





#### Sustainable Energy Curriculums at Santa Fe Community College

Stephen M. Gómez, PhD Chair Trades, Advanced Technologies and Sustainability Department Santa Fe Community College

Energy Sovereignty Institute Tribal Energy Workshop Albuquerque, New Mexico June 28, 2019



- ~ 6,500 credit students
- 70% over 25 years old
- 50% have children
- Public school drop-out rate
  near SFCC 40-50%
- 75% Part time
- 62% Female

CONTRACT II

- 45% Hispanic
- 7.5% Native American

PROPERTY AND STREETS

2015-2019 Best for Vets: Career and Technical Colleges

COLLEGES COLLEG

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<sup>®</sup> SANTA FE COMMUNITY COLLEGE



# SFCC What is Sustainability?

SANTA FE COMMUNITY COLI CENTER OF EXCELLENCE

## The "Five Sovereignties"

- Food
- Water
- Energy
- Land
- Environment SFCC.ic innovation center













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CENTER OF EXCELLENCE B I O F U E L S

# World electricity production: 40% of all greenhouse gases



The "worst" Alternative Energy is still 4X better than the "cleanest" Fossil Fuel

Technology	Description	(g CO <sub>2(ea)</sub> /kWh <sub>e</sub> )
Hydroelectric	reservoir	4
Wind	onshore	12
Nuclear	various generation II reactor types	16
Biomass	various	18
Solar thermal	parabolic trough	22
Geothermal	hot dry rock	45
Solar PV	Polycrystaline silicon	105
Natural gas	various combined cycle turbines without scrubbing	469
Petroleum	Fuel oil	604
Coal	various generator types without scrubbing	1001





Source: LINL April, 2018. Data is based on DOE/EIA MER (2017). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. This chart was revised in 2017 to reflect changes made in mid-2016 to the Energy Information Administration's analysis methodology and reporting. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 21% for the transportation sector, and 49% for the industrial sector which was updated in 2017 to reflect DDE's analysis of manufacturing. Totals may not equal sum of components due to independent rounding. LINL-MI-410527

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## **Trades and Advanced** U.S. Green Building Council LEED® Platinum

- 42,000 ft<sup>2</sup> "living laboratory"
- Rainwater catchment for lavatory use
- Motion-sensing lights with 96% LED lighting
- Skylights with fiber optic tubes to reflect and expand light distribution
- Rooftop water collectors and waste water/gray water recycling for irrigation use
- ICF construction and reflective roofing to ensure an efficient building envelope with R-Value of 30
- 75% of the project's energy cost is offset by renewable site-

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ATEC - Approach



### Stealth STEM

- Students re-entering the community college system DO NOT want an "education"
- They want a good-paying stable JOB!!!!!
- The traditional academic system does not serve their needs:
- Traditional order in college programs:
  - 1. General education courses
  - 2. Core courses
  - 3. Specialized courses
  - 4. Degree



This is why they came back to school

Teach this first!!



ATEC - Approach



### Stealth STEM

### 1<sup>st</sup> Semester

- New students
  - "I don't need biology to learn how to grow algae"
  - "I can't do math"
  - "Why do I need chemistry? I just want to grow plants."
- Put the students in the lab
- Let them work on the topics they came back to school to learn
- Give them enough rope to hang themselves



F ≠ Failure

F = Not ready for the next class

### 2<sup>nd</sup> Semester

- Continuing students
  - "Dr. Gómez, the chemistry class is full. What do I do?"
- Students who "discover" they need STEM courses do much better than students who are "told" they need STEM courses
- Paid internships are the best retention tool
  - "You mean I can get paid to do this?"







### Water Operations



- Ideally suited for students who are looking for stable good paying jobs who do not mind strenuous labor at times.
- Good entry wages with Certificate
- Native students (with upcoming Pojoaque Basin Regional Water System)
- Majority of students Hispanic Males

Change of career





### Water Operations

- Pojoaque Basin Regional Water System
- Aamodt Litigation Settlement Act (Public Law 111-291, Title VI; 124 Stat. 3065) – Signed Dec. 2010
  - Pueblo of San Ildefonso
  - Pueblo of Tesuque
  - Pueblo of Nambe
  - Pueblo of Pojoaque
  - Santa Fe County
  - City of Santa Fe
  - State of New Mexico
  - US Bureau of Reclamation
- To be completed by June 2024

- 30,400-acre general project area
- 151 to 194 miles of water transmission and distribution pipeline
- 26 to 51 acres for regional water system facilities
  - Primary source water collection
  - Water treatment
  - Short-term storage tanks
  - Water transmission and distribution system, including pipelines, pumping plants, forebay tanks, and other associated facilities
  - Electrical power service
- Jobs!!!!!

















#### About

Having a better understanding about algal biology and how to scale up algal biofuels production from cells and populations to large reactors will help us grow the bio-algae industry that has recently begun in the desert Southwest. We will investigate three overarching questions:

- 1. Can inexpensive, scalable, closed bioreactor designs maximize biomass productivities with heat tolerant algae in summer and cold-tolerant strains in winter with minimal water consumption and cultivation costs while achieving a net positive energy balance?
- What species/community characteristics and cultivation conditions best promote stable, reproducible, large-scale production of algal biomass and also harmonize with (i) design specifications for algal cultivation, (ii) extraction and conversion processes for high-, mid- and low-value products and (iii) QA/QC specifications for fuels and co-products?
- 3. Can wastewater sources safely offset nutrient requirements at large scales, and how do associated scale up logistics, reactor design and operation affect output water quality to meet process recycling and discharge requirements?

The innovative technologies that result from NM EPSCoR investments and research will overcome the challenges of developing algal biomass in a desert environment where fresh water is precious. Our goal is to make the use of algal biomass a sustainable, economically viable component of a renewable energy portfolio in New Mexico.







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Search





















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## **SFCC** Algae Cultivation Certificate

- Funded by DOE/Algae Foundation
- Approved by HED Feb. 15, 2018 •
- First Graduates May 12, 2018 •



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New Mexico Higher Education Department Planning and Research Division 2044 Galisteo St., Suite 4

SUSANA MARTINEZ

February 15, 2018

Santa Fe. NM 87505-2100

Barbara Griego Director of Institutional Research Office of Planning and Institutional Effectiveness Santa Fe Community College 6401 Richards Avenue Santa Fe, NM 87508

#### Dear Ms. Griego

This letter confirms the following program CIP code(s) for Santa Fe Community College has been approved by the New Mexico Higher Education Department on February 15, 2018. These additions are included in eDEAR.

Level

#### Program(s)

Insteamp	CIP Code
1711	01.0301

Program CIP Title Agricultural Production Operations, General

BARBARA DAMRON

CABINET SECRETARY

Please feel free to contact us if you need further assistance

Sincerely,

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Dina Advani, Director of Planning and Research





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CENTER OF EXCELLENCE BIOFUELS











#### SFCC - Microgrid









- The infrastructure change has reduced energy costs from ~\$250/FTE to ~\$122/FTE in less than 10 years.
- Phase I, 11,264 ft<sup>2</sup> greenhouse and classroom for instruction in hydroponics, aquaponics, on-site energy production, microgrid controls, and building automation systems. It will operate on campus generated power and will be 100% off-grid ("nanogrid").
- Phase II will be to convert the entire campus into a microgrid.
- A new full-time faculty will help operate the microgrid.



• SFCC goal is to be food sovereign by 2022 and energy sovereign by 2020. This project is supported by EDA BEAMTC Grant #: 08-01-05191, the National Science Foundation EPSCoR Program under Award #OIA-1757207 and in-kind contributions from Siemens Industry







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11/12

13/14

A

AY 14/15

AY 12/13



### Santa Fe **Community College**

90% Land Sovereign ٠

SFCC Solar Electricity

Purchased Electricity

11/12 Purchaced Elect.

= 4.34 x 107 Kg CO<sub>2eq</sub> = \$628,246

15/16 Purchaced Elect.

= 2.61 x 107 Kg CO2ea

= 7099.2 MWh

= \$189/FTE

= 4273.2 MWh

= \$380,831 = \$122/FTE

AY 15/16

- 20% Water Sovereign
  - 50% by 2020 •
- 30% Food Sovereign •
  - 100% by 2022 •
- 70% Energy Sovereign
  - 100% by 2020 ٠



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Problem: World population and food



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### Controlled Environment Agriculture New Mexico EPSCoR

SFCC Smart- and Microgrid Training Center (SMTC)



Future capacity (1/5 UVI system in new greenhouse)

- •Electricity use 166,000 kWh/yr
- •Electricity costs ~\$8000/yr
- •Fish production 2200 lbs/yr
- •Plant production -23,000 lbs/yr
  - Lettuce 266 lbs/wk (533 bags)
    - ○Basil 46 lbs/wk (46 bags)
    - Mesclun (greens) 51 lbs/wk (102 bags)
    - oTomatoes 37 lbs/wk
    - oCucumbers 49 lbs/wk
      - 126,000 lbs food/acre/yr
- •Make up water (1%/day) 642 gal/day, 233,000 gal/yr
- •1 acre 63 tons of food annually with less that an acre-foot of water



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#### SFCC - Microgrid







Technical Education in Energy Storage Technologies

- US DOL projects an increase of ~14,000 jobs for electrical power-line installers and repairers by 2024
  - This projection does not include the "smart" jobs for the new grid









UNM	Center for Emerging Energy Technologies	No formal degree
	Center for Water and the Environment	Graduate programs
	Environmental Engineering Lab	Graduate programs
	Geography and Environmental Sciences	BS and BA
	Indigenous Design Planning Institute	Online Tribal Planning Certificate -planned
	Sustainability Studies	Minor
UNM Gallup	Construction Technology - Solar, Energy Efficiency	AAS and Cert
	Environmental Planning and Design	AAS
UNM Taos	Construction Technology - Green Technology - concentration	Cert - concentration
	Construction Technology - Electrical Technology concentration (PV)	Cert - solar PV
	Construction Technology - General Technology - concentration (PV, Adobe)	Cert - solar PV, Adobe
UNM Los Alamos	Applied Technology - Electro-Mechanical Technology - concentration	AAS
UNM Valencia	Manufacturing and Industrial Technology	AAS









NMSU	Environmental Education Center	temporarily closed
	Computer Science in Smart Grid Research	Graduate programs
NMSU Alamagordo	Renewable Energy Systems Technology	AAS
	Photo Voltaic (PV) Entry Level Grid Tie	Cert
	Advanced Renewable Energy Systems	Cert
	Engineering Technology - Electronics Concentration	AAS
NMSU Carlsbad	Manufacturing Sector Development Program	AAS
NMSU Grants	Energy Technology	Cert
Dona Ana Community College	Basic Solar	Cert
	Solar Energy Technology	Cert
	Energy Conservation	Cert
	Energy Evaluation	Cert
NMISU Doña Ana Community College	Alternative Fuels	Cert
	Environmental & Energy Technologies	AAS





**HIGH** 

EAS

NEW

UNIV





NEW MEXICO			
IGHLANDS UNIVERSITY	NM Tech		Graduate programs
	NM Highlands	Environmental Geology - Water Resources concentration	BS
		Natural Resource Management	Graduate programs
	ENMU	Electronics Engineering Technology	AS, BS, BAAS
LASTERN	WNMU	Environmental Electrician	AAS and Cert
EW MEXICO		Sustainable Development	BA and BS
	NNMC	Electromechanical Engineering Technology	BEng
NIVERSITY		Renewable Energy	Archived?
	U of Phoenix	Advanced Cyber Security	Cert, BA
WECTEDN		Informantion Assurance & Security	AS
WESIEKN			

NEW MEXICO UNIVERSITY

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University of Phoenix®





	Navaio Technical University	Industrial Maintenance & Operations	Cert.
		Building Information Modeling	AAS
N/		Energy Systems	AAS
	OLAVAJO	Engineering Technology	AAS
	ECHNICAL UNIVERSITY	Advanced Manufacturing Technology	BAAS
		Information Technology	BAAS
		Electrical Engineering - Electrical Power and Energy Systems Concentration BS	
	CNM	Commercial, Industrial HVAC & Building Performance	Cert
Cent		Computer Information Systems, Cyber Security	Cert, AAS
		Photovoltaic Systems	Cert
		Programmable Logic Controls (PLC) Systems	Cert
	ntral New Mexico	Sustainable Building Technology	Cert
	ommunity conege	Electrical Trades, Photovoltaic (PV) Concentration	AAS
		Electrical Trades, Programmable Logic Controls (PLC) Concentration	AAS
	Clovis Community College	Industrial Technology	Cert, AAS
		Electrical Maintenance	Cert

#### Clovis Community College







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Luna Community College	Electronics Engineering Technology	AAS
Mesalands Community College	Wind Energy Technology	Cert, AAS
New Mexico Junior College	Energy Technology	Cert, AAS
San Juan College	Instrumentation and Controls Technology	Cert
	Tribal Energy Management	AAS
	Cybersecurity Support	AAS
SIPI	Pre-Engineering	AAS









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# Welcome to the LAB OF ENCHANTMENT

