



# REPORT

AICTE sponsored 6 day online  
ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN  
ENERGY TECHNOLOGIES FOR SOCIETAL  
SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**

**AICTETRAININGANDLEARNINGACADEMY, PUNE**

**Date: 16-12-2024 to 21-12-2024,  
Lakireddy Bali Reddy College of Engineering, Mylavaram, Andhra Pradesh**



AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
 CLIMATE CHANGE MITIGATION**

**Schedule of FDP**

<b>Day-1 16-12-2024</b>	<b>6:00PM to 6:30 PM</b>	<b>6:30PM to 8:00 PM</b>	<b>8:00PM to 9:30 PM</b>	
	-	<b>Session-1</b>	<b>Session-2</b>	
	Inauguration	Green hydrogen from bioresource – pathway, potential and challenges <b>Dr. Anand M Shivapuji</b>	Hydrogen fuelled internal combustion engines for stationary applications <b>Dr.A.Ramesh</b>	
<b>Day-2 17-12-2024</b>	<b>6:00PM to 7:30 PM</b>	<b>7:30PM to 9:00 PM</b>		
	<b>Session-3</b>	<b>Session-4</b>		
	Hydrogen generation using solar energy <b>Dr.D.Jayakrishna</b>	Green hydrogen production and its future in the context of increased climate change <b>Dr.M.Sankara Rao</b>		
<b>Day-3 18-12-2024</b>	<b>6:00PM to 7:30 PM</b>	<b>7:30PM to 9:00 PM</b>		
	<b>Session-5</b>	<b>Session-6</b>		
	Hydrogen and energy storage for sustainable energy systems <b>Dr.E.Anil Kumar</b>	Adoption of green hydrogen technology for hydrogen generation in thermal power plants: benefits and challenges <b>Dr.G.Prasada Rao</b>		
<b>Day-4 19-12-2024</b>	<b>6:00PM to 7:30 PM</b>	<b>7:30PM to 9:00 PM</b>		
	<b>Session-7</b>	<b>Session-8</b>		
	Hydrogen energy generation <b>Mr.N.Vinod Kumar</b>	Representative concentration pathway analysis to understand climate change and role of hydrogen <b>Dr. Anand M Shivapuji</b>		
<b>Day-5 20-12-2024</b>	<b>6:00PM to 7:30 PM</b>	<b>7:30PM to 9:00 PM</b>		
	<b>Session-9</b>	<b>Session-10</b>		
	Solid state hydrogen storage for sustainable energy conversion and storage <b>Dr.E.Anil Kumar</b>	Hydrogen production and its impact on climate change <b>Mr. V.Sethu Ram</b>		
<b>Day-6 21-12-2024</b>	<b>2:00PM to 3:30 PM</b>	<b>3:30PM to 5:00 PM</b>	<b>5:00PM to 6:30 PM</b>	<b>6:30PM to 8:30 PM</b>
	<b>Session-11</b>	<b>Session-12</b>	<b>Session-13</b>	-
	Hydrogen energy applications in Thermal Polygeneration <b>Dr. T.Srinivas</b>	Sustainable Development: Role of second law of Thermodynamics <b>Dr.Bale.V.Reddy</b>	Advances and developments in hydrogen energy technologies <b>Dr.Bale.V.Reddy</b>	Valedictory Session followed by Online test

Along with Dr.Anand M Shivapuji, Senior Research Scientist, Dr.Bale V Reddy Professor Ontario Tech University Oshawa, Canada,Dr. A.Ramesh, Professor IIT Madras, Dr.E. Anil Kumar, Professor, IIT Tirupati, Dr. T.SrinivasProfessor&Head NIT Jalandhar, Dr.D.Jayakrishna, Professor NIT Warangal, Dr.M.Sankararao, Director Nanosol Energy P Ltd, Mr.G.Prasada Rao Asst Executive Engineer, Dr.Narla Tatarao Thermal Power Station, Ibrahimpatnam Vijayawada, Mr.V.Sethuram, Team Lead Global Quest Bengaluru, Mr.N.Vinod Kumar Director JesvidCryo P Ltd Mangalagiriare also invited to deliver lectures on this 6-day online FDP program.

About 227 faculty participants from Academia, industry and research scholars from various colleges across India participated in this event.Dr.P.Vijaya Kumar, Coordinator; Dr. V.Dhana Raju,Co-Coordinator, Dr.M.B.S.S.Reddy, HoD and Convener and Department faculty members are participated in this event.

**Press Release:**

# సాక్షి

## గ్రీన్ హైడ్రోజన్ వాడకంపై పరిశోధనలు జరగాలి

మైలవరం: గ్రీన్ హైడ్రోజన్ వాడుక, ట్రాన్స్పోర్టేషన్, ఇండస్ట్రీస్, డొమెస్టిక్ రంగాల్లో ఉపండుకునే దిశగా ప్రపంచ వ్యాప్తంగా పరిశోధనలు జరగాలని కెనడా ఒంటారియోటిక్ యూనివర్సిటీ ప్రొఫెసర్ డాక్టర్ బాలే ఏ రెడ్డి తెలిపారు. మైలవరం లకిరెడ్డి బాలిరెడ్డి ఇంజనీరింగ్ కళాశాలలో నిర్వహిస్తున్న ఏఐసీటీఐ స్పాన్సర్డ్ ఫ్యాకల్టీ డెవలప్ మెంట్ ప్రోగ్రామ్ ఎమర్జింగ్ గ్రీన్ హైడ్రోజన్ ఎనర్జీ టెక్నాల

జీస్ ఫర్ సొసైటల్ సస్టెయినబిలిటీ అండ్ కలెక్షిబిల్ చేంజ్ మిటిగేషన్ ఏఐ అంశంపై కార్యక్రమం సోమవారం ముగిసింది. ముగింపు కార్యక్రమంలో ప్రొఫెసర్ బాలే వి. రెడ్డి మాట్లాడుతూ సమీప భవిష్యత్తులో గ్రీన్ హైడ్రోజన్ వాడుక ట్రాన్స్పోర్టేషన్, ఇండస్ట్రీస్ తదితర రంగాలలో ఎంతో ఆవశ్యకత ఉందని, వీటిపై అవగాహన పెంచుకోవాలన్నారు. ఐఐఎస్సీ బెంగళూరుకి చెందిన డాక్టర్ ఎం. శివ పూజి, మద్రాస్ ఐఐటీకి చెందిన ప్రొఫెసర్ డాక్టర్ ఏ. రమేష్, కళాశాల ప్రిన్సిపాల్ డాక్టర్ కే. అప్పారావు ప్రసంగించారు.

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**

**LECTURE SESSIONS**

**Day-1: 16.12.2024 (Monday), 6:30 PM -8:00 PM (Session 1)**

**Topic:**Green hydrogen from bioresource – pathway, potential and challenges

**Speaker:**

Dr. Anand M Shivapuji, Senior Research Scientist, Center for Sustainable Technologies, IISc, Bengaluru.

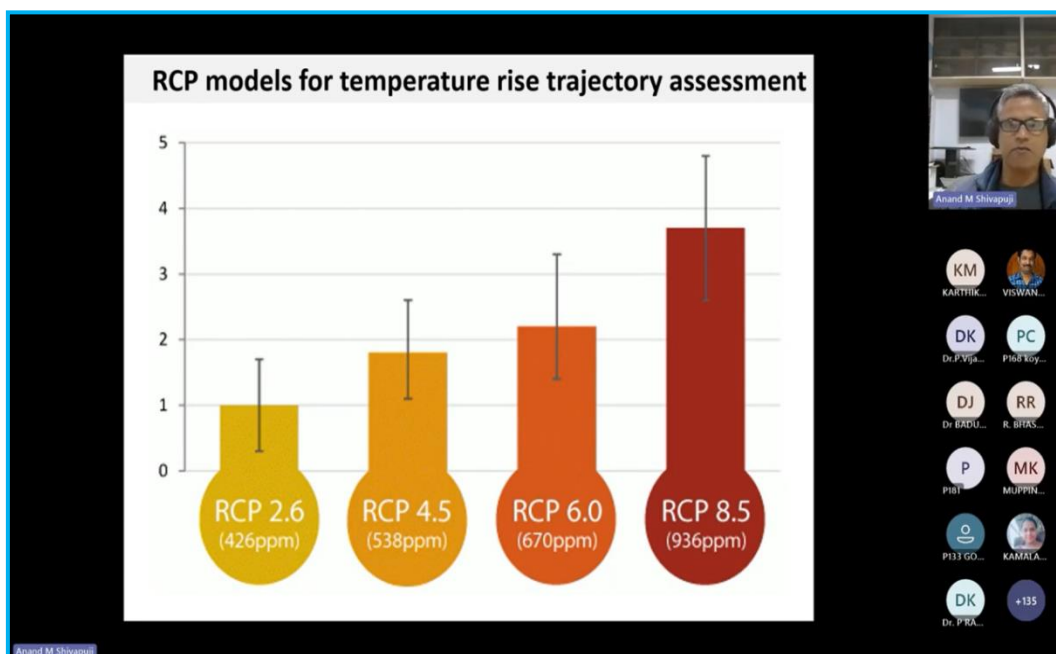
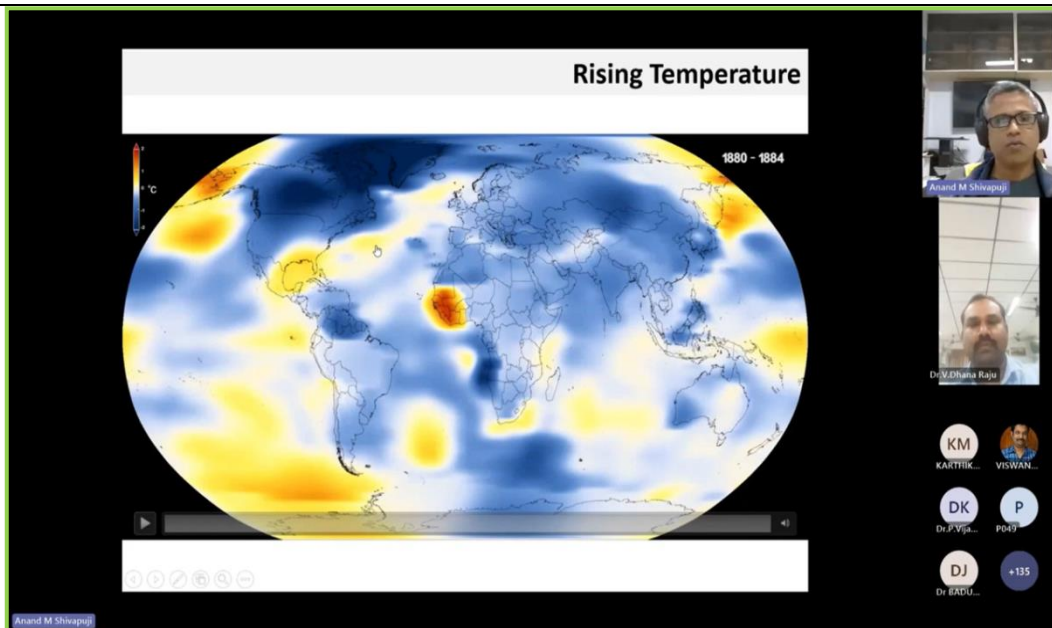


**Dr Anand M Shivapuji**  
Senior Research Scientist  
Centre for Sustainable Technologies  
Indian Institute of Science  
Bangalore - 560012  
anandms@iisc.ac.in  
+91-9448775050 / +91-9901777884

Participants: Anand M Shivapuji, P166, Mahesh Arora, P174, Dr. P. SURESH KUMAR, +136

Participants: KM, KARTHIK..., VISWAN..., DK, RR, Dr. P. Vija..., R. UTAAS..., DJ, PC, Dr. BADU..., P168 koy..., MK, KAMALA..., MUPPIN..., DK, P133 GO..., P, sravane..., P181, Saravana..., DR, Dr. V. Na..., 1, Chiranjiv..., P, +126, P210

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**



**Day-1. 16.12.2024 (Monday), 8.00PM - 09:30 PM (Session 2)**

**Topic:**Hydrogen fuelled internal combustion engines for stationary applications

**Speaker:**  
Dr.A.Ramesh  
Professor  
Department of Mechanical Engineering  
IIT Madras  
Chennai, Tamilnadu.



# Hydrogen fuelled internal combustion engines for stationary applications

**Dr. A. Ramesh**

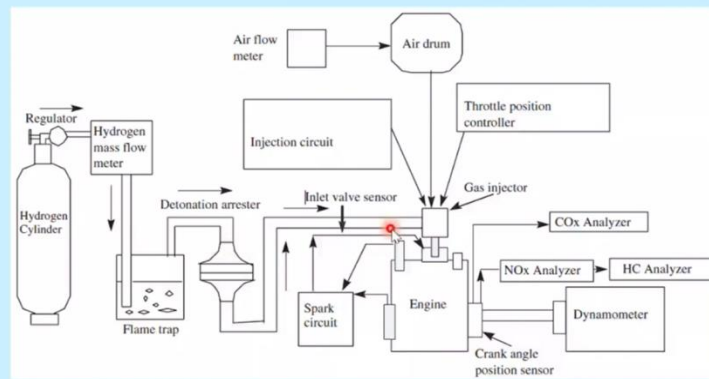
Institute Chair Professor  
I C Engines Laboratory  
Department of Mechanical Engineering  
IIT Madras  
aramesh@iitm.ac.in

Ramesh A, IIT Madras



Ramesh A, IIT Madras

## Experimental Setup

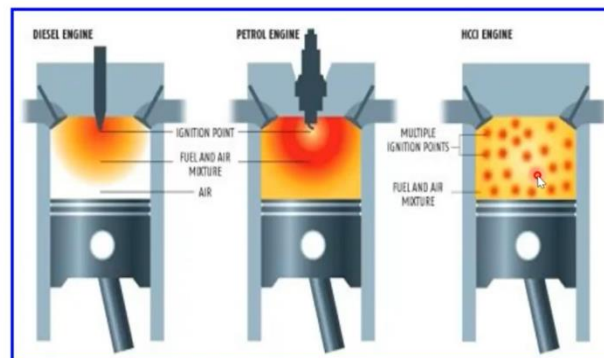


R. Hari Ganes, V. Subramaniana, V. Balasubramanian, J.M. Mallikarjuna, A. Ramesh, R.P. Sharma. / Renewable Energy 33 (2008) 1324–1333

Indian Institute of Technology Madras  
Internal Combustion Engines laboratory

Slide Number: 19

## Homogeneous Charge Compression Ignition (HCCI)



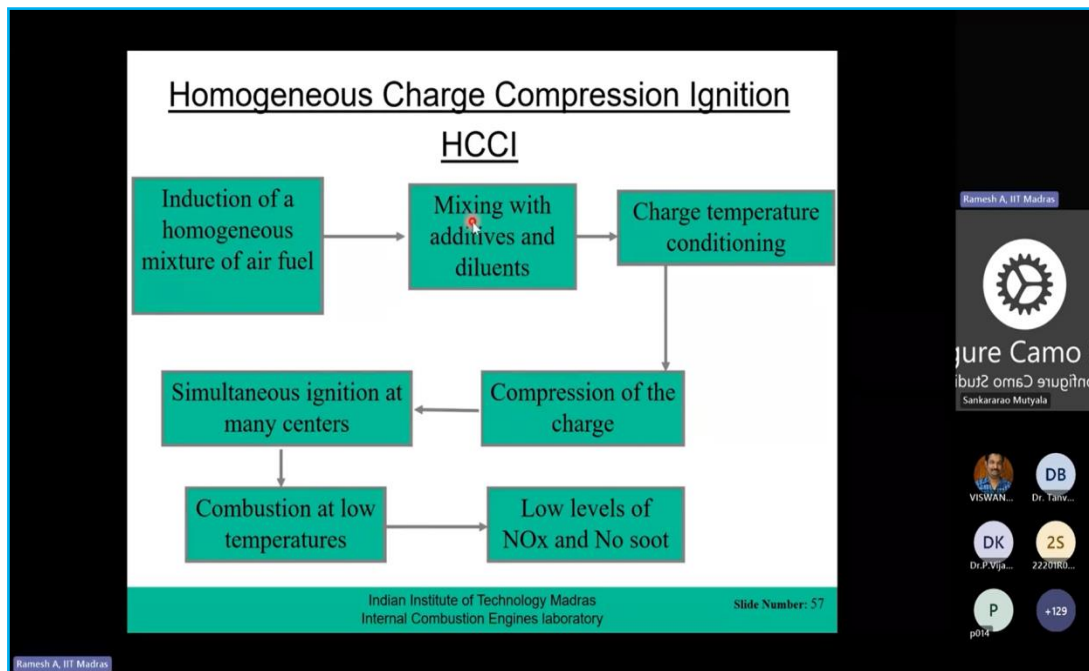
Indian Institute of Technology Madras  
Internal Combustion Engines laboratory

Slide Number: 56

Ramesh A, IIT Madras



Ramesh A, IIT Madras



**Day-2: (17.12.2024) Tuesday 6:00 PM -7:30 PM Session 3**

**Topic:**Hydrogen generation using solar energy

**Speaker:**

Dr. D.Jayakrishna  
Professor  
Department of Mechanical Engineering  
National Institute of Technology Warangal  
Warangal, Telangana.



**Faculty Development Programme (FDP)**  
**(Online mode)**  
**on**  
**Emerging Green hydrogen energy technologies for societal sustainability and climate change mitigation**

**Organized by**  
Department of Mechanical Engineering  
Lakireddy Bali Reddy College of Engineering, Mylavaram

**Presented by**  
**Dr. Jaya Krishna Devanuri**  
Professor  
Department of Mechanical Engineering  
National Institute of Technology, Warangal

12/17/2024  
National Institute of Technology Warangal



### 1. Solar reactor of ETH-Zurich

40

VISWANADH, K.V

(a) 10 lit/min (b) 20 lit/min

Particle trajectories with lines colored by particle diameter ( $\mu\text{m}$ ) with the variation of main flow for F2=1 lit/min (argon), F3=10 lit/min (argon) and non-uniform particle diameter with  $m_p=7 \times 10^{-6}$  kg/s

64

VISWANADH, K.V

Dammalapati Vijaya Lakshmi

P049

P020 - Mounika, P

Dr. HarinathaReddy Maddika

SANYASIRAO SURADA

P148-R. BHASKAR REDDY

P207 (Dr. Tameer Bilal)

**Day-2: (17.12.2024) Tuesday 7.30PM -9:00 PM Session 4**

**Topic:**Green hydrogen production and its future in the context of increased climate change

**Speaker:**

Dr. M.Sankararao  
Director  
Nanosol Energy P Ltd  
Hyderabad, Telangana



Day 2 Session 2

Faculty Development Programme On

Emerging Green hydrogen energy technologies for societal sustainability and climate change mitigation

**Prospects of HYDROGEN as a Clean Fuel – India**

Dr M Sankararao  
Director & CTO

**NANOSOL ENERGY PRIVATE LIMITED**

# Plot No 43, Raghavendra Nagar Colony, Beeramguda, Hyderabad 502032, Telangana  
Email: nagamaheshk@nanosol.in; nagamaheshk@gmail.com; Website: www.nanosol.in

**PEM FUEL CELLS**

Hydrogen Anode:  $2 H_2 \rightarrow 4 H^+ + 4 e^-$

Oxygen Cathode:  $O_2 + 4 e^- \rightarrow 2 O^{2-}$

Overall reaction:  $2 H_2 + O_2 \rightarrow 2 H_2O$

Electrocatalyst: Noble metal supported

**NANOSOL ENERGY PRIVATE LIMITED**

# Plot No 43, Raghavendra Nagar Colony, Beeramguda, Hyderabad 502032, Telangana  
Email: nagamaheshk@nanosol.in; sankars@nanosol.in; Website: www.nanosol.in

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**

**HOT PRESS MACHINE**



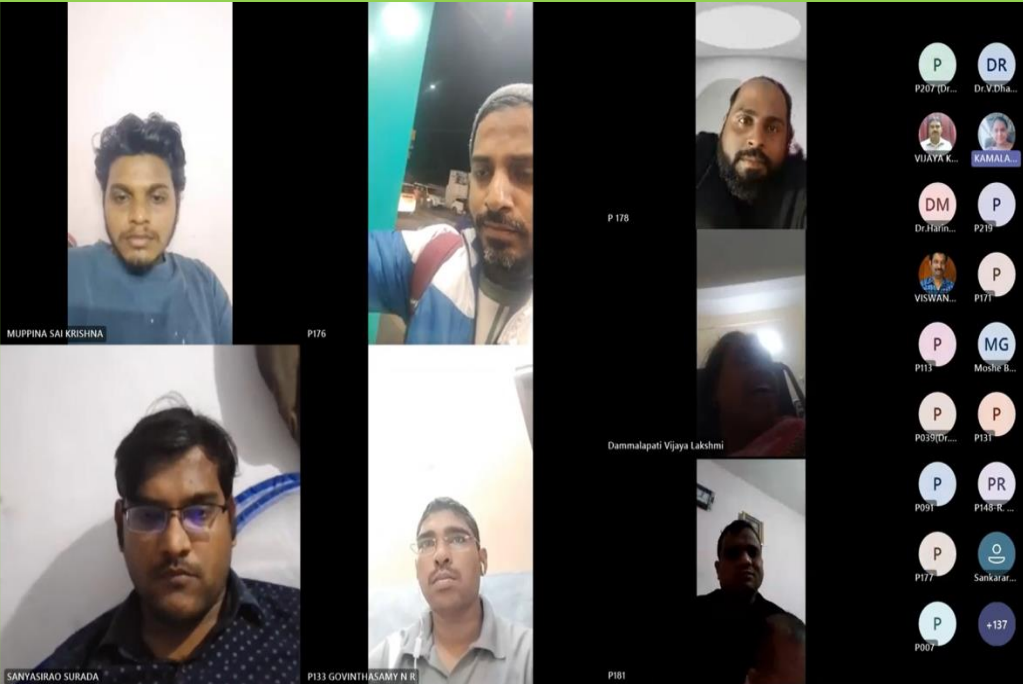
Parameter	Description
Type of Product	Hot Press
Mode operation	Manual / PLC
Plate size	Upto 900 cm <sup>2</sup>
Op Temperature	Upto 300 °C
Op Pressure	Upto 300 bar



**NANOSOL ENERGY PRIVATE LIMITED** # Plot No 43, Raghavendra Nagar Colony, Beeramguda, Hyderabad 502032, Telangana  
Email: [ragamahesh@nanosol.in](mailto:ragamahesh@nanosol.in); [sankar@nanosol.in](mailto:sankar@nanosol.in); Website: [www.nanosol.in](http://www.nanosol.in)

**NANOSOL ENERGY**

Sankarao Mutyala



MUPPINA SAI KRISHNA P176

P 178

Dammalapati Vijaya Lakshmi

SANYASIRAO SURADA P133

GOVINTHASAMY N R P181

P 177 P 178 P 179 P 180 P 181 P 182 P 183 P 184 P 185 P 186 P 187 P 188 P 189 P 190 P 191 P 192 P 193 P 194 P 195 P 196 P 197 P 198 P 199 P 200 P 201 P 202 P 203 P 204 P 205 P 206 P 207 P 208 P 209 P 210 P 211 P 212 P 213 P 214 P 215 P 216 P 217 P 218 P 219 P 220 P 221 P 222 P 223 P 224 P 225 P 226 P 227 P 228 P 229 P 230 P 231 P 232 P 233 P 234 P 235 P 236 P 237 P 238 P 239 P 240 P 241 P 242 P 243 P 244 P 245 P 246 P 247 P 248 P 249 P 250 P 251 P 252 P 253 P 254 P 255 P 256 P 257 P 258 P 259 P 260 P 261 P 262 P 263 P 264 P 265 P 266 P 267 P 268 P 269 P 270 P 271 P 272 P 273 P 274 P 275 P 276 P 277 P 278 P 279 P 280 P 281 P 282 P 283 P 284 P 285 P 286 P 287 P 288 P 289 P 290 P 291 P 292 P 293 P 294 P 295 P 296 P 297 P 298 P 299 P 300 P 301 P 302 P 303 P 304 P 305 P 306 P 307 P 308 P 309 P 310 P 311 P 312 P 313 P 314 P 315 P 316 P 317 P 318 P 319 P 320 P 321 P 322 P 323 P 324 P 325 P 326 P 327 P 328 P 329 P 330 P 331 P 332 P 333 P 334 P 335 P 336 P 337 P 338 P 339 P 340 P 341 P 342 P 343 P 344 P 345 P 346 P 347 P 348 P 349 P 350 P 351 P 352 P 353 P 354 P 355 P 356 P 357 P 358 P 359 P 360 P 361 P 362 P 363 P 364 P 365 P 366 P 367 P 368 P 369 P 370 P 371 P 372 P 373 P 374 P 375 P 376 P 377 P 378 P 379 P 380 P 381 P 382 P 383 P 384 P 385 P 386 P 387 P 388 P 389 P 390 P 391 P 392 P 393 P 394 P 395 P 396 P 397 P 398 P 399 P 400 P 401 P 402 P 403 P 404 P 405 P 406 P 407 P 408 P 409 P 410 P 411 P 412 P 413 P 414 P 415 P 416 P 417 P 418 P 419 P 420 P 421 P 422 P 423 P 424 P 425 P 426 P 427 P 428 P 429 P 430 P 431 P 432 P 433 P 434 P 435 P 436 P 437 P 438 P 439 P 440 P 441 P 442 P 443 P 444 P 445 P 446 P 447 P 448 P 449 P 450 P 451 P 452 P 453 P 454 P 455 P 456 P 457 P 458 P 459 P 460 P 461 P 462 P 463 P 464 P 465 P 466 P 467 P 468 P 469 P 470 P 471 P 472 P 473 P 474 P 475 P 476 P 477 P 478 P 479 P 480 P 481 P 482 P 483 P 484 P 485 P 486 P 487 P 488 P 489 P 490 P 491 P 492 P 493 P 494 P 495 P 496 P 497 P 498 P 499 P 500 P 501 P 502 P 503 P 504 P 505 P 506 P 507 P 508 P 509 P 510 P 511 P 512 P 513 P 514 P 515 P 516 P 517 P 518 P 519 P 520 P 521 P 522 P 523 P 524 P 525 P 526 P 527 P 528 P 529 P 530 P 531 P 532 P 533 P 534 P 535 P 536 P 537 P 538 P 539 P 540 P 541 P 542 P 543 P 544 P 545 P 546 P 547 P 548 P 549 P 550 P 551 P 552 P 553 P 554 P 555 P 556 P 557 P 558 P 559 P 560 P 561 P 562 P 563 P 564 P 565 P 566 P 567 P 568 P 569 P 570 P 571 P 572 P 573 P 574 P 575 P 576 P 577 P 578 P 579 P 580 P 581 P 582 P 583 P 584 P 585 P 586 P 587 P 588 P 589 P 590 P 591 P 592 P 593 P 594 P 595 P 596 P 597 P 598 P 599 P 600 P 601 P 602 P 603 P 604 P 605 P 606 P 607 P 608 P 609 P 610 P 611 P 612 P 613 P 614 P 615 P 616 P 617 P 618 P 619 P 620 P 621 P 622 P 623 P 624 P 625 P 626 P 627 P 628 P 629 P 630 P 631 P 632 P 633 P 634 P 635 P 636 P 637 P 638 P 639 P 640 P 641 P 642 P 643 P 644 P 645 P 646 P 647 P 648 P 649 P 650 P 651 P 652 P 653 P 654 P 655 P 656 P 657 P 658 P 659 P 660 P 661 P 662 P 663 P 664 P 665 P 666 P 667 P 668 P 669 P 670 P 671 P 672 P 673 P 674 P 675 P 676 P 677 P 678 P 679 P 680 P 681 P 682 P 683 P 684 P 685 P 686 P 687 P 688 P 689 P 690 P 691 P 692 P 693 P 694 P 695 P 696 P 697 P 698 P 699 P 700 P 701 P 702 P 703 P 704 P 705 P 706 P 707 P 708 P 709 P 710 P 711 P 712 P 713 P 714 P 715 P 716 P 717 P 718 P 719 P 720 P 721 P 722 P 723 P 724 P 725 P 726 P 727 P 728 P 729 P 730 P 731 P 732 P 733 P 734 P 735 P 736 P 737 P 738 P 739 P 740 P 741 P 742 P 743 P 744 P 745 P 746 P 747 P 748 P 749 P 750 P 751 P 752 P 753 P 754 P 755 P 756 P 757 P 758 P 759 P 760 P 761 P 762 P 763 P 764 P 765 P 766 P 767 P 768 P 769 P 770 P 771 P 772 P 773 P 774 P 775 P 776 P 777 P 778 P 779 P 780 P 781 P 782 P 783 P 784 P 785 P 786 P 787 P 788 P 789 P 790 P 791 P 792 P 793 P 794 P 795 P 796 P 797 P 798 P 799 P 800 P 801 P 802 P 803 P 804 P 805 P 806 P 807 P 808 P 809 P 810 P 811 P 812 P 813 P 814 P 815 P 816 P 817 P 818 P 819 P 820 P 821 P 822 P 823 P 824 P 825 P 826 P 827 P 828 P 829 P 830 P 831 P 832 P 833 P 834 P 835 P 836 P 837 P 838 P 839 P 840 P 841 P 842 P 843 P 844 P 845 P 846 P 847 P 848 P 849 P 850 P 851 P 852 P 853 P 854 P 855 P 856 P 857 P 858 P 859 P 860 P 861 P 862 P 863 P 864 P 865 P 866 P 867 P 868 P 869 P 870 P 871 P 872 P 873 P 874 P 875 P 876 P 877 P 878 P 879 P 880 P 881 P 882 P 883 P 884 P 885 P 886 P 887 P 888 P 889 P 890 P 891 P 892 P 893 P 894 P 895 P 896 P 897 P 898 P 899 P 900 P 901 P 902 P 903 P 904 P 905 P 906 P 907 P 908 P 909 P 910 P 911 P 912 P 913 P 914 P 915 P 916 P 917 P 918 P 919 P 920 P 921 P 922 P 923 P 924 P 925 P 926 P 927 P 928 P 929 P 930 P 931 P 932 P 933 P 934 P 935 P 936 P 937 P 938 P 939 P 940 P 941 P 942 P 943 P 944 P 945 P 946 P 947 P 948 P 949 P 950 P 951 P 952 P 953 P 954 P 955 P 956 P 957 P 958 P 959 P 960 P 961 P 962 P 963 P 964 P 965 P 966 P 967 P 968 P 969 P 970 P 971 P 972 P 973 P 974 P 975 P 976 P 977 P 978 P 979 P 980 P 981 P 982 P 983 P 984 P 985 P 986 P 987 P 988 P 989 P 990 P 991 P 992 P 993 P 994 P 995 P 996 P 997 P 998 P 999 P 1000

**Day-3: (18.12.2024) Wednesday 6:00 PM -7:30 PM Session 5**

**Topic:**Hydrogen and energy storage for sustainable energy systems

**Speaker:**

Dr. E.Anil Kumar

Professor

Department of Mechanical Engineering

Indian Institute of Technology- Tirupati



Google Chrome  
is using the webcam

## Hydrogen Storage for Mobile Applications

Dr. E. Anil Kumar  
(anil@iittp.ac.in)

వారిని శ్రీశైలిలో స్థాపించిన తిరుపతి  
**TIRUPATI**

Department of Mechanical Engineering  
India

Prof. E. Anil Kumar (IIT Tirupati)

Sankarasa Murthy

Prof. E. Anil Kumar (IIT Tirupati)

18-12-2024

### Physical Models Recently Studied

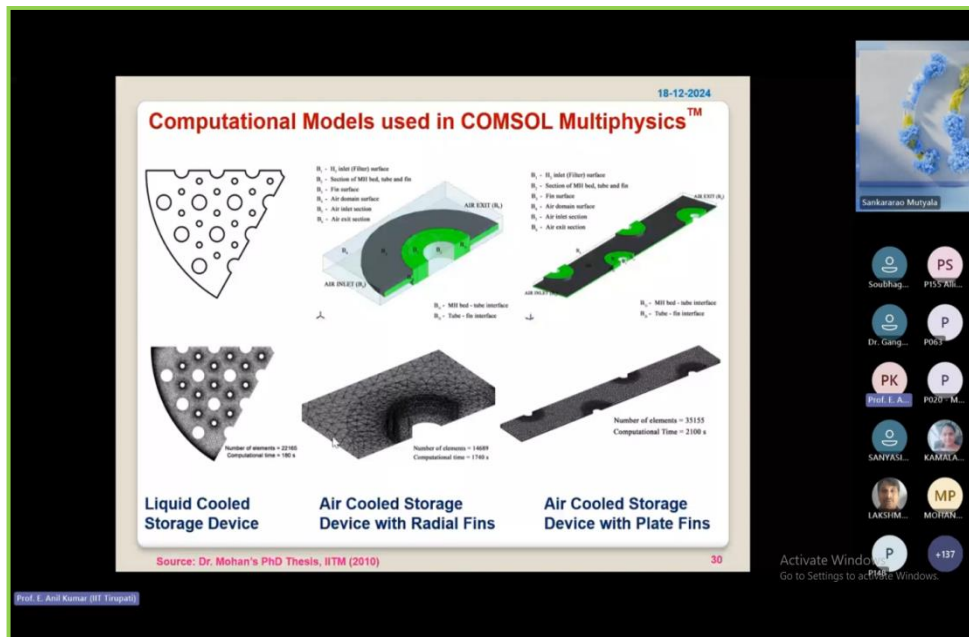
Liquid Cooled Hydrogen Storage Device with bedded Heat Exchanger Tubes

Hydrogen Storage Device with Plate Fins

Hydrogen Storage Device with Radial Fins

Source: Dr. Mohan's PhD Thesis, IITM (2010)

Prof. E. Anil Kumar (IIT Tirupati)

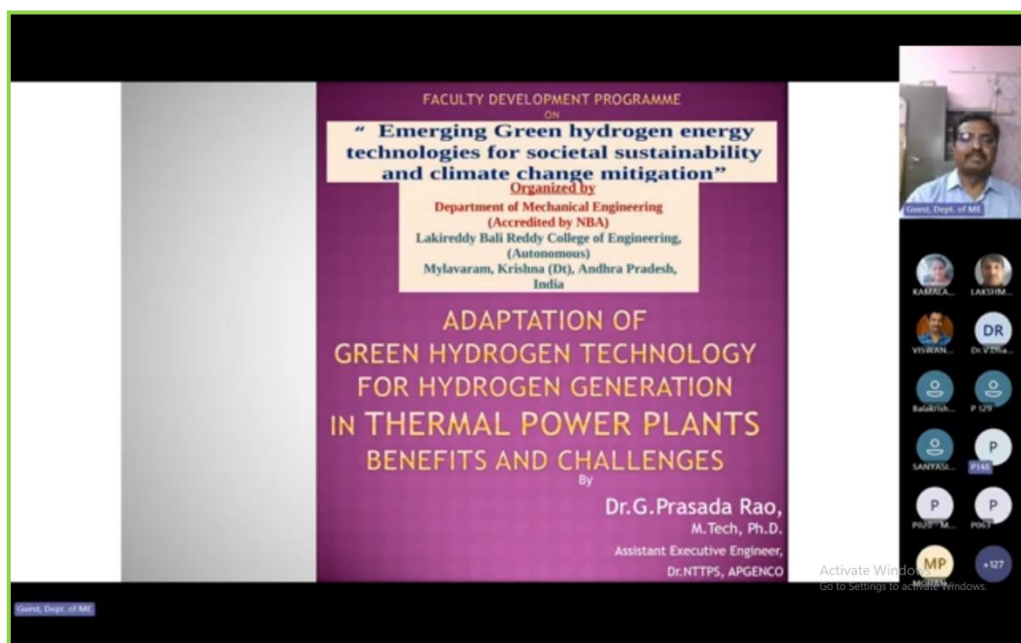


**Day-3: (18.12.2024) Wednesday 7:30 PM - 9.00 PM Session 6**

**Topic:** Adoption of green hydrogen technology for hydrogen generation in thermal power plants: benefits and challenges

**Speaker:**

Mr. G.Prasada Rao  
Executive Engineer  
Dr.Narla Tatarao Thermal Power Station  
Ibrahimpattam, Vijayawada



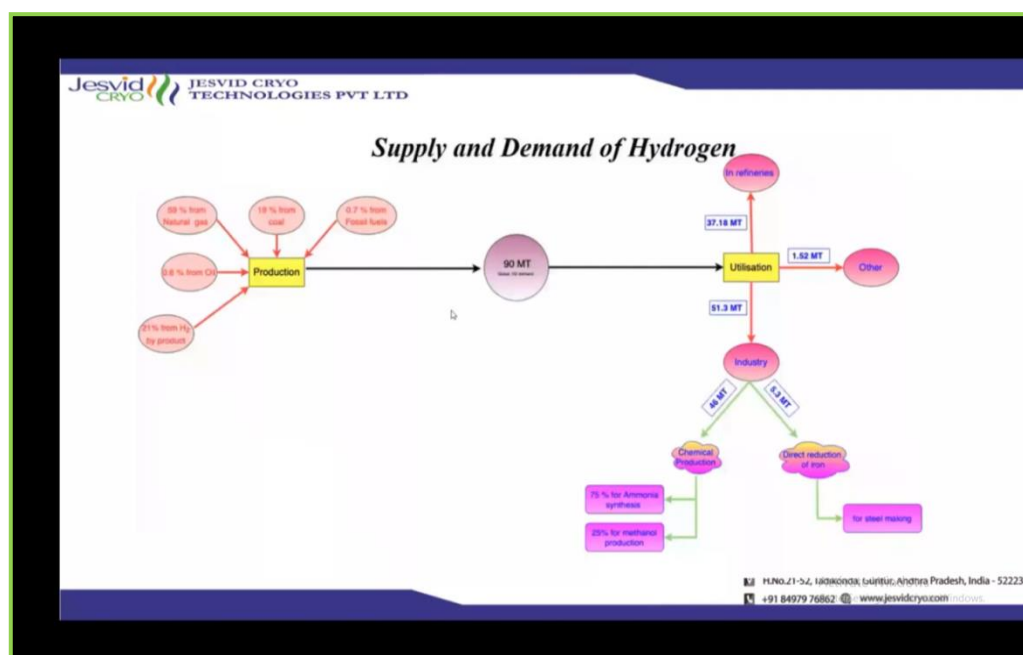
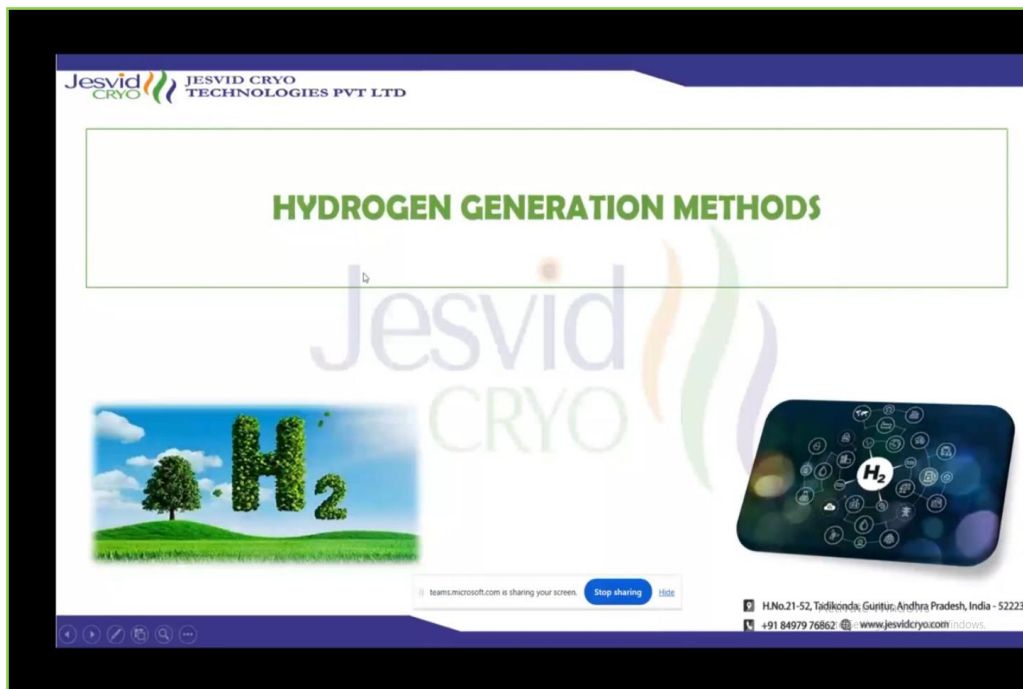


**Day-4: (19.12.2024) Thursday 6:00 PM - 7:30 PM Session 7**

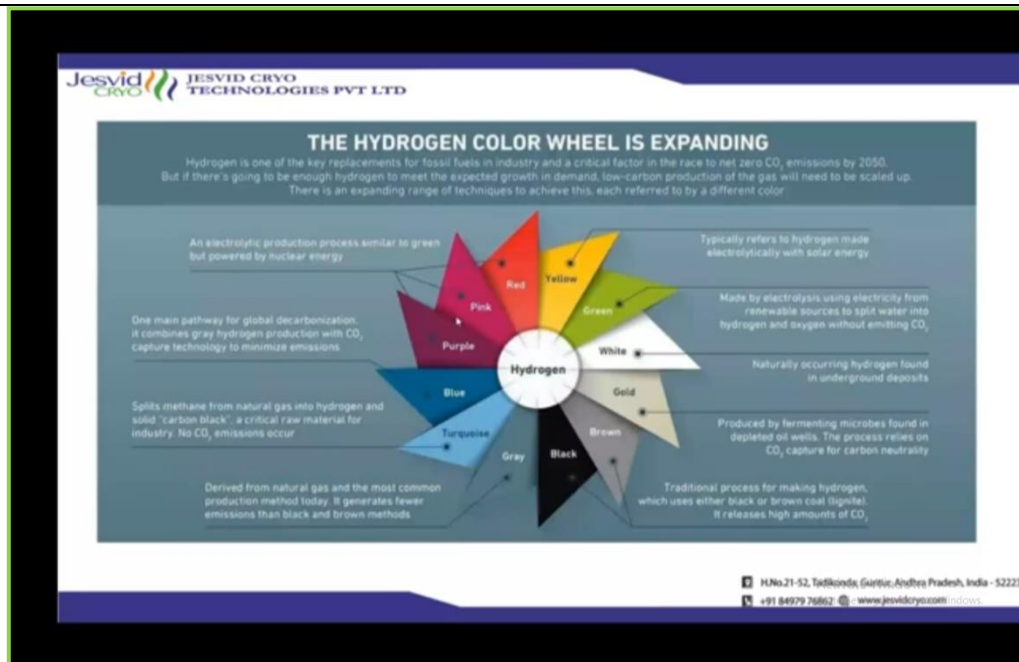
**Topic:**Hydrogen energy generation

**Speaker:**

Mr. N.Vinod Kumar  
Director,  
JesvidCryo P Ltd,  
Mangalagiri, Amaravati.



AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**



**Day-4. (19.12.2024) Thursday 7:30 PM - 9:00 PM Session 8**

**Topic:** Representative concentration pathway analysis to understand climate change and role of hydrogen.

**Speaker:**

Dr. Anand M Shivapuji,  
Senior Research Scientist,  
Center for Sustainable Technologies,  
IISc, Bengaluru.







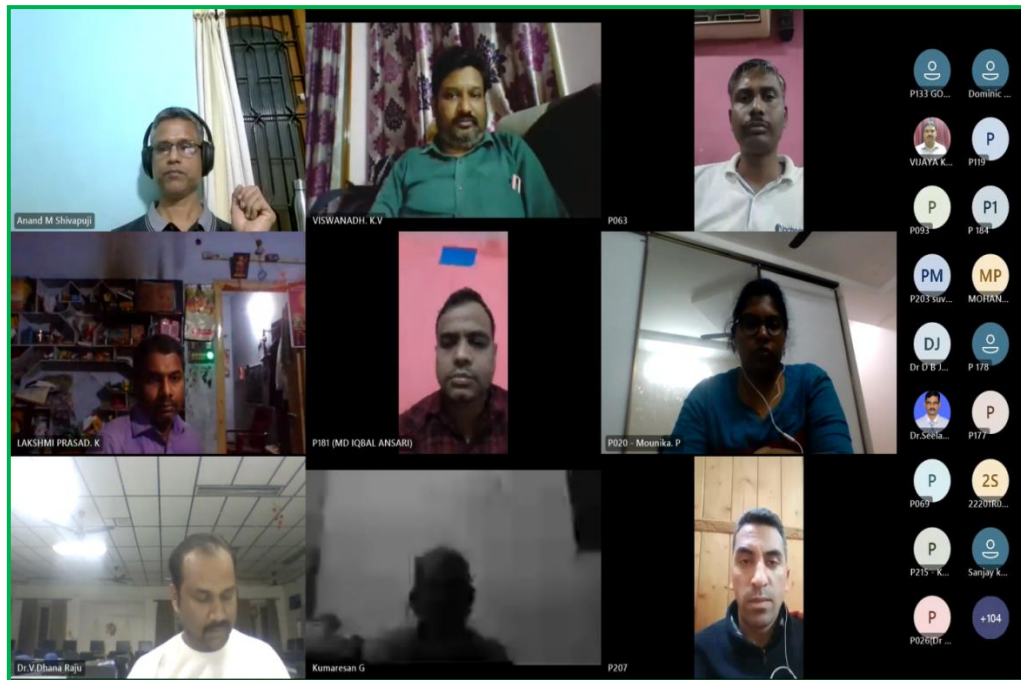
### Gasification Variants – Air and Oxy-Steam Gasification

- *Air gasification*
  - $CH_{1.4}O_{0.6} + 0.26 (O_2 + 3.76 N_2) \rightarrow 0.2 H_2 + 0.2 CO + 0.02 CH_4 + 0.12 CO_2 + 0.46 N_2$
  - Producer gas - 20%  $H_2$  + 20%  $CO$  + 2%  $CH_4$  + 12%  $CO_2$  + 46%  $N_2$  :: ~ 05 MJ/kg
  - 40 - 50g of  $H_2$ /kg of biomass
  - 2.75 kg-producer gas/kg-biomass
  
- *Oxy-steam gasification*
  - $CH_{1.4}O_{0.6} + 0.26 O_2 + 2.5 H_2O \rightarrow 0.5 H_2 + 0.15 CO + 0.05 CH_4 + 0.30 CO_2$
  - Syngas - 50%  $H_2$  + 15%  $CO$  + 5%  $CH_4$  + 30%  $CO_2$  :: ~ 11 MJ/kg
  - 100g of  $H_2$ /kg biomass
  - 2.0 kg-syngas /kg-biomass

### Gasification – Field of use ... Not limed to

Sr.No	Product	Biomass Consumption
01	Electricity through IC engine route	1.000 kg/kWh
02	Thermal energy through burner route	0.290 kg/kWh
03	Green Hydrogen of ISO 14687 quality	15 kg/kg
04	Green Methanol	2.500 kg/kg
05	Green Ammonia	0.265 kg/kg
06	Iron ore reduction	1.000 kg/kg

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**



**Day-5: (20.12.2024) Friday 6:00 PM - 7.30 PM Session 9**

**Topic:** Solid state hydrogen storage for sustainable energy conversion and storage

**Speaker:**  
Dr. E. Anil Kumar  
Professor,  
Department of Mechanical Engineering  
IIT, Tirupati.



20-12-2024

### Schematic of Experimental Setup for Static PCI Measurements

---  $V_1 = 15.608$  ml = volume between  $v_1, v_2, v_3, v_4$  and  $v_5$

---  $V_2 = 3.9460$  ml = volume between  $v_2, v_3$  and  $v_5$

---  $V_3 = 306.36$  ml = volume between  $v_4, C_1$  and DP

---  $V_4 = 3.9576$  ml = volume between  $v_5, v_8$  and  $v_{11}$

---  $V_5 = 11.026$  ml = volume between  $v_6, v_9, v_{10}$  and DP

---  $V_6 = V_7 = 300.598$  ml = volume between  $v_6$  to  $C_2$  and  $v_{10}$  to  $C_3$

.....  $V_8 =$  volume between  $v_{11}$  and  $v_{12}$

\_\_\_\_\_  $V_9 =$  Free volume in reactor up to  $v_{12}$

$v_1 - v_{12}$  - Bellow Valves

$P_1 - P_3$  - Pressure Transducers

$T_1 - T_3$  - Thermocouples

$C_1 - C_3$  - Calibrated Cylinders

DP - Differential Pressure Transducers

P  
P156

PK  
Prof. E. A.

P  
P196

PH  
P199 Dr...

P  
P215 - K...

DK  
Dr. P.R.A...

VISWAN...  
P180

P  
P180

KAMALA...  
DR  
Dr. V.Dha...

DR  
Dr. V.Dha...

P  
P116

P  
P143 An...

PR  
P148 R...

P  
P041 Dr...

DJ  
Dr D E J...

P  
P020 - M...

P  
P119

+107

20-12-2024

### Method for making pellets

Components of Die and Punch

Alloy powder + graphite flakes

CWM Structure

Step 1

Assembling of Die Parts

Step 2

Placing CWM structure

Step 3

Pouring of mixture (alloy powder + graphite flakes)

Pressing

P  
P156

PK  
Prof. E. A.

P  
P196

PH  
P199 Dr...

P  
P215 - K...

DK  
Dr. P.R.A...

VISWAN...  
P180

P  
P180

KAMALA...  
DR  
Dr. V.Dha...

DR  
Dr. V.Dha...

P  
P116

P  
P143 An...

PR  
P148 R...

P  
P041 Dr...

DJ  
Dr D E J...

P  
P020 - M...

P  
P119

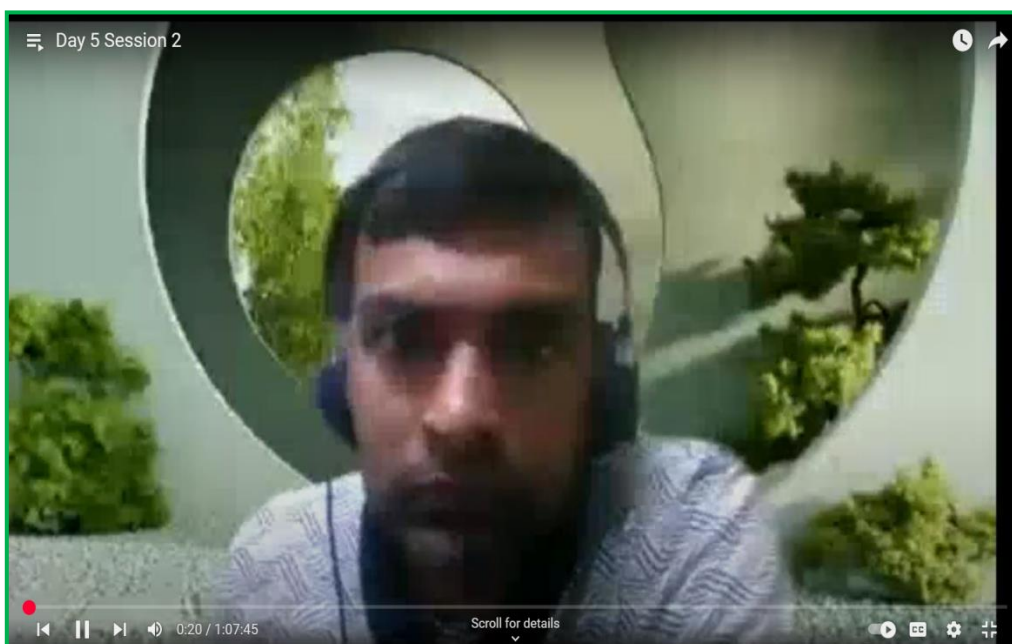
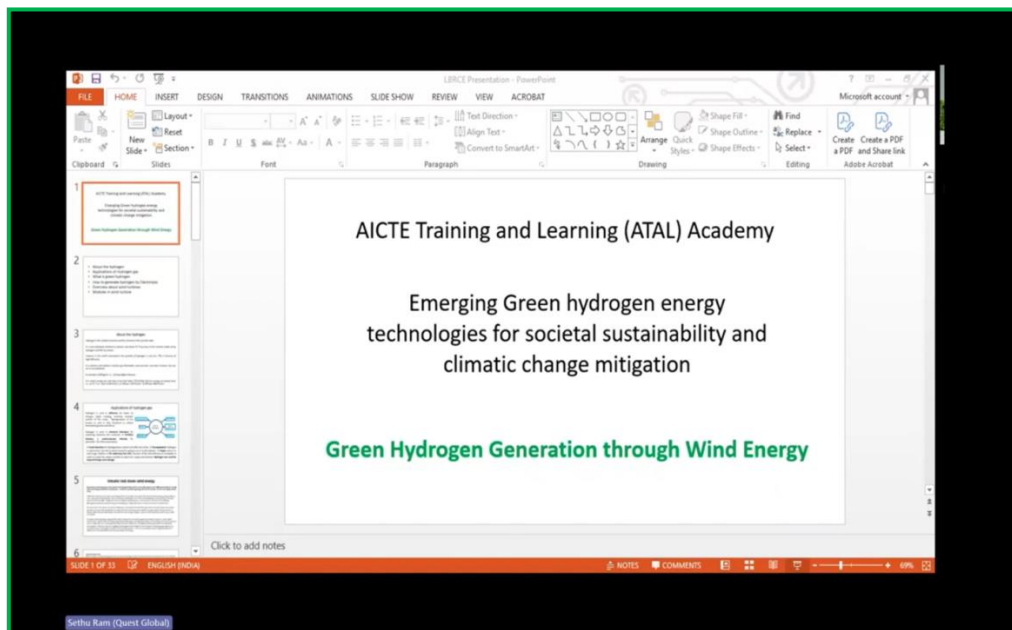
+122

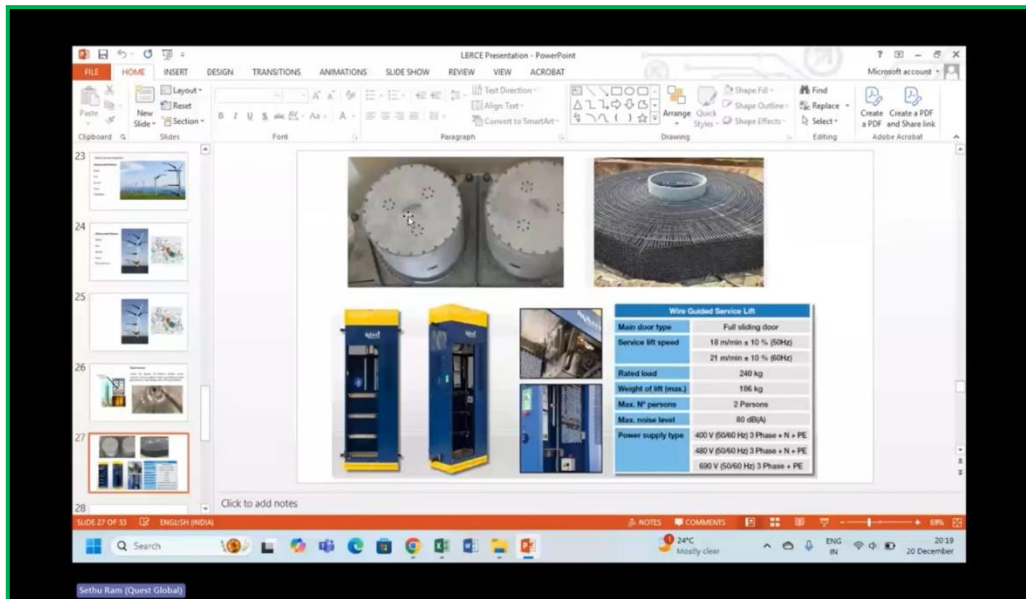
Organized by  
 Department of Mechanical Engineering, Lakireddy Balireddy College of Engineering (Autonomous),  
 Mylavaram, Andhra Pradesh, India.

**Day-5. (6.12.2024) Friday 7:30 PM–9:00 PM Session 10**

**Topic:**Hydrogen production and its impact on climate change

**Speaker:**  
Mr. V.Sethuram  
Team Lead,  
Global Quest Bengaluru





### How to generate hydrogen by Electrolysis?

Hydrogen can be generated from different processes, but to avoid carbon emissions and toxic gases then most preferred method is Electrolysis.

In Electrolysis process electricity (electro-) is used to break down (-lysis) water (H<sub>2</sub>O) into its components parts of oxygen and hydrogen.

The basic equation of water electrolysis is written as:  $H_2O_{(liquid)} + Energy \rightarrow H_{2(g)} + \frac{1}{2} O_{2(g)}$

Cathode      Anode  
Electrolyte Water

### Day-6: (21.12.2024) Saturday 2:00 PM – 3:30 PM Session 11

**Topic:**Hydrogen energy applications in Thermal Polygeneration


**Speaker:**

Dr. T.Srinivas  
Professor & Head,  
Department of Mechanical Engineering  
National Institute of Technology  
Jalandhar, Punjab.

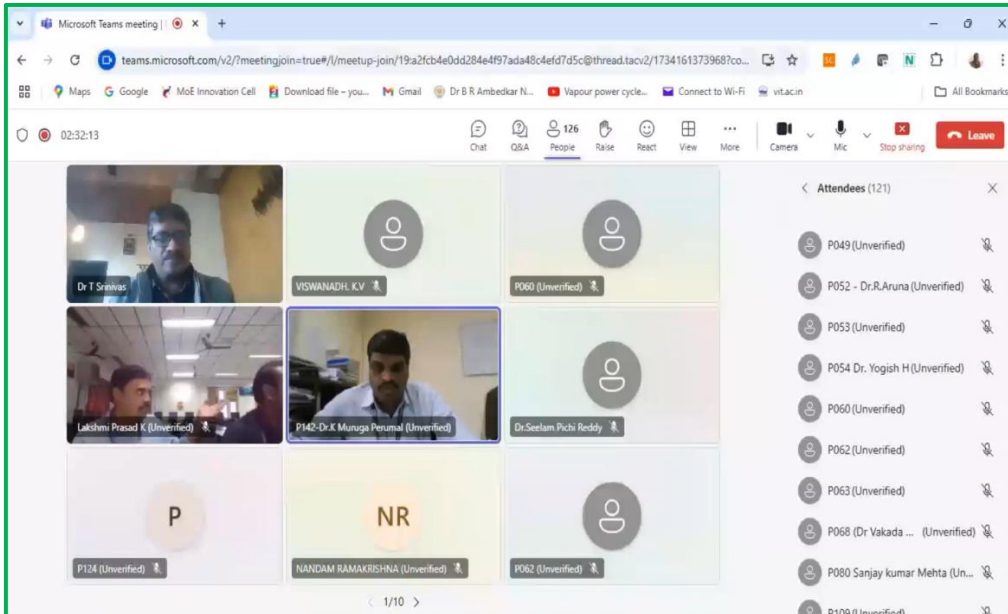


AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
 CLIMATE CHANGE MITIGATION**

## Hydrogen Energy – Thermal Polygeneration



**Dr. Tangellapalli Srinivas**  
 Professor, Department of Mechanical Engineering  
 Dr. B.R. Ambedkar National Institute of Technology Jalandhar, Punjab, India – 144008

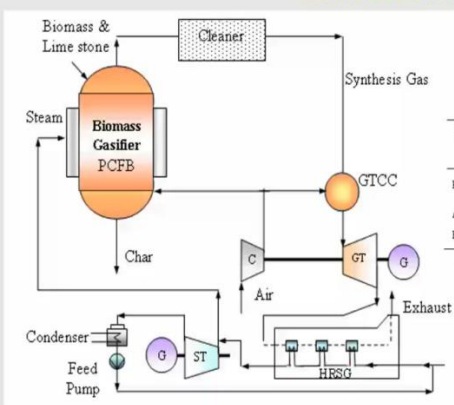


Microsoft Teams meeting | 02:32:13 | 126 People

**Attendees (121)**

- P049 (Unverified)
- P052 - Dr.R.Aruna (Unverified)
- P053 (Unverified)
- P054 Dr. Yogish H (Unverified)
- P060 (Unverified)
- P062 (Unverified)
- P063 (Unverified)
- P068 (Dr Vakada ... (Unverified)
- P080 Sanjay kumar Mehta (Un...
- P109 (Unverified)

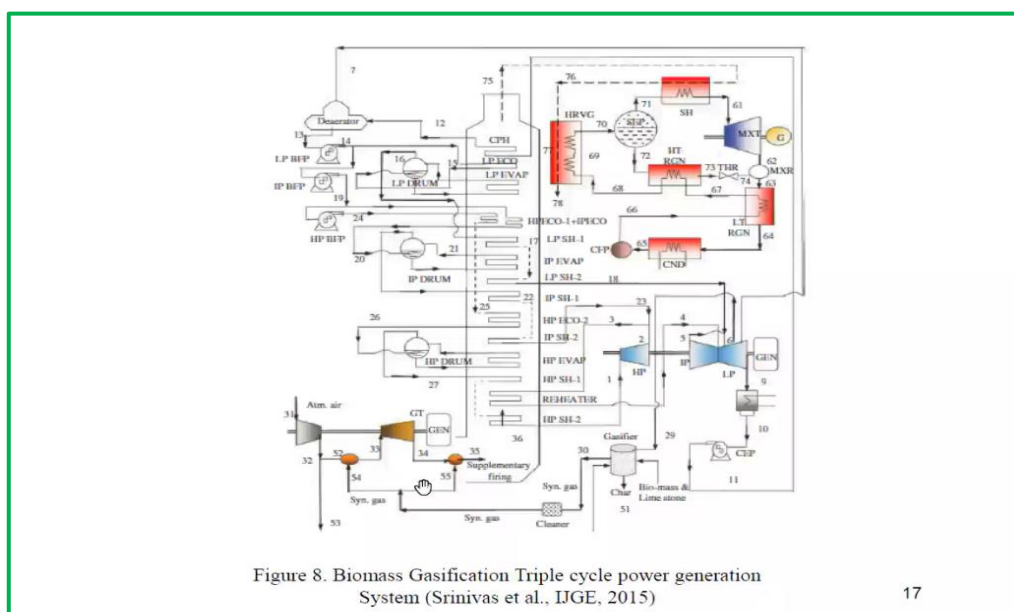
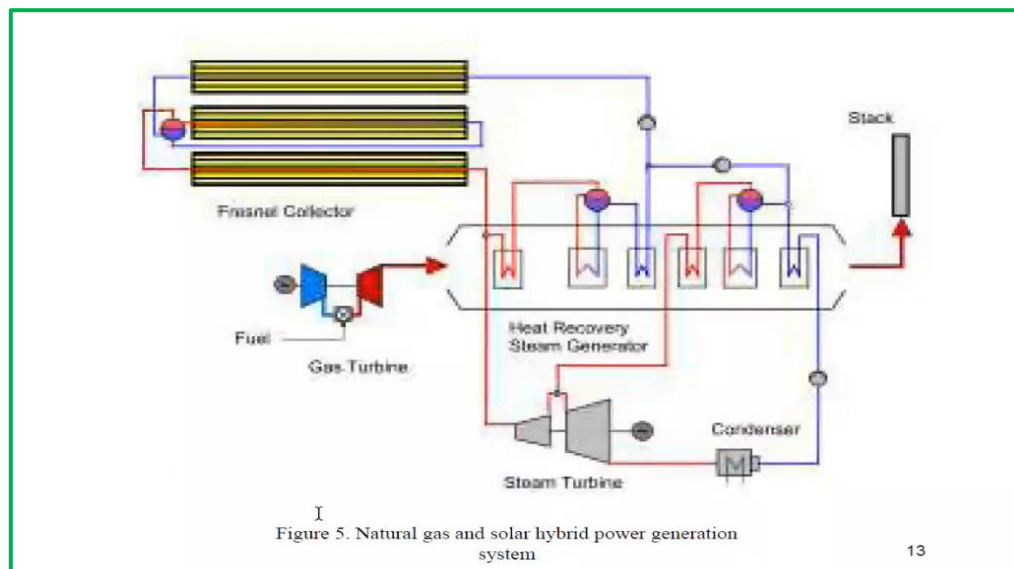
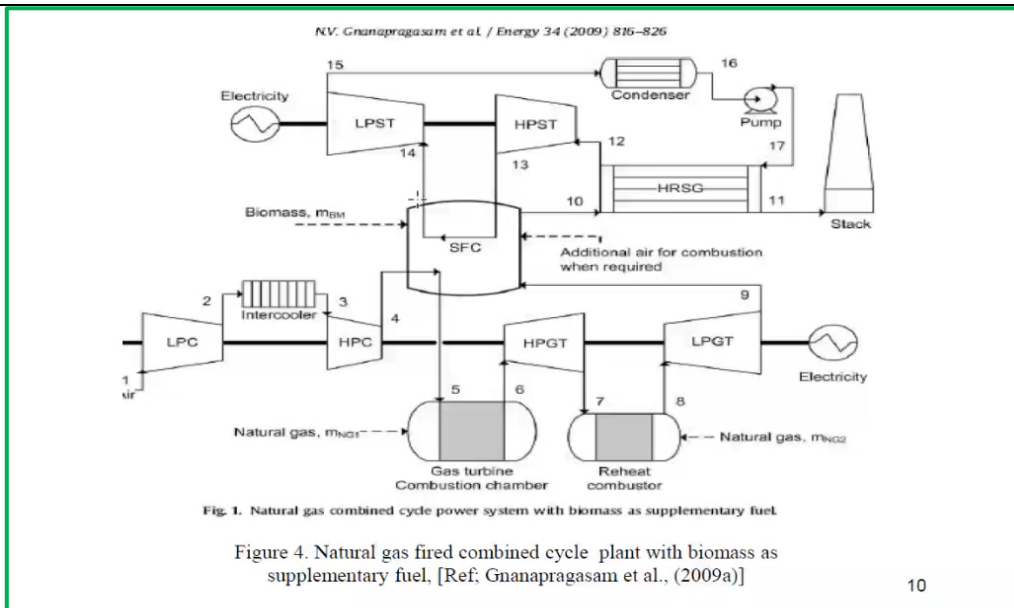
## Gasification



Syn gas composition (dry basis, mol percentage)	H <sub>2</sub>	CO	CH <sub>4</sub>	CO <sub>2</sub>	N <sub>2</sub>
Present model	19.5	20.3	0.01	9.5	50.69
Altafina et al. [18]	20.05	19.7	0	10.15	50.1
Experimental [9]	14	20.14	2.31	12.06	51.49

Source: Srinivas, T., Gupta, A.V.S.K.S. and Reddy, B.V., 2009. Thermodynamic equilibrium model and exergy analysis of a biomass gasifier.







**Day 6. (7.12.2024) Saturday 5:00 PM – 6:30 PM Session 13**

**Topic:**Advances and developments in hydrogen energy technologies

**Speaker:**

Dr. Bale V Reddy  
Professor,  
Ontario Tech University, Oshawa  
Canada



## Advances and Developments in Hydrogen Energy Technologies

B.V. Reddy  
Professor

Department of Mechanical and Manufacturing Engineering  
Faculty of Engineering and Applied Science  
Ontario Tech University (UOIT)  
Oshawa ON, Canada

hydrogen production systems is done. The two different routes are shown in Fig. 4. In PV route, DC electricity is generated first by PV panes and then stored in a battery bank. The DC electricity can be converted to AC electricity by using an inverter and then this electricity is further used to run an electrolyser. In solar thermal route, the thermal energy of solar radiation is

surface to the incident solar energy on the concentrator and can be expressed as,

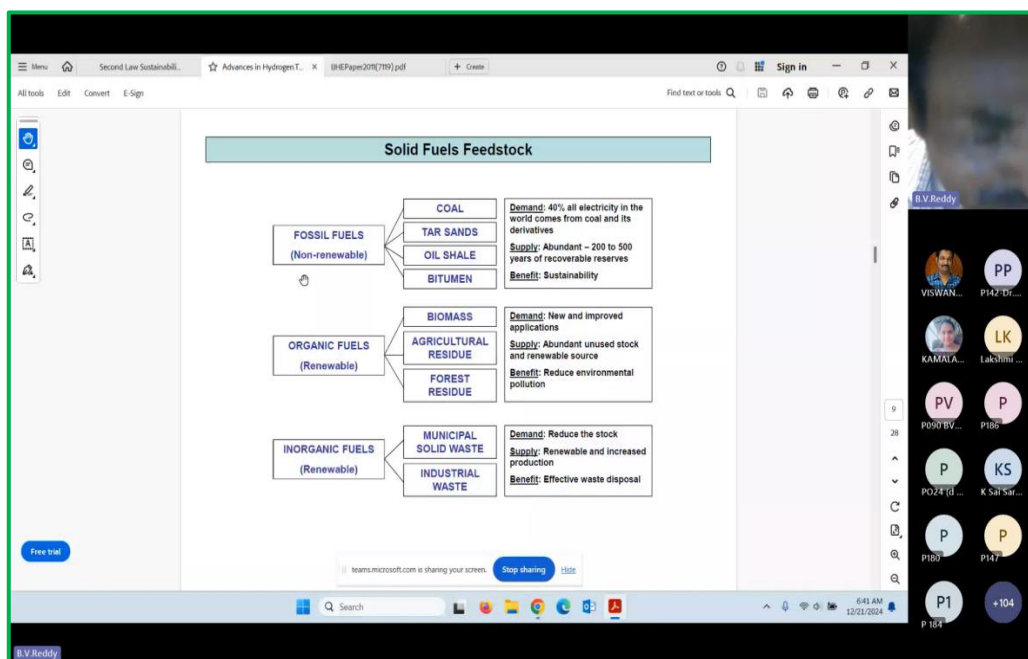
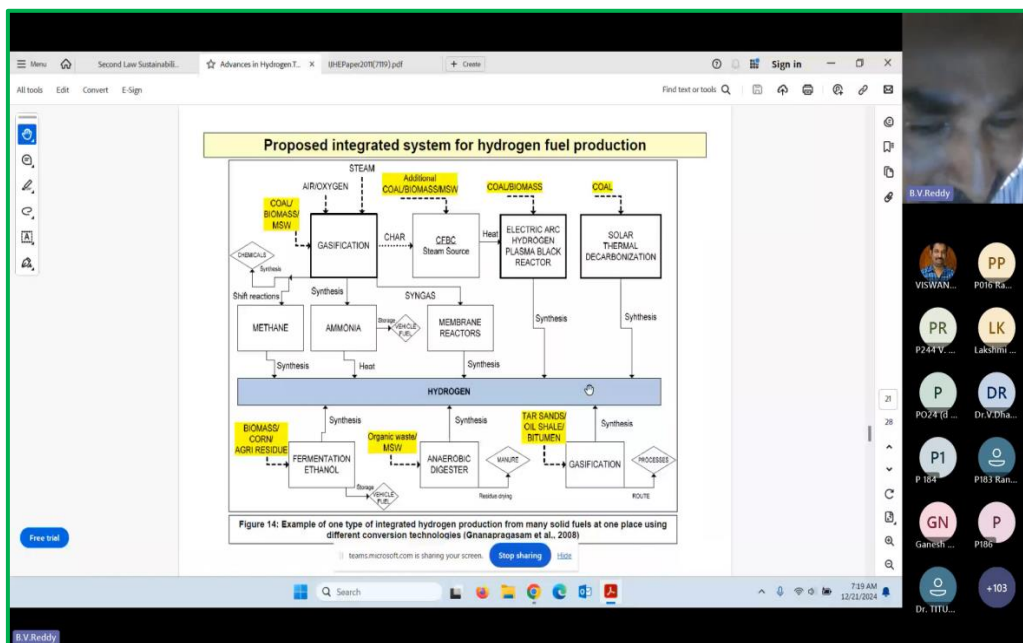
$$\eta_c = \frac{\dot{Q}}{I_s A_c} \quad (9)$$

where  $A_c$  Area of collector ( $m^2$ ).

Fig. 3 – Schematic of a solar thermal hydrogen production system.

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**

---



**[Youtube Playlist Link:](#)**

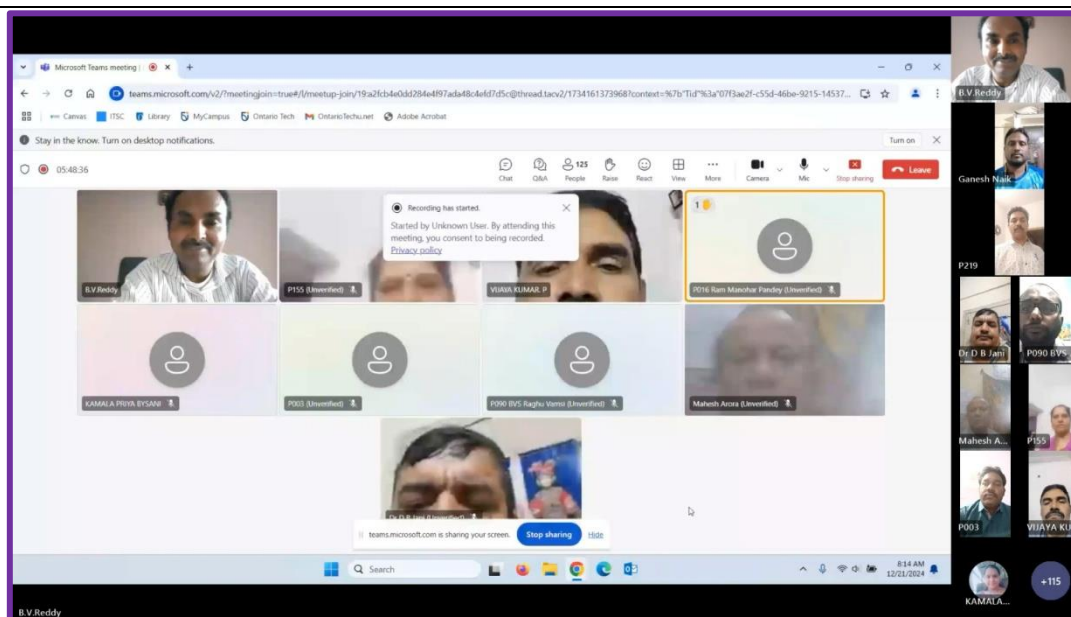
**[https://www.youtube.com/playlist?list=PLq4L14tcDIaLb4gGfJkF8akI\\_3sm2oKRm](https://www.youtube.com/playlist?list=PLq4L14tcDIaLb4gGfJkF8akI_3sm2oKRm)**

**VALIDICTORY**

Department of Mechanical Engineering, Lakireddy Bali Reddy College of Engineering (A), Mylavaram, successfully organized a 6-day online ATAL Faculty Development Program (FDP) sponsored by AICTE on “Emerging Green Hydrogen Energy Technologies for Societal Sustainability and Climate Change Mitigation”.

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**

---



The valedictory function of this insightful 6-day online FDP was held on Saturday, with Dr. Bale V Reddy Professor, Department of Mechanical Engineering, Ontario Tech University, Oshawa, Canada as the chief guest. Addressing the gathering, Dr. Bale V Reddy emphasized the critical importance of advancing green energy solutions and innovative storage technologies to achieve a sustainable future. Dr. Bale V Reddy highlighted recent advancements in renewable energy systems, including solar, wind, and bioenergy, and their integration with efficient energy storage mechanisms such as battery technologies and thermal storage systems. He stressed the need for interdisciplinary collaboration to overcome challenges in energy efficiency, grid integration, and scalability. He also explored the potential of emerging technologies like hydrogen storage, smart grids, and advanced materials for energy storage in revolutionizing the energy sector. Encouraging participants to contribute to this rapidly evolving field, Dr. Bale V Reddy discussed the significant role of engineers to play in accelerating the transition to green energy systems that align with global sustainability goals. The program concluded with a vote of thanks to the distinguished guest, resource persons, and participants, recognizing their dedication and active participation in exploring innovative solutions for a greener and more sustainable energy future.

### **Feedback from participants:**

The Faculty Development Program (FDP) on **Emerging Green Hydrogen Energy Technologies for Societal Sustainability and Climate Change Mitigation** aimed to equip participants with advanced knowledge and practical insights while employing a multi-layered feedback mechanism to ensure participant inputs were effectively collected, analyzed, and addressed. Feedback was gathered through structured ATAL portal reviews, highlighting the relevance of topics and the expertise of resource persons; daily online meeting chats, which enabled real-time adjustments based on participant thoughts and challenges; and a final comprehensive session where attendees shared overall experiences and actionable ideas for teaching and research.

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
 CLIMATE CHANGE MITIGATION**

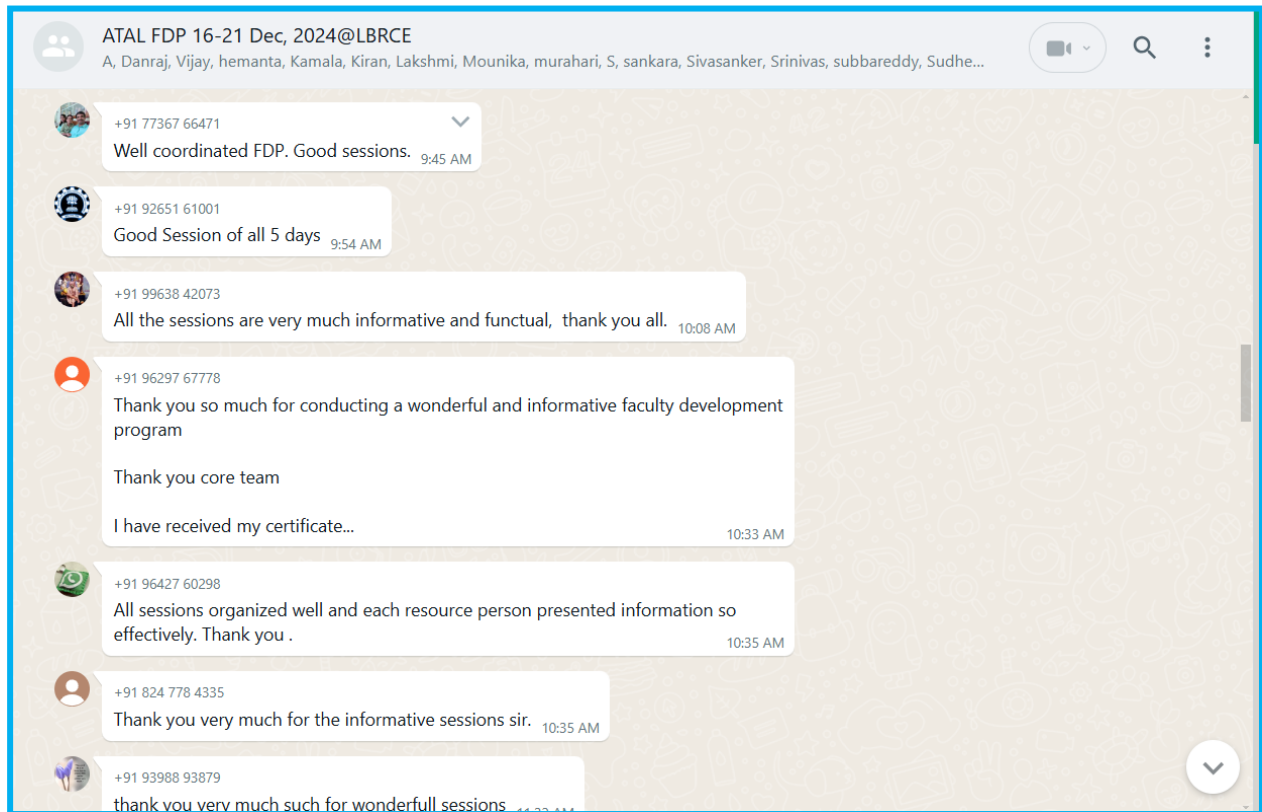
Participants appreciated the program's relevance to current Green Hydrogen energy trends, practical demonstrations, and valuable networking opportunities, while also suggesting the inclusion of more hands-on sessions, extended Q&A time, and follow-up workshops on specialized topics. The FDP significantly enhanced participants' understanding of the important technologies, inspiring them to integrate these insights into teaching modules and initiate research projects focused on sustainable practices.

**Feed back in Teams platform:**

Participants	Image	Feedback
<b>Dr. V.Suresh,</b> Godavari Institute of Engg& Tech, Rajahmundry		I would like to thank convenor, coordinators of the event & management of the LBRCE. We have learned so many things on this FDP. Every session is wonderful and very fruitful information is received. Thank you for giving this opportunity.
<b>Mr. B.V.S. Raghuvamsi</b> SR Gudlavalleru Engineering College, Gudlavalleru		I have attended all the sessions, cover a lot of information starting from generation of Hydrogen in different methods, storage methods and especially today's lecture, which is focused on applications by taking combination of various cycle. All the sessions are very much informative. And the points mentioned by the today's lecture are high lighting important aspects. Very thankful to LBRCE.
<b>Dr.D B Jani,</b> Govt. Engineering College, Dahod, Gujarat		We are thankful to the organizers of this program, coordinators and directors of this institute for arranging very well program regarding the research functions in the renewable energy, we can get lot of knowledge through the using & utilizing solar energy for harvesting the free, sustainable energy source some hydrogen gas storage, transportation and likewise. So we may explore certain new and innovative renewable energy. Thank you all for giving this opportunity.
<b>Dr. Alli Rani,</b> Sri Rama Krishna Engg. College, Coimbatore		I am from electrical background.so, these sessionsI did not know much about to hydrogen energy to be frank. But I have thirst for this topic, for knowing more on topic on this hydrogen generation and storage. At this organization with NIT & IIT for very very good content. And very thankful for the organizers and the institute. ATAL AICTE organization such a wonderful event. Thank you all.

AICTE sponsored 6 day online ATAL Faculty Development Program on  
**EMERGING GREEN HYDROGEN ENERGY TECHNOLOGIES FOR SOCIETAL SUSTAINABILITY AND  
CLIMATE CHANGE MITIGATION**

**Feedback collected from Whatsapp Group:**



Coordinator  
Dr. P.Vijaya Kumar  
Professor  
Department of Mechanical Engineering  
Lakireddy BalireddyCollege of Engineering (A)