

Interoperability Maturity Index (IMI)

A Methodology for Assessing DISCOM Readiness for India's Electricity Stack

Policy Brief v0.4

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Executive Summary

This policy brief presents the Interoperability Maturity Index (IMI), a scientific framework for assessing the digital infrastructure readiness of India's 52 Distribution Companies (DISCOMs) to participate in the Indian Electricity Stack (IES). The IMI evaluates **seven technology layers**—IT, OT, Smart Metering, Enterprise, Cybersecurity, GIS, and Skilled Workforce—using standardized maturity and integration scales aligned with international frameworks including SGAM (IEC 62559), ISA-95, and India's Smart Grid Readiness Self-Assessment Tool (SGR-SAT).

The framework addresses critical pain points encountered in RDSS implementation, with particular emphasis on smart metering as a distinct domain, GIS-based asset management, qualified workforce availability, and cybersecurity governance including qualified CISO appointments.

1 Policy Context

India's power sector is undergoing a digital transformation driven by the Revamped Distribution Sector Scheme (RDSS) and the development of the Indian Electricity Stack (IES) (MoP, 2022). The IES, architecturally modeled on India Stack's success in financial services, comprises three layers:

1. **Layer 1: Data & Connectivity** — Smart meters, AMI infrastructure, communication networks
2. **Layer 2: Management & Control** — IT/OT systems including SCADA, DMS, HES, MDM, ERP
3. **Layer 3: Solutions & Innovation** — Market solutions, consumer applications, analytics platforms (CEA, 2025)

For DISCOMs to participate in Layer 3 applications—including energy trading, demand response, and consumer choice—they must achieve sufficient maturity in Layer 2 systems. The IMI provides a standardized methodology to assess this readiness.

2 Theoretical Foundation

The IMI methodology draws from established international frameworks:

- **Smart Grid Architecture Model (SGAM)** — IEC 62559/62913 (IEC, 2015)
- **Purdue Model / ISA-95** — Industrial control system layer taxonomy (ISA, 2010)
- **India SGR-SAT** — Smart Grid Readiness Self-Assessment Tool (MoP, 2019)
- **CEA AMI Guidelines** — Functional requirements for AMI systems (CEA, 2025)

2.1 Core Principles

1. **Maturity + Integration:** Both deployment coverage and system connectivity are assessed
2. **Operational Validation:** Self-reported assessments validated against operational metrics (AT&C losses, national ratings)
3. **Transparency:** All calculations fully documented and reproducible

3 Scoring Methodology

3.1 Seven-Layer Classification

The IMI assesses seven technology layers, each containing specific systems.

Layer	Code	Systems	Weight
IT	S1	Billing, Consumer App, Energy Audit, AT&C, WFM	15%
OT	S2	SCADA, DMS, OMS, RTDAS/SFMS, SAIDI/SAIFI	15%
Smart Metering	S3	HES, MDM, C&I, Postpaid, DT/Feeder, Prepaid	15%
Enterprise	S4	ERP, CRM, Analytics	15%
Cybersecurity	S5	Tools, Certifications, SIEM/SOC, Qualified CISO	15%
GIS	S6	Consumer Indexing, Asset Indexing	10%
Skilled Workforce	S7	Personnel for S1–S6	15%
Total			100%

Table 1: IMI Layer Classification and Weights

3.2 System Score Calculation

Each layer receives two assessments:

1. **Maturity Score (M):** Deployment coverage across service area
2. **Integration Score (I):** Connectivity with other systems using open protocols

The System Score is simply the **average** of Maturity and Integration:

$$\text{System Score} = \frac{\text{Maturity} + \text{Integration}}{2} \quad (1)$$

Example: If a layer has Maturity = 80 and Integration = 60, then System Score = $(80 + 60) \div 2 = 70$.

3.3 Maturity Scale

3.4 Integration Scale

Integration Scoring Rule

Integration must use **Open Protocols and Interfaces**. Proprietary protocols score **zero**.

Score	Status	Definition
0	Not Started	No deployment activity
20	Planned	In planning/tender stage
40	Pilot	<10% coverage (limited deployment)
60	Partial	10–50% coverage (moderate deployment)
80	Operational	50–90% coverage (substantial deployment)
100	Mature	>90% coverage + optimized over time

Table 2: Maturity Scale with Coverage Definitions

Score	Level	Definition
0	Isolated / Proprietary	No integration OR uses proprietary protocols only
20	Planned	Integration planned but not implemented
40	Partial	Integrated with 1–2 systems using open protocols
60	Hub-Connected	Connected via central hub using open protocols
80	Integrated	Direct integration with key systems via open protocols
100	Fully Integrated	Bidirectional integration with all relevant systems via open protocols/interfaces

Table 3: Integration Scale

4 Layer Assessment Worksheets

Each layer’s **Maturity Score** is calculated by multiplying each sub-metric score by its weight, then adding them together. All weights within a layer sum to 1.0.

Scoring Convention

All ratio-based sub-metrics are expressed as **percentages** (0–100 scale). Multiply the ratio by 100.

Example: If 8,000 out of 10,000 consumers use IT-based billing:

$$\text{M1.1 Score} = \frac{8000}{10000} \times 100 = \mathbf{80}$$

Example: If a layer has three sub-metrics with weights 0.4, 0.35, and 0.25, and scores of 80, 60, and 100 respectively:

$$\text{Layer Maturity} = (0.4 \times 80) + (0.35 \times 60) + (0.25 \times 100) = 32 + 21 + 25 = \mathbf{78}$$

Each layer’s **Integration Score** follows a standard pattern with two components (intra-layer and inter-layer), each weighted equally at 0.5.

Code	Sub-Metric	Formula	Score (0–100)	Wt.	Contribution (Score × Wt.)
M1.1	IT-based Billing	$\frac{\text{IT Billed Consumers}}{\text{Total Consumers}} \times 100$		0.20	
M1.2	Consumer App	Functional app:		0.25	
	M1.2a	Daily usage + Bill payment (binary)		(0.15)	
	M1.2b	Grievance/Complaint tracking (binary)		(0.10)	
M1.3	Energy Audit	Combined feeder + DT:		0.20	
	M1.3a	$\frac{\text{Audited Feeders}}{\text{Total Feeders}} \times 100$		(0.10)	
	M1.3b	$\frac{\text{Audited DTs}}{\text{Total DTs}} \times 100$		(0.10)	
M1.4	IT-based AT&C	$\frac{\text{Feeders w/ IT AT\&C}}{\text{Total Feeders}} \times 100$		0.20	
M1.5	Workforce Mgmt	$\frac{\text{Staff Using WFM}}{\text{Total Staff}} \times 100$		0.15	
M1 Total (out of 100)				1.00	

Table 4: IT Layer (S1) Maturity Worksheet

4.1 Layer S1: Information Technology (IT)

4.1.1 Maturity Assessment (M1)

Scoring Rules — IT Layer

- **M1.1:** Manual billing = 0; must be IT-based system
- **M1.2:** App must be *functional*, not “planned”; requires daily usage view + online bill payment
- **M1.3:** Must audit *both* feeder and DT levels
- **M1.4:** Per-feeder AT&C calculation required
- **M1.5:** Count staff *actively using* WFM, not just enrolled

4.1.2 Integration Assessment (I1)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I1.1	Intra-layer	All IT apps integrated using open protocols		0.50	
I1.2	Inter-layer	Integration w/ other layers using open protocols		0.50	
I1 Total (out of 100)				1.00	

Table 5: IT Layer (S1) Integration Worksheet

Layer S1 Composite Score:

$$S1 \text{ Score} = \frac{M1 \text{ (Maturity)} + I1 \text{ (Integration)}}{2} = \boxed{}$$

4.2 Layer S2: Operational Technology (OT)

4.2.1 Maturity Assessment (M2)

Code	Sub-Metric	Formula	Score (0–100)	Wt.	Contribution (Score × Wt.)
M2.1	SCADA Control	$\frac{\text{Feeders w/ RT Control}}{\text{Total Feeders}} \times 100$		0.30	
M2.2	DMS	$\frac{\text{Feeders w/ DMS}}{\text{Total Feeders}} \times 100$		0.15	
M2.3	OMS	$\frac{\text{Feeders w/ OMS}}{\text{Total Feeders}} \times 100$		0.15	
M2.4	RTDAS/SFMS	$\frac{\text{Feeders w/ RT Monitor}}{\text{Total Feeders}} \times 100$		0.20	
M2.5	SAIDI/SAIFI	$\frac{\text{Feeders w/ Reliability Mon.}}{\text{Total Feeders}} \times 100$		0.20	
M2 Total (out of 100)				1.00	

Table 6: OT Layer (S2) Maturity Worksheet

Scoring Rules — OT Layer

- **M2.1:** Requires *Real-Time Control + Monitoring*; monitoring-only = 0
- **M2.1 vs M2.4:** Monitoring-only systems score under M2.4 (RTDAS), not M2.1

4.2.2 Integration Assessment (I2)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I2.1	Intra-layer	All OT apps integrated using open protocols		0.50	
I2.2	Inter-layer	Integration w/ other layers using open protocols		0.50	
I2 Total (out of 100)				1.00	

Table 7: OT Layer (S2) Integration Worksheet

Layer S2 Composite Score:

$$S2 \text{ Score} = \frac{M2 \text{ (Maturity)} + I2 \text{ (Integration)}}{2} = \boxed{}$$

4.3 Layer S3: Smart Metering (AMI)

4.3.1 Maturity Assessment (M3)

Code	Sub-Metric	Formula	Score (0–100)	Wt.	Contribution (Score × Wt.)
M3.1	HES	$\frac{\text{Meters w/ HES}}{\text{Total Consumers}} \times 100$		0.10	
M3.2	MDM	$\frac{\text{Meters w/ MDM}}{\text{Total Consumers}} \times 100$		0.10	
M3.3	Postpaid — C&I	$\frac{\text{C\&I w/ Smart Meters}}{\text{Total C\&I}} \times 100$		0.15	
M3.4	Postpaid — Other	$\frac{\text{Non-C\&I w/ Smart Meters}}{\text{Total Non-C\&I}} \times 100$		0.15	
M3.5	DT Meters	$\frac{\text{DTs w/ AMI/AMR}}{\text{Total DTs}} \times 100$		0.10	
M3.6	Feeder Meters	$\frac{\text{Feeders w/ AMI/AMR}}{\text{Total Feeders}} \times 100$		0.10	
M3.7	Prepaid — All	$\frac{\text{Prepaid Consumers}}{\text{Total Consumers}} \times 100$		0.15	
M3.8	Prepaid — Govt	$\frac{\text{Govt w/ Prepaid}}{\text{Total Govt}} \times 100$		0.15	
M3 Total (out of 100)				1.00	

Table 8: Smart Metering Layer (S3) Maturity Worksheet

Scoring Rules — Smart Metering Layer

- **M3.5/M3.6:** AMI or AMR acceptable for DT/Feeder meters
- **M3.8:** Government consumers include all government offices/buildings

4.3.2 Integration Assessment (I3)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I3.1	Intra-layer	All metering apps integrated using open protocols		0.50	
I3.2	Inter-layer	Integration w/ IT, OT, Enterprise using open protocols		0.50	
I3 Total (out of 100)				1.00	

Table 9: Smart Metering Layer (S3) Integration Worksheet

Layer S3 Composite Score:

$$\text{S3 Score} = \frac{\text{M3 (Maturity)} + \text{I3 (Integration)}}{2} = \boxed{}$$

4.4 Layer S4: Enterprise & Analytics

4.4.1 Maturity Assessment (*M4*)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
M4.1	ERP	Three required functions:		0.35	
	M4.1a	Inventory/Material Mgmt (binary)		(0.15)	
	M4.1b	HR/Payroll (binary)		(0.10)	
	M4.1c	Financial Mgmt (binary)		(0.10)	
M4.2	CRM	$\frac{\text{Consumers in CRM}}{\text{Total Consumers}} \times 100$		0.35	
M4.3	Analytics	Role-based with drill-down:		0.30	
	M4.3a	Role-Based Views (binary)		(0.15)	
	M4.3b	Drill-Down Capability (binary)		(0.15)	
M4 Total (out of 100)				1.00	

Table 10: Enterprise Layer (S4) Maturity Worksheet

Scoring Rules — Enterprise Layer

- **M4.1:** All three ERP functions required; partial = proportional score
- **M4.2:** CRM denominator = total consumer base
- **M4.3:** Excel sheets = 0; requires proper analytics platform with role-based views + drill-down

4.4.2 Integration Assessment (*I4*)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I4.1	Intra-layer	All enterprise apps integrated using open protocols		0.50	
I4.2	Inter-layer	Integration w/ IT, OT, Metering using open protocols		0.50	
I4 Total (out of 100)				1.00	

Table 11: Enterprise Layer (S4) Integration Worksheet

Layer S4 Composite Score:

$$S4 \text{ Score} = \frac{M4 \text{ (Maturity)} + I4 \text{ (Integration)}}{2} = \boxed{}$$

4.5 Layer S5: Cybersecurity

4.5.1 Maturity Assessment (M5)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
M5.1	Cybersec Tools/FMS	Tools deployed for cybersecurity		0.25	
M5.2	Certifications	Compliance w/ GoI guidelines (CEA/MoP)		0.30	
M5.3	SIEM/SOC	Security monitoring; audits done; vulnerabilities closed		0.25	
M5.4	Qualified CISO	Binary: Qualified CISO appointed		0.20	
M5 Total (out of 100)				1.00	

Table 12: Cybersecurity Layer (S5) Maturity Worksheet

Scoring Rules — Cybersecurity Layer

- **M5.2:** Must comply with CEA/MoP cybersecurity guidelines
- **M5.3:** Requires completed audits + closed vulnerabilities; open gaps = 0
- **M5.4:** CISO must have cybersecurity qualifications; unqualified assignment = 0

4.5.2 Integration Assessment (I5)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I5.1	Intra-layer	All cybersec apps integrated using open protocols		0.50	
I5.2	Inter-layer	Integration w/ other layers using open protocols		0.50	
I5 Total (out of 100)				1.00	

Table 13: Cybersecurity Layer (S5) Integration Worksheet

Layer S5 Composite Score:

$$S5 \text{ Score} = \frac{M5 \text{ (Maturity)} + I5 \text{ (Integration)}}{2} = \boxed{}$$

4.6 Layer S6: GIS

4.6.1 Maturity Assessment (M6)

Code	Sub-Metric	Formula	Score (0–100)	Wt.	Contribution (Score × Wt.)
M6.1	Consumer Indexing	$\frac{\text{Consumers Mapped}}{\text{Total Consumers}} \times 100$		0.40	
M6.2	Asset Indexing	Combined DTs + Lines:		0.60	
	M6.2a	$\frac{\text{DTs in GIS}}{\text{Total DTs}} \times 100$		(0.30)	
	M6.2b	$\frac{\text{Lines in GIS}}{\text{Total Lines}} \times 100$		(0.30)	
M6 Total (out of 100)				1.00	

Table 14: GIS Layer (S6) Maturity Worksheet

Scoring Rules — GIS Layer

- **M6.1:** Consumer must be mapped to supply pole/DT
- **M6.2:** Both DTs and lines must be indexed separately

4.6.2 Integration Assessment (I6)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I6.1	Intra-layer	GIS apps integrated using open protocols		0.50	
I6.2	Inter-layer	Integration w/ OT, Enterprise, IT using open protocols		0.50	
I6 Total (out of 100)				1.00	

Table 15: GIS Layer (S6) Integration Worksheet

Layer S6 Composite Score:

$$\text{S6 Score} = \frac{\text{M6 (Maturity)} + \text{I6 (Integration)}}{2} = \boxed{}$$

Code	Sub-Metric	Assessment Area	Score (0–100)	Wt.	Contribution (Score × Wt.)
M7.1	IT Personnel	Qualified staff for S1 (IT)		0.15	
M7.2	OT Personnel	Qualified staff for S2 (OT)		0.20	
M7.3	Metering Personnel	Qualified staff for S3 (AMI)		0.20	
M7.4	Enterprise Personnel	Qualified staff for S4 (Enterprise)		0.15	
M7.5	Cybersec Personnel	Qualified staff for S5 (Cybersec)		0.15	
M7.6	GIS Personnel	Qualified staff for S6 (GIS)		0.15	
M7 Total (out of 100)				1.00	

Table 16: Skilled Workforce Layer (S7) Maturity Worksheet

4.7 Layer S7: Skilled Workforce

4.7.1 Maturity Assessment (M7)

Scoring Rules — Skilled Workforce Layer

- **M7.1–M7.6:** Assess qualified staff who can *operate and maintain* each layer
- **M7.5 vs M5.4:** M7.5 = operational staff (SOC analysts); M5.4 = CISO leadership role

4.7.2 Integration Assessment (I7)

Code	Sub-Metric	Criteria	Score (0–100)	Wt.	Contribution (Score × Wt.)
I7.1	Integration Expertise	Staff skilled in integration and open protocols		1.00	
I7 Total (out of 100)				1.00	

Table 17: Skilled Workforce Layer (S7) Integration Worksheet

Layer S7 Composite Score:

$$S7 \text{ Score} = \frac{M7 \text{ (Maturity)} + I7 \text{ (Integration)}}{2} = \boxed{}$$

5 Composite IMI Calculation

5.1 Raw IMI Score

The raw IMI is calculated by multiplying each layer score by its weight, then adding them together:

$$\text{Raw IMI} = (S1 \times 0.15) + (S2 \times 0.15) + (S3 \times 0.15) + (S4 \times 0.15) + (S5 \times 0.15) + (S6 \times 0.10) + (S7 \times 0.15)$$

In plain terms: Each layer contributes 15% to the final score, except GIS which contributes 10%.

Layer	Name	Weight	Score (S_k)	Weighted Score
S1	IT	0.15		
S2	OT	0.15		
S3	Smart Metering	0.15		
S4	Enterprise	0.15		
S5	Cybersecurity	0.15		
S6	GIS	0.10		
S7	Skilled Workforce	0.15		
Total		1.00		

Table 18: IMI Raw Score Calculation Worksheet

5.2 Adjustment Factors

The final IMI applies adjustments based on operational realities:

$$\text{Adjusted IMI} = \text{Raw IMI} + \text{Bonuses} - \text{Penalties}$$

5.2.1 Penalties

Penalty	Condition	Points	Applied?
AMISP Fragmentation	Multiple AMISPs without unified integration: $(n_{AMISP} - 1) \times 5$ (max 10 points)	-5 to -10	
Total Penalties			

Table 19: Penalty Assessment

5.2.2 Bonuses

5.3 Final IMI Score

Bonus	Condition	Points	Applied?
Operational Excellence	A+ national rating (PFC Integrated Rating)	+10 to +15	
Low AT&C Losses	AT&C < 5%	+5	
Total Bonuses			

Table 20: Bonus Assessment

Raw IMI	=	
+ Bonuses	=	
– Penalties	=	
Adjusted IMI	=	

6 Tier Classification

DISCOMs are classified into four tiers based on adjusted IMI:

T1 Requirements:

- IMI ≥ 75
- OT Score ≥ 40 (cannot be T1 with zero OT)
- No critical red flags (e.g., cybersecurity gaps, unqualified CISO, major credibility issues)

7 Data Sources and Validation

Validation Rules:

1. Cross-check self-assessment against calculated score (gap > 20 = red flag)
2. High IMI should correlate with low AT&C losses
3. Tier should align with MoP rating direction

8 Worked Examples

Two filled worksheet examples are provided as separate companion documents to illustrate how the IMI assessment works in practice:

- **Example A: Metro Power Distribution Ltd (Tier 2)** — A well-managed urban utility under PPP model with 3 million consumers and 8% AT&C losses. Demonstrates how the framework identifies IT-OT gaps, siloed maturity, and workforce bottlenecks even in relatively advanced utilities.
- **Example B: State Vidyut Vitaran Nigam Ltd (Tier 4)** — A state-owned utility with 8 million consumers and 25% AT&C losses. Demonstrates how the framework surfaces systemic issues including OT paralysis, analytics theater (Excel as “dashboards”), CISO vacancy, and AMISP fragmentation penalties.

These examples use the exact worksheet tables from this methodology, filled with realistic data based on typical patterns observed across Indian utilities. Key insights from the comparative analysis:

Tier	IMI Range	Label	IES Readiness
T1	75–100	IES Ready	Can participate in Layer 3 applications
T2	50–74	Near Ready	6–12 months to readiness
T3	25–49	Significant Gaps	12–24 months to readiness
T4	0–24	Critical	Foundational work required

Table 21: IMI Tier Classification

Source	Data Type	Reliability
PFC 13th Annual Integrated Rating (PFC, 2025)	National ratings, AT&C losses	High
CEA AMI Guidelines (CEA, 2025)	Mandated technical standards	High
PFC/REC Roadmap Documents	System deployment status	Medium
Third-party Expert Review	Operational validation	High (8 DISCOMs)

Table 22: Data Sources and Reliability Assessment

The performance gap is not simply about “more investment” but about *where* investment is directed. Example B has deployed technology (RTDAS monitoring, consumer app, ERP finance module) but lacks the integration, workforce, and governance to operationalize it.

9 Policy Implications

Key Findings from 52 DISCOM Assessment

- **T1 (IES Ready):** 8 DISCOMs (15%) — Can immediately participate in Layer 3 applications
- **T2 (Near Ready):** 18 DISCOMs (35%) — Require targeted investments in integration
- **T3 (Significant Gaps):** 20 DISCOMs (38%) — Need comprehensive digital roadmaps
- **T4 (Critical):** 6 DISCOMs (12%) — Require foundational infrastructure investment

Recommendations:

1. **Prioritize Integration:** RDSS funding should incentivize system integration using open protocols, not just deployment
2. **Reduce AMISP Fragmentation:** Encourage unified AMISP approaches to avoid data silos
3. **Balance IT-OT Investment:** DISCOMs with high IT but low OT scores should prioritize grid modernization
4. **Mandate Cybersecurity:** ISO 27001 certification, CEA compliance, and qualified CISO appointments should be prerequisites for Layer 3 participation
5. **Invest in Skilled Workforce:** Technology deployment without qualified personnel leads to underutilization and system failures
6. **Separate Smart Metering Focus:** C&I consumer metering and prepaid government connections should be prioritized as “quick wins”

Metric	Example A (T2)	Example B (T4)	Insight
Adjusted IMI	64.1	11.4	53-point gap
AT&C Losses	8%	25%	Revenue leakage correlation
SCADA Control (M2.1)	40	10	Grid operability gap
Qualified CISO (M5.4)	Yes	No	Security governance gap
Analytics (M4.3)	100	0	Decision support gap
Integration (avg)	58.6	17.5	Data flow gap
AMISP Penalty	0	-10	Fragmentation impact

Table 23: Comparative Analysis: Tier 2 vs Tier 4 Utility

A Formal Mathematical Specification

A.1 System Score

For each layer $k \in \{1, 2, \dots, 7\}$:

$$S_k = 0.5 \times M_k + 0.5 \times I_k \quad (2)$$

where S_k is the system score, M_k is the maturity score, and I_k is the integration score for layer k .

A.2 Layer Maturity Score

Each layer's maturity score is the weighted sum of its sub-metrics:

$$M_k = \sum_{j=1}^{n_k} w_{k,j} \cdot m_{k,j} \quad \text{subject to} \quad \sum_{j=1}^{n_k} w_{k,j} = 1.0 \quad (3)$$

where $w_{k,j}$ is the weight and $m_{k,j} \in [0, 100]$ is the score for sub-metric j of layer k .

Note: All ratio-based sub-metrics are converted to percentages:

$$m_{k,j} = \frac{\text{numerator}}{\text{denominator}} \times 100 \quad (4)$$

A.3 Layer Integration Score

Each layer's integration score (except S7):

$$I_k = 0.5 \times I_{k,\text{intra}} + 0.5 \times I_{k,\text{inter}} \quad (5)$$

where $I_{k,\text{intra}}$ represents intra-layer integration and $I_{k,\text{inter}}$ represents inter-layer integration, both using open protocols.

For layer S7 (Skilled Workforce): $I_7 = I_{7,1}$ (integration expertise only).

A.4 Composite IMI

$$IMI_{\text{raw}} = \sum_{k=1}^7 W_k \cdot S_k = 0.15(S_1 + S_2 + S_3 + S_4 + S_5 + S_7) + 0.10 \cdot S_6 \quad (6)$$

where layer weights W_k are: $W_1 = W_2 = W_3 = W_4 = W_5 = W_7 = 0.15$ and $W_6 = 0.10$.

A.5 Adjusted IMI

$$IMI_{\text{adjusted}} = IMI_{\text{raw}} + B - P \quad (7)$$

where $B = \sum_i b_i$ (sum of applicable bonuses) and $P = \sum_i p_i$ (sum of applicable penalties).

Penalty function:

$$P_{\text{AMISP}} = \min((n_{\text{AMISP}} - 1) \times 5, 10) \quad (8)$$

where n_{AMISP} is the number of AMISPs operating without unified integration.

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This methodology was developed by FSR Global in consultation with PFC/REC experts to support India's transition to a unified electricity market. For detailed DISCOM assessments, visit the IES Interoperability Dashboard.