheeling charge exemption (INR 10,845 crore). The largest waiver, ISTS exemption (INR 42,288 crore) is on account of central government order on waiver of ISTS charge.

Non-power-related support: The total potential support for non-power-related components is INR 1,484 crore. The capital subsidies for green hydrogen projects are a major contributor to non-power-related incentives in Uttar Pradesh.

- **Capital subsidy:** As outlined in the Uttar Pradesh Green Hydrogen Policy, 2024, this option is the largest component, contributing INR 1,125 crore. This estimate is based on the maximum limit of INR 225 crore per ultra-mega project over five years.
- **Land support:** We estimate the support based on the difference between INR 15,000 per acre as the upper bound on land lease rates and INR 37,500 per acre from an earlier study (Dutt , et al. 2021)
- **R&D expense:** This incentive, calculated at INR 108 crore, is based on the maximum incentive per centre of excellence and the number of such centres, as well as the maximum incentive per start-up and the number of start-ups.

3.5. Rajasthan

As one of the first two states to develop a dedicated green hydrogen policy, Rajasthan aims to produce 2 MTPA by 2030, leveraging its substantial potential for renewable energy generation (Energy Department, Government of Rajasthan 2023).

Incentives: Rajasthan provides the following power and non-power-related incentives.

Power-related incentives:

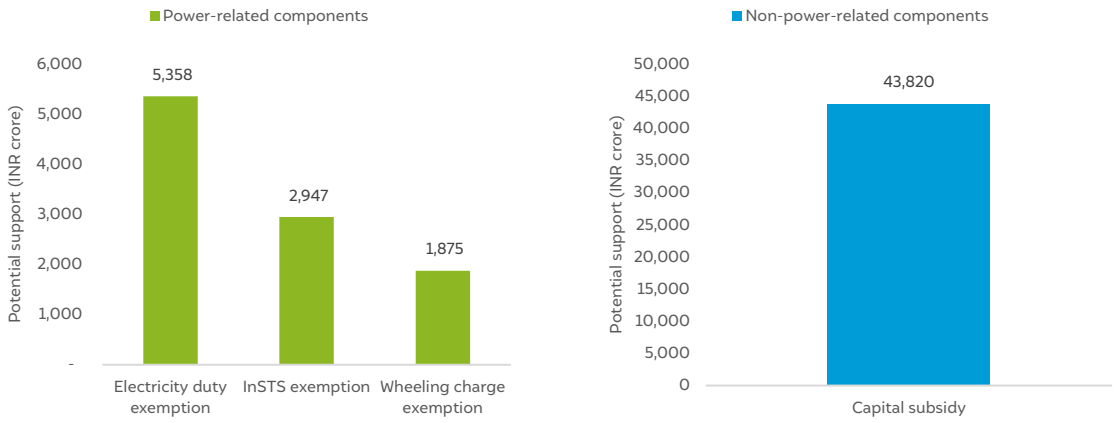
- **InSTS charges, wheeling charges, and electricity duty:** For the first 500 kTPA capacity in the state, a 50 per cent waiver on InSTS, wheeling charges, and ED is provided for the power produced from solar or wind plants (with or without storage) for 10 years (Government of Rajasthan 2023).
- **Cross-subsidy surcharge and additional surcharge:** CSS and AS shall not apply if green energy is utilised for producing green hydrogen and green ammonia (RERC 2023).

Non-power-related incentives: Under the Rajasthan Investment Promotion Scheme, 2022, developers can choose one of the following incentives:

- **SGST reimbursement:** 75 per cent reimbursement of net SGST for seven years from the commencement of commercial production subject to annual ceiling limits (Government of Rajasthan 2022).
- **Capital subsidy:** A capital subsidy of 13–28 per cent of fixed capital investment is available over a period of 10 years, depending on the size of the investment, employment generation, and area category subject to annual limits (Government of Rajasthan 2022).
- **Turnover linked incentive:** A subsidy of 1.2–2 per cent of net sale turnover is available over 10 years, depending on the size of the investment, employment generation, and area category subject to annual limits (Government of Rajasthan 2022).

Total potential support: Rajasthan provides a total potential support of INR 54,001 crore. The breakdown of this support is indicated in Figure 13

Figure 13 The total potential support in Rajasthan is estimated to be INR 54,001 crore



Source: Authors' analysis

Power-related support: The total potential support for power-related components is INR 10,180 crore. Rajasthan, rich in solar (142.31 GW) and wind (284.25 GW) potential, is a windy state providing significant power-related benefits such as an intra-state transmission charge waiver (INR 2,947 crore), electricity duty exemption (INR 5,358 crore), and wheeling charge exemption (INR 1,875 crore) for green hydrogen production.

Non-power-related support: The total potential support for non-power-related components is INR 43,820 crore. Capital subsidy for green hydrogen projects is the only contributor to non-power-related incentives in Rajasthan as it has the maximum value of all available policy options.

- For the capital subsidy component, the Rajasthan Investment Promotion Scheme mentions annual ceiling limits per project of INR 50 crore, INR 65 crore, and INR 80 crore over three years, four years, and three years, respectively (Government of Rajasthan 2022). These limits, along with an estimate of the number of enterprises, have been factored into our calculations.

3.6. Gujarat

Recognising the state's potential for green hydrogen production and its advantageous position for exporting green hydrogen or its derivatives, the government has included green hydrogen as one of the thrust sectors under the *Aatmanirbhar Gujarat Scheme for Assistance to Large Industries and Thrust Sectors* (Industries and Mines Department, Government of Gujarat 2022). We estimate Gujarat's green hydrogen production potential to be 2.18 MTPA by 2030.

Incentives: Gujarat provides the following power and non-power-related incentives.

Power-related incentives:

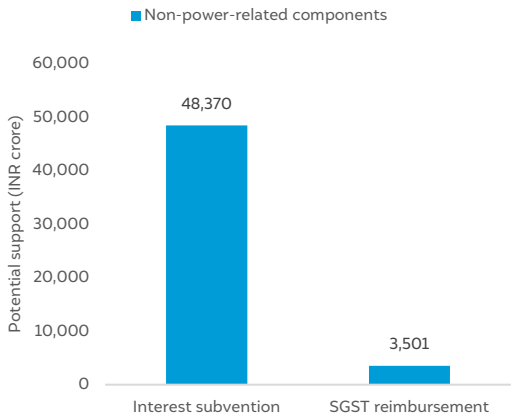
- **Cross-subsidy surcharge and additional surcharge:** CSS and AS are not applicable to captive RE projects (GERC 2024).

Non-power-related incentives:

- **Interest subvention:** Gujarat stands out among all the states that provide interest subvention as a form of support with the maximum rate of 7 per cent for 10 years, up to 1.2 per cent of fixed capital investment per annum (Industries and Mines Department, Government of Gujarat 2022).
- **SGST reimbursement:** The net SGST reimbursement is estimated to be 80–100 per cent for 10 years, depending on the taluka category where the investment is made (Industries and Mines Department, Government of Gujarat 2022).

Total potential support: Gujarat provides a total potential support of INR 51,871 crore for green hydrogen projects. A detailed breakdown of this support is indicated in Figure 14.

Figure 14 The total potential support in Gujarat is estimated to be INR 51,871 crore



Source: Authors' analysis

Power-related support: Gujarat, a windy state with substantial wind (180.79 GW) and solar (35.77 GW) potential, permits green hydrogen projects to be set up using 100 per cent RE from various sources, including

captive, third-party, discoms, and power exchanges. However, the state does not provide specific power-related benefits or exemptions for RE projects established within Gujarat.

Non-power-related support: The total potential support for non-power-related components is INR 51,871 crore. Interest subvention for green hydrogen projects is a significant contributor to the non-power-related incentives in Gujarat.

- **Interest subvention:** The total support amounts to INR 48,370 crore, based on a 7 per cent reduction in the discount rate from a previous study (CFLI India and CEEW 2024) and capital expenditure factors for producing 2.18 MTPA of green hydrogen.
- **SGST reimbursement:** The estimated potential support is INR 3,501 crore, computed similarly to the method described in Section 3.1.

3.7. Andhra Pradesh

Andhra Pradesh aims to produce 0.5 MTPA of green hydrogen or 2 MTPA of green ammonia by 2028 (Energy Department, Government of Andhra Pradesh 2023).

Incentives: Andhra Pradesh provides the following power and non-power-related incentives.

Power-related incentives:

- **InSTS waiver:** 25 per cent of InSTS shall be reimbursed to the developer for a period of five years from the commencement of operation date (CoD) for the power procured from RE (with or without storage) plants within the state, subject to a maximum of INR 10 lakh per megawatt (MW) per year of installed electrolyser capacity (Energy Department, Government of Andhra Pradesh 2023)
- **Electricity duty:** 100 per cent exemption from ED for the power consumed in the production of green hydrogen or green ammonia from RE plants (with or without storage) for a period of five years from CoD (Energy Department, Government of Andhra Pradesh 2023).
- **Wheeling charges:** Distribution charges shall be exempted up to 50 per cent for the wheeling of power generated from new WSH power projects within the state for a period of 10 years from the date of commissioning (Energy, Infrastructure & Investment Department 2019).
- **Cross-subsidy surcharge and additional surcharge:** CSS and AS do not apply if green energy is utilised for producing green hydrogen and green ammonia (Andhra Pradesh Electricity Regulatory Commission 2024).

Non-power-related incentives:

- **SGST reimbursement:** A 100 per cent reimbursement of net SGST revenue from the sale of green hydrogen for five years from the commercial operation date (Energy Department, Government of Andhra Pradesh 2023).
- **Land support:** Government land to be allotted to developers at a lease rate of INR 31,000 per acre per year, with a 5 per cent escalation every two years (Energy Department, Government of Andhra Pradesh 2023).

Total potential support: Andhra Pradesh provides a total potential support of INR 24,926 crore for green hydrogen projects. A breakdown of this support is indicated in Figure 15.

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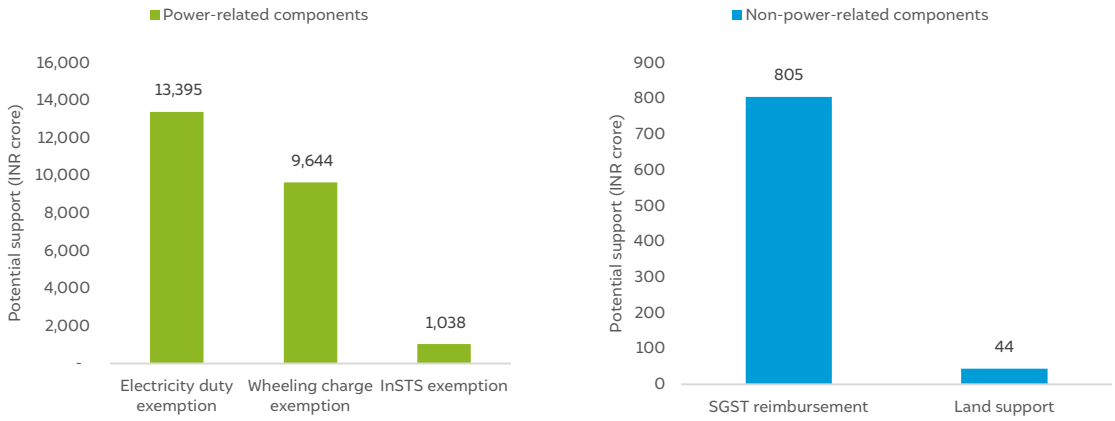
Figure 15 The total potential support in Andhra Pradesh is estimated to be INR 24,926 crore



Source: Authors' analysis

Power-related support: In Andhra Pradesh, the total potential support for power-related components amounts to INR 24,078 crore. With substantial solar (38.44 GW) and wind (123.34 GW) potential, the state offers significant power-related incentives for green hydrogen production. The new Green Energy Open Access Regulations provide a full waiver on CSS and AS, while the WSH policy also provides additional incentives on wheeling charges. Combined with the green hydrogen and green ammonia policy, the key benefits include ED exemption (INR 13,395 crore), wheeling charge exemption (INR 9,644 crore), and a waiver on InSTS charges (INR 1,038 crore).

Non-power-related support: The total potential support for non-power-related components is INR 848 crore. SGST reimbursement for green hydrogen projects is a major contributor to the non-power-related incentives in Andhra Pradesh.

- **SGST reimbursement:** The total potential support for this component is estimated as INR 805 crore. The computation is similar to Section 3.1.
- **Land support:** The total potential support for this component is INR 44 crore with a calculation similar to Section 3.4.

3.8. Haryana

According to the draft *Haryana Green Hydrogen Policy, 2024*, Haryana aims for a green hydrogen target of 0.25 MTPA (New and Renewable Energy Department, Government of Haryana 2024).

Incentives: Haryana provides the following power and non-power-related incentives.

Power-related incentives:

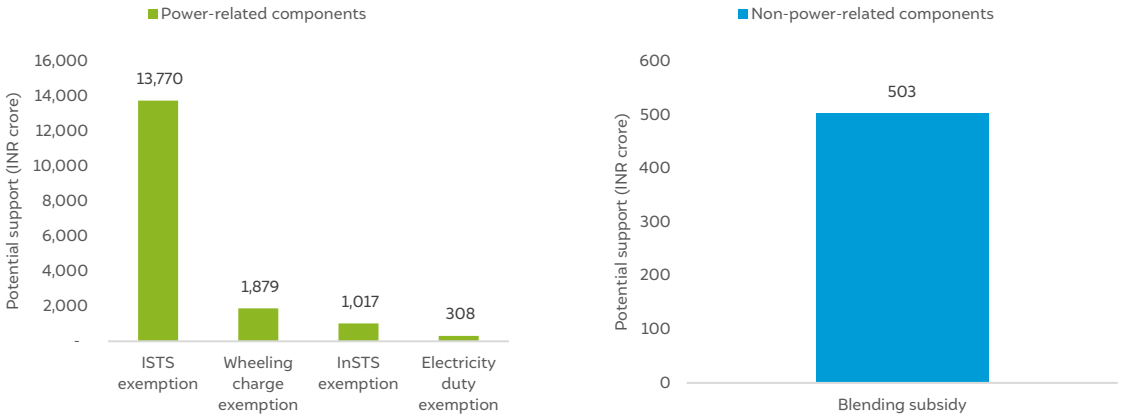
- **InSTS charges and wheeling charges:** A 100 per cent exemption shall be granted for 10 years from the commissioning date of green hydrogen and its derivative projects for electricity sourced from RE plants, with or without storage (New and Renewable Energy Department, Government of Haryana 2024).
- **Electricity duty:** A 100 per cent exemption from ED shall be provided for a period of 10 years from the commissioning date of green hydrogen and its derivatives projects for consumption of electricity procured from RE plants, with or without storage (New and Renewable Energy Department, Government of Haryana 2024).
- **Cross-subsidy surcharge and additional surcharge:** : CSS and AS do not apply to captive RE projects (HERC 2023).

Non-power-related incentives:

- **Blending subsidy:** Subsidy of INR 50 per kg of green hydrogen blended with CNG or PNG (New and Renewable Energy Department, Haryana 2024).

Total potential support: Haryana provides a total potential support of INR 17,476 crore for green hydrogen projects. A breakdown of this support is indicated in Figure 16.

Figure 16 The total potential support in Haryana is estimated to be INR 17,476 crore



Source: Authors' analysis

Power-related support: Haryana, categorised as a non-windy state with limited solar (4.56 GW) and negligible wind potential, provides power-related incentives totalling INR 16,974 crore. This includes a waiver on InSTS charges (INR 1,017 crore), ED exemption (INR 308 crore), and wheeling charge exemption (INR 1,879 crore) for green hydrogen projects. The largest waiver, ISTS exemption (INR 13,770 crore) is on account of central government order on waiver of ISTS charge.

Non-power-related support: The total potential support for non-power related components is INR 503 crore. Capital subsidy for green hydrogen projects is a major contributor to the non-power related incentives in Haryana.

- **Blending subsidy:** We estimate the total blending support to be INR 503 crore, based on the annual natural gas consumption of 4 bcm in the state and a 5 per cent hydrogen blending by volume.

3.9. Kerala

Kerala's industrial policy mentions green hydrogen as a priority sector (Department of Industries & Commerce, Government of Kerala 2023). We estimate the state's green hydrogen production potential to be 0.22 MTPA.

Incentives: Kerala provides the following power and non-power-related incentives.

Power-related incentives:

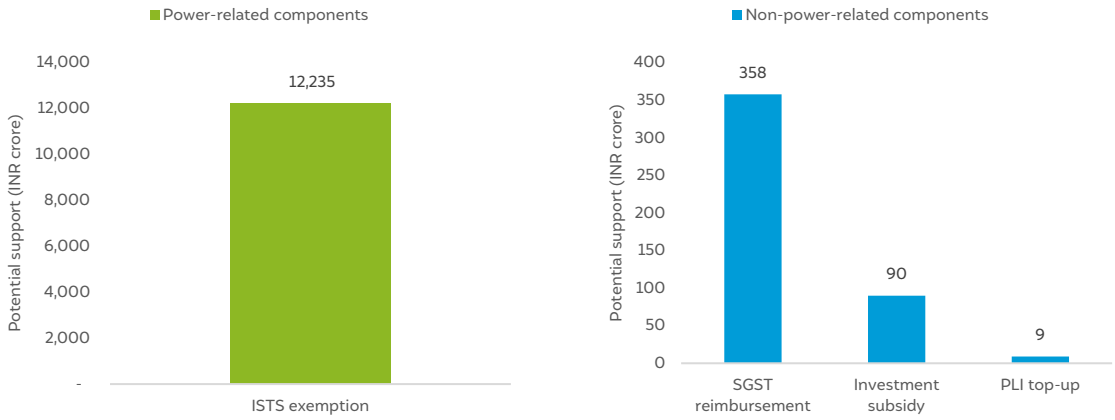
- **Cross-subsidy surcharge:** CSS is not applicable to captive RE projects (KSERC 2013).

Non-power-related incentives:

- **SGST reimbursement:** A 100 per cent reimbursement of SGST on capital investment will be provided to green hydrogen projects for five years (Department of Industries & Commerce, Government of Kerala n.d.).
- **Investment subsidy:** 10 per cent on fixed capital investment, up to a maximum of INR 10 crore.
- **PLI top up:** A one-time top-up of 20 per cent of fixed capital investment, with a maximum limit of INR 1 crore.

- **Total potential support:** Kerala provides a total potential support of INR 12,692 crore for green hydrogen projects. The breakdown of this support is indicated in Figure 17.

Figure 17 The total potential support in Kerala is estimated to be INR 12,692 crore



Source: Authors' analysis

Power-related support: Kerala is categorised as a non-windy state with solar (6.11 GW) and moderate wind (2.62 GW) potential. The state does not provide specific power-related benefits or exemptions. However, the largest waiver, ISTS exemption (INR 12,235 crore) is on account of central government order on waiver of ISTS.

Non-power-related support: The total potential support for non-power-related components is INR 457 crore. SGST reimbursement for green hydrogen projects is a significant contributor to these non-power-related incentives in Kerala.

- **SGST reimbursement:** The total support from this component is INR 358 crore, calculated in the same manner as described in Section 3.1.
- **Investment subsidy and production-linked incentive top up:** They are calculated by considering the maximum value of INR 10 crore per project and INR 1 crore per project, respectively, with an estimate of nine projects in Kerala.

3.10. Punjab

The draft Punjab Green Hydrogen Policy aims to produce 0.1 MTPA of green hydrogen or green ammonia by 2030 (PEDA 2023).

Incentives: Punjab provides the following power and non-power-related incentives.

Power-related incentives:

- **InSTS charges and wheeling charges:** A 50 per cent exemption on InSTS charges and wheeling charges for green energy is utilised for production of green hydrogen and green ammonia (PEDA 2023). The duration of the waiver is not specified in the draft policy, so it is assumed to apply to the project's lifespan, that is, 25 years.
- **Cross-subsidy surcharge and additional surcharge:** CSS and AS do not apply on green energy used for production of green hydrogen and green ammonia (Government of Punjab 2023).

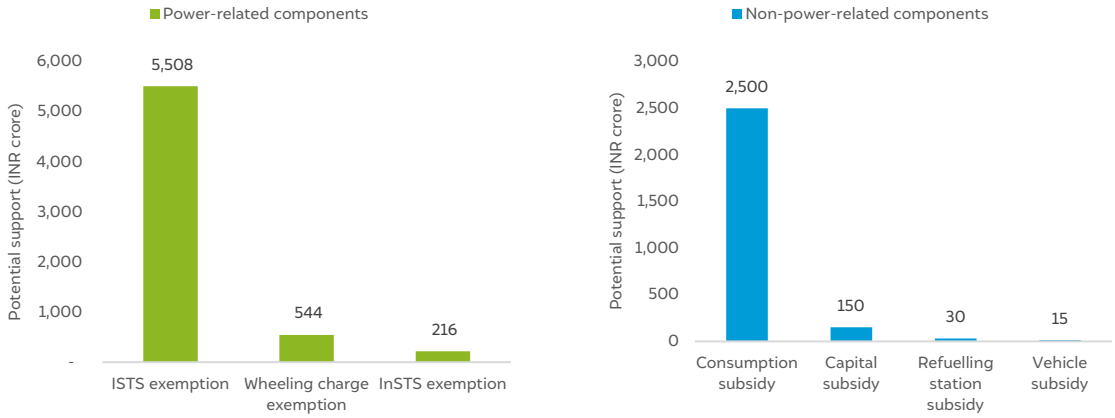
Non-power-related incentives:

- **Consumption subsidy:** INR 50 per kilogram of hydrogen consumption in the state is provided for a period of five years (PEDA 2023).

- **Capital subsidy:** Punjab provides INR 15 crore per project for up to 10 projects based on biomass to green hydrogen technology (PEDA 2023).
- **Vehicle and refuelling station subsidy:** Support of INR 0.15 crore per vehicle and INR 3 crore per refuelling station with an upper limit on the number of vehicles and refuelling stations, respectively (PEDA 2023).

Total potential support: Punjab provides a total potential support of INR 8,962 crore for green hydrogen projects. The breakdown of this support is indicated in Figure 18.

Figure 18 The total potential support in Punjab is estimated to be INR 8,962 crore



Source: Authors' analysis

Power-related support:

- Punjab, a non-windy state with limited solar (2.81 GW) and negligible wind potential, offers power-related benefits totalling INR 6,267 crore. This includes a waiver of InSTS charges (INR 216 crore) and an exemption from wheeling charges (INR 544 crore). However, the policy does not provide a waiver on ED. The largest waiver, ISTS exemption (INR 5,508 crore) is on account of central government order on waiver of ISTS.

Non-power-related support: The total potential support for non-power-related components is INR 2,695 crore. The consumption subsidy for green hydrogen projects is a major contributor to these non-power related incentives in Punjab.

- For all subsidy calculations, the subsidy value per project and the maximum number of projects are considered. A target of 0.1 MTPA is used for estimation for the consumption subsidy.

3.11. Madhya Pradesh

Green hydrogen is integrated into the Madhya Pradesh Renewable Energy Policy 2022 (New and Renewable Energy Department, Government of Madhya Pradesh 2022), and its associated incentives are detailed in the Industrial Promotion Policy 2018 (Department of Industrial Policy and Investment Promotion, Government of Madhya Pradesh 2018).

Incentives: Madhya Pradesh provides the following power and non-power-related incentives.

Power-related incentives:

- **Electricity duty:** Projects are eligible for a 100 per cent exemption from ED on electrical energy generation for 10 years from CoD (New and Renewable Energy Department, Government of Madhya Pradesh 2022).

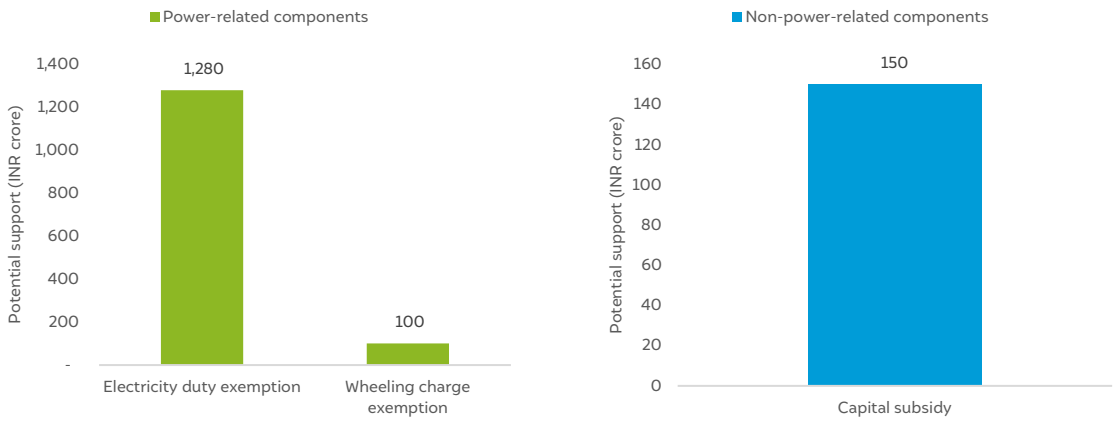
- **Wheeling charges:** A 50 per cent waiver on wheeling charges is available for five years from CoD (New and Renewable Energy Department, Government of Madhya Pradesh 2022).
- **Cross-subsidy surcharge and Additional surcharge** CSS and AS are not applicable to captive RE projects according to the MPERC 2023.

Non-power-related incentives:

- **Capital subsidy:** Support up to a maximum of INR 150 crore is considered as per the policy (Department of Industrial Policy and Investment Promotion, Government of Madhya Pradesh 2018).

Total potential support: Madhya Pradesh provides a total potential support of INR 1,530 crore for green hydrogen projects. The breakdown of this support is indicated in Figure 19.

Figure 19 The total potential support in Madhya Pradesh is estimated to be INR 1,530 crore



Source: Authors' analysis

Power-related support: Madhya Pradesh, another windy state with significant solar (61.66 GW) and wind (55.42 GW) potential, provides incentives to support green hydrogen production totalling INR 1,380 crore. This includes an ED exemption (INR 1,280 crore) and wheeling charge exemption (INR 100 crore). However, there is no waiver for InSTS charges.

Non-power-related support: INR 150 crore

- The total potential support for non-power related components is INR 150 crore. Capital subsidy is the only non-power related incentives.

3.12. West Bengal

West Bengal released its green hydrogen policy in December 2023 to promote the production of green hydrogen and ammonia as energy carriers and chemical feedstocks (Power Department, Government of West Bengal 2023). We estimate West Bengal's green hydrogen production potential to be 0.05 MTPA.

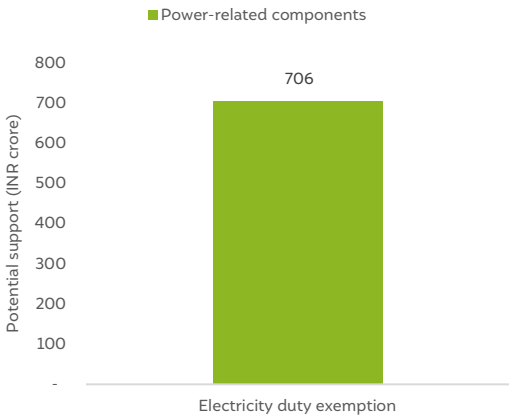
Incentives: West Bengal only provides power-related incentives.

Power-related incentives:

- **Electricity duty:** Developers are entitled to a 100 per cent waiver of ED for the five-year duration of the policy (Power Department, Government of West Bengal 2023).

Total potential support: West Bengal provides a total potential support of INR 706 crore for green hydrogen projects. The breakdown of this support is indicated in Figure 20.

Figure 20 The total potential support in West Bengal is estimated to be INR 706 crore



Source: Authors' analysis

Power-related support: West Bengal, a non-windy state with moderate solar (6.26 GW) and negligible wind potential, provides a single power-related incentive: an ED exemption estimated to be INR 706 crore for green hydrogen production. Compared to open access mode, the current electricity tariff for industries makes discom procurement the preferred route.

4. Limitations of the report

The report estimates total budgetary support of INR 5.05 lakh crore (USD 61 billion) based on the provisions across 12 state and central policies. However, this estimate depends heavily on the assumptions used in the analysis. These broad-level assumptions introduce uncertainties that are expected to significantly affect the budgetary outlay. Therefore, in this section, we outline the following limitations in estimating the financial support for green hydrogen through these policies:

- **Realisable support out of potentially available support**: Our analysis quantifies the total potential support based on policy provisions and our baseline green hydrogen production potential. We have not estimated the proportion that can actually be realised, as it will depend on various factors. Such quantification can only be realised if green hydrogen becomes cheaper than grey hydrogen or HPOs are enforced on end consumers and there are guaranteed offtake contracts for export markets.
- **Changes in capital costs and efficiencies**: We do not account for variations in capital costs or improvements in the efficiencies of electrolysers, solar, and wind modules over time. As a result, the actual budgetary outlay may differ from the estimates provided in the study.
- **Interpretation of state and central policies and regulations:** The final interpretation of policies, rules, and applicable benefits is subject to review and decisions by state and central governments.
- **National-level optimisation of RE assets**: We do not precisely optimise hydrogen costs based on the open-access charges across different states. The relative distribution of wind and solar power for green hydrogen production depends on location-specific profiles, which are challenging to model.
- **Variability in RE deployment:** For intra-state scenarios, solar and wind capacities are used to meet the green hydrogen load. In non-windy states, wind capacity is assumed to be sourced from neighbouring windy states. However, in reality, solar and wind capacity deployment at both inter- and intra-state levels will be influenced by factors such as favourable state policies, cost economics, right of way, and ease of implementation. Therefore, the actual RE deployment may vary, and incentives are likely to differ across states.[9]
- **Assumption of constant charges and their impact on estimated benefits:** Incentives and charges have been assumed to be constant for the applicable period based on state policies or equipment life. In reality, these charges may change due to factors such as inflation and decisions by state and central agencies. As a result, the overall estimated benefits are subject to variation.

[9] We calculated the quantum of waivers for four non-windy states (PB, HR, KL, and UP) under an alternative scenario where both solar and wind are procured from neighbouring states via ISTS. In this scenario, the decrease in waivers ranges from 21% to 41% across these states.

- **Variation in ISTS charges:** The ISTS charge-related waiver is computed using a national average ISTS charge. However, the impact of the ISTS charge waiver will vary for individual states, depending on the quanta of ISTS capacity contracted by each state.

5. Conclusion

The INR 19,744 crore (approximately USD 2.5 billion) outlay in the NGHM is augmented by the total potential financial support in state-level green hydrogen policies, estimated to be around INR 5.05 lakh crore (around USD 61 billion). Of this, 62 per cent is through power-related components, and the rest through non-power-related ones.

The financial support, set to be primarily deployed by 2030, strengthens India's ambitious goal of becoming a global leader in green hydrogen production and exports. Like the NGHM and the GHP, state-level policies offer a range of incentives and exemptions across power- and non-power-related components, effectively covering a host of aspects vital to the sector.

The potential support is not limited to just a few states; instead, 7 of the 12 states offering support account for 92 per cent of the total support. Approximately 66 per cent of this support is estimated to be through budgetary components, highlighting the states' serious commitment to the green hydrogen sector. Realising the potential support could be crucial not only for achieving and surpassing India's green hydrogen goals but also for advancing its decarbonisation, self-reliance, and green industrialisation efforts.

Annexure

Here, we present the various input parameters used in quantifying the potential state wise support to green hydrogen in Section 3.

The details of considered plant load factors (PLF) and capacity utilisation factors (CUF) for an optimised LCOH are provided in Table A1.

Table A1 PLF considerations

Particulars	Value
Electrolyser PLF for wind-solar hybrid (WSH)	74.4%
CUF - solar	25.9%
CUF - wind	34.1%

Source: (CFLI India and CEEW 2024)

To estimate the power-related-support in Section 3, we have used the industry-reviewed power consumption parameters shown in Table A2.

Table A2 Power consumption parameters

Particulars	Value	Unit
Specific power consumption in electrolyser	50.5	kWh/kg
Surplus power	6.1%	
Total power from RE plants	53.6	kWh/kg
Renewable electricity required	53.6	BU/MTPA
Share of solar power	23.0%	
Share of wind power	77.0%	
Solar power output	12.3	BU/MTPA
Wind power output	41.3	BU/MTPA

Source: (CFLI India and CEEW 2024)

In all our calculations, we have considered an underlying plant size based on the parameters listed in Table A3. These were derived from an optimisation model aimed at reducing LCOH.

Table A3 Plant sizing parameters

Particulars	Value	Unit
Electrolyser capacity	7.7	GW/MTPA
Solar power plant size	5.4	GW/MTPA

Wind power plant size	13.8	GW/MTPA

Source: (CFLI India and CEEW 2024)

To estimate the capital subsidy as in Section 3.1, the interest subvention support as in Section 3.6 and the SGST reimbursement as in Section 3.7, certain capital expenditure factors have been considered for the green hydrogen plant such as the cost of an alkaline electrolyser, solar energy and wind energy. These factors along with the currency conversion rate of USD to INR of 1:83 are used for computation. The factors are presented in Table A4.

Table A4 Plant capital expenditure parameters

Particulars	Value	Unit
Alkaline electrolyser capex	750	USD/kW
Alkaline electrolyser stack capex	338	USD/kW
Alkaline electrolyser balance of plant capex	413	USD/kW
Solar capex	625	USD/kW
Wind capex	950	USD/kW

Source: (CFLI India and CEEW 2024)

To calculate interest subvention component of non-power-related support, a reduction in discount rate is considered based on the policy document as discussed in Section 3.6. The discount rate and equipment lifetimes to calculate capital recovery factors are mentioned in Table A5.

Table A5 Discount rate and equipment lifetimes

Particulars	Value	Unit
Discount rate	10%	
Alkaline electrolyser stack life	8.5	Years
Alkaline electrolyser balance of plant life	30	Years
Solar life	25	Years
Wind life	25	Years

Source: (CFLI India and CEEW 2024)

To calculate the SGST reimbursement as in Section 3.7, we have considered the SGST rates on various components of a green hydrogen plant and the cost of green hydrogen production parameters as shown in Table A6

Table A6 SGST rates and cost of green hydrogen production

Particulars	Value	Unit	Source
SGST rate for alkaline electrolyser stack	9.0%		(Clear Tax n.d.)
SGST rate for alkaline electrolyser balance of plant	9.0%		(Clear Tax n.d.)
SGST rate for solar panels	6.9%		(Clear Tax n.d.)
SGST rate for wind turbines	6.9%		(Clear Tax n.d.)
SGST rate for hydrogen	9.0%		(Clear Tax n.d.)
Cost of GH2 production	3.75	USD/kg	(CFLI India and CEEW 2024)
Profit margin	0.375	USD/kg	Assumption

To estimate land support component of non-power-related support as in Section 3.4, we have used parameters in Table A7. In all land related calculations, we neglect the land requirement for wind turbines as their spatial footprint is much lower than the aerial footprint shown below.

Table A7 Land related parameters

Particulars	Value	Unit
Land lease expense for solar or wind projects	37500	INR/acre
Annual escalation	5%	
Land requirement for solar	3.5	acre/MW
Land requirement for wind*	1.8	acre/MW

Source: (Dutt , et al. 2021)
Note: * - Denotes aerial footprint

To estimate the blending subsidy component as in Section 3.2, values depicted in Table A8 are considered

Table A8 Blending parameters

Particulars	Value	Unit	Source
Percentage blending of hydrogen by volume in CNG and PNG	5.0%		(NTPC n.d.)
Density of hydrogen	0.08375	kg/m3	(Hydrogen Tools n.d.)

To estimate the Intra-State Transmission charges (InSTS) waiver as in Section 3, we have used the parameters in Table A9. The values considered are as per the latest transmission tariff order of each state applicable to FY 25.

Table A9 Intra-State Transmission charges (InSTS) Charges

State	Value	Unit	Source
Andhra Pradesh	0.31	INR/kWh	(Energy Department, Government of Andhra Pradesh 2023), Pg. 5/10
Haryana	0.33	INR/kWh	(Haryana Electricity Regulatory Commission 2024), Pg. 62/65
Maharashtra	0.43	INR/kWh	(Maharashtra State Electricity Distribution Co. Ltd. 2023), Pg. 2/2
Punjab	0.14	INR/kWh	(Punjab State Electricity Regulatory Commission 2024), Pg. 3/4
Rajasthan	0.22	INR/kWh	(Rajasthan Electricity Regulatory Commission 2024), Pg. 76/78
Uttar Pradesh	0.29	INR/kWh	(Uttar Pradesh Electricity Regulatory Commission 2023), Pg. 642/765

To estimate the Electricity Duty exemption as in Section 3, we have used the parameters in Table A10**.** The values considered are as per the extant order of each state on Electricity Duty for industrial category.

Table A10 Electricity Duty

State	Value	Unit	Source
Andhra Pradesh	1.00	INR/kWh	(Energy (Power-III) Department, Government of Andhra Pradesh 2022), Pg. 2/3

Haryana	0.10	INR/kWh	(Haryana State Electricity Board 1995), Pg. 1/2
Madhya Pradesh	0.51	INR/kWh	(Government of Madhya Pradesh 2012), Pg. 3/3
Maharashtra	1.20	INR/kWh	(Maharashtra State Electricity Distribution Co. Ltd. 2016), Pg. 5/6
Odisha	0.50	INR/kWh	(Energy Department, Government of Odisha 2022), Pg. 7/39
Rajasthan	0.40	INR/kWh	(Government of Rajasthan 2021)
Uttar Pradesh	0.25	INR/kWh	(Oorja Anubhag - 3, Government of Uttar Pradesh 2012), Pg. 1/1
West Bengal	0.51	INR/kWh	(Finance Department, Government of West Bengal 2004), Pg. 29/194

To estimate the Wheeling charges waiver as in Section 3, we have used the parameters in Table A11. The values considered are as per the latest tariff order of each state applicable to FY 25.

Table A11 Wheeling Charges

State	Value	Unit	Source
Andhra Pradesh	0.72	INR/kWh	(Andhra Pradesh Electricity Regulatory Commission 2024), Pg. 213/338
Haryana	0.61	INR/kWh	(Haryana Electricity Regulatory Commission 2024), Pg. 189/290
Madhya Pradesh	0.16	INR/kWh	(Madhya Pradesh Electricity Regulatory Commission 2024), Pg. 122/232
Maharashtra	0.60	INR/kWh	(Maharashtra State Electricity Distribution Co. Ltd. 2023), Pg. 2/2
Punjab	0.35	INR/kWh	(Punjab State Electricity Regulatory Commission 2024), Pg. 18/20
Rajasthan	0.14	INR/kWh	(Rajasthan Electricity Regulatory Commission 2024), Pg. 222/329
Uttar Pradesh	0.88	INR/kWh	(Uttar Pradesh Electricity Regulatory Commission 2023), Pg. 637/765

To estimate the Cross Subsidy Surcharge (CSS) waiver as in Section 3, we have used the parameters in Table A12. The values considered are as per the latest tariff order of each state applicable to FY 25.

Table A12 Cross Subsidy Surcharge (CSS)

State	Value	Unit	Source
Andhra Pradesh	0.68	INR/kWh	(Andhra Pradesh Electricity Regulatory Commission 2024), Pg. 216/338
Gujarat	1.52	INR/kWh	(Gujarat Electricity Regulatory Commission 2024), Pg. 256/292
Haryana	1.22	INR/kWh	(Haryana Electricity Regulatory Commission 2024), Pg. 196/290
Kerala	1.35	INR/kWh	(Kerala State Electricity Regulatory Commission 2023), Pg. 112/189
Madhya Pradesh	1.38	INR/kWh	(Madhya Pradesh Electricity Regulatory Commission 2024), Pg. 126/232
Maharashtra	1.79	INR/kWh	(Maharashtra State Electricity Distribution Co. Ltd. 2023), Pg. 2/2
Punjab	0.49	INR/kWh	(Punjab State Electricity Regulatory Commission 2024), Pg. 19/20
Rajasthan	1.59	INR/kWh	(Rajasthan Electricity Regulatory Commission 2024), Pg. 229/329
Tamil Nadu	1.92	INR/kWh	(Tamil Nadu Electricity Regulatory Commission 2024), Pg. 21/55
Uttar Pradesh	0.33	INR/kWh	(Uttar Pradesh Electricity Regulatory Commission 2023), Pg. 645/765

To estimate the Additional Surcharge (AS) waiver as in Section 3, we have used the parameters in Table A13. The values considered are as per the latest tariff order of each state applicable to FY 25.

Table A13 Additional Surcharge (AS)

State	Value	Unit	Source
Andhra Pradesh	0	INR/kWh	(Andhra Pradesh Electricity Regulatory Commission 2024), Pg. 219/338
Gujarat	0.94	INR/kWh	(Gujarat Electricity Regulatory Commission 2023), Pg. 4/4 and (Gujarat Electricity Regulatory Commission 2024), Pg. 4/4
Haryana	0.53	INR/kWh	(Haryana Electricity Regulatory Commission 2023), Pg. 9/9
Madhya Pradesh	1.30	INR/kWh	(Madhya Pradesh Electricity Regulatory Commission 2024), Pg. 128/232
Maharashtra	1.39	INR/kWh	(Maharashtra State Electricity Distribution Co. Ltd. 2023), Pg. 2/2
Punjab	1.10	INR/kWh	(Punjab State Electricity Regulatory Commission 2024), Pg. 12/13
Rajasthan	0.53	INR/kWh	(Rajasthan Electricity Regulatory Commission 2024), Pg. 237/329
Tamil Nadu	0.29	INR/kWh	(Tamil Nadu Electricity Regulatory Commission 2024), Pg. 24/26
Uttar Pradesh	0	INR/kWh	No Additional Surcharge value was determined in UPERC Tariff Order FY 25 (Uttar Pradesh Electricity Regulatory Commission 2023)

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Acronyms

APERC	Andhra Pradesh Electricity Regulatory Commission
AS	additional surcharge
bcm	billion cubic meters
BUs	billion units
CNG	compressed natural gas
CoD	commercial operation date
CSS	cross-subsidy surcharge
CUF	capacity utilisation factor
discom	distribution company
ED	electricity duty
EoDB	ease of doing business
GEOA	green energy open access
GERC	Gujarat Electricity Regulatory Commission
GHP	*Green Hydrogen Policy*
GRIDCO	Grid Corporation of Odisha
GW	gigawatts
HERC	Haryana Electricity Regulatory Commission
HPO	hydrogen purchase obligation
INR	Indian national rupee
InSTS	intra-state transmission system
ISTS	inter-state transmission system
KSERC	Kerala State Electricity Regulatory Commission
kWh	kilowatt hour
LCOH	levelised cost of hydrogen
MNRE	Ministry of New and Renewable Energy

MoU	memorandum of understanding
MPERC	Madhya Pradesh Electricity Regulatory Commission
MTPA	million tonnes per annum
MW	megawatts
NGHM	*National Green Hydrogen Mission*
NISE	National Institute of Solar Energy
NIWE	National Institute for Wind Energy
NREL	National Renewable Energy Laboratory
NTP	*National Tariff Policy*
PLF	plant-load factor
PLI	production-linked incentive
PNG	piped natural gas
PEDA	Punjab Energy Development Agency
RE	renewable energy
RERC	Rajasthan Electricity Regulatory Commission
R&D	research and development
SERC	State Electricity Regulatory Commission
SGST	State Goods and Services Tax
SIGHT	*Strategic Interventions for Green Hydrogen Transition*
STU	state transmission utility
TNERC	Tamil Nadu Electricity Regulatory Commission
UPERC	Uttar Pradesh Electricity Regulatory Commission
USD	United States dollar
WSH	wind–solar hybrid

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