Can Trade Deficit of Nepal be Reduced by Enabling Electricity Consumption?

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Association of British Alumnae of Nepal (ABAN)

Bhadra 06, 2079 (August 22, 2022)

Major Burning Issue

Monthly Trade Deficit: 1 Kharba 43 Arba Yearly Trade Deficit: 17 Kharba + (FY 2079/80 Budget) (Kantipur 2079 02 12)



Trade Deficit (source: MoF/Dept of Customs)

25% of total budget of Nepal (about Rs. 4 Kharab) is spent on importing food stuff mainly from India!

BS 2075 – BS 2085 Urja Dashak

(source: Budget Speech FY 2075/76, 2075/02/15, 2077/02/15)

Main Contents

- Chemical Fertilizer Plant
- •LPG Displacement
- •CNG from biodegradable waste
- Rooftop Solar PV System

Chemical Fertilizer Crisis in the Paddy Plantation Season in Nepal (Source: Kantipur, July 15, 2020)

रोपाइँकै बेला मल नपाएपछि किसान आन्दोलित

भारतबाट मल ल्याउन पाउनुपर्ने मागसहित आवागमन ठप्प पारेर प्रदर्शन

ft ang ramanyo.

্য নাজন নায়ৰ অনুকৃতি নাম বট ট উপজ্ঞ ভিতাৰ বাগলৈক কৰিছা ৰাজনাত টাৱল আইপান কিন্তুট কান্দ্ৰই হয় কাল নাম্পান কিন্তুট কিন্তু কালেকৰাৰ নাম্পান চা কালা মহাৰ নাম নাম্পান কৰি বহু নাম কালেকৰাৰ কৰা নাম্পান কৰি হাজনা মহাৰ নাম্পান কৰা নাম্পান কৰা নাম্পান বিষ্ণা কালাছিয়া কুলন নাম্পান কেই কালাইয়া কুলন নাম্পান কিন্তুৰ কালাইয়া কুলন নাম্পান কেই কালাইয়া কুলন নাম্পান কিন্তুৰ কালাইয়া কুলন নাম্পান কেই কালাইয়া কুলন

া গাঁ থকা উদ্যা প্ৰথম কটালা বিষয়ে কৃতিয়াই কাঁচ সমাৰ কটো মাৰা কাঁচৰিয়া নাজাৰ মত্যা মন্ত্ৰাণ মাৰা দ্যু। কৰা মতা আইপ, মানেলফ্ থাৰ জনীয় স্থাপ গণ কেইবট্ নাৰপ্ৰেমিয়া-11 বটিপুল্লী জন কাঁ নামিল, নামলাতে বাছনা না কিলেজ



Flue Gas from Cement Industry



8.5 Million Tons of Cement per year were manufactured from 53 Cement Industries in Nepal as per Er. Dhruba Thapa, President of Cement Manufacturing Association of Nepal, As of October 20, 2018, (i.e 1.25 X 8.5 Million Tons of cement/year= 10.625 Million Tons of CO2e/year is emitted to atmosphere as GHGs)

Out of 44 gm of CO2, 28 gm is used in producing urea ((NH2 CO NH2 =(NH2)2 CO)

Nepal's commitment for ZERO EMISSION by 2045 (COP 26, Glasgow)

Carbon Dioxide has risen by 36% since accurate measurements began in 1958 List of Limestone based Cement industries in Nepal Source: Mr. Raghu Nandan Maru, 24 March 2022

S/N	Industry	Production, TPD	Power Requirement/Flue Gas Volume
1	Hongshi Shivam Cement P. Ltd	6000	
2	Arghakhanchhi Cement Ltd	5000	
3	Maruti Cement Ltd	4000	
4	Sarbottam Cement Ltd	4000	
5	Ghorahi Cement Ltd	4000	
6	Saurya Cement Pvt Ltd	4000	
7	Shivam Cement Ltd	3000	
8	Huaxin	3000	
9	Riddhi Sidddhi Cement Ltd	2500	
10	Palpa Cement P, Ltd	2200	
11	United Cement Pvt Ltd	1000	
12	Shubha Shree Agni Cement	1000	
12	Lidevenue Consent Dut Ltd	800	

List of Limestone based Cement industries in Nepal Source: Mr. Maru, 24 March 2022

S/N	Industry	Production, TPD	Power Requirement/Flue Gas Volume
12	Shubha Shree Agni Cement	1000	
13	Udayapur Cement Pvt Ltd	800	
14	Hitauda Cement	700	
15	Unitech Cement P Ltd	500	
TOTAL		About 45000 TPD per day	

Urea Fertilizer Production Schemes

1. Hydrocarbon Scheme



Urea Fertilizer Production Schemes

2. Electrolysis and Carbon Dioxide Recovery Scheme



What has been done/ Milestones: Fertilizer Plant in Nepal

S/N	Year	Consultant	Country/Agency	Recommendation/Findings
1	1966	James Cooperman	USA AID/APROSC	Small Market, Not feasible until sufficient and cheap electricity is available
2	1973	AMS Baniya	Nepal Bureau of Mines	Dry mixing of the granular fertilizer materials
3	1975	Ing.grad Egon Becherer and Dr. Friederich Reckefub	FGU Kronberg/Germany/for Nepal Bureau of Mines	Install chemical fertilizer plant when electricity will be available sufficiently at prices competitive with international market.
4	1981	NIDC	UNIDO	100 TPD; Details not available
5	1984	Team	JICA	275 TPD based on Electrolysis; Not realized , not enough electricity, start in 1992 after HPP realized
6 7 8 9	2017 2019 2021 March 2022 Jan	Team TEAM/JNS/DRS+ Team Team/BST	India IOE/SEEN Webinar MoAgri KU	Based on Natural Gas Electrolysis; Analysis of previous study JICA, IDEC Electrolysis + Biomass Apply Green Hydrogen
10	2022 Feb 8	IBN	Nepal	Electrolysis is good for Nepal but not field proven; Carbon Capture?

Chemical Fertilizer Plant to increase crop yield

Three Studies carried out in Nepal:

- 1981 UNIDO Report (100 TPD) (report not available)
- 1984 JICA Report (275 TPD)
- 2017 Report Submitted by Indian Consultants (7 Lakh TP/Year detailed report with IBN)



How Much Energy is Required to manufacture 700,000 MTPA of Chemical Fertilizer? (source: 2017 Report submitted by Infrastructure Development Corporation Limited (IDeCK), Institute of Agricultural Technologies , INDIA and Shah Consult

International Private LimitedIndian consultant)

- Area needed for this plant
- Manpower needed experts
- Total estimated cost (Gas)

- : 160 Hectares (3150 Ropani) :400 including 50
- :US\$ 660 Million
- :US\$ 990 Million

:US\$ 1300 Million

(Coal)

Cost of fertilizer: US\$ 303 per MT (2016 AD?)

(Electricity)

Cost can be reduced by 50% if natural like gas is converted to clean electricity (exchange at equal status) (??)

Conclusion of Study by Ministry Of Agriculture and Livestock Development

March 2021 (source: unpublished report, MoA, GoN)

४) अध्ययनको समग्र निश्कर्ष

- तत्काल प्राकृतिक ग्यांस प्रविधि नेपालमा भित्रिन नसकने हुंदा यो प्रविधि पहुंच र परनिर्भरताको हिसावले सम्भाव्य नदेखिएको ।
- अनुसन्धानको नतिजा अनुसार तत्काल यूरिया प्लान्ट स्थापना गर्नाका लागि वायोमास ग्यांसिफिकेसन र जलविद्युतको हाइब्रिड प्रविधि अवलम्बन गर्न सकिने ।
- नेपालमा जलविद्युतको Surplus भएको र मूल्य घट्ने अवस्थामा Electrolysis विधि अवलम्वन गर्न सकिने वा Electrolysis र Haber Bosch (EBH) मा आधारित SSAS
 प्रविधिको अवलम्बन गर्न सकिने ।
- उपयुक्त प्रविधिको छनौटको लागि यस सम्बन्धमा अझ बिस्तृत अध्ययन जरुरी देखिन्छ

Some International Experiences

Hydro installations based H2 as feedstock for NH3 production

- Zimbabwe, 115 MW, 240,000 Tons of fertilizer grade ammonia per year (operational until 2015)
- Aswan (Egypt) 100 MW, 27,100 Nm3 H2/h
- Rjukan (Norway) 165 MW, 27,900 Nm3 H2/h
- •Glomfjord (Norway) 160 MW, 27,100 Nm3 H2/h
- Reykjavik (Iceland) 20 MW, 3000 Nm3 H2/h

Removal of CO2 from Cement Industry, Denmark



9 September 2021

Chart and FLSmidth to collaborate on carbon capture that targets over 90% removal of CO₂ emissions from cement production

PRESS RELEASE, COPENHAGEN, DENMARK

FLSmidth has signed an agreement with Chart Industries, Inc. ("Chart") to implement advanced carbon capture technology to significantly reduce CO₂ emissions from cement production. Cement production represents 7-8% of the global CO₂ emission – carbon capture technologies are essential to reduce that number and meet the targets of the Paris Agreement.

)esktop/Khem%20Gyanwali%20Thapathali%20Campus/Khem%20LATEST%20Green%20Urea%20Progress%20Latest%20July%2010%202022... 🔍

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. Problem statement



How to use surplus electricity from upcoming hydropower?



Fig 3: Electricity demand and supply forecast of Nepal







Figure 1: Block diagram representing the production process of green urea

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Specific Energy Consumption: 28.44 GJ/ MT Urea

Fig. 7. Colour i dia anti a constructional and a state in the second state of the seco

Harek Gara Hara Bhara (Rs. 1.31 Arba for Solar Based Water Lifting for Irrigation/Solar Pumping out Rs. 4.13 Billion for Alternative Energy (Budget Speech FY 2077/78))





6000 Rivers (45,000 Km, 23000 Rivulets (source MoEWRI)

https://www.facebook.com/photo.php?fbid=10207243601038642&set=a.102 04719288252400.1073741850.1542522243&type=1&theater

Irrigation Status of Nepal by Geographic Region



- According to the data released by the Customs Department, the trade deficit from Shrawan to Ashad (12 months) of the last fiscal year 2078/79 has reached **Rs 1.720 trillion (w**hich is About The Annual Budget of Nepal). The trade deficit during the same period last year was Rs 1.398 trillion.
- Nepal Imports Petroleum Products Worth Rs. 3.83 Kharba For The Fiscal Year 2078/79; Trade Deficit of Rs. 17.20 Kharba,
- Nepal's trade deficits have soared 23 percent compared to the last fiscal year 2077/78.

Can LPG be replaced by E-Cooking?

Rs. 375 in 2041 Rs. 1470 in 2071 (with about Rs 500 Subsidy) ? in 2075





70% hhs use LPG in Urban areas 10% hhs use LPG in rural areas (source:CBS/UNDP May 2014)

LPG in remote villages Can we sustain it? ekantipur.com

Nepal has imported about 504,000 MT of LPG

(Source: Dept of Customs as quoted in Kantipur dated 2079/02/04)

about **100,000 LPG cylinders per DAY**, used for cooking purpose with subsidy amount of Rs. 3 Arba per month.

(Source: Kantipur 2079 02 04 based on NOC data)

(14.2 kG LPG cylinder contains about 647MJ i.e. about 180 kWhth))

Cooking Measurement

Cooking Rice using LPG with pressure cooker

listron people











Experimental setup for 0.5 kg rice cooking using induction cooker

Cooking Comparisons using different Cookers

Source: CES/IOE/TU, July 3 2020



What is needed for making Induction based cooking a success?

- Supply of **QUALITY** Electricity (220 V AC, 50 Hz even at a distance of say 5 km from distribution transformer
- SUFFICIENT electricity (is size od distribution transformer adequate?)
- **REGULAR** supply of electricity
- **DEPENDABLE** SUPPLY
- AFFORDABLE price of electricity (should less than the cost of LPG) (reduce electricity cost by 10% now to motivate people)
- Appropriate FUSING of consumer energy meter
- Appropriate size of the Induction cooker (2 pot or 3 pot)

Rice Cooking Using Solar Electricity



12 V DC, 300 Watt, Rice Cooker

(Energy required to cook 1kg of rice is about 300 Watt * 0.5 hour/0.9 = 166 Wh, 30 A X 0.5 h=15 Ah at 12 V DC, 200 Wp Module with 4.5h peak sun), 100 Ah Heavy Duty Battery, capable of providing 35 A for 35 minutes

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Different Cooking Devices powered by Two 12 V DC 150 Ah Trojan Battery with 75 A Discharge Capacity for 60 Min









Purification of Biogas by using Pressure Swing Adsorption Method

RETSUD - 09

Kathmandu, Nepal

November 12, 2009

Wealth from Waste



या शिक्षा विद्यालयले बालबालिकालाइ दिउ ! घरका अभिभावकले आफु जानौं र आफ्ना बालबालिकालाई पनि सिकाऔं ! आफ्नै घरबाट शुरु गरौं: फोहोरलाई मोहोर बनाऔं !





Problem in waste management (600+

tonnes/day in Kath Valley) 2021



Basic idea of the project



Molecular Sieves (MS) (Source: PSA Nitrogen Ltd)



Description of equipment

Scrubber (Pressure Swing Adsorption Type)



Biogas Purification, Compression & Storage Plant @ KU





Energy Balance



AUTOMOTIVE CAR AND THREE WHEELER RUNNING ON ENRICHED BIOGAS





Waste to energy (Cow to Car)



Is Urban Roof Top Solar Program Beneficial for Nepal?

Prof. Jagan Nath Shrestha Center for Energy Studies, Institute of Engineering, Tribhuvan University, Nepal (shresthajn@gmail.com)



Record of Electricity Trade with India

Source: Kantipur Shrawan 27, 2079 (August 12, 2022) based on NEA Data





Institute of Engineering, Tribhuvan University

Residential Grid-connected system

Klaus Töpfer, ex-Federal Minister for the Environment and current executive director of the Institute for Advanced Sustainability Studies (IASS), commented, "When photovoltaics first took off in Germany and the 1000-roof program was launched in the fall of 1990, nobody expected that we would already reach the one-million-system mark by 2011." (17.2 GW)



P1 Location: Pulchowk Campus, TU, CES/IOE with load shedding, without backup system



Smart Metering Handbook for NEA Consumers

Source:NEA%20Reports%20after%20July%202021/Handbook%20of%20Smart%20Meter%20NEA%20Info.pdf 60,000 Smart Meters being used in Ratna Park and Mahrajgunj Area and 37000 will be added in current FY

New generation meters which are capable of sending information to your energy supplier automatically. *(similar to PSTN)*



Comparison between one 100 MW PVPS and 1 kW PVPS in 100, 000 rooftops with the same solar insolation value i.e. Same Energy Generation i.e. 400 MWh/day)

Description	100 MW	1 kW in 100,000 rooftops (eqv 100MW)
Cost of Land	Low to High	Free
Land Restriction	Not allowed in arable land forest area	No restriction
Power Evacuation Cost	Very high, Tx Lines, land compensation	Free
Operation Cost	Low to medium	Free
Maintenance Cost	Low	Free
Licensing Cost/Time/completion Security Cost of Installation/Transportation Cost of BOS Gov Subsidy	2 years Low High US\$X None	Free/some weeks High Negligible Almost same cost or relatively less 75% on Bank Loan interest 79

Policy for Solar Energy Mix

(up to 10% of total supply in INPS System)

- •National Energy Crisis MitigationPlan and 10 Year Electricity Development Plan, MoEWRI, 2016
- •NPC 15 th Five Year Plan
- •Grid Connected RE Karyabidhi, 2078
- •Grid Connected Solar Directives, 2078

International practices on rooftop solar....

Figure: Growing households with rooftop PV system in USA, One installation every 4 min





3 kWp BIPVES installed at Arlington, Massachusetts Guaranteed energy generation is about 3010 kWh/year (about 2.7 kWh/kW per day and about 60,207 kWh in 20 years) (SUN RUN Company, Installer 1st Light Energy)





Residential Rooftop PV Potential



So, Average Gross Rooftop area of residential household in all cities: 72.82 Sq. meter

and Average PV Installation area in rooftop for all cities: ~15 Sq. meter

Technical Feasibility- Residential Sectors..

PV Energy potential with proposed system size (MWh/Day)

Ktm Pkr Birt



Required Parameters of PV based Injected Power to NEA Utility Grid (approved by NEA Board by decision no. 751 on 2074/01/13; decision no. 823 on 2076/10/23) Net metering Contract between Rooftop Solar PV Energy Producer and NEA for 15 years with possibility of extensions

- 1. Frequency: 50 Hz
- 2. Voltage Level: 230 V/ 400 V/ 11 kV +_5%
- 3. Voltage Waveform: Sinusoidal
- 4. Phase Voltage Imbalance in case of Three Phase System: 1% (maximum)
- 5. Harmonic Distortion (THD): <= 3%
- 6. Power Factor in between: 0.85 Lag and 0.95 Lead
- 7. Energy to be injected to Grid: Not more than 90% of Energy consumed from NEA
- 8. Energy Meter: Bi-directional (Grid Side)

Solar Generator Meter (PV Generator Side)

9. Power Level Injection: 500 W to 5 10 kW at 230 V level

For Institutional: more than 5-10 kW to 40 500 kW at 440 V level or more

For Commercial Purpose more than 40 500 kWp at 11 kV level or more (no net metering basis)

Green Energy Related Key Point Mentioned Budget Speech FY 2079/080 Source; MOF, Budget Speech, Jestha 15, 2079

(May 29, 2022)

36. **ग्रीन हाइड्रोजन र ग्रीन एमोर्नया** प्रष्टूवर्ि प्रयोग गरी रासायर्नक मल कारखाना स्ापना गनथ लगानी बोडथ नेपाल मार्थ त कायथ अगार्ड बढाइनेछ।

आगामी वर्थ प्रमखु बालीहरू लगाउनेसमयमा रासायर्नक मलको सहज आपूर्तथ सर्ुनजश्चत गनथ मल खररदका लार्ग रु. १५ Arba अबथ ष्ट्रवर्नयोजन गरेको छु।

तीनै तहका सरकारको समन्त्वयमा प्रत्येक स्र्ानीय तहमा प्राङ् गाररक मल उत्पादन तर्ा उपयोगलाई प्रोत्साहन गनथ आवश्यक रकम ष्ट्रवर्नयोजन गरेको छु।

Way Forward

GoN is advised to request **JICA/JAPAN to review** September 1984 report in close cooperation with **Nepalese professionals** concerned as soon as possible!

What needs to be done?

- R&D related to production of GREEN Urea be funded for REAL PILOT Project at Thapathali Campus/IOE/TU
- Generate Green Energy in all feasible areas of Nepal and help reduce its trade deficit
- Let all Nepalese invest some money in solar electricity sector
- No sunny roof top to be left behind in urban areas of Nepal!
- Demonstration of solar PV applications with mobile van at primary, secondary and tertiary level educational institutions.
- Blending RE sources with Social Sciences taught in Universities of Nepal

Source: Shrestha JN, Raut D B, et. Al., Enabling Electricity Consumption in Nepal, Vidhyut , NEA, Aug 2021



Let us use BEST Availalable Technology (BAT)



Thank You!

CENTER FOR ENI

CES/Zero Energy House/Nepal (2003)

6.5 kW

generating about

Wh/day

NEA Domestic consumers

		Percentage Distribution				
5.N	Category	SA	EA-1SA	16A-30A	31A-60A	Total
1	0-10	26.25%	2.00%	0.50%	0.01%	28.76%
2	11-20	15.80%	1.70%	1.05%	0.00%	18.55N
3	21-30	8.76%	0.56%	0.06%	0.00%	9.38%
4	31-50	11.05%	0.85%	0.13%	0.00%	12.03%
5	51-100	9.65%	2.25%	0.39%	0.01%	12.30%
6	101-150	5.00%	1.85%	0.35%	0.01%	7.21%
7	151-250	3.78%	1.65%	0.65%	0.02%	6.10%
8	251-400	1.75%	1.00%	0.58%	0.02%	3.35%
9	Above 400	0.80%	0.74%	0.74%	0.04%	2.32%
Callering a se	Total	82.84%	12.60%	0.76%	0.17%	100.00%
				1000 C		

(ERCN, 2021)

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