Institutional Capacity Assessment of Vocational Training for Operation and Maintenance in the Energy Sector of Afghanistan

Submitted to,
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Solace Consulting Private Ltd.

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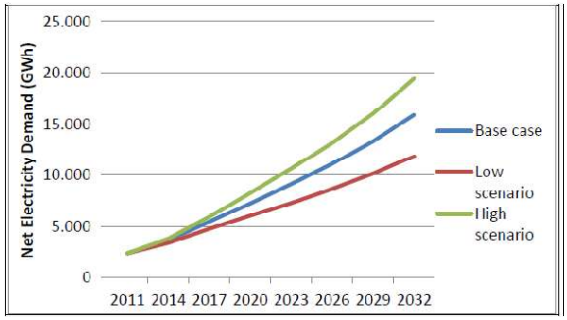
1. Contents

1. Assessment of Future Skill Need for Power Sector

1.1. Power Sector Scenario in Afghanistan

Afghanistan as on date generates 22% of the total power consumed (i.e. 1,073 GWh) mainly from hydropower generating unit followed by fossil fuel (all the existing thermal power plants are fired by imported diesel fuel and presently used to meet the peak demand) and other renewable energy sources. Rest 78% of its requirement is imported from Central Asia (Islamic Republic of Iran, Tajikistan, Turkmenistan and Uzbekistan). The share of renewable energy based power generating unit (other than hydro) in the country is considerably low, with only few MW of cumulative solar power units (till date around 12.898 MW of solar power project is commissioned across the country and 1.571 MW under construction) and almost no biomass, geothermal and wind power projects operating on commercial basis. Hydropower provides 94.6 percent of domestically generated electricity with an installed capacity of 254 MW. Till the mid of 2015 there were 12 hydropower plants in Afghanistan, not accounting around 5,000 off-grid micro hydropower plants constructed under the National Solidarity Program (NSP).The power generation mix is run to minimize costs by favoring cheap power sources from abroad and the use of domestic hydropower over thermal and diesel power plants. The Afghanistan power sector is characterized by fragmentation and underdevelopment. The electricity consumption of 497 kWh per person per year across Afghanistan compares unfavorably with the South Asia's average of 667 kWh per person in 2012 and worlds average of 3,100 kWh in 2012 and is reflected in terms of lower human development index.

The country is now in its growth trajectory and will therefore require stable, sustainable and economic power for all. This will call for substantial increase in the power demand. As per the estimates by ADB[1] the demand of energy in the country is expected to increase several fold to 11,840 GWh in case of low scenario, 15,909 GWh in the base case scenario and 19,474 GWh in case of high scenario by 2032. As per the estimate of MEW with the growth of demand at the rate of 12-15%, the supply shortfall by 2032 will be in tune of 6,000 MW.



In the backdrop of the current power deficit, projection of incremental demand and plan to foster overall societal development, Ministry of Energy and Water has planned to augment both the domestic installed power projects and also the import from projects set out under the National Energy Supply Program (NESP).

Several initiatives has been put in place by MEW to augment the installed capacity along with development of associated transmission and distribution network to meet the current and the forecasted future demand and also reduce the energy dependency of the country. Ministry of Rural Rehabilitation and Development (MRRD) department is also facilitating rural electrification using & decentralized micro hydro & solar home lighting system. Considering the entire planned endeavor of

[1]ADB, Power Sector Master Plan Report April 2013

the Ministry of Energy and Water and MRRD it is quite imperative that the power sector in the country will witness a several fold growth. However it is equally important to note that without the availability of the skilled domestic resources the sectoral growth cannot be sustained.

1.2. Short-term Development Plan in Power Sector

Access to electricity is determined as the key determinant of economic growth and equitable development by the government. The access to electricity in Afghanistan is merely 25-30% in 2015 which in turn has imposed formidable challenge in the pathway of economic growth in the country. Therefore, strengthening of power sector has become the top priority of the government as a part of its developmental perspective. While there are significant potential of energy sector capacity augmentation in the longer term the options in the short terms are limited. The source wise short term capacity augmentation options in Afghanistan are envisaged below:

Source	Pipelines Capacity
Hydro	2,500 MW (theoretical potential of 23GW; Out of the planned 7,500 MW of installed capacity, 5,000 MW is expected to be commissioned by 2023).
Coal	1,200 MW (800 is planned at Dara e Suf in Samangan Province and 400 MW coal-fired thermal power plant is planned at Ishpushta in Bamyan Province, but Realization of these two power plant projects is not expected before 2027, hence not considered as a part of the short term projection).
Gas based /Diesel based	200 MW (uncertainty in regard to commission dates)
Diesel	High cost power generation in the diesel based unit has enforced the utility sector to use it only as a peak/ emergency support unit. (105 MW diesel project at Tarakhil completed in 2010 but has not been used to full capacity due to high operating cost and fuel shortages)
Solar	64 MW[2] (220 GW technical potential[3]).
Wind	14 MW[4](66 GW theoretical potential)

1.3. Power Sector Institutional Framework

Afghanistan's energy sector is predominantly state-owned and operated, with little private sector participation. The Ministry of Energy and Water (MEW) is the main government department responsible for energy sector in Afghanistan. Up until 2009, Afghanistan's power utility was a department of the MEW under the name of Da Afghanistan Breshna Moasessa. The power utility was thereafter restructured in the name of the DABS.

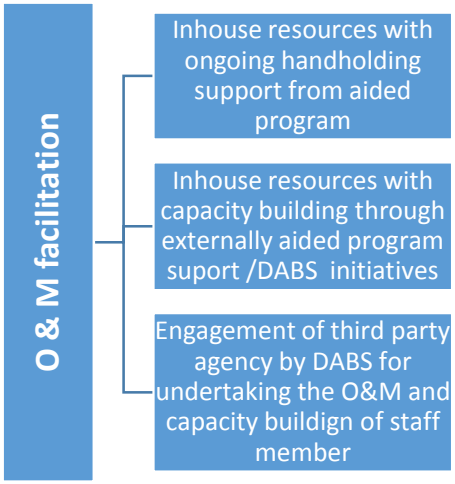
[2] Call for Expression of Interest MEW
[3] National Resource Energy Laboratory (NREL), United States
[4] Call for Expression of Interest MEW

DABS is incorporated and governed by an independent board, which is constituted by different government agencies, with the Ministry of Finance (MoF) holding 45 percent of the ownership of the DABS, the MEW is holding 35 percent and 10 percent each with the Ministry of Economy and Ministry of Urban Affairs. The DABS is now a financially independent and commercially viable entity while remaining under state ownership. Initially, the DABS was only responsible for the daily operation of the transmission and distribution system, but it is increasingly also carrying out its own investment program.

1.4. Power Plant Operation and Maintenance Framework

The challenges to the energy sector in Afghanistan mainly relates to the physical condition of equipment resulting from delays in operation and maintenance and inadequate institutional capacity. This led to large part of infrastructure either having been destroyed or having become dilapidated and has eroded the capacity of operations and investment management at Afghanistan's power utility Da Afghanistan Breshna Sherkat (DABS).

The operation and maintenance of power project in the country is carried out by DABS through its own staff member. Numbers of capacity building and handholding support were provided to DABS to enhance the skills of personnel involved in O&M through third party intervention and bilateral/multilateral program support. Capacity building initiatives were supported by GIZ, World Bank, ADB, USAID and others. However, the utility still lacks the in-house independent capacity to maintain the existing assets of the power sector and also build up the in house capacity of the intake through customized program.



In line with the current skill gap scenario the planned sectoral growth will place additional demands on the capacity of DABS. To cope up with the increased responsibilities, DABS will need to improve upon its staff strength through training and capacity building of the in-house staff through technical and other training and then ensure that these new capacities are applied to the task in hand. It needs more and better trained staff and as such needs to draw from a wider pool of educated and capable professionals, including women.

USAID's Afghanistan Infrastructure and Rehabilitation Program

To increase the power supply in Afghanistan USAID in 2007 contracted Louis Berger Group/Black & Veatch Joint Venture (LGB/B&V) to build Tarakhil Power Plant. After the transfer of ownership of the power plant in 2010 to MEW, DABS was charged with operating and maintain the power plant. USAID through LGB/B&V provided O&M support to the DABS till 2012. However in 2014 it was found that specific support was required to operationalize the power plant and further staff training was required. In this effect further support was extended by USAID.

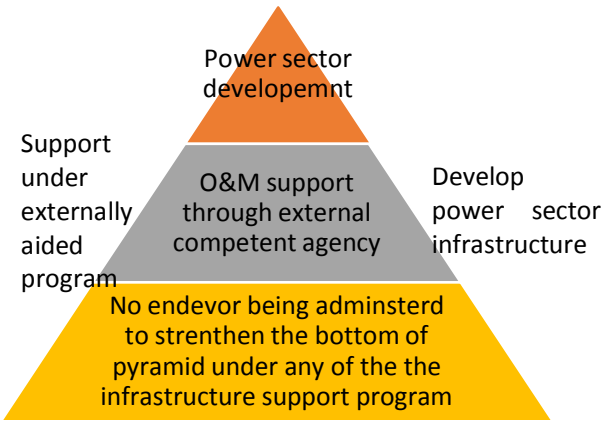
Note: The above case outline the existing skill gap of the resource engaged in power plant O&M.

2. Power Sector and Human Capital

2.1. Situational Assessment

The shortage of skilled human resources is hindering the transition of sustainable energy, contributing to cost overrun, project delay and faulty installation (ILO2011a). Further augmentation initiatives will exacerbate the operation and maintenance problems; which the sector is currently facing due to the dearth of skilled, technically competent and ready to be deployed resources. The skill gaps are widening every year and are likely to impact critical functions and quality of the output in the near future. The shortage of skilled workforce might adversely impact the growth of the power industry as the current sources of training are not scalable and the requirement of skilled resources are quite high.

Two fold analyses are administered under the current study to access the reason behind the lack of skilled manpower. First aspects of the study are aimed at understanding the country perspective that prohibited the development of suitable institutional mechanism to strengthen the skill of the resource across the sector. The second aspects are aimed at accessing the gap of the existing institution that is falling in place to address the skill gap issues.



In line with the consultation with different stakeholders a hypothesis was concluded that the long protracted process of political transition, deteriorating security situation has eroded the investor and consumer confidence across the power sector. In light of the socio-political scenario till 2010 the power sector in the country was largely developed under the externally aided or support program of bilateral and multilateral agencies. As a part of the support program initiative was taken to develop the power sector infrastructure and provide handholding support in maintaining the same. Under all this externally support project internationally competent private sector agencies were entitled to develop the infrastructure. These agencies had brought in its own skilled resource for operationalizing the task. Because of the inflow of skilled personnel from across the globe to support the infrastructure development in the power sector the skill gap was not felt. Moreover there was also no policy in place that administered this private sector agency to develop the skill/competency in house. As part of the handholding support of the skill enhancement program the existing resources were trained to undertake certain activities with no endeavor being made to strengthen their basic knowledge that can form the platform for rendering support service. The gap was felt only when the externally aided support period phased out and the country strategized to have the energy independency through its own endeavor. The lack of basic skill and knowledge began to paralyze the whole process in case of scenario change (technology up-gradation) or unforeseen reactive response requirement as existing resource only possess the operational knowhow without

the basic level of knowledge and skill. No endeavor has been made other than some piece meal initiatives to strengthen the bottom of the pyramid or value chain that can make the sector self-sustaining (for example GIZ programme of the strengthening the skill set for hydro power professional). The current skill gap is most likely to jeopardize the power sector if adequate measure is not being administered to facilitate a mammoth restructuring of the skill supply sector towards attaining the self-sufficiency.

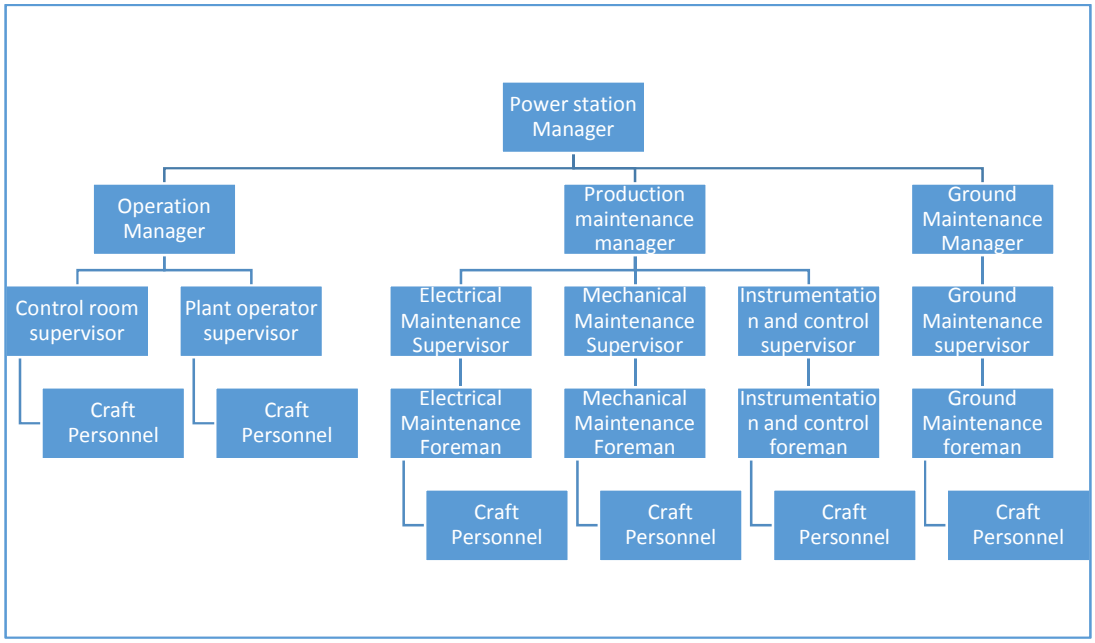
2.2. Professional Requirement for Power Project

From the assessment of the power sector it is quite evident that the major source of power generation is and will be hydro in the short term scenario. As per the current plan solar PV based power generation option is also planned for the country in a larger way considering the higher irradiation potential. Although plans are there for two big tickets coal-based thermal power projects but the projected dates of commissioning are far beyond to be planned under the short term. So for the purpose of the current study focus is given on the hydro and solar PV based power project.

2.2.1. Professional Structure for O&M of Hydro and Solar Power Project

Hydro Power Project

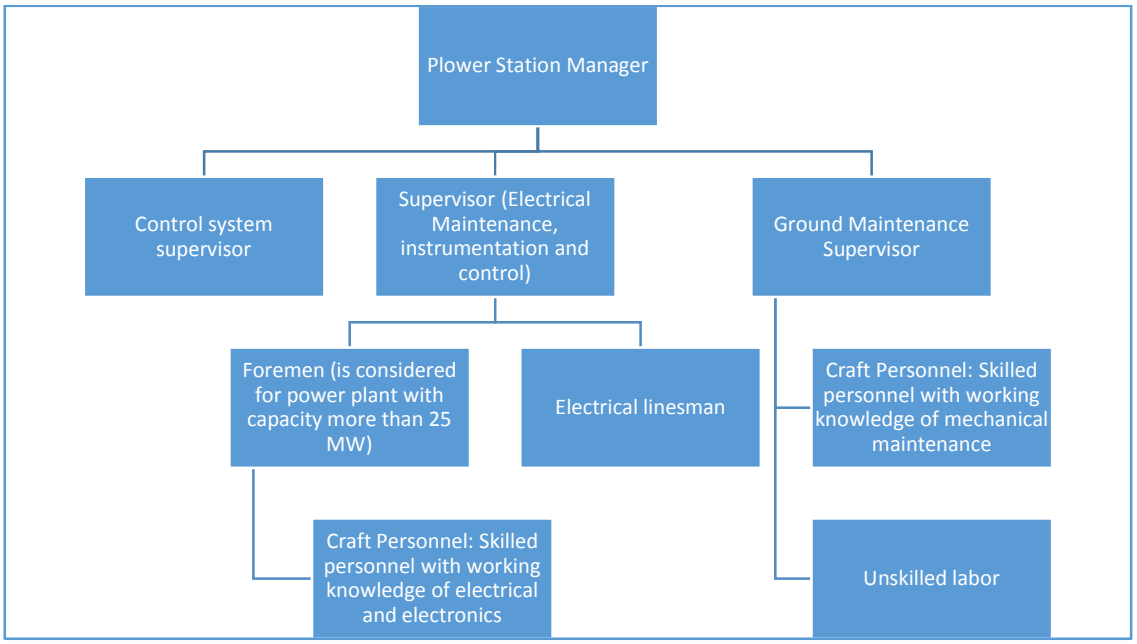
The typical organizational structure for operational and maintenance of hydro power projects are depicted in the organogram below. However with the current technology in place and cost economics these organization structures are valid only for big capacity hydro power project. The medium size and small size hydro power project have in turn obsoleted the manager position and also the foreman/craft personnel position where the supervisor reports directly to station manager and performs the functions through foreman/craft personnel. Even the ground maintenance and instrumentation supervisor role in most cases are consolidated with the electrical and mechanical supervisor scope of service. This calls for broadening of roles and responsibilities thereby requiring multi-skilled and multifunctional workforce.



Position	Qualification	Training/certification required
Power Station Manger	Master of Engineering (Power Plant Engineering/Electrical/Mechanical/Civil) OR Bachelor of Engineering with requisite experience of electrical, mechanical and civil works.	Certification course in hydro power operation and maintenance.
Operation Manager	Master of Engineering (Power Plant Engineering/Control system/Electrical /Mechanical) OR Bachelor of Engineering with requisite experience	Graduate Engineering Training course, IT application in power engineering e.g. SCADA, PLC hardware and software with field interface training, Industrial automation /Other control software as applicable.
Plant Supervisor	Diploma in engineering (Power Plant Engineering/Control system /Electrical /Mechanical) OR Science graduate	Supervisor/operator course in hydro power operation and maintenance, safety, etc.
Foreman	VT/ITI training in Power plant operation/electrical and mechanical maintenance.	Licensed electrical contractor and course in electrical and mechanical operation and maintenance.

Solar Power Project

Owing to the lower standalone installed generation capacity of a single unit, lower operational hours, lack of motive part and state of art sophisticated control system the number of resources requirement for operational and maintenance are quite small. Because of the lower number of resource involved the sector requires highly skilled and multitasking resources. Typical structure of resource engagement in the operation and maintenance of a solar power project are as follows:



Position	Qualification	Training/certification required
Power Station Manger	Master of Engineering (Electrical/Electronics) OR Bachelor of Engineering with requisite experience	Certification course in solar power operation and maintenance
Control system supervisor	Bachelor of Engineering (Electrical/Electronics) OR Diploma of Engineering with requisite experience	IT application in power engineering e.g. SCADA, Other control software as applicable
Supervisor (Electrical Maintenance, instrumentation and control)	Diploma in engineering (Electrical/Electronics) OR Science graduate	Supervisor/operator course in solar power plant operation and maintenance
Foreman	VT/ITI training in Power plant operation/electrical or electronics maintenance /control system	Licensing examination / course in electrical and electronics operation and maintenance
Craft personnel	VT/ITI training in required domain	

2.2.2. Skill Requirement for O&M of Solar Power Project

The objective of the section is to access the professional requirement for managing the solar power plant's operation and maintenance.

Job Description:

The brief role of the technician is to check, inspects, tests and commissions different components of photovoltaic systems that meet the performance and reliability needs of project by incorporating quality craftsmanship and complying with all applicable codes, standards and safety requirements.

Role Description

The basic role of a professional appointed for the operation and maintenance of power plant are:

- Test and commission solar PV system
- Maintain solar PV system
- Maintain personnel health and safety at the project site
- Orientation of customers/unskilled personnel involved with the project

No of resource required

Number of resources required for operation and maintenance of the solar power project are outlined in the section below.

Task required to be covered as a part to each role classified under the purview of O&M

Task	Element	Task to be commissioned	Remarks
1. Test and Commission Solar PV System	Test of the System	PC1. Perform visual inspection. PC2. Inspect mechanical, civil and electrical installation components. PC3. Verify system grounding and measure insulation resistance. PC4. Check continuity of the system and Verify polarity. PC5. Measure DC voltages and currents for each string and array for proper operation of the system. PC6. Verify inverter operation including anti-islanding performance and measure AC system values. PC7. Verify calibration of Data Acquisition System. PC8. Verify workmanship and demonstrate proficiency in using tools. PC9. Preparation of the Inspection report and take appropriate action.	The level of knowledge required by the organization / contractor, technical knowledge required by the individual core skill and professional skill required are presented in Annex 2 of this document
	Commission the System	PC10. Verify labeling of solar PV system. PC11. Initiate startup procedures as per manufacturer instructions and record energy meter reading at startup. PC12. Measure and record voltage of energy storage system. PC13. Record and repair any anomalous conditions. PC14. Document design changes, if any	
2. Maint ain solar	Clean the solar panels	PC1. Understand the importance of cleaning the solar panel as dirt in panel could affect power	The level of knowledge

Task	Element	Task to be commissioned	Remarks
photovoltaic system	periodically	generation. PC2. Clean solar panels from dust, bird droppings, pollen, leaves, branches, snow. PC3. Use water to clean the accumulated dust in the panel. PC4. Wipe hard stains by wiping with sponge/ cotton. PC5. Undertake cleaning activity during when the sunlight is low (early morning or after sunset) to avoid interruption in power generation. PC6. Use cleaning agents such as detergents to clean the stains / dust in the aluminium framing. PC7. Clean without damaging the module by stepping on it, dropping objects, etc. PC8. Clean modules periodically as per specification and document the date of cleaning.	required by the organization / contractor, technical knowledge required by the individual core skill and professional skill required are presented in Annex 2 of this document
	Inspect the system periodically	PC9. Regularly inspect the solar panel system, understand the check points and check for effective functioning. PC10. Ensure that modules are clean and power output is not affected. PC11. Ensure that modules are free of any tree shading, construction or other disruption from receiving sunlight. PC12. Check all cables for loose connections and any mechanical damage. PC13. Check the output voltage of the system and compare with the expected output voltage generation. PC14. Check for any damage for the system by external elements. PC15. Ensure that electrical connections are as per specifications. PC16. Check for the conditions of mounting and its stability to hold solar panels.	
	Troubleshoot to identify faults in the system	PC17. Identify the faults in the system when there is an interruption in power generation. PC18. Perform regular checks like looking for dust, shade, etc., which might interrupt power output. PC19. Check current output for each string and identify the string which gives a low/ undesired power output. PC20. Identify the faulty module in the string by shading the modules and checking the output using	

Task	Element	Task to be commissioned	Remarks
		ammeter reading. PC21. Perform sequentially the standard troubleshooting activity to identify faults when there is power supply interruption in the grid. PC22. Check for working conditions of fuses and circuit breakers. PC23. Check the service panel connections. PC24. Check the cables and ensure that there is no damage. PC25. Check the wire connection to inverter and identify for any damage in wire connection. PC26. Inform the inverter service technician if there is a circuit board level fault for further repair. PC27. Escalate the issue to superiors if faults cannot be identified.	
	Report and document completion of work	PC28. Clean the work area after completing the maintenance activity. PC29. Remove all the tools, consumables used from the installation area. PC30. Fill in the job completion form and get the signature of the customer. PC31. Inform customers about maintenance of solar panels. PC32. Follow company standards in documentation of maintenance activities performed.	
	Follow quality and safety procedures	PC33. Remove any metals or jewelry to avoid possibility of current shock during maintenance activity. PC34. Wear gloves while cleaning aluminium frame with sharp edges to avoid any accidents. PC35. Ensure no material damage occurs during maintenance activity. PC36. Take adequate precautionary measures while handling electrical system. PC37. Keep work area clean and organized. PC38. Adhere to relevant health and safety standards. PC39. Dispose off any waste materials in accordance with safe working practices and procedures.	
3. Maintain Personal Health & Safety at	Establish and follow safe work procedure	PC1. Identify corporate policies required for workplace safety. PC2. Identify requirements for safe work area and create a safe work environment.	The level of knowledge required by the

Task	Element	Task to be commissioned	Remarks
project site		PC3. Identify contact person when workplace safety policies are violated. PC4. Provide information about incident/violation. PC5. Identify the location of First Aid materials and administer first aid.	organization / contractor, technical knowledge required by the individual core skill and professional skill required are presented in Annex 2 of this document
	Use and maintain personal protective equipment	PC6. Identify the personal protection equipment required for specific locations on-site. PC7. Identify expiry dates and wear & tear issues of specified equipment. PC8. Demonstrate safe and accepted practices for personal protection.	
	Identify and mitigate safety hazards	PC9. Identify environmental hazards associated with photovoltaic installations. PC10. Identify electrical hazards. PC11. Identify personal safety hazards or work site hazards and Mitigate hazards.	
	Demonstrate safe and proper use of required tools and equipment	PC12. Select tools, equipment and testing devices needed to carry out the work. PC13. Demonstrate safe and proper use of required tools and equipment.	
	Identify work safety procedures and instructions for working at height	PC14. Check access from ground to work area to ensure it is safe and in accordance with requirements. PC15. Reassess risk control measures, as required, in accordance with changed work practices and/or site conditions and undertake alterations. PC16. Inspect/install fall protection and perimeter protection equipment ensuring adequacy for work and conformance to regulatory requirements. PC17. Identify approved methods of moving tools and equipment to work area and minimize potential hazards associated with tools at heights. PC18. Select and install appropriate signs and barricades. PC19. Place tools and materials to eliminate or minimize the risk of items being knocked down. PC20. Dismantle safety Power Plant in accordance with sequence and remove from worksite to clear work area.	
4. Customer	Handover System	PC1. Record component serial numbers and file data sheet and complete equipment warranty	The level of knowledge

Task	Element	Task to be commissioned	Remarks
Orientation for Solar PV System	Completion Documentation	registration. PC2. Record and document inspection & commissioning certificates/forms. PC3. Deliver as-built documents along with project photographs and Permits. PC4. Deliver O&M documentation and customer operation manual.	required by the organization / contractor, technical knowledge required by the individual core skill and professional skill required are presented in Annex 2 of this document
	Demonstrate Working Procedure of Solar PV system	PC5. Demonstrate Start-up and shutdown procedures. PC6. Demonstrate Safety procedures to the customer. PC7. Demonstrate maintenance procedures and provide basic training to maintain the system. PC8. Demonstrate normal operation procedure of Solar PV system.	

2.2.3. Skill requirement for O&M of Hydro Power Project

The objective of the section is to access the professional requirement for managing the hydro power plant's operation and maintenance.

Job Description:
The brief role of the O&M operator is to undertake preventive maintenance and instrumentation control that meet the performance and reliability needs of project by incorporating quality craftsmanship and complying with all applicable codes, standards, and safety requirements.

Role Description
The basic role of a professional appointed for the operation and maintenance of power plant are:

- Preventive maintenance
- Power plant operation at best possible efficiency
- Instrumentation Protection and Controls for Hydro Plants and Switchyard
- Supervisory Control
- Reliability analysis and operation of intake structure

No of resource required
Number of skilled resources required for operation and maintenance of the hydro power project is around two per MW of plan capacity.

Task	Task to be commissioned
Power plant operation at best possible efficiency	PC1: Physical inspection of the mechanical equipment of water turbines, bearings, turbine auxiliaries, auxiliary systems for water turbine equipment, waterway systems, penstocks, surge shafts, valves and closing elements, etc. PC2: Model testing of water turbines, scale-up of parameters to the prototype,

Task	Task to be commissioned
	methods of measurement of hydraulic values and uncertainty of measurement. PC3: Performance testing for verification of the guaranteed data – steady operation; performance tests for verification of the guaranteed data – transient operation. PC4: Estimation of Power Plant efficiency, methods of optimization connected with operation of individual units to achieve the maximum Plant efficiency. PC5: Undertaking cavitation tests on the model, sigma Plant, influence and consequences for the cavitation pitting on turbines.
Preventive Maintenance	PC6: Operation management and organization of technology, reservoir, intake and dam (weir) structures and Operational management of the plant and accessories with respect to water flow and also during flood. PC7: Implementation of Plant reliability Program and reliability improvement program. PC8: Hydrology and Hydrological data assessment. PC 9: Condition monitoring of the power transformer through: Diagnostic tests: oil tests, turns ratio tests, power factor test, test for gas External inspection and checking: concrete pad, bolts, grounds, bushings, oil leakage, temperature and pressure switches, gauge calibration, control circuits, lubricating, fans and pumps, oil conservator system, tap changer. PC 10: External inspection of System earthing, Equipment earthing, Power station, substations, and overhead lines earthing. Inspection of the storage battery and battery backup system: General appearance and cleanliness, checking of the ambient temperature, condition of ventilating equipment, float voltage, charger output: current and voltage, cell voltage, voltage leakage to ground, specific gravity and electrolyte temperature, evidence of corrosion at connectors, cell cracks and integrity of battery rack.
Instrumentation Protection and Controls	PC 11: Physical inspection, calibration and operational performance monitoring of Control system, measurements and instruments used in a power plant control, measurement signaling, recording, logging, interlocks. PC 12: Regular inspection of the operation of Monitoring and diagnostics systems for damage prevention. PC 13: Understanding Faults type, access its effect and undertake measure to neutralize its effects. PC14: Prevention of Hazards in a power plant by addressing hidden failures. PC15: Online monitoring, diagnostics of the water turbines. PC 16: Calibration of sensors, methods of calibration on site.
Supervisory control	PC 17: Acquainted and capable of SCADA. PC 18: Undertaking Performance Monitoring. PC 19: Undertaking Performance Testing. PC 20: Conducting Instrument Data Validation. PC 21: Conducting Periodic Test Program and test procedures. PC 22: Conducting Online Performance Monitoring. PC 23: Undertaking Index tests, optimization of cam in dependence on changes of

Task	Task to be commissioned
	operational conditions, optimal operation of two and more units. PC 24: Undertaking Diagnostics of vibrations, pressure pulsations.
Reliability analysis and operation of intake structure	PC 25: Undertake maintenance organization and planning. PC 26: Preparation of maintenance documents. PC 27: Undertake plant maintenance program development. PC 28: Undertake maintenance and performance data collection. PC 29: Undertake failure analysis. PC 30: Facilitate maintenance program implementation. PC 31: Undertake maintenance cost analysis and reporting. PC 32: Undertake planning for spare parts monitoring. PC 33: Undertake lean maintenance methodologies. PC 34: Undertake CM Power data analysis
The details of the knowledge requirement for executing the task are outlined in Annex 2	

2.2.4. Skilled Resource Requirement for O&M of Power Project

Solar power project

As per Berkeley report solar PV power projects potentially creates an average of 0.87 job-years per gigawatt-hour (GWh)[5] followed by wind energy an average of 0.17 in compared to nuclear, natural gas and coal creating 0.14, 0.11 and 0.11 job-year per GWh respectively.

PV based power projects will result into both direct (solar developers, EPC firms, and PV component manufacturers) and indirect employments (suppliers of raw materials for manufacturing like cells, modules, battery and balance of systems). While pre-commissioning construction phase creates one time jobs, permanent operations and maintenance creates employment opportunities over the multi-decade life of the solar plant.

Short Term: Construction and Commissioning			
Project Capacity	No of Skilled Employees/project	Duration of employment	No of employee for a yr
<5 MW	20	120	8
5-10MW	12	105	4
10-25MW	25	90	8
>25	30	150	15

Short Term: Design and Pre-construction			
Project Capacity	No of Skilled Employees/project	Duration of employment	No of employee for a yr
<5 MW	7	90	2
5-10MW	12	90	4
10-25MW	7.5	60	2
>25	7	120	3

Long Term: O&M	
Project Capacity	No of Skilled Employees/project/yr
1-5 MW	3
5-10MW	6.5
10-25MW	4
>25	12

The long term engagement for operation and maintenance of solar power projects are as follows:

As against the technical potential of 220 GW the MEW administration has called for expression interest for setting up 65 MW solar power projects across sixteen provinces in PPP mode. The project will engage around 168 skilled resources for at least a year for design, preconstruction,

[5] In US

construction and commissioning of the projects. While 58 number of personnel are expected to be engaged permanently for the life time of the project.

The employment potential for the project 65 MW solar power project is estimated as follows;

Province	Capacity	Design and preconstruction	Construction and commissioning	Operation and Maintenance
		No of employee for a yr	No of employee for a yr	No of Employees/project/yr
Kandhar	30	3	15	12
Kabul	15	2	8	4
Bamyan	1	2	8	3
Ghor	5	2	8	3
Helmand	3	2	8	3
Urozgan	1	2	8	3
Noristan	1	2	8	3
Daikundy	1	2	8	3
Badghis	1	2	8	3
Zabul	1	2	8	3
Paktia	1	2	8	3
Logar	1	2	8	3
Khost	1	2	8	3
Ghazni	1	2	8	3
Paktika	1	2	8	3
Farah	1	2	8	3
Total	65	33	135	58
Temporary Engagement		168		Employee for a year
Permanent Engagement		Total Employee on an annual basis		58

Hydro power project

From the augmentation plan it is quite evident that the capacity addition in the short term scenario will be in the domain of hydro, wind and biogas. The manpower requirements[6] for operation and maintenance of conventional hydro power projects to be commissioned in the short term scenario are outlined in the adjacent table.

Source	Project Capacity (MW)	Long term Employment	
		Operation and Maintenance	
		Total no of person/MW/year	Total no of person/year
Hydro	2500	2	5000
Assuming Retirement-20% and Recoupment-7.5%			

[6]The basis of human resource requirement is obtained from the man-power projection estimated in the 12th five year plan of GoI.

Short term scenario

Form above estimate of generation capacity augmentation plan in next five years (short term scenario) it is **estimated that the human resource requirement will be around 6,000** (although it is in a phased manner).

Midterm and long term scenario

The human resource requirement will increase several fold in the backdrop of hydro power installed capacity augmentation plan of 5,000 MW (expecting to be commissioned by 2023) and coal based power plant (1,200 MW). So considering an increase of power generation capacity the **additional human resources requirement will be in tune of 11,200 personnel**.

Provincial distribution of human resources requirement

As per the proposed distribution of hydro and solar power projects in the near term scenario the permanent human resource requirement for the purpose of operation and maintenance is presented in the adjacent table. For the purpose of estimation the capacity addition of 2,521 MW of hydro power project 65 MW of solar power project and 14 MW of wind power project is considered. However requirement of skilled human resource to be engaged in pre construction, construction and commission stage is not considered as that category of resource will be floating.

Province	Resource for O&M	Province	Resource for O&M	Province	Resource for O&M
Kandhar	12	Zabul	3	Balkh	3
Kabul	4	Paktia	3	Kapisa/ Parvan	420
Bamyan	3	Logar	3	Lagman	360
Ghor	3	Khost	3	Kunar	2178
Helmand	240	Ghazni	3	Panshir/ Baghlan	592
Urozgan	3	Paktika	3	Nangarhar	90
Noristan	3	Farah	3	Kunar	600
Daikundy	3	Badakhshan	898	Uruzgan	180
Badghis	3	Takhar	4	Herat	94

2.2.5. Accessing employment potential for off-grid solutions

Achieving access to modern energy services (both electrical and thermal) is a pre-requisite for achieving socio economic development. In lower-income rural communities, efforts to provide electricity access have tended to focus on small solar home lighting systems. The number of job to be created for providing service to off-grid energy solutions depends largely upon how this technology are distributed, installed and operated.

With focus of Ministry of Rural Rehabilitation and Development to assure energy access in rural area using standalone solar power pack it become essential to possess regional resources to provide necessary services.

2.2.6. Gender dimensions of energy sector employment

Woman's talent and insight remain underutilized in the energy sector. The lacks of the engagement of female employees are mostly due to gender stereo types camouflaged under the perception of skill and mobility.

2.3. Supply Side Assessment of Skilled Resource

Power Industry requires technically trained manpower for various roles such as project planning, implementation, erection, commissioning, testing, O&M including transmission and distribution of power and also across the manufacturing segment (in case of renewable). From amongst four courses conducted at MEW-VTC, one on general electrical energy and other on renewable energy technology align directly to the requirement of power sector. However a thorough assessment of the course and consultation with faculties and management of VTC institute it was concluded that the present level of training is inadequate to equip a person with knowledge of different inputs required for the job performance in Power Sector. The current course curriculum provide courses for basic skill sets only and lacks provision of specialized skill required in the industry. The current level of basic foundation course offered by the institute needs to be supplemented with applied engineering skills in the various spheres i.e. power generation, transmission and distribution.

The pace of change in technology is rapid hence very often the speed of obsolesce overtakes the rate of acquisition of particular skill and knowledge. All sectors are moving towards higher technology platforms hence the need for skilled talent will also increase proportionally which certainly cannot be catered with the current level of infrastructure. The sector is therefore facing the challenges in sourcing skilled manpower and there is a shortage of experienced / skilled manpower as well as of trainers with adequate experience.

2.3.1. Assessment of Skill Gap for Critical Roles in Power Industry

A brief consultation was undertaken and thorough review of curriculum and course materials were undertaken to access the knowledge gap as against the skill requirement for a particular service to be undertaken.

Knowledge requirement	Skill requirement
Position : Plant Electrician	
Theory of operation and use of Programmable Logic Control (PLC) units and other computer based equipment for trouble shooting and diagnostics.	Perform preventive maintenance, test and adjust all electrical systems, equipment and components using a variety of electrical test equipment, meters, powered and non-powered tools
Principles of electronic theory as applied to electrical and electronic circuits, variable speed motors.	Plan the layout of wiring systems, test for, locate and repair malfunctioning.
Methods to operate state of the art High speed, complex and sophisticated electrical, electronic	Assemble and fabricate electrical and electronic components, appliances, connect electrical

Knowledge requirement	Skill requirement
and communications equipment, wiring installations, including lighting, fire protection and security, electronic controls, automated process technologies and robotics/ programming controllers.	equipment to power supplies, switches, outlets and other fittings, circuit breakers, maintain automated production processes.
Safe working practices of the equipment and applicable codes and regulations.	Install electrical and electronic control systems, insulated cables, wiring, switchboards, motors, and other equipment according to Standards/ codes and regulations
Skill Gap 1. Lack of scientific information on Electrical and Electronic Equipment. 2. Lack of information on safety measures and occupational hazards. 3. Lack of practical training to carry out pre-operational checks, preventive maintenance and basic troubleshooting.	
Position: Plant Operator	
Power systems like turbines, boilers, generators and other related equipment in electrical generating stations and substations, switchboards and related equipment in electrical control centers to control the distribution of electrical power in transmission networks.	Operate or control power generating equipment, including boilers, turbines, generators, and reactors, using control boards or semi-automatic equipment.
Knowledge of tools used including their design uses, repair and maintenance viz-viz Blowers, Flow-meters—Turbine flow meters, Heat exchangers, Low voltage alternating and direct current AC DC panel boards — Control boards; Panel boards; Transformer controls.	Monitor and inspect power plant equipment and indicators to detect evidence of operating problems.
Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.	Adjust controls to generate specified electrical power, or to regulate the flow of power between generating stations and substations.
General knowledge of units startup and shut down basic equipment procedures	Operation and Control — Controlling operations of equipment or systems.
	Troubleshoot - Determining causes of operating errors and deciding what to do about electrical power, or to regulate the flow of power between generating stations and substations.
Skill Gap 1. Lack of practical training on operation of Power Equipment like Boilers, Turbines, Generators and related equipment. 2. Lack of information on safety measures and occupational hazards. 3. Lack of practical training to carry out pre-operational checks, preventive maintenance and basic	

Knowledge requirement	Skill requirement
troubleshooting	
Position: Power Equipment Maintenance	
Mechanical and operational working complex boiler, boiler water and feed water testing and treatment procedures Includes knowledge of the care and use of hand & power tools and equipment (i.e., precision measuring devices).	Effectively operation, maintenance, repair, inspection and rebuilding of Power Plant steam generating mechanical and related equipment; inspection, repair and maintenance of steam distribution systems.
Electrical theory and mechanical theory of complex pump and valve operation.	Skill to inspect, overhaul, repair and maintain pulverizes, centrifuges and other power equipment.
Includes basic knowledge of the terminology of various hand & power tools and equipment used at a generating station. Includes machine shop terminology (i.e. lubrication, threading), use of appropriate tools, blueprint reading. System operational parameters.	Skills to use precision measuring instruments to: check clearances and/or tolerances, to layout work, to establish reference points for inspection purposes, assembling, disassembling, repairing, and assembling of equipment, and when aligning and adjusting parts, components, and equipment according to required specifications.
Troubleshooting techniques	Ability to detect faults electrical defects using appropriate instruments; overhaul, repair, tune, maintain and test **equipment**; adjust, remove and replace faulty components.
	Identify needs of the materials and equipment necessary for the equipment on the site and request through the system.
Skill gap 1. Inadequate training facility to understand the mechanical and Electrical Principles of running the machines. 2. Inadequate training facility to carry out basic trouble shooting equipment in case of breakdown. **3.** Lack on training on troubleshooting and preventive maintenance of equipment.	

Accessing reason for skill gap

The basic reasons behind the skill gap as identified through participatory process are:

1. Inadequate Industry Training to a large extent particularly to services in power sector.
2. Skill requirement for renewable energy technologies are unique in nature and vary widely across different sub sectors. There is lack of provision to rope in Industry experts in the field to work as visiting faculty for the training of trainers.
3. Lack of proper communication between training providers and employers resulting in underutilization of training resources and improper training.
4. Limited number of trainers available with adequate exposure.
5. Non availability of well qualified trainers adversely affecting quality of Training of trainees.

6. Fast changes in technology, materials, machinery and equipment manufacturing practices etc necessitate the training content and methodology to be revised and aligned with new requirement.
7. Lack of Emphasis on Training in Transmission & Distribution: Although about 80% of the total personnel of the Power Sector are engaged in the area of Operation and Maintenance of Power System, Transmission and Distribution very little emphasis is being given for training activity in these areas.
8. Inadequate access to on job training facilities.

2.3.2. Global practices for addressing skill gap

European Commission

The European Commission (EC) and the International Labour Organization (ILO) concluded a joint management agreement on Knowledge sharing in early identification of skill needs for the low carbon economy with the aim of enhancing cooperation and knowledge-sharing in the field of early identification of skill needs in renewable energy. The broad strategies are:

1. Plans to develop skills for renewable energy that are sufficiently portable so that they can be applied to new renewable energy technologies and outside the renewable energy sector;
2. Provision for internationally recognized industry certifications in renewable energy skills to complement national qualifications;
3. Develop policy to focus on ensuring that the transition to renewable sources of energy is a Just Transition for those working in fossil energy sectors;
4. There is a need for a range of initiatives to increase the supply of trainers. In support of this many countries are working towards skill development in Power Generation and Renewable Energy Resources.

Scotland

In Scotland Energy Advisory board was set up especially with a focus to review future skills employment demands across the sector which involved engagement with a comprehensive range of partners and stakeholders, working collaboratively with industry to review existing forecasts, analyse gaps and build future employment models. Scotland's colleges have established the Energy Skills Partnership (ESP) with support of the Scottish Funding Council to co-ordinate the group and act as a link to the relevant industry associations, government agencies, universities and awarding bodies. The role and remit of the Partnership is to provide a flexible and responsive, collective collaboration and dialogue with industry, government and universities on all sub-sectors of the Energy Industry and build links with key agencies such as: Renewables UK, Scottish Renewables, OPITO, National Skills Academy for Power, Scottish Enterprise Highlands and Islands Enterprise, Skills Development Scotland, Scotland Development International.

Queensland, Australia

Energy Skills Queensland which responsible for skill development for Queensland's energy and telecommunications industries has made strong investment in Australia's energy and resources industry to exacerbate skills shortages in critical occupations and to facilitate and drive a collaborative approach to workforce planning and workforce development within the industry bringing together key stakeholders. To achieve this, Energy Skills Queensland partners with industry, contractors, education training organizations and corporate groups across our industries, while engaging with other key stakeholders such as government, regulators, unions and other industry peak bodies to ensure solutions, provide a holistic outcome to meet industry expectations, to identify and provide solutions for the skilling needs of industry.

Brunswick, Canada

The Province of New Brunswick has an energy sector workforce development strategy to provide skilled energy workers. The Department of Post-Secondary Education, Training and Labour works closely with labour, industry, New Brunswick First Nations, economic development agencies, communities and their post-secondary education system to build workforce for the energy sector.

Malaysia

Malaysia's National Renewable Energy Policy and Action Plan, approved in April 2010, include five strategic thrusts. One of them, Intensifying Human Capital Development, proposes actions that are designed to build up local expertise and skills in renewable energy, and to provide individuals with the appropriate incentives to acquire these skills. Actions include:

1. Incorporating renewable energy into technical and tertiary curricula, requiring collaboration with relevant ministries and certification of training courses according to the National Skills Development Act;
2. Developing training institutes and centers of excellence, meeting international quality standards for renewable energy education and promoting high class facilities at universities; and
3. Providing financial supports, including technical training subsidies that are paid to individuals after they have completed renewable energy courses and fiscal reliefs for higher education that allow students to treat payable fees as deductible expenses.

India

The Government of India has created power sector skill council with a mandate of empowering the skill education sector. Following are the activity planned:

1. Bring uniformity and standardisation in the various skill types / job roles and the competencies required for those job roles in the industry, through development of National Occupational Standards (NOS).
    - Create a common understanding through extensive interaction with all stakeholders of the various skill types and job roles required in the industry.

- Emphasize on the need to build competency/outcome related occupational standards rather than designation based job descriptions.

2. Identification of critical job roles where major skill gaps exist and plan for future skill development initiatives to focus on addressing these gaps.
   - To prepare a catalogue of type, range and depth of existing skills already
   - Standardize catalogue of type, range and depth of skills as per skill development needs
   - Identify the major pain areas of the industry and focus Phase I on those skill sets with shorter turn-around time for a faster redressal of issues.
   - Focus marketing effort to attract adequate numbers for identified skill gap areas.
   - To develop the competency standards (detailed listing of knowledge, skills and attitudes including technical and soft skills that a worker must possess to perform a task) for each trade and level.

3. Develop and/or collate appropriate courses and curriculum to address the needs for skilling as per the NOS developed.
   - Invite quality training vendors to create courses/modules, for the NOS developed according to the competency development framework.
   - Identify new technologies and areas impacting skill requirement in the Power Industry.

4. Plan and execute Training of Trainers and ensure adequate faculty to support the capacity building in skill development programs
   - Plan for the number of trainers required to carry out the SSC training plan for the next 5 yrs and proactively organise and supervise training directly or through quality vendors.

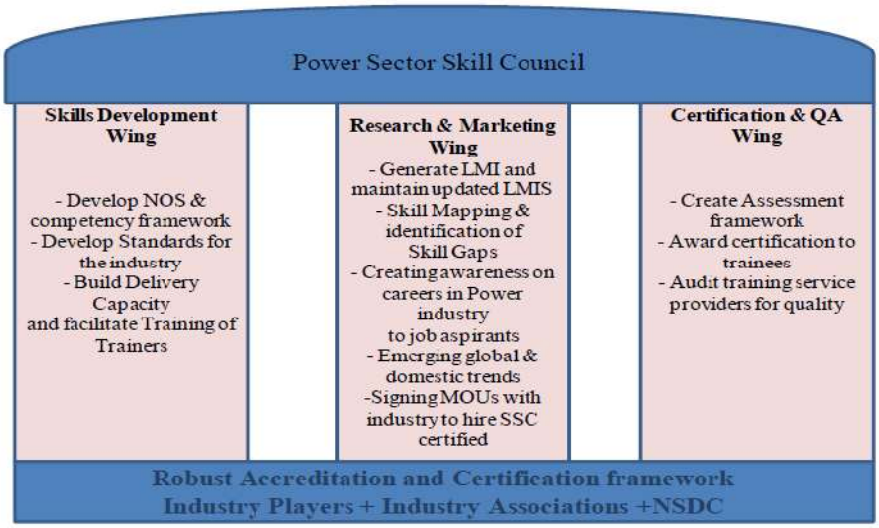
5. Build affiliation and accreditation process for institutions and examination and certification process for trainees.
   - Build a robust and scalable process of assessment and certification of Trainers and Trainees.
   - Identify and partner with institutions who can be accredited to carry out the activity on SSC's behalf to build scale.

6. Encourage maximum participation of private training institutions to run certified programs as per the competency framework developed by the SSC and thus continuously meet the annual skill development targets according to the sector skill development plan.
   - To evolve a mechanism in association with the industry to ensure that only certified workforce is deployed.
   - To provide consultancy to the industry.
   - To carry out research in the area of skill development.

7. Enable maximum employment of SSC certified personnel instead of unqualified people within the Power Industry.

8. Establishment of a well-structured, sector specific Labour Market Information System (LMIS) to assist planning and delivery of training.

- Identify suitable partners to carry out the initial research activity and create an IT enabled platform for the LMIS. Create a process for regular updating of the data through local representatives of the SSC in every state, subsequently.



Institutional structure of Power sector Skill council

The power sector skill council was set up as society under the Society Registration Act managed by the governing council with representation from all segments of power industry. The Sector Skill Council would serve as a nodal/apex body for developing and regulating skills in the Power Industry. However all activities such as Primary Research for Labour Market Intelligence, Development of Occupational Standards, etc would be contracted to vendors / partners who have the expertise for that particular activity and has a task oriented Project Management set-up.

Apart from Power Sector Skill Council Government of India has also notified National Skill Qualification Framework (NSQF) in the year 2013. NSQF is a quality assurance and competency based framework institutionalized with an objective to integrate the general and vocational streams of education, skill training, technical education and job market. The framework organizes qualification into ten levels with each of the NSQF level being characterized by the following categories of competencies:

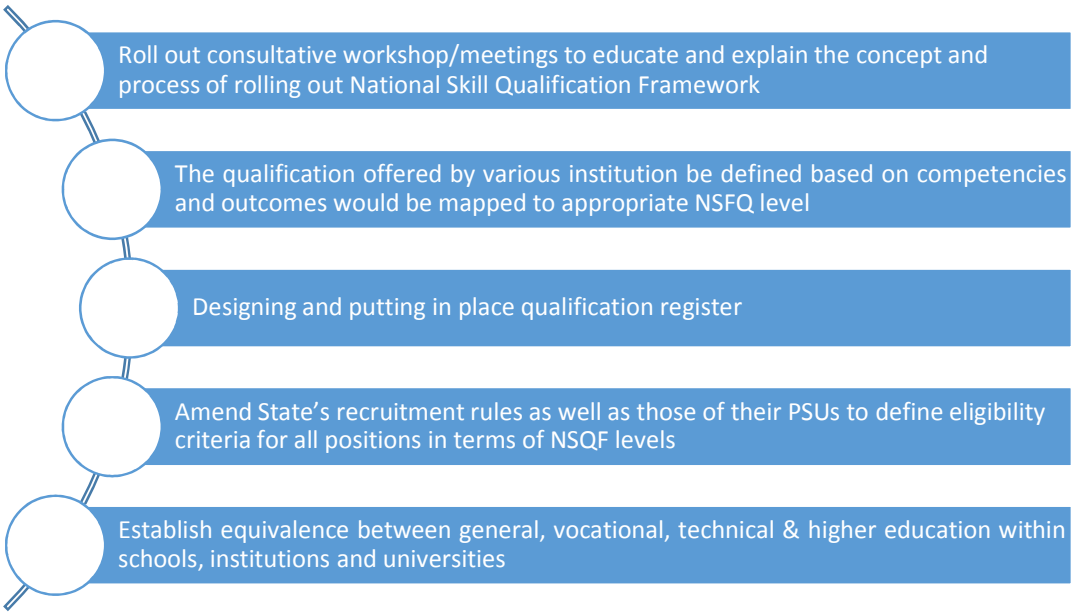
1. Professional knowledge – what the person must know at that level
2. Professional Skills – what the person should be able to do at that level
3. Core skills – which include soft and interpersonal skills
4. Responsibility – the degree of supervision that needs to be exercised over the person while doing the job, or the degree of supervision that person is capable of exercising over others.

The proposed outcome of National Skill Qualification Framework

1. Integration between vocational education, skill training, general education, technical education and job markets.
2. Increased potential for Recognition of Prior Learning (RPL) of individuals who have acquired skills through non-formal channels.
3. Defining competencies and progression pathways that are not completely based on either duration of the programme or specific curricula.
4. Creating a framework where any degree or diploma can be aligned to the NSQF – once the competencies being created through that formal qualification are ascertained.

5. Creating national principles for recognizing skill proficiency leading to international equivalency.
6. Countering the negative perception associated with vocational education & training by development of quality qualifications that also permit acquisition of higher qualifications, including degrees & doctorates.

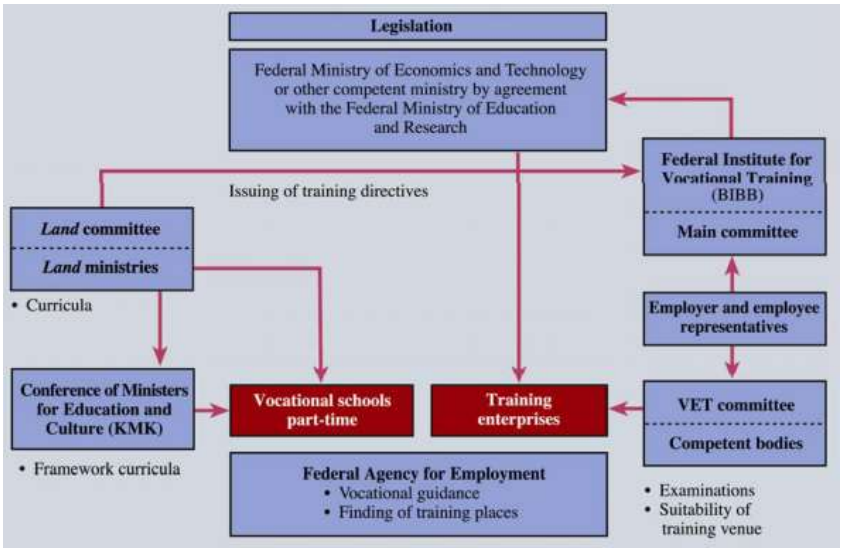
Steps towards rolling out of National Skill Qualification Framework



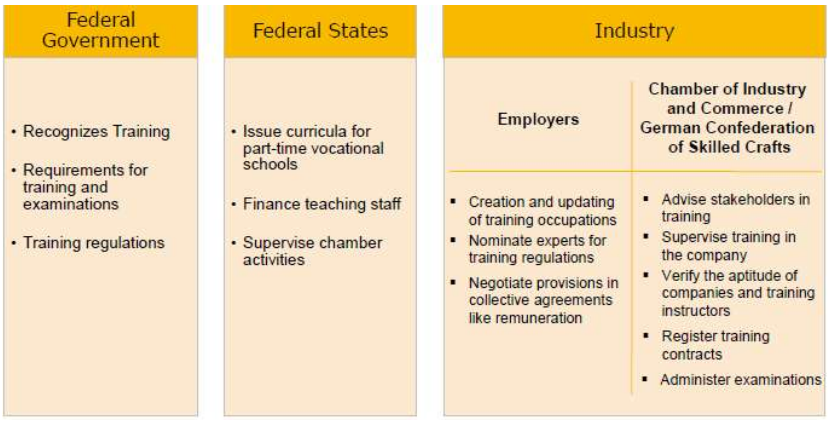
2.3.3. International system of Technical and Vocational Education

Germany

The responsibility of governing the technical and vocational education in Germany bestows with Federal Ministry of Education and Research (BMBF). The Federal Ministry of Economics and Technology is responsible for recognition of training occupation and issue of training directives. The Standing Conference of Ministers for Education and Cultural Affairs is responsible for issuing of framework curriculum. The current vocational education system in Germany is governed by Vocational Education and Training Reform Act in 2005, whereby the earlier ACT was amended.



Developing and modernizing the training directives and framework curricula for initial vocational training



The first steps towards revising the training directives are often taken by enterprises. In such cases, enterprises notify their associations of the need for modernization. The latter pass on the wish for modernization, amendment or rewording of particular qualification profiles to the Federal Institute for Vocational Education and Training. The Institute examines the facts of the matter by means of empirical studies and, if necessary, coordinates the rearrangement or amendment of the training directives.

In Germany, financing of vocational training and continuing training is based on a system of mixed financing with a variety of different backers, both public and private. They include the Federal Ministry of Education and Research, the Federal Ministry of Economics, the Federal Agency for Employment, The States Ministries of Employment, Economics, Education or Cultural Affairs, the European Union, local authorities, companies, unions, Chambers, associations, private institutions and, lastly, the individuals themselves.

India

According to the Indian Constitution, Education is a concurrent subject whereby powers are vested both in the Central and State Governments. The term Technical Education and Vocational Training are sometimes used synonymously. However, as per present practice, the term TE refers to post-secondary courses of study and practical training aimed at preparation of technicians to work as supervisory staff. The term VT refers to lower level education and training for the population of skilled or semi-skilled workers in various trades and it does not enhance their level with respect to general education.

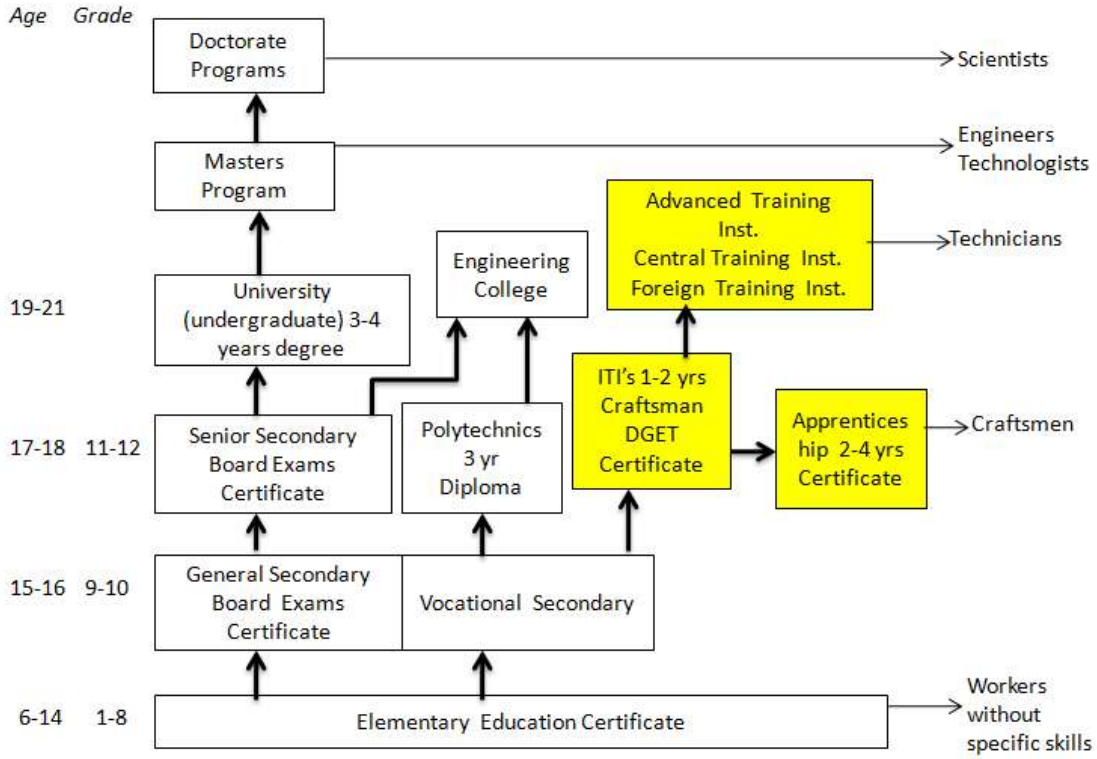
The agencies involved in TVET policy formulation in India are:

1. Central Government
   - National Skills Development Council
   - Ministry of Human Resource Development
     - Department of School Education and Literacy (for TVET programmes in senior secondary schools)
     - Department of Higher Education (for Technical Education)
   - Ministry of Labour and Employment, Directorate General of Employment and Training (for Vocational Training)
   - There are some other 20 Central Ministies and Departments which are running some small TVET programmes.
2. State Government

- Directorate of Technical Education

Vocational Education System

Vocational Education in India cover education and skill development at all levels from post primary to tertiary education - both through formal and non-formal programmes. Vocational Education at the +2 stage, also known as higher secondary stage, develop competencies (knowledge, skills and attitude) required by a specific occupation or a group of occupations, through diversified vocational courses to prepare pupil for the world of work, especially for self-employment.



The Vocational Training in India was imparted by mainly two types of bodies:

- Public Industrial Training Institutes (ITIs)
- Private owned Industrial Training Centres (ITCs)

The DGE&T (Director General Employment and Training) generally regulates these ITIs and ITCs at national level and implements policies for vocational training.

The important bodies under Director General of Training under Ministry of Skill Development and Entrepreneurship are as follows:

1. The **National Council for Vocational Training** (NCVT): NCVT is an advisory body entrusted with the responsibilities of prescribing standards and curricula for craftsmen training, advising the Government of India on the overall policy and programmes, conducting All India Trade Tests and awarding National Trade Certificates.
2. Mentor Council
3. Central Apprenticeship Council

Other government and private bodies providing vocational training in India are:

1. Khadi and Village Industries Commission (KVIC)
2. Tool Room & Training Centers (DC, MSME)
3. National Manufacturing Competitive Council (NMCC)
4. CAPART (Council for Advancement of Rural Technology)
5. Society for Rural Industrialization
6. Ramakrishna Math and Ramakrishna Mission

Australia

Vocational Educational and Training (VET) forms an integral piece of the Australian Education system and is designed to deliver workplace specific skills and knowledge based competencies. VET is a sophisticated system governed by interconnected government and independent bodies functioning within a strict National Skills Framework of qualifications defined by industry Training Packages and explicit quality delivery standards, the Australian Quality Training Framework (AQTF).

The strategic frameworks for Australian Vocational Education are as follows:

1. Australian Qualifications Framework (AQF): Defines all nationally recognized qualifications. It provides a single framework for all qualifications from Senior Secondary Certification to PhD. Under the AQF, the achievement of a group of competencies leads to the attainment of a VET qualification. The following qualifications can be issued within the VET sector: Certificate I; Certificate II; Certificate III; Certificate IV; Diploma and Advanced Diploma.
2. Australian Quality Training Framework (AQTF): Is the national set of agreed standards and conditions for training providers to assure nationally consistent, high-quality training and assessment services for the clients of the VET system. Registered Training Providers (RTOs) must comply with the:
    - AQTF Essential Conditions and Standards for Initial Registration or
    - AQTF Essential Conditions and Standards for Continuing Registration
3. National Training Information Service (NTIS) is the database on vocational education and training in Australia. NTIS is the official national register of information on Training Packages, Qualifications, Courses, Units of Competency and Registered Training Organisations (RTOs) and has been developed for experienced training sector users.
4. Industry Training Packages: define the qualifications available by industry sector; developed by Industry Skills Councils; endorsed by the National Quality Council; and listed on the National Training Information Service.
5. Training providers or Registered Training Organisations (RTOs): Is a vocational education organisation that provides students with training that result in qualifications and statements of attainment that are recognised and accepted by industry and other educational institutions throughout Australia. Only RTOs can deliver accredited training and assessment and issue AQF qualifications. Their ongoing compliance with the AQTF is audited by either the national or their state VET Regulator. RTOs are registered to deliver qualifications in nominated Training Packages. The register of RTOs and the qualifications each is accredited to deliver is found on the National Training Information Service (NTIS).

The strategic players involved in imparting vocational training in Australia are:

1. Ministerial Council of Tertiary Education and Employment (MCTEE) has overall responsibility for the national training system. This includes strategic policy, priority setting, planning and performance, and key cross sectoral issues impacting on the national training system, such as skills forecasting, workforce planning (including skills needs) and articulation between higher education and vocational education and training.
2. The National Quality Council is a Committee of the Ministerial Council for Tertiary Education and Employment (MCTEE), and oversees quality assurance and ensures national consistency in the application of the Australian Quality Training Framework standards for the audit and registration of training providers. It has specific decision-making powers in relation to the endorsement of Training Packages and other aspects of the quality assurance under the National Skills Framework.
3. State Training Authorities. Each Australian state and territory government has a training authority that administers vocational education and training (VET) – allocating funds, registering training organisations and accrediting courses. The state and territory training authorities (STAs) are accountable to their minister, who is a member of the Ministerial Council for Tertiary Education and Employment (MCTEE).
4. Commonwealth and state government education departments provide VET policy, advice and management services.
5. Skills Australia: is an independent statutory body, providing advice to the Minister for Tertiary Education, Skills, Jobs and Workplace Relations on Australia's current, emerging and future workforce skills needs and workforce development needs.
6. Industry Skills Councils (ISCs) work as pivotal change agents within the national training system, the mandate of Australia's Industry Skills Councils is to bring together industry, educators and governments and unite them on a common industry-led agenda for action on skills and workforce development. Industry Skills Councils collect information on training needs from industry employers, unions and industry professional associations in order to provide advice to government on what training is required within their industry. ISCs are the main source of information about the development of training packages, their status and packaging rules.
7. Industry Training Advisory Bodies (ITABs) are autonomous, industry based bodies that are able to speak on behalf of their state industry sectors on training and related matters to support the vocational education and training (VET) system. They work in tandem with national Industry Skills Councils to assist industry with workforce development needs, assisting industry to achieve and maintain a workforce with the right levels and mix of skills to meet business goals. ITABs also provide a range of advisory and consultancy services to government employers and RTOs on the vocational training, skills and workforce development needs their specific industry sectors. ITAB Directory.

United Kingdom

The overall policy for education, vocational learning and skills is the responsibility of the learning or education department of each national government. Universities are independent institutions with their own charter. No single piece of legislation provides the basis for the legal framework for education and training in the UK. Governance and system development is regulated by a series of laws, covering different aspects of education and training. The recent major acts of Parliament are: the Learning and Skills Act of 2000, which reformed the organisations responsible for managing the further education sector; the Education Act of 2002, which included measures to increase schools' flexibility with respect to the curriculum, staffing and governance; the Employment Act of 2002, which included an introduction of a new right to time off work for union learning representatives.

	England	Wales	Northern Ireland	Scotland
Overall policy for Vocational education and skills	Department for Education and Skills (DfES)	Welsh Assembly Government Department for Training and Education	Department for Employment and Learning Northern Ireland (DELNI)	Scottish Executive: Scottish Executive Enterprise, Transport and Lifelong Learning Department (inc. HE but not schools)
Funding of providers in the learning and skills sector (colleges of further education, adult learning and work-based learning providers); determining national priorities	National Learning and Skills Council (National LSC)	EL Wa (Education and Learning Wales)	Department for Employment and Learning Northern Ireland (DELNI)	Scottish Further Education Funding Council (SFEFC), Scottish Enterprise and Highlands and Islands Enterprise through local enterprise companies (LECs) fund work-based learning
Determination of priorities at regional level and rationalisation of provision	Local learning and skills councils (Local LSCs) via the strategic area review (StARs) process Liaison with regional development agencies	EL Wa regional officers via regional statements of needs and priorities and in consultation with community consortia for education and training		Scottish Enterprise (SEn) and Highlands and Islands Enterprise (HIE) working with local enterprise companies (LECs)

	England	Wales	Northern Ireland	Scotland
Inspection of provision in colleges and work-based training	Adult Learning Inspectorate (ALI); for those aged 16-19 this is undertaken jointly with the school inspectors Ofsted (Office for Standards in Education)	Estyn (Her Majesty's Inspectorate for Education and Training in Wales)	DENI (Department of Education Northern Ireland) on behalf of DELNI	HMIE (Her Majesty's Inspectorate of Education) Scotland, as for Scottish Schools Local enterprise companies (LECs) inspect work-based learning
Research and staff development	Learning and Skills Development Agency (LSDA), which also runs the learning and skills research network	Dysg (Welsh arm of LSDA)	LSDA Northern Ireland	Scottish Further Education Unit

3. Situational analysis of the VT in Afghanistan in Energy sector

3.1. Overview of the VT Administrative system in Afghanistan

Vocational Training plays a crucial role in sustainable development (social, economical & environmental development) of a country. The first role is to provide training opportunities and career advancement avenues for the increased school leavers. The second role is to provide skilled manpower that is needed at all levels of the economy. The skills so developed should be able to lead to self-reliance in the absence of salaried employment and enhance the industrialization process.

The development of Technical and Vocational Education and Training (TVET) is an essential foundation for the sustainable development and poverty alleviation in Afghanistan. The Afghan labor market currently faces an acute demand for skilled and semi-skilled people in order to cope with the rapid pace of reconstruction of the country. However, unemployment remains persistent among young Afghans because many do not have the technical skills that are urgently needed for reconstruction efforts as well as the overall economic development of the country. In absence of sufficient local skilled workforce the country has to hire them from other countries and pay high wages out.

Most of the vocational training (VT) institutes in the country are facing a number of serious issues and a great lack of qualified resources. Access to VT is severely hampered by the lack of sufficient and properly equipped learning spaces and facilities. Student enrollments in VTs are very low compare to other academic education. The very low participation of girls raises issues related to the social constraints they are facing and the relevance of the training opportunities offered to them. On the other hand, Amongst the different challenges listed above to socioeconomic development and job creation, the International Labour Organisation's recent report[7], shows that existing capacity development and job creation programs delivered by international and local, public and private, governmental or nongovernmental organizations are in general poorly linked to labour markets. Most tend to exclusively focus on direct and visible outputs, taking little account of employment outcomes.

The existing curriculum offered in the VT institutes does not fully match the needs of the labor market demand and needs to be updated in order to strengthen the quality of VT in the country. Other factors such as the low qualifications of teachers, low salary levels that make it difficult to recruit people with the necessary qualifications and professional experience and high pupil/teacher ratios also affect the current quality of VT institutes. Shortage of qualified teachers, maintaining a good salary range, engaging professional experienced workforce in the system is a big challenge. The linkage between training centers and job market and industry is missing.

A huge problem has been noticed in the VT system in Afghanistan is lack of research by both the teachers and students because it do not have sufficient resources for research, nonexistence of a single

[7] Time to Move to Sustainable Employment_ILO, 2012

portal for information and the system is not wise "teachers influence students for their own purpose, in anyway."

Moreover, it seems that some practical works has been also done in VT system especially the key contributing ministerial offices i.e. Ministry of Education, Ministry of Labor, etc. with an adequate limit of private sector involvement has managed to prepare standards and currently working to develop curriculums for the VT institutions to lead them toward standardization and adopt international and market-driven standards and curriculums. Establishment the Afghan National Qualifications Authority (ANQA) and Development and Implementation of the Afghan National Qualifications Framework (ANQF) are in process. This is a tangible outcome in recent years and putting these efforts in practice through VT institutions can be an inventive and effective step moving toward standardization and modernization of the VT in the country.

3.2. Education Situation in Afghanistan

Overall student enrollment:

Student enrollment has been increased rapidly during the last decade. While only one million children (almost all boys) were enrolled in schools in 2001, over 8.6 million children were enrolled in 2013 of whom 39% were girls. Student enrollment in general education reached 8.6 million students in 2013, of which around 208,000 students study in 5,922 community-based classes and about 185,000 students in cross-border schools.

Number of students, teachers, and schools per type of education in 2012[8]

Particulars	Students			Teachers			Schools
	Female	Male	Total	Female	Male	Total	Total
General Education	3,376,886	5,219,511	8,596,397	61,320	122,858	184,178	14,599
Islamic Education	53,048	207,469	260,517	502	6,311	6,813	1,001
TVET	8,147	52,857	61,004	524	1,757	2,281	244
Literacy	207,857	254,047	461,904	7,227	6,944	14,171	19,787 course
Teacher Education	35,584	41,166	76,750	489	1,977	2,466	42 TTCs and 210 District centers and 57 satellite schools

Gender wise student enrollment ratio

The MoE estimates that gross enrollment ratio (GER) for all levels and all types of education were 69% (56% females and 82% male) in 2013. This is based on UN Population Division estimate of Afghan population and the number of students excluding permanent absents who are about 13% of all students

[8] Ministry of Education, Islamic Republic of Afghanistan

(about 1.1 million in 2012). The overall Gender Parity Index (GPI) was 0.65 in 2013 which means there is an extreme gender disparity in Afghan education.

GER and GPI per level of education in 2013

Gender	Primary	Lower Secondary	Upper Secondary	Total
Female	71%	40%	28%	56%
Male	99%	68%	49%	82%
Total	86%	54%	39%	69%
GPI	0.69	0.57	0.54	0.65

GER and GPI vary considerably among provinces and between rural and urban areas. For example, in 2012 while GPI in Hirat and Badakhshan was 0.9 (9 girls to 10 boys), GPI in Zabul and Uruzgan was 0.1 (1 girl to 10 boys).

3.3. VT in Afghanistan-An Overview

Afghanistan is one of the world's least develop countries with a young and mostly unskilled labour force growing at an annual rate of around 400,000[9]. The per capita gross domestic product was $528 in 2010-11 with more than a third of the population living below the poverty line while more than half are vulnerable and at serious risk of falling into poverty. Illiteracy is estimated at around three quarter of the population[10] . Unemployment is estimated as being between 30 and 40 percent of the total workforce, which is roughly 50 percent of an estimated 25-30 million inhabitants.

The Government of Afghanistan envisions "an education sector that engenders a healthy workforce with relevant skills and knowledge as a key to long term economic growth[11]. Technical and Vocational training are crucial components in the Afghan National Development Strategy and form National Priority Program I. Main reason for the Govt. of Afghanistan to invest & support for expansion of VT is to absorb a number of those students who fail to enter universities due to the large number of high school graduates and insufficient number of places at Universities. Another key concern is the high rate of unemployment and insufficient capacity to provide education and skills training as a means to increase human capital and henceforth employment possibilities. VT programming in Afghanistan is expected to reduce the number of unskilled and uneducated young people, expand the skills base in the labor force and thus contribute to longer economic development needs of the country.

The current VT system in Afghanistan needs to become a demand, rather than supply driven system. The effort must be made to establish the current skills needs of the labour market and develop more modular / tailor made solution.

[9] Afghanistan: Time to move to Sustainable Jobs
[10] World Bank_ Transition in Afghanistan
[11] Afghanistan National Development Strategy 1387-1391

TVET comprises formal, non-formal and informal learning for the young, women & men to enable them to work in a wide range of institutional and work settings and is diverse socio economic contexts. The Third National Congress on Technical and Vocational Education and Training (TVET) was held in Shanghai, People's Republic of China, during May 2012. The goal for this congress was "transforming TVET and building skills for work and life". Some of the most pressing issues identified during the congress for the future of TVET were as follows;

New paradigm for TVET	• Skill development programme should be demand driven.
Social equity & inclusion	• New ways for TVET to become inclusive of the vulnerable is society such as young women.
Policy coherence & governance	• Active involvement of relevent actors, e.g. industry, ministries of education, worker's guide & association, civil society, etc. in design & delivery process of TVET.
Integrated policy making in skill development	• TVET should become a more integrated component of general education.
Research & TVET policy	• New reserch on Skills development is required to contribute in the knowledge base of the TVET policy makers.

There are some other issues such as context relevancy, efficiency and effectiveness in programme implementation, measurable impacts and sustainability continue to present challenges for the donor such as GIZ, World Bank, USAID, etc. with a mandate to support TVET programming in Afghanistan over the longer term. Some of the other key issues are also identified[12] which are given below;

- Gaps between TVET programme and market needs, resulting in a supply driven approach to programming that fails to meet the demand for skills in the Afghan job market.
- Insufficiency emphasis on elevating proficiencies in existing traders/occupations
- Insufficient and inadequate training for emerging traders/occupations.
- Little or no provision of supervisory or middle management skill training.
- Insufficient investment in foreign language (mainly English) education.
- Insufficient investment in more sophisticated forms of computer usage for basic information, research, learning and outreach/advertisement.
- Insufficient or no collaboration of private sector & VT institutes, etc.

[12] DAI, Afghanistan TVET provider's inventory

3.4. TVET mission, strategy and legislation in Afghanistan

TVET mission

Article 20 of the Law on Education sets out the objectives of TVET in Afghanistan, which are to:

- Train human resources in technical-professional, vocational and artistic fields needed by the society and international market, taking into consideration national and international standards with special concern to the needs of women;
- Develop and expand knowledge and skills through theoretical and practical training in the fields important for national development;
- Provide special education for blind and disabled people in relevant fields;
- Prepare students to be admitted to tertiary level institutions and universities.

TVET strategy

The Afghan Ministry of Education aims to address the serious challenges facing the education system including TVET and amongst others has set the following targets:

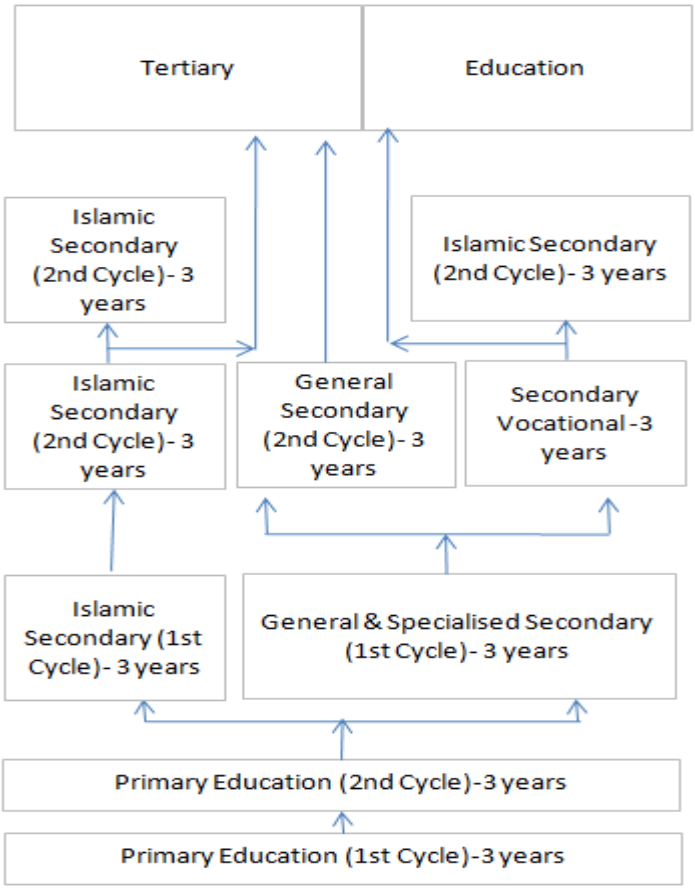
- To increase access to TVET through the establishment of new institutions such as regional institutes from 16 to 32, provincial schools from 38 to 102 and district school to 364 during the years 2009-2014;
- To increase the enrolment and training of TVET students from 19500 in 2009 to 150000 in March 2014, increase female participation in TVET to 30% and to increase disabled participation in TVET to 1000 students;
- To develop teachers' capacities for delivering better services by: (1) making sure that 40% of the TVET teachers pass competency based exams up to 2014; and (2) making sure that 80% of the TVET teachers are using active participation methodology;
- To provide quality and market-aligned curriculum and training materials to the students; and
- To equip schools with quality and market-aligned equipment.

TVET legislation

- The Law on Education adopted by the Cabinet of Ministers in 2008 outlines the general principles of education in Afghanistan. Article 5 of the Law stipulates that public technical and professional, vocational and artistic education is free of charge.
- The National Skills Development Plan (NSPD) is a national priority programme signed by the president of Afghanistan in Berlin in 2004. The goal of NSPD is to contribute to the socio-economic recovery of the country through the development of a national TVET system that is responsive to the needs of the labour market and that provides the population of the country with skills and knowledge for decent employment. NSPD consists of two components: (1) funding of short-term vocational training for building the TVET system; (2) Development of National Occupation Skills Standards

(NOSS); (3) assisting in the development of a National Qualifications Framework (ANQF); and (4) building the capacity of trainers and training providers.

3.5. TVET formal, non-formal and informal systems



Formal TVET system in Afghanistan

According to a report on TVET issued by the "Committee on Education and Skills Policy- CESP (2010)" the provision of TVET is assured by the following establishments:

- NGOs (comprising 30,000 students and assuring the provision of basic vocational skills);
- Private sector (comprising 150,000 students and assuring the provision of vocational skills mainly in computer literacy, English, management and accounting); and
- Public sector: the provision of TVET is assured by the following ministries:

  - The Ministry of Labour, Social Affairs, Martyrs and Disabled (MOLSAMD) oversees 20 training centers providing short-term courses for public sector employees;
  - The Ministry of Education (MoE) coordinates and administers 140 public TVET High Schools and 70 public TVET Institutes while 40 private TVET Institutes are licensed and 120 others

are in the process of being licensed. All of these institutions provide 2-year, 3-Year and 5-year programmes.

TVET education comprises:

- Agriculture, Livestock and Veterinary;
- Technical and Vocational;
- Business Education;
- Construction and Engineering;
- Fine and Arts;
- Special and Inclusive Education Sectors.

The Ministry of Higher Education (MOHE) enrolls 6,500 students in different academic institutions providing programmes in the fields of medicine, agriculture and economics. Post-secondary education, grades 13 and 14, is provided by vocational education colleges, teacher training colleges and Islamic colleges (Dar-ul-Ulums). TVET offered in schools under the authority of the Ministry of Education is mainly for graduates of grade 9. Depending on the field of specialisation and trainee's entry level, programmes last from 2 to 5 years. Upon successful completion (end of grade 14) a diploma or an associate degree is awarded.

Those students who perform better in TVET can be transferred to universities and the credits for the courses already completed are recognised. A reverse transfer is also possible, when students who have completed a university degree in the humanities and social sciences can pursue skills training of different durations at a TVET college.

Non-formal and informal TVET systems

The Ministry of Labour, Social Affairs, Martyrs and Disabled provides short-term vocational skills training courses with the emphasis on practical work that usually last for less than 1 year.

TVET programmes in Afghanistan are offered in a range of disciplines such as carpentry, plumbing, motor mechanics, television repair, electricians, photography, computer studies, music, languages, etc.

Overview of TVET providers

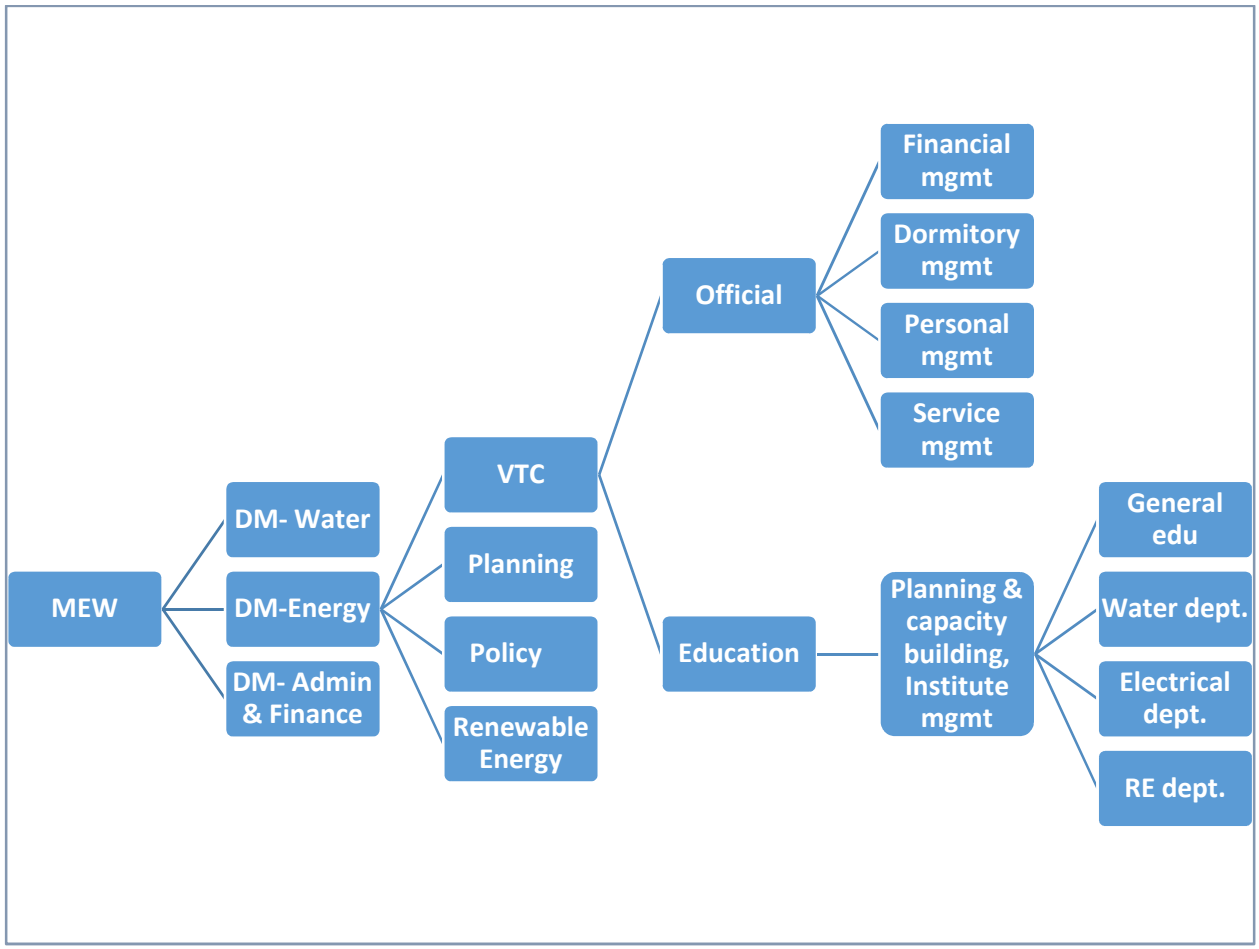
Provider Type	Level	Delivery	Managed by
Public TVET institute	Grades 13-14	Formal	MoE
Public TVET high schools	Grades 10-12	Formal	MoE
Public TVET training centers	Short term (6-12 months)	Non-formal	MoLSAMD and NSDP
Private TVET providers	Mix of above	Mix of formal and non-formal	Not all have contacts with MoE, MoLSAMD and/or NSDP
NGO TVET providers			

4. Institutional Assessment of the MEW VTC

4.1. Assessment of existing institutional framework of VTC

Ministry of Energy & Water (MEW) has overall responsibility for electrification, mainly to provide energy needs to the bulk of the population in Islamic Republic of Afghanistan. MEW is the Government's institution for all issues relating to electricity generation, transmission and distribution, pricing, regulation and consumption. It also serves to coordinate and plan the nation's power sector, formulate policy and liaise with provincial governments on related issues.

Ministry had assessed that there will be a huge requirement of trained manpower for the power sector in Afghanistan. Due to lack of trained manpower available in the local market in 1983 MEW has opened up a technical primary school. In 1993 it was promoted as a technical high school and from 2003 it was recognized as a Vocational Training Institute.



4.2. VTC and Renewable Energy linkage

Energy sectors worldwide are undergoing rapid transformations towards a more sustainable and low-carbon pathway utilising renewable resources. In Afghanistan, renewable energy technologies not only present a more future-oriented technology choice but are in addition a promising way for expanding access to electricity to a larger part of the population (both on and off the grid). To bolster this transformation process in Afghanistan and to build renewable energy markets, capacity building, innovativeness and operation & maintenance of renewable energy installations are essentially required.

Skills to be developed in the renewable energy sector have to cover a wide range of different aspects of the value chain, depending on the choice of technology for a particular project. For solar photovoltaic systems, for example, engineers as well as technicians will be required to cover the whole value chain from assembly of solar PV modules, to project development skills for PV system design, resource assessments, business plans, etc. Project planning skills are central, while particular technical and electrical skills will be needed to construct and assemble solar PV plants. Similarly, hydro, wind, bio-mass power plants, etc. need particular sets of skills in order to develop, build, and operate projects.

Appreciating this future need for skill development in renewable energy aspects, in 2012 the Ministry of Energy & Water (MEW) has incorporated a new graduate course on renewable energy technology in its vocational training center (VTC).

In the above chapter it has been elaborated that different type of technical skills required in different type of renewable energy projects and it also shows that how they may vary according to technology (e.g. hydropower, solar photovoltaic, solar water heating, biomass for electricity generation, biogas, etc.) and type of application (e.g. small off-grid household system vs. larger on-grid plant).

4.3. Conceptualization of VTC

Afghanistan's Ministry of Energy and Water (MEW) is struggling to improve the reliability and availability of its electricity infrastructure. These efforts are exacerbated by a lack of skill sets needed for routine operations and maintenance in the existing and upcoming power plants. The Vocational Training Center (VTC) is the primary instructional resource for MEW serving two purposes: 1) technical high school/institute (grades 10 –14); and, 2) professional development courses for MEW staff.

The VTC structure contained dormitories for residential students, laboratories for practical instruction, classrooms, and a library. The VTC was accredited by the Ministries of Education and Higher Education. The majority of graduates from the VTC are employed by the national electrical utility, DABS, providing a critical stream of personnel to perform a variety of technical functions – assistant engineers, technicians, welders, electricians, civil works, water resources, etc.

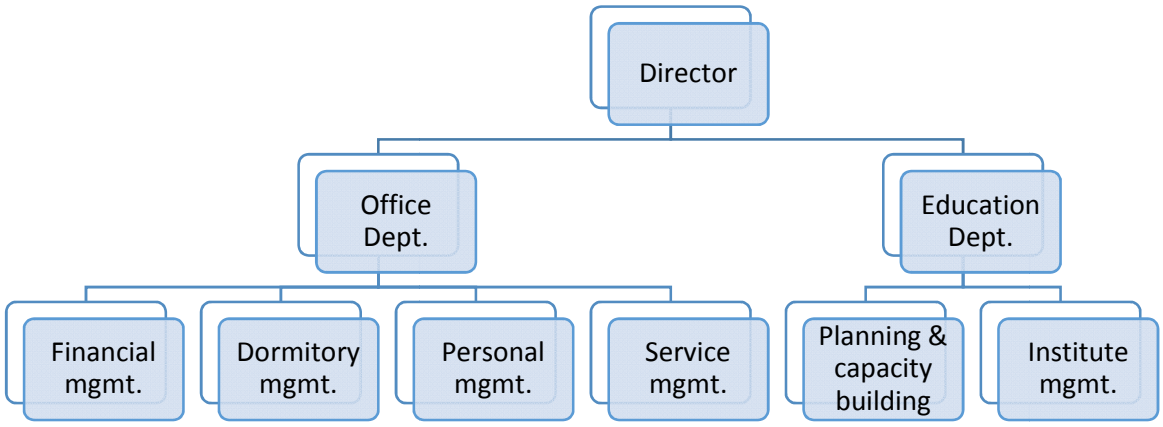
4.4. Significance of VTC in Afghanistan

Vocational Training Center has a relatively long history in Afghanistan. It was established in 1983 as a technical primary school with two major departments electrical & water and in 2003 it was promoted as technical institute. In 2012, MEW has incorporated a new department which called as renewable energy department. The subject is very much linked with the labour market scenario. It will provide the required trained technicians in power sector in Afghanistan. Except VTC no other VT institutes are offering the Renewable energy courses. Presently, VTC is offering following subjects in the field of renewable energy: Mini & Micro hydro power and solar power.

In 2014, The Kabul University (KU), Faculty of Engineering (FE) has incorporated a new engineering department on Energy Engineering (EnE). Total 50 students were enrolled to this new department & in 2017 they will be passed out from KU as graduate engineering in energy engineering.

4.5. Management structure of the VTC

MEW-VTC is lead by a director. After director there are two departmental head official & education department. Under Official department there are three division financial, dormitory & personal management. Education department has two division Planning &capacity building and institute management.



4.6. Cooperation between other ministry, department and private players

VTC is completely managed & operated by the MEW. Course curriculum development & the degree certificate are provided by Ministry of Education. Employees (mainly technicians) of DABS are trained in

VTC (night shift) according to their internal requirement. DABS provide practical training exposure to the VTC students in their sub-station & also recruit as per the project requirement.

In order to tap into Afghanistan's significant energy potential and provide rural populations with power and alternative fuel sources, rural energy technologies are piloted and implemented across the country by MRRD. They are also linked with VTC-RED by providing their key inputs on curricula development. Something they recruit VTC students as per their requirement.

Private sector like Qaderdan Rural Technology Development Workshop is also associated with VTC for providing practical expose to the VTC student.

4.7. Labour market linkage & Objectives of RE Department of VTC

- Train professional people in the field of renewable energy according to the need of Energy Sector in Afghanistan.
- Train professional people to properly use and benefit from renewable energy network.
- Providing training on how to transmit & distribute the energy to remote villages through renewable energy networks.
- Promote the use of RE networks across the country.
- After graduating from VTC-RED, students are able to establish, install/activate, utilize and O & M of power plants.
- Routine check & prevent any damages to the civil, mechanical, power and hydraulics parts and systems as well as micro and mini hydro power plants.
- Control and prevent damages to low and medium voltage systems.
- Repair mechanical and hydraulic parts (welding, cutting, drilling, etc.)

4.8. Faculty details of VTC

Departments	Education qualification of faculty members in VTC								
	Master		Bachelor (16th grade)		Graduate 14th grade		Laboratory (14th grade)		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Electrical	2	1	4	-	4	2	3	2	18
Water Resources	-	-	6	2	-	-	-	-	8
Renewable Energy	-	1	2	-	-	1	1	-	5
General Studies	1	-	2	-	5	-	-	-	8

Faculty members of Renewable energy department are holding bachelor or master degree in Electrical division. VTC don't have any renewable energy experts for their RE department.

4.9. Student enrollment in VTC

The annual university entrance examination or KANKOR is the only national level examination organized by Ministry of Higher Education. The main mandate of VTC is to graduate Students of Grade 12th for 2 years and Grad 10th of school for 5 years through KANKOR exam and as well introduce by the governmental institution (e.g. DABS) for their capacity building in night shifts as they have day and night shifts. According to the marks obtained in KANKOR exam students are eligible to enroll themselves in different universities/institutes & departments for higher education.

According to this system, there are total 360 marks in KANKOR exam. Education departments have been categorized according to their market values and students choose these departments according to their market value, without considering their skills, aptitude and wishes. Students get 330 & above are eligible for medical study. After this comes the turn of engineering and so forth and the students with low scores at the bottom are left with options to accept departments that they might not like to choose. For VTC qualification marks is in the range of 220-250.

Student enrollment in VTC for last 5 years

Particulars	**2015**	**2014**	**2013**	**2012**	**2011**
Through KANKOR exam	110	92	100	126	110
From Different provinces	92	51	65	31	69
Exam for Night shift	108	118	117	116	148
Total student enrollment	310	261	282	273	293

Total No of Student graduated from VTC in Last 5 years

Particulars	**2015**	**2014**	**2013**	**2012**	**2011**
Total student of Day shift	370	420	394	400	347
Total student of Night shift	335	380	380	399	411
Total Student	705	800	774	799	758
Total student graduated from VTC	260	257	203	202	194

Note:

- Semester wise student data base is not available with VTC.
- Department/Faculty wise student enrollment data is not available with VTC.
- Any student failed in their semester exam, they are not promoted to next semester unless until they have qualify the exam.

- Semester wise student dropout rate is very high. Henceforth, it is very much difficult to get the exact figure of how much students has been enrolled in 1st semester and how much has been graduated after final semester. VTC has no such records.
- Gender ration amongst VTC student is very low. Around 5-10% girl students are studying in VTC.
- There is no data base on department wise alumni list and employment details for the VTC student.

4.10. Donor involvement with MEW-VTC

In July 2008, in collaboration with the Government of the Islamic Republic of Afghanistan, USAID launched the Afghan Energy Capacity Building Program. This project provides technical, managerial, and administrative capacity building in the Afghan energy sector, primarily the electrical sector. The Ministry of Energy and Water's (MEW), Vocational Training Center (VTC), the national utility - Da Afghanistan Breshna Sherkat (DABS), etc. are the primary beneficiaries of the project. The overall approach of the project is to develop meaningful capacity-building activities customized to meet the needs of beneficiaries, and address the immediate and long-term needs of the energy sector.

Since 2009, GIZ ESRA supports the MEW in its efforts to contribute towards country-wide electrification while focusing particularly on a sustainable decentralized electricity supply with the help of renewable energy technologies. GIZ ESRA and the MEW planed to set up an Energy Training Centre at the ministry's vocational training centre, with the intention to involve a development partnership between Siemens and MEW. Although due to internal problem in Siemens the programme has not been materialized. VTC Renewable energy department was established in 2012 within the department of Education with the support of Afghan-German cooperation. This was deemed necessary by the Ministry of Energy & Water.

Furthermore, a Curricula for a standardized 2-years training course, on Solar power technologies has been elaborated and successfully developed by GIZ. Within this process, the VTC provided support for the methodology of curriculum development and has offered further pedagogical and didactic training for the teaching staff. In March, 2012 the Ministry of Education acknowledged formally the curricula and training. The first training course (2 semesters) has started in April 2012 with the enrolment of 45 vocational students (predominately from the provinces).

4.11. Advantages and Challenges of VTC under MEW structure

Advantages:

- MEW has a strategic management system which helps VTC
- Financial support
- Technical support
- Operation support
- Job opportunity for the VTC alumni
- Easy to accesses

- Quick decision making process
- Foreign funding opportunities
- Monitoring opportunity

Challenges:

- Lack of university collaboration
- Lack of foreign university collaboration
- Lack of research opportunities
- Knowledge sharing within other technical institute
- Training of teachers

4.12. Main issues and trends

Issues & trends the VTC faces shed light on a numbers of factors which can be summarized as follows:

Strengths:

The MEW VEC system has a number of strengths:

- VTC has a glorious history. It was established in 1983 as a technical primary school under the direct preview of MEW was transformed as a technical high school in 1993. Latter on in the year 2003 it was promoted as a vocational technical institute.
- Earlier there was three departments' electrical, water & general studies. In 2012, Renewable energy department has been opened for fulfilling the demand of renewable energy technicians in Afghanistan.
- Only vocational training institute in Afghanistan, have separate renewable energy department. Energy Engineering Department has been incorporated in Kabul University in 2014 and first batch will receive their bachelor's degree in Energy Engineering in 2017.
- Governance and coordination bodies: Ministry of Education, Ministry of Energy & Water, Technical working group in VTC.
- Working relation with DABS.
- Donor's coordination mechanism: GIZ, USAID, etc.
- International initiatives on renewable energy curriculum development.
- Public spending in VTC has been increased.
- Enrolment in VTC increased.
- Basic infrastructure in VTC: Classrooms, library, laboratory, equipments, computer lab, dormitory, etc.
- Availability of enough land for new study building, workshops, etc.

Challenges:

- Lack of qualified & young professionals. Many of the faculty members do not have any hands on practical exposure in the subject matter.
- Renewable energy technology is a new domain to the students as well as teachers also.

- Lectures & text books are not upto the mark and available in local language only. Most of the curriculums in VTC are old except solar technology.
- Student do not get assess of International journal or publication on renewable energy technology.
- Curriculum is not harmonized with modern technologies
- Teachers as well as students are not familiar with research methods.
- Imbalance theory (approx. 60%) and practical (approx. 40%) classes in VTC. The subjects are more practical than theoretical which is reversed in VTC.
- Poor dissertation facility for the students. They can get only 2-3 weeks for their dissertation.
- Weak system management (MIS, M & E, etc.).
- Poor administrative system in VTC.
- Lack of information publicly available regarding VTC. Institute doesn't have its own website. Weak in public relations and institutes awareness.
- There is no database for alumni of the VTC.
- No on campus placement has been organized by VTC. Students have to find jobs their own way. There are no records on how many students got their job after completing their graduation form VTC
- No/poor industry linkage with VTC. Course curriculum is not developed as per industry/market requirement. No stakeholder consultation has been organized during preparation of course curriculum.
- Low relevance to labour market skills demand, institutional and operational links with industries and sectors.
- VTC has no connection and cooperation with internal and foreign universities.
- Quality career guidance based on labour market information is not available to VTC students.
- Most of the VTC passed out students (alumni of 2015) are mostly unemployed & underemployed. Most of them have been sifted to different trade &some are enrolled for higher study.
- Salary & wedge of the VTC faculty is very poor. Institute can't hire a good academician due to financial constrain. This also demoralized the existing faculty members.
- No apprenticeship facility for VTC students.
- Lack of onsite practical training facility for the VTC students. It does not provide an adequate foundation for a career as well as a first job.
- No technician licensing facility for the VTC alumni.
- Lack of/no occupational standard followed in VTC.
- Quality assurance of apprenticeship training does not guarantee minimum standards.

Recommendations:

- Community engagement for student enrollment in VTC
- Awareness generation about VTC
- Migration of trained professional
- Systematic Professional Development of Instructors / Trainers / Teachers

- Establishment of Management Information System (MIS) & Knowledge Management (KM) System
- Establishment of Monitoring and Evaluation (M & E) Systems
- Quality Assurance of the VTC System
- Incorporation of Occupational standards in VTC
- Public Private Partnership:
- Engaging Industry as Significant Players in VTC
- Funding of TVET
- Incorporation of Internship programme in VTC
- Organisation of annual job fear & alumni meet in VTC:
- In-house publication of annual journals/research paper:
- International Cooperation

Way forward:

- Ensure that VT is more market driven (Demand driven VT).
- Control and assure the quality of VT (Quality Based VT).
- Establish more VT Institutions (Vocational Institutes, Vocational Training Centers, Technical Industrial Schools) with a view to provide technical and vocational education and training to meet the needs of the community.
- Establish different decentralized Enterprise Training Provider Partnerships ETPs for different sectors of industry.
- Set clear national VT strategies and polices.
- Increase funding towards VT. This should be directed towards research and development, acquisition of appropriate and up-to-date equipment and tools and general maintenance and management of VT institution.
- More attention or equal attention should be offered to the VT sector as that offered to the General and Higher Education HE
- Encourage industrial organizations to participate in the formulation of the curricula, provide On-the-Job Training (OJT) programmes and certify the competencies offered.
- Governments should encourage industrial organizations to participate in VT in general by creating incentives for companies, reimbursing training costs, subsidizing apprenticeship wages and for those companies who earn huge profits, by allowing for tax claiming, etc.

4.13. Strategic Models & Solutions for VTC

Considering the myriad problems facing by Islamic Republic of Afghanistan due to lack of technical manpower available in power sector, VTC is not only important, it is a prerequisite. We start by critically reviewing some of the problems and challenges facing the VTC and how VTC could be used to set priorities and alleviate these problems before embarking on suggestions on the way forward. The basic VTC system reform challenges and priorities are listed below:

4.13.1. Engaging Community as Significant Players in VTC

The child population in Afghanistan under the age group of 15 is 48 percent, which is among the highest in the world. Relatively small number of persons in the economically most productive age group 15-64 has to provide for a very large number of people in the dependent ages below 15. This implies a heavy burden for the working population, especially given the poor labour market opportunities in Afghanistan.

In order to develop a nation's economy and society, it is important to note, that in average two thirds of the population should work in jobs and that requires a skill level which is usually associated with vocational education and training.

It has been always a challenge to change the mindset of parents, the community and stakeholders about vocational education being second level choice to academic education. People tend to view VT in a negative way, as education and training meant for those who have failed in the society. Most parents (even the ones with TVET background) want to see their children becoming engineers, doctors, lawyers, etc. just because they believe this will give them better job opportunities. This challenge is vital to development of VT institute and it is apparently one of the major obstacles to improve the social status of TVET. If students who received a vocational education routinely earned same/better incomes than those who choose the academic route, then parents would factor this in their decision making.

The employers and enterprises in most of the Developed Countries are queuing up to hire graduates of TVET programmes and there are more requests from employers and enterprises each year than other graduates form generic education. This means graduates from TVET institutions in Developed Countries earn much more than the graduates from other high institutions. This in turn means parents in Developed Countries are fighting to get their children into those TVET institutions.

Although, there is a negative image of VT graduates in the modern society. A technician can be making as much money as an engineer but at the end of the day, he is still a technician with a lower social status. Money does not always equal higher social status. Apparently in some circles, a university degree is still the ticket to social mobility even if it does not lead to employment or more money. How do we change that perception so that parents use a different yardstick to measure their success as parents is

an important issue? This is interesting question and part of the answer to the question is that better quality of VT will lead to higher performance and productivity of TVET trained graduates and hence higher wages and more job chances.

4.13.2. Awareness generation about VTC

VTC suffers from a relatively poor public image, usually associated with low status jobs, low wedges and lack of personal development opportunities. Generally students enrolled in VTC as they have failed to get into higher education.

VTC needs its own website which will provide all the information regarding mission, vision & objective of the institute. Complete information regarding course curriculum offered, yearly students enrollment, faculty members, placement details of the alumni, etc. will be maintained and available in the website. VTC authorities along with other governing bodies & stakeholders will invest in public awareness campaigns to promote VTC system offering high quality VT programmes and occupational qualifications based on the needs of the labour market with clear opportunities for personal career development. The campaigns will be focus on all target groups in both urban and rural areas, employers & private business sectors.

4.13.3. Migration of trained professional

In total, 4.2 million Afghan residents (16 percent) live in a district that is different from their district of birth. Most of these (2.5 million persons) live in their province of birth and the remaining (1.7 million people) have even moved to another province. Just over half of the internal life-time migrants (52 percent) live in urban areas and only 36 percent reside in rural areas. This is an indication of significant rural-to-urban migration in Afghanistan. The importance of intra-province migration is indicated by the 59 percent of internal life-time migrants who moved between districts within the province of birth, while a – large – minority of 41 percent moved across province borders. For rural residents the intra-province migration is even more important (75 percent against 25 percent who moved to another province), but of the Kuchi migrants more than half (57 percent) were born in another province than where they reside now.

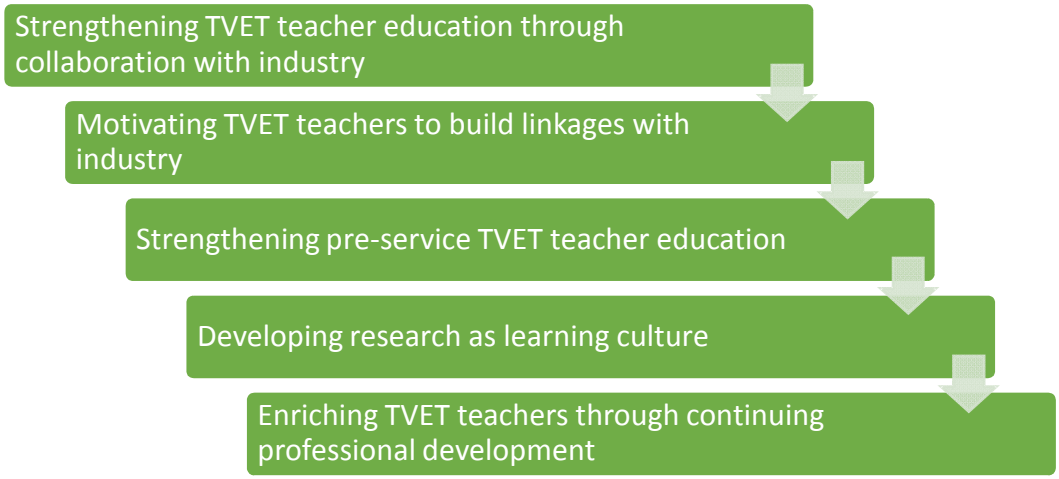
VTC is located in Kabul and it has no branches in the other provinces of Afghanistan. Students came from different provinces, after completing their graduation either they try to settle down in Kabul or enrolled themselves for higher studies. Most of the existing renewable energy power systems (Small/ micro/community base) are located in remote & isolated places in Afghanistan and majority of them are non functional due to non availability of O & M technician in that region. VTC will provide learning opportunities to those students who are residing nearby to the community based RE system so that after graduating from VTC they will go back to their native and serve to the society of Afghanistan.

4.13.4. Systematic Professional Development of Instructors / Trainers / Teachers

It is broadly accepted that the quality of teachers and trainers greatly influences the effectiveness of technical and vocational education and training (TVET) institutes in generating qualified and skilled workers. The effectiveness of any education system also strongly depends on the quality of interactions and relationships that occur between the teachers and students.

Changes in the world of work, founded upon rapid and widespread technological development, have significantly influenced the type of TVET programs that need to be offered. Furthermore, this has influenced the teaching and learning strategies employed by TVET teachers, rendering the nature of TVET unique from all other areas of teaching.

Existing systems generally tend to provide the same pre-service training preparation for TVET teachers as received by their counterparts across the wider field of teaching. Moreover, many TVET teachers enter the classroom without the benefit of an industrial background, and having often lacked the opportunity to experience the world of work. Efforts to strengthen TVET teacher education must therefore adopt a dual focus, incorporating both the pre- training and in service phases.



Strengthening TVET teacher education through industrial collaboration

Industry is an essential component in ensuring the effectiveness of TVET institutions in generating qualified and skilled workers. Linkages between TVET institutes and employers empower TVET teacher education through the acquisition of practical skills, positive professional attitudes and the gradual development of teachers' understanding of working within industry. TVET institutes depend upon industry as a means of accessing the latest technology and practices, as well as indicating the level and types of skills currently required. An effective relationship between TVET teachers and industries will thus ensure that TVET curricula and teaching methodologies are relevant and up-to-date. The close collaboration between TVET teacher education and industry would significantly improve the quality and

relevance of TVET. The success of TVET teacher education (and therefore indirectly, TVET education) is highly dependent on the quality of linkages, emphasized by one participant's characterization as the "backbone" of TVET teacher education.

Motivating TVET teachers to develop linkages with industries

Institute-industry cooperation should be established and continuously harnessed. TVET institute management should develop intrinsic motivation for teachers to succeed in developing linkages with industry. This involves ensuring that working conditions- physical, social and psychological - function in a manner that exceeds minimum standards of quality. More specifically, motivated teachers should be supported by an advisory committee in their efforts to build linkages with industries.

Pre-service TVET teacher education

Most of the pre-service TVET teacher preparation programs are offered to those who will be teaching in general secondary schools. During the TVET teacher training period, many TVET student teachers only receive pedagogic experiences, rather than any practical insight into industry. Participants stated that their experiences of different institutions showed that lecturers prefer teaching largely obsolete theory-based TVET. It is evident that many lecturers still feel proud and comfortable teaching in a method rich in theory yet short on practice. Many TVET teachers enter the classroom and act according to what they were taught, and not necessarily what is best for their students. Consequently, the learning content is often misaligned with the realities and expectations of the learners. In most TVET teacher institutes, no clear distinction is made between the pedagogical requirements of teaching TVET compared to others subjects within secondary education. Many TVET teacher educators still hold the opinion that the most important element of pre-service TVET teacher training is to master the technical subjects, with pedagogic knowledge and skills treated as an insignificant addition to the vocational subjects.

Developing research as a learning culture

It should be mandatory to develop research as a learning culture within TVET teacher education, citing the shifting expectation that research will become increasingly important in higher education. Research should be a central part of any teacher's education, prompting the question of how it should fulfill the specific needs of TVET teachers. It important to gain insight into the type of learning environment, teaching methods and appropriate learning materials to enable TVET students to learn most effectively, and also consider the development of their individual personality. The findings will vary across different TVET disciplines and professions, further underscoring the need for TVET teachers to develop research as a learning culture.

Continuing professional development

TVET teachers need for continuing professional development as part of their lifelong learning education, by applying the recognition of prior learning (RPL) approach. Some teachers may thus already possess the skills and knowledge that enables them to gain a qualification without completing a standard training or course.

Continuing professional development of TVET teachers should be under the term of a professional growth plan. With input from a supervisor, this is intended to outline a number of measurable activities of an individual teacher's development over a stipulated time period. The evidence can be collected in the form of a portfolio, which can be revisited every year to ensure that teachers remain on track with their progress. The teacher's main activities within their professional growth plan should be customized according to their individual needs. The list can be extensive, but in general would differ between a new and an experienced teacher. It is important that the individual teacher should take responsibility for their plan, rather than it being left entirely to the administrator. One importance activity within the professional growth plan of a TVET teacher could be their release back into industry for a period of 6 months. This offered several benefits: the teacher would have an opportunity to network with practitioners in the field; they would learn about current techniques, skills and work processes; and finally, employers might feel that what they are offering is appreciated by the TVET institute and that the institute takes learning seriously.

4.13.5. Establishment of Management Information System (MIS) & Knowledge Management (KM) System

Management information System (MIS) is generally established within VT Reform Systems / Projects / Programmes in order to:

1. Provide a process that facilitate an effective, efficient and timely internal information and data collection from different VT Institutions and Training Providers and make it accessible to all levels with a view to manage VTC effectively.
2. Support the management of most of the administrative functions such as finance; personnel, student admission, resource planning, payroll functions and library functions, etc.
3. Support the sharing of information from resources which are fully familiarized with the prime collectors of labor market details and statistics.
4. Establish a platform for external partnership involvement with the information system related to the labour market.

On the other hand, a Knowledge Management (KM) System within a VT Reform System / Project / Programme is used as a process through which the VT Institutions generate value from their intellectual (intelligence) and knowledge based assets. Most often, generating value from such assets involves organizing and collecting, together in a systematic way, what the staffs of a particular VT Institution or

particular customer (enterprise) knows and sharing that information among different VT Institutions and customers (enterprises) in an effort to collect best practices.

4.13.6. Establishment of Monitoring and Evaluation (M & E) Systems

Monitoring System measures the progress of learning, education & training activities, programmes etc. and it ensures that the objectives have been attained. While "Evaluation System' on the other hand is used to assess and determine the effectiveness and relevance of the learning, education & training activities and programmes in the light of the stated objectives.

M & E Systems are the key to an effective measurement of the entire VTC Reform Project / Programme and essential tools of ensuring quality improvement. With the appropriate indicators, tools and processes, M & E Systems establish performance standards or indicators that would be used to track past performances and forecast future outcomes.

4.13.7. Quality Assurance of the VTC System

It is out most important in managing the VT Systems. A robust system is required at the national level to set traditional criteria for management of quality assurance of the VT System. Such system is generally familiar as TVET Quality Assurance Management System.

The Competency Assurance Management System (CAMS) is an established evidence based quality control and assurance system identifying the methods and procedures followed up to ensure that employees / apprentices/trainees within Enterprises and VT Institutions have the awareness, skills, knowledge and attitudes to provide evidences and perform all the tasks including Health, Safety and Environmental Protection (HSEP).

4.13.8. Incorporation of Occupational standards in VTC

Occupational standards define the competencies of a worker according to the requirements of the labour market, which are the competencies a person needs to have in order to be considered "qualified" in a certain occupation. Competencies include a wide range of skills, knowledge and attitudes necessary to perform a specific job.

The strategy envisages in Afghanistan that there will be a national qualification authority (ANQA), and a TVET Board. The TVET Board will be established with the functions of accreditation, certification, monitoring and evaluation for quality assurance, analysis of labour market needs, and the approval of National Occupational Skills Standards (NOSS). Responsibility for organizing, facilitating, approving and endorsing occupational standards tests with the TVET Board. However, as occupational standards reflect

the competency requirements of the world of work, employers' and workers' organizations, along with public and private TVET providers will be important partners in the development of the standards.

4.13.9. Public Private Partnership

International experiences proved that without strong & well define partnership between government & non-government organisation a TVET programme can not be successful. This partnership needs be strengthened and institutionalized in Afghanistan. The government has the statutory function of regulating the TVET system through establishing laws, by-laws and regulations. The Government of Afghanistan should support all the TVET and supervise their implementation through a quality management system.

4.13.10. Industry-VT Institution linkages

TEVT plays an important role in filling the gap between the general education system and the labour market. One key function is to provide people with opportunities to learn skills and knowledge that are required in the labour market that are not provided by the general educational system. For this reason, the nature of linkages between TEVT institutions and industries is critical in determining the outcome of vocational education and training. Close co-operation between TEVT institutions and industries is recognized as a key factor in the successful delivery of vocational education and training. However, in developing countries, links between employers and institutions have traditionally been weak.

There are different models of industry-institution linkages that exist internationally. These include: industry involvement in curriculum development and delivery and assessment; work placement and staff exchanges; information exchange on current practices; training of students; work experience and apprenticeships; study visits, financial and non-financial resource contributions; career guidance, counseling and placement support and management inputs. In some cases, linkages have extended to business incubation centres, and joint assessment and certification. These activities can positively influence the quality and relevance of TEVT and improve the use of skills in industry. The industry and institution linkage system is increasingly becoming the most important feature of TEVT in its orientation towards development of a workforce on the world of work.

4.13.11. Funding of TVET

One major constraint that VT institutes are facing in Afghanistan, is the limited budget and this becomes the core issue as to why VTC is not able to employ trained trainers, experts, assessors and verifiers, support them in updating and upgrading their skills, purchase most appropriate training facilities, aids and technology for practical training (On-the-Job Training OJT) and accordingly are not able to market themselves effectively, etc.

Application of the modern training methodologies implies budgets, which may not be constant along time. During the initial stage of establishing a VT System /Project, costs are high because the design, development, edition and validation of the full Training and Assessment Matrix take time and effort and it is a costly project. Costs go down as the VT Institutions / Enterprises appropriate the methodologies and the models become consolidated. Another peak in costs occurs when the training materials and facilities have to be reproduced / upgraded. This is even more critical when there are high rates of workers / trainees / students turnover.

4.13.12. Incorporation of Internship programme in VTC

Internship provides real world experience to those looking explores or gains the relevant knowledge and skills required entering into a particular career. Internships are relatively short term in nature with the primary focus on getting some on the job training and taking what's learning in the classroom and applying it to the real word. Interns generally have a supervisor who is responsible for mentoring and coaching interns during the work. Internship is an excellent way to begin building those all-important connections that are invaluable in developing and maintaining a strong professional network for the future.

4.13.13. Organisation of annual job fear & alumni meet in VTC:

A job fair, also referred commonly as a career fair or career expo, is speed dating for companies and professionals job seekers. A job fair is an event in which employers, recruiters, and institutes provide information to potential employees. Job seekers attend these while trying to make a good impression to potential coworkers by speaking face-to-face with one another, filling out resumes, and asking questions in attempt to get a good feel on the work needed. VTC has to establish an in-house placement cell and organize the annual job fair and alumni meet so that final year students can get some campus placement opportunities.

4.13.14. International Cooperation

The practical section of the VTC needs to be supported by donors and private sectors as the governmental budget cannot ensure a further development of the infrastructure and equipment. Finding better funding possibilities requires an active participation in the platforms where donors and other relevant stakeholders can meet.

The process of VTC reform requires the successful utilization of substantial expertise and resources. The VTC board should invite International partners to continue and increase their financial and technical assistance.

5. Way forward strategy

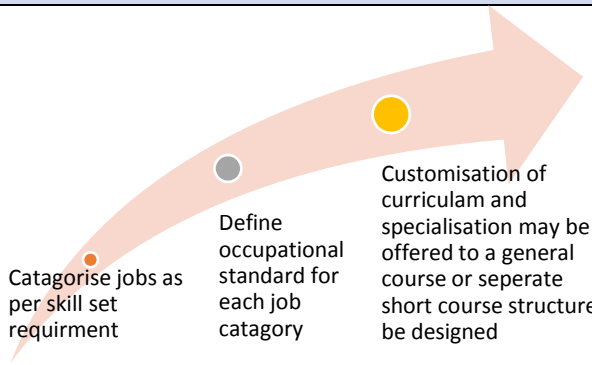
In the backdrop of the planned sectoral growth, current gap in the supply of skilled resources, the Ministry of Energy and Water, has realized the sheer importance reducing the barrier and up scaling the domestic skilling initiatives. Several programmes and schemes are initiated but accounting the sectoral growth it is most likely that the skilling initiative will fall short by a severe amount. The opportunity created through sectoral investment might be lost if the upcoming workforce does not have the access to quality skill programme. So it is therefore imperative that both government and private sector realize the critical role of skill based education system in providing the skilled manpower which can in turn boost economic growth.

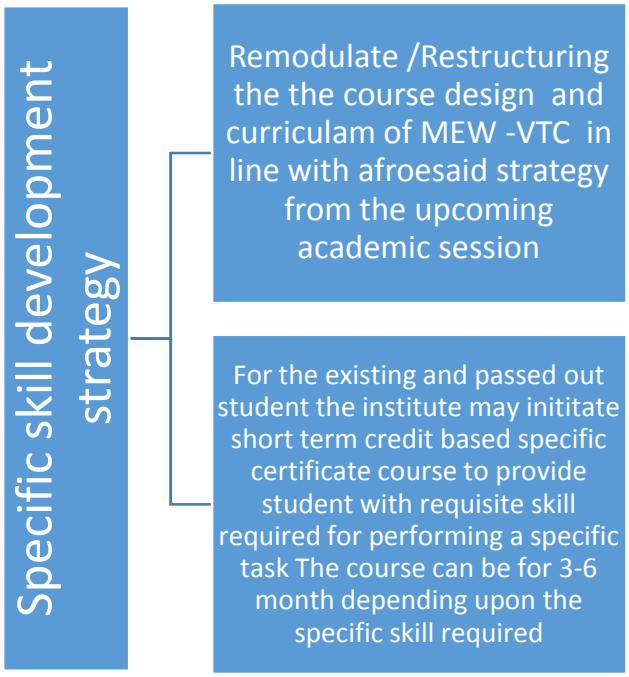
5.1. Strategic Framework

A thorough SWOT analysis was undertaken from the operational perspective of MEW –VTC following a consultative approach. In this section the endeavor is made to present a tailor-made strategy in line with international best practices to address the weakness and threat of the institutional framework in place. The sections present two fold solutions

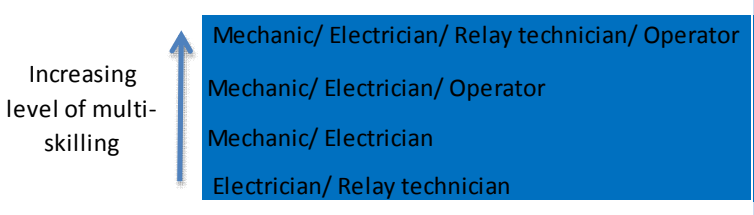
1. Initiatives that can be institutionalized at the MEW-VTC level (1)
2. Initiatives that has to be advocated at the country level (2)

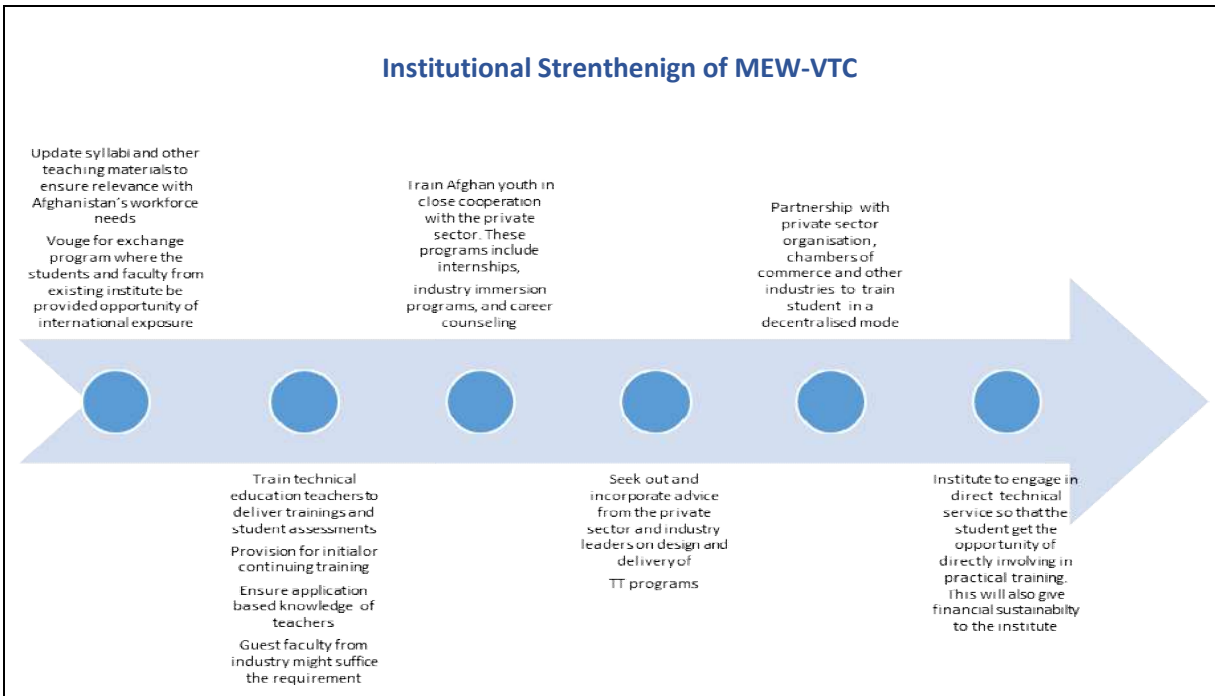
The strategic interventions are outlined as follows:

Situation /Challenges		Strategic Input
Sectoral Strenthening		
Although the different players (manufacturer, power plant management, O&M service provider, equipment suppliers) of power sector requires different skill sets for different operational requirement (installation/commissioning, operation and maintenance) the existing course structure opts for a single course curriculum, i.e. there is no differentiation of labor in respect of skill.	1 & 2	 For the prosperity of a sector it is essential to have specialized work force with specific knowledge and skill required for a particular task. This can be achieved in the following manner Step 1: Mapping standard skill and competency requirement as against different jobs role (competency/outcome related occupational standards rather than designation based job descriptions). Access the skill gap existing as against critical jobs roles based on the current education system

Situation /Challenges		Strategic Input
		Step 2: Notifying national level skill/occupational standard so all the educational unit across the country may align their course structure based on it Step 3: Develop and/or collate appropriate courses and curriculum to address the needs for skilling as per the skill/ occupational standard developed by the institute. Creating national principles for recognizing skill proficiency leading to international equivalency this will also help student in mobility. Now considering the current pattern at MEW-VTC the strategy can be 
General education and vocational education forms two separate stream in the country and there is a perception that for candidates undergoing vocational education there are no provision for further education enhancement	2	Promoting Skill qualification framework amid which general and vocational streams of education, skill training and technical education can be integrated. Moreover provision be made for 1. Aligning the basic level of skill development provision training under the preview of general school education (class 9-class 12) 2. Countering the negative perception associated with vocational education & training by development of quality qualifications that also permit acquisition of higher qualifications, including degrees & doctorates.

Situation /Challenges		Strategic Input
		3. Aligning the vocational education system with the job market. This can be done by developing certification process as against a desired skill set and government, public and private sector employer be motivated to amend their recruitment rules and defining eligibility criteria based on the occupational standard with recognition of skill based certification.
Misconception/Misperception about Vocational training course.	2	Currently, due to lack of proper communication between different stakeholders like training providers, trainees and employers there is a lack of awareness about the type of courses, trades and institutions and also about opportunities in the field of vocational education and training. This is leading to under –utilization of many courses, forbidding intake of quality students and as a result the trainees are not getting placements and employers are not getting trained manpower. The communication needs to be strengthened through awareness Programs in the Schools/Colleges/Road Shows to expand the reach by adopting innovative approaches, career counseling of students helping them explore career opportunities through vocational education and persuading employers on the competencies of the student in serving the required job roles to ensure equitable access to training to all irrespective of any gender, regional, social and sectoral divide.
No provisions for providing skill for multiple functions	1 & 2	Specialized course be designed and promoted as **Multi Skilling Institute** programme. Defining competencies and progression pathways that are not completely based on either duration of the programme or specific curricula and more of a certification based for individuals who have acquired skills through non-formal channels Case Example To reduce the cost of the resource at remotely located small capacity hydro power project the management are most often eliminating layers and then transferring the responsibilities up to the next level or down to the subordinate position. This however requires multifunctional (O&M) and multidiscipline (electrical, mechanical, technician, laborer) skilled personnel. So the concepts of hydro utility workers are in notice today who are capable of undertaking multifunction because of

Situation /Challenges		Strategic Input
		multiple skill training. 
The entrant to the MEW VTC course are selected through screening examination in which dropouts or primary education students cannot qualify	1	Not all the services, especially the support service in operation and maintenance requires student with higher education background. Rather the skill set is of more importance. So drop out underemployed or unemployed youth can be provided with customized training so that they can offer the working world a value skill set.
Lack of policy advocacy	2	Since the institute is a part of MEW, policy advocacy measure be taken up to 1. Facilitate intake of apprentices/ intern 2. Mandating intake rule to support employment of skilled certified personnel instead of unqualified people within the Power Industry 3. Creating a salary differential for those who are skilled and certified vs. those not skilled/certified 4. Establishment of sector specific Labour Market Information System
A considerable portion of student enrolled under this course belongs to a lower economic stratum resulting to dropouts	1 & 2	The ideal solution to the challenge is employability. Institutional structure should be created for job search. This will also help in bolstering confidence and self-esteem of the student. Use income support programs/assignments to train unemployed students and to get them appropriate work experience to qualify for new employment. Financial support in terms of monetary reward can be provided to student for successfully completing the course and also provision for higher education for the passed out student.
Gender empowerment	1 & 2	Participation of woman in the vocational educational course is very poor in the country. Both government institution at demographic locations and civil society organization be entrusted to promote participation of woman as an empowerment strategy.



Course curricula and course structure are designed by the institute without proper private sector consultation	1	To promote synergistic growth in the VTC sector both government and private sectors should be poised to evolve solutions for skill development for its target population. The course curriculum should be market driven and should caters to the requirement of the Industry. The private sector should also be included in development of course curricula and course structure. The VTC framework should be a **skill demand centric**
Inadequate numbers of trainers and trainers lacking adequate training for updating of professional knowledge	1	Provision to be made for enriching the knowledge of faculties through on job training of trainers programme. This can also be achieved through certification of trainers. With the estimation made for number of students to be trained for the power sector requirement it is equally important to estimate the number of faculty required, qualification and experience of the faculty. Provision should also be made towards development of a pool of certified trainers with adequate technical competency to reach the masses.
Lack of infrastructure to provide modernized skill training	1	The institute lacks the basic infrastructure to provide quality training to the student. These require either mobilization of financial assistance from the government or private parties willing to support skill development in the country. Donor may be requested for providing technical support in

		terms of developing international collaboration and facilitate exchange program and also support in developing modern amenities/ facilities for providing training to student. The institute may take a call of infrastructure development in PPP mode with the support of private sector institute from across the globe.
Lack of provision for third party quality assurance	1	A third party /institutional mechanism should be in place (core committee/ steering committee) to ensure that the training institute adopt modern and scientific training methodologies and creating an infrastructure including course materials and training aids, adequacy of the faculty and quality of the certification procedure. This also require the development of standard and provision for its periodic update for assessment and certification of trainers and as also for affiliation of course so as to ensure consistency in quality
Lack of industry association	1	The institute might make provision for providing consulting and other support to industry. This will not only help in developing industry- institute partnership but will also help the institute in the following ways: 1. Student get training on both soft skill and technical competencies required for the job market through practical exposure 2. The institute might facilitate short certification course for the on-job employee for skill up gradation. This will help in strengthening/cementing industry-institute partnership. 3. The financial received through this type of consultancy will provide economic sustainability to the institute and will also lure professionals to be associated with the institute

5.2. Policy Advocacy towards Skill Development

5.2.1. Establishing Skill Development Framework

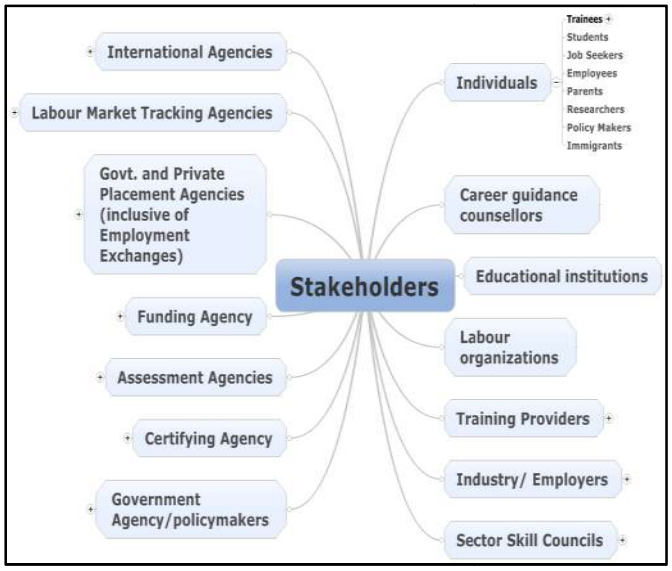
To our assessment, the vocational education system is not considered as a mainstay of the skilled manpower development in Afghanistan. It is largely because sector specific job skills are never recognized. The belief with which students enrolls to this course are not the prospect of employability but the lack of opportunity to peruse other options of formal education. The same legacy has also

passed on to the private sector employer who doesn't recognize the potential of the course. This negative myth associated with vocational education needs to be broken and focus should be centered on mobilization of candidates in the course. This calls for establishment of skill development framework and facilitate to integrate it in the developmental planning of the education sector to promote vocational education in Afghanistan. The basis of designing of the skill development framework is:

Outcome focus	•Assured employbility (Govt and private parties giving weightage to certification) •Provision for higher studies after the completion of course curriculam
Aspiration	•Industry to be encouraged to pay skill premium to skilled and semi skilled •Designing and Facilitating national campign •Policy advocacy towards mandating use of certified skilled manpower
Capacity	• Cater the skilling requirment of the growing economics • Inclusion of droputs under the skill developemnt programme and certifying the skills sets of skilled labor engaged without formal skill training.
Mobilisation and Engagement	• International equivalence of course • Proactive industry participation in designing curricula and standards for skill development training • Industry be encouraged for apprentice and internship
Quality Assurance	•Allignment of curricula to emerging demand, country plan and international practices • Development of framework for integrating general and vocational education sysetm • Making the course designing/updating more participative
Outreach and advocacy	•Expansion of outreach by innovative approaches and incentives, encourage private sector participation •Creation of a robust Labour Market Information System and Skill Development Management Systems
Global Partnership	•Skill development framework be alliened to international framework to promote mobility • Option for online training be encouraged (eg Massive open online courses)
Training of trainers	•Provision for participation of ex-service men from power sector in the core committee of course design

5.2.2. Establishing Skill Qualification Framework

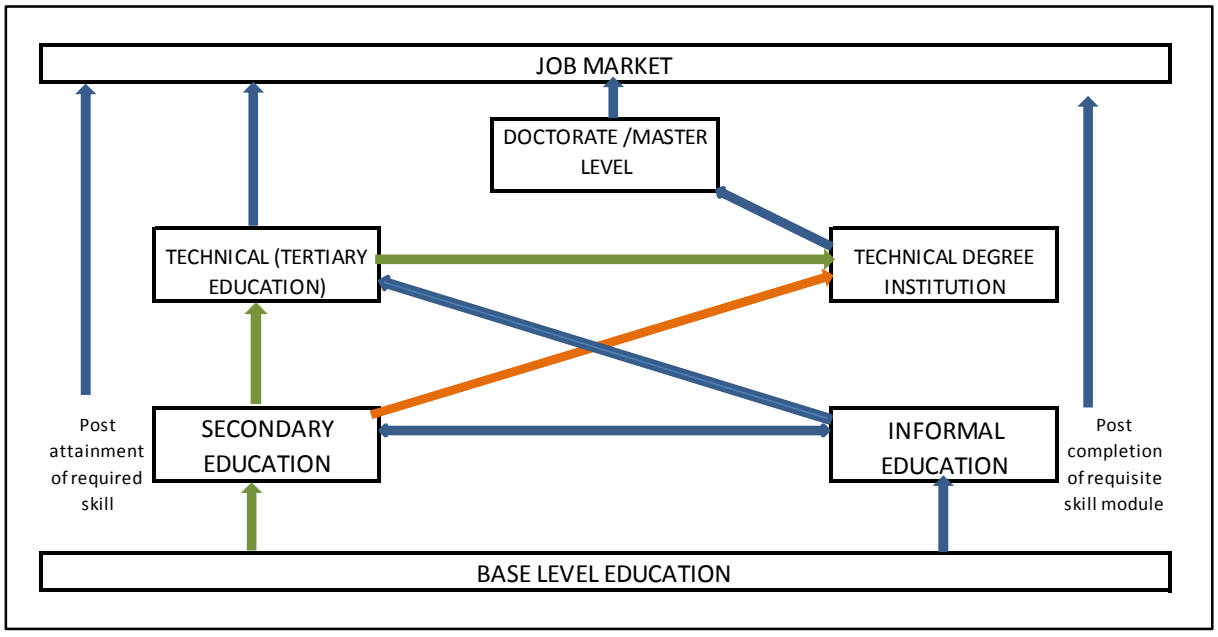
Recognizing the high demand for skilled resource and the negative assumption for the vocational education stream, it was deemed essential to formulate a quality assurance framework. As part of the current practice, general education and vocational education are operating as separate verticals with very little interaction. This led to a hesitation amongst the youth opting for



vocational education, as it is presumed that the current avenue would preclude the concerned individual from acquiring higher degrees and qualification.

This calls for designing a framework that will facilitate a seamless integration between vocational education and regular higher education and setting common principles and guidelines for a nationally recognized qualification system and standards leading to international equivalency. The framework will also organize qualification according to a series of level of knowledge, skill and attitude. The level of knowledge will be defined in terms of learning outcome which the learner must possess regardless of whether they were acquired through formal, non-formal and informal learning. The framework if suitably designed will bring about paradigm shift from education based on input towards education based on learning outcome.

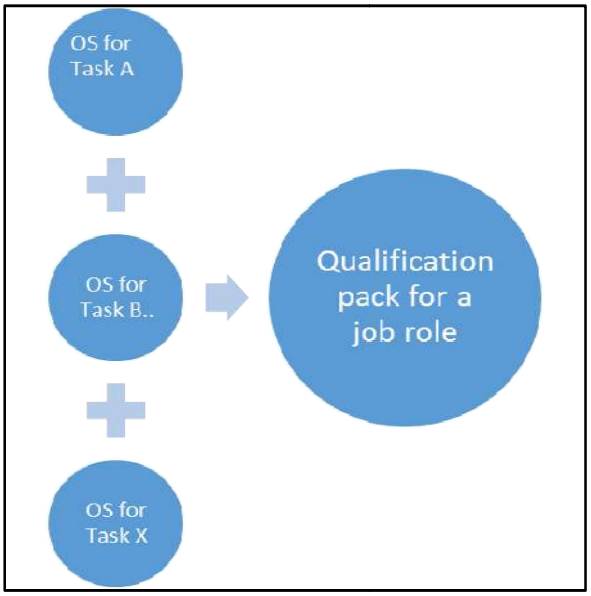
The framework should also make a provision for a candidate to choose either a vocational stream or a conventional stream to reach graduation level. In addition, candidates should have the freedom to move from vocational stream to formal higher education stream or vice versa at various stages. A multi-level entry and exit system along with credit accumulation and transfer system should also be embedded as a part of the framework. If provisioned the frame will be capable of allowing candidate to seek employment after any level and rejoin the education as and when it becomes feasible to upgrade qualifications / skill competency. Moreover the framework should also make provision to accept student who has acquired the skills through work experience, to enter the Vocational stream at an appropriate level provided he is assessed for the skills.



The importance of the frame work is because:

1. It shifts focus from institution(providers) to the student (users of education and training) so the aspiration factor amongst the student is increased

2. The transparency of the course explains the learners the utility of a particular course and how the course is linked with other courses
3. Strengthen the accountability of the qualification
4. The qualification framework will support alignment of national vocational qualification to international qualification standard in accordance with relevant bilateral and multilateral agreements. This will help students for international mobility.
5. If credit accumulation and transfer system can be designed and integrated, it will allow the people between education and training and work at different stages of life according to individual need. This will reduce the chances of drop out.



6. These frameworks should also make provision for recognizing prior learning and improving the transparency of the current vocational educational system.

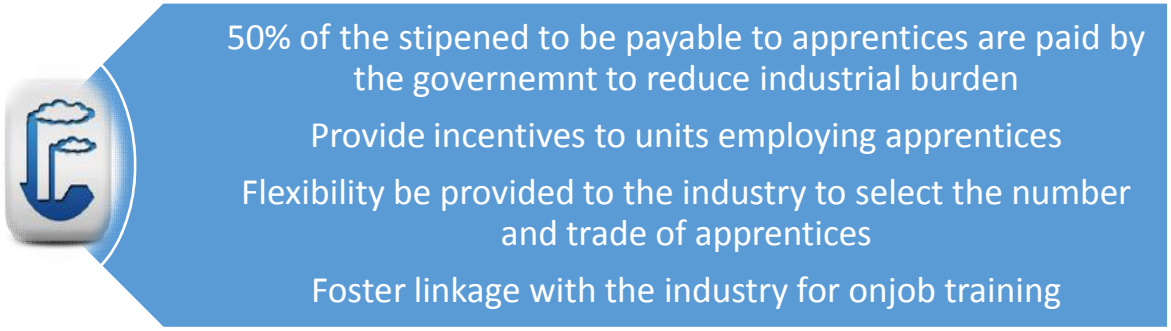
5.2.3. Designing of Occupational Standard

The occupational standard should be designed to measure/ develop the performance outcome required from an individual for performing a particular task. It basically list out the skill, knowledge and competency requirement for performing a particular task. Since each job role requires number of task to be performed therefore occupational standard (OS) should be developed for each of the task. The combination of all the occupational standard is the required qualification for a particular job profile. As against each of the occupational standard a competency development package should also be formulated. Occupational standard should also be include syllabus, student manual, training manual for student and trainers guide, multimedia package and e-material for student and assessment and training guidelines for the management.

This standard once developed and certified by the administrative body / committee can form a benchmark for the institute in designing a course curriculum and for the purpose of recruitment process of both government and private sector units.

5.2.4. Institutionalizing Apprenticeship

Success of a vocational education lies in degree to which a student is subjected to practical exposure. Apprenticeship provides student with the scope of on job learning and employability. The suggested frameworks for institutionalizing apprenticeship are as follows:



5.2.5. Establishment of the Labor Market Information System

- Establishment of the labor market brings together quantitative and qualitative information about the labor market and helps in setting the skilling targets by matching the supply with the demand. The institutional structure of the labor market information system is presented along with.

6. Implementation Arrangement

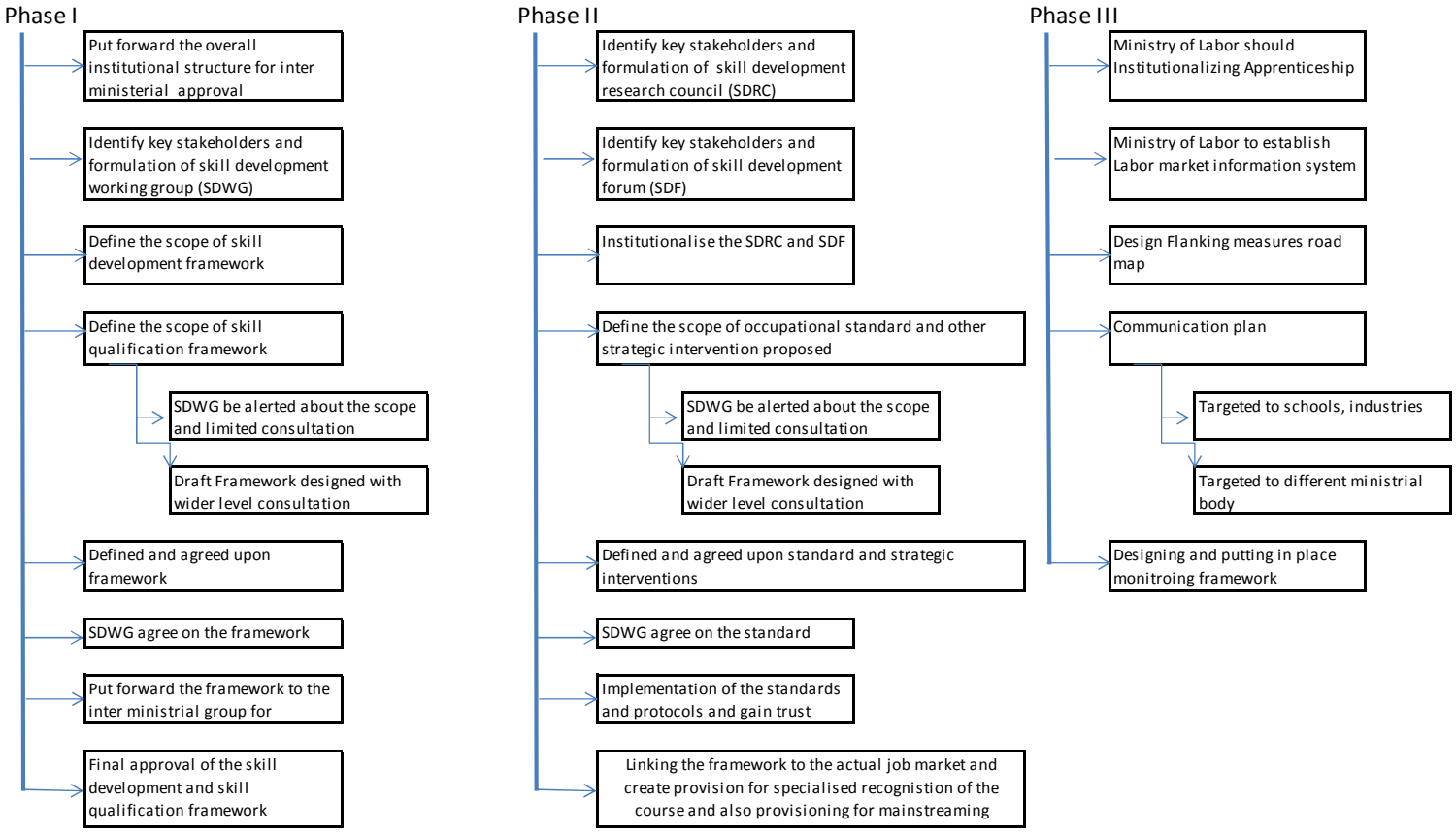
The success of the implementation of the strategic framework discussed above shall be based on the commitment of the institutional framework outlined below and enabling policy and legislation duly notified.

Sl.	Name of the Institution	Level	Role
1.	Skill development Working Group under Ministry of Education	National	The working shall be notified as the apex strategy planning body and members will be drawn from Ministry of Education, MEW, DABS, MEW-VTC, MRRD relevant officers from bilateral and multilateral agency like GIZ, ADB, UNIDO, independent regulators, international ministerial bodies, and industry associations, suppliers. The apex body should entitle the agencies like GIZ engaged in skill enhancement program to design the skill development framework and skill qualification framework that will form the basis of skill enhancement across the country.
2.	Ministry of Labor	National	Ministry of Labor by virtue of its empowerment should be institutionalizing the apprenticeship across the industry and develop labor market information system. GIZ can under its TA programme render support to the Ministry of Labor in creating a skill development cell within the Ministry and provide support in developing the policy framework for institutionalizing the apprenticeship and also create a labor market information system.
3.	Skill development research council in MEW-VTC	Regional	A skill development research council should be institutionalized for developing the skill development road map, standards and certification process. Members to be drawn from academic institutions, strategic research system of the government and its network partners, MEW, industry associations and agencies like GIZ should be entitled to take forward the research. This is to be chaired by an eminent researcher (with background of power sector) and will be on a rotational basis.
4.	Skill development forum	National /	This forum shall operate in a public private partnership mode. It will be the partnership between the power

Sl.	Name of the Institution	Level	Role
		Regional	sector manufacturers/service providers/ equipment suppliers/ EPC contractor associations and the relevant ministries of the Government and bilateral and multilateral agencies like GIZ, ADB, UNIDO and would act as the main advocacy focal point for promoting the Skill Development Framework, Skill Qualification Framework and institutionalize Occupational Standard. The forum can engage the services of specialized agencies in the field of communication, advocacy and policy support.

6.1. Overview of the Implementation Framework

The following implementation framework can be attempted



In the first phase the first step will be get the institutional structure for skill development approved through inter-ministerial consultation and creation of the apex body. The approval will thereby empower the apex body in designing the short term and long term programme and also the framework.

The second phase is aimed at stabilizing and implementation of the framework and standard through series of measures. The most important aspects in this case will be the empowerment of the apex body. This is only possible, if during the limited consultation, the different ministries agree on this and direct the line department at the national and regional level to align and converge. This phase should also be used as a pilot testing phase of all the concepts proposed in the framework and standards.
The third phase will be driven largely through flanking measures and institutionalize the framework and standards that has been tested and piloted in second phase through Ministry of Labor intervention. Communication planning is the most important element of the programme. An agency should be engaged in working out the communication strategy and framework. The recommendation of the agency can be used to roll out this campaign. It should ideally be divided in to three parts with first part focusing on regulatory bodies like MEW, MoLSAMD, MoE and other second part to focus on demand side stakeholders like DABS, MRRD, MEW, industry association, private parties (suppliers, O&M operators, EPC contractors, etc.) and third part should focus on supply side like VT institute, MEW-VTC, students and guardians.

6.2. Flanking Measures

Extensive campaign should be facilitate by the apex body immediately after the formulation of skill development and skill qualification framework to educate people about the cost-benefit of undertaking vocational training course in terms of job market. A campaign will be run in form of a public-private-partnership forum that would involve ministerial agencies, industry, industry associations highlighting the above operational dimensions. Each ULB will get $ 75,000 for this activity.

The forum will extensively use the ICT power of the country and would create and maintain:
• A central web-site with general information.
• An on-line database of skill requirement as per the industry and job and link it with the national labor market information system
• Region-wise helpline and service centre numbers
• Overview and analysis of the present market situation.
• Trends of skill development

6.3. Monitoring and Supervision

Monitoring the implementation of the fame-work at the institute level is of utmost importance:

- To earn the trust of all stakeholders (energy industries, suppliers, EPC contractors, Labor organization, students, ministries and policy makers)
- To get the feedback and improve the frameworks and standards further
- To assess the performance against set targets.
- To set at rest the rumors and doubts on the effectiveness of the VT course and the job market by vested interests.

7. Conclusion

MEW-VTC is one of the premier and the most vital institute in the country offering qualitative training for skilling of resources for technical service across the power sector. Despite this fact certain difficulties has led MEW to conclude that far more actions are required to engender more skilled resources and also provide employability to major section of unemployed youths. Through certain internal assessment the governing body has realized that the current system is not being able to respond to the labor market requirement and must be attuned to the new global standard by promoting creativity and improving the quality of education and training at all levels. A key issue, then, is what reform/interventions are needed to improve the effectiveness of the system.

It was accessed as part of the study that although the operational and management of the course lies with the MEW, the design of course, its curriculum and offering of certificate lies with the Education Ministry. Since the total management is shared between two authorities there are instances of duplication of effort due to lack of co-ordination and diverse accountability. Furthermore, the pre-occupation of the Ministries forbids lack of coordinated efforts.

It is well evident that improvement of the current educational standard requires both institutional strengthening of the MEW-VTC and at the same time reforming the existing vocational training system. Although, the first can be done by the MEW alone, the second requires serious interest and intervention of the Education Ministry. Bringing about reform is always lengthy as centralized systems suffer from lengthy decision-making processes, remoteness from clients, and rigidity to change. Therefore the challenges lies on whether MEW would like to initiate policy dialogue with the Education Ministry for reforming of the VT education system or reform its own education system and facilitate dialogue with the Education Ministry to recognize the modified pattern.

The second most important aspect is the operational management of the VTC at MEW. In case the regulatory body strategizing the educational framework gets engaged in delivery of training proper monitoring won't be possible. Similarly just financing of training does not establish the institutional capacity or the priority of the agency in imparting training. So tailor made options has to be designed to upgrade to efficacy of the current institution responsible for imparting training. The strategic options can be

1. MEW creates a vertical in its ministry making it responsible for imparting technical training. This vertical will also be made responsible for uplifting education standard of its VTC starting for policy advocacy to grounding of the recommendation by the council.

   The current operational framework was designed to uplift the skill of its employed staff along with creating a skilled resource to support the sector.

In order to attain an overall reform of the VTC, MEW should include skill promotion as part of its ministerial objective so that it receives similar importance along with its other priorities. It also requires a separate governing council in the ministry to be dedicatedly responsible for required task.

2. The other options can be that MEW restricts its responsibility as an overarching support agency with oversight functions of training regulation, standards setting, qualification standard, development and dissemination of information on supply and market demands, and monitoring and evaluation of outcomes. It in turns creates a separate body or engages public sector or private sector agencies and devolves authority of imparting training with accountability of results. Autonomy can stimulate resourcefulness and innovations, but it needs to be accompanied by greater accountability.

8. Annexure

8.1. Annex 1: List of Key Definition

Terms	Definition
Apprenticeship	A system of training which usually combines on-the-job training and work experience with institution-based training. It can be regulated by law or by custom.
Capacity	The ability of individuals, organisations and societies to set and achieve their own development objectives (UNDP, 2007).
Continuing education	Undertaken by those who have already completed basic or initial training, in order to supplement acquired knowledge or skills
Core employability skills	Knowledge and competencies that enhance a worker's ability to secure and retain a job, progress at work and cope with change (teamwork, problem solving, information and communications technology (ICT) and communication and language skills).
Direct employment	Direct employment refers to employment that is generated directly by core activities without taking into account the intermediate inputs necessary to manufacture energy equipment or construct and operate facilities.
Dual-system education	Planned learning which takes place in two locations: the employer's premises and the vocational school (ILO, 2012a).
Education/Training	The process of receiving or giving systematic instruction, at a school, university or other institution. Primary education covers the first 5-7 years of formal education, secondary education the following 3-5 years. These can be followed by tertiary (higher, non-compulsory) education, such as at universities or vocational schools.
Indirect employment	Indirect employment includes the employment in upstream industries that supply and support the core activities of e energy deployment. These industries are not directly involved in energy activities but produce intermediate inputs along the value chain of each energy technology.
Long term employment	Long-term employment encompasses jobs that can be maintained for several years due to either domestic deployment or export markets

8.2. Annex 2: Competency Mapping for Solar Power Plan O&M

Competency and Skill required for task: Test and Commission Solar PV System

Competency and knowledge requirement for a solar power project

Criteria	Competency Requirement
Knowledge	
A. Knowledge of the company /Organization and Its processes	KA1. Government/Corporate policies and guidelines on: workplace safety, identification and mitigation of safety hazards, work procedures and guidelines for working at height. KA2. Document information using appropriate corporate forms. KA3. Obtain authorization from specified field safety officer and supervisor. KA4. Legislative, organization, site requirements and procedures. KA5. Diagnostic/fault finding techniques. KA6. The environmental requirements.
B. Technical Knowledge	KB1. Definition of the terms: energy and power, cell, module, string, array, mono-crystalline, poly-crystalline, amorphous silicon. KB2. Units and symbols for irradiation and irradiance. KB3. Know-how of Tools & Tackles required for inspection and commissioning of the plant. KB4. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading. KB5. Perform simple calculations to derive the power and energy received from solar radiation in a given area. KB6. Efficiency, cost, typical specifications, functioning and operating principle of different types of commercially available PV modules, inverters, charge controllers, battery, cables, junction boxes and other electrical components. KB7. Mechanical and electrical features necessary for the long life of the PV system under a wide range of operating conditions. KB8. Determine the type of mounting structure required depending on the type of roof. KB9. Determine the type of footing and fixtures required depending on the type of roof. KB10. DO's and Don'ts of material handling and storage. KB11. Determining whether any shading will occur and estimate its effect on the system. KB12. Determining the cabling route and estimate the length of cable required. KB13. Determining where the array junction box (if required) and inverter will be located. KB14. Measuring solar irradiance with a pyranometer.

Criteria	Competency Requirement
	KB15. Determining, using field measurements and sun path diagram, the times and dates when a PV array will be shaded by obstacles. KB16. Observe how current and voltage of a module varies w.r.t load. KB17. Effect of blocking and bypass diodes. KB18. Basic functioning and Operation of different types of inverters and other electrical components. KB19. Do's and don'ts of DC wiring and installation of other electrical components. KB20. Connection of the Solar Power Plant to the distribution box/ LT Panel and switchover along with precautions based on different types of plants. KB21. Installation work on a PV power system in accordance with relevant standards and regulations. KB22. Testing and commissioning activities and its interpretation – visual inspection, continuity of wiring, Earthing, polarity check, insulation and voltage drop. KB23. Measurement of losses in a PV system at different points and interpretation of the results. KB24. Typical faults, their causes and resolution for all system components. KB25.Occupational health and safety (OHS) standards and associated risks when working on that particular site.
Skill	
A. Core Skills	Writing Skill
	SA1. Fill up documentation applicable to one's role.
	Reading Skill
	SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes as per electrical standards.
	Oral Communication
	SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries.
B. Professional Skill	Decision Making
	SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.

Criteria	Competency Requirement
	Customer Centricity
	SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem Solving
	SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	SB11. Critically evaluate information obtained from customers, supervisor and co-workers to perform day to day activities. SB12. Ask questions for better understanding.

Competency and Skill required for task: Maintain solar photovoltaic system

Competency and knowledge requirement for a solar power project

Criteria	Competency Requirement
Knowledge	
A. Knowledge of the company /Organization and Its processes	KA1. Company's policies on: incentives, personnel management. KA2. Company's code of conduct. KA3. Importance of individual's role in the work flow. KA4. Organisation culture. KA5. Company's reporting structure. KA6. Company's documentation policy. KA7. Company's different department and concerned authority. KA8. Company's installation policy. KA9. Company's customer support policy.
B. Technical Knowledge	KB1. Basics on solar energy system and power generation. KB2. Volts, amps and watts. KB3. Usage and handling procedure of solar panels. KB4. Energy storage, control and conversion. KB5. Basic electrical system and functioning. KB6. Mechanical equipment and its functioning. KB7. Maintenance procedure of equipment. KB8. Cleaning procedures and consumables used. KB9. Voltage requirement of various equipment.

Criteria	Competency Requirement
	KB10. Specifications of a grid connection. KB11. Solar energy system components such as panels, batteries, charge controllers, inverters. KB12. Tools involved in maintenance and troubleshooting the system. KB13. Correct tools and equipment to be used in handling specific components. KB14. Basics in electrical and circuit. KB15. Quality and process standards. KB16. Relevant occupational health and safety standards and waste management Procedures. KB17. Importance of wearing protective clothing and other safety gear while carrying out installation activities. KB18. Precautions to be taken while handling different electrical and mechanical products.
Skill	
C. Core Skills	Reading and Writing Skill
	SA1. How to read product and equipment manuals, system maintenance manuals etc. SA2. How to be able to read warnings, instructions and other text material on product labels, components etc. SA3. How to be able to fill in job completion form after installation activity is completed.
D. Professional Skill	Using Tools and machines
	SB1. How to operate/use screw driver, inspection fixtures, wire cutter, pliers, tester, spanner, etc. SB2. How to use tools for panel mounting.
	Interpersonal skills
	SB3. How to interact with co-workers in order to coordinate work processes. SB4. How to interact with supervisor to understand the daily target.
	Reflective thinking
	SB5. To improve work processes. SB6. To reduce repetition of errors.
	Decision making
	SB7. How to report potential areas of disruptions to work process. SB8. When to report to supervisor and when to deal with a colleague depending on the type of concern.

Competency and Skill required for task: Maintain Personal Health & Safety at project site

Competency and knowledge requirement for a solar power project

Criteria	Competency Requirement

Criteria	Competency Requirement
Knowledge	
A. Knowledge of the company /Organization and Its processes	KA1. Company's Installation Policy. KA2. Company's work safety Policy. KA3. Company's Customer Support Policy. KA4. Company's documentation policy. KA5. Obtain authorization from specified field safety officer and supervisor. KA6. Company's reporting structure and Organization culture. KA7. Company's different department and concerned authority.
B. Technical Knowledge	KB1. The individual on the job needs to know and understand. KB2. Relevant Personal protective equipment's required for installation. KB3. Relevant standards and regulations for installation of Solar Photovoltaic Power Plant in a country. KB4. Occupational health and safety (OHS) standards for installation of Solar Photovoltaic Power Plant. KB5. Risk identification and mitigation procedure for safe installation of Solar Photovoltaic Power Plant. KB6. Knowhow of tools & tackles required to carry out the work.
Skill	
C. Core Skills	Writing Skill
	SA1. Fill up documentation applicable to one's role.
	Reading Skills
	SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical.
	Oral communication (Listening and Speaking skills)
	SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor.
D. Professional Skill	Decision making
	SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response
	Plan and Organize
	SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.

Criteria	Competency Requirement
	Customer Centricity
	SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem solving
	SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	SB11. Critically evaluate information obtained from customers, supervisor and coworkers to perform day to day activities. SB12. Ask questions for better understanding.

Competency and Skill required for task: Customer Orientation for Solar PV System

Competency and knowledge requirement for a solar power project

Criteria	Competency Requirement
Knowledge	
A. Knowledge of the company /Organization and Its processes	KA1. The Keywords and its definitions used in industry. KA2. Complete Technical and Commercial Knowledge of the product. KA3. Document Information using appropriate corporate forms. KA4. Diagnostic/fault finding techniques. KA5. Environment requirements.
B. Technical Knowledge	KB1. Definition of the Jargons/terminologies used by the industry. KB2. Units and symbols for irradiation and irradiance. KB3. Effect on array output of current and voltage based on series / parallel connections of modules, tilt angle, orientation and shading. KB4. Efficiency, Cost, Typical Specification, functioning and operating principle of complete solar PV system including solar PV modules, inverters, charge controllers, battery cables, junction Boxes and other electrical components. KB5. Occupation health and safety procedures (OHS) standards and associated risk when working on the particular site.
Skill	
C. Core Skills	Writing Skill
	SA1. Fill up documentation applicable to one's role.

Criteria	Competency Requirement
	Reading Skills
	SA2. Read English and/or vernacular language. SA3. Read and understand manuals, health and safety instructions, memos, other company documents. SA4. Ability to read from different sources- books screens in machines and signage. SA5. Understand the various color codes, as per standard electrical, mechanical.
	Oral communication (Listening and Speaking skills)
	SA6. Express statements or information clearly so that others can hear and understand. SA7. Participate in and understand the main points of simple discussions. SA8. Respond appropriately to any queries. SA9. Communicate with supervisor.
D. Professional Skill	Decision making
	SB1. Follow organization rule-based decision making process. SB2. Take decision with systematic course of actions and/or response.
	Plan and Organize
	SB3. Planning and organization of work to meet deadlines. SB4. Work constructively and collaboratively with others.
	Customer Centricity
	SB5. Follow code of conduct. SB6. Manage relationships with customers with intent on satisfying its requirements for service delivery.
	Problem solving
	SB7. Recognize problems and search for solutions. SB8. Choose best methods to complete assigned tasks. SB9. Approach relevant authority when required.
	Analytical Thinking
	SB10. Apply domain knowledge, observations and data to select course of action to perform tasks related to Solar Photovoltaic Systems.
	Critical Thinking
	SB11. Critically evaluate information obtained from customers, supervisor and coworkers to perform day to day activities. SB12. Ask questions for better understanding.

Knowledge and Skill required for task: Operation and maintenance of the hydro power project

Area	Knowledge requirement
Knowledge Requirement	

Area	Knowledge requirement
Basics of electrical and mechanical equipment used in power plant	TK1: Theoretical fundamentals of Synchronous Generator, excitation system, governor system, speed and load controller, Transformer, Circuit breaker, Protection system, CT, PT, Isolator, Earthing system, Instrumentation, Switchyard, Transducers, basics of hydromechanics, power plant layout, turbine types, main components of Francis turbines, spiral casing, covers, draft tube, runner, shaft, guide bearings, thrust bearing, guide vanes, regulating ring, servomotors, labyrinth seals. TK2: Understanding of the mechanical drawing including layout of technical drawings, graphic rendition, parts outlines, stated dimensions, accuracy designation, surface roughness, parts breakdown, materials. TK3: Understanding Schematic Diagram and Operating hydraulic units, KKS system of electrical schematic diagram, terminal diagram.
Operating hydraulic units	TK4: Information about governor system, operation guidelines, network requirements, normal operation, start & stop sequences, emergency shutdown, water hammer, runaway, load dispatching, safety aspects.
Familiarization of systems, subsystems and components	TK5: Types and division of Hydro Power Plants, types of water turbines – impulse / reaction, pumps, energetic and operational characteristics and its properties, Construction/design of water turbines, gates, governing systems – power control, water flow control, water level controls, main standards for testing of water machines on model & in situ, Plant Environment, Models of water flow for erosion prevention, types and construction of feeder channel, construction of turbines and closing valve, construction of generator and its control, electrical and mechanical equipment, Operational instrumentation outfit on turbines, turbine instruments connected into the automatic system and unit control. Cubicle wiring, Power supply, Unit control board, Motor control center, Governor compressed air system, Excitation system thyripol, Common control board, Interfacing cubicle, Interlocking cubicle, Generator cubicle, Hydraulic Governor, AC/DC Distribution Board, Transformer, Generator protection and 110 kV overhead line protection.
Devices used in atypical Protection system	TK6: Temperature devices to monitor bearing, stator, and transformer and stator winding, Pressure and Level switches to monitor air and oil system, Over and Under speed switches, Vibration detectors to monitor turbine-generator shaft, Water level sensors to monitor Headwater, Fire sensors, Sensing devices of Wicket gate shear pins, transformer, greasing system, station pump drainage system.
Protection system and relays	TK7: Protection system: Earth fault protection over current protection, distance protection, differential protection. TK8: Protection Relays: voltage restrained over current, ground overvoltage,

Area	Knowledge requirement
	Reverse power, under excitation, Unbalanced current, Field ground, Generator and Transformer Differential, Generator and Transformer Lockout, Generator Under voltage, Bearing Protection; Vibration Protection, Phase Sequence Voltage Relay, Excitation Transformer Over current, Generator overvoltage relay), Voltage balance relay, Frequency relay, Transformer over current relay, Transformer sudden pressure relay, Transformer hot spot.
Maintenance of hydraulic units	TK 9: Choice of adequate materials, corrosion & corrosion protection, cavitation & countermeasures, erosion& countermeasures.
Repair of hydraulic units	TK10: Dismantling and erection, repair methods, repair welding, reshaping wet surfaces.
General Plant trouble	TK11: Station Service failures, DC system trouble, Station Air system trouble, Service water system trouble, Protection or control logic system, malfunction, Utility system troubles: line faults, abnormal voltage, system separation.
Plant electrical equipment troubles	TK12: Generator: Abnormal electrical conditions, Stator winding high temperature, low frequency, motoring, fire, cooling failure; Main transformer: Insulation failure, High temperature, Abnormal oil level, Fire Generator Switchgear and bus: electrical fault, mechanical failure, loss of control power.
Plant Control requirement	TK13: Start and stop sequence control, Breaker operation-open/close, field current or generator voltage, Governor control, Flow control device position, Unit auxiliary system control
Safety of hydraulic units	TK 14: Emergency case procedures, sequence control of activities, information flow and documentation.
Instrumentation requirements	TK 15: kW output, kVar output, kWh output, Field voltage and current, Synchronoscope indication, Generator voltage, current, frequency, System voltage, Head water level, Tail water level, Turbine flow control device position, Status of bypass, sluice, or spillway gate and Transducers or signal transmitter.
Plant mechanical equipment troubles	TK16: Turbine: excessive vibration, bearing problems, over speed, insufficient water flow, shear pin failure, grease system failure, mechanical blockage by seizing or foreign object, mechanical failure and/or cracks, fatigue, corrosion fatigue. TK 17: Hydraulic control system: low accumulator oil level & pressure, hydraulic malfunctions within the governing and/or gate positioning system. TK 18: Water passage equipment: failure of head gate or inlet valve, head gate inoperative, trash rack blockage, water level control malfunction, spillway weirs, bottom outlet gate.
Status/Alarm requirement	TK19: Ready for start, Breaker position alarm if manual operation only, Intrusion alarm, fire alarm, Emergency station alarm, Trashrack differential pressure alarm, Unit sopped when not required, Unit turning when not required, High bearing

Area	Knowledge requirement
	temperature, Loss of lubrication or cooling or both, Low hydraulic system oil pressure, High or Low water levels, Incomplete start or stop sequence, Loss of power.
Basics of Circuit breaker	TK 20: Operating principle, Types of CB, Parts of CB, Operating mechanism, Tripping and Closing circuits, Interconnection of CB with control, panel and disconnecting switch, Condition monitoring: cabinet, trip test, lubricating, control circuits, pneumatic operators, SF6 filling, record the number of operations.
MV junction station	TK21: Common usage related to MV Junction station' fundamentals of Circuit breaker, Protection system, CT, PT, Isolator, Earthing system, Instrumentation, Transducers, Understanding schematic diagram Familiarization of systems and Components, MV feeder protection system and Maintenance of circuit breaker.
Power cable and jointing techniques	TK 22: Types of power cable, Cable structure, Jointing the cables and Terminating the cable.
Hotline maintenance	TK 23: Hotline introduction (hot stick, rubber glove, bare hand), basic of hotline, hotline tools, capability of hot stick technique, Capability of hotline maintenance, Hotline maintenance tools, etc. Deadline practice sessions: Hotline tool installation, tying conductor with tie wires, insulator replacement, Cross arm replacement, connection branch line to main line, drop out fuse replacement, Power cable replacement. Live line practice sessions: insulator replacement, cross arm replacement, connection branch line to main line, drop out fuse cutout replacement, power poles replacement.
Load flow study for Transmission Planning	TK 24: Introduction to Load flow, Modelling of power system, Application of power evacuation study, transmission line reinforcement/expansion
Load Dispatch	TK 25: Defining states of system , Availability study, Scheduling demand forecast, Scheduling power plant and Load dispatch
Skill Requirement	
Maintenance skill	MS1: Workshop technology such as Welding, turning, milling, compressor, pumps, lubrication etc
Computer operation	SKADA, automation system function, accessing event signal system, fault messages assessment, diagnosis of fault, parameter adjustment, control and operation

8.3. Annex 3: Draft Mission, Vision of VTC

Vision:

Provide leadership in assuring quality and in stimulating innovation in technical education and vocational training sector in Afghanistan in its way through vigorous pursuits of industry-academia interface and achieving excellence in the delivery of technical education and training and the resulting output.

Mission:

Serve the public through the promotion and advancement of Technical Education and vocational Training, establish and operationalize policies, regulations and procedures for setting and maintaining standards and quality of technical education and strategic development of the energy sector:

- Upgrade VTC into Center of Excellence of world standard through user friendly course curricula.
- Promote quality and innovation in technical education and training sector.
- Achieve and maintain high quality of education and training;
- Development and advancement of VTC in Afghanistan in a financially self-sustaining manner.
- Changing environment and the future needs in the pursuits of technological advancements.
- Managing the operations and resources to be effective and fiscally responsible.
- Substantial growth of technical education and training sector in VTC with quality to match the national average.

8.4. Annex 4: Draft Five Years Action Plan

Sl. No.	Key Action Points	Time Frame	Implementing Agency
1.	Mapping standard skill and competency requirement as against different jobs role (competency/outcome related occupational standards rather than designation based job descriptions). Access the skill gap existing as against critical jobs roles based on the current education system	MT	MoE, MoLSAMD
2.	Notifying national level skill/occupational standard so all the educational unit across the country may align their course structure based on it	MT	MoE, MoHE
3.	Develop and/or collate appropriate courses and curriculum to address the needs for skilling as per the skill/ occupational standard developed by the institute. Creating national principles for recognizing skill proficiency leading to international equivalency this will also help student in mobility.	MT	MoE, MoHE
4.	Promoting Skill qualification framework amid which general and vocational streams of education, skill training and technical education can be integrated.	MT	MoE
5.	Currently, due to lack of proper communication between different stakeholders like training providers, trainees and employers there is a lack of awareness about the type of courses, trades and institutions and also about opportunities in the field of vocational education and training. This is leading to under –utilization of many courses, forbidding intake of quality students and as a result the trainees are not getting placements and employers are not getting trained manpower. The communication needs to be strengthened through awareness Programs in the Schools/Colleges/Road Shows to expand the reach by adopting innovative approaches, career counseling of students helping them explore career opportunities through vocational education and persuading employers on the competencies of the student in serving the required job roles to ensure equitable access to training to all irrespective of any gender, regional, social and sectoral divide.	ST	MoE, MEW
6.	Specialized course be designed and promoted as Multi Skilling Institute programme.	ST	MoE, MEW
7.	Not all the services, especially the support service in operation and maintenance requires student with higher education background.	ST	MoE, MEW

	Rather the skill set is of more importance. So drop out underemployed or unemployed youth can be provided with customized training so that they can offer the working world a value skill set.		
8.	Since the institute is a part of MEW, policy advocacy measure be taken up to • Facilitate intake of apprentices/ intern. • Mandating intake rule to support employment of skilled certified personnel instead of unqualified people within the Power Industry. • Creating a salary differential for those who are skilled and certified vs. those not skilled/certified. • Establishment of sector specific Labour Market Information System	ST	MEW
9.	Participation of woman in the vocational educational course is very poor in the country. Both government institution at demographic locations and civil society organization be entrusted to promote participation of woman as an empowerment strategy.	MT	MoE, MEW
10.	To promote synergistic growth in the VTC sector both government and private sectors should be poised to evolve solutions for skill development for its target population. The course curriculum should be market driven and should caters to the requirement of the Industry. The private sector should also be included in development of course curricula and course structure. The VTC framework should be a **skill demand centric.**	ST	MoE, MEW
11.	Provision to be made for enriching the knowledge of faculties through on job training of trainers programme. This can also be achieved through certification of trainers. With the estimation made for number of students to be trained for the power sector requirement it is equally important to estimate the number of faculty required, qualification and experience of the faculty. Provision should also be made towards development of a pool of certified trainers with adequate technical competency to reach the masses.	MT	MoE, MEW, Donor
12.	The institute lacks the basic infrastructure to provide quality training to the student. These require either mobilization of financial assistance from the government or private parties willing to support skill development in the country.	LT	MEW, Donor
13.	A third party /institutional mechanism should be in place (core	MT	MEW, MoE

	committee/ steering committee) to ensure that the training institute adopt modern and scientific training methodologies and creating an infrastructure including course materials and training aids, adequacy of the faculty and quality of the certification procedure.		
14.	The institute might make provision for providing consulting and other support to industry. This will not only help in developing industry- institute partnership but will also help the institute in the following ways: • Student get training on both soft skill and technical competencies required for the job market through practical exposure. • The institute might facilitate short certification course for the on-job employee for skill up gradation. This will help in strengthening/cementing industry-institute partnership. • The financial received through this type of consultancy will provide economic sustainability to the institute and will also lure professionals to be associated with the institute.	ST	MEW, MoCI, Private industry, etc.

Timeframe: ST – Short-term (within 1 year), MT - Medium Term (1-3 year), LT – Long term (3-5 year).

8.5. Annex 5: Incorporation of Fee Based Short Term Courses on Renewable Energy

Short Term Course I: Advance Certificate in Solar Photovoltaic System Technician

Job Role: Assessing the installation site job, understanding the principle of PV system, handling installation tools & equipment, understanding functions & process of installation materials, mounting and installing the panels at customer's premises as per design & specification and ensuring effective functioning of solar energy system after installation.

Why become a Photovoltaic System Technician? For Electricians and Domestic Technicians: Rooftop solar Photovoltaics (PV) is a unique and large number of market demand sector, which requires electrical, mechanical, civil and structural skills manpower.

For University Students: This advanced Certification Programme would provide the much required hands-on skills enhancing their employ ability. This Programme also lays the very foundation for advance skill development such as designing of more complex PV systems, performance assessment, calculations, and even research.

For Professionals: This Certification Programme would serve as a skilled course enhancing the understanding and appreciating how photovoltaic systems can install, O&M. Moreover, this Programme is designed in a very flexible manner, where it can be conducted in the evenings and also weekends.

Course of Study and Scheme of Examinations:

Topic Title	Theory Class	Practical Class	Marks
Fundamentals of Electrical Systems	6	2	25
Physic of Photovoltaic System	6	4	25
Solar Resources for Photovoltaic System	4	4	25
PV System Components	6	3	25
Site Assessments, Design & Planning	8	6	25
Installation of Photovoltaic System, O&M	6	10	25
Safety for Photovoltaic System workers	3	2	25
Workplace Relationship & Management	2	0	25
Total	41	31	200

Training Methodology:

The course can be delivered in class room board work, lecture using Power Point, sharing of case examples, design exercises, a complete design task and PV System installation facility at institute's technical laboratory.

Knowledge & Skill from this training Program

Technical Job skill:

- Working process to generate solar power.
- PV Solar Rooftop and Power Plant Calculation, Design, etc.
- Soft skill to design SPV plant.
- Electrical equipments handling & its function.
- Mechanical equipments and its function.
- Site survey and evaluation of various environmental parameters.
- System Installation Process -
    - Civil Work
    - Mechanical Work
    - Electrical Work
- System Test & Commissioning.
- Site Operation and Maintenance Job.
- Occupational health and safety process.

Professional Skills:

- Operate/ use different tools used in installation work.
- Fill report form, make documentation.
- Communicate with supervisor and co ordinate with co workers.
- Work as a team member for achieving quality work/customer satisfaction.
- Understand company's policies and needs, etc.

Short Term Course II: Advance Certificate in Photovoltaic System Installer

Job Role: Assessing the installation site job, understanding the principle of PV system, handling installation tools & equipments, understanding functions & process of installation materials, mounting and installing the panels at customer's premises as per design & specification, and ensuring effective functioning of solar energy system after installation.

Function of Photovoltaic System Installer: Assemble, install or maintain solar photovoltaic (PV) systems on roofs or other structures in compliance with site assessment and schematics. This may include measuring, cutting, assembling and bolting structural framing and solar modules.

Course of Study and Scheme of Examinations

Topic Title	Theory Class	Practical Class	Marks
Fundamentals of Electrical Systems	3	2	25
Physic of Photovoltaic System	2	2	25
Solar Resources for Photovoltaic System	2	3	25
Introduction with PV System Components	2	2	25
Site Assessments & Planning	3	4	25
Installation of Photovoltaic System	2	10	25
Safety for Photovoltaic System workers	2	2	25
Workplace Relationship & Management	4	0	25
Total	20	25	200

Training Methodology:

The course will be delivered in class room board work, lecture using PowerPoint, sharing of case examples, design exercises, a complete design task and PV System installation facility at institute power plant.

Knowledge & Skill from this training Program:

Technical Job skill:

- Working process to generate solar power.
- PV Solar Rooftop and Power Plant Installation.
- Electrical equipments handling & its function.
- Mechanical equipments and its function.
- Site survey and evaluation of various environmental parameters.
- System Installation Process -
    - Civil Work

    - Mechanical Work
    - Electrical Work
- Occupational health and safety process.

Professional Skills:

- Operate/use different tools used in installation work.
- Fill report form, make documentation.
- Communicate with supervisor and co ordinate with co workers.
- Work as a team member for achieving quality work/customer satisfaction.
- Understand company's policies and needs.

Short Term Course III: Advance Certificate in Photovoltaic System Maintenance

Job Role: Solar Photovoltaic Plant Operation and Maintenance engineer inspects and perform schedule maintenance jobs for plant, i.e. include mechanical and electrical components; performs periodic cleaning of PV modules; and maintains performance data records.

Responsibility of O&M Technician: The PV plant operates with the following basic modular building blocks: Solar Inverter, Solar Batteries, Solar Charge Controller and Solar Panels. Operating the plant requires an understanding of the current and voltages across the system.

Balance of System components (BoS) play a huge role in the operation of the plant and these include, system wiring (capacity and size), Earthing and Lightening Protection Equipment and AJB/ DC DB which are basically Junction Boxes.

Course of Study and Scheme of Examinations

Topic Title	Theory Class	Practical Class	Marks
Fundamentals of Electrical Systems	3	2	25
Physic of Photovoltaic System	2	2	25
Solar Resources for Photovoltaic System	2	3	25
PV System Components (BoS)	3	2	25
Solar Photovoltaic Power Plant Inspection	4	4	25
Maintenance and Data keeping	2	10	25
Safety for Photovoltaic System workers	2	2	25
Workplace Relationship & Management	2	0	25
Total	20	25	200

Training Methodology:

The course will be delivered in class room board work, lecture using Power Point, sharing of case examples, design exercises, a complete design task and PV System installation facility at institute's technical laboratory.

Knowledge & Skill from this training Program:

Technical Job skill:

- Working process to generate solar power.
- Understanding of photovoltaic power systems.
- Identify and list the components.

- Electrical equipments handling & its function.
- Mechanical equipments and its function.
- Site survey and evaluation of various environmental parameters.
- Site condition effects on solar PV panel electrical outputs -
    - Shadow effects
    - South Direction, azimuth angle, Sun path
    - Mounting system, tracking system
- System Test & Commissioning.
- Electrical cabling and connections fitted to solar PV panels.
- Identify BoS components: inverter types, MPPTs, junction boxes, cables.
- Identify different types of faults in the solar photovoltaic systems.
- Site Operation and Maintenance Job.
- Occupational health and safety process.

Professional Skills:

- Operate/use different tools used in installation work.
- Fill report form, make documentation.
- Communicate with supervisor and co ordinate with co workers.
- Work as a team member for achieving quality work/customer satisfaction.
- Understand company's policies and needs.