UNE OUVERTURE SUR LE MONDE...

Une nécessité pour les régions de Québec et Chaudière-Appalaches

LE PARC INDUSTRIALO-PORTUAIRE

CRCD
Chaudière - Appalaches

PRÉFACE

Il y a maintenant plus d'un an, monsieur Roger Dussault, président du Conseil régional de concertation et de développement de Québec, et moi-même convenions de relancer les discussions entourant la réalisation d'un complexe industrialo-portuaire dans le secteur de Ville-Guay. Identifié comme un enjeu important à l'intérieur des ententes-cadres entre le gouvernement du Québec et les deux régions respectives, l'établissement d'un complexe industrialo-portuaire est perçu, à juste titre, comme un projet moteur permettant de diversifier la base économique des régions concernées. Notre réflexion à l'égard de ce projet a suscité l'engouement de plusieurs partenariats et créé la synergie nécessaire pour une démarche commune.

Cette démarche commune a permis de nous doter d'un document de présentation du projet. Celui-ci est en quelque sorte un outil promotionnel permettant de mettre en relief ses éléments fondamentaux. Il a comme premier objectif de manifester notre grand intérêt à s'impliquer dans la réalisation de ce complexe industriel et maritime. Aussi, désirons-nous vous le faire partager afin de dégager un consensus très large parmi les différents intervenants. En second lieu, il est primordial de s'adjoindre des partenaires financiers dans l'avancement de ce dossier. À cet égard, l'implication des gouvernements du Québec et du Canada est impérative. C'est pourquoi nous souhaitons des échanges formels et constructifs avec nos différents partenaires gouvernementaux qui permettront, à brève échéance, de convenir d'ententes de collaboration, et d'établir un plan d'action appuyé d'un plan de financement du projet.

Pour l'heure, plusieurs intervenants croient en la qualité de notre dossier et ont démontré une grande sensibilité à ce dernier par la richesse de leur collaboration. Nous désirons ici remercier les personnes suivantes : M. Pierre Boulanger, de la Société de promotion économique du Québec métropolitain; M. Yvon Bureau, de la Société du Port de Québec; M. Roger Carette, de Ville St-Georges; M. Denis Grenier, de la Société du parc industriel et portuaire de Québec-Sud; M. William Keays, de la Chambre de commerce de la Rive-Sud de Québec; M. Réal Lapierre, du Comité du lien sous-fluvial; M. Martin LaRue, du CRCD de Chaudière-Appalaches; M. Roland Leclerc, de la Société du parc industriel et portuaire Québec-Sud; M. Pierre Racicot, du CRCD de Québec; M. Alexis Ségal, de la Société du Port de Québec; M. Jean-Marie Vignola, d'Initiative de concertation sur l'avenir de l'industrie maritime et finalement Mme Carole Voyzelle, de l'Association régionale des commissaires industriels de Chaudière-Appalaches.

Ce groupe de personnes souhaite ardemment partager avec vous la réalisation du complexe industrialo-portuaire pour le devenir du développement des régions de Québec et de Chaudière-Appalaches et espère des discussions constructives concertées entre tous les partenaires impliqués.

Que le meilleur des succès nous accompagne!

Le président du Conseil régional de concertation et de développement de Chaudière-Appalaches,

Christian Jobin

HISTORIQUE et MISE en CONTEXTE

Depuis déjà plusieurs années, la création d'un parc industrialo-portuaire sur la Rive-Sud de Québec est considérée comme prioritaire dans le processus de développement économique des régions de Québec et de Chaudière-Appalaches.

Appui unanime des intervenants dans le cadre de la Conférence socio-économique de Chaudière-Appalaches en 1990

Dès les années 1970, les différentes études de planification réalisées à l'époque, notamment par l'Office de la planification et de développement du Québec (O.P.D.Q.) et la Société Inter-Port de Québec, reconnaissaient l'importance d'un développement industrialo-portuaire pour dynamiser l'économie régionale. Déjà, les analyses visant à définir les sites potentiels pour l'aménagement d'infrastructures destinées à l'implantation d'entreprises structurantes à grand gabarit relevaient le nombre restreint de sites potentiels pour ce genre de développement et identifiaient le secteur de la Rive-Sud comme étant l'un des secteurs à privilégier.

Après avoir procédé en 1983 à une première analyse de l'aménagement possible du secteur de la Pointe-de-la-Martinière, c'est en 1984 que la Société Inter-Port s'impliqua dans la réalisation d'une étude de faisabilité pour l'aménagement d'un site industrialo-portuaire dans le secteur de Ville-Guay. Le projet, qui avait comme objectif l'implantation d'une aluminerie par la compagnie AluSuisse, n'a pu finalement être concrétisé faute d'infrastructures adéquates.

Projet d'avenir retenu par les CRCD de Québec et de Chaudière-Appalaches

En 1988, la Société du parc industriel et portuaire de Québec-Sud (SPIPQS) a été créée afin de favoriser le développement d'un parc industriel et portuaire destiné aux projets d'envergure dans le secteur de la Ville de Lévis. À cette fin, la Société disposait d'une superficie initiale de 62,2 hectares dans le secteur de la Pointe-de-la-Martinière, qui avait été acquise dans les années 80 dans le cadre de l'entente Canada-Québec sur la Société Inter-Port.

Depuis lors, les diverses tentatives pour amorcer l'aménagement des infrastructures portuaires et terrestres nécessaires à l'implantation d'entreprises motrices sont demeurées vaines. Malgré la planification dans le passé d'ententes Canada-Québec visant à favoriser de diverses manières le développement du projet, les interventions gouvernementales n'ont pas permis la concrétisation du projet.

Pourtant, le projet a reçu un appui unanime des intervenants de la région dans le cadre de la Conférence socio-économique de Chaudière-Appalaches tenue en 1990. Les Conseils régionaux de concertation et de développement (CRCD) des régions de Québec et de Chaudière-Appalaches ont également retenu le projet à titre de dossier régional indispensable. La planification des précédentes ententes Canada-Québec reconnaissait l'importance stratégique du projet et la nécessité d'une implication de l'ensemble des intervenants gouvernementaux dans sa réalisation.

Pour mener à bien la réalisation de ce projet structurant, un comité a été formé. Il est composé de représentants des CRCD des régions de Québec et de Chaudière-Appalaches, de la Société du Port de Québec, de la SPIPQS, de la Chambre de commerce de la Rive-Sud, de la Société de promotion économique du Québec métropolitain (SPEQM), de l'Association régionale des commissaires industriels de Chaudière-Appalaches (ARCICA) et du comité INITIATIVE de concertation sur l'avenir de l'industrie maritime. Le présent document vise à démontrer l'importance du projet de parc industrialo-portuaire face aux défis que représente le positionnement de l'économie des régions de Québec et de Chaudière-Appalaches dans le contexte de la mondialisation des marchés et du transport maritime de demain.

LE DÉFI DE LA MONDIALISATION DES MARCHÉS... CONCURRENCE ET PERFORMANCE

L'élargissement de l'accord de libre-échange offre aux entreprises de nouvelles opportunités d'affaires

L'économie mondiale poursuit son développement vers une économie intégrée et globale. Cette internationalisation des marchés, provoquée par la déréglementation et les mécanismes de libre-échange, pousse les industries à étendre leurs activités commerciales vers les marchés outre-frontières. Aux États-Unis, les échanges internationaux représentent au-delà de 12 % du produit intérieur brut, comparativement à 8 % dans les années 80. Dans la Communauté économique européenne (C.E.E.), les échanges commerciaux avec les autres économies mondiales se sont accrus de 5 % depuis 1980, parallèlement à un accroissement important des échanges entre les pays membres.

Au Canada, l'ouverture de plus en plus grande des entreprises vers le commerce international dans le cadre de l'accord de libre-échange a contribué à une évolution appréciable des exportations. Entre 1992 et 1996, la valeur des exportations canadiennes (sur la base de la balance des paiements) est passée de 163 à 280 milliards de dollars, soit une augmentation annuelle moyenne de l'ordre de 18 %. Les exportations vers les pays autres que les États-Unis sont passées de 40 à 59 milliards de dollars, soit une croissance annuelle de 12 %.

L'ouverture des régions de Québec et de Chaudière-Appalaches vers l'exportation implique une optimisation du positionnement concurrentiel

Dans ce contexte de mondialisation, l'élargissement de l'accord de libre-échange vers le Mexique et, éventuellement, vers d'autres pays de l'Amérique latine offre aux entreprises de nouvelles opportunités d'affaires. Les marchés du sud des États-Unis, de l'Europe et de l'Asie constituent désormais des marchés de masse vers lesquels il importe de soutenir les efforts de commercialisation. Pour les régions de Québec et de Chaudière-Appalaches, l'accès à ces marchés implique une optimisation du positionnement concurrentiel dans l'organisation des flux de transport.

TABLEAU 1 COMMERCE DE MARCHANDISES DU CANADA (MILLIONS DE DOLLARS)

	1992	1993	1994	1995	1996
Exportations	163 464	190 384	227 892	264 938	280 566
Importations	154 430	177 593	208 590	231 205	239 577
Balance commerciale	9 034	12 790	19 301	33 732	40 989
Rapport export-import	1,06	1,07	1,05	1,15	1,17
Exportation par pays					
États-Unis	123 464	149 006	180 837	205 853	221 855
Japon	8 254	9 141	10 734	13 070	12 490
Union Européenne	12 777	12 066	12 872	17 915	17 370
Autres Pays	19 056	20 170	23 450	28 100	28 851
Exportations par produits :					
Agriculture et pèche	15 339	16 395	18 877	20 984	24 437
Produits énergétiques	15 452	17 789	19 176	20 296	25 558
Produits forestiers	20 017	23 519	28 912	36 875	34 587
Biens/matières industriels	32 380	35 172	42 387	50 619	52 086
Machinerie et équipement	31 893	36 848	46 571	56 704	62 241
Produits de l'automobile	38 101	48 609	57 608	62 878	63 357
Autres biens	4 469	5 608	7 102	8 307	9 497

Source : Statistique Canada

L'IMPORTANCE STRATÉGIQUE DU TRANSPORT MARITIME

Avec un taux de croissance annuel de 4,1 %, le commerce maritime mondial atteindra 7,1 milliards de tonnes en 2005

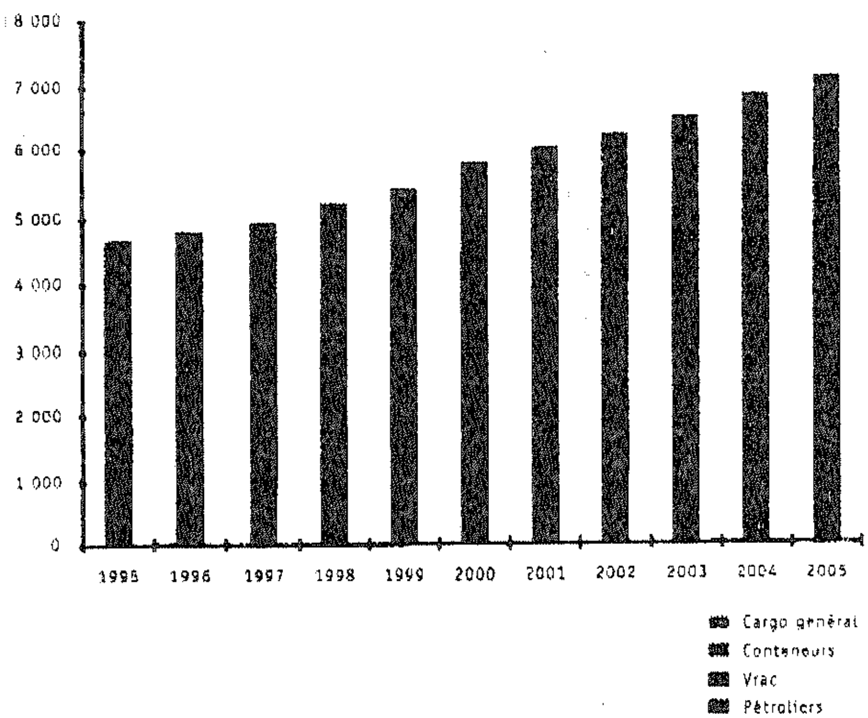
Cette globalisation des marchés a eu un impact important sur le trafic maritime mondial. Au cours des 10 dernières années, le taux de croissance annuel moyen du commerce maritime mondial a été de 3,6 %. Selon les prévisions du World Sea Trade Service (WSTS), reprises dans l'Étude sur les transports maritimes de la Conférence des Nations Unies sur le commerce et le développement (CNUCED) en 1995, cette croissance devrait se poursuivre avec une augmentation moyenne de l'ordre de 4,1 % au cours des prochaines années. En fonction de ces tendances, le commerce maritime mondial atteindra plus de 7,1 milliards de tonnes en 2005, comparativement à 4,6 milliards de tonnes en 1995 (Fearnleys).

À travers ce processus de mondialisation des marchés, l'augmentation des exportations de produits finis et semi-finis devrait accroître la part relative du transport maritime effectué par conteneur et par cargo général. Selon l'étude de la CNUCED, le transport de marchandises générales par conteneur ou par cargo devrait s'accroître de près de 6,4 % par année d'ici 2005, pour atteindre 3,1 milliards de tonnes. Le transport des vracs solides et liquides devrait pour sa part connaître des taux de croissance respectifs de 4,5 % et 2,6 %, pour représenter en 2005 un volume de l'ordre de 4,0 milliards de tonnes.

L'activité portuaire constitue un élément vital du développement économique en permettant de détenir un rôle stratégique fondamental dans l'organisation des échanges internationaux

Dans cette perspective, il est facile de comprendre que l'activité portuaire constitue encore plus que jamais un élément vital du développement économique, en permettant de détenir un rôle stratégique fondamental dans l'organisation des échanges internationaux.

FIGURE 1 PRÉVISIONS DU COMMERCE MARITIME MONDIAL (1996-2005)



Source : CNUCED, Étude sur les transports maritimes 1995

LES DÉFIS DU DÉVELOPPEMENT ÉCONOMIQUE RÉGIONAL...

INVESTISSEMENT ET CRÉATION D'EMPLOIS

LA DIVERSIFICATION DE L'ACTIVITÉ ÉCONOMIQUE

Le développement de la haute technologie et de l'activité industrielle constitue la pierre angulaire du développement régional

L'économie de l'agglomération urbaine des régions de Québec et de Chaudière-Appalaches est avant tout perçue en fonction de ses activités administratives, touristiques et culturelles. Pourtant, le développement de la haute technologie et de l'activité industrielle constitue l'une des pierres angulaires du développement régional à court, à moyen et à long termes.

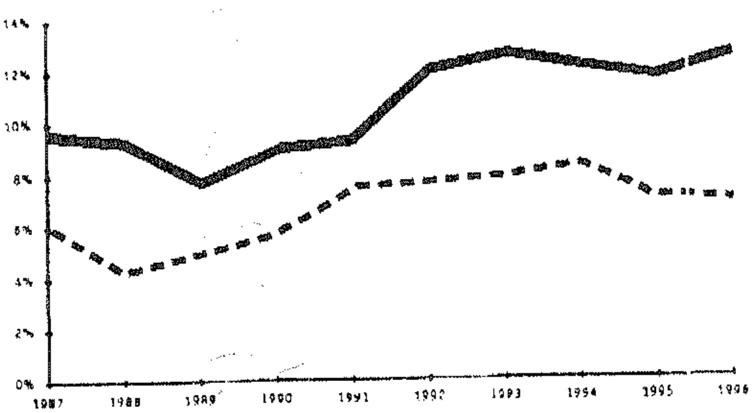
Cette orientation est d'autant plus fondamentale lorsqu'on considère l'impact que peut avoir le processus de rationalisation des services gouvernementaux sur la situation de l'emploi dans la région. En fait, les perspectives économiques régionales sont liées de très près au phénomène des compressions budgétaires gouvernementales. Sans compter les emplois des réseaux de l'enseignement et de la santé, la région regroupe environ 40 % de l'effectif québécois de la fonction publique. Dans ce sens, la réduction du nombre d'emplois et la lente évolution des salaires dans les domaines public et parapublic vont affecter directement les résultats économiques de la région au cours des prochaines années. La création d'emplois dans d'autres secteurs ne pourra compenser à court terme toutes ces pertes. Bien que la vocation de haute technologie de la région se renforce, l'importance relative des activités de la nouvelle économie est encore trop restreinte pour prendre la relève des secteurs public et parapublic.

Pour assurer la mise en oeuvre de projets structurants, il est important de créer un contexte concurrentiel favorable à l'investissement

Selon la Commission de la Capitale nationale, au-delà de 10 000 emplois dans les secteurs public et parapublic auront été éliminés dans la région de Québec au terme des compressions gouvernementales menant à l'équilibre budgétaire. Déjà, l'effet de la récession combiné à celui de la rationalisation de l'administration publique a fait en sorte que le taux de chômage dans la région de Québec est passé de 8,6 % à 12,5 % entre 1990 et 1996.

Face à cette réalité, il importe donc de mettre en place les infrastructures et les effets de levier propices à la création de projets structurants. Le gouvernement du Québec a une responsabilité importante dans la situation de l'emploi dans la région de Québec, et il est de ce fait fondamental qu'il puisse soutenir le développement du projet de parc industrialo-portuaire.

FIGURE 2 ÉVOLUTION DU TAUX DE CHÔMAGE, 1987-1996



Source : *Enquête sur la population active.* *Statistique Canada*

L'INVESTISSEMENT ET LA CRÉATION D'EMPLOIS

Le développement** [illegible] **prioritaires (métaux** [illegible] **pétrochimie et plas**[illegible] **terie) nécessite une** [illegible] **optimale des activit**[illegible] **et intermodales

Dans ce contexte de rationalisation de la fonction publique et parapublique, le développement économique régional doit avant tout reposer sur le développement de l'emploi lié aux secteurs de base de l'économie et sur la mise en place d'un contexte favorable à l'investissement pour le développement des secteurs de pointe.

Afin d'assurer une croissance rapide et soutenue de l'activité économique, l'importation de capitaux doit contribuer au développement de la nouvelle économie, en permettant la création de nouveaux emplois rémunérateurs à partir d'un élargissement des sources de financement. Pour y parvenir, les régions de Québec et de Chaudière-Appalaches doivent plus que jamais être en mesure d'offrir des conditions de localisation hautement concurrentielles. Dans ce sens, la disponibilité d'infrastructures adéquates et l'intégration efficace des systèmes de transport constituent sans aucun doute des facteurs fondamentaux du positionnement stratégique.

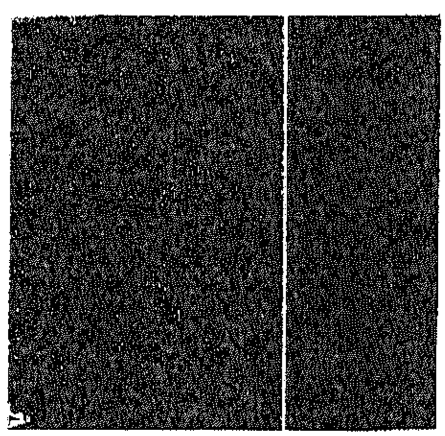
LES SECTEURS INDUSTRIELS À DÉVELOPPER

Pour parvenir à la consolidation recherchée de la structure économique régionale et à la création de nouveaux emplois, les plans d'action stratégique des Conseils régionaux de concertation et de développement des régions de Québec et de Chaudière-Appalaches visent, entre autres, à favoriser le développement d'entreprises manufacturières à forte valeur ajoutée, dans des créneaux pour lesquels la région bénéficie d'acquis stratégiques ou est en mesure de développer des expertises spécifiques. Dans ce sens, la région possède et développe une structure dynamique en recherche et développement technologique, et cette expertise doit servir de base au développement intégré des activités manufacturières.

Parmi les différents créneaux d'activité identifiés comme prioritaires par les organismes de concertation et de développement économique, le secteur des métaux et des minéraux, le secteur de la pétrochimie et de la plasturgie et celui de la foresterie sont résolument tournés vers la mondialisation des marchés. Dans chacun de ces secteurs, l'intégration optimale des activités maritimes et intermodales par rapport aux sources d'approvisionnement et aux marchés potentiels constitue assurément un facteur clé de développement et de localisation.

Métaux et minéraux

Dans le secteur des métaux et minéraux, la métallurgie constitue déjà un moteur économique indéniable de la région, avec la présence de 230 entreprises manufacturières à l'origine de plus de 9 000 emplois. La région affiche plus particulièrement un potentiel remarquable dans les créneaux à haute valeur ajoutée des métaux légers et possède des atouts majeurs pour devenir un acteur de premier plan dans des marchés de pointe à l'échelle mondiale.



En disposant d'un havre naturel de plus de 15 mètres et d'une chaîne de transport intégrée, la région pourra bénéficier d'un positionnement concurrentiel vital

Parmi les projets structurants pour le développement technologique et manufacturier, la région bénéficie d'une structure de recherche et développement particulièrement prometteuse dans le secteur de la technologie du magnésium. Par la création d'une chaire industrielle en technologie du magnésium et la mise en oeuvre d'actions concrètes visant l'expansion des marchés pour les produits du magnésium à l'échelle mondiale, la région est en mesure de se positionner pour devenir un leader international dans ce domaine.

Pétrochimie et plasturgie

Reconnus comme étant l'un des axes centraux du développement économique régional, les secteurs de la pétrochimie et de la plasturgie doivent leur dynamisme à la synergie qui existe entre les entreprises, les centres de recherche et les institutions d'enseignement. Le secteur de la pétrochimie constitue, entre autres, un pôle de croissance vers lequel des efforts particuliers de développement ont été réalisés pour favoriser l'implantation de nouvelles entreprises, le développement de l'innovation et la conquête de nouveaux marchés.

Au cours des dernières années, les pourparlers entamés pour l'implantation d'une usine de fabrication de peroxyde d'hydrogène au port de Québec illustrent à la fois l'intérêt que peut avoir la région pour les firmes étrangères et l'importance de mettre en place les infrastructures favorables à ce type d'implantation.

Foresterie

Les régions de Québec et de Chaudière-Appalaches constituent un centre important de production, de services et de décision stratégique de l'industrie forestière. Avec la présence d'entreprises dans une multitude de secteurs (pâtes et papiers, scieries, meubles, portes et fenêtres, fabrication d'équipement, etc.) et la présence de centres de recherche disposant d'une expertise internationalement reconnue, le développement du secteur forestier est prioritaire et résolument tourné vers les marchés d'exportation.

Le marché des produits à base de bois a beaucoup changé au cours des dernières années. Des nouveaux produits à forte valeur ajoutée, tels que les panneaux MDF ou OBS, les bois lamellés et les bois traités sous pression, ont été développés et connaissent une croissance importante de leur demande. maintenant \ Tennis

LES DÉFIS DU DÉVELOPPEMENT MARITIME ET PORTUAIRE RÉGIONAL... OPTIMISATION ET HARMONISATION

L'ACTIVITÉ PORTUAIRE EN MILIEU URBAIN

Les alternatives de localisation pour assurer le développement intégré des activités industrielles et portuaires dans la région sont limitées

L'intégration des activités industrielles, portuaires et maritimes au milieu urbain environnant constitue de plus en plus un enjeu de taille dans le développement socio-économique régional. Le processus de consultation mené dans le cadre du projet INITIATIVE de concertation sur l'avenir de l'industrie maritime des régions de Québec et de Chaudière-Appalaches a d'ailleurs permis de soulever plusieurs interrogations des intervenants quant à la pertinence de maintenir des sites portuaires en milieu urbain. La prépondérance du caractère touristique et patrimonial de la région contribue largement à cette forte pression qui est exercée pour la réhabilitation du littoral.

Pourtant, l'optimisation de la fonction maritime et portuaire dans une optique d'ouverture vers les marchés d'exportation est prioritaire. Sans cette vision à long terme du positionnement régional dans l'organisation des transports à l'échelle mondiale, l'évolution de la conjoncture risque fort de défavoriser dangereusement la région comme site concurrentiel de localisation industrielle et, par le fait même, de restreindre les opportunités de développement.

Sans cette vision de l'optimisation de la fonction portuaire et maritime, la situation risque fort de défavoriser dangereusement la région comme site concurrentiel de localisation industrielle

Déjà, l'absence d'infrastructures industrialo-portuaires disponibles à court terme sur la Rive-Sud, les contraintes environnementales et la problématique de cohabitation des fonctions urbaines, industrielles et portuaires ont eu jusqu'à présent un impact direct sur le positionnement stratégique de la région et son développement économique. Les choix de localisation effectués dans le cadre de certains projets majeurs de développement, dont notamment les projets AluSuisse, Petresa et Lauralco, sont symptomatiques du risque encouru par la région dans ses efforts de positionnement pour l'implantation d'entreprises motrices à grand gabarit.

Dans le contexte actuel, les alternatives qui se présentent pour assurer le développement intégré des activités industrielles et portuaires dans les régions de Québec et de Chaudière-Appalaches sont limitées. Les analyses effectuées à ce jour montrent que le site de Ville-Guay représente l'un des seuls endroits encore disponibles pour le développement des installations industrialo-portuaires sur la rive sud du Saint-Laurent entre Lévis et Cacouna. Le site de Ville-Guay, en disposant de solides accès intermodaux par la route et le chemin de fer, peut doter la région d'un avantage concurrentiel majeur.

La mise en place d'infrastructures d'accueil constitue un préalable au développement et au positionnement de l'activité industrielle et maritime

Du point de vue stratégique, l'incertitude entourant la faisabilité du parc industrialo-portuaire et la longueur des échéanciers nécessaires à sa réalisation font en sorte qu'il est impossible d'attendre la venue d'investisseurs ou de projets concrets pour amorcer le démarrage du concept d'aménagement. Dans cette optique, la mise en place d'infrastructures adéquates doit constituer un préalable au développement et au positionnement de l'activité industrielle et maritime des régions de Québec et de Chaudière-Appalaches.

En regard de la conjoncture concurrentielle qui caractérise les marchés traditionnels du bois, l'industrie forestière doit de plus en plus tendre vers une diversification des marchés exploités, et ce développement devra se faire en fonction des secteurs de deuxième et troisième transformations.

LE POSITIONNEMENT STRATÉGIQUE DE LA RÉGION

Le transport maritime a connu au cours des années des changements importants qui ont influencé le positionnement stratégique et concurrentiel des ports à travers le monde. En fonction de cette évolution, deux tendances majeures doivent guider le développement et le positionnement de la fonction portuaire :

- d'une part, les navires sont de plus en plus gros et demandent des infrastructures disposant d'une profondeur d'eau suffisante et d'une superficie d'entreposage correspondant à leurs capacités;
- d'autre part, l'intégration de la chaîne des transports nécessite des terminaux portuaires disposant d'une intermodalité complète.

Dans ce sens, les régions de Québec et de Chaudière-Appalaches bénéficient d'avantages concurrentiels majeurs qui, dans un contexte de globalisation des marchés, doivent servir de base au positionnement stratégique de la région et de la province dans l'organisation des échanges internationaux. En disposant d'un havre naturel localisé à environ 1 500 kilomètres à l'intérieur du continent et disposant d'un réseau intermodal structuré, la région est en mesure d'assumer un rôle encore plus marquant dans la planification des efforts de développement.

Les infrastructures portuaires du système Saint-Laurent qui doivent appuyer les entreprises québécoises sont en concurrence avec des ports comme Boston, New York, Philadelphie et Baltimore. Or, pour répondre aux nouvelles tendances du transport maritime, ces ports tentent d'atteindre 13,3 mètres de profondeur d'eau par des opérations de dragage. La région de Québec, en disposant d'une profondeur d'eau de plus de 15 mètres, peut donc bénéficier d'avantages de localisation particuliers.

En ce qui a trait à l'intermodalité des transports, la région est localisée sur la route la plus courte entre le coeur du continent américain et l'Europe du Nord. À titre d'exemple, une cargaison transportée de Chicago à Anvers transitera durant 183,5 heures si elle est transbordée à Québec, comparativement à 204,2 heures par New York et 220,5 heures par Baltimore. Avec la localisation du site proposé le parc industrialo-portuaire bénéficiera d'infrastructures intermodales complètes, à l'avant-garde des exigences en matière de transport, permettant ainsi aux entreprises une concurrence accrue sur les marchés internationaux.

AMÉNAGEMENT DU PARC INDUSTRIALO-PORTUAIRE...
ACCESSIBILITÉ ET INTERMODALITÉ

LOCALISATION ET ACCESSIBILITÉ

Localisé à proximité d'un réseau routier efficace sous-utilisé, le parc peut être développé progressivement à partir de terrains d'une superficie de 420 hectares situés en bordure de l'autoroute Jean-Lesage

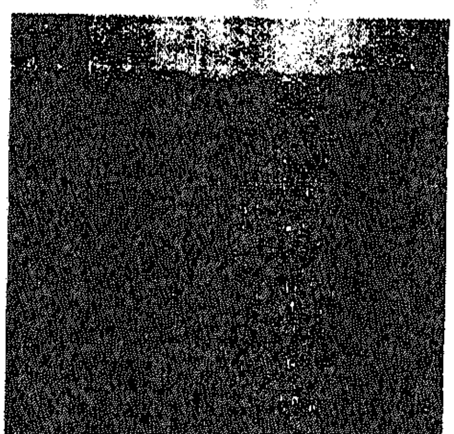
Le territoire visé pour le développement d'un parc industriel et commercial est délimité au nord par le fleuve Saint-Laurent entre la Pointe-de-la-Martinière et la traverse fluviale des lignes électriques, au sud par l'autoroute Jean-Lesage (autoroute 20), à l'ouest par la route Lallemand et à l'est par la municipalité de Saint-Étienne-de-Beaumont. enlever parc de la Martinière

De par sa localisation, le site offre de nombreux avantages pour le développement d'un parc industrialo-portuaire étant situé :

- à proximité de plusieurs sources d'énergie : électricité, gaz naturel; !
- dans un secteur où les sols possèdent les capacités portantes requises;
- près de réseaux de transport ferroviaire et routier bien développés et faciles d'accès;
- en milieu périurbain, éloigné des secteurs résidentiels.

Un premier secteur d'une superficie de 420 hectares peut être aménagé directement en bordure de l'autoroute Jean-Lesage et de la route 132. Adjacent aux infrastructures portuaires, l'aménagement d'une aire d'entreposage et de manutention doit être réalisé par le remblayage de la rive située à l'arrière des quais (voir ci-contre) qui consiste à remblayer la batture sur une largeur de ± 150 m à l'arrière du quai pr obtenir une superficie totale de l'ordre de 5 à 6 hectares.

Réseau routier



Déjà bien desservi par le réseau routier, le parc industriel possède deux accès à l'autoroute Jean-Lesage par les échangeurs de la route Lallemand et de la route 279 à Beaumont. Le site est aussi traversé par le boulevard de la Rive-Sud (route 132). Les aménagements projetés se trouvent également à proximité de l'accès sud de l'éventuel lien sous-fluvial entre les deux rives du Saint-Laurent.

Présentement bien inscrit à l'intérieur d'un réseau routier efficace et encore sous-utilisé, le parc industriel peut être développé progressivement à partir des terrains situés en bordure de l'autoroute Jean-Lesage et de la route 132 selon la croissance et les exigences des utilisateurs.

L'aménagement portuaire peut être desservi directement à partir d'une route d'accès construite en bordure de la route 132. Le chemin d'accès d'une longueur approximative de deux kilomètres peut être aménagé en bordure du fleuve jusqu'à l'aire d'accès au quai. Les travaux de construction d'un chemin d'accès à forte pente (8 %) sont évalués à trois millions de dollars.

Par ses caractéristiques physiques, le site possède plusieurs zones d'accueil propices à l'implantation d'industries à grand gabarit

Chemin de fer

Le parc industrialo-portuaire est aménagé en bordure de la jonction Harlaka de la voie ferroviaire utilisée par le Canadien National. Le parc industriel peut ainsi être desservi par un branchement ferroviaire d'au plus deux kilomètres à partir de la limite ouest du site.

La construction d'une antenne ferroviaire jusqu'à l'entrée du parc industriel est évaluée à un million cinq cent mille dollars. Le prolongement du réseau ferroviaire à l'intérieur du parc peut être estimé à 500 dollars/mètre.

L'aménagement de la voie ferrée menant au terminal portuaire requiert la construction d'une voie ferrée de 4,5 kilomètres implantée en bordure de la falaise. Les travaux ont été évalués en 1986 à environ neuf millions de dollars.

Même si la construction du lien ferroviaire peut être réalisée dans une seconde phase, un corridor d'accès doit être préservé à court terme pour garantir l'intermodalité du terminal portuaire.

Aéroport

L'aéroport international Jean-Lesage de Sainte-Foy se trouve à moins de 30 kilomètres du site, de sorte que les utilisateurs des installations industrialo-portuaires pourront avoir accès en peu de temps aux vols réguliers reliant Québec aux principales villes du continent.

POTENTIEL PHYSIQUE DU SITE

Topographie et géologie

L'ensemble du site situé au sud de la route 132 possède des terrains à faibles pentes, généralement inférieures à 2 %. Cette caractéristique géographique devient un critère physique important lors de l'implantation d'une usine de grande superficie. De plus, la géologie du secteur est caractérisée par la présence d'un socle rocheux recouvert d'une faible couche de mort terrain. Le parc possède plusieurs zones d'accueil favorisant l'implantation d'industries lourdes.

Sources d'énergie

Situé près d'une agglomération urbaine, le parc se trouve à proximité des réseaux de transport d'énergie et des services publics. L'aménagement industrialo-portuaire peut être alimenté en électricité par le poste Bourget de Lévis. Toutefois, si une industrie requiert une forte consommation énergétique, elle pourra être alimentée directement à partir de la sous-station électrique de Saint-Jean-Chrysostome, à moins de 16 kilomètres.

L'aménagement d'un quai de 300 mètres de longueur peut permettre d'offrir une profondeur d'eau de 15 mètres à la marée basse

La conduite de gaz naturel sous-fluviale Saint-Augustin/Saint-Nicolas dessert maintenant la Rive-Sud de Québec. Une conduite de transport de gaz naturel, passant au sud de l'autoroute Jean-Lesage, est en voie de construction.

Services publics

Situé en bordure de la ville de Lévis, le parc peut être desservi en eau potable et en égouts domestiques. La ville de Lévis possède deux prises d'eau au fleuve ainsi que deux usines de traitement dans les secteurs de Lévis et de Lauzon. Le réseau d'aqueduc de Lévis-Lauzon pourra alimenter des industries à grande consommation d'eau, après avoir augmenté la capacité de traitement de ses usines de filtration. L'installation d'un réseau d'aqueduc demande, en plus du renforcement du réseau, la construction d'un réservoir d'eau permettant d'assurer la protection incendie. Les usines peuvent aussi choisir d'installer leur propre prise d'eau de procédé près des aménagements portuaires.

La ville possède aussi une installation récente de traitement des eaux usées. Les égouts domestiques et industriels peuvent s'écouler par gravité jusqu'au boulevard de la Rive-Sud, pour y être pompés vers le réseau principal de la ville.

L'étude détaillée préparée en 1986 par les Consultants Halissey, Asselin et Daigle évalue à environ six millions de dollars les travaux minimaux d'immobilisation. Les travaux initiaux comprennent la modification du système de traitement d'eau potable, le renforcement du réseau d'aqueduc et la construction d'un réservoir dans le parc industriel. Elle englobe aussi la construction de postes de pompage et le renforcement du réseau de conduites gravitaires. Cette évaluation préliminaire des coûts doit être utilisée à titre indicatif et devra être validée aux étapes ultérieures du projet de développement.

L'AMÉNAGEMENT DES INFRASTRUCTURES PORTUAIRES

L'aménagement de base consiste en un quai d'une longueur de 300 mètres, construit à une distance d'environ 500 mètres de la rive, de façon à offrir une profondeur d'eau de 15 mètres à marée basse.

Ce quai est relié à la rive par un corridor technique, lequel consiste en un remblai en rive qui comprend à la fois un chemin d'accès pour les véhicules routiers et un passage pour les services d'électricité, d'eau et autres. Une aire d'opération, aménagée par remblayage derrière le quai, complète l'installation. La superficie de cette aire pourra être ajustée selon les besoins.

LE PARC INDUSTRIALO-PORTUAIRE ET L'ENVIRONNEMENT...

VERS UN DÉVELOPPEMENT DURABLE!

L'adhésion au développement durable se traduit par la volonté de développer en concertation avec les organismes régionaux

Les gouvernements du Canada et du Québec adhèrent sans compromis aux principes du développement durable. Les gouvernements désirent ainsi répondre aux besoins du présent, sans pour autant compromettre la capacité des générations futures de répondre aux leurs. L'application du développement durable implique des concepts écologiques, économiques et sociaux complexes et des prises de décisions intégrées. Pour le Conseil régional de concertation et de développement de Chaudière-Appalaches qui travaille à la promotion du parc industrialo-portuaire de Ville-Guay, l'adhésion au développement durable se traduit par la volonté de développer le projet en concertation avec les organismes régionaux, dans le cadre des outils de consultation proposés dans les lois et règlements en matière d'environnement. Elle se traduit également par la volonté de voir s'établir des entreprises qui utilisent des technologies modernes et peu polluantes.

La volonté de développement du parc est orientée vers l'implantation d'entreprises utilisant des technologies modernes et peu polluantes

Les terrains réservés pour l'implantation du parc industrialo-portuaire le sont depuis près de deux décennies. Le plan d'urbanisme de la Ville de Lévis (1991), qui a fait l'objet d'une vaste consultation de la population, prévoit une affectation d'industries lourdes et à grand gabarit, au sud de la route 132, ainsi qu'un site potentiel pour les infrastructures portuaires en zones riveraines.

L'expertise des vingt dernières années en ce qui concerne le développement industriel, intensifiée grâce aux exigences du cadre légal en matière d'environnement, permet de cibler rapidement les impacts liés à ce type de projet. Ces connaissances couvrent également les méthodes de travail et les mesures d'atténuation applicables pour minimiser ou bonifier les impacts. À ces connaissances se joignent maintenant les développements technologiques qui permettent de mieux contrôler les émissions de contaminants.

L'expertise des vingt dernières années en matière de gestion industrielle et de l'environnement doit servir de base au développement harmonieux des fonctions

La stratégie budgétaire du gouvernement du Québec vise la rationalisation des dépenses publiques. Ce mot d'ordre se traduit au ministère de l'Environnement et de la Faune par des orientations qui ont comme objectifs le partenariat et la consultation, la responsabilisation accrue des entreprises, la modernisation des outils de protection de l'environnement et la régionalisation (MEF 1997). Dans ce contexte, les systèmes de gestion de l'environnement, dont fait partie la série des normes ISO 14 000, sont des outils de performance environnementale auxquels adhèrent de plus en plus les grandes entreprises de classe mondiale. Ces outils permettent non seulement de mettre en œuvre des procédures de contrôle des impacts, mais également poussent la haute direction de l'entreprise à s'engager dans un processus d'amélioration continue de la performance environnementale.

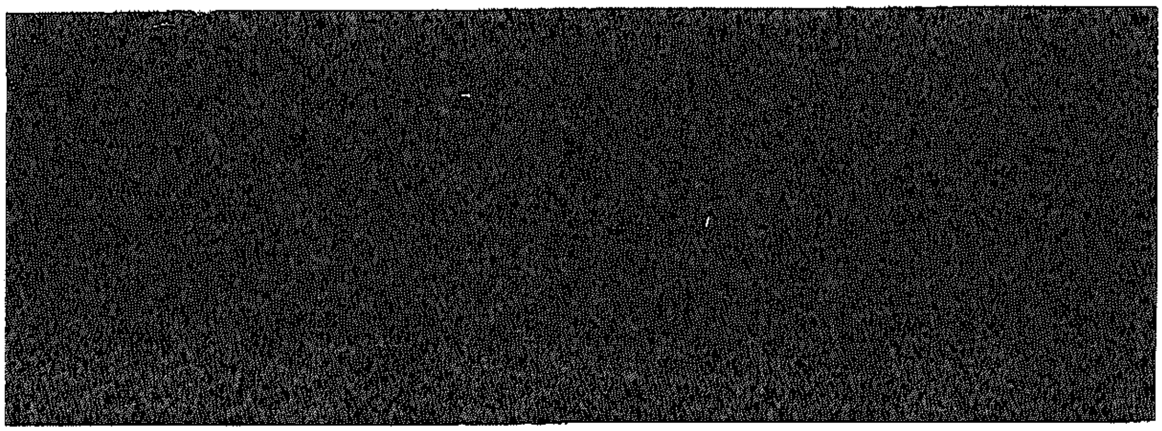
Les groupes environnementaux se sont également donné une structure régionale qui permet une concertation plus efficace entre les groupes environnementaux et les groupes de promotion économique.

Il s'agit des Conseils régionaux de l'environnement de Chaudière-Appalaches (CRECA) et de Québec (CREQ). Avec leur connaissance du territoire et des problématiques environnementales, le CRECA et le CREQ peuvent proposer des pistes pour la gestion adéquate de l'environnement et jouer un rôle de "catalyseur" essentiel auprès des entreprises industrielles, en rapprochant les intervenants qui ont des problèmes (rejets et résidus) de ceux qui ont des solutions. Les processus de concertation encouragent la créativité et la novation dans la résolution des problèmes en faisant intervenir ensemble des sources diverses de compétence. Employés à bon escient, ces processus valent le temps et les efforts qu'on leur consacre, car ils génèrent des solutions créatives et durables.

LE PARC INDUSTRIALO-PORTUAIRE DE LA RIVE-SUD DE QUÉBEC...
UNE NÉCESSITÉ POUR NOTRE AVENIR COLLECTIF

L'accès aux marchés et aux matières premières au plus faible coût possible constitue plus que jamais un facteur fondamental de positionnement concurrentiel et de développement. Dans cette optique, la province et la région doivent disposer des infrastructures capables de répondre aux exigences du transport maritime de demain, de manière à axer le développement industriel et commercial en fonction d'une ouverture complète vers les marchés mondiaux.

Face aux nombreux défis que représente le développement industriel dans un contexte de globalisation des marchés, le projet de parc industrialo-portuaire sur la Rive-Sud de Québec répond aux besoins des années 2000. Par la mise en place d'infrastructures portuaires en eau profonde et le développement d'un réseau de transport intermodal efficace, la région pourra bénéficier des avantages concurrentiels nécessaires à l'implantation d'entreprises structurantes à grand gabarit.



LES PARTENAIRES

Conseil régional de concertation et de développement (CRCD) de Chaudière-Appalaches

Conseil régional de concertation et de développement (CRCD) de Québec

Société du Port de Québec

Société du parc industriel et portuaire Québec-Sud (SPIPQS)

Chambre de commerce de la Rive-Sud de Québec

Société de promotion économique du Québec métropolitain (SPEQM)

Association régionale des commissaires industriels de Chaudière-Appalaches (ARCICA)

Comité INITIATIVE de concertation sur l'avenir de l'industrie maritime

Février 1998
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Conseils d'Administration de Gaz de France du 11/07/05

Article mis en ligne le Tuesday 19 July 2005 @ 10:23:58

CONSEIL D'ADMINISTRATION DE GAZ DE FRANCE DU 11 JUILLET 2005

Ce Conseil d'Administration initialement prévu le 22 juin a été reporté au 11 juillet du fait de la décision gouvernementale d'ouverture du capital de Gaz de France S. A.

Projet RABASKA - Le gaz naturel (GNL) est le composant du marché du gaz qui devrait connaître une forte puissance dans les années à venir du fait, à la fois du développement de ces marchés, de leur taille et de l'éloignement entre les lieux de production et de consommation.

L'objectif du projet est donc de renforcer la capacité d'achat de Gaz de France, mais aussi son implication dans la chaîne GNL et d'établir une possibilité d'arbitrage, Europe, Amérique du Nord.

Ce projet doit être réalisé en collaboration avec Gaz Métro et Embridge (1/3 chacun). Le terminal devant être opérationnel et mis en service en 2010. Il se situe sur la commune de Levis sur la rive sud du Saint Laurent en aval de Québec.

Sa capacité est de 5 Gm3 /an pendant 25 ans et pourrait être portée à 9.

Gaz de France dispose d'une option de ne pas confirmer cet engagement en 2006, s'il ne dispose pas des quantités de gaz nécessaires, ou si les coûts de construction ne sont pas maîtrisés.

L'Administrateur FO, après avoir demandé des garanties sur l'emploi dans le domaine de la R et D et sur la possibilité de Gaz de France d'être l'exploitant du terminal, dans le cadre des échanges d'expérience, a voté POUR ce projet, compte tenu de ces enjeux stratégiques pour l'avenir du groupe.

METHANIER - La situation liée aux difficultés techniques rencontrées par les méthaniers M32 (Gaz de France Energy) et N32 (Provalis), avait déjà été évoquée, lors de Conseils précédents.

L'Administrateur FO s'est prononcé pour une transaction permettant de garantir les intérêts de Gaz de France, sans mettre en difficulté les chantiers de l'Atlantique (Alsthom) confrontés à la concurrence des chantiers Coréens et Japonais. Il est à remarquer une nouvelle fois que la Commission Européenne a lancé une procédure formelle d'examen sur le mécanisme financier ayant permis la construction de ces bateaux, confirmant ainsi son dogme libéral et son mépris pour l'emploi.

FRAM EXXON MOBIL- Il s'agit de l'achat d'un complément de participation dans le champ de FRAM au Nord du complexe de Troll en Norvège.

EXXON MOBIL qui détient 25% de la licence a décidé de se séparer de cet actif en lançant un appel d'offres.

L'Administrateur FO, s'est prononcé pour cet achat, confirmant ainsi un engagement pris en février 2005, du renforcement de gaz de France sur un actif de qualité en partenariat avec l'opérateur Japonais IDEMITSU.

Une nouvelle fois est posé le problème de la stratégie d'achat de Gaz de France, compte tenu de l'augmentation et de la variation des prix du pétrole.

CONTRAT TRIPARTITE ETAT-GAZ DE FRANCE-SOCIETE GENERALE :

Il s'agit de la convention précisant les responsabilités et le coût des modalités techniques de l'offre réservée aux salariés dans les domaines de l'information de la collecte des ordres

d'achat et de leur souscription.
L'Administrateur FO a voté CONTRE ce contrat qui était soumis aux Administrateurs, hors des représentants de l'Etat.
A cette occasion, un certain nombre d'éléments ont été fournis sur les premières estimations sur la participation des salariés aux offres présentées par Gaz de France.
Salariés purement Gaz de France 69% d'actionnaires, salariés mixtes entre 50 et 55%, inactifs 17%.
Des éléments plus précis seront fournis en fonction des différentes formules proposées.

CONCLUSIONS -

Ce Conseil d'Administration qui est le premier après l'ouverture du capital, présage assez bien des difficultés du Conseil pour les mois à venir.

1°) Choix stratégiques de Gaz de France
2°) Arbitrage entre investissements à long terme et rémunération de l'actionnaire
3°) Réorganisation possible en fonction de la communication vers le marché boursier
4°) Gestion des coûts.

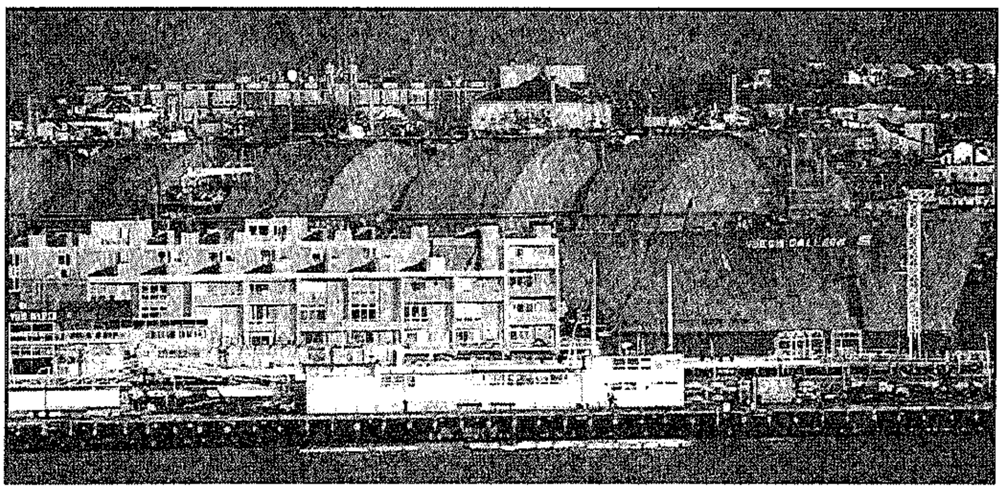
Paris, le 13Juillet 2005

Fédération Nationale des Energies et des Mines Force Ourvière
60 rue vergniaud
75013 Paris
tel: 01 44 16 86 20

Public Safety and FERC's LNG Spin

What Citizens Aren't Being Told

May 14, 2005



Commissioned by:
Pipeline Safety Trust
1155 North State St., Suite 609
Bellingham, WA 98225
(360) 543-5686

Principal Authors:

Richard B. Kuprewicz, President
Accufacts Inc.

Clifford A. Goudey, Outreach Coordinator
MIT Sea Grant College Program

Carl M. Weimer, Executive Director
Pipeline Safety Trust

Public Safety and FERC's LNG Spin

Under an Inter-Agency agreement among the Federal Energy Regulatory Commission (FERC), the U.S. Coast Guard (USCG), and the Office of Pipeline Safety (OPS), the FERC is the lead agency responsible for the environmental, safety, and security review of land-based LNG import terminal applications.[1]

This means that the safety of the populace is dependent on the FERC's proper assessment of the hazards and risks associated with these facilities. Therefore, you might think that the FERC would be a good source of information about the properties of LNG and whether citizens should be concerned when an energy developer targets their community to host an LNG terminal.

Unfortunately, you'd be wrong. The FERC has maintained a consistent, vocal, and naive opinion on the safety of LNG. In spite of numerous scientific studies and real-world disasters, the FERC maintains that LNG terminals belong anywhere project proponents want them.

Over the last two years, and facing a deluge of applications for new and expanded terminals, the FERC has failed to advise any proponent that their proposed location puts too many people at risk. Even though the FERC has already approved more LNG import terminals than are needed to meet demand, the FERC continues to review 16 additional terminal applications and does nothing to discourage the 20 or so more projects that are careening along in the LNG gold rush.[2]

Many fear that the FERC has forgotten its regulatory responsibilities and is hell-bent on allowing, indeed enabling, whatever industry wants. "It's their money. Why not?"

The unique properties of LNG and the scale of the proposed terminals set them apart from many of the facilities FERC regulates. Does FERC appreciate the special consideration that must accompany LNG? An examination of their recent publication, ***A Guide to LNG - What All Citizens Should Know,*** [3] suggests not.

To demonstrate the problem, we present here a comparison of the ***LNG Facts*** found in the FERC guide with the cold reality of LNG, without the pro-industry spin.

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[1] http://www.ferc.gov/industries/gas/indus-act/LNG-Safety-Agreement.pdf
[2] http://www.ferc.gov/industries/gas/gen-info/horizon-lng.pdf
[3] http://www.ferc.gov/for-citizens/my-rights/citizen-guides/citz-guide-lng.pdf

What FERC Says	What The Facts Say
What is LNG? Natural gas, primarily methane, is colorless, odorless and non-toxic. LNG is natural gas that has been supercooled to a liquid at -260°F (-162.2°C). Liquefying natural gas reduces its volume by more than 600 times, making it more practical for storage and transportation. Methane is only flammable at air concentration mixtures of 5%-to-15%. At a higher concentration there is not enough oxygen to sustain a flame, while at a lower concentration the fuel becomes too diluted to ignite.	**What is LNG?** LNG is a very cold liquid (approximately -260° F), containing mostly methane but typically including other "hot" or "wild" hydrocarbons such as ethane and propane, and other contaminants. Increases in natural gas prices, and recent technological improvements in the production and shipping of LNG, have made it possible to profitably export otherwise stranded natural gas reserves. In addition, a ruling by the FERC in 2002 called the Hackberry Decision provided investment incentives for land-based LNG import terminals allowing them to be operated with less regulation.[4] As a result, LNG has emerged as an attractive investment opportunity for the energy industry. LNG is the most energy dense of all the hydrocarbon fuels, yielding 50 million BTUs per metric ton. All other hydrocarbon fuel energy densities fall within the range of 38.1 and 43.3 million BTUs per metric ton.[5]
Is LNG Explosive? LNG is not at all explosive or flammable in its liquid state	**Is LNG explosive?** In the strictest technical sense LNG is not explosive **in its liquid state**. Neither are other flammable liquids such as gasoline, propane, or hydrogen. Unfortunately, because of the extreme cold temperature of LNG, the environment does not want it to remain in a liquid state. Much of the world is roughly 300° F warmer than LNG; therefore the environment around it is continually boiling it. The vaporized LNG must be vented from storage tanks to prevent the buildup of pressure. This boil-off is released, burned, or re-condensed to a liquid and returned to the tank. Vaporized LNG has a relatively broad flammability range, from 5.3% to 15% concentrations in air. Below these concentrations the mixture is too lean to combust. Above these concentrations the mixture is too rich. By comparison, propane has a narrower range of flammability (2.2% to 9.5%), as does gasoline (1.4% to 7.6%).[6] Whether or not LNG vapor will explode depends on a variety of factors related to its concentration in air, temperature, pressure, and the amount of "hot contaminants" included in the LNG. Studies performed to date are incomplete in properly characterizing the explosive potential of LNG and its vapors.

[4] http://www.poten.com/attachments/LNGopinionJan03.pdf
[5] http://www.oilegypt.com/Webpro1/Oil/approxEnergyContent.asp.
[6] http://www.eere.energy.gov/afdc/afdc/pdfs/fueltable.pdf

What FERC Says

What happens when LNG is warmed?
As a vapor, natural gas mixed with air is flammable in the air concentrations noted previously. As LNG vapor warms above -160°F (-106.7°C), it becomes lighter than air and will rise and disperse rather than collect near the ground. However, it is not explosive unless flammable concentrations of gas occur in enclosed or otherwise confined spaces.

Spill sizes as well as fire sizes, vapor clouds, and resulting hazard zones are extensively analyzed. The coordinated efforts of FERC, the Coast Guard, U.S. Department of Transportation (DOT), and other state and federal organizations strive to assure the safe transit to and storage at the terminal and are described in great detail in the analysis.

What is the operational safety record of LNG Facilities?
LNG has been delivered across the oceans for more than 45 years without major accidents or safety problems, and no serious accidents involving an LNG terminal facility in the U.S. has happened in over 25 years.

On October 20, 1944, at an LNG storage facility in Cleveland, Ohio, a tank without an impoundment dike failed and spilled LNG into the street and storm sewer system. The resulting explosion and fire killed 128 people.

That tank was built during World War II, when metals were strictly rationed, using a steel alloy that had low nickel content. The low nickel content made the tank brittle when exposed to the extreme cold of LNG.

Modern LNG tanks are constructed with materials proven capable of safely containing LNG at cryogenic (supercold) temperatures. Modern day spill containment/ dike requirements for LNG facilities ensure that in the unlikely event of an LNG spill, none would leave the plant site.

In 1979, at the Cove Point LNG import facility in Lusby, Maryland, an operational accident occurred when a pump seal failed. Gas vapors entered an electrical conduit and settled in a confined space. When a worker switched off a circuit breaker the gas ignited causing a fatality and heavy damage to the building. Lessons learned from this accident resulted in changes to the national fire codes to ensure that a similar situation could not reoccur.

Similarly, a Department of Energy/FERC investigation of an explosion at an LNG liquefaction facility in Skikda, Algeria in 2004, led to design and hazard monitoring requirements at all U.S. import facilities.

What The Facts Say

What happens when LNG is warmed?
When LNG contacts the natural environment it immediately begins to boil and turn into a flammable and potentially explosive vapor. These vapors are usually a combination of methane, ethane and propane in varying proportions, with methane being the predominant component. The vapor mixture is colorless, odorless, and non-toxic. It becomes an asphyxiant when it displaces the amount of oxygen that humans need for breathing. The vapor formed is heavier then air. This heavier than air cloud will spread over the terrain, moving with the wind, until it is warmed to approximately -160° F, at which point it becomes lighter than air and begins to rise.[7]

What is the operational safety record of LNG Facilities?
For a variety of significant reasons, past operating records do not provide an appropriate perspective for the analysis of LNG risks. Overemphasis on past operations to predict future failures is a characteristic of poor risk management techniques, particularly for such complex systems.

The increasing number and complexity of very unique LNG marine receiving energy infrastructures significantly increase the likelihood that a major event will occur.

In the absence of an adequate model for predicting risk and assessing the resulting outcome of an LNG terminal catastrophe, caution must prevail. Siting these unique facilities in remote locations or offshore is the only way to protect the public.

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[7] Clarke, R. 2005. LNG Facilities in Urban Areas, p 46. http://www.riag.state.ri.us/

What FERC Says

What is the transportation safety record of LNG ships coming to the US?
During more than 33,000 voyages completed since the inception of LNG maritime transportation in 1959, there have been only eight significant incidents involving LNG ships, none of which resulted in spills from cargo tank ruptures.

What The Facts Say

What is the transportation safety record of LNG ships coming to the US?
Past voyage statistics clearly ignore the fact that the number of marine voyages will be increasing many orders of magnitude. In addition to the substantial increase in the number of voyages, trips will be longer, more complex, and traverse areas never experienced before. In addition, most of this history occurred pre-9-11 and does not represent the risks that are present on today's oceans.

The number of LNG ships has doubled in the past ten years to approximately 140. To meet the rising demand for LNG worldwide, the LNG ship fleet will have to more than double again within the next several years.[8]

In addition, ships are getting larger and more complex, while their cost per payload capacity has dropped.[8] We can expect to see much larger and more economical LNG ships as competition among Far East ship builders increases. With these newer ships come changes in design such as power trains with their own associated risk not captured in risk analysis based on past historical operation.

What FERC Says

Where does LNG come from?
Natural gas is converted to its liquid state (LNG) at export facilities called liquefaction plants. Indonesia, Algeria, Malaysia, Trinidad and Qatar are currently the leading exporters of LNG. Nigeria, Russia, Iran, Australia and other countries also have the potential to export LNG. The LNG is imported by many countries, such as the U.S. and especially Japan, where natural gas needs are far in excess of the local production capacity.

What The Facts Say

Where does LNG come from?
Currently, LNG is produced in Trinidad, Iran, Algeria, Malaysia, Brunei, Libya, Egypt, Bolivia, Indonesia, Venezuela, Oman, Nigeria, Qatar and the United Arab Emirates, which are members of the four-year-old Gas Exporting Countries Forum. Each of these countries are locations where al Qaeda has an already established foothold.[9] Russia has the largest gas reserves in the world and has already begun to position itself as an LNG exporter.

Large liquefaction facilities and export terminals are built to produce LNG and to load it aboard ships. The refrigeration of natural gas is energy intensive, as is its transport and ultimate regasification. From 5 to 20% of the gas is used to power these three steps in the LNG supply chain.

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[8] Trends, Technologies & Investments in the Gas Sector http://www.iea.org/textbase/speech/2004/haug/mh_houston.pdf

[9] Clarke, R. 2005. LNG Facilities in Urban Areas, p 26. http://www.riag.state.ri.us/

What FERC Says

How is LNG shipped?

Specially designed tankers are used to transport LNG to import terminals. The ships can carry LNG over long distances and are constructed of specialized materials and equipped with sophisticated systems designed to store LNG safely at temperatures near -260 °F (-162.2°C).

There are two basic LNG tanker designs, both of which are double-hulled. In membrane tank designs, the cargo containment system consists of a very thin invar or stainless steel double-walled, insulated cargo envelope that is structurally supported by the vessel's hull. The second design, with independent tanks, use externally insulated spherical aluminum tanks or externally insulated prismatic shaped stainless steel tanks that are self supporting within the vessel's hull. LNG tanker ships are required to meet international maritime construction and operating standards as well as rigorous Coast Guard safety and security regulations.

Once on shore, LNG is sometimes transported by truck. LNG tanker trucks typically carry between 10,000 and 12,000 gallons (38-to-45 m3) of LNG; enough to supply the daily needs of approximately 1,000 homes. LNG trucks are used to deliver LNG from import terminals to remote or satellite storage facilities.

Where do ships unload LNG?

LNG tankers dock at specially designed terminals where the LNG is pumped from the ship toinsulated storage tanks at the terminal. LNG is converted back to a gas at the terminal, which is linked to natural gas pipelines that transport the gas to where it is needed.

What The Facts Say

How is LNG shipped?

LNG is shipped in specially designed ships, which contain the –260° F liquid in insulated cargo tanks. The current LNG ships in service carry approximately 30 million gallons of LNG and are approximately 1,000 feet long.

The technology for carrying LNG was developed in Europe, and since 1964, 174 LNG tankers have been built and most remain in service. All are foreign flagged and none have U.S. crew. LNG tanker construction is currently dominated by Korea and Japan.

Some of these vessels employ the characteristic spherical tanks while others, called membrane designs, are more shoebox looking. Tank materials in contact with LNG must be of special alloy to prevent embrittlement and possible cracking due to the extreme cold of the cargo. In many newer, more "economical" designs, thin stainless alloy is backed with plywood and insulated with foam. In many of the ships, this foam is flammable.

Because LNG is less than half as dense as water, the cargo holds of LNG tankers extend well above the hull of the vessel, increasing the vulnerability of their volatile cargo to accident and sabotage risks.

Where do ships unload LNG?

Currently there are no federal regulations defining where unique LNG marine facilities may be sited and the ships unloaded.

Because of the very large size of LNG ships, these vessels must be docked at facilities that can accommodate their large drafts. It is this deep-water requirement that often limits the site selection of LNG marine receiving facilities.

Whether a site selection is in offshore water or in deep water docks in harbors or rivers, the receiving pipelines and connection couplings must be designed to take the very cold liquid and severe temperature cycling as LNG is unloaded as a liquid to the onshore facilities.

In the U.S. there are currently four land-based LNG receiving terminals and one located offshore.

What FERC Says

How is LNG stored?

LNG is stored at more than 100 U.S. facilities, typically either for use during periods of peak natural gas demand ("peakshaving") or as a baseload source of natural gas. Most of the existing facilities in the U.S. were constructed between 1965 and 1975.

LNG is stored at very low (near atmospheric) pressure in double-walled, insulated tanks. The inner tank contains the LNG, while the outer tank contains the insulation and prevents any natural gas vapor from escaping.

All new LNG facilities are required to have a dike or impounding wall capable of containing 110% of the maximum LNG storage capacity. In the unlikely event of a spill, this feature will prevent LNG from flowing off site.

Because LNG is less than half as dense as water, the cargo holds of LNG tankers extend well above the hull of the vessel, increasing the vulnerability of its volatile cargo to accident and sabotage risks.

Storage facilities use advanced monitoring systems to immediately detect any liquid or natural gas leaks or fires at the plant.

Which LNG facilities are authorized by the USCG/MARAD & by FERC?

Under the Natural Gas Act, FERC has primary jurisdiction over the siting and operation of onshore LNG facilities and offshore facilities in state waters, whereas the Coast Guard and Maritime Administration (MARAD) have jurisdiction under the Deep Water Port Act for the siting and operation of offshore LNG facilities in Federal waters.

What The Facts Say

How is LNG stored?

Land-based LNG storage tanks require insulation to prevent the rapid boil-off of the –260° F. liquid. The inner containment is made of materials that can withstand these cold temperatures without becoming brittle. LNG exposure to conventional steels even for very brief periods of time can result in catastrophic metal failure.

Surrounding the insulation is the outer shell, which is made of more conventional materials. Storage tank size varies depending on the throughput of the facility and the delivery schedule. Obviously they must be larger than the 30 million gallons received from the ships, so they are visible for miles.

Which LNG facilities are authorized by the USCG/MARAD & by FERC?

The FERC is responsible for authorizing the siting and construction of onshore LNG facilities under Section 3 of the Natural Gas Act.[10] To date, FERC has never denied an application.

In 1971, the first LNG terminal began operation in Everett, Massachusetts. Then, in the late 70s, three more terminals were approved and built, but they did not remain in operation, and only in the last several years have they resumed operation.

The FERC has recently approved applications for eight new or expanded terminals with a combined vaporization capacity of 11.5 billion cubic feet per day.[11] This is a twelve-fold increase in import capacity compared to the period from 1982 until 2002, when only the Everett Massachusetts terminal was in operation.

The Maritime Administration (MARAD) and the United States Coast Guard (USCG) are jointly responsible for processing offshore LNG terminal applications under the Deepwater Port Act. Due to the safety risks associated with land-based terminals, there has been increased interest in offshore siting. Recently three offshore terminals have been approved in the Gulf of Mexico, and one of these has already been built and begun operation.

[10] 15 U.S.C. § 717 et seq. - http://uscode.house.gov/download/pls/15C15B.txt
[11] http://www.ferc.gov/industries/gas/gen-info/horizon-lng.pdf

What FERC Says

How are terminals designed?
All LNG storage facility designs must comply with stringent regulations as required by the DOT's safety standards in Title 49 Code of Federal Regulations (CFR) Part 193 – Liquefied Natural Gas Facilities: Federal Safety Standards and NFPA (National Fire Protection Association) 59A - Standard for the Production, Storage and Handling of Liquefied Natural Gas.

In accordance with federal safety standards, vapor-gas dispersion distances must be calculated to determine how far downwind a natural gas cloud could travel from an onshore storage facility and still be flammable. As required by these regulations, these exclusion zones must not reach beyond a property line where other development could occur.

Since a fire would burn with intense heat, each onshore LNG container and LNG transfer system must also have thermal exclusion zones established in accordance with Title 49, CFR, Part 193. These exclusion zones must be legally controlled by the LNG facility operator, or a government agency, to ensure adequate separation between members of the public and the heat from a fire.

What The Facts Say

How are terminals designed?
LNG terminals have to be designed only to minimum federal standards (49CFR193)[12] and to minimum National Fire Protection Association (NFPA 59A)[13] standards. In the case of a conflict between even these two minimum requirements, the weaker federal standards supercede the NFPA requirements. Neither standard provides appropriate siting guidance for marine receiving facilities that involve an additional series of risks associated with the presence of LNG ships.

Since LNG facilities are designated as transportation infrastructure, these high-energy-density facilities are exempt from Process Safety Management (PSM) requirements defined under federal law (29CFR1910.119).[14] PSM regulation was promulgated to address the many tragedies that were occurring in refinery and chemical plants in the late 1980s. Ironically, LNG companies appear to be undergoing severe management changes similar to those that were occurring in refinery and chemical plants in the late 1980's.

Seismic Design Requirements
LNG facilities must meet stringent standards to ensure public safety and plant reliability in the event of an earthquake. Extensive studies of the geological conditions and earthquake history of a proposed LNG site are required to determine appropriate design loads on the critical components of the LNG plant. These critical components must be designed and constructed to maintain LNG containment during and after an earthquake.

Seismic Design Requirements
Earthquakes could damage LNG tanks and piping. Therefore, LNG terminal infrastructure should be designed and subject to independent review to ensure that the design is appropriate for the earthquake potential at the site. This should include both the magnitude and the type of earthquakes associated with the proposed location and secondary conditions associated with such events such as soil liquefaction or tsunami.

[12] http://www.access.gpo.gov/nara/cfr/waisidx_04/49cfr193_04.html
[13] http://www.nfpa.org/itemDetail.asp?categoryID=279&itemID=22438&URL=Codes%20and%20Standards/Code%20development%20process/Online%20access&cookie%5Ftest=1
[14] http://www.access.gpo.gov/nara/cfr/waisidx_04/29cfr1910_04.html

What FERC Says

What public safety issues are associated with LNG?

If LNG spills it will vaporize. The resulting natural gas vapors will warm and expand, and become lighter than air. The vapors will disperse with the prevailing wind.

If a source of ignition is present where a vapor cloud exists at a 5%-to-15% concentration in the air, the vapor cloud will ignite and burn along a flame-front, back toward the spill site.

If LNG spills and vaporizes in the presence of an ignition source, a fire likely will result. The fire will burn back toward the spill site

What The Facts Say

What public safety issues are associated with LNG?

No other energy infrastructure brings together the four major risk factors that are associated with LNG marine receiving facilities: 1) high energy density, 2) very large inventories, 3) unusual release dynamics associated with extreme cryogenic temperatures, and 4) very large potential impact zones. Studies that examine LNG releases caused only by spills should be carefully questioned, since it is more likely that a major high rate release will not be simply a spill.

The danger to those caught within the potential impact zones include: asphyxiation due to lack of oxygen, exposure to severe cryogenic temperatures, burn from severe heat/thermal radiation, and damage associated with high pressure blast waves and associated flying debris.

The range of risks that can generate these extensive impact zones can come from operational accidents, intentional acts such as sabotage, or natural events. Though the consequences of an LNG accident have been demonstrated in the LNG disasters that occurred in Cleveland in 1944 and in Algeria in 2004, neither of those events represented the scale of destruction that could occur given the enormous amounts of LNG stored at a typical marine receiving terminal.

Extrapolating from the limited experience we have in the U.S. with LNG would be foolhardy even if the world had not changed on 9-11. LNG terminal siting, planning, and operation must occur with the full realization that such facilities represent an attractive target for terrorist groups. Onshore LNG receiving facilities cannot realistically be protected.

Alternatives to the LNG gold rush

Is this disparity between the facts surrounding LNG and the FERC's blatant spin a purposeful campaign of misinformation or is it due to ignorance? Either way, it is obvious that public safety is not an overriding concern within the commission. Nor does it seem that the commission has any intention of implementing rational siting standards for LNG import terminals.

The FERC ought to be able to recognize and quickly reject applicants for LNG terminals at locations that put citizens at risk. A review of their current docket of filings and pre-filings reveals one simple pattern – provide the paperwork *equals* get your permit. We deserve better from an agency regulating the import and storage of substances as dangerous as LNG. Until the FERC can implement a rational standard for land-based LNG import terminal siting and demonstrate the ability to enforce it, they should cease the processing of any more applications.

In a May 5, 2005 speech on energy policy at the Stanford Washington Research Group, FERC Chairman Pat Wood stated that eight additional LNG terminals are needed to meet the nation's short-term natural gas demand. Of those eight, he envisioned two in Atlantic Canada and two in Mexico.[15] Those Canadian and Mexican import terminals have already been approved. That means six more terminals are needed in the U.S.

As of May 2, the FERC has approved eight new or expanded land-based terminals, and MARAD/USCG has approved two new offshore terminals. That is four more U.S. terminals than Wood says are needed. Clearly a moratorium is called for on any new land-based terminals.

It is also clear that a broadening of the FERC's authority in this area would be a grave mistake. In the absence of suitable federal siting standards, state and local review processes are the only mechanisms in place to protect the public. As unregulated private industrial operations, these terminals come nowhere near the threshold for deserving powers of eminent domain.

The unique hazard posed by LNG terminals means agencies tasked with reviewing construction applications and regulating their operation must see public safety as their prime concern, not the profit-driven incentives of multinational corporations. The LNG gold rush needs to be reined in, as the strategic energy interests of the nation must come first.

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[15] Chairman Wood's speech at the Stanford Washington Research Group 2005 Institutional Policy Conference - http://www.ferc.gov/press-room/speeches.asp

About The Authors

All three of the authors were invited to be panelists to provide a "public" perspective at the February 2, 2005 LNG Community Awareness Workshop put on by the U.S. Department of Transportation in Washington D.C.[16] During the workshop presentations were made by industry and all involved federal agencies. At the end of the day this "public" panel unanimously voiced their concern regarding many of the inaccuracies, misleading statements, pro-industry spin, and lack of clear policy. They were assured that this was the first of a series of such meetings. After the recent release of the FERC's A Guide to LNG - What All Citizens Should Know the authors felt compelled to tell citizens what they really should know.

Cliff Goudey is a research engineer at the Massachusetts Institute of Technology in Cambridge, MA. In addition to coordinating marine outreach at the Sea Grant College Program, he is the Director of the Center for Fisheries Engineering Research. He holds graduate degrees from MIT in Naval Architecture and Marine Engineering and in Mechanical Engineering.

Richard Kuprewicz is President of Accufacts Inc, a company specializing in risk management and forensic analysis of hydrocarbon based energy infrastructure. He serves on various boards and committees concerned with energy regulation. He holds B.S. Degrees in Chemical Engineering and Chemistry, and a Master's Degree in Business Administration.

Carl Weimer is the executive director of the national Pipeline Safety Trust based in Bellingham, Washington. He is a member of the U.S. Department of Transportation's Office of Pipeline Safety's Technical Hazardous Liquid Pipeline Safety Standards Committee. He also is the chairman of the Governor appointed Washington State Citizen Committee on Pipeline Safety.

[16] http://primis.rspa.dot.gov/meetings/Mtg29.mtg

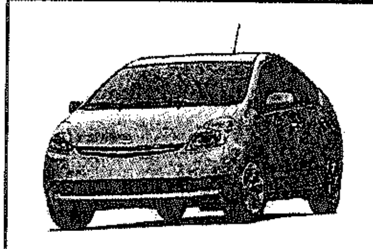
UNIVERSITY OF CALIFORNIA
BERKELEY

REPORT OF THE
RENEWABLE AND APPROPRIATE ENERGY
LABORATORY

Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?

by

Daniel M. Kammen
Kamal Kapadia
Matthias Fripp



of the
Energy and Resources Group
Goldman School of Public Policy

APRIL 13, 2004

Washington, D.C.
April 9, 2004

Dear Friends:

By coordinating public and private policies and investments, the New Apollo Energy Project we are advancing provides the vision for a cleaner, domestically-based, and more secure 21st century energy system. With the pace of technological and market innovation in the energy industry, we see a unique opportunity to redirect and fundamentally strengthen our nation's economic security.

We remain deeply concerned by the fact that the United States has steadily become more dependent on economically and politically unstable imported oil and gas supplies. In addition to the environmental impacts of this dependence, we are missing a huge opportunity to invest in our own industries, communities, and families. With recent technological advances in energy efficiency and renewable energy, a proactive investment agenda can finally make these diverse and fuel-free supply sources cost competitive with imported oil and gas.

This report by Professor Kammen and his research team at the University of California, Berkeley, provides an invaluable comparison of the many recent studies that show how a shift towards clean energy technologies will result in significant job creation. Across a wide-range of assumptions and approaches, these studies confirm that supporting renewable and efficient energy systems will create more American jobs than would a comparable investment in traditional fossil fuel based systems. Moreover, an investment agenda in emerging clean energy technologies would also reduce our foreign trade deficit and reestablish the U.S. as a leader in this growing international market.

Our foremost goal is a robust and sustainable economy and we look forward to working with readers of this report on achieving the vision articulated by the New Apollo Energy Project. We believe that only with sustained and focused efforts will we generate millions of new high paying manufacturing jobs, promote the security of our nation, and ensure the health of our environment.

Sincerely,

Jay Inslee
U.S. Representative

Maria Cantwell
U.S. Senator

Cite this report as:

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Copies of this report can be downloaded from the

Renewable and Appropriate Energy Laboratory website at:

http://socrates.berkeley.edu/~rael/papers.html

PUTTING RENEWABLES TO WORK:

HOW MANY JOBS CAN THE CLEAN ENERGY INDUSTRY GENERATE?

Daniel M. Kammen[1, 2, *], Kamal Kapadia[1] & Matthias Fripp[1]

[1]Energy and Resources Group, [2]Goldman School of Public Policy
University of California, Berkeley, CA 94720-3050

kammen@socrates.berkeley.edu • kamalk@socrates.berkeley.edu • mfripp@socrates.berkeley.edu

OVERVIEW

Expanding the use of renewable energy is not only good for our energy self-sufficiency and the environment; it also has a significant positive impact on employment. This is the conclusion of 13 independent reports and studies that analyze the economic and employment impacts of the clean energy industry in the United States and Europe. These studies employ a wide range of methods, which adds credence to the findings, but at the same time makes a direct comparison of the numbers difficult. In addition to reviewing and comparing these studies, we have examined the assumptions used in each case, and developed a job creation model which shows their implications for employment under several future energy scenarios.

Energy Technology	Source of Estimate	Average Employment Over Life of Facility (jobs/MWa)		
		Construction, Manufacturing, Installation	O&M and fuel processing	Total Employment
PV 1	REPP, 2001	6.21	1.20	7.41
PV 2	Greenpeace, 2001	5.76	4.80	10.56
Wind 1	REPP, 2001	0.43	0.27	0.71
Wind 2	EWEA/Greenpeace, 2003	2.51	0.27	2.79
Biomass – high estimate	REPP, 2001	0.40	2.44	2.84
Biomass – low estimate	REPP, 2001	0.40	0.38	0.78
Coal	REPP, 2001	0.27	0.74	1.01
Gas	Kammen, from REPP, 2001; CALPIRG, 2003; BLS, 2004	0.25	0.70	0.95

Table ES–1: Average employment for different energy technologies. "MWa" refers to average installed megawatts de-rated by the capacity factor of the technology; for a 1 MW solar facility operating on average 21% of the time, the power output would be 0.21 MWa. References in parentheses and sources refer to the studies reviewed in the text.

* Address correspondence to: Professor Daniel M. Kammen, Energy and Resources Group, 310 Barrows Hall #3050, University of California, Berkeley, CA 94720-3050. URL: http://socrates.berkeely.edu/~kammen.

Scenarios	Average employment associated with each scenario (jobs)		
	Construction, Manufacturing, Installation	O&M and Fuel Processing	Total Employment
Scenario 1: 20% Renewable Portfolio Standard (RPS) by 2020 (85% biomass, 14% wind energy, 1% solar PV)	52,533	188,317	240,850
Scenario 2: 20% Renewable Portfolio Standard (RPS) by 2020 (60% biomass, 37% wind energy, 3% solar PV)	85,008	91,436	176,444
Scenario 3: 20% Renewable Portfolio Standard (RPS) by 2020 (40% biomass, 55% wind energy, 5% solar PV)	111,879	76,139	188,018
Scenario 4: Fossil Fuels as Usual to 2020 (50% coal and 50% natural gas)	22,711	63,657	86,369
Scenario 5: 20% Gas Intensive by 2020 (100% natural gas)	22,023	61,964	83,987

Table ES–2: Comparison of the estimated employment created by meeting the equivalent of 20 percent of current U.S. electricity demand via and expansion of fossil or renewables-based electricity generation.

A key result emerges from our work: Across a broad range of scenarios, the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered (i.e., per average megawatt).

In addition we find that the employment rate in fossil fuel-related industries has been declining steadily for reasons that have little to do with environmental regulation. Finally, we find that supporting renewables within a comprehensive and coordinated energy policy that also supports energy efficiency and sustainable transportation will yield far greater employment benefits than supporting one or two of these sectors separately. While certain sectors of the economy may be net losers, policy interventions can help minimize the impact of a transition from the current fossil fuel dominated economy to a more balanced portfolio that includes significant amounts of clean energy. Further, generating local employment through the deployment of local and sustainable energy technologies is an important and underutilized way to enhance national security and international stability.

INTRODUCTION

It is often assumed that environmental protection inevitably comes at a financial cost. However, an increasing number of studies are finding precisely the opposite is true in the case of renewable energy: that greater use of renewable energy systems provides economic benefits through investments in innovation, and through new job creation, while at the same time protecting the economy from political and economic risks associated with over-dependence on too limited a suite of energy technologies and fuels.

This report reviews the range of recent studies on the job creation potential of the renewable energy industry. We critically analyze the studies with a view to answering four main questions:

- How can one compare and make sense of employment impact numbers derived through different methods, and presented in different units?
- What are the potential regional employment impacts of large-scale growth in the renewable energy sector?
- What would large-scale growth in the renewable energy sector mean for those employed in the fossil fuel energy sector?
- What policy measures would maximize the net positive economic and employment benefits that the renewable energy industry offers?

A summary of all studies reviewed, and methods used therein, is provided in Appendix 1. While a simple analytic comparison across studies is difficult for reasons discussed below, we can still draw a number of clear general conclusions:

- The renewable energy sector generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment, than the fossil fuel-based energy sector.
- Jobs in the fossil fuel sector are declining for reasons that are, for the most part, not related to environmental regulations. Nevertheless, a shift from fossil fuels to renewables in the energy sector, at whatever scale, will create some job losses. These losses can be adequately mitigated/ameliorated/alleviated through a number of policy actions.
- Embedding support for renewables in a larger policy context of support for energy efficiency, green building standards, and sustainable transportation will greatly enhance net positive impacts on the economy, employment and the environment.

RENEWABLE ENERGY AND JOBS: KEY ISSUES

We now return to the four questions, and address each in some detail.

How can one compare and make sense of employment impact numbers derived through different methods, and presented in different units?

The studies reviewed use different basic methods and models, and often report employment impacts in different units, which can make comparison difficult. In this section we discuss: a) different ways to derive employment figures for the energy sector, focusing on methods of analysis, and ways of reporting employment impacts; and b) the framework and format we use to provide comparisons for employment across different technologies.

Calculating employment from renewables: methods of analysis

Table 1 contains a list of the studies reviewed. Additional details on each study are compiled in Appendix I.

Number	Year	Author	Study (model type)
1	2004	The Institute for America's Future, The Center On Wisconsin Strategy and The Perryman Group, Waco TX.	The Apollo Jobs Report: For Good Jobs & Energy Independence New Energy for America (I-O model)
2	2003	Greenpeace/European Wind Energy Association	Wind Force 12. A Blueprint to Achieve 12% of the World's Electricity from Wind Power by 2020. (Analytical model)
3	2003	Environment California Research and Policy Center (Brad Heavner and Bernadette Del Chiaro)	Renewable Energy and Jobs. Employment Impacts of Developing Markets for Renewables in California (Analytical model)
4	2002	CALPIRG (Brad Heavner and Susannah Churchill)	Renewables Work.Job Growth from Renewable Energy Development in California (Analytical model)
5	2001	World Wide Fund for Nature (Study conducted by Tellus Institute and MRG Associates)	Clean Energy: Jobs for America's Future (I-O model)
6	2001	Renewable Energy Policy Project (co-authored by Virender Singh of REPP and Jeffrey Fehrs of BBC Research and Consulting)	The Work that Goes into Renewable Energy (Analytical model)
7	2001	Daniel Kammen and Kamal Kapadia, Energy and Resources Group, University of California, Berkeley	Jobs from Renewables, study for Kerry/Kennedy (Analytical model)
8	2001	Greenpeace	2 Million Jobs by 2020. Solar Generation. Solar Electricity for over 1 billion people and 2 million jobs by 2020. (Analytical model)
9	2001	Environmental Law & Policy Center (study done by the Regional Economics Applications Laboratory: Geoffrey Hewings and Moshe Yanai)	Job Jolt: The Economic Impact of *Repowering the Midwest. A Clean Energy Development Plan for the Heartland (I-O model)*
10	2000	Michael Renner, Worldwatch Institute	Working for the Environment: A Growing Source of Jobs (Worldwatch Paper 152)
11	1999	European Wind Energy Association/European Commission Directorate-General for Energy	Wind Energy: The Facts (Analytical model)
12	1999	European Commission/ALTENER Programme DG for Energy and Transport	Meeting the Targets and Putting Renewables to Work (I-O model)
13	1998	Skip Laitner, Stephen Bernow, John DeCicco	"Employment and other macroeconomic benefits of an innovation-led climate strategy for the United States." *Energy Policy* 26, 5: 425-432. (I-O model)

Table 1: List of studies reviewed.

Studies that focus on calculating the employment impacts of the renewables industry can be divided into two main types: a) those that use input-output (I-O) models of the economy; and b) those that use simpler, largely spreadsheet-based analytical models. Among the studies reviewed and listed in Table 1, reports number 1, 5, 9, 12 and 13 are based on I-O models, and the rest are based on analytical models. Analytical models typically only calculate direct employment impacts. *Direct employment* includes those jobs created in the manufacturing, delivery, construction/installation, project management and operation and maintenance (O&M) of the different components of the technology, or power plant, under consideration. I-O models calculate direct employment but also account for *indirect jobs* that are induced through multiplier effects of the industry under consideration. For example, the task of installing wind turbines is a direct job, whereas manufacturing the steel that is used to build the wind turbine is an indirect job. I-O models capture such multiplier effects, as well as the economic impacts of spending by workers in the new jobs. Both types of models have advantages and disadvantages.

I-O models provide the most complete picture of the economy as a whole. They capture employment multiplier effects, as well as the macroeconomic impacts of shifts between sectors; that is to say, they account for losses in one sector (e.g. coal mining) created by the growth of another sector (e.g. the wind energy industry). Analytical models generally ignore these multiplier effects, and are more likely to under-report overall employment impacts.

The disadvantage of I-O models is that they can be opaque, and make a number of assumptions in order to reach a high level of aggregation. All the I-O based studies we reviewed model the impacts of an entire suite of clean energy policies – including renewable portfolio standards, energy efficiency programs, and policies for sustainable transportation – and present impacts on the economy as aggregated net results. Only in one case (the Apollo Jobs Report; see study **1** in Appendix 1) are the employment and economic impacts attributed to separate policy categories such as "strengthening the renewables market," "bio-energy resource development" and "fuel cell R&D and deployment." Even in this report, however, each of these categories includes a suite of specific policies, whose individual impacts are impossible to discern. It is also generally impossible to calculate employment generated by different technology types such as solar PV and wind energy within a larger I-O model, nor are there employment numbers for the fossil fuel industry to draw comparisons with.

Further, all of the studies model only one "idealized" scenario. This makes it is impossible to gauge the effects of alternative policy scenarios (short of actually getting hold of the model itself), or the impact of even slight deviations from the reported scenario. For example, in the WWF study[1], while all states are net winners under the scenario they present, some states are projected to gain as few as 2,600 jobs (in North Dakota) by 2020 (despite being a state with a tremendous wind-energy resource). It is entirely possible that small differences in only a few parameters could turn these job gains to net losses. It is not possible to know which specific set of policies are creating those jobs for each state, nor can one tell what would happen to projected employment in a particular state should one or more policies be implemented in a different form from what is recommended in the report. In comparison, the analytical models are much more transparent. The assumptions are clear, and it is possible for the reader to conduct sensitivity analyses (like changing the nature and types of policy support to see how impacts may change) on their results.

[1] See study 5 in Appendix 1

Reporting employment impacts

Distinguishing between jobs in manufacturing, construction and installations vs. jobs in operations and maintenance, fuel production, extraction and processing

Most of the reports summarized here distinguish between employment in manufacturing/construction and in O&M/fuel processing. However, none of them discuss the policy implications of the different kinds of jobs created by different energy technologies or facilities, which we believe to be important. While the majority of jobs in the fossil fuel industry are in fuel processing, and operations and maintenance (O&M) (see Table 1), the majority of jobs created in the renewable energy industry are in manufacturing and construction. Biomass energy is an exception, where the majority of jobs are also in fuel production and processing (in agriculture), and O&M.

Paying attention to the types of jobs created is especially important for regional and state-level policy. For a particular state or region, even if total person-yrs lost in the fossil fuel energy sector are counterbalanced by total person-yrs gained in the renewable energy industry, the actual shift may be from jobs in O&M, to jobs in manufacturing. It is important to know therefore what *type* of jobs are being lost, and what type created, to determine what sorts of retraining and retooling programs one would need to make sure that jobs remain in the state.

Making the distinction between these two kinds of jobs is also important because the categories 'scale' differently as the industry expands. For example, an expansion of the U.S. PV industry could also lead to the manufacture of more renewable energy system components for export. This would create additional jobs in manufacturing, but no corresponding jobs in O&M.

Most studies report jobs in manufacturing and construction in terms of "person-years per MW," i.e., the amount of labor required to manufacture equipment or build a power plant which can deliver a maximum of one megawatt of power[2]. In contrast, jobs in O&M and fuel processing are usually reported in terms of "jobs per MW," i.e., the number of people who will need to be employed continuously to provide for the ongoing operation of a plant with a maximum output of one megawatt.

In order to calculate the total employment associated with each energy technology, it is necessary to put these job numbers on a common basis and add them together. To do this, we converted the manufacturing and installation jobs (person-years per MW) into jobs per MW by averaging this type of employment over the life of the facility. For example, if it takes 32.3 person-years to make and install one megawatt of solar photovoltaic modules[3], and the modules last 25 years, then this technology will give employment to an average of $32.3 \div 25 = 1.3$ persons in the manufacturing and installation sector over the lifetime of the modules. In reality, manufacturing and installation jobs are concentrated at the beginning of the life of each facility; however, if many facilities of a given type are being built (and eventually replaced) throughout the economy, then this average employment number will indicate the ongoing manufacturing and installation employment that results from these facilities. Once manufacturing and installation jobs have been converted to average values over the life of the energy equipment (in job-years per MW-year, or jobs per MW), it is a simple matter to add to this the ongoing employment required to fuel and operate the equipment (also measured in jobs per MW). The total

[2] This is a simplification. Most commercial power plants have peak outputs of hundreds of megawatts. In that case, the total labor used to build the larger plant is divided by the maximum output of the plant.

[3] Source: REPP Report. See study **6** in Appendix 1.

employment values which we then report can be seen either as the simple average employment over the life of the first set of energy facilities built under a given policy scenario, or as the steady-state employment that will result from installing (and eventually replacing) those facilities in perpetuity.

Jobs per peak megawatt vs. jobs per average megawatt
Another important issue in reporting employment across different energy technologies has to do with whether one calculates jobs per peak (or nameplate) megawatt (MWp), or jobs per average megawatt (MWa). None of the studies surveyed treat this issue adequately. Once again, understanding the differences between these two ways of reporting employment holds implications for policy. This is especially relevant when we are trying to compare employment across different energy technologies.

Suppose we are interested in implementing a policy under which 20% of the electricity ***produced*** in the United States comes from renewable energy sources. This is not the same as saying that 20% of the ***installed energy capacity*** should be renewable. Since it is the actual production of energy that causes environmental problems like global warming or acid precipitation, it makes more sense to think of the renewables/fossil fuel mix in terms of energy produced rather than energy capacity installed. But one megawatt of installed coal capacity does not produce the same amount of electricity as one megawatt of installed solar panels, for instance. A coal power plant is likely to operate for 80% of the time (the rest of the time it is likely to be shut down for maintenance), so one megawatt of installed coal capacity will produce 1MW x 0.8 x 24 hrs/day = 19.2 megawatt-hours (MWh) of electricity over one day. In comparison, a solar array of 1MW capacity will only operate for as many hours as the sun shines. On average, there is the equivalent of five hours of peak sunshine in one day in the US. So the capacity factor for solar PV is 5hr/24hrs = 21%. One megawatt of solar PV will therefore produce on average 1 MW x 0.21 x 24hrs/day = 5 MWh of electricity in one day. In other words, the same nameplate (or peak) capacity of coal and solar PV (1MWp) will produce very different amounts of electricity over a day; the coal facility will produce 19.2MWh, while the solar PV panel will produce 5 MWh per day.

Therefore, to get the same amount of electricity from a solar PV module as from a coal facility, we need about four times more capacity (MWp) of solar PV (i.e. 19.2MWh/5MWh) than of coal capacity (MWp). To account for this, we convert nameplate or peak capacities (MWp) for each energy technology into an average capacity value (MWa), which indicates the average power output that can be expected from that technology over the course of a year. The average megawatt rating puts all technologies on an equal footing. Peak capacities (MWp) are converted to average capacities (MWa) by multiplying the MWp rating by the capacity factor for the technology under consideration (e.g., a 1 MWp solar plant would be counted as 0.21 MWa, while a 1 MWp coal plant would be counted as 0.80 MWa). Conversely, employment per MWp can be converted to employment per MWa by *dividing* by the capacity factor (since power appears in the denominator of these calculations).

It is not possible to directly compare jobs per MWp or jobs per MWa across all the studies, since the assumptions, and types of scenarios modeled vary significantly. Some studies only include direct jobs while others include both. Further, most studies do not report jobs by individual technology type. Given these limitations, we need a more consistent method to understand how jobs from renewables compare with jobs from the fossil fuel sector across technologies, and between manufacturing, construction and installation, and operation, maintenance and fuel extraction and processing.

The numbers provided in three reports (REPP, 2001; Greenpeace, 2001 and Greenpeace/EWEA, 2003[4]) allow us to develop simple scenarios to accomplish this. The results presented in Table 2 demonstrate that:

a) Every technology in the renewables industry generates more jobs per average megawatt of power in the construction, manufacturing and installation sectors, as compared to the coal and natural gas industry.
b) There is not such a clear distinction between fossil-fuel and renewable technologies in the number of jobs created in O&M and fuel processing. Reliable, low-maintenance wind turbines are estimated to require fewer jobs to operate than are needed to fuel and operate coal and gas plants. However, more jobs are created in O&M of PV systems than in the O&M and fuel processing for coal and gas plants, while biomass plants may create more or fewer jobs in O&M and fuel processing than do coal or gas plants, depending on the way biomass collection is organized.

Table 2 allows for a simple comparison between the jobs created per unit of power delivered from each energy technology. However, it is unlikely that the nation's electricity supply will ever rely on any single technology. So a better way to compare employment generation across technologies is to create scenarios that allow us to compare a range of realistic and feasible combinations of renewable and fossil fuel energy sources.

To do this, we have built five scenarios. In scenarios 1–3, we assume a 20 percent Renewable Portfolio Standard (RPS) will be achieved by 2020. The mix of renewables (exclusive of hydro) used to meet the RPS in these scenarios is varied as follows:

Scenario 1: The renewables mix stays approximately the same as it is in 2002; biomass energy (wood and waste electricity) makes up 85% of the RPS, wind energy contributes 14%, and solar PV 1%.

Scenario 2: The proportion of biomass energy is decreased from its current contribution to 60% of the RPS, wind energy constitutes 37%, and solar PV 3% of the RPS.

Scenario 3: We decrease the contribution from biomass energy even further to 40% of the RPS, wind energy now dominates at 55%, and solar PV is at 5% of the RPS.

In scenarios 4 and 5, we assume that all the electricity that would be produced by renewables under a 20 percent RPS by 2020 is produced instead by fossil fuels. We include two scenarios:

Scenario 4: Coal-powered electricity contributes 50% to the mix, and natural gas the other 50%. (i.e., coal makes up 50% and gas the other 50% of the 20% of the total electricity generated in 2020 that we previously assumed to come from renewables)

Scenario 5: Natural Gas constitutes 100% of the electricity mix (i.e., 100% of 20% of the total electricity generated in 2020 that we previously assumed to come from renewables).

[4] Studies **6**, **8** and **11** in Appendix 1.

To facilitate comparison, we have considered jobs in the manufacturing, construction and installation sector, as well as jobs in the O&M and fuel-processing sector. A summary of results of the modeling exercise are presented in Table 3, and represented graphically in Figure 1. In Appendix 2, we provide a more detailed discussion of the assumptions and sources used in this modeling exercise. However, two of these assumptions bear mention here:

a) Our RPS is highly simplified, assuming that electricity production in 2020 is the same as in 2002. One interpretation of this assumption could be that energy efficiency measures will offset any growth in total electricity demand.
b) Our scenarios do not account for learning effects that may occur in these industries, nor for employment that may result from manufacturing energy equipment for export.

We believe these assumptions are compatible with the purpose of this model, which is to compare ***indicative*** employment figures across technologies, in terms of ***average employment over the lifetime of facilities***.

The results show that that in all cases, the RPS produces more jobs in manufacturing, construction and installation, as well as in O&M and fuel production and processing, than the corresponding fossil-fuel scenarios.

Work-hrs per year	2000			Employment Components			Average Employment Over Life of Facility					
							Total jobs/MWp		Total jobs/MWa		Total person-yrs/GWh	
Energy Technology	Source of Numbers	Capacity Factor	Equipment lifetime (years)	Construction, Manufacturing and Installation (person-yr/MWp)	Operation and Maintenance (jobs/MWp)	Fuel extraction and processing (person-yrs/GWh)	Construction, Manufacturing, Installation	O&M and fuel processing	Construction, Manufacturing, Installation	O&M and fuel processing	Construction, Manufacturing, Installation	O&M and fuel processing
PV 1	REPP, 2001	21%	25	32.33	0.25	0	1.29	0.25	6.21	1.20	0.71	0.14
PV 2	Greenpeace, 2001	21%	25	30.00	1.00	0	1.20	1.00	5.76	4.80	0.66	0.55
Wind 1	REPP, 2001	35%	25	3.80	0.10	0	0.15	0.10	0.43	0.27	0.05	0.03
Wind 2	EWEA/Greenpeace, 2003	35%	25	22.00	0.10	0	0.88	0.10	2.51	0.27	0.29	0.78
Biomass – high estimate	REPP, 2001	85%	25	8.50	0.44	0.22	0.34	2.08	0.40	2.44	0.05	0.28
Biomass – low estimate	REPP, 2001	85%	25	8.50	0.04	0.04	0.34	0.32	0.40	0.38	0.05	0.04
Coal	REPP, 2001	80%	40	8.50	0.18	0.06	0.21	0.59	0.27	0.74	0.03	0.08
Gas	Kammen, from REPP, 2001; CALPIRG, 2003; BLS, 2004	85%	40	8.50	0.10	0.07	0.21	0.60	0.25	0.70	0.03	0.08

Table 2: Comparison of jobs/MWp, jobs/MWa and person-yrs/GWh across technologies.

Scenarios	Average employment associated with each scenario (jobs)		
	Construction, Manufacturing, Installation	O&M and Fuel Processing	Total Employment
Scenario 1: 20% Renewable Portfolio Standard (RPS) by 2020 (85% biomass, 14% wind energy, 1% solar PV)	52,533	188,317	240,850
Scenario 2: 20% Renewable Portfolio Standard (RPS) by 2020 (60% biomass, 37% wind energy, 3% solar PV)	85,008	91,436	176,444
Scenario 3: 20% Renewable Portfolio Standard (RPS) by 2020 (40% biomass, 55% wind energy, 5% solar PV)	111,879	76,139	188,018
Scenario 4: Fossil Fuels as Usual to 2020 (50% coal and 50% natural gas)	22,711	63,657	86,369
Scenario 5: 20% Gas Intensive by 2020 (100% natural gas)	22,023	61,964	83,987

Table 3: Comparison of the estimated employment created by meeting the equivalent of 20 percent of current U.S. electricity demand via an expansion of fossil- or renewables-based electricity generation.

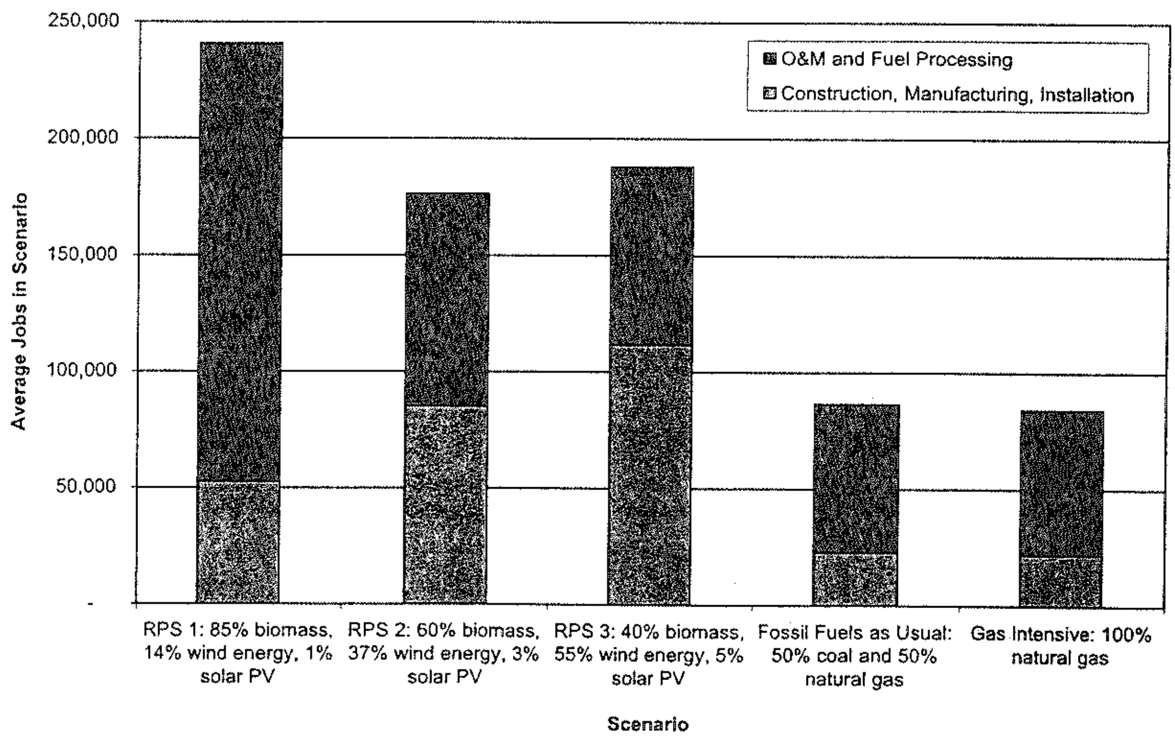

Figure 1: Comparison of average employment from five electricity generation scenarios.

What would large-scale growth in the renewable energy sector mean for those employed in the fossil fuel sector? What are the potential regional employment impacts of large-scale growth in the renewable energy sector?

These two questions are linked, so we address them together. There is little doubt that shifting our energy dependency from fossil fuels to renewables will affect jobs in the fossil fuel sector. The Worldwatch Institute rightly notes that in a shift from fossil fuels to clean energy, while "...the losers are likely to be far outnumbered by the winners, some workers will be hurt in the economic restructuring toward sustainability—primarily those in mining, fossil fuels, and smokestack industries."[5] The "winners" versus "losers" debate also depends critically on the state of the overall energy economy. When demand for energy is rising, as it is now, there is more room for all new suppliers to benefit. A recession, or economic or policy drivers of a shift from one technology to another – such as a shift away from coal that could result from a carbon tax – changes the equation dramatically.

However, it is essential to put the issue of job losses in the fossil fuel industry in perspective:

Overall, the renewable energy industry generates more jobs per MWa than the fossil fuel-based industries (mining, refining and utilities)

Our analysis in the previous section demonstrates that for a variety of feasible scenarios, the renewables industry consistently generates more jobs per MWa in construction, manufacturing and installation, and in O&M and fuel processing, than the fossil fuel industries.

Investment in renewables also generates more jobs per dollar invested than the fossil fuel energy sector. The REPP study[6] calculates that the solar PV industry generates 5.65 person-yrs of employment per million dollars in investment (over 10 years) and the wind energy industry generates 5.7 person-yrs of employment per million dollars in investment (over 10 years). In contrast, every million dollars invested in the coal industry generates only 3.96 person-yrs of employment, over the same time period.

Supporting the renewable energy industry will benefit sectors of the economy and states that currently suffer from high unemployment

The renewable energy industry creates comparatively more jobs in manufacturing than in services and O&M, which will provide a boost to US manufacturing. The results of our model indicate that as we build a clean energy future, jobs in the energy sector are likely to shift from mining and related services to manufacturing, construction and agriculture (if biomass energy forms a large part of the renewables mix). This shift would benefit sectors of the economy suffering from very high unemployment. As Table 4 demonstrates, while unemployment rates in manufacturing and mining are somewhat on par, unemployment rates in construction and agriculture are currently extremely high.

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[5] World Watch Study, page 30; study 10 in Appendix 1
[6] Study 6 in Appendix 1

Sector of the Economy	National Annual Average Unemployment Rate (%) 2002	National Annual Average Unemployment Rate (%) 2003
Mining	6.3	6.7
Construction	9.2	9.3
Manufacturing	6.7	6.6
Agriculture	10.1	10.2

Table 4: Unemployment rates in February 2003 and February 2004. Source: *Bureau of Labor Statistics, 2004*[7].

Our model also does not include jobs that may be generated if the US develops a renewable energy industry for export. The study by the Research and Policy Center of Environment California[8] shows that for California alone, a renewable energy industry servicing the export market can generate up to *16 times more employment* than an industry that only manufactures for domestic consumption (see Table 5). Of course, manufacturing for export means producing at an internationally competitive cost, which can be achieved all the easier if the domestic market creates sufficient demand to bring renewables rapidly down the cost curve.

Technology	Construction Employment for International Market	Construction Employment for In-State Market	Operating Employment for In-State Market	Total
Wind	28,900	1,490	18,930	49,320
Geothermal	800	1,230	59,030	61,070
Biomass	na	540	38,070	38,610
Solar PV	20,300	1,120	1,540	23,000
Fuel Cells	28,100	na	na	28,100
Solar Thermal	na	390	550	940
Total	**78,100**	**4,770**	**118,120**	**201,040**

Table 5: Total California employment growth from renewable energy development (person-years). Source. *Environment California, 2003.*

It is not just states suffering from high unemployment in manufacturing that stand to benefit. The Midwest, for instance, is particularly well suited for wind energy development, with the best wind power resources in the United States. According to Greenpeace-USA, North Dakota alone has enough wind power to produce 1.2 million gigawatt-hours of electricity each year[9], which amounts to 32 percent of total U.S. electricity consumption in 2002. The Environmental Law and Policy Center estimates that a renewable energy portfolio standard of 22 percent can generate 36,800 jobs by 2020 in the ten mid-western states, of which over 52 percent will be in the wind energy industry.

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[7] Bureau of Labor Statistics website http://www.bls.gov/webapps/legacy/cpsatab11.htm, accessed on 03/19/04.
[8] Study 3 in Appendix 1
[9] Greenpeace USA website. http://www.greenpeaceusa.org/media/publications/losing_racetext.htm. Accessed on 3/3/04.

Extractive industries and utilities provide declining number of jobs, for reasons that have little or nothing to do with environmental regulations

According to the Worldwatch Institute, jobs in extractive industries are on the decline, as mechanization and mergers lead to continuous layoffs. While coal production in the US increased 32 percent between 1980 and 1999, coal-mining employment declined 66 percent, from 242,000 to 83,000 workers. Further, jobs in the coal industry are expected to fall by 36,000 workers between 1995 and 2020, even without any greenhouse gas–reducing policies, such as carbon caps or taxes, in place. In the oil industry, over 40 percent of US oil-refining jobs were lost between 1980 and 1999. Petroleum refining and wholesale distribution account for only 0.3 percent of all US employment in 2000. Further, commodity prices' boom-bust cycles make these industries, and employment in them, very volatile.[10]

Contrary to popular belief, very few of these job losses are caused by environmental regulations. The Worldwatch Institute reports: "A survey of 224 permanent plant closings in 1980–86 by the Oil, Chemical, and Atomic Workers' Union found that just 12 plants listed environmental reasons as a *partial* motive for closure. And surveys conducted by the U.S. Bureau of Labor Statistics from 1987–92 and again from 1995 on show that environment–related reasons for layoffs were of minute significance: 0.14 percent of all layoffs in 1995–97 (the surveys cover layoffs of 50 people or more for a month or longer). All in all, annual layoffs from plants shut down due to environmental regulation have averaged 1,000–3,000 in the United States since the 1970s. Relative to economy-wide layoffs of typically more than 2 million workers each year, this is less than one tenth of 1 percent."[11]

The Worldwatch study also demonstrates that mining and utility companies are responsible for substantial toxic pollution. In 1998, the Environmental Protection Agency revealed that 48 percent of the 7.3 billion pounds of toxic pollutants tracked by its Toxic Release Inventory, are released by mining companies (a category which includes extraction of metals, coal, oil and gas). Another 15 percent of TRI releases were attributed to the utility sector. Although these two sectors were responsible for 63 percent of the toxic releases tracked by the EPA, together they provided only 1.4 million jobs, or 1.3 percent of all private enterprise jobs in the United States in that year.[12]

The fossil fuel industry provides little overall new employment, but generates huge economic externalities through pollution that somebody has to pay to clean up, or has to endure. These externalities become manifest in the loss of productive work days caused by illness due to pollution exposure, costs borne by industry (and eventually consumers) to clean up pollution, or costs borne directly by taxpayers for clean-up.

Although winners will outnumbers the losers, some sectors and regions will clearly be hurt by restructuring the energy industry away from fossil fuels and towards renewables

A net gain to the economy and to employment still means that some people will lose jobs, whatever the state of the fossil fuel industry. It is possible, as already discussed, that people employed in fossil fuel–based industries may not have the required skills for new jobs, and will

[10] Worldwatch Study, pages 33-34; study 10 in Appendix 1
[11] Worldwatch Study, pages 26-27; study 10 in Appendix 1
[12] Worldwatch Study, pages 22-23; study 10 in Appendix 1

need retraining. It is also likely that new jobs may arise in other locations. According to the WWF study[13], even under an optimistic scenario in which all states benefit economically and in terms of net employment by implementing a suite of clean energy policies, some states gain more than others. For example, while California is projected to gain 141,400 new jobs, and Texas 123,400 by 2020, West Virginia is expected to gain only 6,000 new jobs. Controlling for population, this means that Texas will gain almost 70% more jobs than West Virginia by 2020[14].

[illegible]	Net gain/loss in jobs by 2020
Overall for all sectors of the economy	+ 1,314,000
Coal mining	– 23,900
Oil and gas mining	– 61,400
Oil refining	– 6,300
Electric Utilities	– 35,100
Natural Gas Utilities	– 26,200

Table 6: Net projected losses by sector of the economy in comparison to overall projected net gains. Source. *Worldwide Fund for Nature. Listed as study **5** in Appendix 1.*

According to the same study, certain sectors will be net losers, as shown in Table 6.

The fact that there will be some losers does not take away from the case for making a shift in the energy economy towards clean technologies. Perpetuating a region's dependence on volatile and polluting industries with low and steadily declining employment rates is bound to negatively affect that region's development in the long run. This would be especially tragic when we have the option to switch to supporting the growth of a sustainable new sector, which will generate substantial employment.

Of course, negatively impacted people and communities must be adequately compensated. They will need retraining to develop the new skills needed in the clean energy industry. Locally relevant programs will be needed for retooling and retraining, and for attracting new industries. As the Worldwatch study states, "as with any fundamental economic transformation, the transition will require attention. The question facing society today is whether this change can be shaped so that the vast majority of people benefit, and so that social pain during the transition is kept to a minimum."[15]

It is also worth noting that there are energy companies based today largely on fossil-fuels which are well prepared to make a substantial shift in their energy business. Both British Petroleum (BP) and Shell, for instance, own two of the world's three largest solar energy companies. In 2002, BP Solar supplied 14 percent of global PV shipments, and Shell Solar 10 percent.

The United States has a lot of catching up to do. For instance, in 2003, total US production of solar PV modules amounted to 121 MWp (21 percent of global solar PV production). This was less than half of Japan's 251 MWp (45 percent of global production) and also less than Europe's 135 MWp (24 percent of global production) that same year[16]. Of the top ten solar PV module

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[13] Study 5 in Appendix 1

[14] Assuming that the ratio of population distribution between states remains the same as today.

[15] Worldwatch Study, pages 9-10; study **10** in Appendix 1

[16] *PV News*, 22(3), March 2003

producers in 2002, only one was an American company (Astropower), although some of the others manufacture (and thus generate jobs) in the United States (for example, BP Solar and Shell Solar both have manufacturing plants in the US).

What policy measures would maximize the net positive economic and employment benefits that the renewable energy industry offers?

There are a suite of policy instruments that can be used to promote renewable energy technologies. These range from financial instruments like tax credits and bond measures to renewable portfolio standards, and support for R&D. Since the focus of this report is the employment dimension of renewables, we will not provide here a complete run-through of policy options. This has been done elsewhere[17], and a set of recommended highest-priority policies is listed in brief in Appendix 3. This section focuses instead on policy requirements to maximize employment benefits while minimizing the negative impacts on people employed in the fossil fuel energy sector. We identify two key areas of intervention, discussed below.

Placing support for renewables in a broader context of support for clean energy measures, including energy efficiency and sustainable transportation will greatly augment economic and employment benefits

Renewable energy, energy efficiency and sustainable transportation are complementary sectors that support and enhance each other. For example, using a solar PV system in the most economic way possible requires that all the appliances being used are energy efficient. Measures that make it easy for an electricity customer to install a solar PV system and retrofit his or her building to be energy efficient will enhance the likelihood of that customer doing both. Consider the market for biomass energy fuels: bio-fuels like ethanol or bio-diesel require that bio-fuel powered cars are easily available, supported by an infrastructure of fuelling stations. In other words, the growth of a particular segment of the clean energy family – be it renewable energy, energy efficiency or sustainable transportation – is often partly dependent on growth in other parts of the energy industry.

This is not to say that a certain sector cannot grow by itself (for instance, a renewable portfolio standard is a good idea irrespective of the presence of other complementary policies). However, it is likely that the renewables sector, and jobs in it, will grow much more quickly if complementary policy measures are in place. This is partly why some of the studies reviewed model an array of policies in all clean energy sectors together. For example, the Apollo Jobs study[18] models a comprehensive scenario of policy and program support in which federal investment of $300 billion is made over 10 years in four categories: increasing energy diversity, investing in industries of the future, promoting high performance buildings, and rebuilding public infrastructure. In this scenario, supporting renewables alone is projected to create 459,189 jobs, while the total investment is projected to yield over 3.3 million jobs.

[17] Testimony of Daniel M. Kammen for the U. S. Senate Commerce, Science and Transportation Committee, "Technology and Policy Options to Address Climate Change". July 10, 2001. Senator John Kerry (D-MA), Chair. Testimony adapted and published in journal form as: Herzog, A. V., Lipman, T., Edwards, J. and Kammen, D. M. (2001) "Renewable Energy: A Viable Choice", *Environment*, 43 (10), 8–20. Note that most of the studies reviewed also provide detailed lists of policy prescriptions for spurring the development of the clean energy sector.

[18] Study 1 in Appendix 1

Programs are needed to retool and retrain those who stand to lose their jobs in the fossil fuel industry

As discussed above, workers who lose their jobs in the fossil fuel industry should have the opportunity to retrain themselves for employment in the clean energy industry. Programs could include:

- Free or low-cost training and certification courses in installation and maintenance of renewable energy systems
- Financial/tax incentives for renewable energy companies which absorb and train unemployed workers
- Support for community colleges and schools that offer training and certification programs in renewables and energy efficiency

Conclusion – Clean Energy for a Sustainable and Prosperous Future

Transitioning from a fossil fuel–based economy to a renewably powered one will spur economic growth and provide considerable employment. A review of 13 studies and our own analysis concur with this conclusion. The national and international security implications of spurring employment through local, sustainable energy generation are compelling. The United States needs to regain its international position as a technology leader, and the technologies of the future are in clean energy. The time is ripe to move beyond studies to action.

Author Biographies

Matthias Fripp is a PhD student in the Energy and Resources Group (ERG) at UC Berkeley. He is studying the integration of renewables into the US electric grid. Matthias holds an M.S. from ERG and a B.A. in environmental studies from Lewis & Clark College in Portland, Oregon. Before coming to Berkeley, he worked for Trexler and Associates, Inc. (a consulting firm specializing in in climate-change mitigation), and was a researcher at the Renewable Northwest Project, both located in Portland.

Daniel M. Kammen directs the Renewable and Appropriate Energy Laboratory (RAEL) at the University of California, Berkeley, where he a professor in the Energy and Resources Group, the Goldman School of Public Policy, and the Department of Nuclear Engineering. Kammen's research is focused on solar, wind, and biomass energy supplies, clean water for developing nations, and on the production and use of hydrogen and fuel cells for stationary power production and for vehicles. Kammen is involved in national and international energy policy analysis and debates, which includes issues of energy resources for both developed and developing nations, and on global and regional climate change. He has testified in front of House and Senate Committees, served as a technical reviewer for the Global Environment Facility, and is a permanent member of the African Academy of Sciences. He is the author of over 150 research papers and reports, and six books, including *Should We Risk It?* (Princeton University Press, 1999). Copies of Professor Kammen's publications, and information on the activities of the Renewable and Appropriate Energy Laboratory can be accessed on the website: **http://socrates.berkeley.edu/~rael/.**

Kamal Kapadia is a PhD student in the Energy and Resources Group (ERG) at UC Berkeley. Her research examines renewable energy technologies use in developing countries. Kamal holds an M.A. from ERG and an M.S. in Environmental Change and Management from the University of Oxford, UK. Before coming to Berkeley, she worked for solar energy companies in the UK, Sri Lanka and India.

APPENDIX 1: SUMMARY OF STUDIES REVIEWED

Number	Year	Author	Study	Method	Scenarios used
1	2004	The Institute for America's Future, The Center On Wisconsin Strategy and The Perryman Group, Waco TX.	The Apollo Jobs Report: For Good Jobs & Energy Independence New Energy for America	Presents scenarios based on a model in which $300 Billion of federal investment is made over 10 years in 4 categories: increasing energy diversity, investing in industries of the future, promoting high performance buildings, rebuilding public infrastructure.	$300 Billion of recommended federal investment includes: 1. $30 Billion support for strengthening the renewables market to get 15% renewables in electricity mix by 2015, and 20% by 2020. 2. $6 Billion for bio-energy resource development 3. $6.5 Billion for hydrogen fuel cell R&D and deployment.
2	2003	Greenpeace/European Wind Energy Association	Wind Force 12. A Blueprint to Achieve 12% of the World's Electricity from Wind Power by 2020.	Uses data from comprehensive study on wind and employment by the Danish Wind Turbine Manufacturers Association (DWTMA) in 1996, updated in 1998. Methodology used by the DWTMA is to break down the manufacturing activities into different sectors – metalwork, electronics, etc and add together individual employment contributions. Results cover three areas – direct and indirect employment from wind turbine manufacture, the direct and indirect employment effects of installing wind turbines, and the global employment effects of the Danish industry's exports business. To allow for greater efficiencies in design, manufacture and installation – resulting in a reduction in employment labour consumption is assumed to follow total value of wind energy installation, a decreasing value over time.	Calculates the employment effect of the 12% global wind energy scenario. For OECD-North America, this means 310,000 MW of wind installed by 2020, for USA alone, 250,000MW.
3	2003	Environment California Research and Policy Center (Brad Heavner and Bernadette Del Chiaro)	Renewable Energy and Jobs. Employment Impacts of Developing Markets for Renewables in California	Uses numbers from above study, based on which authors calculate jobs in California from foreign RET markets, assuming California has 5% market share of geothermal, and 10 % of other technologies.	20% renewables in electricity mix by 2010 in California, which involves addition of 5,900MW renewables, where California has 30% of construction/manufacturing jobs to meet in-state RPS, and 90% of O&M jobs for all technologies. In addition, California also has 10% of manufacturing/construction jobs for foreign markets for renewables (all except geothermal, where California construction job share is 5%)
4	2002	CALPIRG (Brad Heavner and Susannah Churchill)	Renewables Work. Job Growth from Renewable Energy Development in California	Study focussed on California only. Reviews several other studies. Study also collected primary data from renewables industry and natural gas utilities on direct and indirect jobs, and reported results as employment from construction and eployment from operation and maintenance, by technology.	20% renewables in electricity mix by 2010 in California, which involves addition of 5,900MW renewables in ratio of 11% wind, 7% geothermal, 0.2% solar PV, 1% solar thermal, 1% landfill gas.
5	2001	World Wide Fund for Nature (Study conducted by Tellus Institute and MRG Associates)	Clean Energy: Jobs for America's Future	Study models employment, macroeconomic, energy and environmental impacts of an entire range of clean energy policies called "Climate Protectio Scenario". Includes variety of policies measures in building and industry sector, electric sector, transport sector. Uses I-O Model (IMPLAN) tracing linkages in the economy. Policies were compared to base case as given in IEA Annual Energy Outlook 2001. Since macroeconomic impacts are only reported by sector of economy (e.g. agriculture, finance etc), it is not possible to tease out employment impact of renewables alone from the study itself.	For renewables - a US-wide RPS of 15% renewables in the electricity mix by 2020. Total investment needed not specified, however, net impact of all policies in the model predicted to have net positive impact on GDP of $(1998) 23,220 Million by 2010 and $ (1998) 43,860 Million by 2020.
6	2001	Renewable Energy Policy Project (co-authored by Virender Singh of REPP and Jeffrey Fehrs of BBC Research and Consulting)	The Work that Goes into Renewable Energy	Study calculates jobs in person-yrs/MW and person-yrs/$ invested. Uses a simple model, does not take into account multiplier effects as an I-O model would. Authors collected primary employment data from companies in the solar PV, wind energy and coal sectors, and used project scenario numbers for biomass energy. Study takes in account jobs in manufacture, transport and delivery, construction and installation, and O&M.	None

APPENDIX 1: SUMMARY OF STUDIES REVIEWED

Number	Years	Author	Study	Method	Scenarios used
7	2001	Dan Kammen and Kamal Kapadia, Energy and Resources Group, University of California, Berkeley	Jobs from Renewables, Study for Kerry/Kennedy committee	Analysis based on combining industry data with median values of economic models produced by others.	Scenario of 10% US-wide RPS, where 5% of total electricity in 2010 would come from solar PV, 60% from biomass energy and 35% from wind energy.
8	2001	Greenpeace	2 Million Jobs by 2020. Solar Generation. Solar Electricity for over 1 billion people and 2 million jobs by 2020.	Based on employment information provided by the industry, jobs for each world region have been calculated for scenario of 207GWp of installed PV by 2020 . It is ssumed that between 2000 and 2010, 20 jobs are created per MWduring manufacture, decreasing to 10 Jobs per MW between 2010 and 2020. About 30 jobs generated per MW during installation, retailing and providing other local services between 2000 and 2010, going down to 26 jobs per MW between 2010 and 2020. For maintenance, it is assumed that after accunting for economies of scale and other efficiency gains, 1 job will be created per installed MW. Since developing world markets will play a more significant role beyond 2010, proportion of maintenance work is assumed to steadily increase up to 2 jobs per MW by 2020.	By 2020, the goal is to install 207GWp of solar PV globally. Average annual growth rate in PV markets worldwide up to 2009 is projected to be 27% and then rising to 34% between 2010 and 2020. Although initial growth is expected to be fastest in the grid-connected sector, by 2010 this will be replaced by the emerging off-grid rural sector.
9	2001	Environmental Law & Policy Center (study done by the Regional Economics Applications Laboratory: Geoffrey Hewings and Moshe Yanai)	Job Jolt" The Economic Impact of *Repowering the Midwest. A Clean Energy Development Plan for the Heartland*	Regional econometric input-output models developed by REAL to forecast local impacts of changing economic conditions and policies. Using primarily U.S. Census data, REAL's dynamic models track employment, income and output data across 53 industrial sectors, factoring in 13 demand variables (consumption, investment, government expenditures, etc.) and eight demographic variables (age, sex, migration, etc).	Clean Energy Development Plan for 10 mid-western states as outlined in related report *Repowering the Midwest. A Clean Energy Development Plan for the Heartland* . Policies include portfolio of policies in energy efficiency, and an 8% RPS by 2010, 22% by 2020
10	2000	Michael Renner, Worldwatch Institute	Working for the Environment: A Growing Source of Jobs (Worldwatch Paper 152)	Discussion paper on employment impacts of environmental policies and programs. Includes discussion of impacts of environmental programs on employment in the fossil fuel industry, and a section on employment benefits of the renewable energy industry.	NA
11	1999	European Wind Energy Association/European Commission Directorate-General for Energy	Wind Energy: The Facts	Numbers based on 2 prior studies/surveys carried out to determine exisiting employment in wind industry in Europe - Danish Wind Turbine Manufacturers Association and Danish Counties and Municipalities Research Institute (Society Value of Wind Power).	100,000MW of wind energy in the European Comission member countries NOTE: AWEA Wind Energy Fact Sheet (Wind Energy and Economic Development: Building Sustainable Jobs and Communities) refers to EWEA employment figures.
12	1999	European Commission/ALTENER Programme DG for Energy and Transport	Meeting the Targets and Putting Renewables to Work	Uses SAFIRE Energy Model to predict market penetration for RETs and displacement of other technologies for different scenarios. Then RIOT (renewables enhanced input-output tabes) I-O Model is used to calculate employment impact. Model is based on calculation of production funcions that represents the value of inputs (including employment) from different sectors of economy needed to produce a unit of energy from different technologies. Models predict direct and indirect jobs and jobs from agriculture, minus potential losses in conventional energy sector and support mechanisms leading to lower spending elsewhere in the economy.	2 scenarios are modelled - current EU policies, or "CP" scenario, where renewables make up 20.4% of gross European electricity consumption by 2020, and advanced renewable strategy or "ARS" scenario, where renewables make up 27.6% of gross electricity consumption by 2020.
13	1998	Skip Laitner, Stephen Bernow, John DeCicco	"Employment and other macroeconomic benefits of an innovation-led climate strategy for the United States." *Energy Policy* 26, 5: 425-432.	Study used IMPLAN ("Impact analysis for Planning"), I-O model to evaluate impact of "the Innovation Path" scenario Macroeconomic impact calculated for all major sectors of economy. Not possible to tease out impact of renewables only from paper.	"The Innovation Path" scenario, includes policies in residential, commercial, industrial, transportation, and electricity generation secors, to reduce carbon intensity of the US economy by 25.5% by 2010. Policies include variety of energy efficiency measures, renewables development, and development and deployment of near-commerical technologies.

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

The results in our scenarios are only indicative. Comparing jobs/MWa figures from different sources is very difficult, since each study and method draws boundaries at different points in terms of the direct and indirect jobs to include.

Sources and Assumptions for Employment Figures in Table 2 (page 10)

1. For solar PV, wind energy, biomass energy and coal, we have used data from the REPP Report (study 6 in Appendix 1), the Greenpeace Solar Energy Report (study 8 in Appendix 1), and the Greenpeace/EWEA Wind Energy Report (study 11 in Appendix 1), as specified in the table.
2. For wind energy, as the Greenpeace/EWEA study has not specified employment from O&M, we have used the employment figure from the REPP study for both wind energy cases cited.
3. For biomass energy, the high-estimate figures for jobs in O&M and fuel extraction and processing, are based on the upper-end of estimates provided for switchgrass cultivation, and the low estimates are based on the low-end of estimates provided for energy from urban wood waste. As no numbers were supplied in the REPP Report for the manufacture, construction and installation of the energy facility per se, we have assumed that the energy facility would be similar to a coal-fired power plant, and used employment figures for "making coal plant components and for on-site activities, not including O&M" as provided in the REPP report in Appendix B (page 25).
4. For natural gas-based electricity, we have used three different sources:
    a. Manufacturing and construction of the power plant facility is assumed to be the same as for a coal-powered facility, as given in the REPP study. The CALPIRG Study (no. 4 in Appendix 1) also provides employment figures for construction of natural gas facilities, but not for manufacturing the components.
    b. O&M employment figures for the natural gas industry have been taken from the CALPIRG study.
    c. Employment from natural gas extraction and distribution is calculated from data from the Bureau of Labor Statistics and the Energy Information Agency (EIA). The Bureau of Labor Statistics reports 112,510 jobs in 2002 in Natural Gas Distribution and 119,130 jobs in 2002 in Oil and Gas Extraction (http://www.bls.gov). In 2002, natural gas provided 61 percent of the total energy delivered by oil and gas extracted in the U.S., so we assigned 61 percent of the oil and gas extraction jobs (72,900 jobs) to natural gas. Taken with the gas distribution jobs, this yields a total of 185,400 people employed in gas extraction and distribution in the U.S. in 2002. In the same year, 24.7 percent of natural gas consumed in the U.S. was used for electricity production, so we estimate that 45,900 people were employed in the U.S. to extract and deliver natural gas for the electricity sector. The EIA also reports that 685,800 GWh of electricity were produced from natural gas in the U.S. in 2002, so we calculate that each GWh of electricity produced from natural gas requires 0.067 person-years of employment in gas extraction and distribution. (*Source:* Tables 6.5 and 8.2a of the EIA *Annual Energy Review 2002*, available on-line at http://www.eia.doe.gov/emeu/aer/)
5. We have not included any numbers for nuclear energy, as we have been unable to locate data sources.

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

Sources and Assumptions for Scenarios 1–5 (page 11)

1. All electricity generation figures are taken from the EIA *Annual Energy Review 2002*, available on-line at http://www.eia.doe.gov/emeu/aer/.
2. Total electricity generated in the US in 2002 was 3,858,452 GWh. We assume this figure stays constant till 2020, as efficiency gains accompanying a large-scale renewable energy deployment offset the current rate of increase in electricity demand of 2–3 percent a year. This assumption will almost certainly prove to be incorrect, but it does provide a consistent way to compare policies, and our comparative findings will continue to hold even with different assumptions about growth of the electricity supply.
3. We have not included hydro-power as a renewable energy source, as the environmental impact of large hydro facilities is a point of considerable contention. Further, we do not anticipate any substantial increase in hydropower capacity in the country, nor is it a large employer within the energy industry (as there is no ongoing manufacturing, nor fuel extraction involved).
4. Our scenarios are scaled around the current existing mix of renewables in electricity, in which 85% is from biomass energy (wood and waste fuel), 14% from wind energy, and 1% from solar PV.
5. In cases where we have low and high estimates for jobs (solar PV, wind energy and biomass energy), we have averaged the two estimates.

Rapidly but efficiently expanding the renewable energy sector is the most important single step to achieve energy independence, job growth, and meaningful environmental protection. To achieve this goal, markets must be opened for new, clean renewable energy and energy efficiency innovations. In our view, the Renewable Portfolio Standard provides the best near-term mechanism and framework for growth of the solar, wind, biomass, and geothermal generating sectors. A variety of other mechanisms are needed to spur innovation and implementation of clean energy options, but the RPS provides the most natural framework.
We find that a 20% RPS – either as a federal standard or as a federally-supported patchwork of state measures – by 2020 is not only achievable, but would provide a major economic boom to the U.S. economy through job creation and through the export markets we could then address.

By 2050 our energy economy could be driven by over 40 percent renewable energy sources, with higher levels quite plausibly – technologically, economically, and environmentally possible.

The critical move is the first step. A suite of recommended policies would include the following measures, most of which were first proposed by Professor Kammen at the July 10, 2001 Senate Committee on Science, Commerce and Transportation chaired by Senator Kerry.[19]

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[19] Kammen, D. M. (2001) Testimony for the Hearing on 'Technology and Policy Options for Climate Change' for the U. S. Senate Committee on Commerce, Science, and Transportation, July 10 (United States Senate: Senate Committee on Commerce, Science, and Transportation). URL http://www.senate.gov/~commerce/
Appeared in revised form as: D. M. Herzog, A. V., Lipman, T., Edwards, J. and Kammen, D. M. (2001) "Renewable Energy: A Viable Choice", Environment, 43 (10), 8 – 20.

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

Energy Policy Recommendations

- **Increase Federal R&D Funding for Renewable Energy and Energy Efficiency Technologies**

Federal investment in renewable energy and energy efficient technologies has been sparse and erratic[20], with each year producing an appropriations battle that is often lost. A combination of a federal program for steadily increasing funding and active political leadership would transform the clean energy sector from a good idea to a pillar of the new economy.

- **Provide Tax Incentives for Companies the Develop and Use Renewable Energy and Energy Efficiency Technologies**

Support for the production and further development of renewable fuels, all found domestically, would have a greater long-term effect on the energy system than any expansion of fossil-fuel capacity, with major health and environmental benefits as an added bonus. We should extend the existing production tax credits (PTC) for electricity generated from wind power and closed loop biomass for five years. Also, this production credit should be expanded to include electricity produced by open loop biomass (i.e., agricultural and forestry residues but excluding municipal solid waste), geothermal energy, and landfill gas. The same credit should be provided to closed loop biomass co-fired with coal, and a smaller credit (one cent per kWh) should be provided for electricity from open-loop biomass co-fired with coal. We support a minimum of a 15 percent investment tax credit for residential solar electric and water heating systems. In addition, we recommend a 30 percent investment tax credit for small (75 kW and below) wind power systems.

- **Improved Federal Standards for Vehicle Fuel Economy and Increased Incentives for High Fuel Economy Vehicles**

We need to first remove the separate fuel economy standards for cars and light trucks (i.e., close the light truck 'loophole' as proposed in 2001 by Senators Feinstein and Snowe and by Rep. Olver). We then believe that a 40 mpg combined car and light truck fuel economy standard could be accomplished in the 2008 to 2012 timeframe with negligible net cost. We support tax credits of up to $5,000 for hybrid electric vehicles, up to $6,000 for battery electric vehicles, and $8,000 for fuel cell vehicles, and an incentive scheme for energy-use performance that rewards both fuel savings and lower emissions.

- **A Federal Renewable Portfolio Standard (RPS) to Help Build Renewable Energy Markets**

We support a 20 percent RPS by 2020. A number of studies indicate that this would result in renewable energy development in every region of the country with most coming from wind, biomass, and geothermal sources. A clear and properly constructed federal standard is needed to set a clear target for industry research, development, and market growth. We recommend a renewable energy component of 10 percent in 2010 and 20 percent by 2020 that would include wind, biomass, geothermal, solar, and landfill gas.

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[20] Margolis, R. and Kammen, D. M. (1999) "Underinvestment: The energy technology and R&D policy challenge", *Science*, **285**, 690 - 692

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

- **Federal Standards and Credits to Support Distributed Small-Scale Energy Generation and Cogeneration (CHP)**

Small scale distributed electricity generation has several advantages over traditional central-station utility service, including reducing line losses, deferring the need for new transmission capacity and substation upgrades, providing voltage support, and reducing the demand for spinning reserve capacity. In addition, locating generating equipment close to the end use allows waste heat to be utilized to meet heating and hot water demands, significantly boosting overall system efficiency. We support at least a 10 percent investment tax credit and seven-year depreciation period for renewable energy systems or combined heat and power systems with an overall efficiency of at least 60-70 percent depending on system size.

- **Enact New and Strengthen Current Efficiency Standards for Buildings, Equipment, and Appliances**

Significant advances in heating and cooling systems, motor and appliance efficiency have been made in recent years, but more improvements are technologically possible and economically feasible. A clear federal statement of desired improvements in system efficiency is needed to remove uncertainty and reduce the economic costs of implementing these changes. Under such a federal mandate, efficiency standards for equipment and appliances could be steadily increased, helping to expand the market share of existing high efficiency systems.

- **Institute a National Public Benefits Fund**

We recommend a public benefits fund financed through a $0.002/kWh charge on all electricity sales. Such a fund could match state funds to assist in continuing or expanding energy efficiency, low-income services, the deployment of renewables, research and development, as well as public purpose programs the costs of which have traditionally been incorporated into electricity rates by regulated utilities.

- **Investigate and Work Towards a Carbon Tax**

A diverse range of analyses – environmental, economic, and from an energy policy perspective – all support the notion that a carbon tax provides one of, if not the, most effective means to efficiently and cost-effectively safeguard the environment while encouraging economic growth. We strongly support the notion of a carbon tax, and would welcome the public discussion and exchange that high-level recognition of this vehicle would engender. A carbon tax could be gradually implemented, beginning at a token level, and could be managed to work effectively between mobile and stationary sources of emission

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