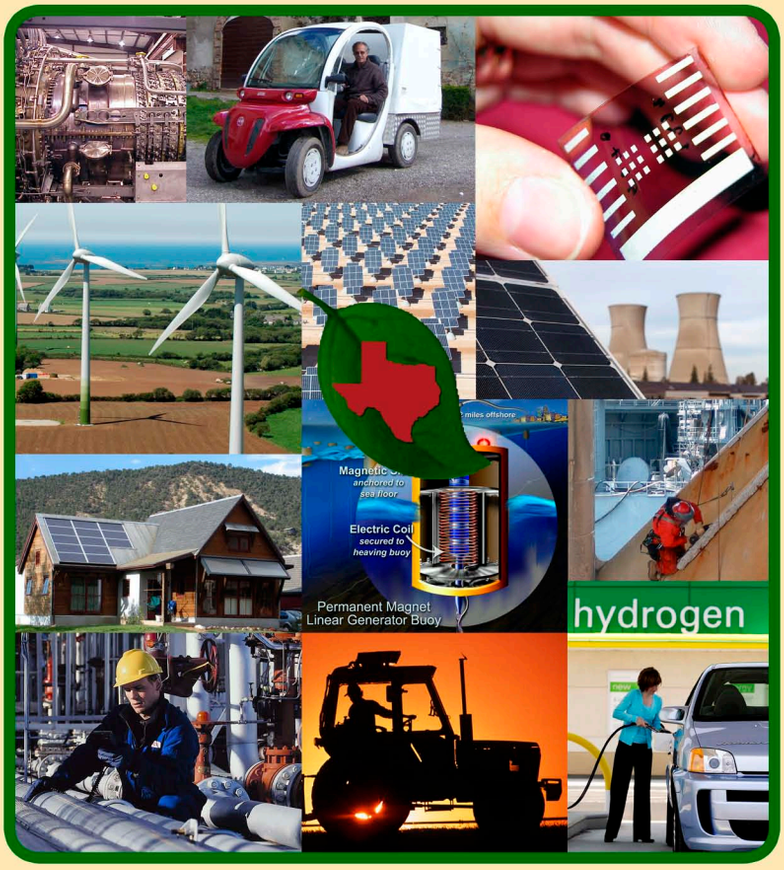
Green Collar Workers

And Other Mythical Creatures



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August 1, 2008

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Preface

Historians will likely note that 2008 was the year America began to earnestly turn green. The soaring prices of gasoline, combined with serious debate on the causes and remedies of global warming, have awakened the national consciousness in terms of energy conservation. It is only natural that part of framing the discussion involves defining and measuring our economy in light of the new green standard. This research monograph offers such a framework.

Green Collar Jobs 101
Pop Quiz

Before reading the attached monograph, please take the pop quiz below. (It is sort of a pretest as used in an experimental design to establish a baseline for assessing learning gains.)

Q1) What is the difference between Exhibit A and Exhibit B?

Q2) Which one is "green"?

Exhibit A

Exhibit B

Q3) When did federal legislation mandate the installation of toilets like the one in Exhibit B?

Q4) Do the design differences between Exhibits A and B require radically different sets of knowledge, skills and abilities for their respective installation and repair by a licensed plumber?

Q5) Do the design differences have any impact on employment demand for plumbers?

Q6) Do the design differences have any effect on employment demand in general?

(Pop Quiz continued in Appendix E)

Enthusiasm plus ambiguity may suffice to create the political will to promote green collar jobs but sound policy and effective strategies require clarity and prudence.

That which is not defined cannot be measured. That which is not measured cannot be improved. That which is not improved will languish.

Without a clear definition, green initiatives will be too diffused to be effective and success will be impossible to measure.

Green is here but it doesn't carry a banner.
Green industries don't have their own NAICS code.
Green occupations don't have their own SOC code.
Green jobs don't have their own flag in standard data sets.

Disclaimer

This draft is intended to stimulate a deeper and more thorough examination of green economy concepts by labor market analysts, workforce professionals and educators & trainers. All the views and opinions expressed herein are solely those of the principle author, Marc Anderberg. They do not constitute the official position of the Texas Workforce Commission or the State of Texas.

Green Collar Workers
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Labor market analysts have to cut through the fog of overlapping, conflicting and even nonsensical uses of the terms "green jobs" *and* "green collar workers" *before they can give valid and reliable counts of workers employed in them, provide employment demand growth estimates and identify the requisite KSAs for green employment (as opposed to employment in their non-green predecessors). This monograph explores the myths and mysteries of green collar jobs and offers an action agenda to aid workforce professionals in understanding and implementing job training requirements imposed by Title X of the Green Jobs Act of 2007.*

Exploring Green Technologies and the Demand for Green Collar Workers

Applying the "*green collar*" label to a job says absolutely nothing about employment demand. The greenness of jobs even within a single occupation will vary according to the nature of the firm or establishment, the current project or specific work assignment and the specific employer's workplace rules and policies. Thus, labor market analysts can't merely count all employees in a particular occupation (much less in an entire industry) as green collar workers. Moreover, the greening of the economy is an evolutionary process (albeit one that is picking up a head of steam). That is, employers in virtually every sector are striving to conserve energy and resources while reducing their carbon footprint and switching from oil-dependence to renewable energy. Arrayed along any of the various dimensions popularly identified as comprising the green movement, there is no current benchmark at which green companies can be separated from non-green ones. Nor is there any useful milestone for deciding at what point in time to move all of a company's employees from the non-green column to the green column. Therefore, labor market analysts can't simply count all of the employees of a specific firm as green and employees of other companies in the same industry as non-green.

While the nation's economy is in the process of becoming greener, the most rational approach to take for strategic planning purposes is to describe the various projected trajectories of demand for green collar workers industry-by-industry, occupation-by-occupation, firm-by-firm or project-by-project. Another possibility would be to add another element to the federal O*NET database to differentiate radically different green work activities or to rate all activities on a greenness scale as one would rate the level of numeracy or literacy required to perform them. Neither would be an easy task because current data collection and classification systems were not developed with the concept of greenness in mind. Rather, either would take: careful pattern-detection through the analysis of key words in job postings; and/or lengthy consultation with incumbent workers, front-line supervisors and relevant education & training specialists.

But we are not at the point where the conceptual development of the term "*green"* will tell labor market analysts what key words in job postings should be counted. Nor is it clear what

questions should be asked of experts in related fields. The meaning of "*green*" varies from one industry or occupation to another. It is being changed on the fly as new technologies and processes are developed and commercialized. Moreover, each industry and each occupation is likely to adopt peculiar jargon and acronyms to describe its unique green attributes and economic activities. And pattern-detection will be confounded to the extent that some firms use green jargon to describe authentic, meaningful job qualifications and requirements while others will use the same terms disingenuously as they posture to market a greener image or to gain access to new streams of green targeted public funds.

In the absence of any clear-cut metric, it's impossible to provide an acurate baseline count of green collar workers or employment demand growth for them. In the absence of any clear-cut benchmarks, it is impossible to declare unambiguously that demand for green collar workers in any industry, occupation or region has reached a critical threshold where workforce dollars need to be plowed into specific outreach, education & training, job development or placement efforts. Until such time as an august body of labor market economists can be convened to hammer out a meaningful consensus definition of terms and actionable metrics, the most prudent course for workforce intermediaries is to engage employers in their region in exploratory discussions to provide measured and scalable responses to their concerns and demands regarding their need for workers who have specialized training to master specific green technologies.

For workforce planning and development purposes, there is no point in generating nonsensical data on green collar workers merely to satisfy the media's thirst for numbers to make oversimplified reports sound credible or to provide good news that an economic development agent can paste on a bumper sticker.

Conferring the green label to entire constellations of occupations or to discrete tasks and work assignments does not necessarily imbue them with special skill requirements that must be addressed with some new education & training intervention (see Green Collar Jobs 101 Pop Quiz). The skills needed to perform some green work assignments will be absolutely no different than those required to perform tasks and work assignments similar, if not identical, to their non-green predecessor. Other green work assignments may be so radically different than their predecessors that an entire degree- or certificate-granting program needs to be developed to impart the necessary knowledge, skills and abilities (KSAs).

Ideally, a two-pronged approach would be used to determine the KSAs required to perform green duties, tasks and work assignments: 1) directly observe incumbent workers as they perform their jobs; and 2) collect opinions through structured DACUM focus groups or an electronically-mediated Delphi process from subject matter experts. Key informants will include: the most proficient workers, frontline supervisors from green-certified firms, corporate and vocational educators who specialize in training workers for related occupations and apprenticeship directors from related fields. Data from these two techniques can be merged and synthesized into learning objectives, criterion-referenced/performance-based KSA assessment tools and meaningful KSA-certification standards.

- It's entirely possible that for many jobs which are candidates for the green collar label, the KSAs of incumbent workers would be immediately and completely transferable.

- For others, no more than a short demonstration of slightly modified work activities and related new KSAs might be required. These may lend themselves to short (less-than-semester length) skill-upgrade training.
- A very small handful may differ so radically from predecessor jobs that lengthy, specialized training would be required. This might be achieved simply by adding a new capstone course to an existing program. It may require a completely new one-year certification program, an entirely new Associate's degree or a new apprenticeship program.

To date, no such rigorous data collection and analysis has been conducted. For now, the best we can do is to pose illustrative questions and offer tentative hypotheses for an incomplete set of "*suspects*" (i.e., occupations that are likely candidates for classification in part, or *in toto,* as "*green collar jobs*"). The following section explores various technologies and processes that some suggest are ripe for green education and training investments. This overview introduces various energy, construction and manufacturing scenarios with some discussion of each process. The reader is encouraged to contemplate the differences between these scenarios and more traditional activities to ascertain the workplace implications of various green investments. This exploratory coverage is not exhaustive; but rather, is meant to suggest the kinds of questions to ask in order to get actionable answers.

Alternative Energy

Biofuel Manufacturing

Do the processes used to produce biofuels differ radically from petroleum refining? Yes. Petroleum refining requires knowledge about catalysts and fractional distillation of hydrocarbons (i.e., "*hydrocracking*" which yields multiple product takeoffs at different boiling points). Conventional ethanol production is based on a simpler distillation process (i.e., with one product takeoff at one specified boiling point). Cellulosic ethanol and bio-butanol production rely on various fermentation processes where different enzymes and micro-organisms are used (depending on the feeder stock).

While an understanding of these differences is critical to those who design, construct and maintain the various kinds of fuel-producing facilities, day-to-day operations of each are in the hands of process control technicians. Regardless of the kind of fuel a facility produces, process control requires a common skill set — generally acquired through a one-year certificate or two-year Associate's degree program. However, the required capstone course for completing a process control technician training program would vary depending on the particular kind of facility where the student/trainee intends to work after graduation.

Hydrogen (industrial scale) and Nuclear Energy

These sources of energy are produced by processes (nuclear: fission or fusion; hydrogen: steam reforming and electrolysis) which are fundamentally different than those used in petroleum refining or in bio-fuel distillation and fermentation. In both of these processes, the fuel source is used to heat water to create steam for turning electricity-generating turbines. The steam turbine technology, *per se*, would be very similar to that used in natural gas-, oil- or coal-fired plants and in large-scale solar farming. But working in either a nuclear or hydrogen energy production facility would require specialized training — particularly since safety and particle-containment procedures are critical to both.

Since it is lighter than air, hydrogen is stored and transferred under pressure as a liquid from the production point to the user. It can escape into the atmosphere at any point where it is transferred from a carrier to storage unit or to an industrial user. (Inadvertent release of hydrogen poses no environmental hazard.) Therefore, transportation, storage, transfer and containment technologies are fundamentally different than those used in the nuclear industry.

Given the long half-life of radioactive materials, the nuclear energy industry has unique toxic waste disposal problems. Workers engaged in removing, containing, shipping and disposing spent rods from nuclear power plants must have very specific training and certification. While operators of nuclear and hydrogen facilities might take the same foundation courses in process control and turbine technology, they would need different kinds of capstone courses on how to handle nuclear materials versus hydrogen.

Throughout this discussion of alternative energy, frequent references are made to "steam turbine technology." Most of the electricity supplied to Texas is generated in plants which use this technology. Currently fossil fuels (chiefly conventional coal) are the most common elements used to heat water to make the steam to drive the turbines. However, in order to qualify for federal financial incentives, states must adopt a timetable of targets for making the transition to alternative energy. These are known either as State Renewable Energy Standards (SRES) or State Renewable Portfolio Standards.[1] Not only are new alternative energy producing plants coming online, old conventional coal- and oil-fired plants are being taken off line or converted in order to achieve the SRES. Workers displaced by the closure of old power plants will have transferable skills they can use to tend steam turbines in the new plants.

Gasification and Liquefaction

These are not techniques for producing energy, *per se*; but rather, they are processes for altering the form of fossil fuels to make them cleaner-burning and/or easier to transport. The end product of either process is burned like natural gas or oil to heat water to produce steam for turning electricity-generating turbines. The turbine technology is virtually identical to that used in conventional natural gas-, oil- and coal-fired plants, nuclear facilities or solar farms. (See the textbox above.) However, workers engaged directly in operating the gasification or liquefaction process would need specialized training similar to that provided for process control technicians who work in petroleum refineries or bio-fuel, nuclear and industrial hydrogen production facilities – with their own special capstone course.

Geothermal Energy

Electricity can be produced by tapping into superheated subsurface water for use as steam to turn turbines. Steam turbine technology is virtually the same whether used in electricity generation at nuclear plants, solar farms or natural gas-, oil- and coal-fired plants. (See the textbox above.) The KSAs for tapping superheated subsurface water are virtually identical to those required in drilling for crude oil or natural gas. Oil field service workers have many of the necessary transferable skills.

Geothermal energy production often is piggybacked on petroleum extraction operations. If a well fails to strike oil or gas but hits superheated subsurface water, then the steam it produces can be used to generate electricity to drive productive wells in the same field. Having lost heat during the electricity-generating process, steam that has passed through a turbine is released as water. An injection well can force that water back into the ground for hydraulic fracturing of impermeable rock layers. That allows subsurface oil to flow more easily to the wellhead. Hydraulic fracturing long ago became a common technique for extracting additional oil from reservoirs which have passed their peak production. KSAs related to the technique already are imparted during the training of oil field service workers.

Methane

CH_4 is an abundant, naturally-occurring chemical compound found in the Earth's crust and in the atmosphere. It also is produced when animal or plant mater is digested or decays in natural and manmade settings (e.g., landfills, wastewater treatment plants or the holding ponds of dairy farms, pig farms, feedlots, etc.). In the atmosphere, it is considered a potent greenhouse gas linked to global warming. But, if captured from natural or manmade settings, CH_4 is clean-burning. It can be used like natural gas to heat water for steam turbine energy production. (See the textbox on page 4.)

There is nothing unique about methane's use in power generation or in the way it is transported (via pipelines) from source point to user. Workers trained to work in steam turbine-based power generation or for shipping natural gas by truck or pipeline could be employed without additional training in facilities which store, ship or use methane.

Special training would be required to prepare workers who: design/redesign and manage municipal landfills, wastewater treatment plants and farm & ranch/feedlot holding ponds to facilitate methane capture; or install, retrofit and maintain methane-capturing systems.

Solar Energy

There are fundamental differences between small-scale (e.g., rooftop) solar energy production and large-scale solar farming. Small-scale systems use photovoltaic cells which convert sunlight directly into electrical current. Solar farming, on the other hand, uses various kinds of mirrors to focus radiant energy on pipes filled with water or other liquids. When heated, the liquid turns to steam which is used to drive electricity-generating turbines. (See the textbox on page 4.)

Both small- and large-scale solar systems use new technology batteries to store power generated during daylight hours for release 24/7 on a per-demand basis. The KSAs related to storage battery installation and maintenance are transferable between both kinds of solar energy production. Those same KSAs also apply to handling battery storage components used in wind- and wave-energy production.

KSAs required for installing solar panels are fundamentally different than techniques used to construct and precisely align mirrors for solar farming. The former requires overlapping skills similar to those of both roofers and electricians (or even television satellite dish technicians). The latter requires overlapping skills similar to those of civil engineering technicians, crane operators, plumbers & pipefitters and boilermakers.

Wave and Tidal Energy

These forms of energy use the force of water itself (not steam) to turn electricity-generating turbines on the same principles used in producing electricity at hydroelectric dams. Positioning and servicing wave- and tidal-powered electricity-generating systems, however, is similar to the float-and-tilt techniques used in placing and anchoring offshore oil & gas drilling rigs after they have been constructed onshore. Workers previously employed in erecting offshore rigs have many of the necessary transferable KSAs.

Wind Energy

Erection of wind turbines requires knowledge of welding, electricity and engineering technology that is not much different than the KSAs required for derrick construction by oil field workers. Therefore, many of the required KSAs are transferable.

A modest amount of specialized training may be required for those workers who install and maintain the new technology batteries used to store energy produced during peak wind periods for release 24/7 on a per-demand basis.

Ideally, the components and subassemblies comprising the equipment which generates electricity from alternative feeder stocks should be manufactured near the generation site (e.g., solar or wind farm). Given the tremendous weights involved, that would minimize freight charges. (The nacelle which houses the gearbox and generator for a wind turbine, for example, weighs 72 tons; the rotor and blade assembly weighs 40 tons.) Unfortunately, venture capitalists are leery about financing alternative energy equipment manufacturing because the investment climate is unstable. First, it is not yet clear which of several competing technologies will emerge as the industry standard for either wind or solar energy. Second, the Congress has made it a habit of authorizing short-term investment tax credits only to let them lapse once every two years. (The current tax credit for wind power R&D is set to lapse at the end of 2008. While renewing tax credits for domestic oil and gas companies in the 2007 Energy Independence Bill, Congress failed to renew tax incentives to develop wind power. See Thomas Friedman, *Dumb as we Want to Be ,* New York Times, April 30, 2008 and Hot, Flat and Crowded: Why We Need a Green Revolution and How it Can Renew America forthcoming from Farrar, Straus and Giroux.)

Given the uncertain investment climate in the United States, R&D and component manufacturing are being done where tax incentives are more lucrative with longer time horizons: in Spain, Denmark, Germany and India. Limited production in the United States is being done chiefly by subsidiaries of foreign-owned corporations (Gamesa and Acciona of Spain and Siemans of Germany) or by American-based multinationals (e.g., Westinghouse and General Electric). They are using their profits from alternative energy in Europe to underwrite foreign direct investment to give themselves a beachhead in anticipation that the American market will eventually take off. Thus while Texas leads the nation in wind energy megawattage, only a handful of equipment manufacturers are based in the state: Diab, Inc. of DeSoto (a blade manufacturer) and TECO-Westinghouse (producing nacelles in Round Rock) are notable examples.

The bottom line is that a national commitment to increase financial incentives and stabilize the investment environment through long-term tax breaks for R&D will go much further to create green jobs than will tens of millions of dollars earmarked for green training programs. It's estimated that an investment of $62 billion in public and private funds (enough to add 125,000

MW of energy production over ten years) would add 400,00 manufacturing jobs to the economy.

The most critical training areas for the alternative energy industry are those related to: the science & engineering that goes into designing and building power-generating facilities & related equipment; and logistics — such as organizing the processes, coordinating feederstock supplies, and managing base- & peak-load production & demand by integrating the new energy forms with the existing infrastructure (e.g., the electricity grid, pipelines, transportation, storage and transfer). While some of the specific technologies are still evolving, the basic principles of physics, chemistry, engineering and biotechnology underpinning each are very well developed. Preparing qualified workers to meet increased employment demand is largely a matter of recruiting more students into related postsecondary training programs and facilitating their persistence to degree completion. The chief bottleneck seems to be in secondary education. Too few students are prepared adequately to do college-level work in related math, science and technical fields.

The thorniest problems inherent in workforce development for alternative energy jobs do not involve estimating demand for, or the education & training of, workers who will run local energy-producing facilities once they are constructed or those who will use the energy that is produced. While a green strategy may improve marketing and the value added to the user's business, conversion to energy derived from alternative sources does little to create a net growth of permanent jobs in a region. Only the construction of large scale facilities is labor intensive. But that phase is both relatively short and highly specialized. Planning and delivering a measured and scalable regional response depends on understanding fully the difference between: which phases are labor-intensive and which are not; which will be performed by locals versus those likely to be performed by "*imported*" specialty workers.

Once large scale facilities are built to produce alternative energy, it takes relatively few operators to staff them. That is, it may take 1,000 workers to build a facility which can be operated by 20 people.

Big facility construction (e.g., nuclear plants, refineries, ethanol/butanol plants, solar farms) in any given region is not commonly done by local firms. Only a handful of corporations build nuclear plants all over the world (e.g., Westinghouse, GE, Mitsubishi, Hyundai, Hitachi and Avera). The same is true for the construction and expansion of refineries or bio-fuel plants (i.e., Becon – a subsidiary of the Bechtel Group; Zachry; Kellogg, Brown & Root; and Fluor). Typically, these prime contractors work on a turnkey basis — providing everything from design to groundbreaking to going online.

Prime contractors often receive financial incentives to use local subcontractors. The subs may hire local residents to handle those aspects of construction where the work is no different from what they would do in non-green projects: crane, bulldozer, excavation and trenching equipment operators; welders; plumbers, pipefitters and boilermakers; concrete finishers; electricians, carpenters and their helpers. But the prime contractor typically brings in its own high level personnel. They are likely to be the only ones who need (and already have) special training to carry out or oversee green activities during the construction phase: field engineers; construction managers; quality-control inspectors; process control equipment installers and system integrators.

During the construction phase, expenditures by the prime contractor's personnel may stimulate non-green businesses (e.g,, accommodations and food service). But most of their earnings are riddled with "*leakage*" — that is, the highly specialized, but itinerant, workers' earnings flow out of the region where the construction site is located. They usually flow to the region where those highly specialized personnel reside permanently (typically in the region where the prime

contractor's headquarters are located). Once a project is complete, the prime contractor's highly specialized personnel move to the next project site — which is just as likely to be in Dubai as it is to be in some other region of Texas. They take their earnings, spending, savings and investments with them.

The bottom line is this: conversion to alternative energy is a direct (or "*pro-active*") economic development strategy but only an indirect (or "*reactive*") workforce development strategy. While availability of appropriately qualified workers in a labor shed may be a prime consideration in the site-selection for other kinds of businesses (especially in the IT sector), local availability of concrete workers, plumbers and pipefitters, etc., has less bearing on site-selection for large scale energy production facilities. Conversely, the absence of highly specialized green collar workers in the labor shed around a proposed energy production site is not a deal breaker.

Site-selection (and commensurate job creation) in the alternative energy industry is driven less by the skills of workers in the labor shed and more by the availability of:

1) suitable space, for example —
   a. wind farms — open land with average daily wind speeds greater than 8 knots per hour along ridgelines and escarpments in unpopulated rural areas or along the coast line where they won't interfere with recreation or navigation;
   b. wave-, tidal- or current-driven power generation — open waters offshore where it won't interfere with recreation, navigation or commercial fishing;
   c. solar farms — barren flatland with above average annual number of cloudless days.

2) availability of, or access to, essential inputs, for example –
   a. feeder stocks for biofuels;
   b. coal for gasification & liquefaction;
   c. superheated subsurface water for geothermal energy production;
   d. surface water for cooling processes used in any form of power generation and in refining.

3) infrastructure (i.e., proximity to deep water ports and navigable rivers, rails and highways; tie-ins to an efficient and reliable electrical grid); and

4) Stable and predictable financial incentives (i.e., research and development grants; tax waivers, rebates and credits; low-interest loans; job training assistance).

One way to stimulate job growth in the alternative energy sector is to divert money which currently subsidizes the use of conventional coal and foreign oil into: R&D; supporting infrastructure; and financial incentives for firms developing renewable, sustainable and cleaner sources of energy. Another way is to strengthen the penalties on facilities which emit CO_2. Or increase payoffs for carbon capture & sequestration as well as energy- and resource-conservation. Create and maintain an infrastructure to support sustainable/renewable & clean energies. Streamline and accelerate the permitting process for building alternative energy facilities and certifying them as safe to come online. Promote coordination and cooperation between sparsely populated regions where much of the alternative energy will be produced (i.e., west of the IH-35 corridor in Texas) and the densely populated regions where industrial, residential and vehicular users are concentrated (i.e., along and east of the IH-35 corridor in Texas).

Green Building Construction

Carpenters, Insulation Installers, Mason/Concrete/Tile and Terrazzo Workers

Contractors may voluntarily seek certification as "*green builders*." To be certified, they meet criteria which vary by type of structures they build (e.g. single-family residential, multi-family residential, commercial and industrial). For example, to be a green residential builder, a contractor must use lumber from a certified building supply company which harvests timber only from old growth forests and engages in intensive reforestation. But are radically different KSAs required when using certified building materials for constructing green buildings? Probably nothing more than can be imparted via a short demonstration to incumbent workers.

Electricians, Plumbers, Pipefitters, Heating/Ventilation/Air-Conditioning (HVAC) Technicians

Are radically different KSAs required to install furnaces, air-conditioners, heat pumps, hot tubs, water heaters, etc., if they are powered by rooftop solar panels rather than line current? No! Would it matter if the power in the line current was generated at a wind, wave, solar or geothermal farm or a nuclear plant rather than at an oil-, natural gas- or coal-fired power plant? Certainly not!

What if the building is powered by a stationary hydrogen fuel cell in the garage or in the backyard? Specialized training likely would be needed to certify the stationary hydrogen fuel cell installer and repairer. The KSAs required of the electricians, plumbers, pipefitters and HVAC technicians would not change markedly.

A measured and scalable response does not require every region creating new technical education courses, apprenticeships or Associate's degree programs in the construction trades or recruiting huge numbers of students to enroll therein.

Glazer

Are different KSAs required of a glazer who installs *low-e* (energy-efficient) glass rather than conventional glass? No. Are additional KSAs required of glazers who work with electricians or wire & cable installers to integrate the functions of photosensitive windows and electrical systems for automated thermostat and lighting adjustments? New installation techniques for glazers, electricians and wire & cable installers most likely could be mastered after a short demonstration. The greenness is imbedded in the software to regulate heating, cooling and lighting equipment. It's the sensor & digital control designers and software developers who will need brief training to understand underlying meteorology and analog-to-digital/digital-to-analog conversion processes of servomechanisms.

Inspectors, Appraisers and Realtors

Contractors build to buyers' specifications within parameters set by local building codes, zoning ordinances and individual building permits. Contractors currently subscribe to voluntary green guidelines. Only a few counties and municipalities have adopted and enforce mandatory green standards. Nothing prevents contractors from marketing themselves disingenuously as "*green builders*." For now, the most effective drivers for green construction are *ex post* verifica-

tion and due diligence by inspectors, appraisers and realtors. Short courses could be developed to train workers in those occupations to identify/verify, document and assess the value added by green building practices.

The most profound implications for the greening of the construction industry deal with the invention/design, manufacturing and integration of new materials and technologies. For example, while extensive knowledge of physics and chemistry is required for those who try to make photovoltaic cells more efficient, it would take less than a day to explain to an experienced electrician how those devices work. A simple demonstration would suffice to teach virtually anyone to "*repair*" them by swapping out defective equipment at the component level. Green building, like alternative energy, is more of an economic development issue than a workforce preparation one. Builders are not going to become green simply because the workforce preparation system churns out job candidates with some sort of green collar certification (not yet specified).
Greening of the construction industry will accelerate as builders are:

1) *pulled* into adopting green practices by:
   a. the market penetration of, and value-added profits to be made from using, energy-saving/nontoxic materials, more environmentally-friendly excavation and landscape design, installing on-site alternative energy sources and equipping commercial & residential structures with energy-conserving heating, air-conditioning, ventilation, lighting systems, water heaters & appliances;
   b. financial incentives from governmental agencies, nongovernmental organizations (NGOs), mortgage lenders and utility companies (e.g., rebates, tax breaks, reduced points on loans, reduced permit fees and expedited permitting); and/or

2) *pushed* into adopting green practices by:
   a. greener building codes and zoning ordinances or federal regulations (such as those contained in the Energy Policy and Conservation Act of 1994 to mandate installation of low-flow, water-conserving toilets);
   b. public sector office- and commercial-space procurement policies; and
   c. changing tastes & demands of increasingly aware buyers (especially high-end ones).

Again, it makes little sense to engage in handwringing about green collar worker shortages (as yet unspecified) in the commercial & residential construction industries. Rather than put the cart before the horse, it makes more sense to invest public funds in:

1) research in biotechnology, materials sciences, nanotechnology and the science & engineering underpinning on-site small-scale alternative energy production;

2) start-up or expansion funding for green building material manufacturers, sensor & controller manufacturers and software firms that write computer code to integrate various on-site devices;

3) adding modules to, or continuing education units for:
   a. architectural design programs to address resource- and energy-conservation, environmentally-friendly civil engineering & landscape design, new materials and on-site energy production;
   b. certification courses to sensitize inspectors, appraisers and realtors to green building practices.

Is the Construction Industry Green or Gangrene at Present?[2]

It bears repeating that conferring the green title on the construction industry as a whole or on a specific firm says nothing about employment demand therein. It would be all too easy to let excessive exuberance for the greening of the industry color our judgment and misguide strategic planning for its workforce preparation. In the wake of the subprime fiasco, foreclosures and defaults are on the rise. They are bringing down the prices of both new and old houses on the market. Nonetheless, the inventory of houses for sale is moving slower because of tightening credit practices among mortgage lenders and slumping consumer confidence among potential buyers. Residential construction has slowed dramatically (in terms of new housing starts and applications for building permits). The residential construction industry likely will continue to shed jobs through the rest of 2008. Commercial building, though not hit as hard, also is slumping. Employment demand will be revived not by the greening of the industry but by gradually restoring consumer confidence and legitimately improving credit and lending practices.

Retrofitting Existing Structures

The Energy Information Administration (EIA) estimates that 40 percent of the nation's energy is used by *existing* structures (101 million residences and 4.6 million commercial buildings). Retrofitting them to meet the Leadership in Energy and Environmental Design (LEED) standards of the Green Building Council (GBC) would do more to improve energy-efficiency and reduce greenhouse gas emissions than conversion from fossil fuels to all other alternative energy sources combined. The public sector can lead the way with a commitment to retrofit "*MUSH*" (***M***unicipal buildings, ***U***niversities and ***S***chools, and public ***H***ospitals) as well as through financial incentives provided to targeted populations living in the least energy-efficient older dwellings (e.g., weatherization programs for the elderly and low income families). The retail electricity providers and their energy service company (ESCO) offshoots are also taking the lead. The Department of Energy estimates that the ESCOs nationwide will do more than $8 million in energy audits and retrofits in 2008 with returns on investments (ROI - in terms of lowered energy costs) of 2.1 to 1 for private residential improvements and 16 to 1 for improvements to commercial buildings over a ten year payback period. (Note that the ROI estimates above were based on the cost per megawatt of energy before rapidly increasing crude oil prices started pushing up the per megawatt cost of electricity.)

Jobs involving retrofiting existing structures can't be offshored.

Various efforts have been made to estimate job creation resulting from investments in retrofitting existing structures. The Council on Wisconsin Strategy (COWS) reports that for every 1 gigawatt of energy saved, 1.5 jobs will be created and every $1 million spent on retrofits will result in 8 to 10 new jobs in construction. Retrofitting also has ripple effects. Each 50,000 MW in energy-efficiency gains yielding 100,000 jobs in green energy equipment manufacturing, certified building materials manufacturing and wholesaling, trucking, etc. (For an explanation of the payback calculus and job creation estimates by COWS, see pages 15 and 25 of Green Pathways, available online at www.cows.org/greenpathways.)

Green Transportation

Manufacturing

Aircraft Engine and Airframe Manufacturing

The greenness of aircraft manufacturing depends on the materials used in their construction, the aerodynamics of their design, the engine technology and the kind of fuel they use. None of those factors has much impact on the way workers assemble airframes, attach engines or install the avionics nor on the core education and training requirements.

Auto/Truck Parts and Automobile/Truck Manufacturing

The greenness of on-the-road vehicles depends on the materials used in their construction, the engine technology and the kind of fuel they use, tire pressure, gear ratios, how well they are maintained and how they are driven. None of those factors has much impact on the way workers assemble automobiles and trucks.

Will green technology save domestic automobile manufacturing?

Just as we posed the question above regarding the residential & commercial construction industries, we have to interject a reality check regarding employment demand in the automobile manufacturing industry. Sales are slumping for the Big Three domestic automakers. All three are closing assembly plants in the United States. They are buying an ever increasing percentage of their parts and subassemblies from foreign suppliers. Most of their growth is coming from sales in foreign countries as they build factories abroad to penetrate new markets. Back in the United States, Toyota has leaped into the lead — but even its American sales figures are slumping. It makes little sense to talk about training new workers for green jobs in automobile manufacturing when: 1) the leading firms are laying off workers; and 2) skill sets required at new, greener production facilities can be taught as part of a skill upgrade initiative for incumbent workers.

In aircraft manufacturing, employment demand is driven more by the purchases of new and replacement aircraft by the military and commercial airlines rather than the availability of green collar workers. Boeing, for example, lost to a joint venture by Northrop Grumman Corp. and EADS (Europe-based Airbus) in landing a contract worth more than $150 billion to build 200 jumbo aerial-refueling tankers for the Air Force).[3]

Service

Auto Body Repairers

Are radically different KSAs required to repair auto bodies made of light-weight plastics, composites or nano-materials (e.g., carbon nano-tubes) rather than steel, chrome and aluminum? Yes. It probably would require incumbent worker skill-upgrade training and revisions to the current auto body repair curriculum.

Auto Mechanics

Are radically different KSAs required to work on internal combustion engines which run on various grades of ethanol rather than gasoline? Probably not. To install retrofit kits which allow gasoline engines to run on a variety of biofuels? Yes, but probably no more than a short demonstration or one day of training. To work on all-electric or hybrid cars? Yes, probably as a special certification module added to existing training programs. To work on hydrogen fuel cell cars? Yes, so radically different that a separate and fairly lengthy certification program would be required.

Diesel Mechanics

Are radically different KSAs required to work on diesel engines if they have been running on biodiesel or non-virgin vegetable oil rather than petroleum-based diesel? No.

Making transportation greener will depend more on regulations, research & development and financial incentives than on the preparation of workers to do some sort of new green collar jobs in either manufacturing or servicing them.

Greater fuel-efficiency is achieved chiefly by building smaller cars, making vehicles and aircraft from lighter weight materials, improving engine technology (e.g., using variable cylinder management which shuts down half of a car engine's valves when the vehicle is cruising on a relatively flat roadway or downhill), changing gear ratios, etc.

See the EPA's personal emissions calculator with tips for energy conservation and emission reduction at www.epa.gov/climate change/missions/ind_calculator.html.

Fuel conservation is achieved largely in reducing the number of miles driven (e.g., through car pooling, telecommuting, mass transit), keeping vehicles well maintained (including proper tire inflation), even by designing roads to minimize congestion and eliminate bottlenecks or synchronizing traffic control lights to minimize idle times.

Emission reduction is achieved by changing the fuel source from gasoline to bio-butanol or cellulosic ethanol; adoption of all-electric, hybrid or hydrogen fuel cell technology.

Air Traffic Control and Fuel Conservation

Rapid increases in the price of jet fuel are focusing more attention on energy inefficiency in the airline industry. Airline companies are doing what they can to improve fuel efficiency. Most have orders pending to replace their aging fleets with new models (like Boeing's Dreamliner) which are lighter weight and more fuel efficient. Airlines are now using a single engine to taxi into position for take-off when the tarmac is backed up. Most have imposed a "*second bag*" fee to reduce weight. American Airlines has gone to a "*per bag*" fee and others are likely to follow. Southwest Airlines figures to save $42 billion because it locked into a long term contract to buy aviation fuel at $2.00 per gallon. In addition, it has slowed its flights by an average of 10 mile per hour and strives to improve its on-time arrivals and departures through better scheduling at its hubs. (Just as it improves gas mileage for cars, reducing speed improves fuel efficiency for aircraft.)

But the most significant waste is the result of an antiquated, ground-based air traffic control system. Industry spokespersons told a Congressional committee that 740 million gallons of jet fuel were wasted in 2007 due to flight delays (e.g., idling on the tarmac awaiting take-off or

circling airports waiting for clearance to land). When wholesale prices averaged $2.15 per gallon, that translated into $1.6 billion in wasted aviation fuel. Because the price of aviation fuel is rising, estimated fuel waste in the industry will easily top $2 billion in 2008. When human resources (airline personnel and passengers' loss of productive time) are factored into the equation, the estimated annual cost of flight delays tops $42 billion.

A satellite-based GPS system would allow closer spacing between planes in the air and shorter intervals between sequential landings and take off. (Additional fuel is wasted by the present system where routes run in zigzag fashion guided by ground-based vector beacons instead of flying directly point-to-point.) By modernizing its air traffic control system, Germany has improved aviation fuel efficiency by 25 percent; New Zealand has improved its system by 30 percent. This again illustrates a central theme regarding green job creation. That is, having the national will to use tax dollars to make the public infrastructure greener (e.g., investing in an overhaul of the nation's antiquated air traffic control system) will go much further to create green jobs than tens of millions earmarked for green training programs.

Production of greener vehicles and aircraft will accelerate when manufacturers are:

1) *pulled* into adopting new technology by:
   a. the market penetration of, and value-added profits to be made from using lighter weight composites and energy-saving engines.
   b. financial incentives for R&D in material science, nanotechnology, jet propulsion and avionics (often coming through the Defense Advanced Research Projects Agency and NASA's procurements).

2) *pushed* into adopting green practices by:
   a. changes in driving habits and buyers' demands in the face of
      i) rising fuel prices and operating costs due to
         - increases in the price of imported oil;
         - higher taxes on, and stiffer penalties for, greenhouse emission by energy producers (e.g., adoption of a "*cap and trade*" program);[4]
         - rising social consciousness to contribute to the greening of America,
      ii) supply interruptions (e.g., from international conflict or storms like Hurricane Rita).
   b. an increase in federally-mandated Corporate Average Fuel Economy (CAFE) standards across auto manufacturers' portfolio of models;
   c. competition from foreign manufacturers who produce smaller, more energy-efficient vehicles that use alternative energy;
   d. government (especially Defense Department) procurement policies which increasingly emphasize energy-saving technologies and alternative energy sources (e.g., biodiesel for the Army's tank corps, light weight composites in the airframe of the Air Force's new jumbo aerial refueling jet tankers) for national security reasons in addition to a desire to jump-start the alternative energy industry and help it achieve economies of scale to compete on price with fossil fuels; and
   e. demands of buyers (particularly motor- and air-fleet buyers) who need to hold down operating costs to remain competitive.

The greening of the economy is not confined to the industries previously discussed, nor to the industries and sectors named in the DoL's request for proposals (RFPs) for first round funding under Title X of the WIA (See *Developing a Green Collar Action Agenda* in the next section of

this discussion). Take Agriculture for example. As the Earth's population grows and as the caloric and protein intake of rising middle classes in emerging nations increase, worldwide demand is pushing up food prices. That means greater opportunities for wealth creation from (and employment in) farming & ranching, food processing, commodities trading and exporting. But in the face of urban sprawl and climate change, farmers & ranchers must get higher yields from fewer acres of land which is becoming less arable. To keep profits from being squeezed by rising costs for irrigation and for fuel, fertilizer, herbicides & pesticides derived from petroleum, they are turning to: farm implements which use biodiesel; wind and solar power to drive their electrical equipment; GPS-based pinpoint agriculture; and more drought-tolerant and pest-resistant genetically-engineered seed stocks.

Indeed, the green label could be applied legitimately to any goods producers who are changing product designs, production processes or even their packaging materials and design to conserve energy & resources and to reduce greenhouse gas emissions (or even toxic liquid effluents). It's all too easy when caught up in the hoopla and political hyperbole to equate "*advanced manufacturing*" with the production of digital devices (such as consumer electronics). But advanced manufacturing techniques and new materials (especially those produced as the result of breakthroughs in nanotechnology), can be used to reduce the weight, increase the useful life ("*ruggedize*"), minimize the power consumption & emissions, capture & sequester the greenhouse gasses created in the production or during the entire product-life use or to create a virtuous cycle for using the waste/byproducts, recycling or reusing a product or remanufacturing of even the most conventional (non-green) widgets.

Labor market economists need to infuse today's overly enthusiastic but ambiguous discussions of green collar jobs with both common sense and analytic rigor. The first thing to get straight is the temporal sequence of cause and effect in job creation whether we are talking about green jobs or non-green ones. Employment demand is derived from opportunities to profit from making more and different goods & services to meet consumption demand. Employment demand is <u>not</u> created by the training of students and job-seekers or by well-meaning efforts to re-employ UI benefit recipients, move TANF recipients off welfare or to lift families out of poverty. Green job creation will occur when:

1) consumers are better educated about the value of environmentally-friendly, energy-conserving goods & services as well as the hidden costs of their personal oil dependency,

2) employers figure out that being environmentally- and energy-consciousness adds value to the goods & services they produce and the sustainability of their profits — that can be
   a. paid out in dividends or
   b. reinvested in job-creating business expansion; and

3) the "*leakage*" of dollars to foreign oil suppliers stops and energy-cost driven price increases decelerate. Then American consumers and producers in all sectors of the economy will have more money to spend on expanding domestic production of goods & services.

Some of the jobs created by the greening of the economy will require slightly different KSAs. A handful likely will require radically different KSAs. Most will not. But it's not really the greenness of the jobs, *per se*, that counts, it's how the greening of the entire economy creates more employment opportunities and sustains the paychecks that come with them through:

1) creating new profit centers (e.g., manufacturing new vintage equipment for distributed production of alternative energy; carbon capture & trading by the "*smokestack saddled*" producers of old vintage items); and

2) stopping revenue leakage to foreign oil suppliers to facilitate retention of dollars in the domestic economy for: reinvesting in R&D, innovation, technology-transfer, infrastructure upgrades; and marketing, delivering & servicing new vintage goods.

In the next section we will look more closely at government-sponsored efforts to promote a greener economy. In particular, we will focus on the Green Jobs Act of 2007 and Title X of that act as it influences the Workforce Investment Act (WIA) federal job training program agenda.

Developing a Green Collar Action Agenda

Emerging Popularity: Green as the "*New Gold*"

As the introductory section of this piece indicated, a new term has moved to the front burner of discussions about employment in the new economy - "*green collar worker*." Pundits from radio, television, newspapers and magazines are using the term with ever increasing frequency.[5] The term has its own Wikipedia entry.[6] One organization (GreenCollar.com) has been granted a trademark on, and copyrights to, the phrase "*Green Worker Program*." The term has even made its way into the speeches of presidential candidates from both major parties. Ralph Nader's claims notwithstanding, Senators McCain, Clinton and Obama are jockeying to be perceived as leading the charge to promote green collar jobs.[7] Each has accused the others of stealing the term.[8]

In the last three years, Congress has passed legislation to provide financial incentives through the Department of Energy (DoE) and the Environmental Protection Agency (EPA) for starting up new firms in the alternative energy industry, helping petroleum-dependent firms make the transition to alternative fuels and enabling utility companies to tap new power sources. Federal procurement policy (exercised through the General Services Administration and the Pentagon) pushes government agencies to buy alternative fuels for their motor vehicle fleets (e.g., biodiesel for the Army's tank corps) and to house operations in green buildings. Major cities (e.g., Seattle, Dallas, Austin) are being more aggressive than the federal government on green procurement and green building policies for all public office space they build or lease.

In December, 2007, the Green Jobs Act of 2007 (PL110-140) was passed as an attachment to the Energy Independence and Security Act of 2007. It added a mandate (Title X) to the Workforce Investment Act (WIA). Under Title X, up to $125 million will be funneled through the Department of Labor (DoL) to establish national and state job training programs. The new programs are to address job shortages that are "*impairing growth in green industries, such as energy-efficient buildings and construction, renewable electric power, energy-efficient vehicles and biofuels development*." First round funding under Title X will include $10 million in competitive grants to build "*high-skill trade careers in the energy and construction industries*."

Multi-faceted Popularity as the Movements Converge

Unfortunately, since the new legislation was backed by a broad coalition of groups with quite diverse objectives, there is no clear-cut definition of "*green collar*" jobs. Indeed, discussions about green collar jobs dovetail into several parallel movements to promote alternative energy. The variety of objectives voiced by members of the broad emerging green coalition can be distilled into four main motives: 1) environmental protection & sustainability; 2) economic development & job creation; 3) national security; and 4) moral obligation.

Environmental Protection and Sustainability

Environmental activists see adoption of various forms of alternative energy, resource conservation and emission-reduction technology as essential to building a sustainable economy while enhancing the quality of life. Petroleum geologists note that oil & gas reserves may have already passed peak production and are in decline. Other nonrenewable resources are being depleted more rapidly as emerging nations develop. Moreover, according to this group, climate change attributed to manmade greenhouse gasses is extracting an economic toll. Normally arable lands are yielding smaller harvests as temperatures rise and more frequent droughts last longer. Employee absenteeism due to respiratory problems increases and productivity slumps. (See, for example, the dramatic increase in cities along the east coast of China as they undergo rapid industrialization in direct proportion to the increase in a region's industrial pollution.)

Economic Development and Job Creation

Economists use the "*leakage argument*." They tout conversion to alternative energy as essential for competing successfully in a global economy. That is because the rapidly increasing price of foreign oil is driving up the cost of goods to American consumers and eating into the profitability of domestic firms across <u>all</u> sectors. When locally produced forms of alternative energy are substituted for oil, leakage of American dollars to foreign suppliers will be reduced. That, say the economists, will provide price stability and bring down the cost of everything. Domestic economic growth and job creation will be stimulated by freeing up "*petro-dollars*" for Americans to spend on the entire gamut of goods & services produced in this country.

Visionary entrepreneurs who embraced the findings of climate science two decades ago are reaping sound returns for being the first movers to invest in emission-control technology, carbon sequestration, energy & resource conservation, conversion to alternative energy sources, the production of green products and establishing green images. Their success in the marketplace has captured the attention of profit-minded, but heretofore skeptical and recalcitrant, capitalists.

Farmers & ranchers see opportunities to profit by: growing feeder stocks for bio-fuels; converting animal waste and horticultural by-products into energy; leasing land for wind, solar or geothermal farming; and selling the surplus energy they generate back to the grid under the net metering provisions of the Public Utility Regulatory Policy Act of 1978 (PURPA).

National Security

Policy-makers see alternative energy in international security terms — as a means of weaning this nation (<u>especially the military</u>) from its dependence on foreign oil from unstable, undemocratic and often hostile parts of the world. For example, they envision tanks sent to protect oil supply lines being cut off from petroleum-based diesel by hostile forces. Running the tank corps on biodiesel makes it less vulnerable. Moreover, with armed forces stretched thinly across multiple fronts, conversion to alternative energy would enable the United States to disengage from costly military operations to protect foreign oil supply lines and American's access to them.

Officials with the Department of Homeland Security see the vulnerability of critical infrastructure where the petroleum refining of this oil-dependent nation is concentrated in a handful of areas. Conversion to alternatives allows for a dispersion of production (e.g. wind farms in the Trans-Pecos and bio-fuel production in the Panhandle) that would better ensure energy supplies in the wake of an attack on, or a natural disaster in the area surrounding, refineries currently concentrated in the Texas Coastal Corridor from Corpus Christi to Beaumont.

Moral Obligation

Members of the growing "*Stewardship Movement*" see resource conservation and environmental protection as Biblical mandates. Their position is that at the Creation, God gave mankind a pristine and bountiful paradise. It is sinful to despoil and befoul the Earth or to squander its resources.

What is Green? Challenges to Establishing an Operational Definition

Given multiple objectives manifest in the drive to create and train workers for green jobs, there is an overabundance of definitions for green collar jobs. Several overlapping, but somewhat inconsistent, approaches are being used. What we need at this juncture is "*data reduction*" — looking systematically across contending definitions to chunk and cluster them into a manageable number of categories which allow for unambiguous and exhaustive coding. We are getting just the opposite. With substantial amounts of money on the table, every interested party is pushing for a peculiar definition which will favor its own grant application.

Objective and detached labor market analysts will have to flesh out an operational definition for the terms in Title X of the WIA. How can allegedly green economic activities be chunked, clustered, categorized and, hopefully, coded? What are the strengths and limitations of the various approaches? Can "*green collar jobs"* be operationally defined in an unambiguous way that will be useful, fair (i.e., even-handed, neutral) and actionable in evaluating competing grant applications? The next section of this paper will examine a variety of plausible approaches suggested for conceptualizing the green economy.

An Industry-Based Approach

One way to approach the definition of green collar jobs is to use an industry- or sector-based approach. The DoL seems to take this approach in its request for proposals (RFP) under Title X of the WIA. That is, the DOL's current RFP stresses worker preparation for jobs in green industries such as "*energy-efficient buildings and construction, renewable electric power, energy-efficient vehicles and biofuels development*."

On close inspection, however, this industry-based approach seems inadequate and ambiguous. Congress left the definition of "*green industries*" open-ended. While four industries (or

Using Qualitative Analysis to Help Define the "*Green Economy*"

Qualitative analysis will have to precede quantitative analysis. Unfortunately, most of what we do as labor market economists is quantitative analysis. That is, we examine the relationship between well-defined data elements which have been collected in a consistent fashion over a long period of time. We use frequently refined analytic tools to draw inferences from scientifically drawn samples to relevant parts of the labor force. We extrapolate from historic data to bolster confidence in predictions about future employment demand. But with respect to the greening of the economy, we have no set theory from which to draw testable hypotheses. We have no historical precedents to tell us who will fill these jobs with what knowledge skills and abilities in which regions under what conditions. The objective of qualitative analysis, on the other hand, is to establish "*grounded theory*" – i.e., literally building theory anew from the ground up.

rather niches within four industries) are offered as illustrations, inclusion of the words "*such as*" in the RFP suggests that grant applicants are welcome to propose worker preparation for jobs in industries which are not listed in the RFP. That leaves the playing field wide open.

BP, for example, technically is classified as a "*Petroleum Manufacturing*" firm. But BP is investing heavily (along with DuPont – technically a "*Chemical Manufacturing*" firm) in new energy technologies. The same is true of Chevron. Meanwhile, some firms which produce alternative energy are using abundant, but nonrenewable, feeder stocks. For example, Peabody Coal and Duke Energy are investing heavily in coal gasification and liquefaction. Those technologies significantly reduce CO_2 emissions compared to burning conventional coal to produce energy.

Firms in some industries may be accomplishing one objective behind the policy mandates without necessarily being green. Oil & gas exploration and oil field service firms (e.g., Schlumberger) provide interim solutions to the nation's energy woes. They find and tap new domestic reserves or rework old wells. That does little to help reduce the nation's *overall* dependence on oil. But every barrel of oil extracted from new or reworked domestic fields will displace a barrel of imported oil until various alternative energies achieve economies of scale to be cost competitive. It will also reduce the energy used to move petroleum from the well head to the consumer.

But not all technologies used by firms in the enumerated sectors are equally green. Given that petroleum products (e.g., fuel & fertilizers) are used more heavily in growing cereal grains than for other feeder stocks, conventional ethanol producers are considerably less green than those who produce cellulosic ethanol or non-virgin biodiesel from used cooking oil.

A Firm-Based Approach

Since companies within the same industry vary widely in their commitments to alternative energy and emission reduction, a firm-based approach to identifying green collar jobs might be more appropriate. Such an approach would distinguish BP, DuPont and Chevron from other Petroleum and Chemical Manufacturing firms which have been slower to diversify into alternative energies (e.g., Exxon). Similarly, it would differentiate by degree of greenness among firms which produce conventional ethanol versus those producing cellulosic ethanol, bio-butanol and non-virgin biodiesel.

An Establishment-Level Approach

While slightly better than an industry-based approach, the firm-based approach is still inadequate. The greenness of economic activities will vary within one firm from one of its establishments (i.e., facilities or subsidiaries) to the next.

- BP and Chevron continue to manufacture conventional petroleum products in some of their facilities while producing alternative fuels in others.
- Duke Energy still produces the majority of its energy from oil- and coal-fired plants while it starts to venture into alternative energy.
- Every auto manufacturer produces a variety of cars. We instinctively think of all-electric or hybrid cars and experimental ones which run on hydrogen fuel cells as energy-saving and emission-reducing. But, while assembling alternative energy vehicles in some of their facilities, auto makers are turning out cars at their other facilities with conventional internal combustion engines. Some of those conventionally-powered cars will achieve more fuel economy because they are being equipped with: superior fuel injection technology; car

bodies made from light weight composites; and/or sensors which allow them to cruise on half their cylinders when not passing, hauling or going uphill.

- Workers at one Caterpillar plant produce bulldozers from scratch. Workers at another Caterpillar facility remanufacture bulldozers with a 70 percent savings in materials and energy.

An Occupational Approach

None of the approaches suggested above provides a method for distinguishing green collar workers from other employees in the same industry, firm or establishment. For example, take three employees of a green building construction firm: a bookkeeper/accountant; a roofer who installs conventional shingles; and a solar panel installer. Are all three to be considered "*green collar*" because they work for a green builder? Using an occupational-based approach, only the solar panel installer would be considered green. Using this approach, dispatchers for UPS could be considered green collar workers since they are equipped with logistical planning software which plots the shortest routes with the fewest traffic lights or congestion to reduce engine idle time for optimum fuel efficiency by the firms' delivery fleet.

A Task-, Project- or Location-Based Approach

Within any occupational classification, some workers will be greener than others. Both the shingle installer and the solar panel installer technically may be classified as "roofers." Or the same roofer may install conventional shingles on one project and solar panels on the next.

Should all UPS truck drivers now be considered green because they follow dispatchers' directions to take the most fuel-efficient routes? Would those who drive hybrid or bio-fuel powered UPS trucks be considered green while those who drive gasoline-powered delivery & long-haul vehicles be considered non-green? If the drivers simply do their routes as assigned, are they non-green while the dispatchers are green? Should the "*green*" label be reserved for the software engineers who devised the fuel-saving logistics software? If drivers simply operate alternative fuel delivery vehicles, are they non-green while the refuelers back at the fleet maintenance center are green? Should the "*green*" label be reserved for the procurement officer who mandated the conversion to green vehicles and alternative energy for the company's fleet? In any event, are radically different KSAs required to drive hybrid or bio-fueled trucks for UPS?

One automotive engineer may be engaged in designing cars to run on conventional internal combustion engines while others in the same occupational classification at the same firm are working to design hydrogen fuel cells or auto bodies built from light weight composites. Should the latter be labeled as "*green engineers*" while the former are labeled "*non-green*"?

Assume one accountant for the auto manufacturer commutes to work five days per week while another telecommutes four out of five days. The later reduces overall fuel consumption among the firm's employees. Does that make the telecommuter green?

In short, the greenness of workers' activities may vary from one day to the next, by task/work assignment, project or work location. Under an occupational approach, one could identify any occupation that had green elements to it, e.g. sometimes used green building materials. But such definitions, while yielding a coveted occupational list, offer little legitimate insight into the extent of green work activities. There still has to be a less ambiguous way to define "*green collar workers*." In the following section, we posit a more reasonable and actionable option — an outcomes-based approach.

An Outcomes-Based Approach

Each of the approaches outlined above leads to splitting hairs. The basic problem is that the greenness of economic activities is not a dichotomous (either/or) construct; but rather, it is a continuous variable (i.e.; occurring in degrees that vary across industries, firms, establishments, occupations, projects, tasks and the work arrangements/practices/habits or location of individual employees). Only the measurable outcomes of discrete work activities can serve as adequate criteria for evaluating competing grant applications for round one funding under WIA's new Title X. Therefore, it should be incumbent on any party submitting a proposal to quantify the following:

1) For the job designated as the object of green education & training under WIA's Title X (herein called the "*target-job*"), what are the *net* energy savings relative to a comparable job producing the equivalent conventional product or one which uses a more conventional production process?
   a. This dimension would allow the proposer to build a case for training or retraining workers (regardless of their occupational classifications) to be productive as telecommuters who ostensibly would have a smaller carbon footprint while generating the same output.
   b. It would give preference to training workers for remanufacturing any product over those who make the same product from scratch.

2) How would the target job contribute to improving national security or address the revenue leakage problem? How many barrels of foreign oil will be displaced annually by the activities of each worker in the target-job? (This dimension would allow for the training of oil field workers in new techniques for discovering, extracting and processing domestic reserves – a potentially crucial interim solution for the nation's energy woes.)

3) What does the target-job contribute to the *net* reduction in the "*carbon footprint*" of the worker's employer or of consumers who buy/use the firm's goods and services?

4) Will the KSAs required to perform the job be so radically different that:
   a. a new curriculum will have to be devised to impart the required KSAs;
   b. once the KSAs have been mastered, the worker will be more productive and add more value to the firm's goods and services than his or her non-green counterpart; and
   c. will the productivity gains (in terms of efficiency or value-added) warrant some sort of green wage premium, salary or bonus?

Applying the Outcomes-Based Approach

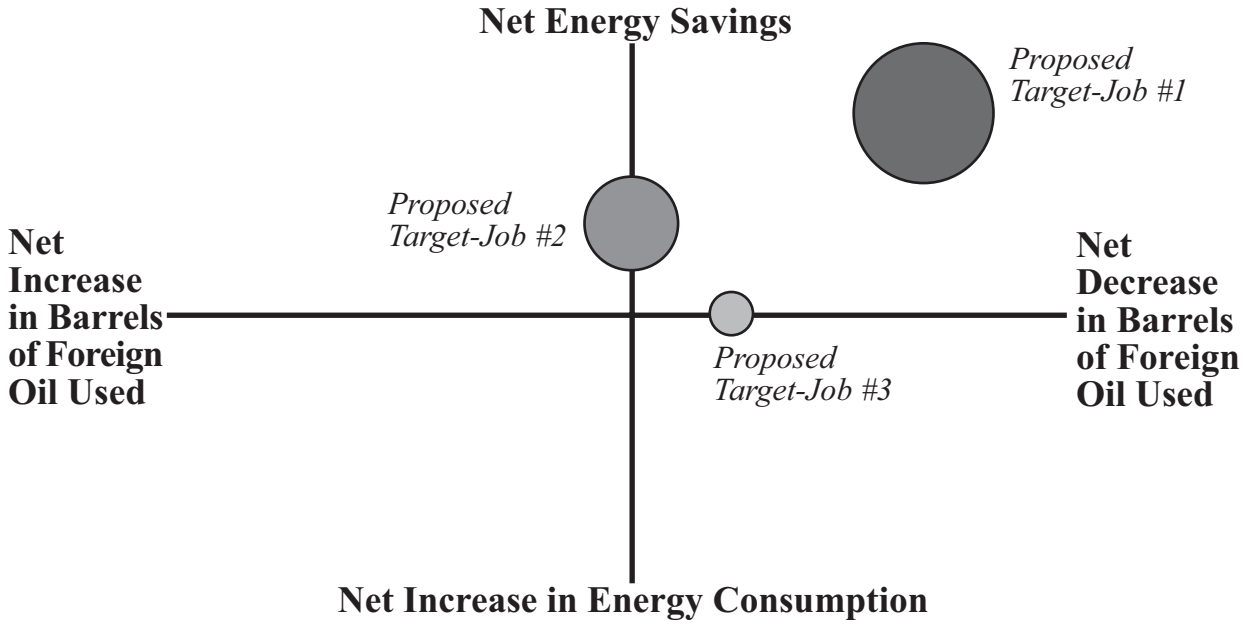
The outcomes-based approach will make it easier to evaluate RFPs submitted for the first round of workforce preparation funds under Title X of the WIA. Evaluators could devise bubble charts which would give them an intuitive grasp of meaningful comparisons among competing proposals as depicted in the illustration on the next page.

For example, the vertical axis might represent the *net* energy savings achieved because workers are deployed in the target-job. Crosswalk tables are readily available for converting various measures of energy consumption into some "*common currency*" such as megawatt-hours (MW-h) or British Thermal Units (BTUs). Let the horizontal axis represent the number of barrel equivalents of foreign oil saved or displaced because workers are deployed in the target-job.

Again, there are conversion tables for translating alternative fuels (such as a metric ton of coal) into their "*barrel of oil equivalentsl*" (bboes or BOEs). Let the size of circles on the coordinate axes depict target-jobs in terms of their impact on the net reduction of the carbon footprint.

Bubble charts do not lend themselves to contemplation of more than three dimensions at the same time. Our outcomes-based approach, however, lists more than three considerations. One possibility is to evaluate grant applications by determining *ex ante* which three dimensions should receive the greatest weight. Plot those three on a coordinate axis (it really does not matter which two elements are arrayed along the axes or which is depicted by different sized circles so long as the plotting helps make intuitive sense of the comparisons). By convention, the upper right quadrant should contain the best choices; larger circles should represent more of the desired element than smaller circles. Reserve the fourth consideration (the one *not* depicted) as the tie-breaker. In the hypothetical bubble chart below, for example, the tie breaker might be a value-added or the wage premium to be paid to a worker who successfully completes the proposed green training.

Beyond the first round of Title X funding, the outcomes-based approach could be used by economic development corporations (EDCs), regional competitiveness centers (RCCs) or state-level development offices in evaluating competing proposals for financial incentives to start up or grow specific firms. Similarly, Local Workforce Development Boards (LWDBs) can use an outcomes-based approach in assessing the likely benefits of funding firm-specific training of incumbent workers or for partnering with education and training providers in the region to develop a green curriculum (e.g., courses for certifying: construction workers for work using energy-saving materials; building inspectors to conduct energy audits; auto body repairers to work on light weight composites; or auto mechanics to work on hydrogen fuel cells) as part and parcel of both their economic development and workforce preparation strategies.



LWDBs can use the outcomes-based approach in their strategic planning to design useful employer services. They might engage contract service providers capable of helping businesses in their region become greener by:

1) re-examining the energy consumption and emissions over the lifecycle of the goods & services they produce;

2) re-thinking their business strategies to turn emission control, carbon capture & sequestration, alternative energy production, remanufacturing, reuse and/or recycling into profit centers;

3) redesigning their production & delivery processes to be more energy- and resource-efficient;

4) revising work assignments (e.g., telecommuting, four 10-hour workdays) and altering the workplace (e.g., lighting, insulation, temperature control, energy source) to conserve energy and to reduce the carbon footprint of both the firm and its employees; and/or

5) revamping their community services and philanthropic efforts to include green projects which would enhance environmental quality where their employees work and reside.

Such services would help employers achieve sustainable profits in the new age economy where consumers are increasingly environmentally-sensitive and energy-conscious. Thereby, they would indirectly stimulate business expansion and job creation. In some cases, no worker training or re-training would be required to fill revised or newly created jobs. Equally important, achieving a green corporate identity/image/ethos will help employers recruit and retain top talent from Generations X and Y who want to: engage in meaningful work (e.g., producing goods and providing services that are energy-efficient and environmentally-friendly); live and work in an emission-free environment; and do their part as individuals (e.g., by telecommuting or establishing work-site-based recycling projects) to improve the environment and "*quality of place*" and "*quality of life*."(See Appendix B for an extended discussion and a hypothetical comparision of two proposals using an outcomes-oriented approach.)

Alternative Criteria: Community Benefit

The outcomes-based approach to evaluating proposals and grant applications overlaps but does not contradict an alternative approach based on community benefit. In the latter, evaluators would take into account the existing carbon footprint of the worksite or community targeted for green development. Proposals which would use green energy, construct or retrofit green buildings or use green production techniques in communities with "*non-compliant*" air quality, for example, might get bonus points in the evaluation process over applications to fund projects in "*compliant*" areas. If evenly matched on outcomes-based criteria, the tie-breaker might favor the community most in need. (Similarly, one might look at the target communities competing for funds and give bonus points to the one with the highest unemployment rate or population living in poverty.) To determine which communities are "*most in need*" or "*most likely to benefit*" based on their current carbon footprints, go to the Texas Commission on Environmental Quality at http://www.tceq.state.tx.us/. You also can use the Zip code lookup function at http://www.eredux.com/ or do *ad hoc* calculations at http://www.carboncounter.org/?gclid=CMCpgo3M2JMCFSemQQodrjKEZw.

Measurable and Scalable Response

Providing a "*measured and scalable*" response does not mean having every region rush to create programs to train large numbers of workers in very specialized fields that are so radically different that they can genuinely be called "*green collar*." It does mean steering economic development incentives to grant applicants who demonstrate the greatest commitment to resource- and energy-conservation and emission reduction. In the long run, they are the ones who will produce the highest sustainable profits and derivative employment stability. It does mean working as an "*honest broker*" — as a go-between with EDCs and education & training institutions to align workforce preparation plans with the trajectory of regional employment demand and economic development initiatives.

To be well positioned for site selection by alternative energy producers, communities should plan to infuse the *entire* public education curriculum with more of the appropriate math, science and technology fundamentals. Where possible, modestly revise the existing postsecondary curriculum or add new specialty capstone courses to existing programs (e.g., for each slightly different process control or particulate-containment operation, or storage, transportation, transfer and disposal situations). Create whole new postsecondary programs only where the required green KSAs are *radically* different from those essential to performing non-green predecessor work assignments. Even then, scale those programs' enrollments to realistic forecasts of related employment demand. Thus, while independent school districts across the state may be engaged in beefing up the math, science and technology curriculum, only one or two postsecondary institutions will have to tackle the *specialized* training required to meet the demands of a greener economy.

The region-specific demand for program completers may not be large enough to warrant starting new courses at the local level.[9] But statewide demand may be large enough to justify a new Associate's degree program at a Texas State Technical College campus.[10] Or it might mean endowing one chair to attract a leading scholar-educator to a branch campus university. In other cases, it may mean creating a single post-baccalaureate program, fully equipping a laboratory at one of the state's flagship research universities or creating an "*Applied Baccalaureate*" degree which would fully integrate green-related academics and applied technical skill training.[11]

We're putting the cart before the horse by wringing our hands about devising workforce preparation programs (as yet undefined) in anticipation of a shortage of green collar workers (as yet undocumented, but nonetheless worrisome and highly politicized). Start first by realigning private market forces and financial incentives from the public sector (and/or NGOs) to help alternative energy producers, related technology manufacturers and feeder stock suppliers achieve the economies of scale necessary to compete on cost with energy derived from conventional coal and imported oil. Funnel discretionary workforce dollars into:

1) efforts to collect data and develop sound forecasts on how emerging technologies will alter the trajectory of employment demand and changes (if any) in KSA requirements
   a) use focus groups to get input from:
      - innovators who invent, develop and prototype alternative energy technology;
      - entrepreneurs and technology-transfer agents with insights into the speed of diffusion, uptake and commercialization; and
   b) directly observe first movers on-the-job as they blaze the trail for working with the new technology and develop hands-on knowledge; and
   c) help them transform tacit knowledge into learning objectives for widespread diffusion through formal training programs.

2) career decision-making tools & materials to steer students toward:
   a) the appropriate foundation courses in math, science and technology at the secondary level;
   b) basic postsecondary certificate and degree programs in math, science and technology; and
   c) work experiences which will position them to move nimbly once
      - the definition of green collar jobs crystallizes and
      - employment demand can be documented and confidently forecasted.

3) case management tools for matching job-seekers to high-wage, sustainable careers dealing with alternative energy — including skill-upgrade training modules that the workforce boards' service contractors or local community colleges can deliver to:
   a) incumbent employees of firms making a transition from fossil fuels to alternative energy; and
   b) workers who are dislocated when their firms are punished by market forces for their failure to make that transition.

In sum, the outcomes-based approach to defining green initiatives and green collar jobs will serve well: in providing criteria for evaluating first round Title X grant proposals; prioritizing competing claims on scarce resources for incumbent worker training and workforce preparation curriculum development; helping local workforce boards become more imaginative in offering employer services to create sustainable profits and help them recruit and retain top talent in the new age economy where employers, workers and consumers are increasingly energy-conscious and environmentally-sensitive.

ENDNOTES

[1] State Renewable Energy Standards typically set milestone dates for achieving a specified target percentage of their total energy-producing portfolio through alternatives to fossil fuels. Texas, for example, has set a target for using renewable alternative energy to produce a minimum of 5,800 MegaWatts of electricity by 2015. To learn more about the targets in Texas, go to Public Utility Commission of Texas. To see how Texas plans to achieve its targets, go to Texas Incentives for Renewable Energy at *http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=TX03R&state=TX&CurrentPageID=1*. State-by-state monitoring of State Renewable Standards and progress being made toward achieving them is being done independently by the Union of Concerned Scientists (USC). The USC has a toolkit planners can use to track related events in their state and in neighboring states. Go to *http://go.ucsusa.org/cgi-bin/RES/state_standards_search.pl?template=main.*

[2] Instead of splitting hairs about green jobs, labor market analysts can look at lead indicators when forecasting employment demand in the construction industry.

- For residential construction, for example, look at: changes in the Consumer Confidence Index (CCI) from the Conference Board (at *www.conference-board.org*). The direction the CCI is headed has been a reliable advance indicator of domestic consumers' willingness to buy big ticket items like houses and cars. Also look at the direction prices are headed in the regional housing market (see National Association of Realtor's Metropolitan Price Index at *www.nar.org* or the Case-Shiller Index from Standard and Poors), changes in the percentage of houses for sale that are foreclosures, the average duration that new homes stay on the market relative to the inventory of older homes for sale, changes in the number of new construction permits and the number of new housing starts. In Texas, particularly as one moves from north to south, the slump in residential construction has been accompanied by a steep decline in remittances to Mexico and other Central American nations. Some analysts suggest that alien workers (legally or illegally residing in the United States) are the first to be laid off in a slump. When the industry shows signs of rebounding, residential construction companies may venture forth cautiously — hiring alien workers on a temporary basis.

- For commercial construction, look at lead indicators such as changes in the occupancy rate of, and the direction lease prices per square foot are headed for, warehouse, industrial and office building space. Also look at the trajectory of the business equivalents of the CCI from the Conference Board (such as CFO Confidence) or you region's Federal Reserve Bank (go to *http://www.federalreserve.gov/otherfrb.htm* and select your region on the map then select your district bank's economic research and data page). Such indices signal the mood of businesses with respect to growth plans which will require facilities expansion and more office space.

[3] When trying to forecast employment demand in Aircraft, Airframe and Avionics Manufacturers, watch the news on military procurements and commercial airline fleet-purchases. News of billion dollar deals will be published in major business journals such as the Economist and BusinessWeek along with indications of the winning bidder's intent to use subcontractors who

have facilities in your region. Because of red tape delays between contract-letting and production start-up, those news souces provide sufficient lead time to get worker recruitment, education, training and placement programs in place.

[4] Senators McCain and Obama have indicated their support for a "*carbon cap & trade*" program if elected president. Bipartisan bills have already been introduced in both houses of Congress. No action is likely until 2009 because President Bush has threatened a veto.

[5] See, for example, the Washington Post, January 23, 2008 at page C01.

[6] At *http://en.wikipedia.org/wiki/Green-collarworker.*

[7] Senator McCain, for example, is on the board of Republicans for Environmental Protection.

[8] See the CNN Situation Room telecast of January 28, 2008 at *http://mediamatters.org/items/200801250014*, the Green Collar Job series from NPR (*http://www.npr.org/templates/story/story.php?storyId=19096637* or the Wall Street Journal Online from February 11, 2008 at *http://blogs.wsj. com/washwire/2008/02/11/clinton-pushes-green-collar-jobs-in-md-factory-tour/*. The following from *http://www.prospect.org/csnc/blogs/tappedarchive?Month=02year=2008&basename=friends_in_low_places* illustrates the kind of coverage this issue is receiving in the mass media.

> *[Senator] Clinton herself borrowed heavily from the climate plans of Obama and Edwards. Though she's now claiming that she was the first to tie her climate plan to economic stimulus in the form of new "*green collar jobs*," that was a central component of both Obama and Edwards' plans — which both came out well before Clinton's Nov. 5 speech on the subject that her camp is touting as the "*original*" discussion of the matter.*

[9] See the Texas Higher Education Coordinating Board's completer placement standards for justifying new program start-up and state funding at *http://www.thecb.state.tx.us/Rules/SearchTAC.cfm.*

[10] The mission of the TSTC System is to serve the entire state rather than a local taxing district. Therefore, statewide employment demand for specific kinds of green collar workers may be large enough to justify offering related education and training at one of the TSTC campuses even if the demand is not concentrated enough in any community college's taxing district to meet THECB's new program approval requirements.

[11] For readings on the development of the Applied Baccalaureate Degree concept, go to the Education Resource Information Center (ERIC) at *http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED433046&ERICExtSearch_SearchType_0=no&accno=ED433046*

Appendix A: Annotated Glossary

Blue Collar

"*Blue Collar*" traditionally refers to relatively low skill jobs — chiefly in manufacturing, often unionized and commonly paid an hourly wage. Broadly construed, they include jobs in any sector whose duties & tasks entail significant elements of manual labor (e.g., construction trades, industrial assembly, janitorial services, farming & ranching). The label is derived from the durable, easy-to-launder blue shirts or coveralls typically worn by workers who do manual labor.

All too often, "*blue collar*" is used in a derogatory fashion by linking occupational employment in, or vocational preparation for, jobs involving manual labor with low skills, low wages and lack of social status. All encompassing disparagement of blue collar jobs clouds rational assessment of labor market realities and unwittingly disparages viable career pathways.

- Parents, particularly in the upper two or three quintiles economically and educationally, aspire for their progeny to go to college regardless of their children's interest in, or aptitude for, postsecondary education or jobs which do not entail much manual labor. Their derogatory use of the term "*blue collar*" is meant to persuade their children to pursue "*higher aspirations*" but without clearly specifying what those "*loftier*" or "*more prestigious*" aspirations might be.
- Parental disparagement of blue collar jobs tends to be reinforced by educators. At the secondary level, counselors and administrators may disparage blue collar employment if their own job performance is assessed in terms of the percentage of their students who go on to college immediately after graduating from high school. At the postsecondary level, the disparagement is more circuitous when done by recruiters and admissions directors whose job primarily is to generate tuition dollars by filling slots and by faculty who presume that the road to success follows educational paths identical to those they once tread.

The labor market reality is that there are ample opportunities for employment in blue collar jobs. Most pay a living wage. Some pay enough to rival more prestigious white collar jobs.

Although the growth rate is decelerating for many blue collar jobs and is flat for others, they will still account for more occupational employment demand in coming years than high-skill/high-wage jobs. Jobs requiring a baccalaureate or more in science, technology, engineering and math (STEM) are growing at a faster rate. But they start from a much smaller base. Since the base of blue collar employment currently is so much larger, replacement demands (particularly in the face of Baby Boomer retirements) will account for more job openings than will high-skill jobs in the decade to come. (See Harry Holzer and Robert Lerman, *America's Forgotten Middle-Skill Jobs: Education and Training Requirements in the Next Decade and Beyond,* November 2007, available online at *http://www.urban.org/UploadedPDF/411633_forgottenjobs.pdf* .)

Moreover, blue collar jobs should not be dismissed summarily by case managers, counselors and educators as low paying, dead end ones. References to average earnings by level of educational attainment — cited by workforce intermediaries and college recruiters (and repeated, often indiscriminately, by parents) — mask wide variance in wages by field of study. Plumbers and carpenters, for example, may earn more than persons with advanced degrees in the humanities and liberal arts who find work in sedentary white collar jobs.

Lastly, not all persons (regardless of their well-meaning parents' aspirations for them or the college recruiters' hyperbole) have the interest, aptitude or persistence to get a college degree that would qualify them for jobs which entail little or no manual labor.

Gold Collar has three very different uses.

Some use the term "*gold collar*" to describe low-skill jobs when held on a full-time basis by dropouts, recent high school graduates and young adults. Jobs described as "*gold collar*" in this sense include: entry-level ones in the food service industry, retail sales and grocery stores which rely heavily on young, part-time workers. For gold collar workers without additional household members (e.g., spouse and/or children) to support, a disproportionate percentage of the paycheck is considered disposable income (i.e., available to be spent on entertainment, cars, clothing, electronic consumer goods, etc.). But not all persons in low-skill, entry-level service jobs are gold collar workers. Used in this way, the term refers more to the psychology, age, educational and household status of the job-holder than it does to the type of employment. The term suggests that such jobs, if pursued full-time by persons not enrolled in postsecondary studies, act as "*golden handcuffs*." They tend to reinforce young adults' focus on immediate consumption and instant gratification. That diverts their attention away from the linkage between additional education and higher wages. Insofar as they would have to be foregone, earnings derived by adolescents and young adults from gold collar jobs factor into their intuitive calculation of opportunity costs for pursuing additional education and training. They fail to get the training they need for higher wage jobs which are more likely to assure their financial independence once they have children, mortgages, and other serious financial obligations later in their worklives.

Others use the term "*gold collar*" to refer to jobs held by college students on a part-time basis to: a) finance more lavish lifestyles than their college-going peers; and b) avoid racking up huge amounts of student debt. As in the first definition of gold collar jobs, typical occupations associated with this second use of the term are in food service and retail trades. But the psycho-social connotations differ significantly from those previously described. If held by college-going students on a part-time or seasonal basis (i.e., summer jobs, Christmas rush), gold collar jobs in this sense may, in the short run, retard their progress toward timely degree completion. But, in the long run, part-time work in the service sector may financially enable students to persist in their pursuit of postsecondary degrees. Under such conditions, a gold collar job might be considered a "*golden ticket*" to higher earnings later in their worklives — particularly for first generation college-goers or students from low- to middle-income families who otherwise might not be able to afford a college education.

Commentators who use the term "*gold collar*" in this sense often commend service sector employers who:

- consciously recruit postsecondary students;
- adjust work schedules to accommodate their classes and study arrangements; and
- provide "no-strings-attached" tuition assistance as a matter of corporate policy.

The third use of "*gold collar*" refers to the most highly skilled and best paying managerial, professional and technical jobs. Heretofore, such jobs were classified as "*white collar*." (See the description of "*white collar* jobs.") This use of "*gold collar*" differentiates the occupations (or subset of occupational workers) engaged in non-routine cognitive duties and tasks (i.e., creative thinking, problem-solving, system integration) from clerical and administrative white collar jobs whose tasks are repetitive/routine and less cognitively complex. The latter are more amenable to being automated and/or shipped offshore to low-wage countries. Whereas declining employment opportunities put downward pressure on wage demands of low- to mid-level white collar workers, the upper echelon (whose skills are *not* considered "*tradable*") are in high demand. In this sense, gold collar workers can expect more long-term employment security and demand a large education premium in their wages.

Gray Collar has Two Overlapping Uses.

When used in a derogatory sense, "*gray collar*" refers to those blue collar workers who are most likely to get their hands and clothes soiled: workers in extractive industries like farming & ranching, mining, oil & gas extraction; or those who work in smelters and other heavy industrial facilities (as opposed to assembly line workers in "*light industry*"). Derogatory use of the term "*gray collar"* diverts attention from an emerging labor market reality. Namely, many of the widely disparaged gray collar jobs are becoming increasingly viable career options:

- As emerging economies prosper, they use more resources (e.g., steel, copper) thus driving up employment demand in, and wage expectations for, workers in mining, oil & gas exploration & extraction and ferrous & non-ferrous metal industries. See, for example, the employment demand increases and wage growth in exporting nations like Brazil, Australia and Canada that are generating wealth from resources other than crude oil (e.g., iron ore, bauxite).

- As the middle class grows in an emerging nation, consumption demand shifts toward the patterns of more developed nations (e.g., higher caloric and protein intake). Exports of, and prices for, agricultural products are driven not only by increased foreign demand, but also by bad weather in several agricultural regions and the growing domestic demand for bio-mass feeder stocks that can be used in alternative energy production.

- Many gray collar jobs in extractive and heavy industries are becoming more technical, less physically demanding (e.g., highly mechanized, GPS-guided pinpoint agriculture; hydraulic- and robotic-driven smelters). While fewer workers are needed when capital is substituted for labor, remaining jobs in these industries pay higher wages and tend to be less onerous.

- Lastly, most of the gray collar jobs in this sense are tied to specific locations: arable/tillable lands, mineral deposits and oil reserves, etc. Thus, such jobs are less likely to be offshored.

A second use of the term "*gray collar*" refers to jobs where elements of traditional blue collar and white collar functions/positions are being combined as work organizations are "*flattened*." How duties, tasks and general assignments are unbundled then re-bundled into new occupations has profound implications for the tradeability of gray collar jobs.

Consider the following. In the past, a radiology technologist with a four-year degree performed manual tasks (e.g., positioning patients under X-ray machines, arranging lead shields) and cognitive tasks (e.g., interpreting images). With state-of-art equipment, digitized images can be sent offshore instantaneously to be interpreted at a lower cost by foreign technologists who are guided by codified decision rules. Meanwhile, the residual work assignments are non-tradable because they entail face-to-face interaction. However, most of the patient contact functions are manual ones that can be performed here at a lower cost by a radiation technician with a two-year degree.

While traditionally considered white collar work, software development entails a creative component (i.e., systems analysis and design specifications) and fairly routine, "*head down*" code writing. The former is less likely to be considered tradable than the latter. Indeed, new "*agile development utilities*" are beginning to be adopted by large software houses. They automate much of the drudge work of writing code, debugging software and documenting it.

Much of what accountants do is guided by decision rules (i.e., tax preparation or making

journal entries and reconciling them). Those rather routine blue collar aspects of accounting are increasingly being sent offshore. Non-tradable white collar aspects of accounting are directed toward "*growing beans rather than counting beans*" (i.e., as in IBM/PriceWaterhouse's new business consultancy approach).

Green Collar

An industry-based definition of green collar jobs would include, but be not limited to, those in:

- Alternative Energy — wind, wave/tide, solar, hydroelectric, geothermal, nuclear, coal gasification/liquefaction, hydrogen and carbon capture & sequestration.
- Construction — residential and commercial plus remodeling, inspecting and appraising.
- Building Material Manufacturing — e.g., high R-factor insulation, low-e rated glass.
- Component Remanufacture — materials rework, parts recycling and refurbishing
- Air-Conditioning, Heating & Ventilation and Refrigeration Equipment Manufacturers.
- Agriculture — e.g., grain production and biomass horticulture.
- Automobile and Transportation Manufacturing (e.g., including: aircraft/airframe manufacturing such as Boeing whose new 787 Dreamliner will have more fuel-efficient jet engines and an airframe made from light weight composites; and Air Craft Engine Manufacturers such as GE which is working with Boeing on the GERnx project to produce jet engines that will work on alternative fuels such as alcohol, bio-butanol and biodiesel mixes.)
- Government agencies and NGOs which advocate for, plan, monitor and enforce regulations aimed at conserving energy and/or reducing emissions.

Using a firm- or establishment-based approach, one would include jobs at facilities (regardless of the putative industrial classification) engaged in producing products and services or deploying new production techniques (including remanufacturing) which conserve energy and/or reduce emissions. If using this approach, one might look at ratings by organizations which monitor the energy-consumption and emission-reduction efforts of specific firms (e.g., the California state employees' and teachers' pension funds – CalPERS and CalSTAR; the Carbon Disclosure Project, the World Wildlife Fund; and Environmental Defense).

Using an occupational approach, one would include workers engaged in the design, production, installation, maintenance, support and end-of-life salvage or recovery of goods which conserve energy and/or reduce emissions. Occupational workers could be further subdivided to differentiate those whose specific duties, tasks, work assignments, and/or individual work habits & arrangements contributed directly to energy conservation and emission reductions.

Using an outcomes-based approach, green collar jobs would be arrayed along several dimensions based on quantitative measure (or good faith estimates) of their impact on energy use, emissions and consumption of products distilled from imported oil.

Pink Collar

"*Pink collar*" typically refers to jobs entailing little manual labor which, historically, were held by females: nurses, teachers, secretaries and interior decorators. The entry "*pink collar*" in Wikipedia, notes that, until passage of the Equal Employment Opportunities Act (EEO), classified ads in major American newspapers had headers which differentiated between "*jobs for men*" and "*jobs for women*." Pink collar jobs, on average, provided lower earnings than jobs in occupations traditionally dominated by males with comparable (or even less) formal education.

The term is seldom used now that the EEO is enforced rigorously and women have succeeded in securing employment in occupations previously dominated by men. It is worth mentioning only by way of a caveat to well-meaning parents, workforce intermediaries and educators who might unconsciously harbor gender biases or stereotype the aptitudes and interests of young males and females then inadvertently steer either into tradition-bound career pathways. To guard against gender-bias in case management, counseling and student- or worker-recruitment, intermediaries and employers can obtain data from the Bureau of Labor Statistics (BLS) on the percentages of male and female workers by occupation and any differences in their prevailing occupational wages.

However, there is some evidence of backsliding. Some employment gains made from the mid-1960s through the 1990s by women in historically male-dominated occupations are reversing direction. In the Information Technology (IT) sector, for example, employment is once again much more disproportionately male. Case studies and surveys suggest that females are increa-singly likely to shun IT sector employment because the prevailing ethos is not conducive to "*work/life balance*." Long work days, excessive overtime and project-length tenure with unben-ding deliverable deadlines make few allowances to attend to family matters. Solitary, head down work in cubicles with little creativity or interaction with coworkers does little to fulfill non-tangible aspirations and socio-emotional interests.

Thus the term "*pink collar*" is making a modest come back. It is being used more frequently to describe work conditions rather than the gender, *per se*, of occupational workers. That is, "*pink collar*" is increasingly used to describe work: in any environment which facilitates social interaction among coworkers; for an employer whose human resource policies foster a satisfactory work/life balance; and in occupations which entail and reward creative thinking. In this new parlance, pink collar is a heuristically useful concept insofar as it provides direction to:

- workforce development planners who will have to devise strategies for increasing the labor force participation rate among females to fuel economic development and growth as the retirement of male Baby Boomers significantly reduces the labor–to-population ratio;
- human resource managers who likely will need to make a concerted effort to recruit and retain more women in the face of an anticipated shortage of knowledge workers once male Baby Boomers retire; and
- employers who, as they face labor shortages, likely will have to raise the wages of, and improve working conditions for, pink collar occupations (especially nursing and teaching) to levels comparable to those occupations which require similar levels of education and training.

Ironically, "*pink collar*" has implications for male workers as well. While they often paid women less than men employed in other occupations that required comparable levels of education, many of the pink collar jobs are less vulnerable to skills tradeability than historically male-

dominated occupations. This is particularly true of blue collar jobs in manufacturing and low- to mid-level white collar jobs entailing routine cognitive tasks. Insofar as their services are delivered in face-to-face situations, jobs like nursing, teaching and cosmetology are unlikely to be shipped offshore.

Therein are opportunities for males to enter historically female-dominated occupations which now may afford more stable/less vulnerable employment. Case managers, counselors and educators likely will need to overcome latent gender biases in order to help male job-seekers weigh their options in a global economy where price and wage competition have made skills tradeability an increasingly important consideration in informed career choice.

White Collar

White collar jobs generally refer to those whose primary work assignments entail cognitive tasks rather than duties entailing significant amounts of strenuous manual labor and heavy physical exertion. The term is associated with corporate dress codes of the 1950s and 1960s which often prescribed white dress shirts and ties for males employed in professional, managerial, administrative and clerical occupations.

The old notion of "*white collar*" referred more to the work environment (i.e., offices versus factories, farms or storefronts) rather than to either a job's skill level or prevailing wage. In the traditional sense, white collar jobs could range from clerical workers earning hourly wages to salespersons working on commission to executives paid a salary — often with stock options and profit-sharing arrangements.

In the old industrial economy, the broad distinction provided a useful way off differentiating blue collar jobs vulnerable to automation and/or relocation from white collar ones believed to be relatively immune from technological obsolescence or offshore competition from low-wage nations. But then globalization and free trade came along. All that changed and the broad distinction between blue collar and white collar lost its relevance.

- Seniority and longevity premiums paid to blue collar workers in unionized states in the Northeast and Midwest provided earnings comparable to the education premiums paid to many white collar workers. But price competition from goods manufactured in non-union labor markets or offshore created pressure on businesses to relocate many blue collar jobs. At first , they went to right-to-work states in the South and Southwest. In a second wave of labor-cost cutting, they went to Mexico, Latin America, Taiwan, or South Korea; later to India or China. Now they are headed to developing nations in Asia (e.g., Bangladesh or Indonesia) and Africa (e.g., Senegal or Ghana) where the wages are even lower.

- Blue collar jobs involving repetitive/routine manual tasks could be automated: first by numeric control devices; then by robotics.

- Continued price competition, particularly in the wake of accelerated free trade, has led to the automation and/or offshoring of white collar jobs whose cognitive tasks can be reduced to unambiguous binary decision rules. Today, the skills associated with some white collar jobs are as tradable as those associated with blue collar ones. Therefore, just as gray collar jobs were differentiated from the balance of blue collar jobs on the basis of the tradeability of their skills, the less vulnerable/higher paying gold collar jobs must be differentiated from the more vulnerable, low-paying, repetitive and routine white collar jobs. (See the previous descriptions of "*blue collar*," "*gray collar*" and the third usage of "*gold collar*.")

Appendix B: Sample Scenario Using an Outcomes-Based Approach to Evaluate Two Competing Title X Green Job Training Grant Applications

Applicant A **Funds Requested = $25,000**

Purpose: To enable 10 incumbent accounting/bookkeeping clerks to telecommute (work at home) three days per week and still achieve their current in-office level of performance. The money requested would be used to procure ten laptop computers (@ $1,000), modify the firm's proprietary accounting software and management information system (MIS) to facilitate secure remote access ($5,000) and provide skill-upgrade training to the ten clerks to bring them up to an acceptable level of proficiency in accessing and using the modified accounting software and MIS remotely and to use project management software to track their time & effort, project milestones & benchmarks and to document their performance. Compensation for the 10 workers will not change.

Assumptions, Data and Calculations:

On average, each of the ten workers commutes 20 miles (round trip) each of the five days they come to the office every work-week. Each would continue to report to the office on Mondays (to receive weekly assignments) and Fridays for team meetings and reviews of their week's output and performance. Each would work form from home Tuesdays through Thursdays. Total commuting miles saved per week would be

(10 workers X 3 days X 20 miles/day) = **600 miles**

Each worker has four weeks of vacation each year and, with mid-week holidays, will likely not be scheduled to work for another 7 days.

Total weeks worked per year by telecommuters = **47 weeks per year**

Assume the cars driven by the ten workers get an average of 15 miles per gallon when driven in stop-and-go rush hour traffic.

Total gallons of gasoline saved annually due to telecommuting = **1,880 gallons per year**

1 barrel contains 42 gallons of crude oil. The typical refinery produced 19.5 gallons of gasoline from the average barrel of crude oil (depending on both the grade of the crude oil input and the grade of gasoline produced). However, since the remainder of the distillates of crude oil are used for other purposes, the conservative approach is to assume 1-to-1 displacement of imported foreign crude oil for each barrel of gasoline saved =

Approximate number of volume of foreign crude displaced by gas savings **44 barrels per year**

Estimated CO_2 emissions from a motor vehicle depends on its fuel-efficiency and the vintage & maintenance of its emission controls. Using EPA's online personal emissions calculator at www.epa.gov/climatechange/emissions/ind_calculator.html (parsed on Transportation only) for 28,200 mi./yr. with average fuel efficiency of 15 mi./gal. =

Estimated net annual reduction in CO_2 emissions from reduced commuting slightly more than 19 tons at **38,392 pounds/year**

Applicant B **Funds Requested = $25,000**

Purpose to train five recruits for a new work team to: use a hoisting crane to erect wind turbines; anchor, fit and weld components; connect turbines to the electrical grid; and maintain them. Candidates recruited for the team would be selected from the local Dislocated Worker or Trade Adjustment Act programs who previously had been employed to erect and provide power to derricks by Oil & Gas Exploration & Extraction Companies or Services to Mining. Each would be provided five weeks of noncredit, customized skill-upgrade training (at $5,000 per recruit) under a contract with the Engineering Technology Department of the local community college. Upon successful completion of the skill-upgrade training, each recruit will be hired on a full-time, permanent basis at $35,000 per year with benefits including health care coverage plus lodging and meals if assigned to any worksite more than 50 miles from the firm's operating center in the region. Payroll dollars added to region's economy = $175,000.

Assumptions, Data and Calculations

Assume that, on average, the five person team can erect and connect two wind turbines every three weeks. (Allowing for weather-related interruptions and periodic maintenance visits to previously erected turbines, the team is expected to devote 45 weeks per year to turbine erection. Number of wind turbines erected/year	
(45wks X 2turbines/3 wks) =	**30 turbines**
Using 2.5MW rated equipment from GE, each turbine has the theoretic capacity to generate	Theoretic capacity each
(2.5MW X 365 days per year X 24 hours per day) =	**21,900 MWh/year**
Given the variable weather and wind speed averages in the target locations, assume that each turbine will work at 50% of its theoretic capacity over the course of the year (i.e., factor capacity of .5 X 21,900 MWh/year =	Estimated annual actual factor capacity each **10,950 MWh/year**
Estimated actual annual energy output for 30 wind turbines (30 turbines X estimated actual factor capacity per year) =	**328,500 MWh/year**
Assume the current electricity provider operates a coal-fired plant (the most common source in Texas) which gets 3.33 MW from one ton of coal. Total coal displaced by use of 30 wind turbine's actual annual output =	Tons of conventional coal displaced annually by using 30 wind turbines **98,649 tons of coal**
Translate to common factor for comparing grant applications where 1 ton of coal = 4.879 barrels of crude oil =	Equivalents of foreign crude oil displaced **481,276 barrels**
Assuming on average that a coal-fired plant creates 2,000 pounds of CO_2 per MWh of electricity it produces =	Annual reduction in CO_2 emissions **657,000,000 pounds/year**

In the main text (at page 22) we suggested creating a bubble chart to facilitate intuitive comparisons of competing grant applications. It should be fairly obvious which of these two proposals would contribute more to the greening of the region's economy. Applicant B wins by a huge margin. Nonetheless, we can construct a bubble chart to illustrate our point. Let the vertical axis represent the estimated reduction in CO_2 emissions (in million tons). Let the horizontal axis represent the equivalent barrels of foreign crude oil displaced.

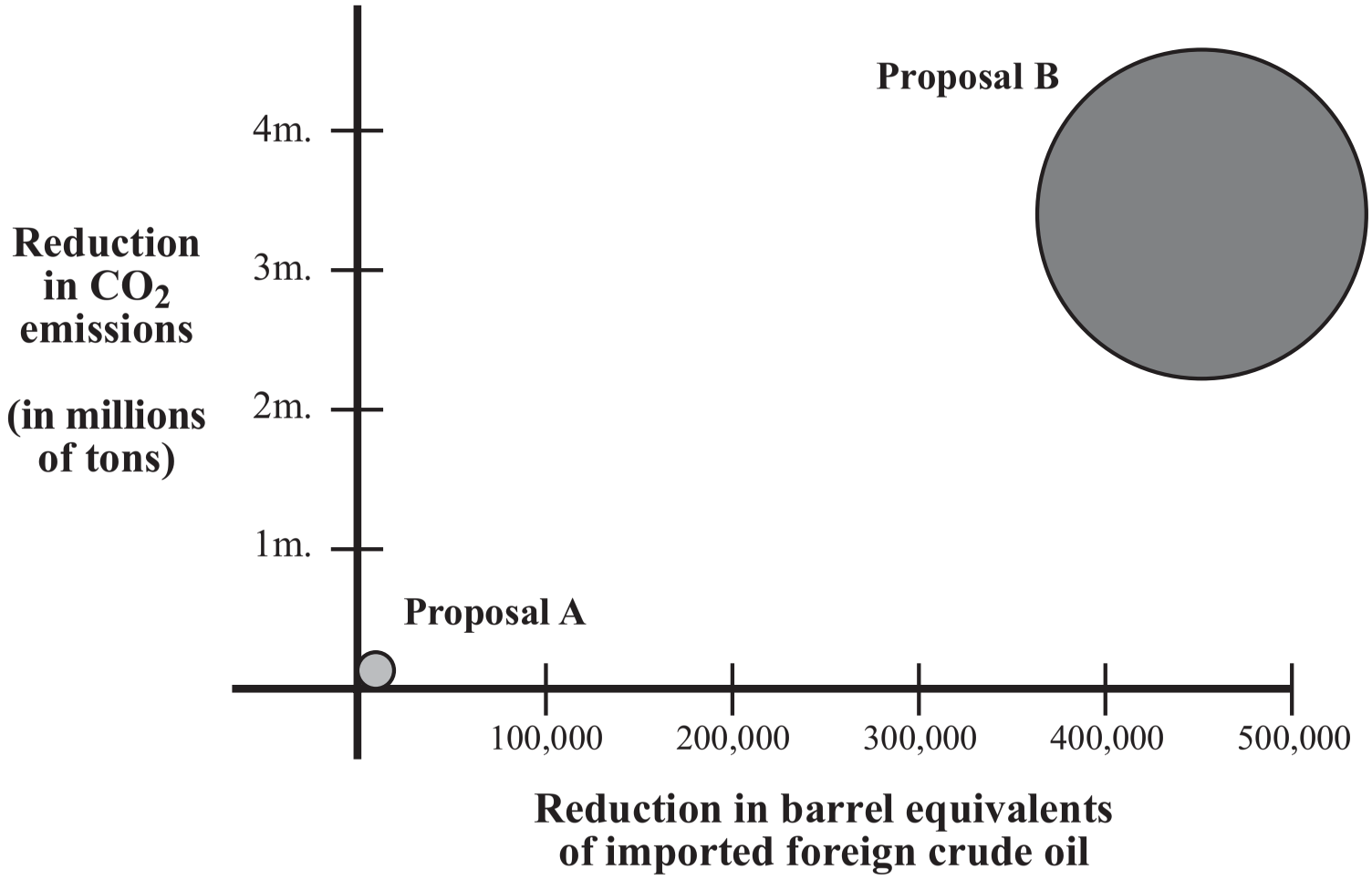
We still need a third variable to factor into the evaluation. In addition to promoting a green economy, first round funding under Title X is supposed to help Unemployment Insurance (UI) claimants regain employment or to recipients off Temporary Assistance for Needy Families (TANF). Again, Applicant B should win handily by reemploying 5 dislocated or trade-affected workers to zero for Applicant A. (Indeed, with a data point of zero, the circle on the bubble chart representing proposal A's impact on the UI or TANF systems would have no circumference.) The same would be true if we chose the net annual addition to the region's total payroll as the third variable to plot. (Applicant A's proposal = $175,000/year versus Applicant B's proposal = $0.)

To give every consideration to Applicant A's proposal, lets assume that regular grade gasoline continues to sell for $3.15 per gallon. By making telecommuting arrangements for ten workers three days per week, Applicant A is freeing up a total of $5,922 for them to spend in the local economy. We can treat those savings as if they were after-tax payroll dollars added to the region's economy. To compute the after-tax addition of payroll dollars to the region's economy as a result of Proposal B, assume that all five workers have an effective tax rate of 20 percent for a net increase of $140,000.

Using the addition of after-tax payroll dollars to the region's economy as the third variable to be displayed visually to facilitate meaningful intuitive comparisons of Proposals A and B, the bubble chart would look something like the one on page 37. The bubble chart is constructed in such a way that larger circles represent better outcomes on one dimension while locations toward the top and right side of the quadrant represent better choices on the other two variables respectively. Care has to be taken in conceiving the variables in such a way that the axes are properly oriented to convey positive outcomes. (In this case we used reductions in barrels of oil and emissions as positives).

Grant applications received in response to the current and subsequent RFPs are likely to be closer together in terms of their green impacts and financial returns (returns on investments or ROI) to the regional economy. The purpose of this scenario is to illustrate how data related to key considerations can be displayed graphically to facilitate meaningful comparisons.

Hypothetical Comparison:
Bubble Chart of Expected Outcomes



Appendix C: Getting Valid Employment Figures

Employment demand forecasts generally entail extrapolations from historic trends in employment. In the main text, we describe how new technology is changing the trajectory of employment demand in the emerging green economy and the skills that will be required to fill green collar jobs. But for many of the industries listed as "*green*" in the Department of Labor's request for proposals for first round funding under Title X, we don't even have good baseline data from which to extrapolate. The following discussion uses the Nuclear Power Industry to illustrate some of the data problems.

In the wake of disasters Three Mile Island (Pennsylvania) and Chernobyl (Ukraine), there was a virtual moratorium on the construction and expansion of nuclear power plants in the United States. While employment demand abroad was steady for specialty trade construction workers as other countries went forward to replace fossil fuel-fired electricity-generating plants with nuclear power plants (e.g., France, China, South Korea), demand plummeted in the United States. The Energy Act of 2005 signaled that the *de facto* moratorium is being lifted. While logic tells us that will create an upward spike in employment demand for specially-skilled construction workers, engineering technicians, etc., trend lines have pointed downward for more than three decades.

We also see downward slopes to historic trend lines for employment of nuclear power plant personnel.

1) Process technology was made more efficient thus making it possible to run nuclear power plants with fewer workers.

2) As with firms in other sectors of the economy, public utilities (conventional and nuclear) were apt to offload non-core functions to subcontractors. A subcontractor, for example, might take over an employee cafeteria's operations using existing on-site equipment and retaining food service workers previously employed by the energy firm. While the total employment numbers would not change in such a scenario, the labor market analyst sees a decrease in employment under the nuclear power company's industry classification (NAICS = 221113) and a proportionate increase in jobs found under Food Service Contractors (NAICS = 722310).

3) Like employers in other segments of the economy, energy producers are increasingly likely to use Temporary Help Agencies to meet their staffing needs.
   a. Temporary Help Agencies facilitate ramping up staff size and shedding workers as demand for goods and services fluctuates.
   b. Workman's compensation rates vary by industry with the frequency of on-the-job injuries. Staffing high-risk facilities with workers technically employed by temporary help agencies (where they are pooled with those who work in much lower risk jobs such as accounting). The temp worker strategy can reduce a firm's workman's compensation insurance premiums. The same tasks are being performed at the same location but from the labor market analysts perspective, it looks like a decrease in the nuclear industry (NAICS = 221113) and a proportionate increase in jobs under the Temporary Help Agency classification (NAICS = 561230).
   c. Similarly, a firm may downsize its in-house staff then re-employ workers as independent contractors to perform the same functions. Also, some older workers may retire then come back to work as independent contractors. Either staffing strategy looks to the

labor market analyst as a decrease in the nuclear industry's employment under NAICS 221113 and an increase in employment in the specialty field of the worker who moved (voluntarily or involuntarily) to independent contract status (e.g., Computer Software Consulting, NAICS = 541512; Engineering Services, NAICS = 541330).

4) In addition to using Temporary Help Agencies, various work activities are being outsourced either to offshore firms or to domestic companies that are classified in different industry codes. This results in what appears to be employment declines in a region when, in fact, the same work tasks are being done by employees of a contracted firm. An excellent example of outsourcing is ExxonMobils' expansion of their Baytown, Texas refinery. ExxonMobil, despite what appears to be significant construction activity, has reduced payroll employment in the region. However, Worley-Parsons, a privately held Australian company specializing in energy infrastructure design, has thousands of job openings for engineers, construction workers and specialty trade contractors to work on the Baytown project.

5) The energy industry in general, and the nuclear power industry in particular, may be harder hit than other sectors of the economy by Baby Boomer retirements.
   a. As Baby Boomers entered postsecondary education, this nation was prompted by the Space Race and the Cold War to underwrite training in math, science and engineering (e.g., see appropriations tied to the National Defense Education Act.) Scientists and engineers from the Baby Boom graduated from college and sought jobs when demand was high at the peak of power plant construction in the late 1960s and throughout 1970s.
   b. Fewer members of subsequent generations (e.g., "*Gen X*" and "*Gen Y*") found jobs in the industry as employment flattened for the reasons previously cited. Consequently, energy firms may be top heavy with Baby Boomers and weak in their "*bench strength*" (i.e., lacking appropriately educated and experienced mid-level workers groomed to replace key managerial, professional and technical personnel who are about to retire).

These data problems transcend the industry regardless of the pace any firm is making toward becoming greener. Before we can sort out the demand for green collar workers from non-green workers in any industries, labor market analysts will have to engage employers in forthright discussions about both their replacement needs as Baby Boomers retire and the number of projected new job openings as green alternatives change the landscape of energy demand and supply. The energy companies, in particular, will have to do in-depth succession planning with respect to retiring Baby Boomers and gap analysis to determine if jobs at new facilities can be filled by workers with transferable skills whose current jobs are likely to end because old vintage facilities are taken offline under mandates to achieve the State Renewable Portfolio Standard.

Appendix D
Pop Quiz (Continued)

Q7) In the following matrix, rank the cells from 0 to 15 in terms of a forklift operator's contribution to the greening of the economy with 0 = no contribution and 15 = very significant contribution.

Careful, this is a trick question.

	Forklift is powered by:			
Forklift used primarily to move:	**Diesel**	**Bio-fuel+**	**Electric Motor***	**Hydrogen Fuel Cell**
Virgin logs to be milled into fence posts				
Crushed auto bodies of old high-emission, low fuel-effieciency cars taken off the roads in a buy-back/recycle program				
Bales of used cardboard boxes for recycling				
Used pallets to be ground into pellets for use as a supplementary fuel in a coal-fired electricity generating plant				

+ Actually, the energy-efficiency rating, displacement of foreign oil and emission-reduction will depend on the kind of bio-fuel (conventional ethanol, cellulosic ethanol, biodiesel, bio-butanol).

* Actually the emission-reduction and displacement of foreign oil will depend on the power source used by the utility company in generating the electricity (hydro, oil, natural gas, coal, wind, solar, nuclear, wave, tidal, geothermal etc.)

Q8) Is there anything in the nature of a forklift's power source that will change the demand for forklift operators?

Q9) Is there anything in the nature of the objects being moved by a forklift that will change the demand for forklift operators?

Q10) Is there anything in the nature of a forklift's power source or in the objects it is used to move that will require developing a radically different education and training program to prepare workers to operate forklifts?

Q11) Bonus points. Can you think of any job at a recycling plant which might require a specialized training course? What would you expect the duration of that training course to be? Will the prevailing wage for that job be high enough to lift a worker out of poverty (assuming a household size = 3)?

Q12) Explain net metering and the role it plays in PURPA. Why is that important to strategic planning for economic development and workforce preparation?

Q13) How many pounds of pressure per square inch (PSIs) are required to store and transport hydrogen (H) as a liquid? Why would a labor market analyst care?

ANSWER KEY

Q1) Exhibit A is a traditional (high-flow) toilet. Exhibit B is a water-conserving low-flow toilet. The tank in Exhibit A held anywhere from 5 to 7 gallons of water. The tank in Exhibit B, by law, can hold no more than 1.6 gallons.

Q2) Exhibit B is considered "*green*" (environmentally-friendly) in that it is supposed to conserve water.

Q3) Toilets like those in Exhibit B were mandated for installation in new homes built in the United States after passage and implementation of the Energy Policy and Conservation Act of 1994 (EPCA).

Q4) The skills required of a plumber to install or repair the toilet in Exhibit A are no different than those required to install and service the one in Exhibit B. (Except, perhaps, for completing paperwork to verify that new construction is EPCA compliant.)

Q5) Employment for plumbers is driven more by population growth, increases in building permits for the construction of new residential and commercial structures, and the age and condition of existing (legacy) structures in the community.

Q6) A thriving business – akin to rum running during Prohibition – has sprung up to bring illegal toilets into the USA from Windsor, Ontario. See Stacy Perman's article, *Psst! Wanna Buy an Illegal Toilet?* at http://www.time.com/time/magazine/article/0,9171,996507,00.html Time Online April 3, 2000.)

Q7) Frankly, I have not given you enough information to fill out the matrix. For example, see the caveats explained in the textbox titled "*This is a Trick Question*" regarding variation in energy efficiency and emissions even within one class of power sources. Also, all the operations would

have to be reduced to a common denominator such net barrel equivalents of oil saved in average annual use. The point being made with the matrix is that the greenness of work is not dichotomous; rather, it is a continuous variable.

Q8) Not directly. There may be indirect ripple effects from reducing the firm's energy costs thereby freeing up its capital to spend on business expansion. There may be induced ripple effects if the firm passes on its energy cost savings to its consumers as lower prices. That would free up the consumers' capital to spend on other goods and services, some of which would necessitate hiring more forklift operators somewhere (but not necessarily at the firm in question).

Q9) Not directly. But, as in the annotations on Q8, there may be positive indirect and induced ripple effects depending on the capital that can be freed up by the energy conservation and emission reductions that result from substituting the firm's end product for more resource-hungry alternatives.

Q10) Not really. There may be some modest differences that could be communicated quickly to an incumbent forklift operator transferred from another job. For example, the weight distribution on the forks would be different for oblong chunks of crushed auto bodies versus square bales of use cardboard. The load of flat, used pallets probably would be more stable than the round logs being moved to the milling area. The logs, used cardboard and used pallets would be more combustible than the crushed auto bodies. But none of those variations would require a formal skill upgrade training for incumbent forklift operators or a special training module for novices.

Q11) This is more of a thought question – to get analysts to make the distinction between the greenness of a job, the training requirements and the impact the prevailing wage will have on reducing poverty and welfare dependency. Perhaps the best way to approach this is to posit cases at the two extremes of the recycling plant's staffing pattern.

a) Pallet-to-pellet chipper/grinder machine designer: the education and training for this position would likely be the same as for any mechanical/industrial engineer/drafts person. The prevailing wage for someone with those KSAs most likely would support a household of three persons at a level well above the poverty line. However, welfare recipients with little formal education and limited work experience likely would not have the foundation skills to benefit from immediate enrollment in a related education and training program. Rather, the specialized KSAs are more likely to be delivered in the form of a capstone course, say, in an engineering technology program or as skill upgrade training for incumbent workers being transferred into a new green division of an existing firm.

b) Recyclable material sorter: ferrous metals may have to be separated from nonferrous ones. Glass objects may have to be sorted into piles — clear vs. opaque; paper into white/news-print vs. colored/glossy. Biodegradable containers may be separated from conventional plastic ones and the plastics further sorted by their polymer type (i.e., thermoplastics that can be melted for reformation vs. thermosetting ones that can only be crushed or chipped for uses such as insulation or playground cover) according to their resin identification code (see *http://en.wikipedia.org/wiki/Resin_identification_code*). A short demonstration (no more than one week) coupled with close supervision for a short interval would be enough to impart the essential KSAs. Some recyclables are sold by weigh, others by volume. Additional training may be required if the sorter is tasked with pricing the

recycled materials. If the sorting requires separating items for reuse from those destined to be recycled, then additional training may be required in the use of test equipment. While essential KSAs likely could be imparted quickly to a welfare recipient with little formal education and limited work experience, a recyclable materials sorter likely would not earn sufficient income to support a household of three above the poverty line.

Q12) A conventional meter measures the flow of electrical current from the utility company's line to the end user. Today's technology (e.g., rooftop solar panels) allows end-users to produce their own energy. Under the Public Utility Regulatory Policies Act of 1978 (PURPA), utility companies are required to buy back surplus energy produced by end-users at the wholesale rate. A *net meter* measures the flow of current in both directions so an end-user's sale of surplus energy at the wholesale price can be subtracted from the price the end-user pays (at retail) for energy purchased from the utility company. PURPA increases the demand for green collar workers who design, manufacture, install and service distributed (as opposed to central) alternative energy-generating equipment. Moreover, to the extent that end-users can cut expenses by producing their own alternative energy and generate dollars by selling surplus energy back to the grid, they will have more disposable income to spend on other goods and services. That, in turn, can drive up employment demand for workers who produce both green and non-green widgets.

Q13) It depends on the temperature. Hydrogen's normal "*fueling temperature*" is minus 253° C. Storage tanks for Mercedes' experimental hydrogen cars exert up to 10,000 psi on liquid hydrogen. More hydrogen for more miles between refills can be held as the tank's PSIs increase. You can find formulas for calculating Mass, Temperature and Pressure (MTP) interactions for storing cryogenic liquids from the Department of Energy (at http://www.hydrogen.energy.gov/h2a_delivery.html?print).

The KSAs required to handle liquid hydrogen are radically different than those for handling gasoline which can be stored and transported at regular atmospheric pressure. Differences between gaseous hydrogen molecules and liquid or solid hydrocarbons are critically important to those who design hydrogen production and storage facilities rather than petroleum refineries. Understanding the relationship between M, T and P for hydrogen storage and transfer is important to cryogenic transport drivers and to mechanics who work on hydrogen fuel cells. As the economy gets greener, employment demand and the requisite KSAs will change for some occupations as the transition is made from fossil fuels to a hydrogen economy.

Labor market analysts have to cut through the fog of overlapping, conflicting and even nonsensical uses of the terms "*green jobs*" and "*green collar workers*" before they can give valid and reliable counts of workers employed in them, provide employment demand growth estimates and identify the requisite KSAs for green employment (as opposed to employment in their non-green predecessors). This monograph explores the myths and mysteries of green collar jobs and offers an action agenda to aid workforce professionals in understanding and implementing job training requirements imposed by Title X of the Green Jobs Act of 2007.

Appendix E

Tentative Exploration of Green Work Assignments

Below is a tentative – but certainly not exhaustive – list of occupations touted as candidates for the green collar label. Attached to each is a preliminary educated guess about the training requirements and which traditional occupational workers might be able to move quickly into the new occupation because they already possess transferable skills.

Industry	Function or Work Assignments	Who Might Have Transferable Skills?	Likely Training Scenario
Alternative Energy	Install and repair small-scale stationary hydrogen fuel cells for residential customers	Plumber, Pipefitter, Electrician, HVAC Technician	Less than 1 month for experienced craftspersons
	Install and maintain stationary large-scale hydrogen energy systems for commercial buildings or industrial use	Electrical Engineer, Electrical Engineering Technician, Stationary Engineer	Enroll more students in existing adademic programs. Create apprenticeship or Applied Baccalaureate degree programs; and offer continuing ed. short couse or skill-upgrade contract/noncredit training focused on hydrogen energy for incumbent workers in conventional energy firms.
	Process control in distillation plant (making conventional ethanol)	Process Control Technician - Refinery, Industrial Engineer, Chemical Equipment Operator/Tender, Chemical Technician, Chemical Plant & System Operator, Mixing and Blending Machine Operator, Chemical Equipment	Develop distinctive capstone courses for each type of plant to top off a 2-year program in the fundamentals of Process Control; provide skill-upgrade training < 6 months or OJTs for former Petro/Chemical Plant Operators depending on their prior experience**
	Process control in fermentation plant (making cellulosic ethanol)		
	Process control in a nuclear power plant	Nuclear Engineer, Nuclear Power Reactor Operators, Nuclear Technician	Recruit more students for existing postsecondary degree programs (AAS through PhD); Create a new Applied Baccalaureate degree program
		Power Plant Operators (nonnuclear)	Provide skill-upgrade training < 6 mo. or OJT for former nonnuclear power plant operators depending on prior experience.

**See the Bio-fuel Technician curriculum developed in Iowa at Indian Hills Community College and Iowa Central Community College and in Nebraska at Northeast Community College

Industry	Function or Work Assignments	Who Might Have Transferable Skills?	Likely Training Scenario
Alternative Energy	Process control in an industrial hydrogen production facility	Process Control Technician - Chemical Manufacturing, Chem. Plant & System Operator, Chemical Equipment Operator, Chemist, Chemical Engineer, Chemical Engineering Technician	Distinctive capstone course atop a Process Control program for Chemical Manufacturing; OJT for experienced Chemical Plant Operator/Chemical Technician
	Process control in a gasification or liquefaction facility		
	Process control at a large-scale solar farm	Power Plant Operator, Electrical Engineering Technicians, Electrical Repairers (Powerhouse/ Substation/Relay), Electro-Mechanical Technicians.	Distinctive capstone course atop a Process Control program for non-nuclear electricity-generating facilities; OJT for experienced Power Plant Operators and Technicians.
	Construct and maintain a large scale solar farm, distillation or fermentation plant, gasification or liquefaction facility	Stationary Engineer, Operating Engineers (heavy construction equipment), Civil Engineering Technicians, Electro-Mechanical Repairer, Boilermaker, Welder, Plumber, Pipefitter, Concrete Finishers, and Steamfitter	Brief OJT for construction of nuc-lear and nonnuclear facilities
	Construct and maintain nuclear power plant		Additional training for quality control and inspection for nuclear power plant constructors
	Set and anchor wave- or tide-powered electricity-generating equipment and service it.	Oil & Gas Roustabouts (Offshore Derricks), Riggers, Commercial Divers, Electro-Mechanical Technicians	OJT or brief skill-upgrade training for roustabouts experienced in setting and anchoring offshore rigs which were constructed onshore.
	Erect, connect and maintain wind turbines	Stationary Engineer, Electrical Engineers, Electrical Engineering Technicians, Electrical Repairers (Powerhouse/Substation/Relay), Electro-Mechanical Technicians.	Add instructional module to syllabi of existing courses at AAS or BS levels.**
		Electrical Power Line Installers (High Voltage), Oil & Gas Roustabouts (Derrick Assembly), Welders, Crane Operators, Riggers	OJT

**See the Wind Technician and *Windsmith* programs developed by the Texas State Technical College, Mesaland Community College (New mexico), Iowa Lakes Community College, Columbia Gorge Community College (Oregon), west Community and Technical College (Minnesota) and Madison Area Technical College (Wisconsin)

Industry	Function or Work Assignments	Who Might Have Transferable Skills?	Likely Training Scenario
Alternative Energy	Erect, operate and maintain a geothermal-powered electricity generating system	Stationary Engineer, Electrical Repairers (Substation/Powerhouse/Relay), Electro-Mechanical Technicians, Derrick & Rotary Drill Operator, Oil & Gas Roustabouts (Derrick Assembly), Welders, Riggers, Steamfitter, Hydrologist/ Geoscientist	OJT
Overlap of Alternative Energy & Emission Control	Construct and maintain a methane capture and methane-powered electricity generating system	Civil Engineer, Stationary Engineer, Liquid Waste Treatment System Operator, Environmental Engineer, Environmental Engineering Technician, Civil Engineering Technician, ElectroMechanical Technician, Pipe Layer	OJT
	Remove toxic and hazardous waste, brownfield reclamation, "*slop oil*" recovery, spill control	Civil Engineer, Environmental Engineer, Civil Engineering Technician, Environmental Engineering Technician, Hazardous Waste Handler, Emergency Management Specialist, Environmental Protection Technician, Biotechnician	OJT or skill-upgrade to handle specific toxins/hazardous wastes
			Special training and certification of nuclear technicians for waste removal and disposal
Emission Control and Abatement	Install and maintain carbon capture and sequestration system	Environmental Engineer, Environmental Engineering Technician, Civil Engineer, Civil Engineering Technician, Industrial Engineer, Environmental Protection Technician, Biotechnician	OJT or continuing education on emerging technologies for carbon capture and sequestration
	Carbon credit trading	Commodities Trader	1 day seminar, self-guided study
Overlap of Energy Conservation & Construction	Energy conservation and emission abatement planning, consultation, inspection and enforcement, retrofit existing facilities (industrial and commercial buildings).	Environmental Engineer, Environmental Engineering Technician, Environmental Protection Technician, Industrial Engineer, Health and Safety Engineer/Inspector, Architect, Construction and Building Inspectors, Electronic/Digital Systems Integrator	Continuing education on emerging technologies for detection, conservation and abatement

Industry	Function or Work Assignments	Who Might Have Transferable Skills?	Likely Training Scenario
Overlap of Energy Conservation & Construction	Energy conservation and emission abatement planning, consultation, inspection and enforcement, retrofit existing facilities (residential)	Environmental Engineer, Environmental Engineering Technician, Architect, Construction Manager, Construction and Building Inspectors, Remodeling Contractor, Electronic/Digital Systems Integrator.	Continuing education on emerging technologies for detection, conservation and abatement
Green Construction	Design green buildings (commercial and residential)	Architect, General Construction Contractor	Continuing education on emerging technologies for detection, conservation, abatement, and new building materials
	Construct green buildings	All Specialty Construction Trades	Simple demonstration of new materials and techniques
	Install & service small-scale solar energy system	Roofer, electrician, electronics technician, home security system installer, satellite dish installer, home electronics systems integrator, wiring and cable installer	Simple demonstration of new materials and techniques
	Teach specialty construction trade workers in use of new materials	Career and Technology Education Instructors (high school, apprenticeship and community college level)	Add modules on new materials and techniques to existing curriculum
	Assess the value added by green building materials and techniques	Realtors, Appraisers and Assessors, Building and Construction Inspectors	Continuing education on emerging technologies for detection, conservation, abatement, and new building materials

Industry	Function or Work Assignments	Who Might Have Transferable Skills?	Likely Training Scenario
Landscape and Agriculture	Design and maintain environmentally-friendly habitat (e.g., "*xeriscape*" landscaping, greenbelt, outdoor recreation)	Landscape Architect, First-line Supervisor of Groundskeepers/Landscape/Lawn Service Workers, Arborist, Forrester, Biologist, Botanist, Horticulturalist, Organic Lawn & Garden Supply Wholesaler/Retailer	Continuing education on emerging technologies for detection, conservation, abatement, and new building materials
	Organic farming, raising free range livestock, pinpoint agriculture, "*no-till*" farming, biomass & biofuels feeder stock production	Farmers and Ranchers, County Agricultural Extension Agents, Horticulturalists. Veterinarians, Veterinary Technicians, Genetic Engineers (seed stock and livestock), Wildlife Managers, Agronomists, Agricultural Economists, Career and Technology Education Instructors (agriculture), Biochemists, Biotechnicians, Biologists	Continuing education on new technologies, commodity demand forecasting, seed stock and livestock improvements, energy conservation, emission control & abatement, stand-alone electricity-generating systems
	Ensure quality control for food products, certify organic products	Meat Inspectors, Compliance Officers (Food Safety and Agricultural), Agricultural Inspectors, Food Scientists and Technologists, Nutritionists & Dieticians, Agricultural & Food Scientist Technicians,	Increase hiring. Add module on detecting non-organic additives, organic labeling and certification.
Transportation	Design more fuel-efficient, lower emission automobiles	Automotive Engineers, Materials Scientists, Nonoscientists	Add courses to current education & training programs.
	Repair auto bodies made of new, light weigh materials (e.g., carbon nanotubes).	Auto Body Repairers	Add module to career & tech-nology education at secondary and postsecondary level; Skill-upgrade training or OJT ≤ 1 month
	Retrofit fuel economy, alternative fuel conversion kits; service and repair hybrid and all electric vehicles power systems	Auto Mechanics, Diesel Mechanics	
	Service and repair hydrogen fuel cells (vehicular)		Probably requires an entirely new training program ≤ 1 year
	Recover & filter non-virgin vegetable oil for use as biodiesel	Pump Operators, Refuse & Recyclable Collector, Truck Driver/Route Sales, Truck Diver/ Light, Cargo Handlers/Liquids	OJT

Industry	Function or Work Assignments	Who Migh Have Gransferable Skills?	Likely Training Scenario
Transportation	Inspect vehicles and enforce vehicular fuel efficiency and emissions standards	Transportation Inspectors, Inspectors/Testers, Health & Safety Testers, Auto Mechanic, Diesel Mechanic	Skill-upgrade training or OJT ≤ 1 week
	Teach people how to drive and monitor vehicle maintenance to conserve fuel (Driver Retraining Instructor)	Miscellaneous Training (Driver's Education), First-Line Supervisors of Taxi, Bus & Truck Drivers, Police & Sheriff's Patrol Officers	Revise/add module to existing curriculum
	Redesign and monitor roadways to improve traffic flow (ground equivalent of air traffic control)	Urban & Regional Planners, Civil Engineers, Transportation Engineers, Traffic Technicians, Electro-Mechanical Device Installers/Repairers (cameras, sensors, GPS), Dispatchers, First-line Supervisors of Police and Sheriff Patrol Officers, Wide-Area Network Administrators, System Integrators, Dispatchers	Revise curriculum
	Operate cryogenic transport to deliver liquid hydrogen, transfer liquid hydrogen from storage to transport vehicles	Truck Driver (Heavy/Tractor Tailor), Truck Driver (Industrial), Cargo Handler (Cryogenic Materials)	Skill-upgrade training or OJT ≤ 1 month
	Design more fuel-efficient aircraft	Aerospace Engineers	Revise curriculum
	Build more fuel-efficient aircraft using lighter weight materials	Aircraft Structure & Surfaces Assembler	Skill-upgrade training or OJT ≤ 1 month
	Improve air-traffic control through the use of satellite-based GPS rather than land-based radar and line-of-sight	Aerospace Engineers, Electronics Engineers (Transportation & Avionics), Avionics Technicians, Air Traffic Controllers, Pilots & Flight Engineers	Recertification program

Industry	Function or Work Assignments	Who Migh Have Gransferable Skills?	Likely Training Scenario
Other	Disassemble & reassemble durable goods (remanufacturing and reuse)	All Assemblers and Fabricators	Skill Upgrade Training or OJT
	Implement life-cycle design standards (e.g., design from the outset for reuse, recycling or remanufacturing	Industrial Engineers, Mechanical Engineers, Automotive Engineers, Aerospace Engineers, Electrical and Electronics Engineers, Materials Scientists, Nanotechnologists, Drafters, Team Assemblers and Fabricators	Capstone course atop various engineering programs.
	Sort, compact, chip, shred, reconstitute recyclable materials	Refuse and Recyclable Material Handlers	OJT
	Manufacture equipment to produce energy from alternative sources	Sheet Metal Workers, Cutting, Bending and Punching Machine Operators, Welders, Numeric Control Machine Operators, Metal and Plastic Fabricators, Drill Press and Boring Machine Operators	No change

Occupations listed in the table above are not intended to exhaust the full range of green collar jobs. Nearly all are occupations currently employed in traditional work but are *contributing* to the greening of the economy. As the economy becomes greener, we fully expect demand for workers in these occupations will increase. In addition to creating myriad entry–level jobs, we expect green activities will result in more *occupational employment security* for incumbent workers in green collar jobs, upward pressure on wage expectations in them and *opportunities to move up career lattices* into jobs as front-line supervisors, inspectors, purchasing managers, etc.

Our list is very similar to one produced by Robert Pollin and Jeannette Wicks-Lim of the Political Economy Research Institute in a piece titled Job Opportunities for the Green Economy (University of MA – Amherst, June 2008). Pollin and Wick-Lim tentatively offer employment data in related occupations at the national level and for twelve states but immediately qualify all those figures with prudent caveats. We share their hesitance to put numbers beside any "green collar" job. While national, statewide and regional or MSA-level data are readily available on *current* employment for *legacy* occupations which will be affected directly by green initiatives, there is no commonly accepted method of determining the percentage of incumbent workers engaged in green activities versus the percentage doing traditional tasks.

It is even more difficult to forecast the rate at which employment demand will increase for any of the occupations listed. Significant job creation will *not* occur as the result of a modest increase in WIA dollars set aside to fund the training of green collar workers. Our theme throughout this briefing paper is that any *significant* increase in employment demand for green collar workers will have to be driven by increases in the demand for greener goods and services. That will be stimulated by:

- efforts to educate consumers about the advantages of going green (even if that, for now, requires them to pay premium prices for green goods);
- a *long-range* (beyond a single election cycle) commitment by Congress, the White House and federal agencies to –
  - bringing stability and predictability to the investment climate (e.g., through tax breaks, R&D credits, longer time horizons on subsidies, carbon cap & trade credits) to attract angel, venture and conventional capital to green start-ups;
  - being more aggressive in using standards & regulations, fines and permit requirements to compel firms in all industries to be more energy-efficient and environmentally-friendly; and
  - using proactive procurement policy (e.g., for government building construction, leased government office space, military vehicles and the civilian motor fleet) to jumpstart and sustain green industries.
- financial incentives (i.e., grants, low-cost start-up loans, tax breaks) for capacity-building to achieve economies of scale that will bring the prices of green goods and services closer to those of traditional ones.

Pollin and Wicks–Lim as well as the Center on Wisconsin Strategies (COWS) correctly note that conventional Input/Output (I/O) models can be used to estimate direct employment demand growth for green collar workers plus indirect and induced growth in demand for other occupations as change factors ripple through a region's economy. The Bureau of Economic Analysis (BEA) and other vendors have already pieced together the multipliers for business-to-business (B2) interactions from national product accounts. But I/O analysis is not well-suited for tracing ripple effects for the input of training dollars at the national level. Rather, it is best suited

for estimating the likely consequences of putting dollars into specific programs at the local level (e.g., $1 million in program to assist elderly residents of Milwaukee weatherize their homes).

Doing employment demand forecasts at the *regional* level for *specific* green initiatives is especially important for another reason. Namely, unlike many of the jobs dealing with digital goods and services, those in green collar occupations (particularly in green building, residential retrofitting, agriculture and trucking) are not tradable. That is, they are *geographically "anchored"* or "*rooted*" and, thus, not likely to be outsourced to a firm in a distant substate region or offshored to a low-wage country.

Finally, two cautionary notes need to be added.

1) An increased demand for green collar workers will not occur in a vacuum. Before becoming excessively exuberant about the prospects for growth, take recessionary factors into account. In the absence of special incentives (e.g., a local weatherization program), consumers currently may not be willing to pay out of their own pockets for the premium prices of green goods and services. They are being more frugal as: inflation and the declining value of the dollar threaten to raise all prices; falling consumer confidence makes them cautious and hesitant to spend; increasing unemployment raises job-loss fears; and falling home prices reduce the equity they can borrow against to finance big ticket items.

2) A greener economy is not exempt from Joseph Schumpeter's theory of creative destruction. While we have focused on green collar job creation, it is inevitable that some traditional jobs in the same industries and occupations will be eliminated. Assume, for example, that we adopt a policy whereby all vehicles as of a date certain have to run on hydrogen fuel cells. The following day (if not before-hand) workers who manufacture gas tanks for cars and trucks or who assemble, install and maintain automobile gas station pumps would be out of jobs. Some, but not necessarily all, of the displaced workers would have transferable skills to find employment in new, greener hydrogen-based firms.

For a comprehensive guide to designing training programs for emerging green collar jobs see Michigan Regional Skill Alliance's Alternative Energy Industry Knowledge Guidebook. Also see North Central Indiana's plan titled Energy Efficiency Technology and Knowledge Transfer Program. The United States Department of Energy maintains a database of training programs at http://www.eere.energy.gov/windandhydro/windpoweringamerica. The multi-state Consortium for Education in Renewable Energy Technology (CERT) headed by Madison (WI) Area Technical College used a National Science Foundation Grant to assemble a wide variety of online courses in this field. Short courses include: photovoltaics, solar/thermal, wind, transportation and biomass. Longer courses suitable for Associate degree-granting programs and apprenticeships are available in: electronics, electrical engineering technology, industrial maintenance technician, construction and remodeling.